Report on Effects of Aircraft Overflights on the National Park System

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United States Department of the Interior / National Park Service

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July 1995

United States Department of the Interior / National Park Service
Prepared Pursuant to Public Law 100-91, The National Park Service Overflights Act of 1987

The Eloquent Sounds of Silence

Everyone of us knows the sensation of going up, on retreat, to a high place and feeling ourselves so lifted up that we can hardly imagine the circumstances of our usual lives, or all the things that make us fret. In such a place, in such a state, we start to recite the standard litany: that silence is sunshine, where company is clouds; that silence is rapture, where company is doubt; that silence is golden, where company is brass.

But silence is not so easily won. And before we race off to go prospecting in those hills, we might usefully recall that fool's gold is much more common and that gold has to be panned for, dug out from other substances. "All profound things and emotions of things are preceded and attended by Silence," wrote Herman Melville, one of the loftiest and most eloquent of souls. Working himself up to an ever more thunderous cry of affirmation, he went on. "Silence is the general consecration of the universe. Silence is the invisible laying on of the Divine Pontiff's hands upon the world. Silence is the only Voice of our God." For Melville, though, silence finally meant darkness and hopelessness and self-annihilation. Devastated by the silence that greeted his heartfelt novels, he retired into a public silence from which he did not emerge for more than 30 years. Then, just before his death, he came forth with his final utterance—the luminous tale of Billy Budd—and showed that silence is only as worthy as what we can bring back from it.

We have to earn silence, then, to work for it: to make it not an absence but a presence; not emptiness but repletion. Silence is something more than just a pause; it is that enchanted place where space is cleared and time is stayed and the horizon itself expands. In silence, we often say, we can hear ourselves think; but what is truer to say is that in silence we can hear ourselves not think, and so sink below our selves into a place far deeper than mere thought allows. In silence, we might better say, we can hear someone else think.

Or simply breathe. For silence is responsiveness, and in silence we can listen to something behind the clamor of the world. "A man who loves God, necessarily loves silence," wrote Thomas Merton, who was, as a Trappist, a connoisseur, a caretaker of silences. It is no coincidence that places of worship are places of silence; if idleness is the devil's playground, silence may be the angels'. It is no surprise that silence is an anagram of license. And it is only right that Quakers all but worship silence, for it is the place where everyone finds his God, however he may express it. Silence is an ecumenical state, beyond the doctrines and divisions created by the mind. If everyone has a spiritual story to tell of his life, everyone has a spiritual silence to preserve.

So it is that we might almost say silence is the tribute we pay to holiness; we slip off words when we enter a sacred space, just as we slip off shoes. A "moment of silence" is the highest honor we can pay someone; it is the point at which the mind stops and something else takes over (words run out when feelings rush in). A "vow of silence" is for holy men the highest devotional act. We hold our breath, we hold our words; we suspend our chattering selves and let ourselves "fall silent," and fall into the highest place of all.

It often seems that the world is getting noisier these days: in Japan, which may be a model of our future, cars and buses have voices, doors and elevators speak. The answering machine talks to us, and for us, somewhere above the din of the TV; the Walkman preserves a public silence but ensures that we need never—in the bathtub, on a mountaintop, even at our desks—be without the clangor of the world. White noise becomes the aural equivalent of the clash of images, the nonstop blast of fragments that increasingly agitates our minds. As Ben Okri, the young Nigerian novelist, puts it, "When chaos is the god of an era, clamorous music is the deity's chief instrument."

There is, of course, a place for noise, as there is for daily lives. There is a place for roaring, for the shouting exultation of a baseball game, for hymns and spoken prayers, for orchestras and cries of pleasure. Silence, like all the best things, is best appreciated in its absence: if noise is the signature tune of the world, silence is the music of the other world, the closest thing we know to the harmony of the spheres. But the greatest charm of noise is when it ceases. In silence, suddenly, it seems as if all the windows of the world are thrown open and everything is as clear as on a morning after the rain. Silence, ideally hums. It charges the air. In Tibet, where the silence has a tragic cause, it is still quickened by the fluttering of prayer flag, the tolling of temple bells, the roar of wind across the plains, the memory of chant.

Silence, then, could be said to be the ultimate province of trust: it is the place where we trust ourselves to be alone; where we trust others to understand the things we do not say; where we trust a higher harmony to assert itself. We all know how treacherous are words, and how often we use them to paper over embarrassment, or emptiness, or fear of the larger spaces that silence brings. "Words, words, words" commit us to positions we do not really hold, the imperatives of chatter; words are what we use for lies, false promises and gossip. We babble with strangers; with intimates we can be silent. We "make conversation" when we are alone, or with those so close to us that we can afford to be alone with them.

In love, we are speechless; in awe, we say, words fail us.

— Pico Iyer

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

SEP 1 2 1994

Honorable J. Bennett Johnston
Chairman, Committee on Energy
and Natural Resources
United States Senate
Washington, D.C. 20510

Dear Mr. Chairman:

Pursuant to the provisions of the National Park Overflights Act of 1987, Public Law 100-91, the Department of the Interior is pleased to submit the study report on the impacts of aircraft flights over units of the National Park system.

The study identifies the problems associated with aircraft flights over units of the National Park System, and distinguishes between the impacts caused by sightseeing aircraft, military aircraft, commercial aviation, general aviation, and other forms of aviation which affect these units. The study also identifies those National Park System units in which the most serious adverse impacts from aircraft overflights exist, and pursuant to the Overflights Act, reports particular overflight problems at five units of the System. The report also includes recommendations from the National Park Service to provide for "substantial restoration of the natural quiet and experience" for Grand Canyon National Park.

An identical letter is being sent to the Honorable Malcolm Wallop, Ranking Minority Member, Committee on Energy and Natural Resources, United States Senate, the Honorable George Miller, Chairman, Committee on Natural Resources, United States House of Representatives, the Honorable Don Young, Ranking Minority Member, Committee on Natural Resources, United States House of Representatives, and the Honorable William F. Clinger, Ranking Minority Member, Committee on Public Works and Transportation, Subcommittee on Aviation, United States House of Representatives.

Sincerely,

George T Frampton, Jr.

George T. Frampton, Jr.
Assistant Secretary for Fish
and Wildlife and Parks

Enclosure

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

Honorable George Miller
Chairman, Committee on Natural Resources
U.S. House of Representatives
Washington, D.C. 20515

SEP 12 1994

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Sincerely,

George T. Frampton, Jr.

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Assistant Secretary for Fish and Wildlife and Parks

Enclosure

U.S. Department
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Federal Aviation Administration

800 Independence Ave., S.W.
Washington, D.C. 20591

OCT 21 1994

Mr. John J. Reynolds
Deputy Director
National Park Service
P.O. Box 37127
Washington, DC 20013-7127

Dear Mr. Reynolds:

The Department of Transportation (DOT) has reviewed the final report that the National Park Service (NPS) has prepared and submitted to Congress pursuant to Public Law (P.L.) 100-91. We appreciate the opportunity the NPS provided for us to review the report in draft form and the responsiveness of the NPS to our comments and concerns.

The Department of the Interior (DOI) and DOT have made great strides recently in limiting the impacts of aircraft noise on national parks while allowing aviation vitality to continue. The efforts of the DOT/DOI Interagency Working Group established last December by Secretary Peña and Secretary Babbitt have resulted in a productive new working relationship for resolving issues effectively in the Grand Canyon and other units of the National Park System. I believe the group embodies the spirit of the Clinton Administration's effort to reinvent government. Therefore, I commend the report's strong support of continuing the Interagency Working Group's efforts and concur with your recommendation to identify and document a process for addressing these issues at local levels. The Interagency Working Group would be the appropriate mechanism for establishing a memorandum of understanding defining the scope of our collective efforts and the procedures for surfacing and resolving these concerns.

While we reached an understanding on most issues in the NPS report, a number of unresolved DOT concerns remain. This letter identifies the major unresolved issues and renews our commitment to finding workable solutions.

First, the appropriate metric for assessing noise impacts and standard for determining appropriate corrective actions remains a primary issue. Environmental actions must be based on objective measures that are capable of withstanding both legal and technical challenges. The report continues to recommend percent of time audible, or audibility, as the trigger for further action. We do not object to the NPS's use of audibility as a determinant for further noise analysis using equivalent sound level (L_{eq}) or another scientifically validated metric. However, audibility should not be used to determine the need for Federal actions to mitigate aircraft noise in parks without the benefit of additional analysis. Considerably more work needs to be done to validate both the NPS survey results and the derivative dose-response relationships before this methodology is used as a basis for making decisions that will affect aviation. The DOT supports your efforts to refine existing noise methodologies for assessing aviation noise impacts on parks. We will continue to work with you in achieving this goal.

Second, the issues of defining natural quiet, the extent to which a natural quiet standard should be applied to units of the National Park System, and what constitutes its substantial restoration are significant for both the NPS and the Federal Aviation Administration (FAA). The DOT recognizes the NPS's mandate for substantially restoring natural quiet in the Grand Canyon and understands NPS's interest in achieving this goal at other units of the National Park System. However, we question the practicability of applying this standard throughout the National Park System, particularly when coupled with use of the audibility measure as a trigger for action. A standard of "natural quiet" could likely be achieved only by the virtual elimination of all overflights. We believe that it would establish an unrealistically high goal, one that may only lead to future frustration for all concerned. Although the Congress did not request the NPS to study other types of noise, we think the report needs to be read and evaluated with the understanding that there are multiple sources of noise impacting national parks as confirmed by visitor surveys. While the NPS studies confirm that aviation noise impacts a limited number of parks and perhaps only a limited number of sites within those parks, at other parks there is no problem associated with aircraft sounds. We will be pleased to continue working with you in developing a viable understanding of the relationship between natural quiet and feasible levels to be obtained from mitigating aviation noise impacts.

Third, the DOT supports P.L. 100-91's objective of substantially restoring natural quiet in the Grand Canyon. The NPS report defines such substantial restoration to mean "that 50 percent or more of the park achieve[s] 'natural quiet' (i.e., no aircraft audible) for 75-100 percent of the day." (Emphasis in original.) The FAA is conducting an operational and noise analysis of the report's Grand Canyon recommendations to identify their potential impact on overflights, effectiveness in reducing noise levels, and feasibility for implementation. We will evaluate the impact of high altitude overflights on natural quiet, any potential change in the noise environment should the flight-free zone ceilings be raised, and the impacts on both noise and aviation of each of the report's recommendations for changing current SFAR 50-2 provisions regarding flight corridors and routes. Our evaluation will include not only the noise reductions which would be achieved but also the safety and other relevant impacts.

Fourth, the FAA has sole statutory authority for the control of airspace use and the DOT is committed through the Interagency Working Group effort to resolving aviation noise issues in parks. For safety and other reasons, this authority should and, we assume, will remain exclusively with the FAA. Accordingly, we would find inconsistent with these statutory responsibilities any suggestion in the report that the NPS could act to direct airspace actions through issuance of concession permits or other mechanisms. The DOT recognizes that the NPS has significant park management concerns that, in some cases, may support action by the FAA to adjust or restrict aviation. However, any changes in aviation must be assessed in the context of the national airspace system, with safety as a paramount factor and the public interest in air commerce as a significant consideration.

It is the policy of the Federal Government that the FAA, like other agencies, will exercise its authority in a manner that will enhance the environment, and that the FAA will make a special effort - insofar as is technologically and economically practicable - to preserve the natural beauty of public park and recreation lands, wilderness areas, and wildlife refuges. The DOT supports your proposal for establishing a management process that will facilitate identification, coordination, and resolution of aviation issues in parks. The actions and commitment of both of our departments through the Interagency Working Group demonstrate that this process is well under way. Continuing these efforts will assure that we find a balance between preservation of park values by the NPS and the FAA's responsibility to assure the safety and efficiency of aviation.

I reiterate that we are committed to working with you to address the issues raised in the report. As you know, the FAA already has undertaken a number of non-regulatory initiatives to address noise and safety concerns at the Statue of Liberty, Glacier National Park, Zion National Park, and Hawaii Volcanoes National Park. We are ready to proceed with similar initiatives at Perry's Victory and International Peace Memorial and at the Mt. Rushmore National Memorial within the next six months. We will schedule an Interagency Working Group meeting specifically to develop an action plan for an orderly prioritized approach to the recommendations in your report.

The DOT will be pleased to continue working with you in resolving these and other aviation issues affecting the National Park System.

Sincerely,

Dale E. McDaniel

Barry L. Valentine
Assistant Administrator for Policy, Planning,
and International Aviation

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ACKNOWLEDGEMENTS

This Report to Congress provides the U.S Department of Interior, National Response to Public Law 100-91, the National Parks Overflights Act of 1987. The information presented herein represents the combined efforts of many scientists, specialists, and park managers and staff. In particular, the National Park Service would like to acknowledge the contribution of the following:

The Department of Interior — Department of Transportation Interagency Working Group

Ms. Jackie Lowey, Ms. Barbara West, Mr. Joseph Canny, Mr. John Reynolds,
Mr. Dale McDaniel, Mr. Destry Jarvis, Mr. Hal Becker, and Dr. Wes Henry

Grand Canyon National Park

Superintendents Boyd Evison and Robert Arnberger and Staff, especially Mr. Mike Ebersole and Ms. Linda Mazzu.

The National Park Service, Denver Service Center

Mr. Rick Ernenwein and Mr. Elmer Hernandez

Research Contractors and Subcontractors

Harris Miller Miller & Hanson Inc: Mr. Nicholas P. Miller and Staff
BBN Systems and Technologies: Dr. Sanford Fidell and Staff
HBRS, Inc.: Dr. Robert Baumgartner and Dr. Cary McDonald
Sterna Fuscata, Inc.: Mr. Douglas Gladwin and Ms. Alexie McKechnie
Research Triangle Institute: Dr. Ronaldo Iachan

Executive Summary

EXECUTIVE SUMMARY
Report on Effects of Aircraft Overflights on the National Park System

1 Introduction

The National Park Service (NPS) was created by Congress to

> *". . . promote and regulate the use of Federal areas known as national parks . . . [so as to] conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."*[1]

In doing so, the NPS mission was defined as two-fold: conservation of resources and providing for visitor enjoyment. But the NPS Organic Act was amended by the Redwoods Act of 1978, and this act unambiguously defines resource preservation as the primary responsibility for the National Park Service. Given that natural quiet is a clearly identified resource, that aircraft overflights can affect this resource and that the FAA controls use of the airspace, meshing the disparate missions of the NPS and FAA has, until recently, appeared to be an intractable task.

1. *NPS organic act, 16 USC 1*

The NPS manages the many units of the National Park System to accomplish the overall goals of the Organic Act and any specific goals identified when Congress established the various parks, monuments, preserves, recreation areas, and other units. Among the goals are provision of opportunities for visitors, such as the opportunity to experience solitude or to experience nature in a state unaffected by the effects of civilization. Increased numbers of low-flying aircraft over various units of the National Park System diminish opportunities for solitude and natural quiet, and raise concerns about other impacts and the appropriateness of this activity over national parks. To these ends, in August of 1987 Congress passed Public Law 100-91, the National Parks Overflights Act. The Act directed the Secretary of the Interior to conduct studies that provide information and evaluations regarding nine questions relevant to national parks. Table 1 lists the specific questions to be answered, identifies the section of the law which poses each question and the chapter(s) of the full report which provides the answers[2].

TABLE 1: QUESTIONS POSED BY P.L. 100-91

Question to be Answered	Section of P.L. 100-91 where Question is Posed	Chapters of Report that Address the Question
1. What is the nature and scope of the overflight problem in the National Park System?	§1.(b)	2
2. What are other injurious effects of overflights on the natural, historical, and cultural resources for which such units were established?	§1.(c)(3)	3,4,5
3.a. What is the proper minimum altitude which should be maintained by aircraft when flying over units of the National Park System?	§1.(a)	3
3b. What have been the effects of the minimum altitudes established over Yosemite and Haleakala National Parks?	§2.(c)	9
3c. Has the plan for management of airspace above the Grand Canyon succeeded in substantially restoring the natural quiet in the park?	§3.(b)(3)(A)	9
3d. What revisions in the airspace management plan for the Grand Canyon may be of interest?	§3.(b)(3)(B)	10
4. What is the impairment of visitor enjoyment associated with flights over such units of the National Park System?	§1.(c)(2)	6
5. What are the impacts of aircraft noise on the safety of the park system users, including hikers, rock-climbers, and boaters?	§1.(c)(1)	7
6. What are the values associated with aircraft flights over such units of the National Park System in terms of visitor enjoyment, the protection of persons or property, search and rescue operations and firefighting?	§1.(c)(4)	8

2. *The law specifically excludes from consideration all National Park System units in the State of Alaska. So all information in this report, when applicable to the "park system" really applies to the non-Alaskan units of the National Park System. This distinction is repeated where appropriate.*

2 Answers to Questions

In response to these questions, the NPS conducted numerous studies, all of which are listed in Appendix A of this report. The many studies provide answers to the questions posed by the National Parks Overflight Act. This section summarizes the answers and refers to the chapters that present the supporting information.

2.1 Nature and Scope of the Overflight Problem

2.1.1 Number of Parks Affected

Aircraft overflights can and do produce impacts both on park resources and on visitors. These impacts, however, do not occur evenly throughout the National Park System, but occur at some parks to a considerably greater extent than at others depending upon local air traffic (§2.1.4[3]), and local park management objectives (§2.1.5). Congruence between management perceptions and visitor responses (§6.3.1) means it is likely that as many as 50 to 100 units of the park system currently may have overflight problems in need of resolution (§2.1.1), and that 30-40 of these parks are priorities for research and problem solving. Passenger satisfaction with air tours (§8.2.1) and park visitor interest in seeing parks from the air imply that the demand for air tours will continue and the NPS expects further increases in the number of tour overflights and in the number of park units affected by air tours.

2.1.2 Types of Aircraft

Reported numbers of overflights by type of operation vary considerably from park to park, with slightly less than half the parks reporting more than 10 overflights per day. Commercial passenger aircraft, sightseeing and general aviation operations are more prevalent than other types of overflights. Military overflights and park administrative overflights are the least common (§2.1.4).

For the parks where commercial passenger aircraft overflights occur, these aircraft tend to produce the highest numbers of overflights; sightseeing or general aviation aircraft, on average, produce about one-sixth as many overflights as commercial passenger planes. Military aircraft average about half as many overflights as sightseeing or general aviation aircraft. Overflights for NPS administrative and emergency purposes are insignificant in numbers (§2.1.4).

3. *Refers to specific chapter section where supporting information appears.*

2.1.3 Aircraft Sound Levels

Sound levels were measured at various locations in eight national parks[4]. though decibel levels were collected, data were also collected on how long aircraft could be heard. During measurement periods that generally included several hours of data collection, aircraft could be heard from a low of about 5 percent of the measurement time to highs of 70 to 90 percent of the time. Of 78 locations measured, aircraft were audible more than 50 percent of the time at 34 locations. The locations were not chosen randomly, so general judgements about the audibility of aircraft should not be made. However, these measurements show that in these parks, aircraft have a significant effect on the audible environment at some locations (§2.3).

Decibel data show that non-aircraft background sound levels in parks can be exceedingly quiet, often less than 20 decibels more than half the time, and that aircraft levels can protrude well above these background sounds (§2.3). Flight-free zones and minimum altitudes can limit such protrusion, but ground elevations and distances to aircraft flights must be carefully considered.

2.1.4 Relative Seriousness of Overflight Problem

For parks affected by overflights, about 70 percent of the managers identified aircraft as a potential sound problem, while road traffic was identified as a potential problem by about 40 percent of these managers. Less than 15 percent of the managers identified each of four other sources (power generators, audio equipment, domestic animals, people talking) as potential sound problems (§2.1.5).

Most, though not all, managers of the parks with perceived overflight problems rate aircraft as one of their more important management problems. Also, managers demonstrate differing degrees of concern about overflights. Hence any systematic method for assessing aircraft overflight problems should be designed to incorporate local management objectives in the identification of the problem and in developing solutions. The starting point for resolving overflight issues over national parks needs to begin with an examination of those parks whose managers are very to extremely concerned about overflights.

Visitors' differing perceptions of overflight problems are discussed in section 2.7.

4. *Grand Canyon N.P., Haleakala N.P., Hawaii Volcanoes N.P., Cumberland Island N.S., Mount Rushmore N.M., Yosemite N.P., Petroglyphs N.M. and Glacier N.P.*

2.2 Other Injurious Effects of Overflights on Resources

Aircraft overflights appear to have adverse effects or impacts on other park resources, and studies examined the potential effects on cultural and historical resources, sacred sites and ceremonies, wildlife, and natural quiet.

2.2.1 Impacts on Cultural and Historical Resources, Sacred Sites and Ceremonies

Park Manager and Visitor Opinions

The park manager and visitor surveys provide two perspectives on the interference overflights may have on visitor's opportunity to appreciate the historical and/or cultural significance of the parks. About half of the approximately 100 park managers surveyed thought that aircraft activity interfered moderately, very much or extremely with the opportunity for visitors to appreciate these historical/cultural resources (§4.1.1). Based on the visitor survey, it is concluded that across the system, an estimated 4-5 million visitors feel their opportunities to experience the historical and cultural resources in parks is impacted — a small percentage of the visitor population.

Acoustic Impacts

The sound from aircraft activity can impinge on the solemnity of sacred sites as well as interfere with Native American and other traditional ceremonies. As shown in Chapter 3, and discussed below under Impacts on Natural Quiet, national parks provide opportunities for quiet generally unavailable in common non-park settings. Quiet park surroundings can provide unique opportunities for visitors to experience cultural and historic sites and for traditional ceremonies to be conducted in an historically accurate audible environment — the environment that existed before the introduction of mechanized power. If national parks are to provide opportunities for visitors to see and experience authentic historical settings, for practitioners to conduct authentic ceremonies, and for visitors to witness such ceremonies, the parks must be able to control or limit the audible and visual intrusion of aircraft. Such intrusions not only detract from the authenticity of the experience, but for some settings and ceremonies, participants may consider intrusions to damage or destroy the very purpose of the setting or ceremony (§4.2).

Induced Vibration Impacts

The sound from aircraft activity can cause archeological resources, structures, and museum objects to vibrate. Depending on the character of the sound, the effects range from audible rattle, to items "walking" across surfaces, to fatigue cracking, and potentially to direct or indirect structural damage. Potential for impact depends upon the relationship of the aircraft overflight to the resource, the frequency of overflight, and the frequency-dependent responses of the resource to impinging sound waves. Some studies suggest that historic structures exposed either to sonic booms or to helicopter operations at close range may be at risk of weakening or being damaged. Situations need to be examined on a case-by-case basis. The NPS proposes, where warranted, to develop a systematic approach for examining appropriate structures to determine levels of sound-induced vibration. Lacking such detailed information, eliminating sonic booms or keeping helicopters distant should protect most structures (§4.3.2, §4.3.3, §4.3.4).

2.2.2 Impacts on Wildlife

The effects of overflights on wildlife are less well understood than are the effects of overflights on structures. Though there are many reports of behavioral responses in animals, these responses vary study to study, species to species, season to season, habitat to habitat (§5.3). Indirect effects on wildlife such as accidental injury, energy losses, habitat avoidance and abandonment are very difficult to detect, but some experts suspect that they occur (§5.4). Such uncertainties, however, do not prevent definition of impact criteria to use in judging potential for impacts on wildlife at specific parks. In the following criteria, "species of concern" include federally- or state-listed threatened, endangered, and candidate species, species of local economic importance, or species of particular concern to conservation or other interest groups. This definition can be expanded to include any species that is known to be susceptible to disturbance. "Habitat" is used to refer to the physical landscape and its ecosystem components that are subjected to overflights (§5.10). The following guidelines can be used to identify impacts of overflights on wildlife.

Negligible impacts

- No species of concern are present and either no or only minor impacts on any species are expected.
- Minor impacts that do occur have no secondary (long-term or population) effects.

Low impacts

- Non-breeding animals of concern are present in low numbers.
- Habitat is not critical for survival and not limited to the area of overflight use; other habitat meeting the requirements of animals of concern is found nearby and is already used by those species.

- Occasional fright responses are expected, but without apparent interference with feeding, reproduction, or other activities necessary for survival.
- No serious concerns are expressed by state or federal fish and wildlife officials.

Moderate impacts

- Breeding animals of concern are present, and/or animals are present during particularly vulnerable life-stages such as migration or winter (depends upon the species in question).
- Mortality or interference with activities necessary to survival are expected on an occasional basis.
- Mortality and interference are not expected to threaten the continued existence of the species in the area.
- State and federal officials express some concern.

High impacts

- Breeding individuals are present in relatively high numbers, and/or animals are present during particularly vulnerable life-stages.
- Habitat targeted for overflights has a history of use by the species during critical periods, and this habitat is not extensive outside the area targeted for overflight use; animals cannot go elsewhere to avoid impacts (animals can rarely "relocate" except temporarily).
- Mortality or other effects (injury, physiological stress, effects on reproduction and young-raising) are expected on a regular basis. These effects could threaten the continued survival of the species.
- State and federal wildlife officials express serious concern.

2.2.3 Impacts on Natural Quiet

The resource of natural quiet is defined as the *natural ambient sound conditions found in a park*. The NPS has long regarded "natural quiet" as a park resource. This perspective is reflected in current public law, in explicit park management policy, and by the visitors themselves (§3.1). Just as parks contain many *tangible* features, such as animals, plants, waters, geological features, historic buildings and archeological sites, they have intangible qualities as well. These qualities include solitude, space, scenery, clear night skies, sounds of nature and "natural quiet."[5] Such intangible qualities are important components of visitors' overall enjoyment of parks, and are thus valued resources.

Congressional acts and NPS management policy reflect the importance of preserving natural quiet in the national parks.

In developing an approach to preserve natural quiet, the NPS recognizes the following five important facts:

1. Natural quiet is a resource for preservation within the National Park Service mandate.

2. The human auditory system is an excellent mechanism for determining the presence or absence of natural quiet. No readily available electronic device can duplicate human hearing for identifying audible sounds produced by non-natural sources.

3. The difficulty of preserving natural quiet is directly related to how quiet it is. If the natural ambient sound conditions are relatively loud, as along a beach with pounding surf, or near a waterfall, then intruding non-natural sounds will have to be comparably loud to be heard. On the other hand, in a remote park location with no wind or water, or one with little or no vegetation or wildlife, even very quiet intruding non-natural sounds will be audible.

4. Humans are not always aware of sounds that are audible. Humans, when engaged in any number of activities, may have their attention focused on the activity and not be aware that a new sound has become audible. Visitors who for the first time view the Grand Canyon at Lipan Point are not very likely to remember hearing any aircraft, where only about 30 percent of the visitors interviewed reported hearing aircraft (§6.3.1) even though roughly 90 percent of them could have.

5. Park settings can provide levels of natural quiet that are so quiet, there is no sound to be heard except that generated by the listener – the sounds of walking, breathing, heart pumping, and blood flowing (§3.2.2 and §3.3).

These five facts have important implications for park management and for working to achieve compatibility between use of air space and the underlying park lands. First, preserving natural quiet is a park management objective, a

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5. *NPS-77, Natural Resource Management Guideline, which addresses protection of aesthetic values, clearly identifies intrusive sounds as affecting an aesthetic value of a park and appropriate for mitigative action. NPS-77, Chapter 2, "Protection of Aesthetic Values."*

part of the mission of the NPS, and decisions concerning in which parks and in which locations natural quiet is to be preserved are to be made by the NPS.

Second, if an attentive listener with normal hearing can hear aircraft, then natural quiet does not exist while the aircraft is audible.

Third, achieving natural quiet 100 percent of the time, or even a significant portion of the day, will not always be achievable, nor will it be necessary, in all locations in all parks. There are locations where intruding sounds cannot be eliminated. Local street traffic, other visitor activity, as well as aircraft can eliminate natural quiet. On the other hand, the studies have shown that visitor judgement of the importance of natural quiet varies, probably as a function of the type of visitor, and his or her activity (§3.1.4), and hence, from the visitor perspective, natural quiet is not equally important in all locations or for all visitor activities (a position not necessarily shared by park managers).

2.3 Proper Minimum Altitude

Establishing a minimum altitude for aircraft overflights over all units of the National Park System is neither feasible nor necessary. In those cases where significant impacts from overflights have been identified, park management objectives and the physics of sound propagation suggest that no single minimum altitude can eliminate all aircraft produced impacts. However, national park experience with minimum altitude restrictions implies that some impacts can be reduced with an appropriately chosen minimum altitude. Minimum altitudes have been in force over Yosemite and Haleakala National Parks (see 2.4) and are combined with flight-free zones over Grand Canyon National Park (2.5). These restrictions have not restored natural quiet, but the most egregious impacts have been reduced or eliminated where the altitude restrictions have kept aircraft several thousand feet from visitors, as at Yosemite, at some locations in Haleakala, and at some sites within flight-free zones in the Grand Canyon (§2.3, §9.1, §9.2). It is clear, however, that setting of a minimum altitude for a park, when appropriate and approved by the FAA, must reflect park management objectives and the elevations of the specific sites that are to be protected. Minimum altitudes, or, more accurately, minimum stand-off distances can also reduce the risk of impacts on cultural resources (§4.3.4). In any case, however, minimum altitudes alone cannot be expected to preserve or restore natural quiet (§3.4), or to completely eliminate the adverse effects on all visitors (§6.3.1).

2.4 Effects of Minimum Altitudes Established Over Yosemite and Haleakala National Parks

Public Law 100-91 specified minimum altitudes for aircraft flying (visual flight rules) over certain areas of Yosemite National Park and over Haleakala National Park. Park management reports that at Yosemite visitor complaints about overflights have diminished, and at Haleakala where sound levels have been reduced, increased numbers of overflights may have significantly negated any improvement the restriction might have made (§9.1.1 and §9.1.2). The lessons learned from these two case studies may be summarized as follows:

- Raising the minimum altitude to 2000 feet reduces egregious impacts and may reduce complaints, but does not effectively restore natural quiet. Not only are the lower altitude aircraft audible, but high altitude jets are unaffected by such minimum altitudes.
- Numbers of overflights have an important impact on length of time visitors have an opportunity to experience natural quiet. Unabated increases in numbers can negate gains made through increasing the distance between aircraft and visitors.
- As part of their management strategies, park resource managers must carefully consider when and where to preserve natural quiet.
- Impacts on natural quiet are likely to be unique at each park, and the solutions equally unique. Approaches to problem solving need to be flexible to produce effective solutions.

2.5 Has the Plan for Airspace Above the Grand Canyon Substantially Restored Natural Quiet?

Section 3 of P.L 100-91 directed the Secretary of the Interior to develop an airspace management plan for Grand Canyon National Park (GCNP), to be implemented by the Administrator of the Federal Aviation Administration (FAA) that would

> *". . . provide for substantial restoration of the natural quiet and experience of the park and protection of public health and safety from adverse effects associated with aircraft overflight."*

A plan to achieve these purposes, Special Federal Aviation Regulation (SFAR) 50-2 was implemented in November 1988. In general, SFAR 50-2 regulates all aircraft operations below 14,500 feet above mean sea level (MSL) by providing four flight-free zones covering about 45 percent of the park (§9.2.2). GCNP monitoring and visitor complaints, measurement of sound levels at various locations throughout the park, surveys of visitors, and acoustic modeling provided information for evaluating the effectiveness of the SFAR (§9.2.3).

Despite extremely high compliance with the SFAR by aircraft operators, and reduced complaints from visitors, aircraft are still audible large percentages of the time in much of the park. The SFAR has significantly reduced aircraft sound levels for many locations, but natural quiet has not been substantially restored. For some visitors, experiencing natural quiet is almost as important a reason for visiting the Grand Canyon as is viewing the scenery. Visitors still notice aircraft, and believe that the sound has interfered with their appreciation of natural quiet, especially in the backcountry, and along the river corridor and corridor trail system use zones (§9.2.3).

Chapter 9 of the full report begins by defining a "substantial" restoration of natural quiet to be 50 percent or more (50 to 80 percent) of the park for 75-100 percent of the time, and concludes that a substantial restoration of natural quiet has not been achieved under the current regulation. The conclusion is based on acoustic monitoring results and supported by computer modeling. Visitor surveys resulted in identifying those visitor populations most sensitive to overflights and correlated the percent of time aircraft were audible with visitor perceptions. The majority of park visitors support 1) maintaining or reducing current amounts of overflight and 2) some type of restrictions to meet such policies (§9.2.3).

Furthermore, computer modeling suggests that if no further actions are taken to improve the current regulation, due to projected overflight increases (forecasted in the Grand Canyon Airport Expansion Plan), there will be a loss in that proportion of GCNP currently experiencing a substantial restoration of natural quiet. Specifically, the proportion of the park experiencing a substantial restoration of natural quiet would drop from 34 percent of the park currently to less than 10 percent by the year 2010. Consequently, the NPS is compelled to strongly recommend that SFAR 50-2 be revised to effect and maintain a substantial restoration of natural quiet over time (§9.2.3).

2.6 Revisions in the Grand Canyon Airspace Management Plan

The NPS recommendation for revision of the Grand Canyon Airspace Management Plan is based on the following general concepts (§10.3.10):

- Expansion in the size of flight-free zones
- Simplification of the commercial tour route structure
- Use of temporal restrictions ("no fly" times)
- Accommodation of the forecast growth in the air tour industry

- Phased-in use of "quiet aircraft technology".

Computer modeling suggests that this combination of elements will most effectively restore natural quiet as mandated by Public Law 100-91. A reasonable phase-in (15 years) is desirable from all perspectives. The modeling takes into account forecast increases in the Grand Canyon air tour industry over the next 15 years, and incorporates a gradual conversion to quiet aircraft over that same time period.

A summary of the four recommended phases of the plan follows (§10.3.10.1):

Year 1: Expand existing flight-free zones and create a new flight-free zone in western Grand Canyon. This recommendation includes combining the Shinumo and Bright Angel Flight-Free Zones into one large zone (to be named the Bright Angel Flight Free Zone) and expanding it north to the SFAR boundary. The Toroweap/Thunder River Flight-Free Zone would be expanded to better protect the Toroweap Overlook area and the Desert View Flight-Free Zone would be expanded north and east to better protect the Desert View area. The current SFAR 50-2 tour routes and route segments would be reduced and adjusted accordingly. Routes within flight corridors would provide for one-way traffic only.

The Dragon Flight Corridor would be abolished, but two quiet aircraft routes (one for airplanes, one for helicopters) will exist in this area (the new Bright Angel Flight-Free Zone) for five years. This would allow those air tour operators who have already invested in quiet aircraft technology to be rewarded for their efforts. Traffic will be one-way only on these two routes.

The Fossil Canyon Flight Corridor would be realigned and the minimum altitude for general aviation aircraft in the Tuckup Flight Corridor would be lowered from 10,500 feet MSL to 9,500 feet MSL.

Year 5: Limit the Fossil Canyon Flight Corridor to quiet commercial tour aircraft. The two quiet aircraft routes within the new Bright Angel Flight-Free Zone would be eliminated. This action is necessary because the computer modeling indicates that having two flight-free zones in that area (the current Shinumo and Bright Angel Flight-Free Zones) with a flight corridor in-between them (the current Dragon Flight Corridor) can not protect or maintain natural quiet adequately over the sensitive areas below.

Year 10: Limit the Zuni Point Flight Corridor to quiet commercial tour aircraft. This means that those companies without quiet aircraft technology would only be able to fly over the western part of the SFAR or over Marble Canyon.

Year 15: Limit the entire Special Flight Rules Area to quiet commercial tour aircraft. That is, all tour routes would be flown only with quiet aircraft.

One very important facet of this recommendation would be the establishment of an aircraft monitoring program to ensure that the substantial restoration is maintained. This program would be designed to measure sound levels on the ground in areas where the agency seeks to protect natural quiet. The NPS would identify benchmark sites and establish a protocol for collecting acoustical data at those sites for the purpose of establishing "action triggers". These triggers would specify a noise level that should not be exceeded. The NPS would work with the FAA to initiate actions which would rectify the situation when the noise level is exceeded.

The predicted result of the NPS recommendation is that by the year 2010, natural quiet would be substantially restored to 64 percent of the park, 75 to 100 percent of the time. Forty-four percent of the park would experience natural quiet 100 percent of the time. In contrast, the modeling suggests that if "no action" is taken to improve SFAR 50-2, less than 1 percent of the park would experience 100 percent natural quiet and less than 10 percent of the park would achieve a substantial restoration by the year 2010 (§10.3.10.6).

It is clear that a "no action" alternative is unacceptable. It is equally clear that achieving the substantial restoration mandated by P.L. 100-91 can be accomplished only by the proposed restructuring of the airspace with larger flight-free zones <u>and</u> the gradual conversion of the air tour fleet to quiet aircraft.

The NPS recommendation offers immediate rewards and long-term incentives to those companies which have voluntarily invested in quiet aircraft technology and to those companies willing to do so in a timely manner. It is important to note that these recommendations will not only achieve substantial restoration, but also maintain it in the long term even though increases in overflights are forecast. The NPS believes that this recommendation strikes an appropriate balance between resource protection and visitor enjoyment.

2.7 Impairment of Visitor Enjoyment

2.7.1 Background

The effects of aircraft overflights on visitor enjoyment were examined primarily through two surveys: the "Visitor Survey" and the "Dose-Response Study." The Visitor Survey was designed to provide National Park system-wide[6] estimates of visitor impacts, but the results also provide valuable information on the variation in effects from park to park. The Dose-Response Study examines visitor reactions to overflights of specific park locations and provides a quantitative relationship between aircraft sound level and visitors' reactions to these sound levels.

The information from the Visitor Survey was obtained through a careful five-stage sampling process of park units throughout the system. Interviews were conducted of visitors as they left the various selected parks. Approximately 15,000 visitors were interviewed during the busiest two months of the season at 39 parks across the country.

The Dose-Response Survey included both interviews of visitors and simultaneous sound level data measurement. Visitors to four specific sites at the Grand Canyon, to one site at Haleakala and to one site at Hawaii Volcanoes were interviewed as they left each site. While they were at the site, sound levels that they could have heard were measured. Visitors' replies to questions about the effects of aircraft overflights were matched with the sound levels that were measured while they were at the site. Thus, sound levels that could be heard (doses) could be related analytically to visitor reactions (responses).

2.7.2 Impacts Across the National Park System

Importance of Natural Quiet

During the Visitor Survey, visitors were asked how important it was to be able "to enjoy the natural quiet and sounds of nature" and "to enjoy the natural scenery" as reasons for their visit to the park. Visitors were given the choice of five possible responses: not at all important, slightly important, moderately important, very important and extremely important. Table 2 summarizes the responses for the park system. System-wide, enjoying natural quiet is about as important as viewing natural scenery as a reason for visiting national parks (§6.2.1).

6. *Excluding park units in Alaska.*

TABLE 2: IMPORTANCE OF NATURAL QUIET AND NATURAL SCENERY AS REASONS FOR PARK VISIT		
Reason for Park Visit	**Estimate**	**95% Confidence Interval**
Enjoy Natural Quiet		
Percent of Visitors[a]	90.7%	88.3% to 93.1%
Number of Visitors[b]	397.1 M	386.6 M to 407.6 M
Standard Error[c]	1.23	
(n=15,150)[d]		
View Natural Scenery		
Percent of Visitors[a]	93.2%	91.3% to 95.1%
Number of Visitors[b]	408.0 M	399.7 M to 416.3 M
Standard Error[c]	0.98	
(n=15,227)[d]		

[a]Respondents who answered 3, 4, or 5 on the following scale: 1=not at all, 2=slightly, 3=moderately, 4=very, and 5=extremely.
[b]Estimate of the 1992 visitor population is 437.8 million visitors. As used here, "visitor" means one person exiting the park. Hence, if a person enters and leaves a park once each day for three days, that person is counted as three "visitors".
[c]Standard error is of the percent, not of the number of visitors.
[d]Number of completed interviews.

Impacts Produced by Hearing and Seeing Aircraft

Visitors were asked if they heard or saw any aircraft during their visit, and if they did, whether the aircraft interfered with their enjoyment, whether they were annoyed, and whether the aircraft interfered with their appreciation of the natural quiet and the sounds of nature. Table 3 summarizes the results for the park system. About one fifth of all visitors to the national parks (about 80 million visitors a year) remember seeing or hearing aircraft during their visit to the park, and about 2 to 3 percent of all visitors, or roughly 7 to 13 million visitors annually, can be expected to be impacted by hearing or seeing aircraft (§6.2.2).

Impacts Among Different User Groups Produced by Hearing Aircraft

Impacts of overflights on different user groups were also examined. Three visitor groups were identified: frontcountry, backcountry, and overnight backcountry permit holders. Visitors who completed the exit survey could be categorized based on their primary recreational activity. Those who indicated their primary activity was backpacking or hiking were classified as "backcountry" users, while all other surveyed visitors were classified as "frontcountry". The third group, the backcountry permit group, is a sample of permit holders from those NPS units that require a permit to stay overnight in the backcountry. These permit holders were surveyed by mail.

TABLE 3: NUMBERS OF VISITORS HEARING OR SEEING AIRCRAFT, AND THE RESULTANT IMPACTS		
Type of Effect	**Estimate**	**95% Confidence Interval**
Heard Aircraft Percent of Visitors[a] Number of Visitors Standard Error (n=15,190)	20.1% 88.0 M 5.10	10.1% to 30.1% 44.2 M to 131.8 M
Saw Aircraft Percent of Visitors Number of Visitors Standard Error (n=15,081)	18.8% 82.3 M 4.10	10.8% to 26.8% 47.3 M to 116.3 M
Hearing Aircraft Interfered with Visitor Enjoyment Percent of Visitors Number of Visitors Standard Error (n=15,150)	1.9% 8.3 M 0.65	0.6% to 3.2% 2.6 M to 14.0 M
Annoyed by Hearing Aircraft Percent of Visitors Number of Visitors Standard Error (n=15,174)	1.6% 7.0 M 0.77	0.1% to 3.1% 0.4 M to 13.6 M
Hearing Aircraft Interfered with Appreciation of Natural Quiet Percent of Visitors Number of Visitors Standard Error (n=15,049)	2.8% 12.3 M 0.99	0.9% to 4.7% 3.9 M to 20.6 M
Annoyed by Seeing Aircraft Percent of Visitors Number of Visitors Standard Error (n=15,072)	3% 13.1 M 0.86	1.3% to 4.7% 5.7 M to 20.6 M
[a] See notes to Table 2.		

Figure 1 shows the percentages of visitors in each of the three groups who remembered and reported hearing aircraft, who were annoyed, who indicated aircraft sound interfered with their enjoyment, and who indicated aircraft sound interfered with their appreciation of natural quiet and sounds of nature. A higher percentage of backcountry than frontcountry visitors report hearing aircraft and are more likely to experience impact from these aircraft. Though the reasons for these differences have not been identified, it is clear that hiking and backpacking do not remove visitors from the impacts of overflights (§6.2.3).

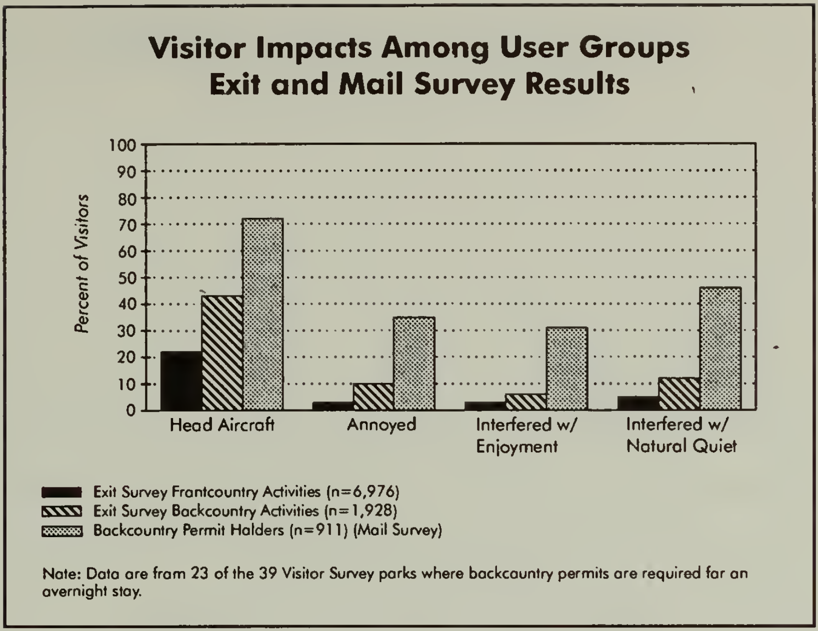

Figure 1: Impacts of Hearing Aircraft Among Different Visitor Groups

2.7.3 Impacts at Specific Parks

The Visitor Survey information summarized above was collected at 39 different units of the National Park System. Examining results from these individual parks provides an indication of the wide variation in aircraft impacts from park to park. Figure 2 is based on the visitor survey data and shows estimates of the number of visitors who heard aircraft and the number who were annoyed at each of the parks during the two month survey period. The numbers next to the plotted points refer to the specific park as given in Table 6.5 of the full report, and Table 4 lists the specific parks of Figure 2 having more than 10,000 visitors annoyed by aircraft during the survey. (As above, see notes to Table 2, visitors are counted as annoyed if they answer 3, 4, or 5 on the following scale: 1=not at all, 2=slightly, 3=moderately, 4=very, and 5=extremely.) Park visitor reports of exposure to aircraft (hearing aircraft) and of impacts from the exposure vary widely from park to park, and the system wide results summarized in Table 3 can not capture the nature and severity of impacts that may occur at specific parks (§6.3.1).

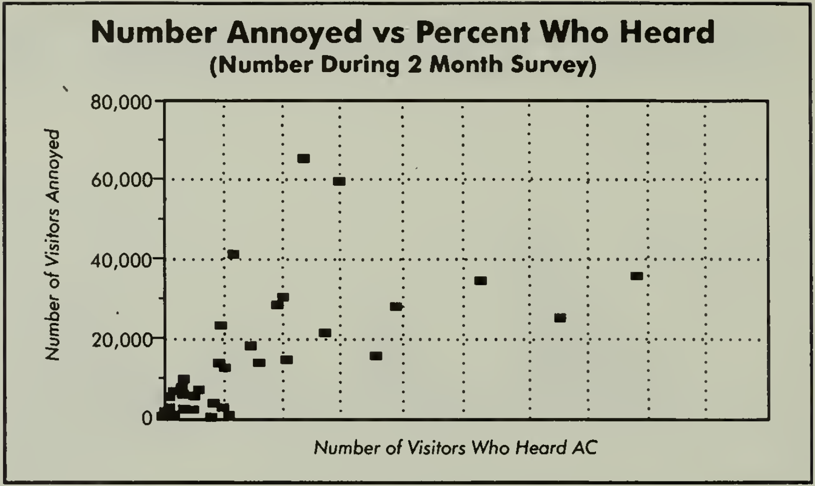

Figure 2: Numbers of Visitors Hearing Aircraft and Annoyed by Aircraft at Visitor Survey Parks

TABLE 4: VISITOR SURVEY PARKS WITH MORE THAN 10,000 VISITORS IMPACTED BY OVERFLIGHTS DURING SURVEY	
	National Park Unit
5	Cape Cod National Seashore
11	Everglades National Park
15	Glacier National Park
16	Glen Canyon National Recreation Area
17	Grand Canyon National Park
18	Great Smoky Mountains National Park
19	Gulf Islands National Seashore
20	Haleakala National Park
21	Hawaii Volcanoes National Park
24	Lake Mead National Recreation Area
27	Mount Rainier National Park
28	Mount Rushmore National Monument
29	North Cascades National Park
35	Sleeping Bear Dunes National Lakeshore
38	Yellowstone National Park
39	Yosemite National Park

2.7.4 Impacts at Specific Sites

Though the Visitor Survey provides much useful information about the impacts of overflights system wide and about impacts at the specific surveyed parks, it was not designed to collect any quantitative information about the actual sounds that visitors could have heard. It therefore provides no means for answering questions that would help quantify the relationship between visitor impacts and aircraft sound level. Since the Visitor Survey could not provide any information about sound levels experienced by visitors, the

Dose-Response Study was designed and conducted to answer the following three questions:

1. Does impact as reported by visitors depend upon sound levels produced by aircraft overflights?
2. If so, what is the relationship between reported impact and aircraft sound levels?
3. What factors other than aircraft sound affect visitor impacts?

Figures 3 and 4 present dose-response curves that were developed from the data collected at five specific sites. In each, the horizontal axis gives the dose, while the vertical axis gives the response, and the curves show the relationship between the two. The two figures are for two doses and one response.

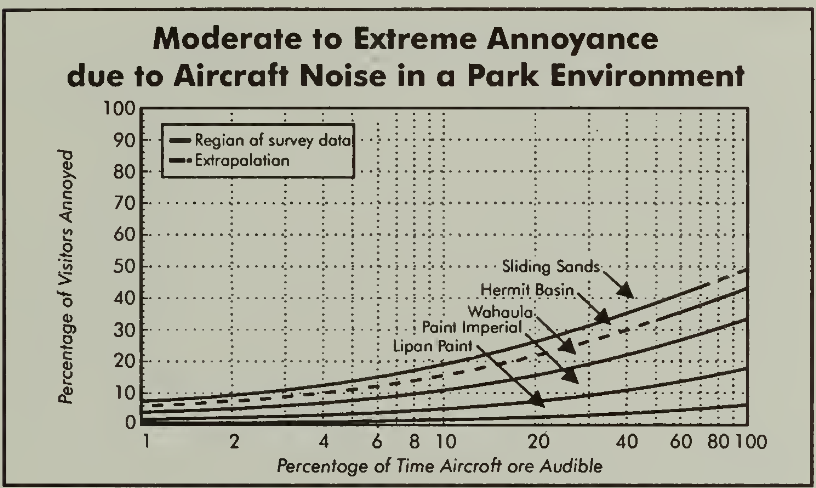

Figure 3: Dose-Response Curve for Visitor Annoyance vs Percent of Time Aircraft are Heard

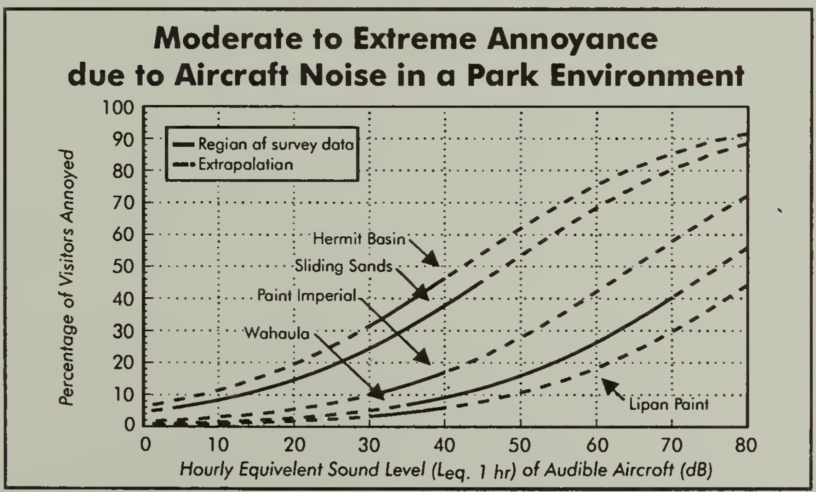

Figure 4 : Dose-Response Curve for Visitor Annoyance vs Hourly Equivalent Sound Level

The doses are percent of time aircraft are audible, and hourly equivalent level, $L_{eq,1hr}$ for audible aircraft[7]. The response is percent of visitors who said they were annoyed by aircraft noise while at the site[8]. The solid portion of the curve shows where the data lie, the dashed portions are extrapolations based on analysis. The dose-response curves, to the extent that they are applicable to a given site, can be used to predict visitor responses (impacts) by measuring (or predicting) dose. For example, if monitoring at a site similar to Sliding Sands shows aircraft audible about 30 percent of the time, then Figure 3 predicts that about 32 percent of the visitors will be annoyed. Alternatively, if $L_{eq,1hr}$ of 40 dB from audible aircraft were measured or predicted for the site, Figure 4 shows that about 37 percent of the visitors will be annoyed. Hence, visitors report negative reactions to the sound of aircraft at specific sites, and these negative reports increase as exposure to aircraft sounds increase (§6.3.2).

These curves demonstrate that sound exposure, though an important variable, is not the sole determinant of impact on visitors. Not only do the impacts on visitors clearly vary considerably from one site to another, but statistical testing of the data has shown that several other specific factors affect visitor response. Though the importance of these factors varies depending upon which dose and which response are examined, some generalizations are possible. First time visitors to a site are less sensitive to aircraft sound than are repeat visitors; visitor "groups" of one or two people are more sensitive than are larger groups; visitors who thought enjoying the natural quiet and sounds of nature was a very or extremely important reason for visiting the site were more sensitive to aircraft sound than visitors who judged quiet and sounds of nature as less important. Other factors may also be important in affecting how visitors respond, but lack of data prevented developing statistically verifiable results. The type of site is clearly important, since the curves vary from site to site; what is unknown is what characteristics of the site are important.

2.7.5 Identification, Analysis and Mitigation of Impacts

When used in conjunction with NPS management judgement, the dose-response results provide a means for quantitatively identifying and rank

7. *Percent of time aircraft are audible, while simple to measure, is extremely difficult to predict. On the other hand, measurement of $L_{eq,1hr}$ of audible aircraft is somewhat difficult, but reasonably easy to predict with current available computer models. Hence, dose-response curves for both metrics have been developed to provide the tools necessary for measurement, analysis and mitigation of overflight noise problems in parks.*

8. *The response of annoyance rather than interference with enjoyment was chosen for two reasons. Primarily, annoyance is the metric of response that has been used for almost two decades to assess the impact of intruding sounds, and particularly aircraft sounds on humans. The use of annoyance thus continues a well-established approach. Second, visitor impact in terms of annoyance and in terms of interference with enjoyment have proven to be virtually identical, see for example Table 6.5 in Chapter 6 of the full report. Curves were also developed for the dose of interference with the natural quiet and sounds of nature.*

ordering sites within parks that potentially produce significant impacts on visitors. The Visitor Survey shows that impacts on visitors do occur, but to very different degrees at different parks. The NPS has developed a ranking of 50 to 100 parks with potential overflight produced problems. Using these NPS identified parks, candidate sites within the parks should be identified where visitors may be impacted, and with the proper data collection process, the dose-response curves can be used to determine the sites with significant problems.

Park personnel will collect time audible data, using a carefully designed sampling procedure, and compare the results to the appropriate curve to estimate the degree of impact. The NPS will set criteria for acceptable degrees of impact, identifying both maximum acceptable percentages and maximum acceptable numbers of visitors impacted for each type of site or activity. If these maximums are exceeded, the NPS will initiate a process of analysis and interaction with aircraft operators and other agencies (eg., the Federal Aviation Administration, the Department of the Air Force, etc.) to eliminate or reduce the impacts.

The criteria for maximum acceptable impact will be developed by the NPS in terms of both percent of visitors to a site and numbers of visitors to a site. In terms of percent of visitors, a maximum acceptable value of between 20 and 30 percent will be identified. For example, where park measurements show a dose that results in more than 25 percent of visitors impacted, analysis and mitigation efforts will commence. Maximum acceptable numbers of visitors impacted will also be identified.

A flexible approach to analysis and mitigation will be developed and pursued. In some cases, for example, discussions with aircraft operators may identify simple changes (for example re-routings of air tours) that can be tested, found to provide acceptable reductions of impact, and implemented. In other cases, detailed analyses of many alternatives may be necessary. In such cases, the simple time audible metric can no longer be used. This metric, as mentioned, is extremely difficult to predict, and the alternative dose-response curves using hourly equivalent sound level, $L_{eq,1hr}$, of audible aircraft will be employed.

Detailed analyses of aircraft produced sound levels have long been conducted for airports and military air facilities. These efforts have resulted in computer models that can predict, generally within acceptable tolerances, how sound levels on the ground will be altered by changes in airspace use. These models are being adapted or expanded to provide predictive capabilities for aircraft overflights of parks. Using these computer models and information about airspace use including aircraft types, number of flights per day, location of flight corridors, altitudes of flights and terrain features, $L_{eq,1hr}$ can be computed for current operations and predicted for future or proposed operations, and appropriate dose-response curves and criteria can be used to estimate resulting visitor impacts.

2.8 Impacts on Safety

In the survey of 98 parks, a substantial majority of managers had slight or no concern about safety risks posed by overflights, and believed that both visitors and staff felt little or no threat to their safety from aircraft (§7.1). However, managers at 16 parks perceived that aircraft overflights represented a serious or very serious safety problem. The managers specific concerns ranged from perceptions that mid-air collisions were a problem, to safety of visitors on the ground, to possibility of collision with landmarks, to disruption of trail horses.

The survey of visitors revealed that virtually no visitors perceived any safety risk posed by aircraft overflights (§8.2). Some outdoor recreation organizations indicated concern, and it is likely that ensuring separation of helicopter overflights and horse traffic would provide some benefit (§7.3). Temporary flight restrictions (TFR's) around forest fires do not seem to have prevented airspace conflicts, and the Bureau of Land Management, U.S. Forest Service, Department of the Interior, Federal Aviation Administration and the Department of Defense are all developing improved means for communicating TFR information to pilots (§7.4).

2.9 Values Associated with Overflights

Value to NPS

The values or benefits of administrative and air-tour flights were examined. Sixty-five percent of the 98 parks with potential overflight problems report using aircraft in an administrative capacity, and by far, the greatest amount of flying time is spent fire fighting using helicopters (§8.1). In general, however, managers reported that the overflights by aircraft on park administrative purposes make up a small fraction of all overflights (§2.1.4). It is clear that national parks and visitors benefit from administrative overflights.

Value to Visitors

Many people take air tours over national parks, including approximately 750,000 people visiting the Grand Canyon in 1992, and perhaps nearly as many in Hawaii. A questionnaire was mailed to passengers of four Grand Canyon tour operators, and three Hawaiian tour operators. The sample of air tour passengers (555 responded) cannot be considered as truly representative since there is no confidence that it was a random sample.

Consequently, results cannot be used to make generalizations about sightseeing passengers at Grand Canyon National Park, the Hawaiian national parks, or to air tour passengers overflying the National Park System as a whole.

A significant majority of responding air tour passengers reported that the flight was very or extremely enjoyable, very much or extremely increased their appreciation of the park, and would recommend the flight to others. More than 95 percent of the respondents were first time air tour passengers, and while about 90 percent of the Grand Canyon air tour passengers also visited the canyon on the ground, fewer than 30 percent of the Hawaii tour passengers also visited the park on the ground (§9.2.1).

By far the most important reason for taking an air tour, identified by about 65 percent of the passengers surveyed, was to see the park from a unique perspective. The second most important reason, identified by about 20 percent, was limited time. Fewer than 10 percent of the passengers identified each of the following reasons: "experience a unique activity", "health or physical disabilities", or "other" reasons. Finally, when asked whether the benefits of air tours to passengers outweigh the disturbances to park visitors, about 55 percent of the passengers agreed or strongly agreed, about 30 percent were neutral, and the remaining 15 percent disagreed or disagreed strongly.

Values to Local Economies

Limited information is available on the economics of air tourism in the United States, especially as it relates to national parks. It is privileged economic data that the FAA does not collect. Based on industry reports, the economic impact of Grand Canyon air tours alone is two hundred and fifty million dollars ($250,000,000). The industry in Hawaii is apparently very nearly as large, and there is a sizable industry in other parts of the country including New York, St. Louis, and Southeastern Alaska. The FAA estimates that there are at least 187 air tour operators across the nation. This suggests the total economic impact of the industry is in the range of one-half to three-quarters of a billion dollars a year.

3 Conclusions

Between 30 and 40 non-Alaskan parks are current priorities for research and problem-solving with respect to aircraft overflights. The problems may differ considerably from park to park and developing solutions will require detailed knowledge of specific park conditions. Where are the most sensitive park areas? Where do aircraft fly in relation to these areas? What types and numbers of aircraft fly over the park, and who operates them? Where do the most serious impacts occur? Local park personnel need to gather considerable information in order to work knowledgeably toward solutions with aircraft operators, but the information collected needs to be reliable, related to what is known about the impacts produced by overflights, and useful in developing solutions. Reliability, relevance and usefulness can be assured by uniform application of the information presented in this report. Such information appears to be adequate to develop uniform methods of data collection and analysis, impact reduction alternatives, and methods for implementation and monitoring. The details of overflight problems and their solutions are local, but the process and general methods for problem identification, analysis and resolution must be uniform throughout the National Park System.

For example, research has shown that simple listening for aircraft, conducted with well-defined logging and sampling procedures, will determine not only the amount of time that natural quiet exists, but, by using the dose-response results, can estimate the impacts of overflights on visitor annoyance and on visitor perception of interference with the appreciation of natural quiet. Uniform guidelines developed from the research reported here will help local park management assess not only probable impacts on natural quiet and on visitors, but on historic or cultural structures, and on wildlife. Such information can help define the degree of the problem and, by deduction, may suggest how difficult solutions may be.

Because the details of problems are park specific, and because the NPS recognizes that air travel is an essential part of the nation's life, no single minimum altitude can be identified for the entire national park system. Minimum altitudes, or more properly, minimum stand-off distances, can be useful to eliminate the severest impacts, but unless very large, are unlikely to restore natural quiet. A 2,000 foot minimum altitude, such as in the current FAA advisory for overflying national parks, is useful but should not stand alone as the solution to park overflight issues.

The enthusiasm and enjoyment engendered in air tour passengers by their experience overflying national parks has serious implications for the NPS. Such customer satisfaction and apparent associated demand for air tours suggests growth potential for the air tour industry. The NPS must anticipate that air tour operations will continue to expand, not only over parks currently overflown, but at parks presently free of any significant overflight activity. A process must be established for the park service to participate early in the establishment of air tours over parks, and to interact in a way that can influence decisions about where and under what conditions new air tours operate.

Finally, though SFAR 50-2 has greatly improved the sound environment in areas of the Grand Canyon, natural quiet has not been substantially restored, and further improvements to the regulation are essential to achieve the substantial restoration of natural quiet mandated by Public Law 100-91.

4 Recommendations

4.1 Recommendation 1

Develop Airspace/Park Use Issue Resolution Processes

The NPS recommends that the Department of Transportation – Department of the Interior Interagency Working Group be maintained as a functioning entity to manage interagency problem solving through to the operational level of both agencies. Their priorities should be to identify and document processes that can be clearly communicated to field offices where problem solving should occur. Although many of the recommendations that follow are tied to this process, there may be some airspace/park use issues that go beyond the scope of the following recommendations. The general shape of this process should be as follows:

- Define and report issues in a format agreed upon by the agencies, including definitions of impacts outlined in this report.
- Forward information to points of contact in NPS and FAA who would be expected to seek resolution of the issues.
- Specify the time period during which a resolution must be achieved.
- Issue a joint report to the Interagency Working Group on success of resolution or mitigation efforts. If resolution is not possible, the issues would be addressed by the policy group.
- Issues not resolvable by the Interagency Working Group would be forwarded to the Secretaries of Transportation and Interior for final resolution.

The NPS also recommends that NPS and DOD use the newly established Federal Interagency Airspace/Natural Resources Coordination Group to develop similar issue resolution processes for low-level military overflights.

4.2 Recommendation 2

Establish and Maintain Agency Points of Contact

The NPS strongly recommends that agency points of contact be officially established and maintained as follows:

NPS — Deputy Director and Overflight Studies Coordinator

FAA — Air Traffic Operations (AAT), Flight Standards (AFS), and Environment and Energy (AEE).

DOD — To be requested through the new Federal Interagency Airspace/Natural Resources Coordination Group.

4.3 Recommendation 3

Use the Full Range of Methods and Tools for Problem Solving

The NPS recommends that all reasonable methods and tools be used in airspace/park use issue resolution processes. The following is a partial list of methods, any of which might be reasonably effective, feasible, and verifiable for use on a specific situation. The NPS has developed tools that permit identification of locations impacted by overflights, that compute, in terms of sound levels, the effects of changes in aircraft operations and that can be used to measure the reductions in impacts that result from such changes. The tools are based on a number of studies including, dose-response results, simplified sound level measurement techniques and computer programs that estimate sound exposure results from aircraft overflights.

The partial list of methods includes the following:

Voluntary Agreements: Voluntary agreements can have a role in resolving or mitigating airspace/park use issues if some fundamental weaknesses can be addressed. The FAA, the NPS, and air tour operators need reasons to enter into these agreements. Furthermore, there are no enforcement or penalties involved should operators withdraw from or refuse to participate in agreements. If rulemaking and penalties result when voluntary agreements do not work, then all parties will have incentives to make and comply with these agreements.

Incentives to Encourage Use of Quiet Aircraft: NPS research suggests that quieter aircraft can play an important role in substantially restoring or maintaining natural quiet in parks. Although there is no Federal requirement for air tour types of aircraft to be manufactured to produce less noise than Stage 3 standards for large commercial aircraft, some aircraft are significantly quieter than others and more appropriate for use in air tour operations. Because of the significant expense, incentives need to be developed to encourage air tour operators to replace equipment with quieter aircraft. Internally, the NPS will need to work with the Department of the Interior's Office of Aircraft Services to also provide incentives for parks to use quiet aircraft. P.L. 102-581, an "Act to amend the Airport and Airway Improvement Act of 1982 to authorize appropriations, and for other purposes, " requires the FAA to identify "any measures to encourage or require the use of quiet aircraft technology by commercial air tour operators."

The NPS defers to FAA expertise on this subject, but strongly recommends that FAA facilitate the introduction of quiet aircraft technology to benefit national parks, among many others.[9]

Spatial Zoning: Flight-free zones and flight corridors have been implemented in the Grand Canyon with some success. Experience has shown that, to preserve or restore natural quiet, flight-free zones must be quite large in extremely quiet places, approximately 20-30 miles minimum dimension. The problem, discussed in Chapter 3 of the full report, is that some park environments are so quiet that the sound of aircraft can be heard at great distances from flight paths.

Altitude Restrictions: Minimum altitudes can help, but for tour aircraft or low-altitude military training, the altitudes necessary to significantly reduce impacts may essentially defeat the purpose of the overflight. On the other hand, altitude restrictions used in Yosemite and Haleakala have helped to reduce the most egregious impacts even though overflight impacts have not been eliminated.

Operating Specifications for Operators: As part of its certification processes, FAA may require operators to conform with certain operational requirements. These requirements generally identify the types of operations authorized, the types of airplanes permitted, airports authorized for use and time limitations for maintenance, and training. Operations specifications that relate directly to park overflight operations may provide a reasonable method to address some documented adverse effects of overflights.

Treatment of Air Tour Operations as Concessions: National parks treat all commercial services provided to visitors in parks as concessions (i.e. regulated industries) which insures services will conform to minimum standards, are not priced unreasonably, and are consistent with park values. In some ways, air tour operations are similar to

9. *The FAA is awaiting completion of the NPS Report to Congress before it completes the report required by the Airport and Airway Safety, Noise Improvement, and Intermodal Transportation Act of 1992.*

ground-based services. In fact, where airstrips are inside parks, the NPS has several air tour operations under concession permit. If a joint FAA-NPS permitting process can be developed, similar arrangements may be possible where it is determined that air tour operations use the resources of the national parks. The purpose of this is to reduce resource impacts and to provide a specific visitor service.

Noise Budgets: Noise budgets have been used at some airports (Denver-Stapleton was one of the first) to allot responsibility for and control of noise among operators. Such budgets assume that the total noise generated by the airport, and by each operator, can be quantified. Each operator can be allocated an amount of "noise," generally based on an existing or previous level of operations. If an operator uses quieter aircraft, through retrofit or new purchases, more flights can be conducted while staying within the budget. Budgets are negotiated rather than imposed. Noise budgets may provide a means for limiting growth in air tour traffic over parks in that they focus on the goal of limiting or reducing the impact of the sound of overflights, not on directly limiting the number or type of aircraft operations. A draw-back for park application may be the need for tracking numbers of operations by time and type of aircraft. Another drawback is that adverse effects to visitor experience may not necessarily be addressed.

Limits on Times of Operations: Some sensitive areas on the ground may have cyclical daily, weekly or seasonal high and low visitation periods. Aircraft operations may be timed to coincide with low use periods. Alternatively, air tours may have slow days, periods or seasons, and visitors in search of tranquillity and natural quiet could be informed of the best times to visit the park and avoid significant numbers of overflights. Limited "No Fly" periods could provide visitors with certainty of natural quiet in some parks and should be further evaluated.

4.4 Recommendation 4

FAA to Address High Priority NPS Airspace/Park Use Issues

The NPS recommends that NPS/FAA/DOD jointly commit to resolving and mitigating airspace/park use issues beginning with identified priority areas. Such a commitment may enable the agencies to develop and more effectively communicate how issues can be resolved at the local level.

4.4.1 NPS Managerial Priorities

NPS believes its managers' identification of areas with aircraft overflight problems is a relatively accurate indicator of where airspace/park use issues exist. There is basic congruence between manager and visitor perceptions. Many of the 98 areas identified by managers have some type of overflight-related problem. Mitigation is possible for some areas and unlikely for others. The NPS seeks resolution of its top priorities and recognizes that the others (See Appendix B of the full Report) merit further investigation as well. Based on top priority NPS areas for resolution of airspace issues include:

Grand Canyon National Park
Hawaii Volcanoes National Park
Haleakala National Park
Great Smoky Mountains National Park
Glacier National Park
Bryce Canyon National Park
Bandelier National Monument
Statue of Liberty National Monument

The NPS will further evaluate the complex air traffic patterns over Yosemite National Park and Cumberland Island National Seashore to see if mitigation appears to be possible and will then discuss those situations with FAA.

4.4.2 NPS Priorities for Protection of Natural Quiet

The following is a list of parks where the NPS believes maintaining or restoring natural quiet is an immediate priority. Natural quiet is an increasingly scarce resource in the United States. There ought to be national parks where this can be experienced. Criteria for the selection of these areas is listed in section 10.3.6 of the full Report. Highest priority areas meeting these criteria include:

Glacier National Park
Zion National Park
Southeast Utah Group Parks
Haleakala National Park
Crater Lake National Park
Isle Royale National Park
Mesa Verde National Park
Rocky Mountain National Park
Chaco Cultural National Historical Park

The NPS will work with the FAA to further refine the criteria and how they may apply to other parks.

4.4.3 NPS Priorities for Resolution of Safety Concerns

The NPS recommends that its perceived on-ground safety concerns related to overflights be investigated by FAA to see if these problems can be resolved or mitigated. The FAA and the NPS are cooperating in an effort to identify and put into effect recommended air tour patterns and altitudes that will enhance aviation safety around the Statue of Liberty and reduce other impacts there as well. Additionally, the FAA is developing a Special Federal Aviation Regulation that will improve the safety of commercial air tour operations in Hawaii through establishing minimum altitudes, minimum standoff distances, and additional safety measures. The priorities for the NPS include:

Statue of Liberty National Monument
Hawaii Volcanoes National Park
Perry's Victory Memorial & International Peace Park

The process exists for the FAA to use its authority and expertise to resolve reported safety issues. These and any other issues that are identified by park managers will be forwarded to the FAA for investigation and resolution through the FAA's compliance and enforcement program.

4.4.4 NPS Priorities for Problem Solving with Department of Defense

The NPS recommends that NPS and DOD agencies explore resolution of airspace issues at the following priority areas through the Federal Interagency Airspace/Natural Resources Coordination Group. It will be important for the FAA to be involved in this process as well. This group will report to their respective policy representatives by the end of 1994 on recommendations for resolving existing and potential airspace conflicts. NPS priorities for areas to be examined during this search for procedures include the following:

Congaree Swamp National Monument
Sequoia-Kings Canyon National Parks
Organ Pipe Cactus National Park
Death Valley National Park
Channel Islands National Park
Joshua Tree National Park
Petrified Forest National Park
Pu'ukohola Heiau National Historic Site
Gulf Islands National Seashore
South Florida parks (Everglades National Park/Big Cypress National Preserve/Dry Tortugas National Park

DOD is required to report back to the Senate Armed Services Committee on development of procedures to resolve airspace/park use issues by January 1, 1995. The NPS will also report to the Subcommittee on National Parks, Forests, and Public Lands as well as to the House and Senate Armed Services Committees on the success and utility of this approach to problem solving.

4.5 Recommendation 5

Develop a FAA Operational Rule Triggered by NPS

The NPS recommends that FAA develop an operational rule to regulate air tour operations where they have or may have adverse effects on national parks. If voluntary agreements are not adequate, the NPS should be able to trigger action by the FAA to delineate aerial sightseeing areas defined by FAA Handbook 92.01 for Principal Operations Inspectors. The NPS would forward recommendation on the size, altitudes and routes to effect noise abatement and mitigate impacts to persons and property on the ground in parks. The FAA may adjust the recommendations and incorporate them into tour operators' operation manuals. The rule would need to specify that tour operators operate in accordance with Part 135 FAA Regulations. Any request by an operator to the FAA to fly below 2,000 feet or within 2,000 feet horizontally of sensitive areas and structures would need clearance from the FAA only after coordination and concurrence by the park manager.

This rule would minimize the effect on other types of aviation by targeting specific problem areas. The rule's existence would facilitate the use of voluntary agreements. The NPS recommends FAA consider a special sub-part of 135 regulations to be developed for air tour operations.

Areas where this rule is most needed include the national parks in Hawaii, Glacier National Park, Canyonlands National Park, Great Smoky Mountains National Park, Zion National Park, Bryce Canyon National Park, and Rocky Mountain National Park.

4.6 Recommendation 6

Develop a FAA Rule to Facilitate Preservation of Natural Quiet

The NPS recommends that FAA, under the authority of Section 611 of the Federal Aviation Administration Act,[10] implement a rule which would provide for the protection of natural quiet.

Several nationally applicable environmental statutes and regulations recognize that there are circumstances where special protection — beyond ordinary performance standards or requirements — may be necessary to adequately protect nationally significant resource values.

Class I Designations under the Clean Air Act require new air pollution sources which may affect designated airsheds — including many in national parks — to prevent significant deterioration of existing air quality so that

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10. *49 U.S.C. Section 611 (b)(1)*

resources including air quality-related values such as scenic vistas are not adversely affected. The absence of air pollution in some areas is what makes us aware of air pollution in others; if all areas are equally polluted, we have no way to know what is natural. Most Class I areas are at least 5,000 acres in size.

Outstanding National Resource Waters (ONRW) designations under the Clean Water Act often mean that no new point source discharges of pollutants are permitted in streams or other water bodies designated as ONRW. Waters in national parks are specifically referred to in the regulation that implements ONRW and several states have designated ONRW in parks. Their overall purpose is to keep the cleanest of the nation's waters clean.

The provisions of Section 522, **Designating Lands Unsuitable** for all or certain types of mining, of the Surface Mining Reclamation and Control Act, allow for the protection of unique resources, such as those in the National Park System, by prohibiting all or certain types of coal mining in certain areas. In one such designation, the Secretary of the Interior found some Federal lands adjacent to Bryce Canyon National Park to be unsuitable for surface mining because of the potential for adverse effects to scenic resources and quiet.

Each process shows that what is generally applicable may not adequately safeguard the unique resources and attributes of special, nationally significant lands and that as a consequence, designations or categories need to be implemented that establish a higher standard of protection. The NPS believes that there are parallels between these processes and overflight-related adverse impacts to units of the National Park System. Practices that are generally suitable for aircraft elsewhere may not be suitable in a limited number of cases where natural quiet or especially sensitive cultural resources or threatened or endangered species can be adversely affected by overflights. The NPS believes the following criteria can provide a starting point for establishing a similar process for outstanding natural quiet parks:

Critical habitat for an endangered species known to be adversely affected by noise (e.g., the grizzly bear in the lower 48 states). Excessive and avoidable noise could be found to be an adverse modification of habitat.

- Seriousness and solemnity of purpose characterizes the park unit or a portion thereof and the sights and sounds of overflights can diminish the ability of visitors to experience — with respect and reverence — the resources and values embodied in selected Civil War battlefields or Mount Rushmore, for example.

- Natural quiet is a central resource value to the park and its absence imperils the totality of the visitor experience, especially when the visitor comes to the park expecting peace and quiet and enjoyment of nature and natural sounds. For example, an experience in a canyon in southern Utah is not complete without the call of a canyon wren or the sounds of wind. An experience of the northern lakes is not complete without the call of loons.

- Wilderness has been designated on all or part of the park, and given characteristics of the terrain and sound attenuation, opportunities for solitude would be substantially diminished by overflights. This requires the area to be at least 5,000 acres in size unless there are special circumstances.

In some cases these criteria could be used as the basis to petition the FAA to implement, through their rulemaking process, an aircraft management plan for that park to establish flight corridors or flight tracks that would keep areas naturally quiet and preserve the visitor experience of them.

4.7 Recommendation 7

Develop a Movie Waiver Policy

The NPS recommends that FAA amend its policy relating to the conditions and limitations for movie filming operations conducted in national parks. The new policy should require the operator flying the filming crew to have the following:

- An operating plan specific to the park where the filming is being done.
- Approval of the plan by the park superintendent
- Notification of the appropriate Flight Standards District Office (FSDO)

4.8 Recommendation 8

Develop an Interagency Airspace Coordination Guide/Training

The NPS recommends that the NPS, FAA, and the military services complete an Interagency Airspace Coordination Guide that would incorporate what the agencies learn about how to resolve airspace/park use conflicts. The NPS and the Air National Guard are currently developing a proposal to DOD's Legacy Program for that purpose. It is further recommended that this be the basis for training interagency planners from all the agencies involved, pilots from the Armed Services, etc.

4.9 Recommendation 9

Seek Continued Improvements in Safety and Interagency Planning Related to Airspace Management

The NPS makes the following recommendations with respect to safety and planning:

- FAA and the NPS work together jointly to investigate the parks where serious safety issues may exist. FAA would take corrective actions if appropriate.
- FAA and NPS jointly develop a reporting format for safety issues to be used as part of interagency issue resolution processes. The NPS would use this format to report additional issues as they arise.
- Land management agencies, the FAA and the DOD need to give greater priority to identifying how to avoid collisions associated with the Temporary Flight Restrictions around forest fires. Department of Interior agencies need to support development and use of CAHIS (Computer-Aided Hazard Information System).
- Land management agencies, including the NPS, should provide the Armed Services with geographically-based databases of their noise sensitive areas for use in Armed Services planning.

All the agencies need to explore how to get critical items highlighted in each others planning processes.

4.10 Recommendation 10

Improve SFAR 50-2 to Effect and Maintain the Substantial Restoration of Natural Quiet at Grand Canyon National Park

Epilogue

Achieving an equitable balance between the impacts and benefits of aviation in parks is a difficult but desirable task, one that is still in its infancy. It is a long-term goal for both the NPS and the FAA to seek that balance. Prior to the establishment of the Department of the Interior — Department of Transportation Interagency Working Group and the emerging dialogue between the FAA and the NPS, there was no adequate method to address the issue. The NPS is confident that with the FAA's continued cooperation and good faith that both agencies will be part of the balanced resolution of potential difficulties. It is a new way of doing business for both the NPS and the FAA and one that holds promise for the future.

Report to Congress

Chapter **1**

INTRODUCTION

1.1 Background

The National Park Service (NPS) was created by Congress to

> *". . . promote and regulate the use of Federal areas known as national parks . . . [so as to] conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."*[1]

In doing so, the NPS's mission was seemingly defined with an inherent conflict between the goal of conservation and the goal of providing for enjoyment. Enjoyment requires that visitors have access to the parks, and conservation requires that such access not damage or diminish the resources that the park was created to protect. But the NPS Organic Act was amended by the Redwoods Act of 1978, and this act unambiguously defines resource preservation as the primary responsibility for the Park Service. Given that natural quiet is a clearly identified resource, that aircraft overflights can disturb this resource and that the Federal Aviation Administration (FAA) controls use of the airspace, meshing the disparate missions of the NPS and FAA has, until recently, appeared to be an intractable task.

For three main reasons, aircraft flying low over parks present the NPS with a very different and unusual set of problems.

1. *NPS Organic Act, 16 USC 1*

First, the "natural quiet" found in many national park units has long been regarded as a park resource. This perspective is reflected in law, policy and by park visitors. It is a highly valued and increasingly rare resource in some parks that can be affected by low-flying aircraft.

Second, the effects produced in parks by aviation are perhaps less obvious and, in some ways, less permanent than the effects produced by visitors on the ground. Worn trails and facilities, crowded camping areas and automotive traffic jamming park roads are easily observed and agreed upon effects that threaten visitor enjoyment. The overflight of a single aircraft, however, creates what is often perceived as a temporary visual effect, produces non-natural sound levels that are audible for a finite period, and may, if flying low enough and fast enough, startle visitors or the horses/mules of mounted visitors resulting in some risk of injury. Because of the paucity of studies and the difficulty of quantitatively proving impacts on visitors, wildlife, or other resources, the visual and audible effects produced by aircraft tend to be judged subjectively with the acceptability of these effects being a matter of personal opinion (Dunholter, et. al. 1989)[2].

The third main reason this is such an unusual and difficult problem is that the authority to legally exercise control on aviation access[3] does not lie with the NPS. For all visitors to parks who travel by ground, the NPS has the authority to manage their impacts. Whatever type of ground transportation visitors use, the NPS can control where, when and how park areas are accessed and used. Further, any

> ***". . . public accommodations, facilities, and services as have to be provided within those areas should be provided only under carefully controlled safeguards against unregulated and indiscriminate use, so that the heavy visitation will not unduly impair [park] values and so that development of such facilities can best be limited to locations where the least damage to park values will be caused."[4]***

Thus, for access on ground, the NPS can exercise controls based on park policies developed to fulfill the mission of the NPS and of the specific park.

On the other hand, Congress unambiguously vested authority for all aspects of airspace management in the Administrator of the FAA. The Federal Aviation Act of 1958 gives the Administrator the authority and the mandate

2. *"While extensive research has been completed on the effects of aircraft overflights on urban populations in the vicinity of airports, [a literature search conducted for the National Park Service] revealed a shortage of information on the subjects of enroute aircraft sound, aircraft sound in wilderness settings, or the acoustic effects on a park visitor population."*

3. *Access via aviation means, for this report, aircraft flying over land areas administered by the NPS for use and enjoyment of park resources.*

4. *79 Stat. 969*

to prescribe rules and regulations governing the flight of aircraft, including rules as to the safe altitude of flight, for the purposes of 1) the navigation, protection, and identification of aircraft, 2) the protection of persons and property on the ground, 3) the efficient utilization of navigable airspace, and 4) protection to the public health and welfare from aircraft noise and sonic boom.[5]

Thus, to the extent that use of airspace has effects on park lands, the NPS must work with the FAA to determine what controls are possible. Such a division of authority has meant in some cases that where NPS and FAA are unable to agree, resolution has had to occur through the President or Congress.

This type of conflict resolution between resource protection and airspace use is not new. Aircraft flights over and into the area now designated as the Boundary Waters Canoe Area Wilderness present an early example. As early as the 1930's, floatplanes provided sport fishing access to the Superior National Forest (now the Boundary Waters Canoe Area Wilderness) in northern Minnesota, and by 1948 Ely, Minnesota was reputed to be the largest freshwater floatplane base on the continent with approximately 70 planes making multiple round trips per day into remote lakes. Considerable publicity through writings and a short documentary film brought national attention, and on December 17, 1949, President Truman issued Executive Order 10092 establishing an airspace reservation of certain areas of the Superior National Forest. The order prohibited, with a few exceptions, flight below the altitude of 4,000 feet above Mean Sea Level (MSL) over designated areas. In 1978, Congress passed the Boundary Waters Canoe Area Wilderness Act into which E.O. 10092 was incorporated by reference (FAA, 1988).

Grand Canyon National Park (GCNP) has had ever increasing overflights by aircraft. But whereas aircraft provided transportation to lakes in the Superior National Forest, aircraft use over Grand Canyon National Park is primarily for sightseeing purposes. Scenic tour flights began over the park in 1926, when an airstrip was developed on the south rim near Red Butte. The completion the GCNP Airport in 1965, two miles south of the park boundary in Tusayan, contributed in a major way to the expansion of an air tour industry. By 1987, about 40 companies provided over 50,000 air tours over the canyon.

The increasing number of flights over the Grand Canyon, combined with increases in air traffic over parks in Hawaii, the Colorado Plateau, and elsewhere raised both NPS and visitor concerns that overflights were having a

5. *S. Rep. No. 1811, 85th Cong., 2d Sess. 14 (1958)*

significant impact on park values and on the visitor experience. For the Grand Canyon, this concern grew to such an extent that in January 1975, when Public Law 93-620, the Grand Canyon National Park Enlargement Act was passed, its Section 8 recognized "natural quiet" as a value or resource in its own right to be protected from significant adverse effect. In addition it specifically addressed the potential for aircraft or helicopter operations to cause a significant adverse effect on the natural quiet and experience of the park.

Public Law 93-620 led to early research to determine if adverse effects were being caused by aircraft overflights. Acoustic research to develop a baseline on levels of aircraft sounds and sociological surveys to determine visitor reactions to the sound of aircraft were undertaken. Acoustic research found sound levels from aircraft to be quite high in various locations due to extensive numbers of flights. Surveys established that a range of visitors (from 20% of rim visitors, to 70% of backcountry users) were dissatisfied with aircraft overflights or related sound levels. Also in response to Section 8 of the law, a public process was begun in October 1984 to review research and to discuss associated issues. By March of 1986, this process convinced the NPS that aircraft activity occurring over or within the park was causing a significant adverse effect on the natural quiet and experience of the park, and was likely to cause an injury to the health, welfare, or safety of visitors to the park. In June of 1986, two tour aircraft collided over the park, killing 25 people. This tragedy focused national attention on the aircraft overflight issue at the Grand Canyon, and led in part to passage by Congress, in August 1987, of Public Law 100-91, the National Parks Overflights Act. This report responds to the requirements of that law.

1.2 Public Law 100-91 and this Report

This law directed the NPS and the U.S. Forest Service to study the effects of aircraft overflights and report to Congress on the results. A less complex Forest Service study reported on work conducted earlier (USDA, 1992); this report presents the results of further studies conducted by the NPS. The law required that the NPS answer more complex and specific questions than the Forest Service. Table 1.1 lists these questions, the section of P.L. 100-91 in which they appear and the chapter or chapters that address each of the question areas.

TABLE 1.1 QUESTIONS POSED BY P.L. 100-91		
Question to be Answered	**Section of P.L. 100-91 where Question is Posed**	**Chapters of Report that Address the Question**
1. What is the nature and scope of the overflight problem in the National Park System?	§1.(b)	2
2. What are other injurious effects of overflights on the natural, historical, and cultural resources for which such units were established?	§1.(c)(3)	3,4,5
3.a. What is the proper minimum altitude which should be maintained by aircraft when flying over units of the National Park System?	§1.(a)	3
b. What have been the effects of the minimum altitudes established over Yosemite and Haleakala National Parks?	§2.(c)	9
c. Has the plan for management of airspace above the Grand Canyon succeeded in substantially restoring the natural quiet in the park?	§3.(b)(3)(A)	9
d. What revisions in the airspace management plan for the Grand Canyon may be of interest?	§3.(b)(3)(B)	10
4. What is the impairment of visitor enjoyment associated with flights over such units of the National Park System?	§1.(c)(2)	6
5. What are the impacts of aircraft noise on the safety of the park system users, including hikers, rock-climbers, and boaters?	§1.(c)(1)	7
6. What are the values associated with aircraft flights over such units of the National Park System in terms of visitor enjoyment, the protection of persons or property, search and rescue operations and firefighting?	§1.(c)(4)	8

1.3 Organization of Report

The organization of the report is based on the questions posed by Public Law 100-91. The nine major research areas of the report are described in this section:

1.3.1 The Nature and Scope of Overflight Problems

Chapter 2 presents information provided by park managers about the nature and scope of the problem. It examines which and how many parks are affected, what types of adverse effects or impacts are perceived, what types of aircraft and aircraft operations are responsible for overflights, how many overflights are estimated to occur, and how much of the time aircraft are audible at specific locations in eight national parks.

1.3.2 Effects of Overflights on Natural Quiet

"Natural quiet" is a resource found in many parks which, under the NPS Organic Act, as amended, is to be protected. How and why overflights effect natural quiet in national parks is examined in Chapter 3. The chapter examines the importance of natural quiet, provides both qualitative and quantitative descriptions of natural quiet in parks, and discusses why natural quiet is so difficult to preserve.

1.3.3 Effects on Cultural and Historical Resources, Sacred Sites and Ceremonies

The law requires information and evaluation of injurious effects of overflights on the historical and cultural resources of parks. Chapter 4 examines these effects from manager and visitor perspectives, and then discusses the potential for acoustic impacts and for vibration impacts.

1.3.4 Effects on Wildlife

Wildlife is one of the parks' natural resources that can be impacted by overflights, and is required to be examined by the law. Chapter 5 discusses physiological and behavioral responses of wildlife to overflights, presents a summary of observed responses for various species, and examines indirect effects of disturbance from overflights such as accidental injury, reproductive and energy losses and habitat avoidance and abandonment. It also presents factors that influence animal responses to aircraft, discusses some of the problems with detecting long-term effects of aircraft-produced disturbance, and examines the limitations of current information about wildlife responses to aircraft overflights.

1.3.5 Effects of Overflights on Visitors

P.L. 100-91 directs the NPS to provide information and an evaluation of the impairment of visitor enjoyment associated with flights over units of the National Park System. Chapter 6 draws on information primarily from two different surveys of visitors to examine how aircraft overflights affect visitors and their enjoyment of the parks. Visitor opinions about overflights are presented both for the National Park System (excluding Alaska), and for 39 specific parks. Visitor opinions addressed include ratings of how overflights affect their enjoyment, how overflight sounds rate as a problem compared with other sounds, types of aircraft heard, and effects of hearing or seeing aircraft. Visitor opinions are used to rank order the 39 parks by "degree of overflight problem", and this ranking is used to better understand visitor opinions and reactions. Management rankings of park overflight problems are compared with the visitor-based ranking. Finally, study results that quantitatively relate visitor reactions (responses) to measured aircraft sound levels (doses) are presented.

1.3.6 Aircraft Overflights and Safety

Chapter 7 presents management concerns about safety, with specific examples at surveyed parks, gives visitor opinions about aircraft and safety, and discusses the special problems associated with Temporary Flight Restrictions around forest fires or other major incidents.

1.3.7 Values Associated with Aircraft Overflights

Public Law 100-91 also requires that the research provide information and an evaluation regarding ". . . the values associated with aircraft flights . . . in terms of visitor enjoyment, the protection of persons or property, search and rescue operations and fire fighting." Chapter 8 examines these benefits from management and air tour passenger perspectives.

1.3.8 Restoration of Natural Quiet

P.L. 100-91 explicitly states that "Noise associated with aircraft overflights at the Grand Canyon National Park is causing a significant adverse effect on the natural quiet and experience of the park. . . ." The Act requires the NPS to implement a plan for management of air traffic, and to report on ". . . whether the plan has succeeded in substantially restoring the natural quiet in the park. . . ." The Act also sets limitations on flight over Yosemite National Park and Haleakala National Park. Chapter 9 specifically examines the effectiveness of the minimum flight altitudes set in accordance with P.L. 100-91 in Yosemite and Haleakala National Parks and addresses whether Special Federal Aviation Regulation (SFAR) 50-2, stemming from this legislation, has succeeded in substantially restoring natural quiet in the Grand Canyon National Park.

1.3.9 Conclusions, Issues and Recommendations

Chapter 10 presents conclusions of NPS studies, issues needing to be addressed, and NPS recommendations. It also specifically addresses the P.L. 100-91 question of whether possible revisions to SFAR 50-2 are necessary.

1.3.10 Availability of NPS Studies

The series of NPS studies upon which this report is based are listed in Appendix A and are available through the National Technical Information Service.

Chapter
2

NATURE AND SCOPE OF OVERFLIGHT PROBLEMS IN THE NATIONAL PARK SYSTEM

The effect of aircraft overflights on public lands has been a concern to land management agencies for many years. Beginning in the 1940's with the floatplane access to the Boundary Waters Canoe Area Wilderness and sightseeing tours over the Grand Canyon in the late 1960's, an established air tour industry has developed that provides tours over 30 – 40 national parks including such diverse areas as the Grand Canyon, the Hawaiian parks, the Badlands of South Dakota, Cape Cod National Seashore, and Great Smoky Mountains National Park. In addition, the need for military training space and the preference that this be located over unpopulated areas, as well as increasing long-distance commercial air travel mean that the airspace over public lands is under increasing demand. Public Law 100-91 recognized the increased concern about aircraft, and in directing the study of park overflights, gave specific requirements that the nature and scope of the problems be determined. Section 1(b) of the law states:

> *The study shall identify any problems associated with overflight by aircraft of units of the National Park System and shall provide information regarding the types of overflight which may be impacting on park unit resources. The study shall distinguish between the impacts caused by sightseeing aircraft, military aircraft, commercial aviation, general aviation, and other forms of aircraft which affect such units.*

In response to this section, the NPS took three major actions:

First, in 1992 a list of parks affected by aircraft overflights was developed and a questionnaire mailed to each park manager. Detailed data were collected about the nature and extent of the problems. (McDonald *et al.* 1994) This questionnaire asked about both factual matters and matters of opinion. Questions of fact addressed the use of aircraft by the park, the numbers and types of other aircraft that fly over the park, visitor complaints and safety issues. Questions of opinion, specifically to be answered by the park manager, asked about the general types of problems occurring in the park, the level of concern about various problems, the existence and significance of any problems created by aircraft overflights, and opinions about how any aircraft-related problems should be resolved.

Second, a study to estimate the aircraft-produced sound exposure for all park units as well as USFS wildernesses areas was completed. (Tabachnick *et al.* 1992) Since data on exposure were prohibitively expensive to collect for all parks, this effort to characterize the sound exposure for all parks used secondary information such as maps of the parks, maps of military and commercial aviation routes, and estimates of overflight operations. This report provides estimates of noise exposure for each NPS unit and for each Forest Service Wilderness,[1] and permits a rank ordering of parks or wildernesses by "exposure".

Third, four sound measurement studies were completed. (Dunholter *et al.* 1989; Fidell *et al.* 1994; Horonjeff *et al.* 1993; Miller *et al.* 1994) Each of these studies served a different purpose, and all but the first provide comparable quantitative data on aircraft and non-aircraft sound levels in various parks. First, the Mestre Greve report addressed the techniques for measuring aircraft sounds within park and wilderness settings and examined the acoustic parameters that are important in describing aircraft sound within such settings. Second, though the BBN study had several objectives, a primary one was to determine the extent to which natural quiet had been restored in the Grand Canyon; as part of this investigation, sound measurements were made in the Grand Canyon during the fall of 1989 and the spring of 1990. Third, the purpose of the first HMMH study was to measure and present detailed "acoustic profiles" for 23 locations in Grand Canyon National Park, four locations in Hawaii Volcanoes National Park, and four locations in Haleakala National Park. Fourth, the second HMMH study developed a simplified method for collecting sound level data, and park personnel were trained in the method and used it to collect data in five units of the National Park System: Cumberland Island National Monument, Glacier

1. *NPOA Report 92-1 provides in its Figure 5-3 the specific equations used to compute noise exposure.*

National Park, Mount Rushmore National Memorial, Petroglyph National Monument, and Yosemite National Park.

This chapter reports on the information provided as a result of these three specific actions. The information is combined and summarized to provide an overall picture of the numbers of park units affected, the aircraft overflight types and numbers, the degree of concern about the impacts of overflights, and the sound levels that result from these overflights.

2.1 Survey of Park Managers

The survey of park managers collected information about the numbers of park units experiencing aircraft overflight problems, the types of aircraft operations affecting each park, the types of impacts produced by the overflights, and additional detail about the park managers' perception of aircraft overflights and associated problems.

2.1.1 Number of Parks Affected

The survey first determined the number of park units affected by aircraft overflights. A screening telephone call to Regions and parks identified 98 out of the then-total of 341 non-Alaska parks as having some type or level of concern about overflights. Figure 2.1 depicts the relationship between parks with identified overflight problems and those without. It shows this relationship in terms of numbers of parks, park acreage, and visits[2]. Figure 2.2 displays the 98 identified park locations, and Appendix B lists them. This leads to Conclusion 2.1 drawn in the sidebar.

CONCLUSION 2.1:
NPS managers believe that approximately 30% of all National Park System units have aircraft overflight problems. These affected parks account for about three-fourths of the total NPS administered acreage, and about half the total park visits. Low-level overflights constitute a management problem for the NPS, one that needs to be addressed in a systematic manner.

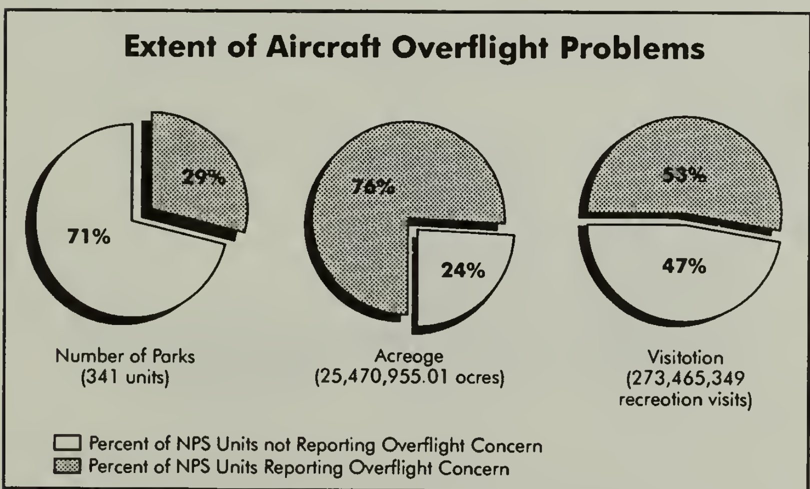

Figure 2.1: Extent of Aircraft Overflight Problems in the National Park System

2. *Visits are defined as the number of people entering a park over the course of the year for recreational purposes.*

Figure 2.2: Locations of the 98 Park Units with Identified Aircraft Overflight Problems

CONCLUSION 2.2:

Managers report that overflights of parks result from all types of aircraft; general aviation and military aircraft overflights are the types most often mentioned. This reporting of overflights of many aircraft types reinforces the nation that a systematic approach is needed to address these issues and to identify the most serious overflight problems.

2.1.2 Types of Aircraft Overflights

The survey asked park managers to identify the types of aircraft flying over their parks. Figure 2.3 shows the number of parks with overflight problems that mentioned each of four general types of aircraft overflights. Parks identifying each of these types of overflights included: general aviation (81), military (78), high-altitude commercial (55), and sightseeing (42).

2.1.3 Types of Impacts

The survey also asked managers to identify the types of impacts they believed the aircraft overflights produced at their parks. In general, the types of impacts may be characterized as safety related, sound related and visual related.

One question on the survey asked "Do you feel visitors are concerned for their safety as a result of aircraft overflights over your park?" Eighteen NPS managers perceived overflights to be a serious or very serious safety issue for their park.

A second question asked managers to identify, from a list of sources of sounds, which types of sound they considered a problem, and also to identify the degree of the problem. Eighty-eight of 91[3] responding parks identified the sounds from "airplanes, jets, helicopters or any other aircraft" as a problem to some degree.

A third question asked managers to identify the extent to which aircraft activity adversely impacts visitors, using a five scale choice from "no impact" to "very large impact". Sixty-four of 88 responding parks said that aircraft overflights had some degree of impact on the "ability of visitors to appreciate park scenery." These responses are graphed in Figure 2.4 as a "visual" impact.

CONCLUSION 2.3: *NPS managers most often identified the sound of aircraft overflights as producing negative impacts on visitors. Safety was judged as least frequently impacted. Reported visual impacts, though perhaps highly dependent on the scenic resource, upon the way in which the question was asked (or on the person answering the survey), were nevertheless not as commonly judged as negative.*

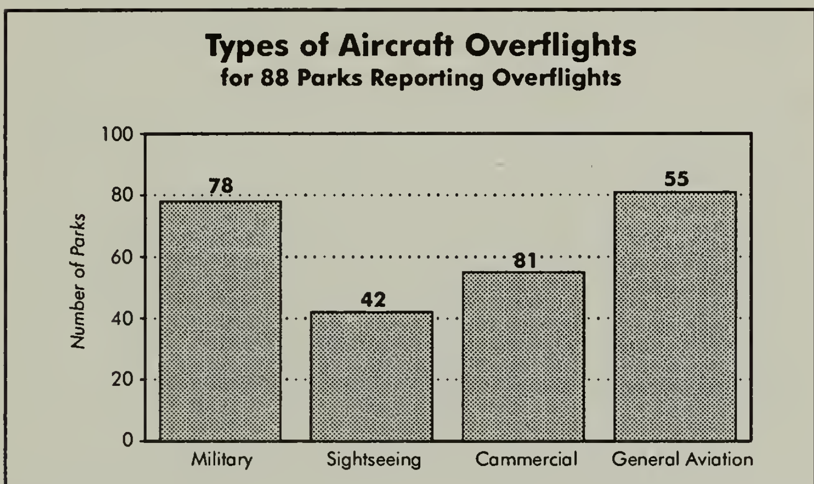

Figure 2.3: Types of Aircraft Overflying National Parks as Identified by Managers

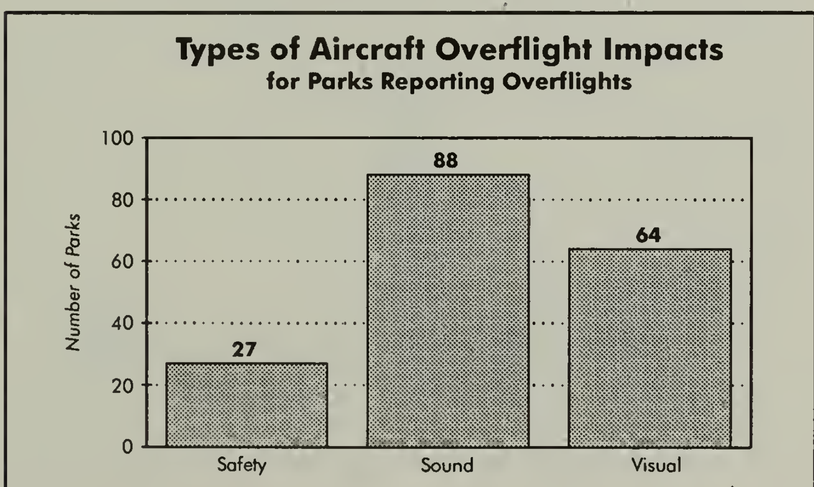

Figure 2.4: Park Manager Judgements of Types of Impacts

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3. *Not all parks responded to specific questions on the survey.*

2.1.4 Estimated Numbers of Overflights

The survey asked managers to estimate the numbers of overflights per week that their parks experienced. They were asked to make these estimates for six types of operations: 1) military training, 2) sightseeing tours, 3) transporting commercial passengers between cities, 4) park management, research and maintenance, 5) emergency services like fire fighting or search and rescue, and 6) private aircraft flights (general aviation). The numbers used here are intended by the reporting parks to include all overflights in order to provide a sense for relative numbers of overflights, and to show the nature and potential scope of the overflight problem.

Figure 2.5 sums the number of overflights per week reported by the surveyed parks to provide an indication of the relative level of operations. The total indicates that commercial operations are apparently responsible for the greatest number of overflights. Even if the estimates for George Washington Memorial Parkway (6,300 commercial overflights), Golden Gate National Recreation Area (14,000 commercial overflights), Joshua Tree National Park (7,000 overflights) and Manassas National Battlefield Park (3,200 overflights) are removed, the results still show (Figure 2.6) that commercial overflights are judged to generate more than twice as many overflights as either sightseeing or general aviation. Military overflights and park management and emergency operations are, respectively, the least common types of overflights.

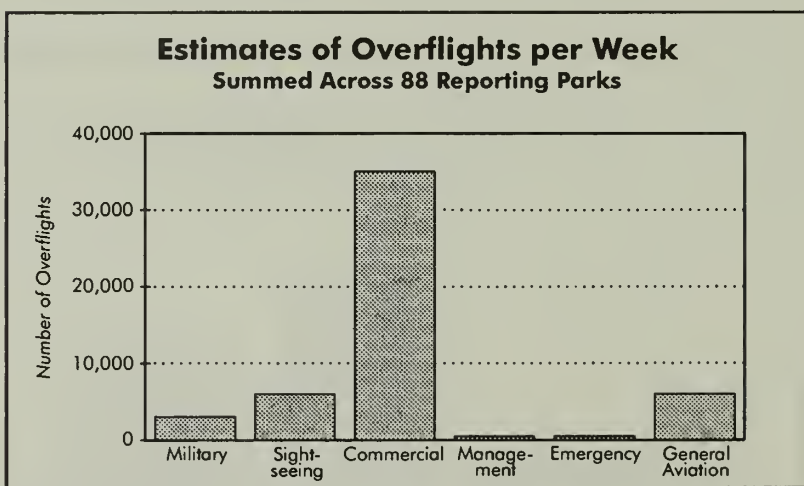


Figure 2.5: Reported Number of Overflights per Week by Aircraft Type for All Parks

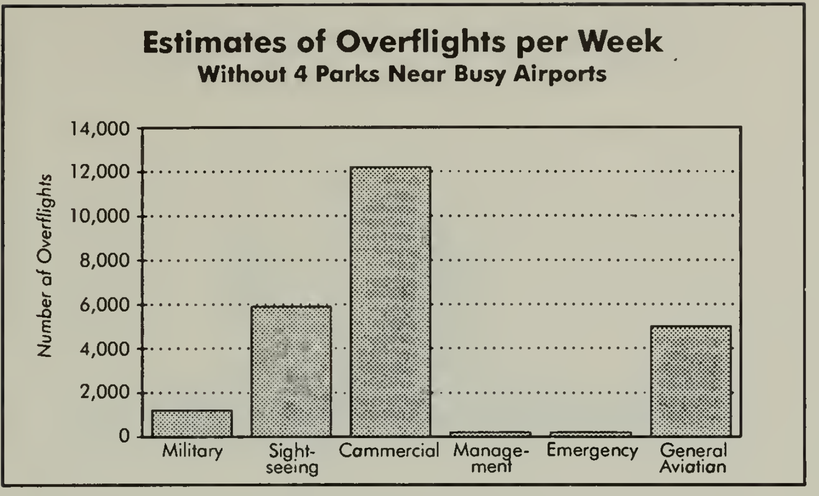


Figure 2.6: Reported Number of Overflights per Week Reduced by Four Porks

Estimates of overflights are presented in alternative form in Figures 2.7 through 2.11. The figures group parks by numbers of reported overflights per day. (Overflights per day are computed by dividing reported overflights per week by seven.) Each figure presents the distribution of parks for a different type of aircraft operation. Figure 2.7 shows the distribution of the 91 reporting parks for all operations.

(For example, 36 parks reported that the number of overflights for all types of operations as between 1 and 10 per day. Similarly, 10 parks reported fewer than 1 overflight per day and 19 parks reported having between 10 and 50 overflights per day).

Figures 2.8 through 2.11 provide the distribution for the four types of operations: military, sightseeing, commercial, and general aviation. These data suggest several generalizations. First, though many of the parks experience military overflights (78 parks, see Figure 2.3), most of the parks report relatively few military overflights per day (fewer than 10 per day, Figure 2.8). Alternatively, though a smaller number of parks report sightseeing overflights (42 parks, Figure 2.3), those that do tend to report greater numbers (up to 50 per day or more, Figure 2.9). Commercial and general aviation distributions tend to lie between these two patterns: more parks report commercial overflights than report sightseeing, and numbers range from modest to very high (over 500 per day, Figure 2.10). More parks report experiencing general aviation overflights than report any other type (81 parks, Figure 2.3), but most report fewer than ten overflights per day (Figure 2.11).

CONCLUSION 2.4:
Reported numbers of overflights by type of operotion vory considerobly from pork to pork. Relotively few porks receive high numbers of ony one type of overflight. Commerciol ond sightseeing operotions ore more prevolent thon other types of overflights. Militory ond pork odministrotive overflights ore leost common.

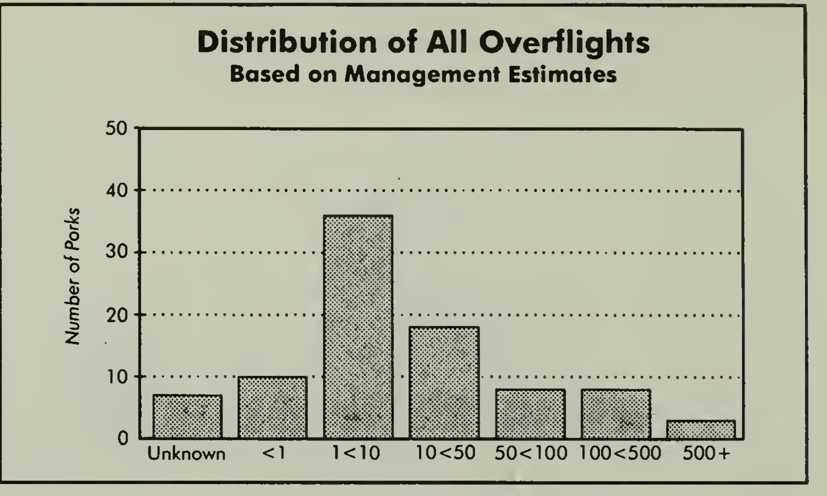


Figure 2.7: Distribution of Overflights per Day for All Aircraft Combined

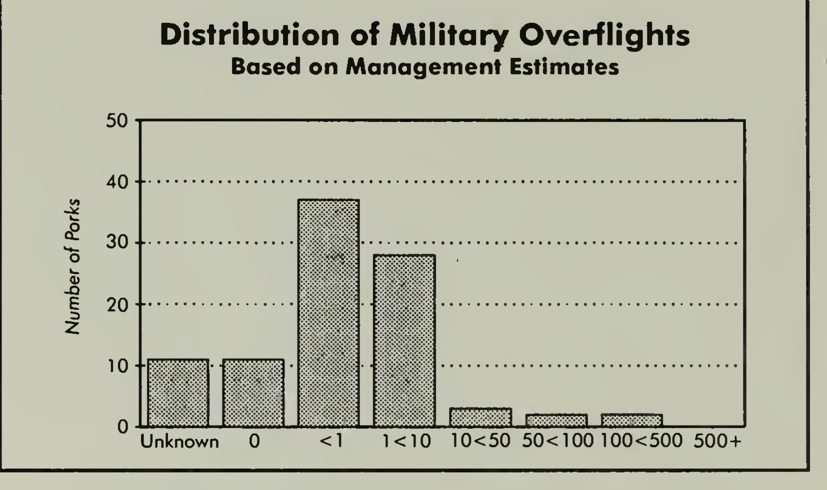


Figure 2.8: Distribution of Overflights per Day for Military Aircraft

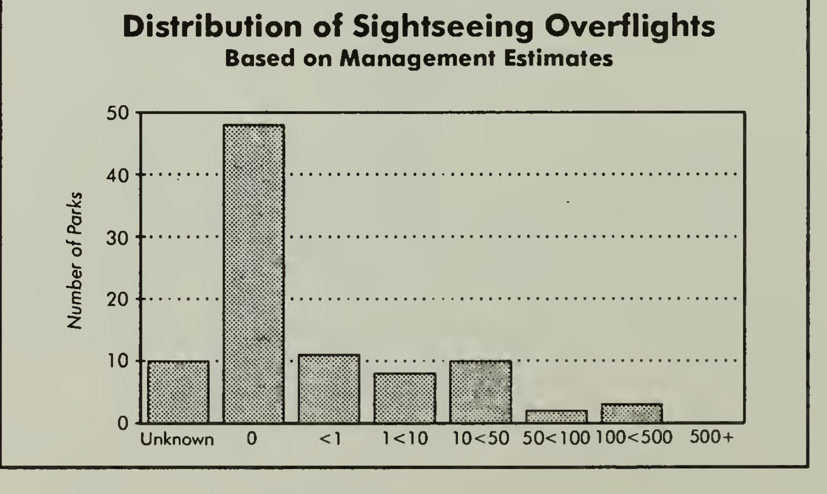


Figure 2.9: Distribution of Overflights per Day for Sightseeing Aircraft

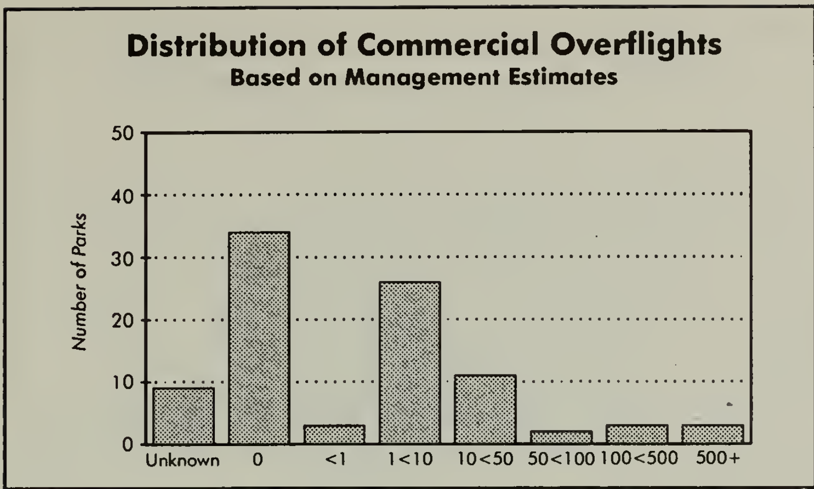


Figure 2.10: Distribution of Overflights per Day for Commercial Aircraft

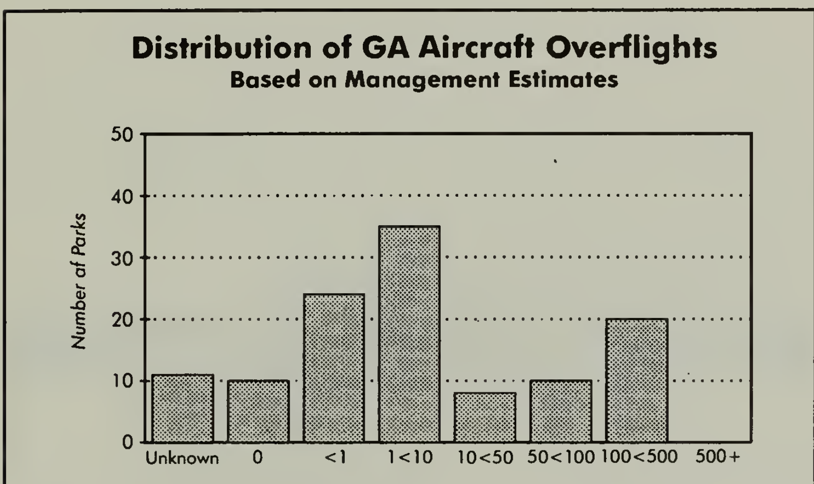


Figure 2.11: Distribution of Overflights per Day for General Aviation Aircraft

2.1.5 Superintendents' Judgments of Overflight Problems

The survey specifically asked NPS managers their opinions about several matters related to aircraft overflights. The questions attempted to determine the overall level of concern superintendents have about overflights and the types of effects they believe overflights produce. Most questions were to be answered with a five-point scale ranging from "no concern" or "not a problem" to "extremely concerned" or "very serious problem".

Degree of Concern

CONCLUSION 2.6:
Most, though not all, managers of the parks with perceived overflight problems rate aircraft as one of their most important problems. Also, managers demonstrate differing degrees of concern about overflights. Hence any systematic method for assessing aircraft overflight problems should be designed to incorporate local management objectives in the identification of the problem and in developing solutions.

Each manager was asked to judge the seriousness of ten specific types of potential problems in his/her park. Figure 2.12 shows how many superintendents reported each of the problems to be a moderate, serious or very serious problem. For example, 53 responded that mechanical noises like vehicles, aircraft and generators were either a moderate, serious or very serious problem. Only maintenance of park facilities and damage to natural resources were rated as problems by more superintendents. Additionally, managers were asked to rate six different specific sounds as potential problems, and Figure 2.13 summarizes the responses. Of the 91 reporting superintendents, 65 (over 70 percent) rated the sounds from airplanes, jets, helicopters and any other aircraft to be a moderate, serious or very serious problem. The next most often identified sound-related problem was road traffic, with 37 parks (about 40 percent) rating cars, buses, trucks or motorcycles as a moderate to very serious problem.

CONCLUSION 2.7:
The starting point for resolving overflight issues over national parks needs to begin with an examination of those parks whose managers are very to extremely concerned about overflights.

The managers were also asked to identify their overall concern about aircraft activity over the park. Figure 2.14 gives the distribution of their responses. Overall, 67 out of 91 who answered this question responded that they were either moderately, very or extremely concerned about aircraft activity. The parks whose managers are very or extremely concerned about aircraft overflights are listed in Table 2.1.

TABLE 2.1 NATIONAL PARKS WHOSE MANAGERS ARE VERY TO EXTREMELY CONCERNED ABOUT AIRCRAFT OVERFLIGHTS

EXTREMELY CONCERNED	VERY CONCERNED
Bandelier National Monument	Big Cypress National Preserve
Cape Lookout National Seashore	Bryce Canyon National Park
City of Rocks National Reserve	Channel Islands National Park
Fort Vancouver National Historic Site	Crater Lake National Park
Glacier National Park	Guadalupe Mountains National Park
Great Smoky Mountains NP	Joshua Tree National Park
Haleakala National Park	Kalaupapa National Historical Park
Hawaii Volcanoes National Park	Lassen Volcanic National Park
Isle Royale National Park	Manassas National Battlefield Park
Kings Canyon & Sequoia NP	Mesa Verde National Park
Minute Man National Historic Park	Mount Rainier National Park
Organ Pipe Cactus Nat. Monument	Navajo National Monument
Shenandoah National Park	Perry's Victory & Int. Peace Memorial
Southern Utah Group[3]	Statue of Liberty National Monument
	Prince William Forest Park
	Pu'uhonua o Honaunau NHP
	Puukohola Heiau National Historic Site
	Saguaro National Monument
	San Antonio Missions NHP
	White Sands National Monument

4. *The Southern Utah Group (Canyonlands National Park, Arches National Park, and Natural Bridges National Monument) was inadvertently left out of the Survey but has requested that it be shown here.*

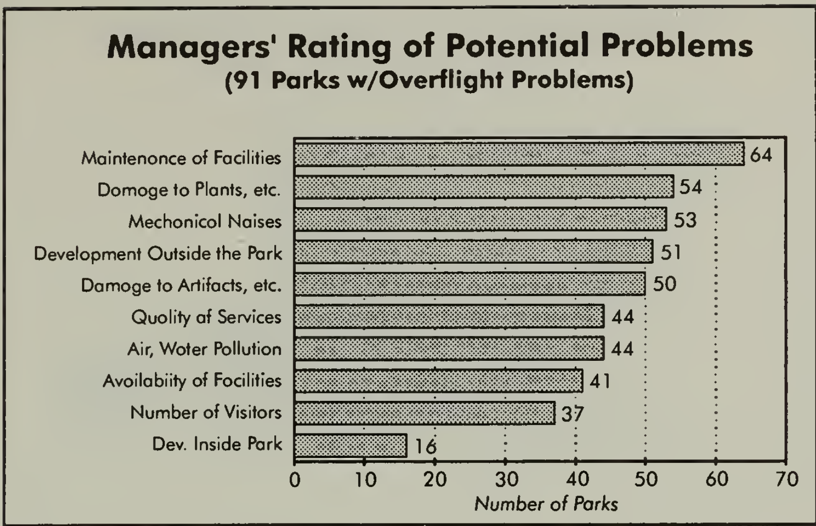


Figure 2.12: Managers' Rating of Ten Potential Problems in Their Parks

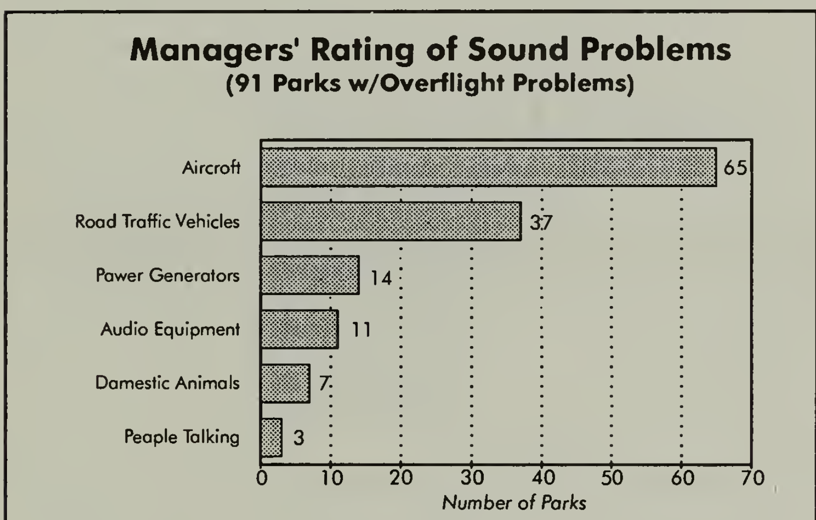


Figure 2.13: Managers' Rating of Sound-Related Problems in Their Parks

Types of Effects

NPS managers were asked to give their judgments about specific effects of aircraft overflights. First they were asked, if they had concerns about aircraft overflights, what bothered them most about the aircraft activity. Figure 2.15 shows how many park managers rated any of six effects as moderate, serious or very serious problems. Most managers (69 out of 91 responding parks) believed the loudness was a problem, while the particular areas overflown was next most often identified. Fewest managers considered aircraft to be a threat to visitor or staff safety.

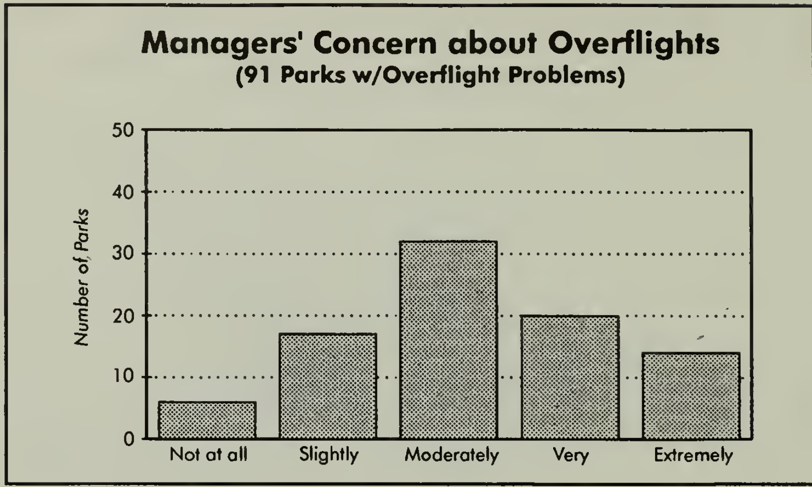


Figure 2.14: Managers' Reported Degree of Overall Concern about Overflights

CONCLUSION 2.8:
Loudness and area overflown were the most bothersome aspects of overflights to NPS managers. With respect to impacts on visitors, managers were most concerned about the ability of the visitors to experience natural quiet and the sounds of nature, although other noise impacts were identified. An understanding of the specific park problem will be important to factor into any systematic approach to resolving or mitigating overflight issues.

NPS managers were also asked to rate five possible impacts on visitors, and Figure 2.16 summarizes the responses. Figure 2.16 shows the number of managers who responded that they rated the impact on the listed qualities as moderate, large or very large. The largest number (63) responded that overflights produced impact on the "ability of visitors to experience natural quiet and the sounds of nature." Forty-three thought aircraft produce moderate to very large impact on the "ability of visitors to appreciate the historical and/or cultural significance of the park." About equal numbers of managers identified impact on the ability of visitors to "hear interpretive programs," or "appreciate park scenery," or to "carry on normal conversations."

2.2 Estimates of Overflight Exposure

Development of a logical and rigorous plan for conducting field studies of aircraft overflights required estimates of aircraft overflight exposure for all units of the National Park System and for Forest Service Wildernesses (Tabachnick *et al.* 1992). Exposure estimates permit a rank-ordering to insure that all levels of exposure were studied. But the limits of cost and schedule prevented collection of on-site acoustic data or direct observation of overflights, and considerable effort was devoted to collection of information through secondary sources. Maps and charts were used to locate parks and wildernesses. Aeronautical charts used by general, commercial and military aviation planning and routing provided location information for various routes and flight areas. The FAA tried to provide information on use of high altitude jet routes for four seasons, but at the time of the report had

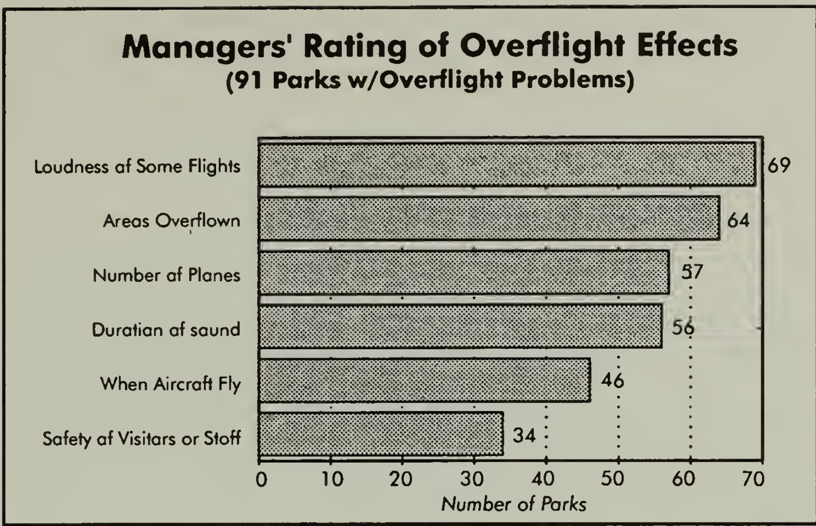


Figure 2.15: Managers' Rating of Most Bothersome Aspects of Overflights

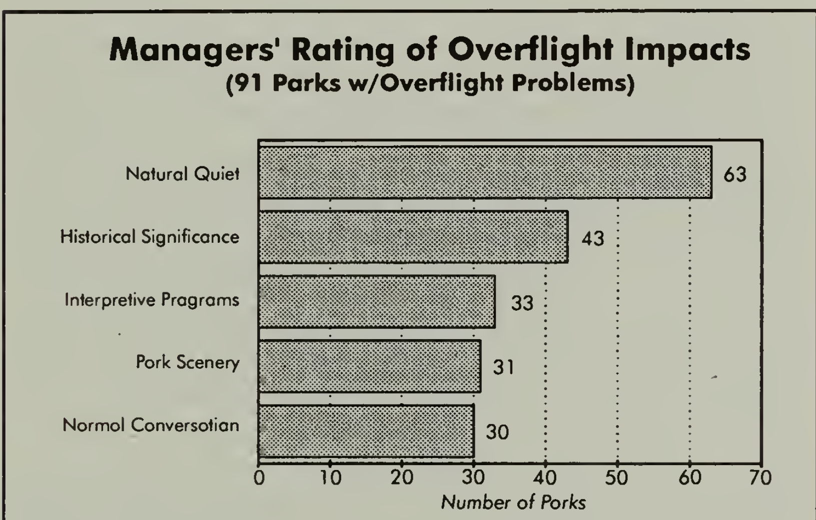


Figure 2.16: Managers' Rating of Overflight Impacts on Visitors' Enjoyment

only been able to provide partial information. Despite a formal Memorandum of Understanding between the Secretaries of Defense, Agriculture, and Interior, it was not possible to obtain information suitable for inclusion in this effort from the Department of Defense. Telephone interviews of tour operators, used to ascertain flight activity on sightseeing routes, yielded some information, but several operators refused to provide information or referred inquiries to national or state coalitions of air tour operators. Finally, there is no accurate method for estimating the level of general aviation traffic on any route within any airspace. Furthermore, there is no strong correlation of exposure based on these numbers and the numbers of visitors who reported hearing aircraft, or the number of

CONCLUSION 2.9:
It is extremely difficult, if not impossible, to obtain accurate determinations of aircraft activity over units of the National Park System without on-site collection of objective information. Moreover, numbers of overflights by themselves are not necessarily indicative of the extent of exposure to aircraft sounds or of the severity of a sound exposure problem.

overflights reported by the NPS managers or with the degree of concern expressed by managers.

2.3 Sound Measurement Results

There are many methods for collecting objective data on-site that can be used to quantify aircraft activity over units of the National Park System. One method is to measure aircraft sound levels, and various types of sound measurements have been conducted in many of the national parks over the years. In response to Public Law 100-91, the NPS conducted four sound measurement studies, and three of these provide sound measurement results that can be readily compared and summarized.

Percent of Time Audible

Though many metrics are available for quantifying sound, one that the NPS has found has proven useful in examining the sounds produced by aircraft overflights of national parks is the "percent of time audible". NPS studies found this metric to be best correlated with visitors' response to sound (see Chapter 6 and Anderson *et al.* 1993). This is a measure of the amount of time aircraft can be heard at a specific location by an attentive listener, and it is simply the percent of the time that the listener can hear aircraft. It is a measure that is very easy to compile with no special instrumentation other than a stop watch, a pencil and a sheet of paper. As will be discussed in Chapter 6, "Effects on Visitor Enjoyment," percent of time audible is useful because it can be related to visitor reactions to the sound of aircraft overflights. It is also useful because it accounts for the non-aircraft sound levels. For example, if a site is near flowing water or a parking area, the aircraft may not be heard as easily as in a very quiet location. Hence, percent of time audible is a measure of how long aircraft sound levels protrude above all other sounds. As will be discussed in Chapter 6, percent of time audible is easy to measure but extremely difficult to compute or predict. Hence, once a problem site is identified with percent of time audible data, data collection and analysis need to be done with an analytically manageable metric (e.g. Equivalent Level or L_{eq}).

Figure 2.17 summarizes the percent of time aircraft were audible at specific locations in eight units of the National Park System.

Grand Canyon: Data were collected in Grand Canyon National Park during three time periods, including shoulder (Spring and Fall) and high visitor use seasons. The first two data collection efforts, in October/November of 1989 and in April/May of 1990, were conducted by observers who made continuous digital sound level tape recordings, and who pressed a button that recorded a tone on the tape whenever an aircraft was heard. (Fidell *et al.* 1994) The 1989 and 1990 data were collected at each of the locations listed in Figure 2.17 for periods of several hours per day for four or more days. In general, the average time for data collection at these 1989 and 1990 sites was 16 hours. Thus, for example, at Sanup Plateau, where data were collected a total of about 24 hours, aircraft could be heard for about 14 hours or 58 percent of the time.

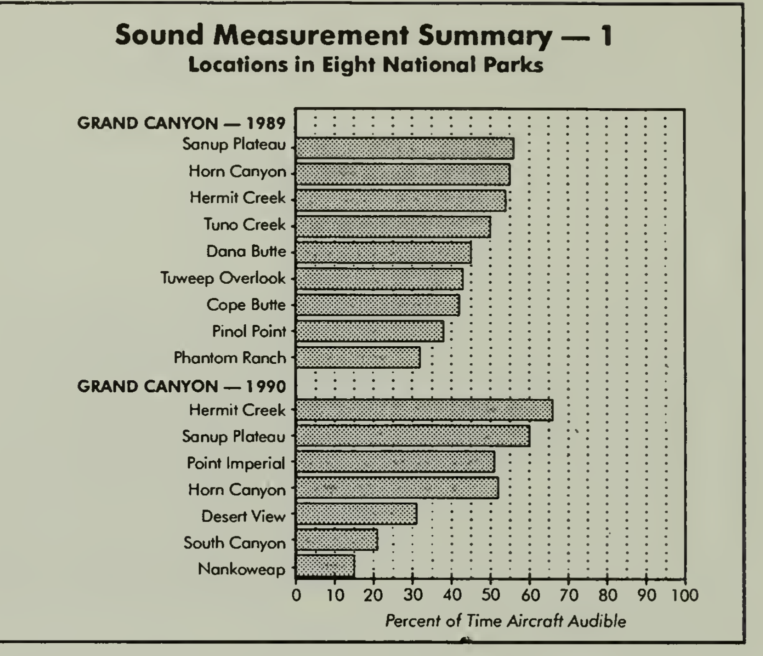
The third period of data collection occurred between August/September of 1992, and data was acquired by observers who used sound level monitors that collected and stored sound level data once a second, and who used palm-top computers to key in the times aircraft were heard, the type of aircraft, and the type of non-aircraft sounds that could be heard when no aircraft were present. Data were collected for about 4 hours at each location, except at four sites where visitors were also interviewed (see Chapter 6). At the four interview sites, sound level data were collected an average of 15 hours. All data were collected during daylight hours.

Though these measurements provide far more data than is displayed in Figure 2.17 (see the following section "decibel based data"), the percent of time audible metric provides a means for a simple and quick comparison of the extent to which aircraft are audible. Parts 1 and 2 show aircraft audibility in various parts of the Grand Canyon. For the sites measured, aircraft were heard from a low of about 5 percent of the time to a high of almost 80 percent of the time. The sites were not randomly chosen, so should not be thought of as representing all possible aircraft sound exposures in the Canyon. Rather, the data should be taken to show the general range of aircraft sound exposures and to show that there are many locations where aircraft could be heard for moderate to high percentages of the time.

Hawaiian Parks: The techniques used in 1992 in the Grand Canyon were also applied in Hawaii. (Horonjeff *et al.* 1993) Data were taken over 4 to 6 hour periods at four of the sites (Kalahaku Overlook, Pu'u Mamane, Pu'u O'o and Halemaumau Crater) and for periods of 21 to 25 hours at the other four locations. The results are presented in part 3 of Figure 2.17.

Five Other Parks: Park personnel were trained in the use of a simplified method to collect sound level data. The method requires a sound level meter and limited training in use of a specialized data form (Miller *et al.* 1994). It yields several sound metrics, including percent of time aircraft are audible. In general, the method requires that sound level samples be taken every 15 seconds for 20 to 30 minute periods with the observer keeping a log of which samples include audible aircraft sound. The method was used by park personnel in the five parks shown in Figure 2.17, parts 3 and 4.

CONCLUSION 2.10:
"Percent of time audible" provides a simple method for the NPS to use in quantifying how much of the time aircraft can be heard at locations in a given national park.



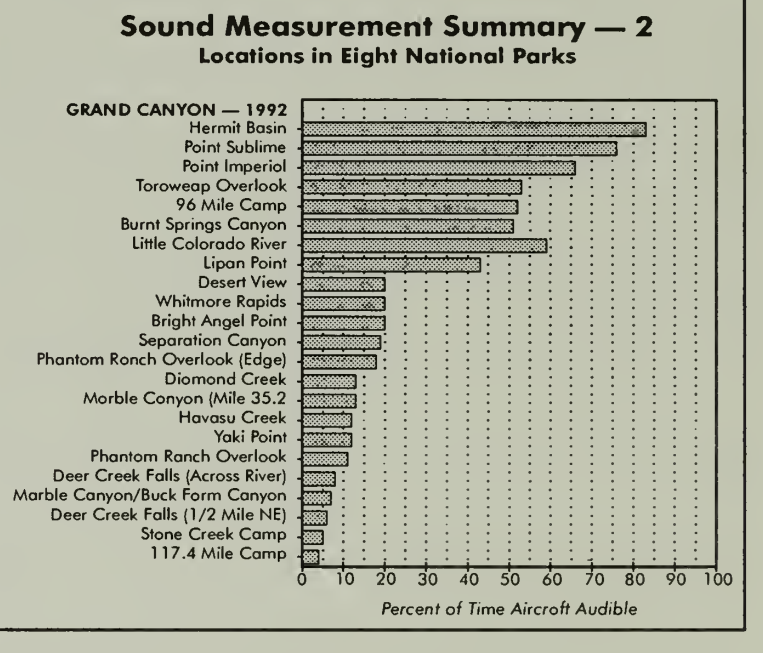
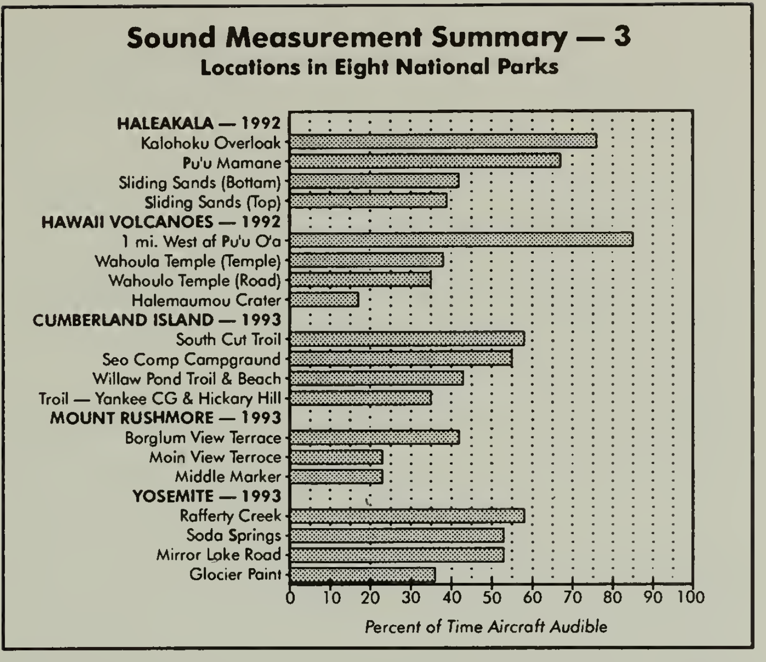
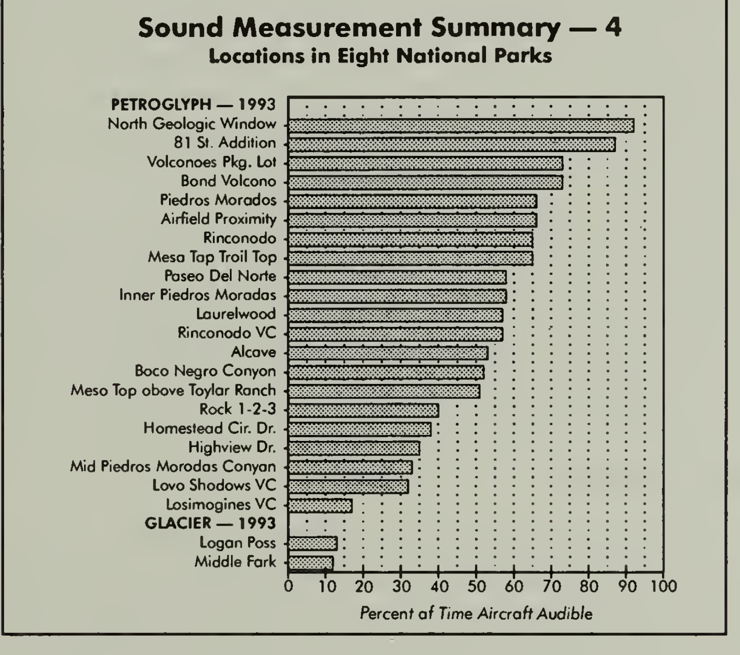


Figure 2.17: Sound Measurement Results Acquired in Eight National Parks


Sound Measurement Summary — 3
Locations in Eight National Parks
HALEAKALA — 1992
Kalohoku Overlook
Pu'u Mamane
Sliding Sands (Bottom)
Sliding Sands (Top)
HAWAII VOLCANOES — 1992
1 mi. West of Pu'u O'o
Wahoula Temple (Temple)
Wahoula Temple (Road)
Halemaumau Crater
CUMBERLAND ISLAND — 1993
South Cut Trail
Sea Camp Campground
Willow Pond Trail & Beach
Trail — Yankee CG & Hickory Hill
MOUNT RUSHMORE — 1993
Borglum View Terrace
Main View Terrace
Middle Marker
YOSEMITE — 1993
Rafferty Creek
Soda Springs
Mirror Lake Road
Glacier Point
0 10 20 30 40 50 60 70 80 90 100
Percent of Time Aircraft Audible


Sound Measurement Summary — 4
Locations in Eight National Parks
PETROGLYPH — 1993
North Geologic Window
81 St. Addition
Volcanoes Pkg. Lot
Bond Volcano
Piedras Moradas
Airfield Proximity
Rinconado
Mesa Top Trail Top
Paseo Del Norte
Inner Piedras Moradas
Laurelwood
Rinconado VC
Alcove
Boca Negro Canyon
Mesa Top above Taylor Ranch
Rock 1-2-3
Homestead Cir. Dr.
Highview Dr.
Mid Piedras Moradas Canyon
Lava Shadows VC
Losimogines VC
GLACIER — 1993
Logan Pass
Middle Fork
0 10 20 30 40 50 60 70 80 90 100
Percent of Time Aircraft Audible

CONCLUSION 2.11: *"Percent of time audible" data taken in eight national park units, though limited for some of these areas, suggests that there are locations and times in many of these parks where aircraft can be heard for significant portions of time.*

Cumberland Island: Measurements were conducted eight times at the four locations, so that each site was monitored for about 4 hours. Thus, for example, out of about 4 hours of listening at the Sea Camp Campground, aircraft could be heard more than 55 percent of the time.

Mount Rushmore: Measurements were conducted more than 20 times over nearly two weeks time at the three sites, and each site was measured for eight to ten hours total. Hence, over approximately 10 hours of monitoring at Borglum View Terrace, aircraft could be heard more than 40 percent of the time.

Yosemite: Measurements were conducted twelve times over one to three days at the four sites for a total measurement time of about six hours at each site. Thus, out of 6 hours of listening, aircraft were audible more than half the time at three of the four locations: Rafferty Creek, Soda Springs and Mirror Lake Road.

Petroglyph: Measurements were conducted for approximately 20 minutes at each location. Thus, measurements here provide information over more locations, but with less certainty at any single location. The results in Figure 2.17, part 4, show the wide variation in aircraft sound that can be experienced in this park. Of 21 locations where measurements were made, aircraft could be heard more than half the twenty minute listening period at 15 sites.

Glacier: Measurements were conducted seven times over three days at Logan Pass, and three times over two days at Middle Fork. This small sample is not believed to be representative of the situation in Glacier. Of 3½ hours of listening at Logan Pass, for example, aircraft could be heard slightly more than 10 percent of the time.

Sound Level Data

Report NPOA 93-4 presents detailed sound level data collected in 1992 in the Grand Canyon and in Haleakala and Hawaii Volcanoes National Parks. Figures 2.18 and 2.19 present samples of these "acoustic profile" data measured in the Grand Canyon and in the Hawaiian Islands, respectively. The form is a graphic one (though the data are also tabulated in NPOA 93-4), and shows both non-aircraft background levels, and maximum aircraft produced levels for the entire day's measurement, a period of 4 to 7 hours for the locations shown.

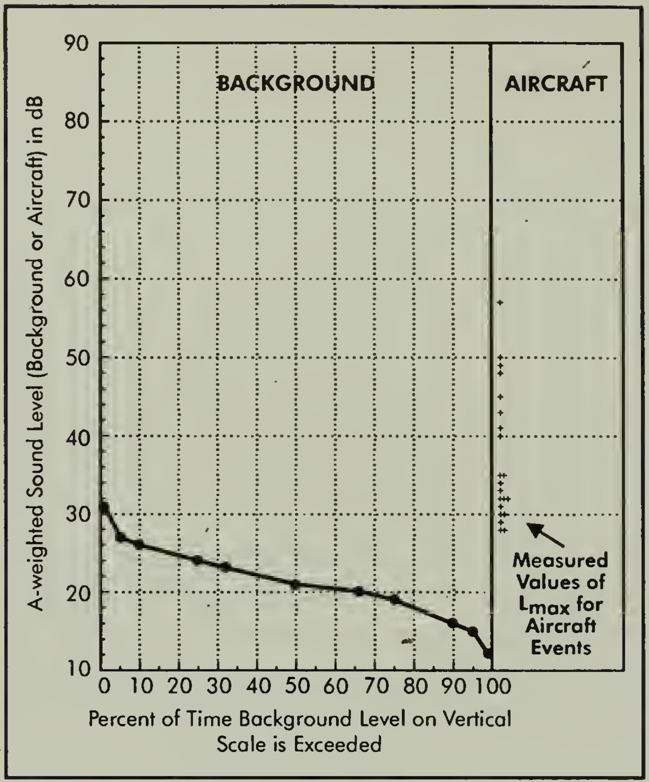
The vertical axis of the graph shows the A-weighted sound level in decibels. The curve on the left-hand portion of the graph describes the background sound level; the "+" signs on the right hand side describe the maximum sound levels of individual aircraft overflights. The curve on the left shows how background levels varied over the measurement. At Separation Canyon (site number 9, see Figure 9.2 in Chapter 9), background levels were between approximately 31 dB and 12 dB; ten percent of the time they were above 26 dB and 90 percent of the time they were above roughly 16 dB. In comparison, the aircraft that were measured produced maximum levels, L_{max}, between about 28 and 57 dB. When the aircraft levels are about the same as the background levels, at least for some of the time, aircraft sounds will tend to be less audible or "masked"; aircraft levels that are above all background levels are easily heard.

Separation Canyon is in an area where the minimum flight altitude is 5000 feet above sea level (MSL). The elevation of the site is about 1300 MSL, so aircraft should be a minimum of 3700 feet above the site. Bright Angel Point, on the other hand, is well within a flight-free zone created by SFAR 50-2 (See Chapter 9, Figure 9.1) and is one of the quietest areas with respect to aircraft sound. As shown, at Bright Angel Point many of the aircraft produced levels are at the level of the background sound levels, at least part of the time. Tour aircraft are audible less of the time at Bright Angel Point (about 6 percent of the time) than at Separation Canyon (about 16 percent of the time, see Chapter 9, Tables 9.2 and 9.3).

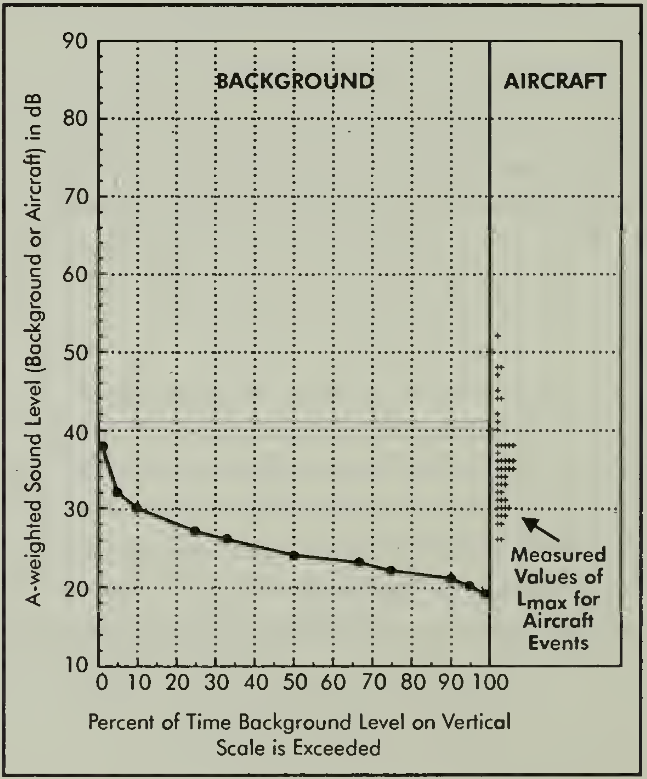
Toroweap Overlook is within, but at the edge of another SFAR 50-2 flight-free zone. Aircraft stay over a mile from this location. The figure shows clearly, however, that aircraft sound levels considerably exceed the background levels, which are quite low. Point Sublime is also within a flight-free zone, and though aircraft levels are lower than at Toroweap, aircraft are audible more than 70 percent of the time.

The data from the Hawaiian parks, Figure 2.19, suggest the effectiveness of setting minimum altitude restrictions. Over Haleakala (Sliding Sands and Kalahaku Overlook), P.L. 100-91 restricts flight to 9,500 MSL or higher; this restriction is intended to keep aircraft above the rim where the elevation is about 9,600 MSL. Both the Sliding Sands and Kalahaku sites are at about 9,400 MSL. On the other hand, there are no altitude restrictions for Wahaula Temple or Pu'u O'o. Some aircraft flew quite low over Wahaula Temple.

CONCLUSION 2.12:
Flight-free zones can be designed to effectively limit aircraft sound levels, but they must be very large if natural quiet is to be restored or substantially restored.

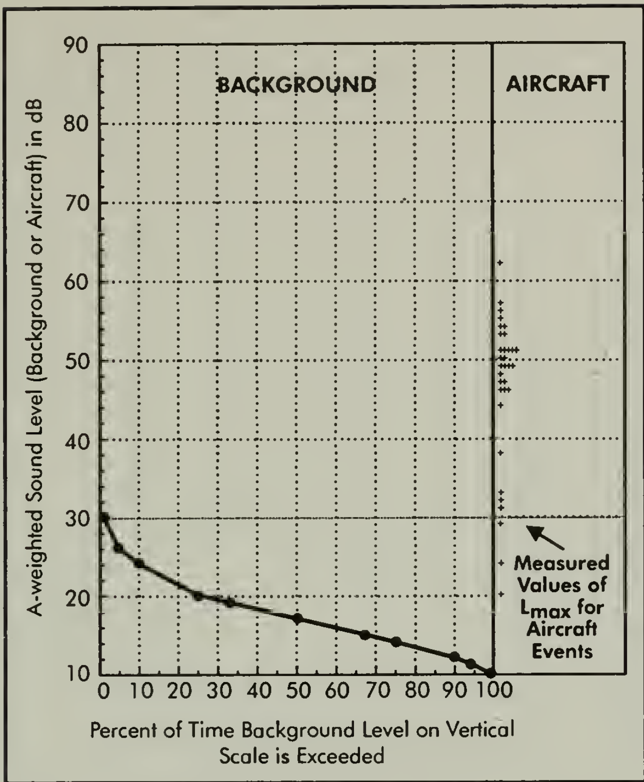


SEPARATION CANYON (9)

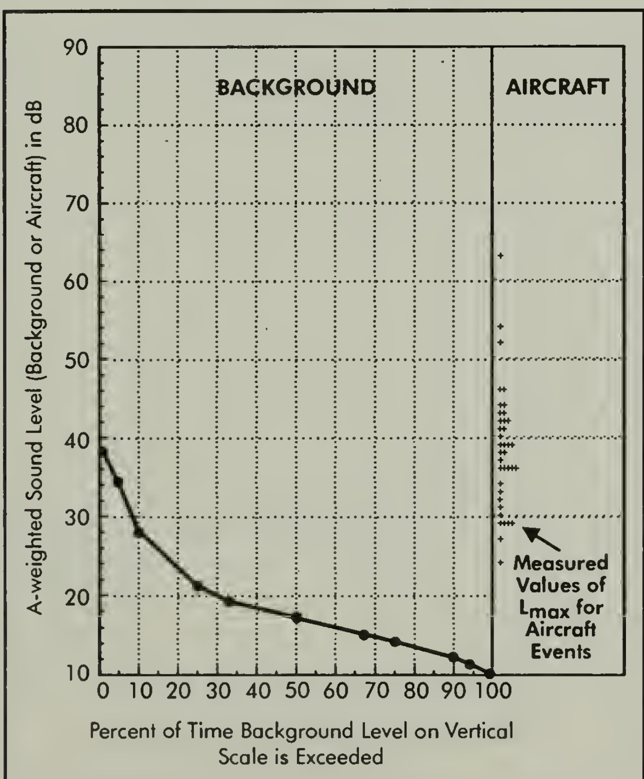


BRIGHT ANGEL POINT (10)

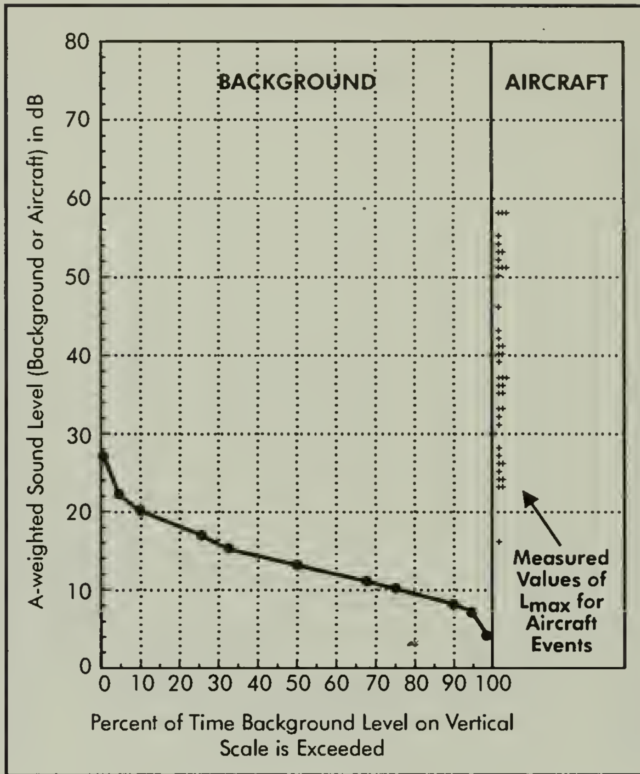
Figure 2.18: Acoustic Profile Data from Grand Canyon National Park



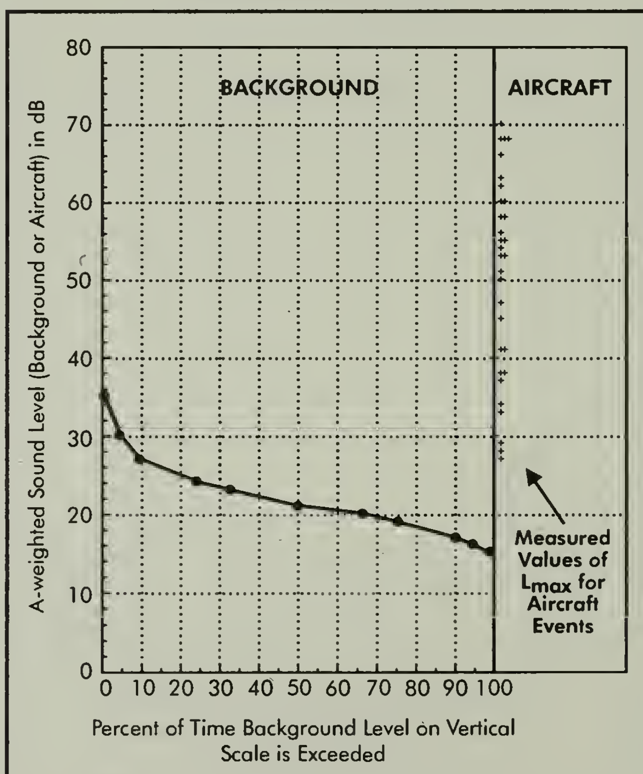
TOROWEAP OVERLOOK (14)



POINT SUBLIME (19)

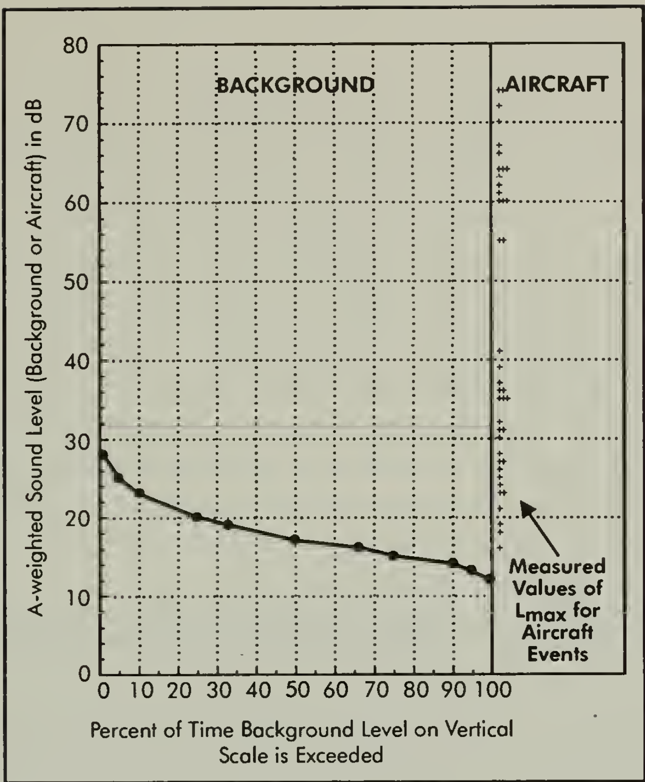


SLIDING SANDS — BOTTOM (52)

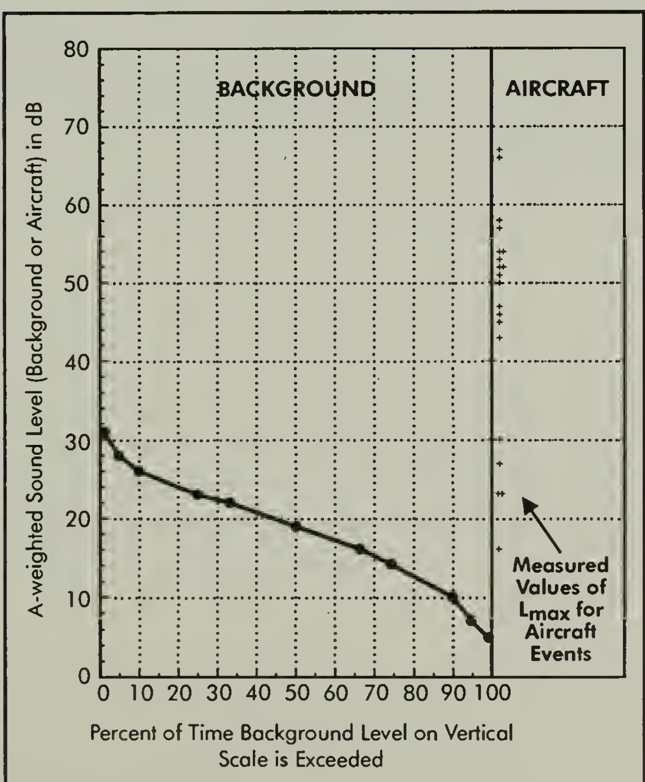


KALAHAKU OVERLOOK (55)

Figure 2.19: Acoustic Profile Data from Haleakala and Hawaii Volcanoes National Parks



WAHAULA TEMPLE — TEMPLE (63)



PU'U O'O (65)

2.4 Summary

CONCLUSION 2.13: *Minimum oltitude restrictions con help limit oircroft sound levels, but the restrictions should be carefully chosen, considering location and elevotion of the park areas of concern.*

It is likely that there could be as many as 50 to 100 units of the park system where overflight problems are likely or certain to exist. NPS managers have consistently, for nearly a decade, identified 30-40 parks as priorities for research and problem solving. NPS managers believe about 30 percent or approximately 100 of the National Park System units (excluding Alaska) experience some level or type of aircraft overflights that constitute a problem. In one-third of this set of parks, managers are very or extremely concerned about overflights. More than half of the affected parks are overflown by military, commercial passenger aircraft and general aviation aircraft. Somewhat fewer are overflown by sightseeing aircraft. The primary impact of these overflights is believed by park managers to be the sound produced, and that the sound impact produced by aircraft is more of a problem than sound from any other sources.

Because of the variations in numbers and types of overflights, a systematic method is needed to objectively determine the degree of the overflight problem. However, such a method must be integrated with management objectives. Park managers differ in their concern about aircraft overflights. Local conditions and management objectives play an important role in determining management concern. One objective method that can be used is measurement of "percent of time audible" which answers the question of how often aircraft can be heard. Sound level data in decibels, of the type presented in Section 2.3, graphically show the relation of aircraft to background sound levels.

Chapter
3

EFFECTS OF OVERFLIGHTS ON NATURAL QUIET

The National Park Service manages "natural quiet" as a park resource. This responsibility is based in current public law, in explicit park management policy, and in visitors' reactions to park experiences. Just as parks contain many *tangible* features, such as animals, plants, waters, geological features, historic buildings and archeological sites, they have intangible qualities as well. These qualities include solitude, space, scenery, clear night skies, sounds of nature and natural quiet. Such qualities are increasingly rare in much of America. The scarcity of these resources and their importance to the park experience also makes them valued by park visitors.

3.1 How Important is Natural Quiet?

The concept of natural quiet and its importance as a resource is embodied in the 1916 NPS Organic Act, as amended.[1] For Grand Canyon National Park (GCNP), Congress embedded the concept into two major public laws. It is also stated quite explicitly in NPS policy. Natural quiet is also very important to park managers and to a majority of park visitors.

1. *NPS Organic Act, 16 U.S.C. 1*

3.1.1 Importance to the Congress

As directed by the Organic Act:

> *". . . . The service thus established shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations hereinafter specified, except such as are under the jurisdiction of the Secretary of the Army, as provided by law, by such means and measures as conform to the fundamental purpose of such parks, monuments, and reservations, which purpose is to conserve the scenery and the national and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."*

The national parks must be managed to conserve their resources and allow their enjoyment. This section has been interpreted by the courts as providing the Secretary of the Interior with authority to determine how best to control these areas.

The United States Congress has repeatedly recognized the need to preserve the national parks in their natural state. In Section 101(b) of the Act of March 27, 1978, P.L. 95-250 (The Redwood Act), 92 Stat. 166 (codified at 16 U.S.C. 1), Congress stated that:

> *". . . . The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress."*

According to the legislative history of this provision, "the Secretary has an absolute duty, which is not to be compromised, to fulfill the mandate of the 1916 Act to take whatever actions and seek whatever relief as will safeguard the units of the National Park System." Furthermore, 16 U.S.C. 3 indicates that to carry out these Congressional mandates, the Secretary of the Interior "shall make and publish such rules and regulations as he may deem necessary and proper for the use and management of parks. . . ." No limitations on the Secretary's power are noted. In the absence of specific Congressional mandate, the Secretary must determine for the National Park Service how best to protect park resources and thus how best to manage any adverse impacts.

In the case of GCNP, Congress has provided direct and explicit guidance. In the Grand Canyon National Park Enlargement Act of January, 1975, Congress stressed the importance of natural quiet in directing certain corrective actions whenever:

> *". . . the Secretary has reason to believe that any aircraft or helicopter activity or operation may be occurring . . . which is likely to cause an injury to the health, welfare, or safety of visitors to the park or to cause a significant adverse effect on the* ***natural quiet*** *and experience of the park . . ."* [2] *(emphasis added)*

Twelve years later, Congress reiterated the same concern in Public Law 100-91, The National Parks Overflights Act of 1987. A portion of that act states:

> *"Noise associated with aircraft overflights at the Grand Canyon National Park is causing a significant adverse effect on the natural quiet and experience of the park and current aircraft operations at the Grand Canyon National Park have raised serious concerns regarding public safety, including concerns regarding the safety of park users."* [3]

Regarding guidance to achieve natural quiet in areas exposed to aircraft overflights, the legislative history of Public Law 100-91 provides important guidance on how a substantial restoration of natural quiet is to be achieved:

> *"Flight-free zones are to be large areas where visitors can experience the park essentially free from aircraft sound intrusions, and where the sound from aircraft traveling adjacent to the flight-free zone is not detectable from most locations within the zone."*

3.1.2 Importance of Natural Quiet to the National Park Service

NPS management policy clearly articulates the value of natural quiet as a resource. Regarding the intrinsic value of the resource, NPS management policy (NPS 1988) states:

> *"The natural resources and values that the Park Service protects . . . include plants, animals, water, air, soils, topographic features, geologic features, paleontological resources, and aesthetic values, such as scenic vistas,* ***natural quiet****, and clear night skies . . ." (emphasis added)*

NPS policy also tasks the agency with protecting natural quiet as a resource. Regarding protective actions to be taken, NPS policy (NPS 1988) states:

---

2. *Public Law 93-620, "Grand Canyon National Park Enlargement Act", 93rd Congress of the United States, January, 1975.*

3. *Public Law 100-91, "Aircraft Overflights Act", 100th Congress of the United States, August, 1987.*

> *"The National Park Service will strive to preserve the* ***natural quiet*** *and the natural sounds associated with the physical and biological resources of the parks (for example, the sounds of the wind in the trees or of the waves breaking on the shore, the howl of the wolf, or the call of the loon). Activities causing excessive or unnecessary unnatural sounds in and adjacent to parks, including low-altitude aircraft overflights, will be monitored, and action will be taken to prevent or minimize unnatural sounds that adversely affect park resources or values or visitors' enjoyment of them." (Emphasis added)*

These policy statements make clear the importance of natural quiet as a resource in many units of the National Park System. This resource is defined as the *natural ambient sound conditions found in those units*. It refers to the absence of mechanical noise, but accepts the "self-noise"[4] of park visitors. This definition provides local park managers with a point of departure for developing strategies to protect this resource.

NPS-77, Natural Resource Management Guidelines (NPS 1990), also addresses the issue of protecting aesthetic values. The Guidelines define "aesthetic value" as a:

> *". . . value, in the framework of natural resource management in the NPS, that is attributed by people to natural, unmanipulated conditions and is perceived through the senses — by seeing, hearing, touching, smelling, and tasting."*

The Guidelines provide guidance on considering basic questions of aesthetics.

> *"To determine whether a proposed action or activity may affect resources and values important to the aesthetic experience, consideration of the following questions may be helpful. The questions can assist not only in evaluating the activities and actions that take place outside park boundaries, but also in those under the regulatory control of the NPS within park boundaries. . .*
>
> *Could the action or activity be seen from the park. . . ?*
>
> *Could the action or activity be heard in the park? Where in the park would the sound be most noticeable or intrusive? From developed overlooks, headquarters areas, or trails? Would the sounds be continuous or intermittent? Are there any ways in which the effects of the sound could be mitigated or lessened. . . ?*
>
> *Would the perceptible sight or sound change the nature or quality of the visitor's experience? In what ways. . . ?*

4. *"Self-Noise" is the noise generated by the visitor—the tread of hiking boots on the trail, the creaking packframe, rattle of pots or pans, talking, etc.*

Does the frequency or duration of the activity or action affect the degree to which it could be perceived?

As these questions indicate, systematically looking at the effects of proposed activities or actions aims at evaluating what may be lost. . ."

The Guidelines further note that the courts have been reluctant to expand the regulatory control of the Service for aesthetics beyond designated park boundaries. NPS managers are encouraged to look for methods other than litigation or Congressional appropriations to preserve the aesthetic integrity of parks.

3.1.3 Importance of Natural Quiet to Park Managers

In 1992 the NPS surveyed the managers of 98 parks (excluding Alaska parks) who had reported overflight problems. Although the questionnaire solicited the opinions about many aspects of aircraft overflights, three of the questions asked managers to consider the issue of natural quiet. As applied to their particular park, these questions asked for opinions about:

> The importance managers ascribe to providing an opportunity for park visitors to appreciate the natural quiet of the park, [5]
>
> The degree to which managers feel aircraft activity interferes with their ability to provide this opportunity, and
>
> The degree to which managers feel aircraft activity negatively impacts visitors' ability to appreciate natural quiet.[6]

Figure 3.1 provides a summary of the responses to the first question. Although managers attached most importance to visitor enjoyment at most parks, the opportunity for natural quiet is extremely important to half the managers, and moderately to very important to roughly the other half. Figure 3.2 shows the responses to the second question. More managers believe aircraft overflights interfere with the opportunity for natural quiet, and to a greater degree, than believe aircraft interfere with enjoyment or historical significance. (These views, that aircraft most interfere with natural quiet, are confirmed by visitor surveys, see Section 3.1.4 and Chapters 6 and 9.)

5. *This question was asked in a context of three different opportunities: Visitor Enjoyment, Appreciation of Natural Quiet, and Appreciation of Historical Significance.*

6. *This question was asked in a context of five potential impacts: Normal Conversation, Natural Quiet, Historical Significance, Park Scenery, and Hear Interpretive Programs.*

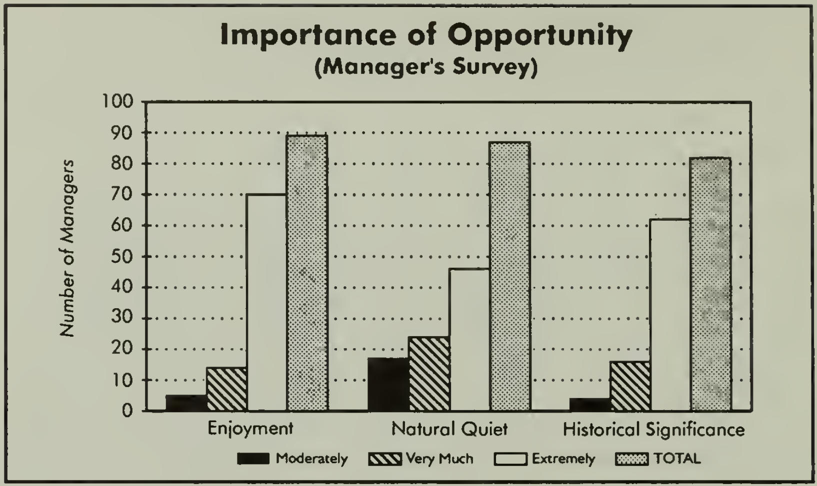


Figure 3.1: Importance to Management of Various Opportunities

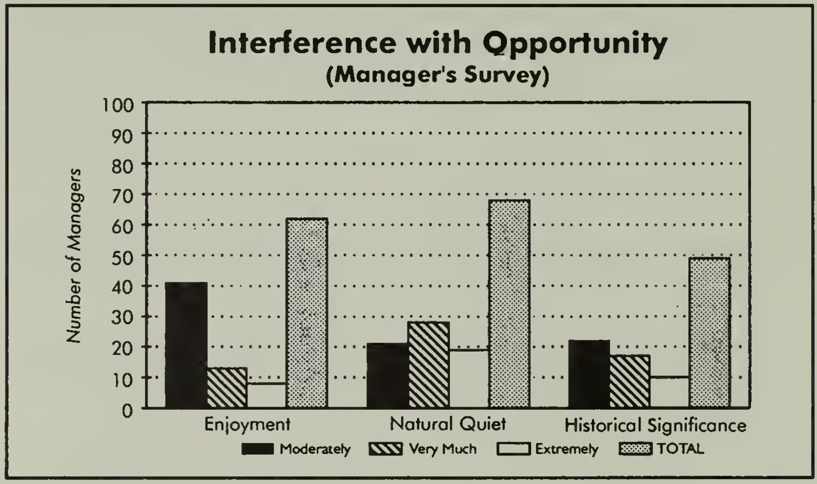


Figure 3.2: Management Perspective on Interference with Opportunities

CONCLUSION 3.1:
Preserving natural quiet is an integral part of the mission of the NPS. This is confirmed in law, policy, and the beliefs of NPS managers. Aircraft are judged by most managers to interfere with this opportunity, and interfere more with this opportunity than with other types of opportunities. The specific mandates and opportunities of individual parks to provide natural quiet need to be considered when estimating the severity of the effects of overflights.

As part of the third question, managers were also asked to rate the degree to which aircraft activity impacted four aspects of the visitors' experience besides natural quiet. Those additional aspects were normal voice conversation, historical significance of the park, enjoyment of the scenery, and the ability to hear interpretive programs. Figure 3.3 shows the managers' responses and puts the issue of natural quiet in perspective with these additional concerns. The length of each bar in the figure shows the percentage of managers who rated impact to be moderate to extreme for each aspect of the experience. In comparison with other potential impacts, natural quiet drew the highest percentage of responses.

3.1.4 Importance of Natural Quiet to Park Visitors

A survey of visitors to the Grand Canyon (Baumgartner *et al.* 1994) showed how different visitor groups felt impact from aircraft overflights. Figure 3.4 provides information about five different Grand Canyon visitor groups: frontcountry visitors, summer and fall backcountry visitors, river users in motorized boats, and river users in oar-powered boats. For all groups, more visitors reported impact in terms of interference with natural quiet, than reported interference with enjoyment or annoyance.

Figure 3.4 shows also that overflights of the Grand Canyon produce greater impacts, in terms of percent of visitors who are affected, in the backcountry than in the frontcountry. Though the reasons for this greater impact cannot be determined, it is evident that backcountry use (including river use) does not provide an escape from the impacts of overflights.

CONCLUSION 3.2:
Aircraft appear more likely to interfere with natural quiet for visitors than with visitor enjoyment or to produce annoyance. This relationship held true for Grand Canyon visitors, regardless of activity.

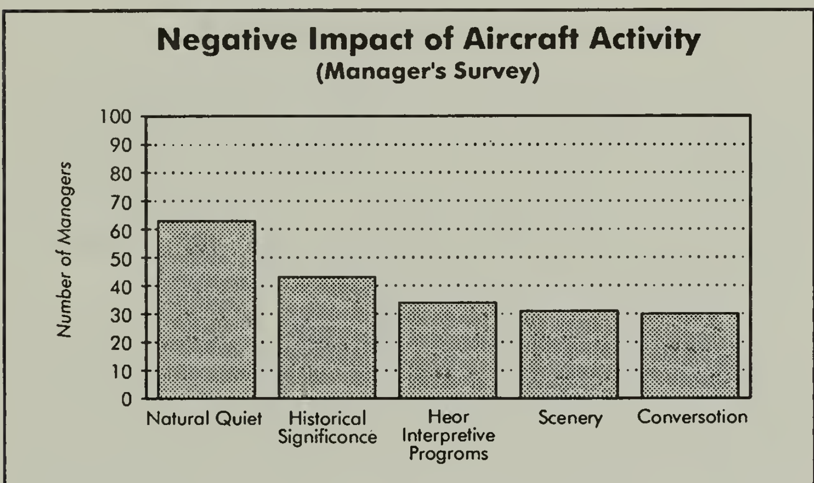


Figure 3.3: Management Reports of Aircraft Impact on Park Resources

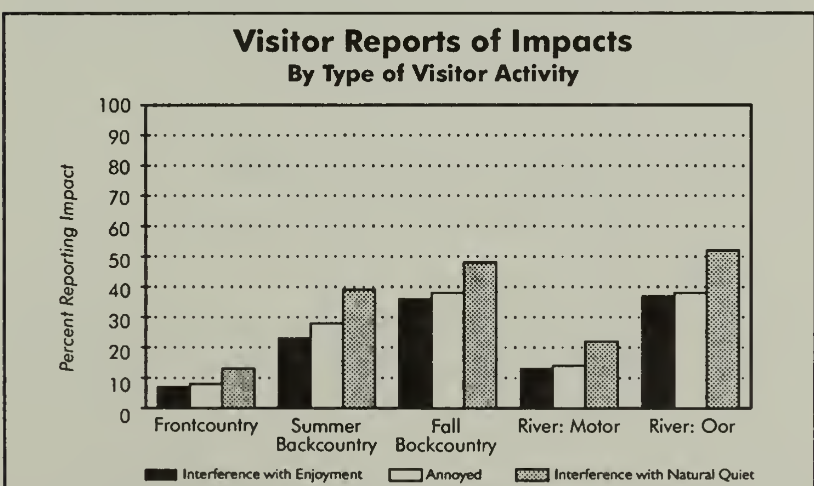


Figure 3.4: Grand Canyon Visitor Reports of Aircraft Impact on Park Resources

3.2 What is Natural Quiet?

Parks and wildernesses offer a variety of unique, pristine sounds not found in most urban or suburban environments. They also offer a complete absence of sounds that *are* found in such environments. Together, these two conditions provide a very special dimension to a park experience.

In considering any sound environment, it is often helpful to classify the components of the environment into one of two categories: those sounds that contribute to the more or less continuous background (ambient) sound environment (such as waves breaking on the shore, or a distant waterfall), and those sounds which are intermittent in nature (such as the call of a coyote, or the passing of a flock of vocal geese). This distinction is important, because it is the ambient environment that establishes the quieter moments in the park, and provides masking to intermittent sources (such as aircraft).

3.2.1 Qualitative Assessment of Natural Quiet

Quiet itself, in the absence of any discernible source (especially man-made), is an important element of the feeling of solitude. Quiet also affords visitors an opportunity to hear faint or very distant sounds (such as animal activity, waterfalls, etc.). Such an experience provides an important perspective on the vastness of the environment in which the visitor is located, often beyond the visual boundaries determined by trees, terrain, and the like.

The range in ambient sound levels, even from indigenous sources, can vary considerably from one location to another, or time to time at any given location. At one end of the spectrum is the sound level at the base of a powerful waterfall. At the other end of the spectrum is the near absence of any perceptible sound at all. These latter conditions may be found in areas devoid of flora or fauna. In the middle is an array of sound conditions which vary from moment to moment, hour to hour. During non-inclement weather conditions, these variations result from three factors in natural environments:

- Wind (its interaction with foliage, irregular terrain, or the human ear)
- Water (movement in steams, falls, or wave action)
- Animal (near continuous, such as insect; or intermittent, such as birds, coyotes, etc.)

Lulls in the wind or interludes between animal sounds create intervals where the quiet of a sylvan setting is quite striking. In considering natural quiet as a resource, the ability to hear clearly the delicate and quieter intermittent sounds of nature, the ability to experience interludes of extreme quiet for their own sake, and the opportunity to do so for extended periods of time is what natural quiet is all about.

3.2.2 Quantitative Assessment of Natural Quiet

To provide a quantitative perspective on the quiet found in many parks, Figure 3.5 shows sound levels for a range of park and non-park settings in the form of an "acoustic thermometer." Values at the bottom of the thermometer are very quiet. In comparison, values at the top of the thermometer are much noisier. The sound levels shown on the thermometer are measured in decibels.

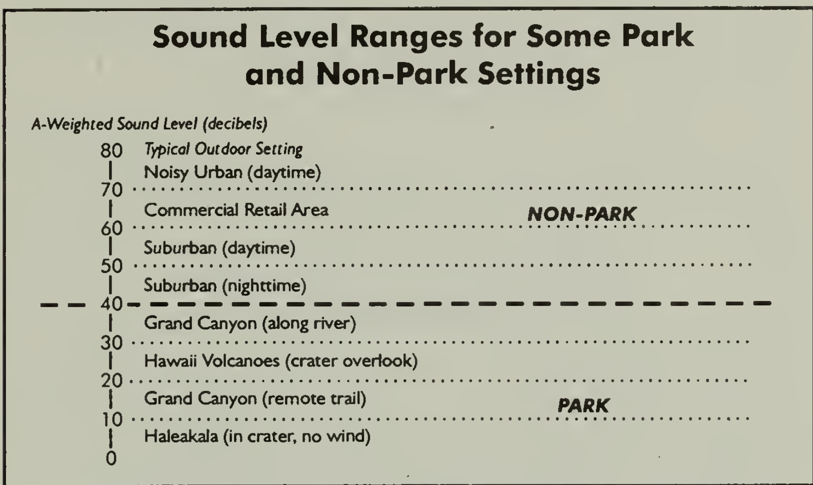


Figure 3.5: Sound Level Ranges Between Park and Non-Park Settings

The "A-weighted sound level" title over the scale refers to an internationally recognized measurement standard that accounts for the different sensitivity of the human ear to different frequencies (pitches) of sound. This standard is used to assure that two different sounds which seem equally loud to a human observer will have very nearly the same measured sound level, in decibels[7].

The thermometer in Figure 3.5 is divided into two ranges. The upper half shows sound levels of typical non-park settings, and the lower half shows the ranges of sound levels measured in parks. At the high end of the non-park environments are outdoor settings in downtown areas of large, busy cities, such as New York, Chicago, or Washington, DC. Further down the scale are daytime suburban settings out-of-doors in areas around these cities, and even further down are out-of-doors suburban settings at night.

In the lower range are sound level environments found in parks. This range includes sound levels that most people who live in urban or suburban environments rarely encounter during their normal daily routines. At the upper end of this range are areas along a major river, such as the Colorado

7. *Technically, the specified ranges of Figure 3.5 may be thought of as identifying commonly occurring equivalent levels, L_{eq}, for the identified location and condition.*

River in GCNP. In the middle of the range are scenic overlook areas where a few visitors may congregate at any one time, and areas along remote backcountry trails where encounters with other visitors are infrequent.

At the very bottom of the range are extremely quiet areas of parks or wildernesses generally devoid of vegetation or major terrain features which might generate noise from the wind or might support insect or animal populations. In the absence of wind, these locations have ambient levels very near the human threshold of hearing. Such environments may be found in places like Death Valley National Monument or in the crater of Haleakala National Park (where they have been measured with specialized instrumentation). To put the lower half of the figure in some perspective, sound levels in the 20 to 30 decibel range would be found late at night inside a single family residence, with all windows closed, no internal noise sources operating (such as heating or ventilating systems) and no local traffic in the vicinity.

CONCLUSION 3.3:
The quiet afforded in park settings is virtually in a range of its own, well below that which we experience in our normal daily routine.

Some perspective on how quiet the natural environment of a park can be may be gained by comparing the two ranges in Figure 3.5. The relatively large sound level range (of roughly 40 decibels) that can be found between a busy downtown area and the suburbs at night, can also be found in park areas, but lying entirely below the lowest of the common outdoor sound levels in suburban environments. In such quiet park areas, it is not surprising that even relatively quiet aircraft can be heard at great distances.

3.3 What Are the Characteristics of Natural Quiet?

Generally low sound levels, but with considerable variability over both time and location, characterize the ambient sound environments in many national parks. The rise and fall of the wind in a coniferous forest can change the ambient sound level over a matter of minutes at a single location. Likewise, the synchronized activity of insects such as crickets can produce substantial changes in the ambient sound environment as well.

From one location to the next, the proximity of vegetation and water, the local insect population (and its normal diurnal activity patterns), and the location's susceptibility to winds can give rise to large differences in ambient sound levels. Figures 3.6 through 3.8 show a range of ambient sound levels measured during the summer and fall of 1992 at a number of diverse locations in three parks. (Horonjeff *et al.* 1993) The bars in each figure show the range in sound levels observed 90 percent of the time during the measurements (5 percent of the time levels were higher than shown, and 5 percent of the time levels were lower than shown).

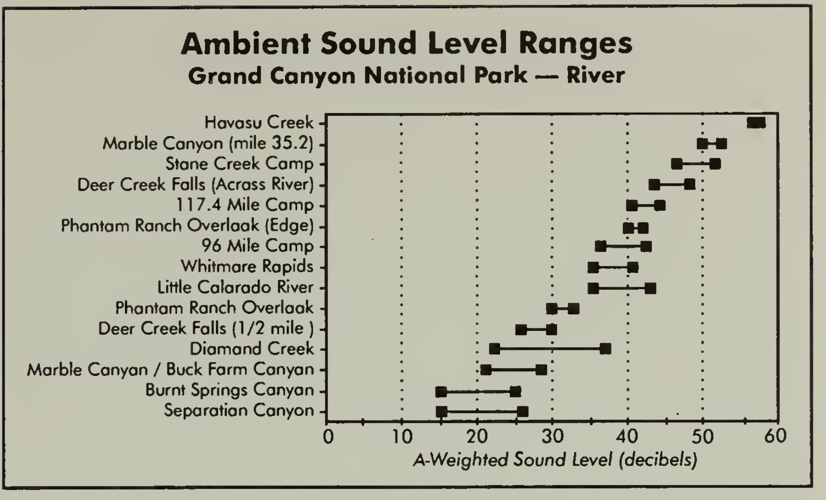


Figure 3.6: Measured Ambient Sound Levels Along Colorado River in Grand Canyon National Park

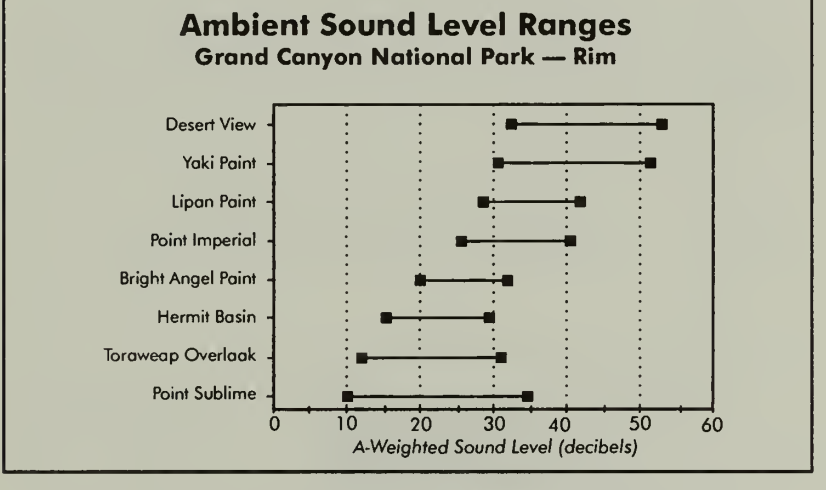


Figure 3.7: Measured Ambient Sound Levels Along the Canyon Rim in Grand Canyon National Park

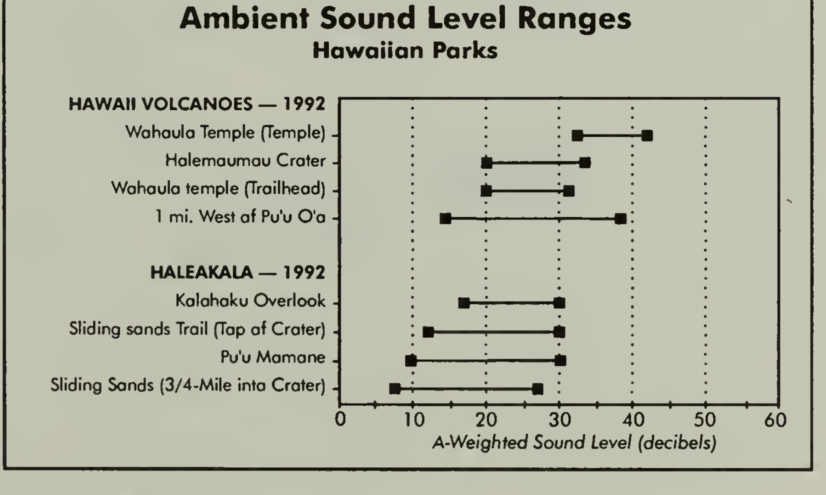


Figure 3.8: Measured Ambient Sound Levels in Hawaii Volcanoes and Haleakala National Parks

Looking at the three figures as a whole, a range of almost 50 decibels may be observed between the levels at Havasu Creek on the Colorado River and the lowest levels along Sliding Sands Trail in the crater of Haleakala National Park. Such a range is indicative of the differences to be found across the remote visitation areas of the park system. Within a single park the range can be almost as large. Generally speaking, at locations dominated by water noise, the range in ambient levels will usually be smaller (the 2 to 10 decibel ranges, as shown in Figure 3.6) than in other areas due to the consistency of water flow. In other areas the range is generally 15 to 20 decibels (Figures 3.7 and 3.8).

The relationship between these quiet settings and aircraft overflights is shown in Figure 3.9. The vertical axis of this figure shows the sound level in decibels, and the horizontal axis shows the passage of time over a 50 minute period. In the upper left portion of the figure, a 20-minute portion of a sound level trace obtained at the Great Meadows National Wildlife Refuge is presented. Great Meadows is located in a suburban area approximately 25 miles northwest of Boston, MA. The trace shows an ambient environment of 45 to 50 decibels, largely controlled by wind interacting with deciduous

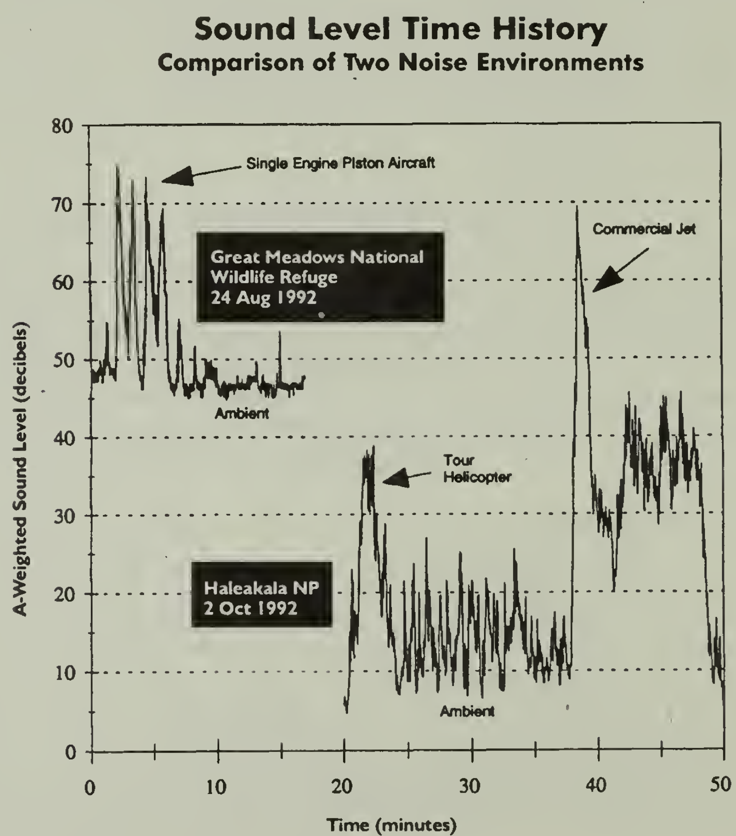


Figure 3.9: Protrusion of Aircraft Noise Above the Ambient in Various Settings

woods and distant road traffic. The trace also shows four single-engine propeller aircraft overflights which protrude 20 to 25 decibels above the ambient level, and are clearly audible in the ambient of Great Meadows.

To the right in the figure is a 30-minute trace showing helicopter and ambient sound levels at Haleakala National Park. The extreme quiet of the crater is exemplified by the ambient sound levels ranging from 7 to 27 decibels. The distant air tour helicopter at the beginning of the trace rises about 20 decibels above the ambient, and is clearly audible. The maximum level of this helicopter overflight is almost 10 decibels below the ambient at Great Meadows. Thus, the same helicopter overflight at Great Meadows would have been largely inaudible in that ambient environment.

Later in the Haleakala trace, a commercial jet aircraft overflew the crater and the maximum level exceeded the ambient by approximately 50 decibels. This event would have been noticeable in the Great Meadows environment as well as at Haleakala, but the protrusion of the sound event above the ambient is more pronounced at Haleakala, and is likely to be perceived as a greater intrusion. Immediately following the commercial aircraft overflight, a second air tour helicopter entered the crater area and began circling approximately one mile away. The maximum levels were about 30 decibels above the ambient and the aircraft was clearly audible. The same helicopter event in the presence of the Great Meadows ambient noise would have likely gone unnoticed.

Another important observation to be made from Figure 3.9 is the dynamics of the ambient sound level. While the *difference* between maximum and minimum ambient levels is different for the two environments shown, for each ambient the sound level consistently returns to within 2 or 3 decibels of the lowest levels every few minutes. Hence, in the absence of any other sounds, the visitor has a consistently recurring opportunity to experience and appreciate the quietest levels the particular location has to offer.

CONCLUSION 3.4:
Extremely low ambient sound levels in many parks means that visitors to remote sections of those parks are likely to hear aircraft, even if aircraft sound levels are very low.

3.4 Why is it Difficult to Preserve Natural Quiet?

There are four primary reasons why natural quiet is difficult to preserve:

- Pressures to increase aircraft activity are on the rise in many parks (see discussions in chapter 8), and the NPS has no authority or influence over this activity.

- The quiet to be preserved is the lower end of the ambient sound level range that occurs regularly between wind gusts, animal sounds, etc., not just the average sound level.

- To provide a reasonable assurance that an aircraft will not be noticed by park visitors, the aircraft sound level cannot exceed the lowest levels of the ambient by more than a few decibels.

The extreme quiet in many parks coupled with typical tour and commercial aircraft source levels require very large distances between the aircraft and the visitors to prevent audibility. (Anderson, G.S. *et al.* 1992)

With aircraft activity on the rise in many parks and without FAA assistance in regulating the increases, the amount of uninterrupted time available for visitors to notice, appreciate and contemplate the quiet of the park will decrease proportionately. While more flights do not necessarily mean higher sound levels, there are two inevitable outcomes of increased flights. First, if increasing numbers of flights are routed along a limited number of existing flight corridors, then the length or number of quiet interludes between flights will decrease. If additional flight corridors are opened to serve the rising demand, then new land areas will be affected and interludes of natural quiet will be reduced in new (and perhaps previously unaffected) areas as well.

CONCLUSION 3.5: *Preserving natural quiet is difficult because many park areas experience very low levels of ambient sound and aircraft are consequently audible at considerable distances (several miles).*

With the exception of water-related sources, there are few naturally occurring sound sources in many parks which continually generate sound levels capable of masking the sound of nearby aircraft. Sources that do provide a predictable and constant level of masking sound generally do so to a fairly localized geographic area. High ambient levels from ocean surf, or from river rapids are usually limited to distances well under a mile, and therefore are of limited value in protecting large areas of a park from aircraft audibility.

3.5 Aircraft Overflight Effects on Natural Quiet

When visitors can hear the sound of aircraft, they cannot experience natural quiet. Specific areas within specific parks provide the opportunity to experience natural quiet. Such areas, however, are likely to have very low ambient sound levels and hence, intruding sounds will be more easily heard. For these areas, actions are necessary to preserve the natural quiet resource. The NPS recognizes that achieving natural quiet will not always be possible at these locations. There are locations where intruding sounds cannot be eliminated. Local street traffic, other visitor-generated mechanical noises as well as aircraft can eliminate natural quiet. On the other hand, studies have shown that visitor judgment of the importance of natural quiet varies, probably as a function of the type of visitor activity, (see Figure 3.4), and hence, from the visitor perspective, natural quiet is not equally important in all locations or for all visitor activities.

In developing an approach to preserve natural quiet, the NPS recognizes the following five important facts:

1. Natural quiet is a resource for preservation within the NPS mandate.

2. The human auditory system is an excellent mechanism for determining the presence or absence of natural quiet. No readily available electronic device can duplicate human hearing for identifying audible sounds produced by non-natural sources.

3. The difficulty of preserving natural quiet is directly related to how quiet it is. If natural quiet, natural ambient sound, is relatively loud, as along a beach with pounding surf, or near a waterfall, then intruding non-natural sounds will have to be comparably loud to be heard. On the other hand, in a remote park location with no wind or water, or one with little or no vegetation or wildlife, even very quiet intruding non-natural sounds will be audible.

4. Humans are not always aware of sounds that are audible. Humans, when engaged in any number of activities, may have their attention focused on the activity and not be aware that a new sound has become audible. Visitors who for the first time view the Grand Canyon at Lipan Point are not very likely to remember hearing any aircraft. Only about 30 percent of the visitors interviewed reported hearing aircraft, (see Chapter 6) even though roughly 90 percent of them could have.

5. Park settings can provide levels of natural quiet so quiet that there is no sound to be heard except that generated by the listener — the sounds of walking, breathing, heart pumping, and blood flowing, (Figures 3.5 through 3.9).

3.6 Summary

The NPS studies discussed in this chapter demonstrate that:

A natural sound environment, and especially the extreme quiet found in many parks, is a resource valued by both park management and visitors.

The very low sound levels in many parks allow non-indigenous sounds, such as aircraft, to be clearly audible even at great distances, The complexity of the issue strongly suggests that a system-wide framework is required with flexibility to define unique park problems and solutions because it would:

1. carefully consider the resource values to be preserved and the types of experiences desirable to provide visitors, as well as consider the interests of the locally affected parties, and

2. recognize both the visitation opportunities and variable visitor sensitivities in concert with the physical characteristics unique to each park location.

Chapter
4

EFFECTS ON CULTURAL AND HISTORIC RESOURCES, SACRED SITES, AND CEREMONIES

A variety of laws, executive orders, and regulations clearly charge the NPS with preserving cultural resources and providing for their enjoyment "in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." Parks offer special opportunities for people to experience their cultural inheritance by offering special protection for cultural resources.

The NPS *Management Policies* recognize five broad categories of cultural resources, with many resources often classified into multiple categories.

Archeological resources are organized bodies of scientific evidence providing clues to the mystery of past events, primarily objects in context, ranging from household debris in a site from a past culture, to foundations of buildings, to pottery and tools, to paintings or writings.

Cultural landscapes are settings humans have created in the natural world showing fundamental ties between people and the land, ranging from formal gardens to cattle ranches, and from cemeteries or battlefields to village squares.

Structures are large, mechanical constructions that fundamentally change the nature of human capabilities, ranging from Anasazi cliff dwellings to statues, and from locomotives to temple mounds.

Museum objects are manifestations and records of behavior and ideas that span the breadth of human experience and depth of natural history, and may include archeological resources removed from the context where they were found.

Ethnographic resources are the foundation of traditional societies and the basis for cultural continuity, ranging from traditional arts and native languages, spiritual concepts and subsistence activities which are supported by special places in the natural world, structures with historic associations, and natural materials.

An important aspect of cultural resources is their non-renewability: If they lose significant material aspect, context, associations, and integrity, they are lost forever. The responsibility of the NPS is to minimize loss of pre-historic and historic material. Closely related but secondary responsibilities include maximizing the expression of historic character, integrating site development with natural processes, sustaining the lifeways of ethnic groups, increasing our knowledge of past human behavior, and supporting the interpretation of park resources.

Cultural resources of the NPS affected by overflights range from Anasazi cliff dwellings and museum objects, to the faces at Mount Rushmore, to Civil War battlefields and cemeteries, to religious ceremonies at Hawaiian temples, to the Statue of Liberty and the Jefferson National Expansion Memorial, to reenactment of important events in history or living examples of everyday life during an historical time period. They encompass museums, ships, and factories as well as paintings, clothing, dishes, books and fragile artifacts.

Possible adverse aircraft overflight impacts on cultural resources entrusted to the NPS include physical impacts from vibrations, loss of historical or cultural context or setting, and interference with visitors' park experience. The term "adverse effect" has special meaning when used in association with historical properties. The definition put forth in The National Historic Preservation Act of 1966 states:

> ***"An undertaking is considered to have an adverse effect when the effect on a historic property may diminish the integrity of the property's location, design, setting, materials, workmanship, feeling or association."***

While physical impacts can permanently harm objects, impacts to context or setting, such as when aircraft fly over an 1800's reenactment or an ancient religious ceremony, can significantly reduce the associations and integrity of the objects, and the enjoyment and understanding of the cultural heritage.

Section 1 of Public Law 100-91 requires the NPS to assess the effects of aircraft overflights on historical and cultural resources:

> *"The research at each such [park] unit shall provide information and an evaluation regarding each of the following . . .*
>
> > *"(3) other injurious effects of overflights on the natural, historical, and cultural resources for which such units were established. . . ."*

At a large number of parks, cultural and historical resources are the focal point of the park. In many cases these resources were the primary reason for the park's creation, and they continue to be the reason for its existence. For example, cultural resource preservation is the primary mission at park units such as Chaco Culture National Historical Park, Canyon de Chelly National Monument, Colonial National Historical Park, Gettysburg National Military Park, Gila Cliff Dwellings National Monument, Mesa Verde National Park, Pu'uhonua o Honaunau National Historical Park, San Antonio Missions National Historical Park, Statue of Liberty National Monument, and numerous historical forts around the country. This section addresses whether overflights adversely affect cultural sites, structures, objects, as well as sacred sites and ceremonies.

4.1 Extent of Concern by Park Management and Visitors

Two recent surveys provide information on the extent and intensity of concern by park managers and by visitors.

4.1.1 Park Management Assessment

Park managers are responsible for safeguarding the resources in their parks. Cultural and historical resources are no exception. In order to learn more about these concerns, in the context of aircraft overflights, the Park Manager Survey (HBRS, Inc., 1994) asked questions about cultural and historical resource preservation. Survey questionnaires were sent to 98 park managers whose units had been previously identified as having some level of aircraft overflight problems. The responses provided by the managers are reported below. Although the results cannot be applied to the entire National Park System, they reflect the perspective from nearly one-third of the units in the System with 76 percent of the acreage and 53 percent of the visitation. And they reflect the subset of park units where aircraft overflights have generated some level of concern.

To determine the proportion of parks where cultural and historical resources were considered important, managers were asked how important it was for their park to provide an opportunity for visitors to appreciate the historical and cultural significance of the park. Their responses are shown in

Figure 4.1. Out of 91 park units responding, 90 percent of the managers said that providing this opportunity was "moderately," to "extremely" important to them.

The managers were then asked the degree to which they felt aircraft activity interfered with their ability to provide this opportunity. Their ratings are shown in Figure 4.2. Opinions are clearly distributed across the entire range, from "not at all" to "extremely." However, over 50 percent of the managers rated the degree of interference in their parks as "moderate" to "extreme," and over 10 percent rated interference in the "extreme" category alone.

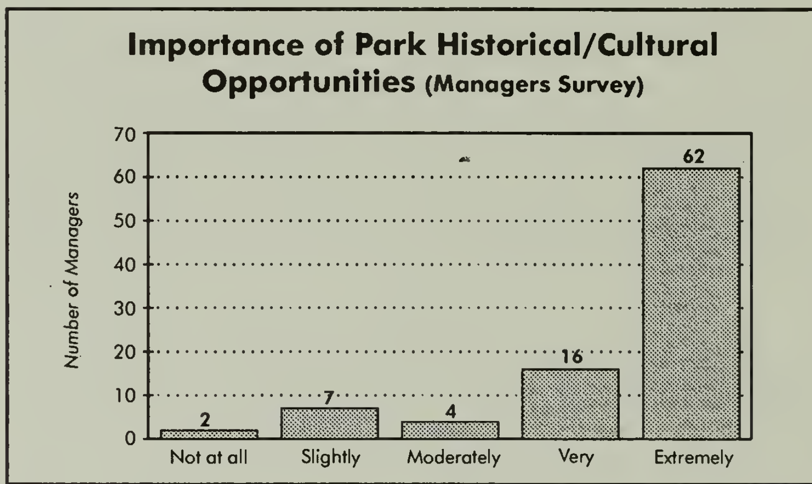


Figure 4.1: Management Rating of Importance of Providing Historical and Cultural Opportunities

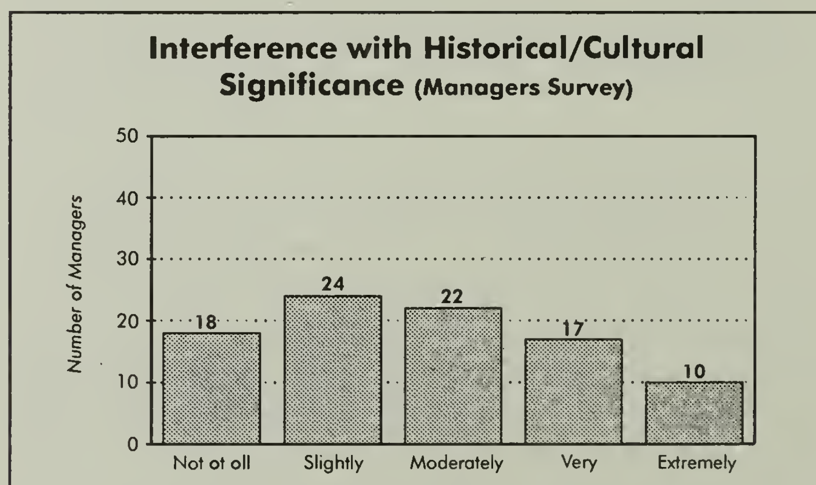


Figure 4.2: Management Perspective on Interference with Opportunities

The responses provided by the managers to these two questions make two important points. First, cultural and historical resources exist in, and are important to, the vast majority of the 91 park units who responded to the survey. This finding suggests that the *potential* for impact exists in many park units. Second, the extent to which this potential has been realized is sizable. As was true in the case of managers' evaluations of overflights in general, (as discussed in Chapter 2), the impacts in cultural and historic sites are judged to vary widely from park to park, with serious impacts occurring in some parks.

CONCLUSION 4.1:
Park managers believe that providing an opportunity for visitors to appreciate the historical and cultural significance of the parks is an important goal, and that aircraft overflights, in certain circumstances, can significantly interfere with that opportunity. A systematic approach for addressing overflights must account for any special cultural or historical opportunities provided by specific parks.

4.1.2 Visitor Assessment

During the spring, summer and fall of 1992, the NPS conducted the Visitors Survey of park visitors at 39 park units selected to represent the National Park System (McDonald *et al.* 1994). Of these, eight were primarily cultural or historical parks. The parks were selected through a very careful, system-wide sampling of NPS units in order to achieve a statistically valid sample of the entire National Park System (excluding Alaska). In this survey, visitors were asked to complete a brief questionnaire as they exited the park.

As part of the survey, visitors were asked how much the sounds of aircraft interfered with their appreciation of the historical and/or cultural significance of the park. Figure 4.3 summarizes the responses from the eight cultural and historical parks sampled. A great majority of visitors felt that little interference had occurred. Similarly, system wide only about two percent of the visitors (about 7 million visitors) reported a moderate to extreme degree of interference.

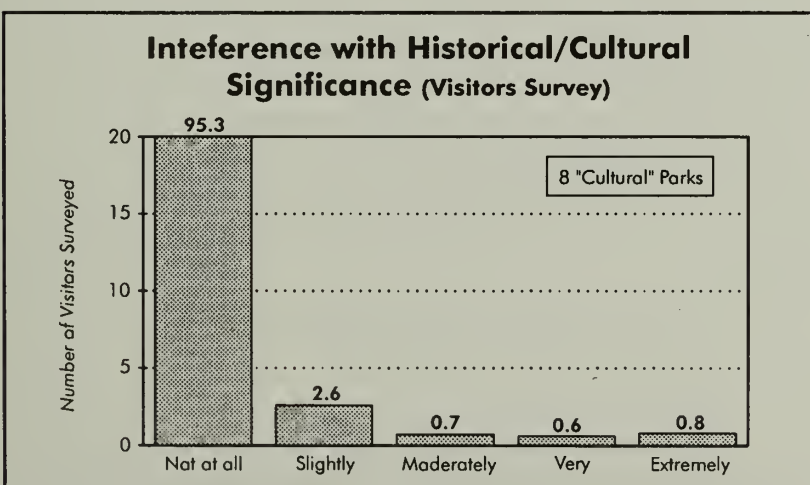


Figure 4.3: Visitor Ratings at Eight "Cultural" Parks of Aircraft Interferences with Historical and Cultural Significance of Park

These results present an expected difference from those of the managers' survey shown in Figure 4.2 (where 49 out of 91 managers reported moderate to extreme interference with their ability to provide cultural or historical opportunities). This difference is attributable to two primary factors:

- Managers have a greater awareness of the opportunities their parks have to offer than do most visitors; most visitors have little understanding of the cultural resources that are at risk.
- The Visitors Survey was designed to obtain a system-wide sample of visitor reactions at all parks, not visitor reactions at historical/cultural parks, whereas the manager survey was restricted to parks where aircraft overflight concerns had been previously expressed.

CONCLUSION 4.2:
There is no wide-spread impact on the appreciation of historical and cultural resources by visitors from aircraft overflights. But under certain combinations of aircraft overflights and cultural / historical park opportunities, visitors' experience may be impacted. The NPS believes this impact is occurring at a limited number of areas.

As with other forms of impacts on visitors discussed in chapter 6, the impact on appreciation of the historical/cultural significance varies considerably park to park. Figure 4.4 shows for each of the Visitor Survey parks the percent of visitors reporting interference with appreciation of history/culture and the percent of visitors who reported hearing aircraft. Like the other impacts investigated, an understanding can be gained only by examining individual parks.

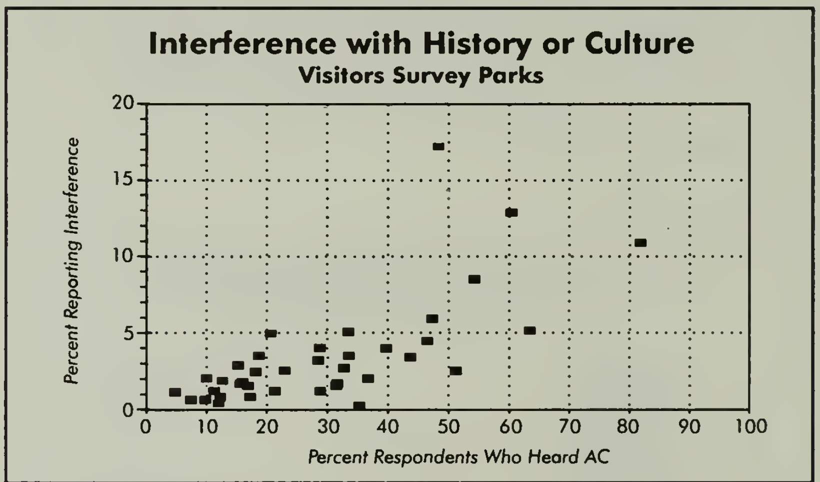


Figure 4.4: Percent of Visitors Reporting Interference with History or Culture at Specific Parks

4.2 Acoustic Impact on Cultural and Historical Resources

Because of the diversity in the cultural and historical resources of the National Park system, as well as in the types of aircraft overflights the parks experience, many types of impact can occur. For convenience, these impacts may be divided into two major categories (1) audible *acoustic* impact, and (2) noise-induced *vibration*. In addition, the NPS has some concern that the rotor wash from helicopters approaching too close to cliff dwellings could disturb materials in context (e.g., pollen, soils, etc.). Audible non-indigenous sound affects solemnity, natural quiet, and speech communication. Noise-induced vibration affects artifacts and structures. These impacts are addressed in subsequent subsections.

The sound from aircraft activity can impinge on the solemnity of sacred sites as well as interfere with Native American ceremonies. National parks provide opportunities for quiet generally unavailable in common non-park settings. Such quiet park surroundings provide unique opportunities for visitors to experience cultural and historic sites in an historically accurate audible environment – the environment that existed before the introduction of mechanized power.

An illustrative example of how overflights can impact site solemnity, speech communication, and historic structures is the situation at Taos Pueblo, one of the oldest living communities still existing in the United States, and a candidate World Heritage Site. In a 1992 letter and position paper on the subject of military overflights of the Taos Pueblo, pueblo spokesperson gave this overview of their problem:

> *"The Pueblo of Taos has serious concerns with continual overflights of aircraft which intrude into the sensitive areas of our village and our sacred wilderness lands under trust protection with the United States Government.*
>
> *Our Blue Lake Wilderness is a place of retreat and prayer to regain the Strength of Life for our People. Our sacred shrines lie throughout the region. Within our village is the place of ceremony where, within our Kivas and ancient homes, a season of quiescence is observed in reverence for the Earth. In recognition of these sacred ways and our ancient architecture, our village is denominated a National Historic Site and is under consideration as a World Heritage Site. Intrusions to our privacy cannot be tolerated, for they threaten the continuance of an ancient way of life.*
>
> *In recent years, we have experienced an astonishing increase of both proposed and actual airflight activity over Taos Pueblo lands. The FAA and Town of Taos have proposed a commercial air corridor directly over our village and wilderness, originating approximately three miles from our borders. This project is currently in the EIS process. Private overflights are increasing. During our annual Blue Lake pilgrimage, our People were buzzed by low-flying Cessna aircraft, sixty to eighty feet high,*

> *attempting to film the sacred "Journey for Life." In 1991, the U.S. military proposed a low-level flight training corridor across our lands. This process has been temporarily halted from community outrage. Six months later, at least two out-of-state military bases adopted flight patterns across our wilderness, resulting in forty to seventy overflights a day. The flights alternate between low-level passes through our canyons, and B-1 high-altitude refueling flights, which echo off the mountain passes because of the size of these bombers."*[1]

In an earlier letter that year to the National Congress of American Indians on this subject, the Taos Pueblo more fully communicated the nature of their concern on this issue:

> *"Under the traditional ways of Taos Pueblo, air is part of the 'sacred realm' to which we hold inseparable responsibilities from land and water protection. Our ceremonial ways protect all things of the Earth and all things overlying the earth. It is impossible for us to conceive of adequately carrying forth our traditional responsibilities when we can no longer control what happens within the sacred realm of the "upper domain." Among our people, it is understood that there is no separation between Earth and the realm overlying the Earth. It is an inseparable extension of life and the responsibilities toward life.*
>
> *"These are concepts that are not understood by non-Indian people. Native American Indian people alone understand the unique responsibilities that Tribes hold toward the perpetuation of life, and how the successful outcome of our ceremonial responsibilities provide the link for human beings to maintain their connections to all life.*
>
> *The space overlying our sacred shrines and wilderness areas which are used for the perpetuation of tradition must be protected at all cost. Airspace to Native American Indian people is more than a resource for the generation of income. It is the sacred medium through which we make our connection the Spirit of Life, and through which all life is maintained."*[2]

National parks in Alaska, Hawaii, and the contiguous 48 states contain abundant resources traditionally defined and used as sacred and subsistence grounds by Native Americans and others associated with areas now under NPS stewardship. Some resources that Native Americans define as meaningful fall into the historic preservation category of "cultural resources," or sites, structures, and landscapes. Others may be termed "natural resources" for land management purposes, but are defined culturally by Native Americans and other traditional user groups as places of religious

1. *October 5, 1992 Letter and position paper from the Taos Pueblo to Senator Daniel Inouye (Hawaii) seeking relief from military overflights of the pueblo.*

2. *June 10, 1992 Letter from the Taos Pueblo to the National Congress of American Indians (NCAI) explaining the overflight issue at the Taos Pueblo.*

meanings. These include naturally configured shrines, power rocks and caves, ethnobotanical gathering areas, and traditional ceremonial hunting areas. Subsistence areas and wildlife, especially in Alaska, are among the resources invested with cultural significance for food-gathering purposes. Characteristically, Native American food-gathering also occurs within a religious context.

Native Americans note that undisturbed habitats, particular resources, and contexts are pivotal to the success of religious practices. Contemplative activities involving communication with holy beings require the intense concentration that quiet, restful surroundings engender. Unnatural disturbances during religious ceremonies portend harm to traditional practitioners of sacred acts and their intended beneficiaries. Mark Schoepfle (Schoepfle, 1989), for example, suggests that ". . . disruptions may cause important supernatural power to be misdirected, at considerable peril to the beneficiary of the ceremony or medicine man or shaman. In these cases sickness or harm may require further ceremonial or religious intervention, at considerable expense to the people involved." In this same vein, Thomas Greider's work (Greider, 1993) for the U.S. Air Force on the effects of low-level flyovers on Native American religious practices indicates there is a noticeable effect on the practice of Native American curing ceremonies from the flyovers.

Data on traditional ceremonials disrupted in parks by low-flying craft have not been systematically collected, but informal comments suggest problems. At risk, for example, from disruptive overflights are religious activities and practitioners associated with the Timbisha Shoshone Tribe who live at Death Valley National Park. Overflights at Grand Canyon can threaten religious activities of neighboring Hopi, Navajo, Hualapai, Havasupai, and Paiute. Observers have noted that on the flight corridors that run immediately south of the Kaibab Paiute Indian Reservation, adjoining Pipe Spring National Monument, caravans of B-52s can be observed traveling east to west close enough to the ground for their aircraft numbers to be read easily.

CONCLUSION 4.3:
Just as the sound of overflights can impair opportunities for experiencing natural quiet, so too can these sound levels adversely affect not only the experience of visiting historic, cultural or sacred sites, but also the preservation of traditions that are an inherent part of a way of life. A process for identification and resolution of overflight impacts must recognize these significant adverse effects though they may be subtle to the uninformed.

4.3 Vibration Impact on Cultural and Historical Resources

The sound from aircraft activity can cause archeological resources, structures, and museum objects to vibrate. Depending on the character of the sound, the effects range from audible rattle, to items "walking" across surfaces, to fatigue cracking, and potentially to direct or indirect structural damage (Hanson *et al.* 1991). Considerable government sponsored research has been conducted on the effects of aircraft noise on structures. Most of this research, however, has been related to sonic booms. Research includes work sponsored by the U.S. Air Force (USAF) under its Noise and Sonic Boom Impact Technology (NSBIT) program, by the National Aeronautics and Space Administration (NASA), and by the FAA. Environmental impact assessments conducted by the USAF for proposed low-level military training routes, measurements of noise-induced vibration of buildings conducted by NASA near rocket launch sites, and measurements of airborne noise effects from blasting by the Bureau of Mines also provide valuable information. By comparison, only a limited number of vibration measurements have been conducted on archeological ruins exposed to fixed- and rotary-wing aircraft noise. This work has been conducted by the U.S. Geological Survey and the USAF Geophysics Laboratory.

4.3.1 How Structures Respond

Airborne sound is a form of energy which travels in waves through the air. When sound waves encounter a structure or solid object, part of the energy is transferred to the structure and part is reflected. The portion which is transferred causes the object to vibrate. The magnitude of the resultant vibration is dependent on the characteristics of both the sound source and object itself.

A very important characteristic of the structure is the way it responds to being shaken at different rates. Structures are very much like a series of springs and weights in the way in which they respond to acoustic pressure loadings. The type of construction (masonry, wood frame, etc.) determines both the springiness and the weight. Together, the springs and weights create *natural frequencies* in the structure. If structures are shaken at their natural frequencies they will vibrate more than if they are shaken at other frequencies, even though the shaking force is the same.

An example of the natural frequency phenomenon may be observed by attaching a small weight to a rubber band (a weight sufficient to stretch the rubber band about 2 inches). Holding the rubber band between the fingers, if the rubber band is shaken very slowly (up and down about once per second) the weight moves up and down about the same distance as the hand inducing the motion. When the speed of the shaking (the frequency) is slowly increased, the weight will begin to travel a greater distance than the hand. As the frequency is increased further, this phenomenon will reach a maximum. Shaking at even greater frequencies will reduce the motion of the weight, and as the speed is increased even further, the weight will hardly seem to move at all. The rate of shaking which produced the maximum movement of the weight is the natural frequency of the system.

The most important observation from the preceding experiment is that the weight moves a considerably greater distance than the source of the movement (the hand) when the system is shaken at its natural frequency. The spring and weight system actually *magnifies* the amplitude of the motion. Buildings and structures behave the same way. Thus, seemingly minor acoustic pressure loadings on a structure can have significant damage potential. When the sound wave contains considerable energy in the vicinity of the structure's natural frequency, the damage potential is maximized. Typical natural frequencies of structures are in the region of 8 to 12 complete cycles per second. The cause for concern is that sonic booms, helicopters and jets generate considerable energy at these frequencies.

4.3.2 Types of Aircraft Noise That Can Excite Structural Response

Damage potential from aircraft activity depends on the character of sound produced by the aircraft. For analytical purposes, aircraft sounds are divided into three categories: Sonic booms, subsonic fixed-wing noise, and helicopter noise.

Sonic Booms. These are caused when an aircraft flying faster than the speed of sound passes an observer or structure. The result is a very brief pressure pulse similar to that shown in Figure 4.5 (Sutherland *et al.* 1990). Because of its shape it is frequently called an "N-Wave." The amplitude of the wave can be very large, even when the aircraft is several miles away. During the wave, the pressure rapidly increases to a maximum (above atmospheric pressure), then decreases less rapidly to a minimum (below atmospheric pressure), and finally returns rapidly to atmospheric pressure. The upper peak of the "N" is the *overpressure* and the lower peak is the *underpressure*. These pressures are affected by the size, speed and altitude of the aircraft.

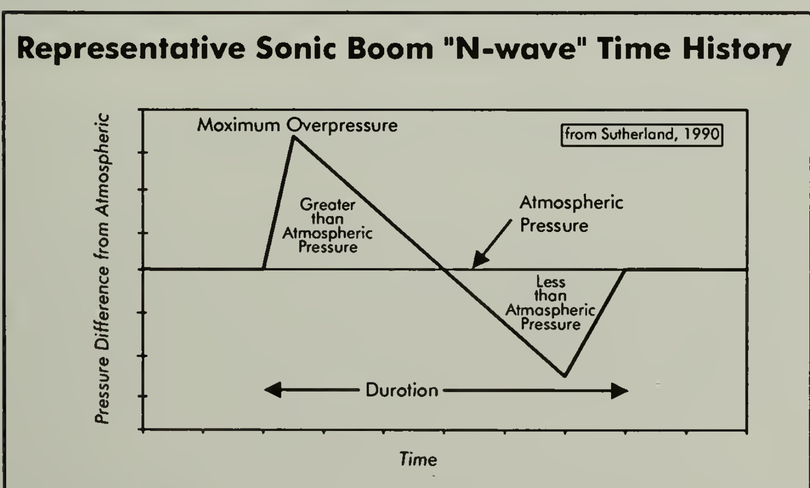


Figure 4.5. Representative Time History of a Sonic Boom "N-wave" Pressure Pulse

This wave usually sounds like two sharp booms in rapid succession (one from the steep initial part of the wave, and one from the steep return to atmospheric pressure). To a structure, however, the experience is much different. The structure generally responds to the lower frequency components of the pressure wave which are not audible to the human ear. The structure experiences a large push from the positive part of the wave, and then a pull from the negative part. Much like an ocean wave, the angle at which the wave encounters the structure determines whether particular surfaces experience the load of the wave head-on or as the wave ripples by. Either way, a unique bending load is placed on the structure. In general, the larger the surface, the greater the load because the pressure has a larger surface to act on. Sonic booms often produce sizable amounts of energy at the natural frequencies of structures.

Subsonic, Fixed-Wing Flybys. Heavy aircraft (bombers) at close range can produce substantial low frequency energy. Depending on factors such as airspeed, wing area, and distance, heavy low-flying aircraft can generate substantial turbulent vortices. The vortices from heavy aircraft are of concern at all major airports because of their ability to compromise the safety of smaller aircraft following in their wake. The FAA has strict air traffic control guidelines to ensure adequate distance separation to prevent incidents. The same turbulent vortices of concern to the FAA can also place large turbulent loads on structures.

Subsonic, Rotary-Wing Flybys. Helicopters produce a substantial amount of their energy at the natural frequency of structures. The size of the rotor (which provides lift as well as propulsion) produces significant acoustic energy, and the relatively slow speed of the rotor causes this energy to be concentrated at low frequencies. In general, the heavier the helicopter, the greater the radiated low frequency energy. The main rotor is a very directional sound source: it produces sound that has unique radiation patterns depending on where the observer is located in relation to the aircraft.

There are two important radiation phenomena of helicopters when it comes to structural response: blade vortex interaction, and "thickness" noise. Blade vortex interaction (sometimes referred to as "blade slap") occurs when the helicopter is in forward motion. A blade passing along the back side of the aircraft encounters (slaps) the turbulent wake created a fraction of a second earlier by another blade passing along the forward side of the aircraft. This sound radiates down and to the front of the aircraft, as shown in Figure 4.6. It is very directional, and not audible after an aircraft passes overhead.

Thickness noise from helicopters is not routinely experienced by observers on the ground. This is because the noise generating phenomenon radiates sound only in a narrow angle (± 10 degrees) above and below the plane of the main rotor, as shown in Figure 4.7. Hence, an observer must be at about the same elevation as the aircraft to observe thickness noise. Substantially more energy at the natural frequency of structures is radiated in thickness noise than in blade vortex interaction.

CONCLUSION 4.4:
Aircraft overflights create sound levels of frequencies low enough to induce natural frequency vibrations in structures. Supersonic aircraft flight, overflights by very large aircraft, and helicopters can all produce levels that may cause structural vibrations. In the case of subsonic flight, the aircraft must fly relatively near the structure for vibrations to be great enough to result in risk of damage.

Figure 4.6: Helicopter "Blade Slap" Sound Wave Impinging on a Historical Site

Figure 4.7: Helicopter "Thickness" Noise Radiating to a Cultural Resource

4.3.3 Damage Potential

Damage potential from aircraft activity also depends on the structure itself. Structural vibrations, especially with repeated exposures, can eventually lead to structural damage of irreplaceable resources. These resources include historical and archeological structures such as sites on the National Register of Historic Places and National Landmarks, and under certain circumstances, archeological sites and artifacts and cultural resource objects inside structures. In looking at damage potential, there are short-term and long-term effects.

Short-Term Effects. A short-term effect is one in which one or two noise events are sufficient to produce a permanent displacement in a structural element. A collapsed roof, or a broken window are dramatic examples of acoustic pressure loads that are capable of producing structural failure or a major compromise to structural integrity in only a few flexure cycles. Bric-a-brac or historical artifacts falling off shelves is another example. These effects are most often associated with large amplitude single events such as sonic booms. Damage risk criteria have been developed for different types of construction, and boom strength estimating procedures have been developed for different types of aircraft and supersonic maneuvers. Together, they provide a first level means for predicting damage potential.

Long-Term Effects. More insidious are the long-term effects created by repeated exposures at lower acoustic levels. While the dramatic effects of sonic booms can result from only a few, large-amplitude pressure cycles, equal damage can be accomplished with greater numbers of lower amplitude pressure cycles (a single helicopter hovering for 30 seconds with a blade passage rate of 12 per second would produce 360 pressure cycles). In contrast to a major structural displacement, the smaller pressure cycles may initiate a slower process consisting of three stages: 1) fatigue cracking, 2) moisture damage, and 3) erosion damage. The lower amplitude acoustic pressure cycles can initiate fatigue cracking. Although these cracks are often no more than hairline in width, they begin when brittle materials, such as masonry, are momentarily stretched beyond their breaking strength. Careful observations have confirmed that repeated exposures to acoustic excitations produce ever-widening cracks. Most masonry construction is particularly vulnerable because of its brittle nature. Mortar joints, as well as plaster or mud veneers, are construction elements most susceptible to fatigue cracking.

Once fatigue cracking has begun, nature can complete the damage without further assistance (although repeated exposure to acoustic loads hastens the process). Mortar joints are important to masonry structures because they hold the various building blocks of the structure together. Veneers are also important because they act as moisture seals to protect the more vulnerable interior core wall constructions, particularly adobe, brick or rubble. Once a crack has been initiated (or accelerated) by acoustic excitation, moisture penetration can occur. The moisture then initiates a further disintegration process, either by eroding the structural integrity of a wall or roof directly, or by feeding the forces of freeze-thaw cycles. Freeze-thaw cycles are particularly damaging after moisture invasion has occurred because the freezing moisture expands and widens cracks even further. As cracks widen, further moisture is admitted and the process accelerates. Eventually, erosion occurs, and in time the structure is finally compromised.

This entire process may take several years to occur, but the origins are in the initial fatigue cracking. The length of time between the initial cracking and the final collapse of a structure can be years or decades depending on the natural forces at work. This slow process, along with myriad intervening factors, makes it difficult to prove conclusively that any particular structure failed due to aircraft noise exposure alone, or even that the process was hastened by such exposure.

Damage risk criteria have been developed for heavy fixed-wing aircraft and also for helicopter flyovers. The major risk factors identified are low-flying heavy helicopters and bomber aircraft. Lacking however, are risk assessments for potentially equally damaging exposures of aircraft flying at the same elevation as structures (such as cliff dwellings), an emerging area of interest to the air tour industry. Neither the effects nor the acoustic loads have been carefully documented for this activity.

CONCLUSION 4.5:
Cause and effect are extremely difficult to determine for sound/vibration induced damage to structures. Accordingly, the NPS needs to develop a systematic method to inventory sensitive structures likely to be subject to potentially damaging sound exposures, and prepare methods for minimizing damage risk.

4.3.4 Mitigation

Mitigation is a three step process. It involves: 1) assessing the acoustic pressure levels associated with potentially damaging aircraft activity, 2) identifying the types and structural conditions of vulnerable structures, and 3) predicting the damage risk for the identified combinations of acoustic loads and structures. Currently, no formal compendium is available enabling park managers to assess for themselves the potential impacts of different types of aircraft activity to be encountered in parks. Sound level prediction methods have been developed for subsonic aircraft (fixed- and rotary-wing), and for supersonic activity. Risk assessments have been published by various researchers for particular combinations of aircraft operations and structures. While much is known, some areas of risk assessment are incomplete. Most noteworthy for the absence of criteria is the damage risk posed by helicopters flying at the same elevation (or vertically within ± 10 degrees) of at-risk structures.

Much of the damage risk assessment literature focuses on probabilities of damage from single occurrences of acoustic events. Estimates of cumulative effect, the probabilities of damage from continued and repeated exposures, are also available. The best available cumulative effect information is crucial to NPS planning because long-term assessment strategies are needed to preserve valuable resources over very long periods of time. Perhaps the best mitigation method to prevent potential adverse effects to nationally recognized cultural resources is by establishing standoff distances.

CONCLUSION 4.6:
Some damage risk criteria are available, but important areas of information regarding long-term exposure and helicopter sound levels are not. If the NPS is to develop guidelines for minimizing risk to structures, such guidelines will require additional data, or they should be based on conservative (protective) assumptions about vibration-induced damage.

4.4 Summary

NPS managers believe overflights interfere with the historical or cultural significance of some national parks. Across the National Park System an estimated 4-5 million visitors feel their opportunities to experience the historical and cultural resources in parks is impacted. However, this small percentage of park visitors increases significantly at parks where managers perceive overflight problems. Consequently, the NPS finds that aircraft overflights are impacting a limited number of cultural and historical parks in the National Park System. Studies show that at parks where aircraft overflight problems are perceived, visitors do indeed notice aircraft and react to them. And it is clear that although there is a need for a systematic approach to problem solving, it must be flexible enough to respond to unique park-by-park, location-by-location problems.

Resolving NPS concerns will require addressing how to prevent vibration related damage from occurring, how to prevent loss of historical or cultural context, how to ensure solemnity for sites and ceremonies, and how to provide interpretation for visitors without serious speech interference.

Chapter
5

EFFECTS OF OVERFLIGHTS ON WILDLIFE

5.1 Introduction

In general, wild animals do respond to low-altitude aircraft overflights. The manner in which they do so depends on life-history characteristics of the species, characteristics of the aircraft and flight activities, and a variety of other factors such as habitat type and previous exposure to aircraft. The potential for overflights to disturb wildlife and the resulting consequences have drawn considerable attention from state and Federal wildlife managers, conservation organizations, and the scientific community. This issue is of special concern to wildlife managers responsible for protecting populations, and to private citizens who feel it is unwise and/or inappropriate to disturb wildlife. Two types of overflight activities have drawn the most attention with regard to their impacts on wildlife: 1) low-altitude overflights by military aircraft in the airspace over national and state wildlife refuges and other wild lands, and 2) light, fixed-wing aircraft and helicopter activities related to tourism and resource extraction in remote areas.

The primary concern expressed is that low-level flights over wild animals may cause physiological and/or behavioral responses that reduce the animals' fitness or ability to survive. It is believed that low-altitude overflights can cause excessive arousal and alertness, or stress (see Fletcher 1980, 1990, Manci *et al.* 1988 for review). If chronic, stress can compromise the general health of animals. Also, the way in which animals behave in response to overflights could interfere with raising young, habitat use, and physiological energy budgets. Physiological and behavioral responses have been repeatedly documented, that suggest some of these consequences occur. While the behavioral responses by animals to overflights have been well-documented for several species, few studies have addressed the indirect consequences. Such consequences may or may not occur, and may be detectable only through long-term studies.

The scientific community's current understanding of the effects of aircraft overflights on wildlife are found in the literature. Such studies identify: collision with aircraft (Burger 1985, Dolbeer *et al.* 1993); flushing of birds from nests or feeding areas (Owens 1977, Kushlan 1979, Burger 1981, Anderson and Rongstad 1989, Belanger and Berad 1989, Cook and Anderson 1990); alteration in movement and activity patterns of mountain sheep (Bleich *et al.* 1990); decreased foraging efficiency of desert big horn sheep (Stockwell and Bateman 1991); panic running by barren ground caribou (Calef *et al.* 1976); decreased calf survival of woodland caribou (Harrington and Veitch 1992); increased heartrate in elk, antelope, and rocky mountain big horn sheep (Bunch and Workman 1993); and adrenal hypertrophy in feral house mice (Chesser et al. 1975). Over 200 published and unpublished reports can be found on the subject. These reports range in scientific validity from well designed, rigorous studies to professional natural resource manager and pilot reports.

Recent concerns have focused on the significance of impacts as they affect wildlife populations. Defining a population as "a group of fish or wildlife in the same taxon below the subspecific level, in common spatial arrangements that interbreed when mature,"[1] it is possible to draw the conclusion that impacts to wildlife populations are occurring from low level aircraft overflights. This assertion is supported by numerous studies including the following:

- decreased calf survival of woodland caribou (Harrington and Veitch 1992)
- disturbance to wintering snow geese documents the effects on staging/wintering subgroup (Belanger and Beard 1989)
- impacts on nesting herring gulls documents effects on a subgroup during production periods (Burger 1991)

Additional research will be required to fully address the significance of such population impacts. However, waiting for and relying on future research results for current policy decisions is not possible. Therefore, it is necessary to make informed decisions recognizing that all of the consequences of disturbance will not be completely understood.

1. *50 CFR Part 17.3*

5.2 Physiological Responses to Aircraft Overflights

When disturbed by overflights, animal responses range from mild "annoyance," demonstrated by slight changes in body position, to more severe reactions, such as panic and escape behavior. The more severe reactions are more likely to have damaging consequences. Studies of aircraft impacts suggest that whether or not disturbance occurs, and whether or not disturbance has a harmful effect depends on a variety of characteristics associated with both the animal and with the aircraft.

When the sudden sight and/or sound of aircraft causes alarm, the physiological and behavioral responses of animals are characterized as manifestations of stress. The effects of chronic stress from overflights have not been formally studied, though several national wildlife refuge managers suspect that stress from overflights makes waterfowl more susceptible to disease (Gladwin et al. 1987, US Fish and Wildlife Service 1993). Other types of disturbance-induced stress have been documented to produce a variety of other problems, such as toxemia in pregnant sheep (Reid and Miles 1962) and abnormal births (Ward 1972, Denneberg and Rosenberg 1967). That exposure to low-altitude aircraft overflights does induce stress in animals has been demonstrated. Heart rate acceleration is an indicator of excitement or stress in animals, and increased heart rates have been shown to occur in several species exposed to low-altitude overflights in a wild- or semi-wild setting. Species that have been tested include pronghorn, elk, and bighorn sheep (MacArthur et al. 1982, Workman et al. 1992*a*,*b*,*c*). Stress responses such as increased heart rates by themselves are an adaptation for encounters with predators and other environmental threats, which presumably must be faced daily. It is not known, therefore, if the addition of stressful events such as overflights actually harm animals. It may be that a few overflights do not cause harm, but that overflights occurring at high frequencies over long periods of time, do.

Biologists caution that the consequences of disturbance, while cumulative, are not additive. Effects could be synergistic, especially when coupled with natural catastrophes such as harsh winters or water shortages (Bergerud 1978, Geist 1994). Also, the tendency for additional stress to be harmful probably depends on other factors, such as the general health of animals to begin with. Some species are likely to be more susceptible to damage than are others. Research has shown that stress induced by other types of disturbance produces long-term, deleterious effects on the metabolism and hormone balances in wild ungulates (hoofed mammals) such as bighorn sheep (Geist 1971, Stemp 1983). Many animal biologists maintain that excessive stimulation of the nervous system can amount to chronic stress, and that continuous exposure to aircraft overflights can be harmful for the health, growth and reproductive fitness of animals (see Fletcher 1980, 1990 for review).

CONCLUSION 5.1: *Overflights can induce physiological responses in animals, such as increased heart rates, but whether or not such responses cause harm is unknown. Effects may be synergistic, as when combined with natural events such as harsh winters or water shortages.*

The auditory systems of some animals may be particularly susceptible to physical damage, and such animals may experience hearing loss from exposure to chronic aircraft sound. Animals living in quiet desert environments have evolved particularly fragile ears and hence appear to be at great risk of sound-induced hearing damage (Bondello and Brattstrom 1979, Fletcher 1990). While aircraft noise and its effects on animal hearing have not been tested, other types of sound such as motorcycle noise have been shown to cause hearing loss in desert species, including the desert iguana (Bondello 1976) and the kangaroo rat, an endangered species (Bondello and Brattstrom 1979). Hearing loss can occur after as little as an hour of exposure to loud noise, and can be temporary or permanent, depending on the degree of exposure to sound and the susceptibility of the individual animal.

5.3 Behavioral Responses to Aircraft Overflights

Behavioral responses of wild animals to overflights nearly always accompany physiological responses. Behavioral responses reflect a variety of states, from indifference to extreme panic. To some extent, responses are species-specific, whereby some species are more likely to respond in a certain manner than are others. However, even within a species, individual animals vary. Documented variations between individuals may be due to differences in temperament, sex, age, prior experience with aircraft, or other factors. For these reasons, anecdotal information about one animal's response to an overflight is not useful for drawing conclusions for that or any other species. Often, animals exhibit very subtle and seemingly minor behavioral responses to overflights. Minor responses that are typical of both birds and mammals include head-raising, body-shifting, and turning and orienting towards the aircraft. Animals that are moderately disturbed usually show "nervous" behaviors such as trotting short distances (mammals), standing up with necks fully extended and scanning the area, or walking around and flapping wings (birds).

When animals are more severely disturbed, escape is the most common response. Perching or nesting birds may flush (fly up from a perch or nest) and circle the area before landing again. Some birds, particularly waterfowl and seabirds, may leave the area if sufficiently disturbed. There are dozens of reports, mostly from national wildlife refuges, of waterbirds flying, diving or swimming away from aircraft (e.g. U.S. Fish and Wildlife Service 1993). This is apparently a widespread and common response. Bird flight responses are usually abrupt, and whole colonies of birds often flush together. Disturbed mammals will run away from overflight paths. Table 1 lists behavioral responses to overflights that have been documented during studies and incidental observations.

This table was generated from a review of published literature on the subject. Reports varied widely in how information was gathered. Aircraft altitudes are noted where known. Some reports are from rigorous studies, others from anecdotal information. In general, more severe responses (such as panic and escape) were a result of lower-altitude overflights. Responses that were not described in detail are in quotation marks.

As Table 1 illustrates, only a handful of the thousands of animal species in the United States have been studied for their responses to overflights. Also, a disproportionate number of studies have concentrated on ungulates such as caribou and bighorn sheep. Carnivorous mammals have been virtually ignored, as have marine mammals, small mammals, and bats. Birds are more evenly represented, with studies on waterfowl, shorebirds, marine birds, and raptors, although songbirds and owls are notably absent. Reptiles and amphibians have never been studied for responses to aircraft. This uneven distribution of species representation is likely a result of two factors: 1) researchers acknowledge that some species are more susceptible to harm than are others, and have allocated efforts accordingly; and 2) some animals are easier to study than others.

CONCLUSION 5.2:
Researchers have documented a range of wildlife behavioral responses to aircraft overflights. Variations in response may be due to differences between individuals, and anecdotal information about one animal's response is not useful for drawing conclusions regarding that or other species. Behavioral responses may be subtle.

Generally, fish have not been considered at risk from aircraft disturbance. Because most fish and other aquatic organisms live entirely below the surface of the water, they do not experience the same sound levels that terrestrial animals do. Marine mammals (besides dolphins and whales) are an exception because they spend time above water, on shore. Data on behavioral responses of marine mammals to aircraft overflights are scarce. However, a study at Copalis National Wildlife Refuge in Washington State (where the U.S. Navy conducted pilot training from 1944 to 1993) reported responses of harbor seals and northern sea lions to military A-6 jet overflights as ranging from no response to abruptly leaving resting sites on the rock shore and entering the sea (Speich et al. 1987). California gray whales and harbor porpoises, conversely, showed no obvious behavioral responses during this study.

5.4 Indirect Effects of Disturbance from Overflights, and Consequences for Animals

The behavioral responses to aircraft overflights described above are direct, or immediate, responses. Biologists and others are concerned that indirect effects of these responses may have harmful consequences for animals, especially when overflights (and responses) are frequent. Behavioral reactions have the potential to cause injury, to influence breeding success, energetics and habitat use, and to result in bird strikes. Whether or not such indirect effects occur depends on other factors associated with the natural history of a species. Some animals are more susceptible than others to disturbance, because of unique life history patterns such as colonial breeding, habitat requirements, and restricted distribution. Others may need special protection during certain periods. Indirect effects are difficult to detect. However, some effects, such as habitat avoidance, have been detected (e.g. McCourt et al. 1974, Schweinsburg 1974*b*, Krausman et al. 1986).[2] Large-scale consequences such as permanent habitat abandonment or regional or national population declines have not been well documented, though some experts suspect that they occur. For example, refuge managers at Key West National Wildlife Refuge suspect that the only known colony of magnificent frigatebirds in the United States is declining due to frequent low-altitude overflights by tour planes (Gladwin et al. 1987).[3]

TABLE 1: GENERAL RESPONSES BY SPECIFIC ANIMAL SPECIES TO AIRCRAFT OVERFLIGHTS

Species	Response	Aircraft[2]	Flight Altitude[3]	Reference
Large Mammals				
Pronghorn	Accelerated heart rate Run short distance Bolt and run	FW MJ H	500 5000 100	Workman et. al. 1992a
	No response Stop feeding, tense muscles Run	H	150-400	Luz & Smith 1976
Mule Deer	No response Minor behavior changes	MJ	<3000	Lamp 1989
Bighorn Sheep	Accelerated heart rate	MJ FW H	5000 100 100	Workman et al. 1992b
	Decrease food intake while feeding (interruption) Take more steps while feeding	H	—	Stockwell et al. 1991
	No response Accelerated heart rate Run	H H	1640-4920 490-660	Mac Arthur et al. 1979
	No response Minor behavior changes Leave area	MJ	<3000	Lamp 1989
	Leave area	H	160-650	Bleich et al. 1990
	No response Interrupt normal activities Run <330 feet Run .62-1.2 es	FW	100-990	Krausman & Hervert 1983

2. *FW = small, fixed-wing aircraft, H = helicopters, MJ = military jet aircraft, C = commercial jet aircraft.*

3. *Aircraft flight altitudes in feet, rounded to nearest 10.*

TABLE 1: continued

Species	Response	Aircraft[2]	Flight Altitude[3]	Reference
Large Mammals continued				
Bighorn Sheep continued	Run > 1 mile	H	—	Horejsi 1975 Kiger 1970
Desert Mule Deer	No movement Move ≤ .6 mile to new habitat	FW	260	Krausman et al. 1986
Elk	Accelerated heart rate	MJ H	5000 100-500	Workman et. al. 1992c
	Congregate together Watch aircraft	MJ	—	McCullough 1969
	Run away	H	—	Jorejsi 1975
Mountain Goat	React "adversely" May abandon area	H	—	Ballard 1975
	Run away	H	—	Horejsi 1975
	Are "terrified" May abandon areas	H	—	Chadwick 1973
Dall Sheep	No response Get "excited" Do not abandon habitat	FW	—	Nichols 1972
	Run away	H FW	—	Feist et al. 1974 Schweinsburg 1974a
	Alarm behavior Crowd together	FW H	—	Linderman 1972
	React "severely"	H	—	Andersen 1971
Gray Wolf	Initially freight response, (scatter, run), later accept	FW	260	Krausman et al. 1986
Grizzly Bear	Run Hide	FW H	—	Harding & Nagy 1976
	"Mild" behavior response Run away	H	>3280	Ruttan 1974
	Run in "panic" Hide (may associate aircraft with capture)	H	—	Pearson 1975
	Interrupt activity, leave area Run towards cover	FW	>1000 200-500 200-500	McCourt et al. 1974a Klein 1973
Bison	No response	MJ	—	Frazier 1972
	No response Run 1 minute Run 5 miles	FW	200-490	Fancy 1982
Reindeer	Crowd together, panic	FW H	<100 <100	Ericson 1972
	Run away	FW	—	Slaney & Co. Ltd. 1974

TABLE 1: continued				
Species	**Response**	**Aircraft[2]**	**Flight Altitude[3]**	**Reference**
Large Mammals continued				
Caribou	Move short distance Rarely leave area	FW	—	Staney & Co. Ltd. 1974
	No response Panic, flee	FW H	200-500 200-500	Klein 1973
	Walk, trot, gallop away Momentarily stop feeding	H	980	Gunn et al. 1985
	Panic, escape	FW H	500 500	Calef et al. 1976
	Brief startle response Run for 8-27 seconds No effect on daily activity No effect on distances traveled	MJ H	100-500 100-500	Harrington & Veitch 1991
	Mothers and calves not separated	H	—	Miller & Broughton 1973
	Run away from area	FW	—	Valkenburg & Davis 1985
	Minor changes in behavior Panic and run	FW H	<1300 <1300	Miller & Gunn 1979
	Calves died from trampling during escape from either wolves or aircraft		—	Miller & Broughton 1974
	Calves died	MJ	—	Harrington & Veitch 1992
	Panic and escape	H FW	<790 <790	Surrendi & DeBock 1976
Small Mammals				
House mouse	Enlarged adrenal glands	C		Chesser et al. 1975
Marine Mammals				
Atlantic Walrus	Raise head towards aircraft Shift body position Leave rocks, enter ocean	H	4270	Salter 1979
Harbor Seal Northern Sea Lion	Leave rocks, enter ocean	MJ	<500	Speich et al. 1987
Raptors				
Bald Eagle* Golden Eagle Peregrine Falcon Gyrfalcon Rough-legged Hawk	No response Panic, frantic escape No effect on raising young	H	—	White & Sherrod 1973
Peregrine Falcon* Cooper's Hawk Common Black Hawk Harris' Hawk Zone-tailed Hawk Red-tailed Hawk Golden Eagle Prairie Falcon	"Minimal response" Alarm behavior Fly from perch or nest No effect on raising young	MJ	<980	Ellis et al. 1991

TABLE 1: continued				
Species	**Response**	**Aircraft[2]**	**Flight Altitude[3]**	**Reference**
Raptors continued				
Osprey	No effect on raising young	H	—	Carrier & Melquist 1976
	Rarely leave nest No effect on raising young	FW H	—	Poole 1989
Northern Harrier	No response	MJ	—	Jackson et al. 1977
Peregrine Falcon	No response "Severe" response	H	<2000	Ritchie 1987
Gyrfalcon	Fly away Alert behavior No nest abandonment No effect on daily activity patterns May avoid returning to breed in following years	H FW	500-1000 500-1000	Platt 1975 Platt & Tull 1977
Prairie Falcon	Flush from perches	H	—	Craig & Craig 1984
Red-tailed Hawk	No response Flush from perches	H	—	Craig & Craig 1984
Golden Eagle	No response	H	—	Craig & Craig 1984
Ferruginous Hawk	No response	FW	<100	White & Thurow 1985
Red-tailed Hawk	Flush from nests No effect on raising young	H	100-150	Andersen et al. 1989
Waterbirds				
Brant* Emperor Geese Canada Geese	No response Alert behavior Flight	FW H	0-500 0-500	Ward & Stehn 1989
Oldsquaw* Surf Scoter	Swim away Dive into water No response	H	100-750	Ward & Sharp 1974
Oldsquaw* Surf Scoter	Escape Alert Behavior Dive into water Flock together Change activity budgets (resting, feeding, sleeping)	H	100-750	Gollop et al. 1974a
Migrating ducks* (various species)	No reaction Minor behavior changes Flush from lakes	MJ	<3000	Lamp 1989
Ducks and geese* (various species)	Fly away Swim away Dive into water Abandon some lakes for >4 days	FW	—	Schweinsburg 1974a Schweinsburg 1974b
Canada goose	Arouse from sleep Alert behavior Call	MJ	<3000	Lamp 1989

TABLE 1: continued				
Species	**Response**	**Aircraft[2]**	**Flight Altitude[3]**	**Reference**
Waterbirds continued				
Trumpeter Swan	Stop activity; head up Flush from nests	FW H C	200-2000	Henson & Grant 1991
	Seek cover in tall vegetation Cygnets crowd together	FW H	740-990 500	Shandruk & McCormick 1989
Snail Kite	No response Watch aircraft	C	—	Synder et al. 1978
Brant	Panic and escape area	FW H	<500-1000	Henry 1980
	Fly away Widespread "panic" Lost feeding time	FW H	<1650	Owens 1977
Brant* Glaucous Gull Arctic Tern	Flush from nests Disrupt nesting behavior	FW H	500-1000 500-1000	Gollop et al. 1974b
Common Eider	No effect on nesting behavior	FW H	—	Gollop et al. 1974b
Tufted Puffin* Brant Double-crested Cormorant Common Murre Glaucous Gull	No response Wing-flapping Flush from perches Abrupt departure of area	MJ MJ	>500 >500	Speich et al. 1987
Sooty Tern	May disrupt breeding May cause hatching failure	MJ	Supersonic	Austin et al. 1970
Crested Tern	Scan sky Alert behavior Startle and escape	C	250-1000	Brown 1990
White Pelican	Stampede, panic Eggs lost, abandoned, eaten	C	>33	Bunnell et al. 1981
Herring Gull	No effect on breeding No response	C	—	Burger 1981
	Flush from nests Eggs broken, lost, eaten	C	Supersonic	
Cattle Egret* Double-crested Cormorant Great Blue Heron Great Egret White Ibis	No effect on colony establishment No effect on colony size No effect on nesting behavior No effect on breeding success	MJ	<500	Black et al. 1984
Oldsquaw* Scaup species Redhead Canvasback	Flush up and away from lake	H	—	Christiansen & Younge 1979
Snow Goose	Raise head Crowd together, call Stop feeding, Fly away (return in 5 min.)	FW H	—	Davis & Wisely 1974

TABLE 1: continued

Species	Response	Aircraft[2]	Flight Altitude[3]	Reference
Waterbirds continued				
Snow Goose continued	No response Minor behavior changes Flush, circle over, depart or land again	MJ	<3000	Lamp 19891
	Leave lake area	FW	98-9800	Spindler 1983
	Flush from lakes	FW	300-1000	Salter & Davis 1974
Kittiwake* Northern Fulmar	Stay on nest (no response)	H	—	Dunnett 1977
Brunnich's Quillemot* Kittiwake	No response Flush from nests No egg or chick losses	H	0.5-3 miles distant	Fjeld et al. 1988
Snow Goose* Canada Goose Purple Gallinule Northern Pintail American Coot	Flush	H	—	Edwards et al. 1979
Pacific Eider	No response	H	—	Johnson et al. 1987
Great Egret* Snowy Egret Louisiana Heron	Flush from nest, return <5 minutes No response	FW H	395	Kushlan 1979
Songbirds				
Lapland Longspur	No avoidance of nest sites Nestlings died	FW H	50	Gollop et al. 1972
Game birds				
Chukar	Flush No response	MJ	<3000	Lamp 1989

*Studies of more than one species generally documented all of the listed responses occurring by all of those species.

5.4.1 Accidental Injury

A common concern among biologists is that animals will occasionally fall, run into objects, or become trampled when they panic and run from aircraft. For example, at Cabeza Prieta National Wildlife Refuge, it was reported that a low-flying helicopter startled a deer, which ran off of a 26-foot cliff and broke its leg (USFWS 1993). Young ungulates are especially vulnerable to being trampled. One study of caribou calf mortality documented that three young caribou were trampled during panic and flight from either wolves or aircraft (Miller and Broughton 1974). Startle responses that cause panic and quick movements are most likely to cause injuries to animals in rugged topography (boulder fields, cliffs, scree slopes), at river crossings, or on icy ridges, especially when animals are grouped closely together (Harrington and Veitch 1991).

5.4.2 Reproductive Losses

For many species, it has been argued that disturbance could cause reproductive losses by altering patterns of attendance to young. Disturbed mammals and birds have been noted to run or fly away from the stimulus (i.e. the aircraft), and leave eggs or young exposed. Birds that quickly flush from nests may accidentally break eggs or kick eggs or young from their nests. Mammal adults and young may become separated when they panic and flee. Leaving the young exposed also makes them vulnerable to predators.

Numerous studies have addressed the effects of aircraft overflights on the breeding success of ungulates such as caribou and Dall sheep. Generally, overflights have not been shown to cause adults and young to separate. Yet one study attributed Caribou calf mortalities to frequent low-level military aircraft overflights (Harrington and Veitch 1992). This study compared calf mortality rates in groups that were exposed to overflights with rates in groups that were not exposed. Mortality rates were significantly higher in the exposed group. The researchers hypothesized that milk release was inhibited in caribou mothers that were disturbed by the overflights, and so young became malnourished. As this example suggests, calves might not die directly from overflights, and so mortalities cannot be detected unless studies are designed to compare rates of survival between calf groups that are and are not exposed to overflights. Numerous studies have reported that overflights do not affect survivorship in young, yet they do not compare survivorship of young that were and were not subjected to overflights. This example demonstrates how complex cause and effect relationships can be between disturbance and effects. It also shows that casual observations of how animals respond to overflights do not necessarily reveal ultimate consequences.

Waterfowl and seabirds nesting on national wildlife refuges are commonly exposed to both military and private aircraft overflights. Whether or not overflights have indirect effects on breeding success depends on the circumstances and types of behavioral responses of the adult birds: whether or not they flush from their nests, whether the exposed nests are vulnerable to predators, proximity of other nests (some birds nesting close together tend to fight after a disturbance, resulting in egg breakage), and physical characteristics of nests and of the adults. Many refuge managers have reported that birds flush from nests in response to overflights (Gladwin et al. 1987, USFWS 1993). This is considered a problem because of the potential for losses of eggs and young. Gulls, cormorants, and murres, for example, kick eggs from nests when they flush during disturbance, and eggs are lost, broken or eaten by predators. These events have been documented to occur on several national wildlife refuges (USFWS 1993). Some species, such as tundra swans and pelicans, apparently abandon nests due to chronic disturbance from overflights (Gladwin et al. 1987, USFWS 1993). Leaving eggs exposed to sun or rain also jeopardizes their survival.

Several studies have been conducted on nesting birds and their responses to overflights. Both American white pelicans and brown pelicans appear to be particularly susceptible to disturbance. Pelican biologists have discovered that low-flying aircraft can contribute to dramatic reductions in survivorship of young and in overall productivity of a nesting colony (Bunnell et al. 1981, Gladwin et al. 1987). Some species, when subjected to overflights during studies, did not flush from nests and so losses did not occur. Such species include: trumpeter swans (Henson and Grant 1991), cattle egrets, double-crested cormorants, great blue herons, great egrets, and white ibises (Black et al. 1984). Others did flush from nests but did not tend to kick eggs from them and so no losses occurred. These species include: great egrets, snowy egrets, and tricolored herons (Kushlan 1979). These species have only been tested for responses to overflights during the studies referenced above. Therefore it is not known whether more intense stimuli such as aircraft flying at lower altitudes might cause more panic and subsequent egg or chick losses.

Disrupted patterns of parental attendance to eggs or chicks is also a concern. Although this phenomenon has been noted on a local scale, it has not as yet been widely linked to reproductive losses at a regional or national scale. One study, however, suggests that supersonic overflights might cause large-scale losses. In 1969 low-altitude supersonic aircraft overflights of the Dry Tortugas during the nesting season were suspected to cause a massive hatching failure for sooty terns (Austin et al. 1970). This incident is widely cited as one of severe disturbance, though the cause and effect relationship cannot be proven. Studies of some nesting birds that respond to less intense (i.e., subsonic) overflights generally return to the nest to resume incubation after the aircraft has passed.

Raptors (birds of prey) have also been monitored for signs of disturbance from overflights during the breeding season. Occasionally, raptors are disturbed by aircraft enough to respond by flushing from their perches or nests. One pair of bald eagles at Cross Creeks National Wildlife Refuge in Georgia reportedly abandoned nesting activities altogether and left the area after repeated overflights by a military helicopter (Gladdys 1983). On the other hand, once eggs are laid, raptors may be less inclined to abandon nests. Ellis et al. (1991) reported that nest abandonment and nest failures through predation, exposure of the eggs, or egg losses did not occur during a study of raptor responses to low-flying military jet aircraft. Although conclusions cannot be made from these two reports alone, the evidence suggests that the seasonal timing of overflights may be an important factor in the outcome of disturbance.

5.4.3 Energy Losses

Panic reactions and escape responses to overflights can be energetically "expensive" to animals for two reasons. First, feeding animals nearly always stop ingesting food when disturbed, which means a decrease in energy intake. Second, disturbed animals usually run or otherwise move away from the aircraft, thus increasing their energy expenditure. Running can increase an ungulate's metabolism twenty-fold over the normal resting rate (Mattfeld 1974). Hence frequent disturbance imposes a burden on the energy and nutrient supply for animals (Geist 1978), which can compromise growth and reproduction.

There is a particular concern that birds may suffer from energy losses due to chronic disturbance, especially during periods when increasing and storing energy reserves is critical for survival. During winter, the energetic costs of daily activities, such as keeping warm and feeding, mean that animals can spare little extra energy. During other seasons, such as the staging period or breeding season, large net gains of energy are required for migration and/or raising young. For example, the high energy requirements of ducks and geese during the molting season may not be met if these birds continuously swim, dive, or run from aircraft (Gollop et al. 1974*b*). Migrating birds such as snow geese may be vulnerable to disturbance during the staging season, when energy accumulation must be great enough to prepare for the high energetic demands of migration. Salter and Davis (1974) documented snow geese flushing repeatedly in response to overflights during the staging period just prior to their migration. The amount of time available for and the limits to compensatory feeding, or making up for lost time, are unknown. When animals are already feeding for a significant portion of the day, the opportunity for compensatory feeding is probably limited.

There have been four notable attempts to examine the effects of aircraft disturbance on bioenergetics of animals. Three were conducted on birds during the staging season; two of these used snow geese as models, (Davis and Wisley 1974, Belanger and Bedard 1989*a,b*), the other used brant (Ward and Stehn 1989). All three of these studies found that, in the presence of frequent overflights, birds lost feeding time because they stopped feeding to react to the aircraft. Belanger and Bedard observed snow geese and their responses to human-induced disturbance, including aircraft, on their staging grounds over three years. They found that snow geese both increased their energy expenditure and decreased energy intake in response to aircraft disturbance. They found that, if disturbance occurred at a rate of 1.46 per hour (as it did during their study), birds could compensate for energy losses by feeding at night, but if they flushed from disturbance and did not return to feeding areas, they would have to feed during 32 percent of the night— a significant time commitment. They also found that birds did not compensate during the day by increasing the rate at which they fed after disturbance. These researchers concluded that man-induced disturbance can have significant energetic consequences for staging snow geese.

The amount of food that bighorn sheep ingest while grazing in the presence and absence of tourist helicopters was investigated in Grand Canyon National Park (Stockwell and Bateman 1987). Sheep spent 14-42 percent less time (depending on the season) foraging in the presence of helicopters. In addition, sheep increased the number of walking steps while foraging by 50 percent. This study suggests that the increase in energy expended, coupled with a decrease in energy consumed, might contribute to an energy deficit for animals when disturbance is chronic. Disturbance has been documented as influencing pronghorn foraging also (Berger et al. 1983).

5.4.4 Habitat Avoidance and Abandonment

Many wildlife biologists are concerned that the disturbance from overflights could cause sensitive animals to abandon their habitats. This subject has drawn attention because the consequences of habitat abandonment can be serious, particularly for species whose high-quality habitat is already scarce. Observations suggest that some animals do abandon their habitats in response to overflights, and some do not. This difference may be due to differences in the sensitivities of individual animals. On the other hand it may be a factor of different levels of exposure to aircraft during these studies (different flight altitudes, aircraft types, and flight frequencies). Two studies found that caribou did not abandon areas in response to small aircraft overflights (Bergerud 1963, Harrington and Veitch 1991), and one found that they did (Gunn et al. 1985). Grizzly bears (McCourt et al. 1974), mountain sheep (Krausman and Hervert 1983, Bleich et al. 1990), and mountain goats (Chadwick 1973, Ballard 1975) all have been noted to abandon areas in response to small aircraft overflights, even when overflights were infrequent. It is not known how many other species avoid areas used by aircraft.

Waterfowl biologists and national wildlife refuge managers have expressed concern about how waterfowl use of open water and emergent wetland habitats is disrupted by aircraft overflights. Overflights have been reported to cause disturbance at dozens of wildlife refuges in 30 states (Gladwin et al. 1987). Most often, waterfowl flush from lakes and fly away, but return once the noise levels in the area return to ambient. On the other hand, several refuges have reported that some waterfowl species have been completely driven off by frequent aircraft activity. Belanger and Bedard's (1989*a,b*) study on snow geese energetics and disturbance showed a significant drop — 50 percent in the number of geese using feeding grounds on days following aircraft disturbance. Waterfowl using lakes in Canada were displaced for several days when disturbed by light aircraft overflights (Schweinsburg et al. 1974*b*). Wintering sandhill cranes leave feeding and loafing areas (resting areas) for extended periods when low-altitude overflights take place over Cibola and Imperial Wildlife Refuges (USFWS 1993). Wood storks may also abandon habitat in response to overflights (USFWS 1993). Observations by refuge biologists suggest that the endangered Palila Bird in Hawaii underutilizes a sizable portion of its critical habitat because of low-altitude military aircraft overflights (Gladwin et al. 1987). It is not currently known how the use of ponds, lakes and wetlands in national parks is affected by overflights.

Wildlife refuge and national park managers are also concerned because game animals are sometimes chased from parks and refuges into areas where they may be hunted. This has been documented in several refuges and one national park[4] (USFWS 1993). This harassment is suspected to be intentional; hunters are gaining access to animals which are usually protected.

Aircraft activities appear to have varying impacts on raptors' use of habitat. In general, raptors are sensitive to the activities of people, although species-specific differences are evident. Raptors have been documented to abandon both wintering and breeding habitats as a result of human disturbance (Stalmaster and Newman 1978, White and Thurow 1985). Ellis et al. (1991) found little evidence, however, that raptors abandon habitat in response to aircraft overflights.

5.4.5 Potential Bird Strike Hazards

CONCLUSION 5.3:
Researchers have documented some indirect effects for some species and individuals, such as eggs kicked from nests when birds flush in response to overflights, loss of feeding due to overflight disturbance, abandonment of habitat in response to overflights. Other studies have found no such effects for some species and individuals.

There is some concern over potential aircraft collisions with airborne birds among national wildlife refuge managers. Collisions are a misfortune for both birds and pilots. Bird strikes have cost the lives of many pilots and/or damaged aircraft. Military aircraft are most vulnerable to bird strikes since they fly at low altitudes and high speeds. The US Air Force reports 3,500 bird strikes annually (Spectrum Bird Aircraft Strike Hazard Team 1994). The Air Force continues to develop methodologies for avoiding concentrations of birds, in order to reduce this frequency. The FAA further recognizes that large concentrations of migratory birds are a safety hazard to pilots.

4. *Memorandum dated March 7, 1994 from Superintendent, Olympic National Park, to Acting Associate Director, Operations, National Park Service.*

5.5 Factors that Influence Animal Responses to Aircraft

It is clear from numerous studies that differences in animal responses to aircraft do not depend solely upon the species in question. Many other factors contribute to the responses to overflights, some having to do with the animal and its particular environment and some having to do with the aircraft stimulus itself.

5.5.1 How Animals Perceive the Aircraft Stimulus

An animal's sensory perception of aircraft activity depends, in part, on the physical features of its environment, as well as on its own physiological attributes. Some habitats enhance stimuli associated with aircraft overflights. For example, high canyon walls have the effect of amplifying and repeating (echoing) aircraft sound, and yet they can also obstruct the aircraft from view. The sound and visual stimuli associated with aircraft have different effects in an open desert than in a forest where trees can obscure the sight and may reduce the sound of aircraft. A further consideration is the animal's sensitivity to different types of stimuli, which depends on physical limitations of the senses. Some animals can clearly see aircraft when they are barely visible to others, and the range of frequencies of sound that can be detected varies greatly from species to species.

One relationship between aircraft and animals is clear: the closer the aircraft, the greater the probability that an animal will respond, and the greater the response. Unfortunately, there is no particular overflight altitude at which all animals are or are not disturbed. Even within a species, no particular altitude can be identified as causing a sudden increase in disturbance, because so many other factors influence disturbance. Notably, some studies have shown that animals react in the same manner regardless of altitude (e.g., Lenarz 1974, McCourt et al. 1974). It is unlikely that one overflight altitude exists that is sufficient for avoiding disturbance to all animals while not necessarily imposing undue restrictions on pilots. For instance, a 5,000 foot minimum altitude may avoid disturbance to all species, but may not be necessary at all times. Researchers have reported disturbances to walruses by helicopters flying as far away as 4,270 feet (Salter 1979). Grizzly bears run away from aircraft flying at altitudes as high as 3,000 feet. Few other animals have been tested for responses to aircraft at altitudes this great, though many show disturbance from aircraft at lower altitudes.

5.5.2 Aircraft Sound and Animal Hearing

It is apparent that animals can be disturbed by either the sight or sound of aircraft (McCullough 1969, Snyder et al. 1978, Ward and Stehn 1989, Brown 1990). The relative importance of each stimulus is not known, and may depend on the species in question. Both birds and mammals respond to the sound of aircraft before it is visible, yet they also tend to track aircraft visually as they pass overhead (McCullough 1969, Snyder et al. 1978, Brown 1990).

Aircraft sound is broadband, containing sound energy over a wide frequency range, rather than a pure tone. There is some evidence that the high-frequency whine of some turbine-powered helicopters is less disturbing to raptors than the low-frequency sound of piston-engine helicopters (White and Sherrod 1973). Other than this, little is known about how the frequencies of aircraft sound influence animal responses. Sound levels at which animals show strong negative responses in the wild generally have not been determined.

Helicopters apparently disturb some animals more than other types of aircraft. Comparisons of how animals respond to helicopters versus other aircraft types have shown that animals respond more strongly to helicopters. For example, caribou ran longer and farther in response to helicopter overflights than they did in response to low-altitude overflights by military jets during a study in the Yukon (Harrington and Veitch 1991). Ward and Stehn (1989) also noted that greater percentages of brant responded to helicopters than to fixed-wing aircraft in Alaska. Colonially-breeding marine birds also generally flushed when helicopters flew over them at 1,000 feet above ground level (AGL), while light, fixed-wing aircraft could pass over at 500 feet AGL before generating a similar response (Gollop et al. 1974*b*). In addition to their engine and "rotor-wash" sound, helicopter flight patterns may contribute to disturbance. Brant (Henry 1980), reindeer (Ericson 1972), caribou (Calef and Lortie 1973, Miller and Gunn 1977), pronghorn, elk, bighorn sheep (Workman et al. 1992*a*, 1992*b*, 1992*c*), and Dall sheep (Andersen 1971) all have been documented to show a more extreme panic response when helicopters fly slowly or hover over animals.

Sudden aircraft approaches that cause surprise may also influence responses. Raptors, for example, panicked and exhibited frantic escape behavior when helicopters appeared from over the tops of cliffs, but did not do so when helicopters could be seen approaching from a distance (White and Sherrod 1973). Hence topography should be taken into consideration when predicting animal responses to overflights.

5.5.3 Increased Tolerance to Overflights

In some cases, animals may develop an increased tolerance to frequent overflights. This has been demonstrated by correlating changes in behavior with sequences of overflights. Other studies have compared reactions of animals having a history of exposure to aircraft with those that were naive. In many cases, experienced animals were more tolerant of aircraft, showing less extreme responses than naive animals.

For animals to become desensitized to sound, there must be consistent stimuli (Borg 1979); frequent, predictable overflights, such as those at major airports, are more likely to promote tolerance than occasional ones. Several studies suggest that animals might not become tolerant of infrequent aircraft activity. Colonially-breeding wading birds in Florida, for example, never adapted to infrequent low-altitude military flight activities conducted over two breeding seasons (Black et al. 1984). It is not known just how frequently a stimulus must occur in order for an animal to become desensitized to it, though it probably depends upon the species in question, as well as other factors.

It is important to note that some studies do not support the idea that animals' tolerances of aircraft overflights increase with exposure, even when overflights have been frequent. For example, brant, emperor geese, and Canada geese in Alaska (Ward and Stehn 1989) exhibited alert and flight behavior in response to aircraft activity, despite previous exposure for several seasons. Harding and Nagy (1976) noted that grizzly bears also never became tolerant of aircraft, despite very frequent exposure.

The degree of disturbance to which animals can habituate is probably limited. Evidence suggests that aircraft activities that cause mild responses may become tolerated more so than those that cause panic. This has been demonstrated in reindeer (Ericson 1972), Dall sheep (Summerfield and Klein 1974), and herring gulls (Burger 1981). Also, while some species have the ability to become tolerant, others may not. For example, whooping cranes appeared to have become tolerant of light aircraft activity on Aransas National Wildlife Refuge in Texas, but sandhill cranes had not (Gladwin et al. 1987).

CONCLUSION 5.4:
Factors that can influence animal responses include distance to the aircraft, aircraft type, suddenness of aircraft appearance and frequency of overflights. Closer aircraft generally are more likely to produce a response, though no minimum distance that produces no effect has been found, the responses being species dependent. Some tolerance for overflights has been observed when flights are frequent or regular, but not among all species.

5.6 Biotic Factors that Influence Animal Responses to Aircraft

While sound levels and aircraft proximity to animals are probably the most important factors affecting the levels and types of responses elicited, an animal's immediate activities are also important. Animals show different levels of response to overflights depending in part on whether they are traveling, feeding, resting, or attending young. Habitat features may also influence the degree to which animals react to overflights. For example, bighorn sheep in the San Andreas National Wildlife Refuge appeared more at ease in response to helicopters when in open terrain where they could escape more easily (Kiger 1970).

CONCLUSION 5.5:
The type of onimol octivity offects response to overflights. Whether an animal is feeding, resting, coring for young, etc., can offect how it responds to an overflight.

An animal's seasonal activities such as reproducing or hibernating influence how they respond to overflights as well. Consequently, during some seasons, animals may be more reactive than during other seasons. Slight seasonal differences in responses to overflights have been noted in reindeer (Slaney and Co. 1974), bighorn sheep (Stockwell and Bateman 1987), and caribou (Klein 1973, McCourt and Horstman 1974, Jakimchuk et al. 1974, Calef et al. 1976). Generalizations cannot be made across species correlating specific seasons with greater reactions.

At present, general relationships between external factors and animal responses are unclear because other variables have not been held constant during studies. In other words, to determine how habitat type (for example) influences responses, all other factors such as group size, season, etc. must be held constant so that habitat differences alone can be compared. Stronger patterns should emerge once more controlled studies are conducted. The existence of many variable factors may explain inconsistencies between reports of species-specific responses to overflights. Clearly, whether an animal (or group of animals) responds to aircraft overflights depends on many factors, and those mentioned here constitute only a partial list. Therefore, when attempting to assess the possible impacts of proposed or existing low-altitude aircraft operations on wildlife, it is essential to keep in mind that each situation is unique and must be evaluated accordingly. Figures 5.1 and 5.2 summarize some of the influential factors associated with aircraft overflights and animals that have been addressed.

INFLUENCING FACTORS

Previous experience with aircraft
Sex & age
Season
Habitat
Current Activity
Life-cycle state (breeding, migrating, etc.)

— **ANIMAL**

DIRECT EFFECTS	INDIRECT EFFECTS	ULTIMATE CONSEQUENCES
Behavioral reponse		
none	no effect	none
stop current activity	energy losses	reduced survivorship
look up, change body position	altered patterns of care to young	reprodctive losses
leave area (temporary or permanent)	habitat avoidance	habitat loss
	accidental injuries	
Physiological reponse		
no effect	none	
hearing loss	increased susceptibility to disease	
increased heart rate	increased vulnerability to predators	
adrenaline release		

Figure 5.1: Animal Responses to Low-Altitude Aircraft Overflights

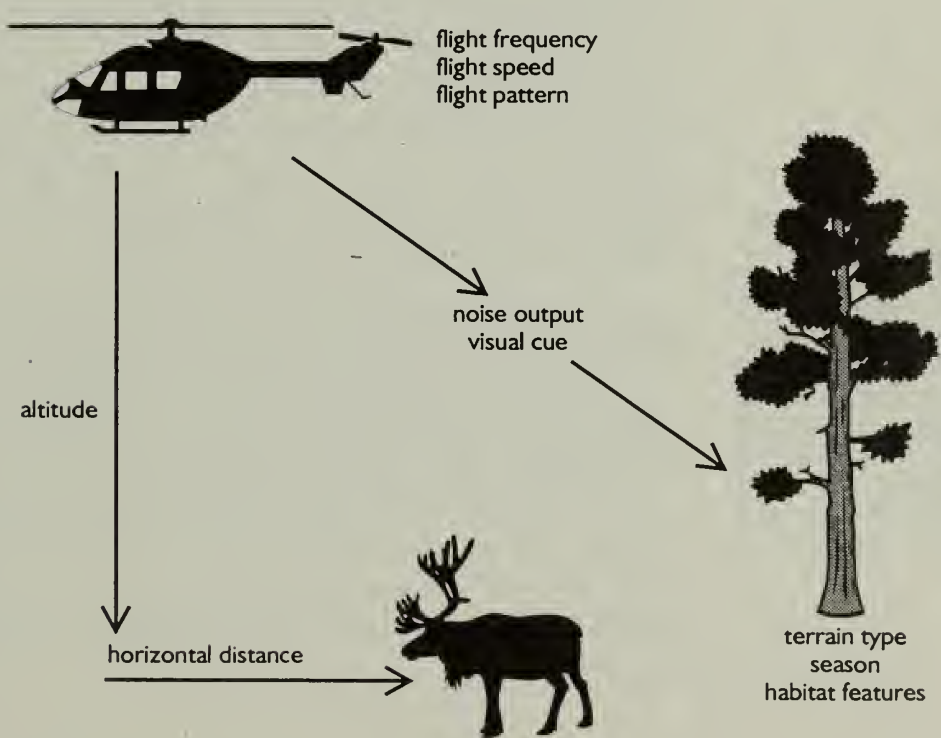


Figure 5.2: External Factors that Influence Animal Responses to Overflights

5.7 Problems with Detecting Long-Term Effects of Aircraft Disturbance

While short-term responses are easily documented, long-term responses are more difficult to verify. This is due both to the limitations of ecological research and to the nature of long-term responses. Long-term responses that might occur include permanent changes in habitat use, increased mortality of birds during migration (due to lower weight gains during staging, as described previously), or population effects due to reduced reproductive success (due to egg losses, for example). Assigning a cause and effect relationship between overflight disturbance and these types of phenomena is difficult because there are so many other variables that also cause them. It is very difficult to quantify small decreases in the survivorship of young that are directly attributable to overflights, because predators, weather, food availability, and adult skills all affect survivorship as well. For example, several studies have examined overall survivorship of young across a season by comparing young subjected to overflights with control animals and have concluded that overflights have little effect. However, closer examination has revealed that mortality rates increased during the specific periods of overflights, though these increases were not detectable by the end of the season (e.g., Harrington and Veitch 1992). Other long-term effects are difficult to correlate with overflights because they occur during a time or in a place not immediately associated with the overflights, such as migrating birds that die enroute to their destination after energy losses at feeding grounds.

Long-term effects are difficult to detect also because they may occur infrequently. This is due, in part, to the fact that most studies are short-term, making documentation of infrequent events unlikely. With the exception of an eight-year study of white pelicans (Bunnell et al. 1981), too little time has been spent assessing long-term effects.

CONCLUSION 5.6: *The long-term effects of overflights on wildlife have not been determined, and are unlikely to be investigated because of the magnitude of the effort required. Occasional use of aircraft to survey animals is unlikely to cause harm.*

Many biologists have published reports on the effects of the use of aircraft to survey animals. In most cases, overflights do no harm (Carrier and Melquist 1976, Kushlan 1979) because normal behavior is interrupted only briefly. In addition, the surveys are conducted only once or twice per season, and generally they are avoided during poor weather, when stressing an animal could result in harm, and during parts of the breeding season, when the consequences of disturbance might be compounded (White and Sherrod 1973, Poole 1989). Hence the argument that biologists themselves make overflights of animals should not be used to suggest that overflights do not cause disturbance.

5.8 Overflight Impacts on Endangered Species

There are 98 species on national park lands that have been identified as threatened or endangered. Of these, 36 are bird and 29 are mammal species. The impacts on threatened or endangered species from overflights is largely unknown. Of all threatened or endangered species Federally listed in the United States, there is information regarding responses to overflights only for the grizzly bear, sonoran pronghorn, peregrine falcon, bald eagle, and everglades kite. None of these species have been studied enough to differentiate between aircraft activities that do and do not cause harm. However, observations do indicate that some species are susceptible to disturbance and subsequent harm. The grizzly bear, for example, has been noted to panic and flee areas from overflights in nearly all cases where they have been observed (see Table 1). Biologists recognize that impacts may occur. Wildlife refuge managers have cited concern for many threatened or endangered species regarding impacts from overflights, including wood storks, Hawaiian geese, marbled murrelets, bald eagles, peregrine falcons, masked bobwhite quails, Stellar sea lions and least terns (USFWS 1993). In Washington State, USFWS is developing recovery plans for both the marbled murrelet and northern spotted owl which include 2,000-foot minimum flight restrictions over feeding grounds and nesting sites for these birds[5].

Many threatened or endangered species have achieved their special status due to habitat loss from development and general human encroachment. They are species for which habitat is limited; their natural histories prevent them from using any but specific habitat types. For this reason, it is important that overflights not cause further habitat loss to these species, since they cannot simply "relocate".

Whether or not a taking of a threatened or endangered species from Federal action occurs from overflights may be an area for additional research. It would be prudent for Federal agencies to take an active approach to evaluating this, rather than letting the decision lie with the courts. Studying threatened and endangered species and their responses to overflights is within the purview of the law so long as research enhances the survival of the species. However, some have expressed concern for the idea of subjecting animals to overflights and monitoring their responses if indeed those responses suggest that damage is occurring.

CONCLUSION 5.7:
Ninety-eight threatened or endangered species inhabit units of the National Park System. Their responses to overflights are largely undocumented, but Federal agencies may nevertheless be held responsible for impacts related to overflights.

5. *Memorandum dated March 7, 1994 from Superintendent, Olympic National Park, to Acting Associate Director, Operations, National Park Service.*

5.9 Overflight Impacts on National Park Animals

Disturbance levels and consequent impacts to animals living on national park lands have been anecdotally reported but not quantified. Several NPS superintendents have prepared reports on the subject which can be used as indicators of the types of problems some parks are having. Yet the degree to which these problems are occurring in other parks cannot be measured without a comprehensive survey.

Reports of park disturbance to animals from overflights exemplify the general points described earlier: 1) Animals have been noted to modify their behavior in response to overflights in parks, and 2) the consequences of this disturbance can only be inferred in the absence of long-term studies. At Hawaii Volcanoes National Park, the endangered Hawaiian (Nene) goose has been seen flushing from feeding and socializing areas after tour helicopters passed overhead[6]. Aircraft also alter normal feeding and socializing habits in response to frequent overflights. The consequences of altering social behaviors and time and energy budgets of animals have not been identified. Forest birds at this park also stop calling or flee from local habitat, as noted by biologists monitoring songbird behavior. Biologists speculate that bird behavior is modified because their calls are interrupted, hence territories cannot be properly delineated. Feeding is also interrupted, and other critical activities cannot be consummated when birds are disturbed by overflights.

At Congaree Swamp National Monument, bald eagles and osprey are believed to avoid habitats they would otherwise use because of overflights by military jets and helicopters.[7] Similar impacts to raptors have been reported from Glacier National Park. There, overflights are suspected of disrupting nesting and foraging activities of bald eagles, golden eagles and falcons. Biologists are concerned about possible impacts to raptors that use corridors through the park for migration[8]. Colonial seabirds have been seen flushing in response to overflights in Olympic National Park as well[9]. Other birds that may suffer harm from overflights in this park include the bald eagle, peregrine falcon, northern spotted owl, and marbled murrelet. These are all Federally-listed species.

Mammals are also disturbed by overflights in parks. Over 80 percent of grizzly bears observed in remote areas of Glacier National Park showed a

6. *Memorandum dated March 7, 1994 from Superintendent, Hawaii Volcanoes National Park, to Acting Associate Director, National Park Service.*

7. *Pers. comm., Robert McDaniel, Superintendent, Congaree Swamp National Monument, to D. Gladwin, Sterna Fuscata Inc. 1994.*

8. *Memorandum dated March 7, 1994 from Superintendent, Glacier National Park, to Acting Associate Director, Operations, National Park Service.*

9. *Memorandum dated March 7, 1994 from Superintendent, Olympic National Park, to Acting Associate Director, Operations, National Park Service.*

"strong" reaction to helicopters, according to studies in the park from 1982-1986.

Aircraft disturbing park animals include both military and civilian fixed-wing aircraft and helicopters. Helicopter tours for the public are most often cited as causing problems for wildlife. Most problems occur when aircraft fly at low altitudes such as 500 feet AGL. Helicopter tour operations are frequent in some parks; Glacier National Park reports 10 per day, and Hawaii Volcanoes National Park reports 60-80 per day. Hence cumulative effects of disturbance are likely, as animals are chronically interrupted from important life-maintenance activities.

Several efforts to solve disturbance problems have been initiated by park personnel in recent years. Monitoring low-level overflights and maintaining statistics at Congaree Swamp National Park have helped to quantify the frequency of problems. At Olympic National Park, the staff are cooperating with the USFWS refuge staff and the endangered species field office in documenting and reporting aircraft harassment of seabird colonies. At Glacier National Park, employees are trained to identify aircraft and estimate altitude. A strict plan is in place there for the use of the park's own aircraft. Parks have also discussed problems with aviation proponents. Meetings with tour operators, FAA, and military personnel have been somewhat successful, though problems do not always cease. For example, Congaree Swamp national park managers note that, although military personnel are receptive to cooperation in avoiding disturbance, no efforts have been made by the military to address problems themselves or to offer mitigation strategies. At Hawaii Volcanoes National Park, staff have been negotiating a voluntary agreement with the helicopter operators association, with assistance from the FAA.

Park superintendents have an interest in addressing cumulative effects of aircraft disturbance on wildlife. They also support continued efforts to work with the military and civilian aircraft operators to develop mutually agreeable solutions. Preparing educational material on the sensitivity of wildlife and natural areas has been suggested as a means of reducing disturbance.

CONCLUSION 5.8:
In general, reports from national park about the effects of overflights on wildlife tend to mirror the points made earlier in this chapter: animals have been observed to modify their behavior in response to overflights, but without long term study, the consequences of such modifications can only be inferred.

5.10 Development of Impact Criteria

Studies to-date have verified that physiological and behavioral responses by wildlife to low-flying aircraft do occur. The nature of these responses suggests that at least some animals suffer other consequences. The studies by Stockwell et al. (1991) and Belanger and Bedard (1989*a,b*) provide compelling evidence that energy losses and habitat avoidance are occurring in response to overflights. Unfortunately, these studies cannot be used to infer damages in other species or from other overflight regimes. Only a handful of the many species that inhabit national parks have been studied for responses to overflights. It is very likely that there are park species that are susceptible to disturbance that have never been studied. There is also little information suggesting how flight patterns, frequencies and altitudes affect any species, other than the broad generalizations described earlier. Data to support the occurrence of damage in a variety of situations would require many years of extensive and costly research.

It is also not possible to evaluate the after-effects of overflights because in most cases, animal responses fall across a spectrum so that the question of whether or not a disturbance occurs cannot be answered with a yes or no. For example, an overflight generally causes some animals to panic, some to be mildly disturbed, and some animals to ignore the aircraft. At a lower altitude, the overflight causes more to panic and fewer to be mildly disturbed. At what degree of disturbance in what percentage of animals should overflights be considered detrimental or otherwise unacceptable? At present, these questions have only largely subjective answers.

Defining impacts according to some specific, measurable criteria is a useful first step towards developing a policy. There is no consensus in public or scientific communities regarding impact definition. The following categories of impacts are adapted in part from a matrix of definitions developed by Oak Ridge National Laboratory staff members Roger Kroodsma and Warren Webb in cooperation with the U.S. Air Force (Braid 1992). They are meant to help agencies in determining the severity of impacts. In these definitions, "species of concern" include Federally- or state-listed threatened, endangered, and candidate species, species of local economic importance, or species of particular concern to conservation or other interest groups. This definition can be expanded to include any species that is known to be susceptible to disturbance. "Habitat" is used to refer to the physical landscape and its ecosystem components that are subjected to overflights.

Negligible Impacts

- No species of concern are present and no or minor impacts on any species are expected.
- Minor impacts that do occur have no secondary (long-term or population) effects.

Low Impacts

- Non-breeding animals of concern are present in low numbers.
- Habitat is not critical for survival and not limited to the area targeted for overflight use; other habitat meeting the requirements of animals of concern is found nearby and is already used by those species.

- Occasional fright responses are expected, but without interference with feeding, reproduction, or other activities necessary for survival.
- No serious concerns are expressed by state or federal fish and wildlife officials.

Moderate Impacts

- Breeding animals of concern are present, and/or animals are present during particularly vulnerable life-stages such as migration or winter (depends upon the species in question).
- Mortality or interference with activities necessary to survival are expected on an occasional basis.
- Mortality and interference are not expected to threaten the continued existence of the species in the area. State and federal officials express some concern.

High Impacts

- Breeding individuals are present in relatively high numbers, and/or animals are present during particularly vulnerable life-stages.
- Habitat targeted for overflights has a history of use by the species during critical periods, and this habitat is somewhat limited to the area targeted for overflight use; animals cannot go elsewhere to avoid impacts (animals can rarely "relocate" except temporarily).
- Mortality or other effects (injury, physiological stress, effects on reproduction and young-raising) are expected on a regular basis. These effects could threaten the continued survival of the species.
- State and federal wildlife officials express serious concern.

This evaluation process relies on the opinions of wildlife managers and researchers. In general, members of the scientific community agree that damage to animals should not need to be proven before impacts are considered likely. In the conclusion of the majority of studies, researchers caution that, though they cannot prove that impacts occur, overflights that cause disturbances should be avoided.

In defining what level of disturbance to park animals by overflights is unacceptable, the NPS must rely on less than complete information. It is clear that disturbances can result as direct and indirect effects, and that consequences may affect survivorship. Until more information is available, it is recommended that the NPS use the levels of impact listed to "trigger" actions to eliminate or reduce such impacts. In general, the NPS would regard situations consistent with "low impacts" to warrant monitoring, while situations that represent "moderate impacts" or "high impacts" would require pursuit of solutions.

5.11 Summary

A wide range of impacts (disturbances) to wildlife due to aircraft overflights have been reported in the literature. There are many reports of behavioral responses in animals, these responses are highly variable depending on the type of study, the species under consideration, spatial and temporal parameters, and other broad ecosystem characteristics.

Indirect effects on wildlife such as accidental injury, energy losses and impacts to offspring survival have been documented. Current literature supports the argument that aircraft overflights negatively impact wildlife populations. However, the significance of such impacts is not clear. Additional studies are still needed to better assist land managers in substantiating the effects on population subgroups.

It is certain that some impacts do occur under certain circumstances and that it is a NPS priority to protect wildlife, especially threatened and endangered species, whenever a probable impact exists or is expected. Hence, a series of conditions, applicable system-wide, have been listed that can be used to define general levels of impacts. Working with these guidelines at specific parks will lead to setting of priorities, both for possible alteration of overflight times, locations and numbers, and for identification of further research needs.

Chapter
6

EFFECTS OF OVERFLIGHTS ON VISITOR ENJOYMENT

6.1 Introduction

Public Law 100-91 directs the Secretary of the Interior to study the effects of aircraft overflights at no fewer than ten units of the National Park System, and to provide information at each unit regarding

> *"... the impairment of visitor enjoyment associated with flights over such units of the National Park System."*

This chapter presents the results of two studies that were conducted in response to this requirement and that serve to identify the effects on visitors and also to provide a basis for using visitor reactions, as one measure among others, to identify, analyze and mitigate aircraft overflight sound produced impacts at units of the National Park System.

The two studies that serve as the basis for most of the analysis presented in this chapter are the Visitor Survey (McDonald *et al.* 1994) and the Dose-Response Study (Anderson *et al.* 1993). The Visitor Survey consists of two surveys of visitors: a visitor intercept survey conducted at exits to parks as visitors were departing, and a mail survey sent to a sub-group of these visitors. The Dose-Response Study included simultaneous sound level measurements and visitor interviews at specific sites which are overflown by aircraft on a regular basis. The Visitor Survey was designed to provide National Park System-wide estimates of visitor impacts, but the results also provide valuable information on the variation in effects from park to park.

The Dose-Response Study examines visitor reactions to overflights of specific park locations and provides a quantitative relationship between aircraft sound level and visitors' reactions to these sound levels. The sections of this chapter examine in succession the effects on visitors system-wide, at specific parks, and at specific sites within parks. These effects, and in particular the results of the specific site Dose-Response Study, are then used as the basis for a process of identification, analysis and mitigation of overflight produced visitor impacts.

Understanding Visitor Enjoyment

In order to understand the following shifts of analysis from park system to individual parks to specific sites, it is necessary to understand how visitors report enjoyment and how the NPS views its mandate to provide for visitor enjoyment. In a recreational setting, visitor reports of enjoyment (or visitor satisfaction, as it is often termed in the literature) have two important qualities: 1) reports of satisfaction and dissatisfaction depend upon how specifically a visitor is questioned about an experience; 2) satisfaction cannot really be examined with a single measure, but consists of multiple satisfactions. First, previous work has shown that people evaluate their reactions to an event more reliably to the extent that they are questioned specifically about the event. In the context of examining the effects of overflights on visitors, questions asked about the effects of overflights at a specific site, asked right at the site were judged to provide more reliable reports of impact than questions asked at the time of exiting the park. Second, early research on visitor satisfaction centered upon a single measure of visitor satisfaction, but more recent efforts have indicated that a single overall measure is inadequate, and now conceptualize visitor satisfaction as consisting of multiple satisfactions. In other words, impacts on visitors from aircraft are only one of numerous factors that can affect visitor enjoyment. To understand visitor reactions to aircraft, visitors must be questioned specifically about aircraft.

What these two aspects of visitor satisfaction mean is that impacts of overflights can not be easily perceived by broad-brush examination of visitor satisfaction long after the experience with overflights occurs. Rather, direct questions about the perceived effects of overflights have to be asked specifically and close to the time of the experience. Though the visitor survey was conducted primarily to permit generalization to the entire park system, it also provides useful information for understanding the differences in the impacts of overflights at different parks. The Visitor Survey had two parts, an initial intercept survey at park exits and a follow-up mail survey. Results of the intercept survey are more representative of visitor reaction to overflights and less affected by passage of time after the possible exposure to the overflights. The best time to ask opinions about overflights is to ask shortly after the experience, as was done during the dose-response study conducted at specific sites.

By examining the effects of overflights on visitor enjoyment system-wide, at individual parks and at specific sites within parks, the following conclusions are drawn:

System-wide, on an annual basis, about one-fifth of all park visitors (88 million) report hearing aircraft, and two to three percent (nearly 7 to 12 million visitors) report impacts from these overflights. These numbers take on greater significance when problems are concentrated in a limited number of parks. So while problems are spread widely enough to make a systematic approach desirable, they make simple systemic solutions, like the setting of a minimum flight altitude over parks, impractical and inappropriate. A systematic approach to problem solving must be linked to understanding impacts on a park-by-park, site-by-site basis with careful consideration given to the types of visitor experiences that the park should be providing.

Visitor impacts vary significantly park-to-park, and the parks included in the Visitor Survey demonstrate this variability. The variation in visitor impacts across these parks correlates, though weakly, with NPS management rankings of park overflight problems and add weight to the conclusion that the 50 to 100 parks identified by management may be in need of investigation and remedy.

Locations that have significant overflight problems can be objectively identified and analyzed by using NPS guidelines that include setting limits on percentages of visitors impacted and on numbers of visitors impacted.

6.2 The System-Wide Impacts of Overflights on Visitors

The Visitor Survey was designed to provide information system-wide about how visitors feel about aircraft overflight related issues. Three survey objectives relate to understanding effects on visitor enjoyment. These objectives are:

- Determine the importance of "natural quiet" to visitors.
- Determine the numbers and percentages of park visitors who remembered and reported hearing aircraft.
- Determine the numbers and percentages of park visitors who reported impacts from aircraft overflights.

In order to permit generalization of the results to the park system, a five-stage sample design was used. This involved selecting: (1) NPS units from identified strata, (2) two-month sampling periods, (3) exits and days, (4) groups of visitors within those exit-days, and finally (5) a subset of visitors to receive a questionnaire in the mail. The result was two sets of survey results: those from visitors who were intercepted and interviewed as they exited the various parks, and those from visitors who also received the mail questionnaire. In the following discussions, the results from the intercept or exit survey are used to provide information about the three survey objectives listed above[1]. These results are based on visitor responses collected during the busiest two months of the season from visitors exiting during the busiest 6 hours of the day.

6.2.1 Importance of Natural Quiet

During the intercept survey, visitors were asked how important it was to be able "to enjoy the natural quiet and sounds of nature" and "to enjoy the natural scenery" as reasons for their visit to the park. Visitors were given five choices for responding: not at all important, slightly important, moderately important, very important and extremely important. Table 6.1 shows, based on the survey responses, what percent and what corresponding annual number of park visitors could be expected to answer moderately, very or extremely important to these reasons.

6.2.2 Impacts Produced by Hearing and Seeing Aircraft

First, visitors leaving the parks were asked if they heard or saw "any airplanes, jets, helicopters or any other aircraft during your visit to" the park. Table 6.2 presents the results and estimates of the corresponding number of 1992 visitors who would have heard or seen aircraft.

Visitors who reported hearing or seeing aircraft were then asked whether they were bothered or annoyed by aircraft noise or by seeing aircraft. Visitors who heard aircraft were also asked whether the sounds of aircraft interfered with three aspects of their visit: enjoyment of the park; appreciation of the natural quiet and sounds of nature at the park; appreciation of the historical and/or cultural significance of the park. Visitors could respond with one of five answers for each question: not at all, slightly, moderately, very much, extremely. Table 6.3 gives the impacts for hearing aircraft, and Table 6.4 shows the reported annoyance for visitors who saw aircraft. The percents shown are percents of the total visitor population, not percents of visitors who heard or saw aircraft.

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1. *The mail survey results provide information about visitor perceptions of benefits and about approaches to management presented in Chapters 8 and 9.*

TABLE 6.1: IMPORTANCE OF NATURAL QUIET AND NATURAL SCENERY AS REASONS FOR PARK VISIT

Reason for Park Visit	Estimate	95% Confidence Interval
Enjoy Natural Quiet		
Percent of Visitors[a]	90.7$	88.3% to 93.1%
Number of Visitors[b]	397.1 M	386.6 M to 407.6 M
Standard Error[c]	1.23	
(n = 15,150)[d]		
View Natural Scenery		
Percent of Visitors[a]	93.2%	93.1% to 95.1%
Number of Visitors[b]	408.0 M	399.7 M to 416.3 M
Standard Error[c]	0.98	
(n = 15,227)[d]		

[a] Respondents who answered 3, 4, or 5 on the following scale: 1 = not at all important, 2 = slightly important, 3 = moderately important, 4 = very important, and 5 = extremely important
[b] Estimate of the 1992 visitor population is 437.8 million visitors. As used here, "visitor" means one person exiting the park. Hence, if a person enters and leaves a park once each day for three days, that person is counted as three "visitors"
[c] Standard error is of the percent, not of the number of visitors
[d] Number of completed interviews

CONCLUSION 6.1:
Enjoying the natural quiet is about as important as viewing natural scenery as a reason for visiting national parks. In both cases over 90 percent of the visitors report moderate to extreme importance for both.

TABLE 6.2: NUMBERS OF VISITORS WHO REPORTED HEARING OR SEEING AIRCRAFT

	Estimate	95% Confidence Interval
Heard aircraft		
Percent of Visitorsa	20.1%	10.1% to 30.1%
Number of Visitors	88.0 M	44.2 M to 131.8 M
Standard Error	5.10	
(n = 15,190)		
Saw aircraft		
Percent of Visitors	18.8%	10.8% to 26.8%
Number of Visitors	82.3 M	47.3 M to 116.3 M
Standard Error	4.10	
(n = 15,081)		

*See notes to Table 6.1

CONCLUSION 6.2:
About one fifth of all visitors to the National Parks (about 80 million visitors a year) remember seeing or hearing aircraft during their visit to the park.

TABLE 6.3: IMPACTS THAT RESULTED FROM HEARING AIRCRAFT		
Type of Impact	Estimate	95% Confidence Interval
Interfered with Visitor Enjoyment Percent of Visitors[a] Number of Visitors Standard Error (n = 15,174)	1.9% 8.3 M 0.65	0.6% to 3.2% 2.6 M to 14.0 M
Annoyed by Hearing Aircraft Percent of Visitors[a] Number of Visitors Standard Error (n = 15,174)	1.6% 7.0 M 0.77	0.1% to 3.1% 0.4 M to 13.6 M
Interfered with Appreciation of Natural Quiet Percent of Visitors Number of Visitors Standard Error (n = 15,049)	2.8% 12.3 M 0.99	0.9% to 4.7% 3.9 M to 20.6 M
[a] See notes to Table 6.1		

CONCLUSION 6.3:
About 2 to 3 percent of all visitors, or roughly from 7 to 13 million visitors annually, can be expected to report impact from hearing or seeing aircraft overflights.

TABLE 6.4: ANNOYANCE THAT RESULTED FROM SEEING AIRCRAFT		
Type of Impact	Estimate	95% Confidence Interval
Annoyed by Seeing Aircraft Percent of Visitors[a] Number of Visitors Standard Error (n = 15,072)	3% 13.1 M 0.86	1.3% to 4.7% 5.7 M to 20.6 M
[a] See notes to Table 6.1		

6.2.3 Impacts Among Different User Groups Produced by Hearing Aircraft

Impacts of overflights on different user groups were also examined. Three visitor groups were identified: frontcountry, backcountry, and overnight backcountry permit holders. Visitors who completed the exit survey could be categorized based on their primary recreational activity. Those who indicated their primary activity was backpacking or hiking were classified as "backcountry" users, while all other surveyed visitors were classified as "frontcountry". The third group, the backcountry permit group, is a sample of permit holders from those NPS units that require a permit to stay overnight in the backcountry. These permit holders were surveyed by mail.

Figure 6.1 shows the percentages of visitors in each of the three groups who remembered and reported hearing aircraft, who were annoyed, who indicated aircraft sound interfered with their enjoyment, and who indicated aircraft sound interfered with their appreciation of natural quiet and sounds of nature. Frontcountry visitors are less likely to report hearing aircraft, and to be less impacted by aircraft sounds than backcountry visitors. Such differences could be attributed to a number of factors. First, aircraft may be less likely to fly at lower altitudes near more populated frontcountry areas, possibly avoiding areas where typical frontcountry activities occur. Second, backcountry visitors may spend a much longer period of time in the park, thus increasing their opportunities to hear aircraft. Third, backcountry visitors typically spend a greater portion of their visit away from crowds, traffic, noise, etc., in locations where aircraft sounds may be more intrusive. Fourth, previous research has shown that backcountry and frontcountry visitors generally have different expectations and are seeking different experiences in visits to national parks.

CONCLUSION 6.4:
A higher percentage of backcountry than frontcountry visitors report hearing aircraft and are more likely to experience impact from these aircraft. Though the reasons for these differences have not been identified, it is clear that hiking and backpacking do not remove visitors from the impacts of overflights.

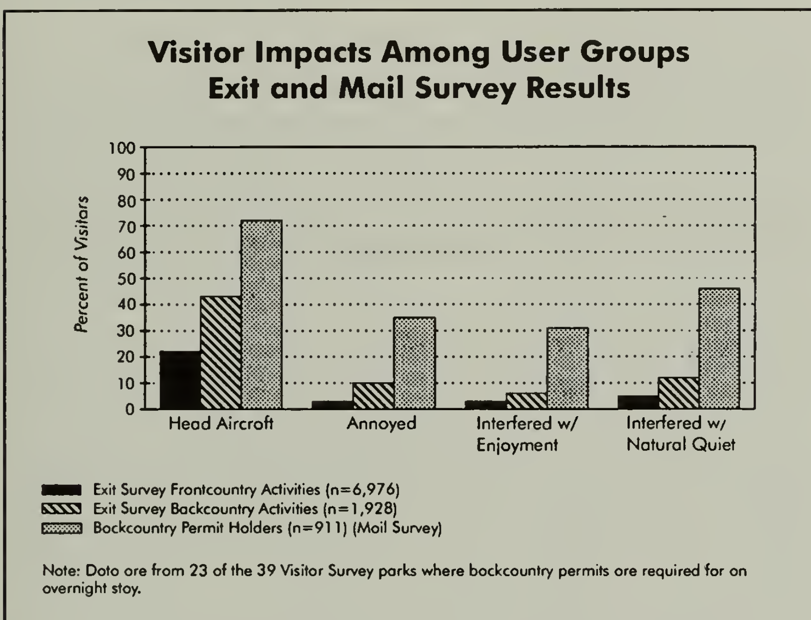

Figure 6.1: Impacts of Hearing Aircraft Among Different Visitors Groups

6.3 Impacts at Specific Parks and at Specific Sites

The previous section presented the broad, system-wide picture of the impacts on visitors produced by aircraft overflights. However, both the Visitor Survey and the Dose-Response Study provide more information about visitor reactions to overflights, the distribution of overflight impacts on visitors, the relation of sound level to visitor reaction, and factors affecting visitor reactions. This section presents this additional information by examining the study results for specific parks and for specific sites within parks.

6.3.1 Impacts at Specific Parks

Percentages of Visitors Impacted

CONCLUSION 6.5:
Park visitor reports of exposure to aircraft (hearing aircraft) and of impacts from the exposure vary widely from park to park.

The Visitor Survey was conducted at a carefully designed and selected sample of units of the National Park System. This sample was drawn to permit generalization of results to the entire non-Alaskan system of parks. However, examination of the data from these individual parks indicates that a wide variation in overflight produced impacts exist. Table 6.5 lists the parks where visitors were surveyed. It gives also the numbers of visitors who were surveyed as they exited the park, and the percent of visitors, weighted to reflect the total number of visits during the two month survey period, who expressed annoyance, stated that the sound of aircraft interfered with their enjoyment of the park or with their appreciation of the natural quiet and sounds of nature.

Figure 6.2 presents graphically for each of the Visitor Survey parks two of the quantities listed in Table 6.5: percent of visitors who reported hearing aircraft and the percent of visitors who were annoyed. The numbers next to the points in the figure indicate the specific park as listed in Table 6.5. As shown, parks with higher percentages of visitors reporting hearing aircraft also tend to have larger percentages of visitors annoyed by the aircraft.

CONCLUSION 6.6:
The nature and severity of impacts at specific sites within parks may not be captured by the judgments gathered in the exit Visitor Survey.

Low percentages of visitors impacted in Table 6.5 and Figure 6.2 do not necessarily imply no overflight noise problems exist. First, the Dose-Response Study, discussed in more detail below, shows that significant impacts to visitors can occur at specific sites. Figure 6.3 shows the same variables, percent who heard aircraft and percent who were annoyed, for five specific sites. Haleakala, Hermit Basin (in the Grand Canyon), and Wahaula (Hawaii Volcanoes) all showed more than 20 percent of the visitors to these specific sites were annoyed. In Figure 6.2, Haleakala, number 20, Grand Canyon, number 17, and Hawaii Volcanoes, number 21, all show less than 10 percent of visitors reporting annoyance with the sound of aircraft overflights. If parks such as these that show 5 to 10 percent of the visitors are impacted can also have sites in the park where more significant numbers are affected, it is likely that the parks of Figure 6.2 that have more than 10 percent of visitors annoyed also have specific sites where significant percentages of visitors are impacted.

Table 6.5: Reported Exposure and Impact from Hearing Aircraft at Visitor Survey Parks

	National Park Unit Surveyed	Number of Visitors Interviewed	Percent[a] of Visitors Reporting			
			Hearing Aircraft	Annoyance[b]	Interference with	
					Enjoyment[b]	Natural Quiet[b]
1	Assateague Island National Seashore	516	29	1	<1	3
2	Bandelier National Monument	424	34	3	1	3
3	Buffalo National River	171	40	4	4	5
4	Canaveral National Seashore	252	32	<1	2	4
5	Cape Cod National Seashore	290	44	2	4	4
6	Cape Hatteras National Seashore	280	37	<1	1	2
7	Casa Grande National Monument	490	5	1	1	1
8	Cumberland Island National Seashore	703	82	19	15	26
9	Delaware Water Gap	277	22	1	1	2
10	Dinosaur National Monument	598	8	1	1	2
11	Everglades National Park	268	49	17	17	21
12	Fort Sumter National Monument	474	17	1	<1	2
13	Fredericksburg & Spotsylvania	230	36	11	6	12
14	Gettysburg National Military Park	356	16	1	1	2
15	Glacier National Park	404	29	2	3	5
16	Glen Canyon National Recreation Area	285	52	4	4	8
17	Grand Canyon National Park	536	34	5	5	10
18	Great Smoky Mountains National Park	266	12	1	1	3
19	Gulf Islands National Seashore	356	64	3	5	8
20	Haleakala National Park	533	47	6	6	12
21	Hawaii Volcanoes National Park	550	48	7	7	12
22	Hot Springs National Park	623	13	1	1	1
23	Kings Canyon & Sequoia National Park	304	13	3	3	5
24	Lake Mead National Recreation Area	199	32	1	2	3
25	Lake Meredith National Recreation Area	188	10	<1	1	1
26	Lassen Volcanic National Park	384	19	4	2	5
27	Mount Ranier National Park	390	23	5	4	6
28	Mount Rushmore National Monument	530	61	9	10	17
29	North Cascades National Park	437	17	2	3	5
30	Olympic National Park	203	33	8	5	12
31	Perry's Victory	500	29	1	3	4
32	Rocky Mountain National Park	501	11	1	1	2
33	Saguaro National Monument	270	21	3	5	7
34	Shenandoah National Park	458	13	4	4	5
35	Sleeping Bear Dunes National Lakeshore	372	16	1	2	3
36	Walnut Canyon National Monument	542	11	1	2	4
37	Wilson's Creek National Battlefield	453	19	1	2	3
38	Yellowstone National Park	394	18	1	1	1
39	Yosemite National Park	337	55	15	14	19

a Percents are based on weightings using actual numbers of visitors to each park during the survey periods.
b Respondents who answered 3, 4, or 5 on the following scale: 1 = not at all, 2 = slightly, 3 = moderately, 4 = very much and 5 = extremely

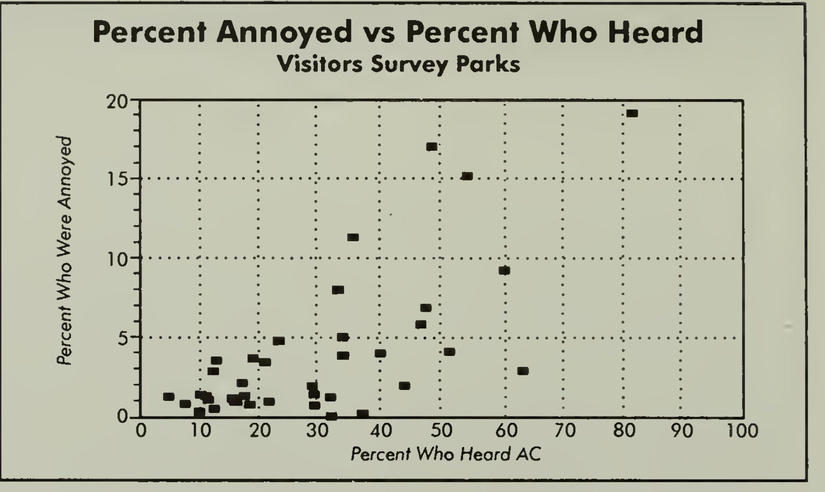

Figure 6.2: Percent of Visitors Hearing Aircraft and Annoyed by Aircraft at Visitor Survey Parks

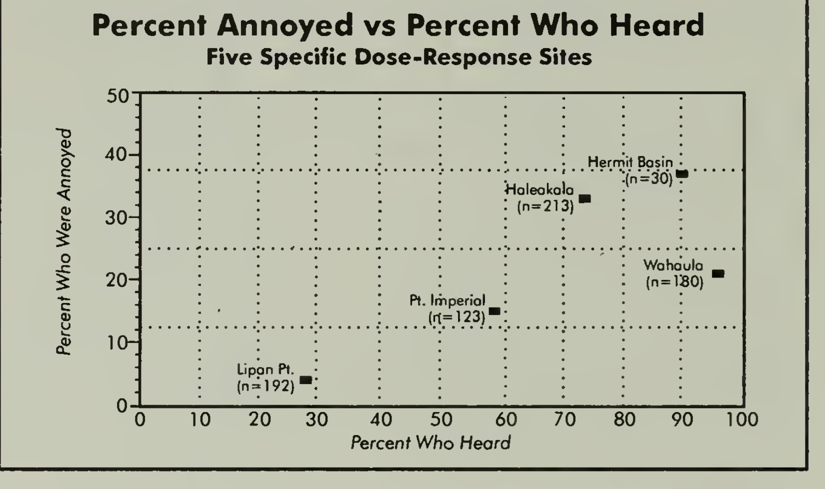

Figure 6.3: Percent of Visitors Hearing Aircraft and Annoyed by Aircraft at Five Specific Sites

Numbers of Visitors Impacted

The impacts of overflights at the specific parks may also be examined by estimating the numbers of visitors annoyed during the two month sample periods. Figure 6.4 is like Figure 6.2, except estimated numbers of visitors are used rather than percents of visitors. Note that Grand Canyon, 17, Haleakala, 20, and Hawaii Volcanoes, 21, all are estimated to have more than 10,000 visitors impacted during the two month survey period. Table 6.6 lists the parks of Figure 6.4 having more than 10,000 visitors impacted.

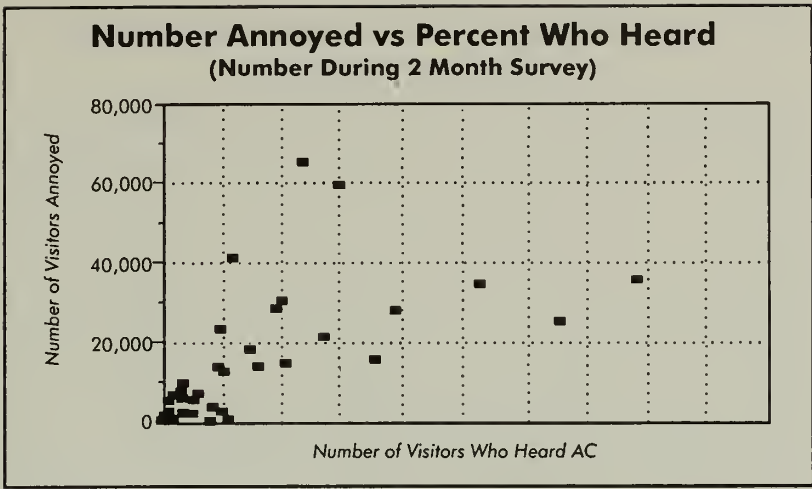

Figure 6.4 Numbers of Visitors Hearing Aircraft and Annoyed by Aircraft at Visitor Survey Parks

TABLE 6.6: VISITOR SURVEY PARKS WITH MORE THAN 10,000 VISITORS IMPACTED BY OVERFLIGHTS DURING SURVEY	
National Park Unit	
5	Cape Cod National Seashore
16	Everglades National Park
15	Glacier National Park
16	Glen Canyon National Recreation Area
17	Grand Canyon National Park
16	Great Smoky Mountains National Park
19	Gulf Islands National Seashore
20	Haleakala National Park
21	Hawaii Volcanoes National Park
24	Lake Mead National Recreation Area
27	Mount Rainier National Park
28	Mount Rushmore National Monument
29	North Cascades National Park
35	Sleeping Bear Dunes National Lakeshore
38	Yellowstone National Park
39	Yosemite National Park

Comparison of Park Specific Impacts with Management Ratings

Three different rankings of parks with potential overflight problems were developed. First, the National Park Service developed a ranking from 1, most severe, to 9, the least severe for parks within each NPS region. Second, NPS developed a national ranking from 1, greatest potential for aircraft overflight exposure, to 3, the least potential. Third, a ranking of "exposure" was developed based on limited information about flight routes and air traffic information (Tabachnick *et al.* 1992). These three rankings were examined for correlation with visitor reports of hearing aircraft, and with visitor reports of impact (McDonald *et al.* 1994). Modest correlations were found for the NPS management rankings and hearing aircraft, and weak correlations with impact (annoyance, interference with enjoyment or with appreciation of natural quiet). The exposure metric, developed from incomplete information about routing of flights and operations numbers, correlated to little or no extent with visitor responses.

Figures 6.5, 6.6 and 6.7 show the relationship of the NPS national ranking and the parks included in Pubic Law 100-91 with hearing aircraft and annoyance for the parks of the Visitor Survey. These figures show the tendency for the higher ranked parks to be parks were greater percentages of visitors report hearing aircraft and where greater percentages or numbers of visitors are impacted by hearing aircraft. Reasons for differences between management rankings and visitor reactions can be many: management knows the purpose and mission of the parks; visitors are at parks generally a few days at most; visitors have limited experience with the opportunities offered by the park. Nevertheless, very few of the parks with the higher visitor impacts are excluded from the higher management rankings.

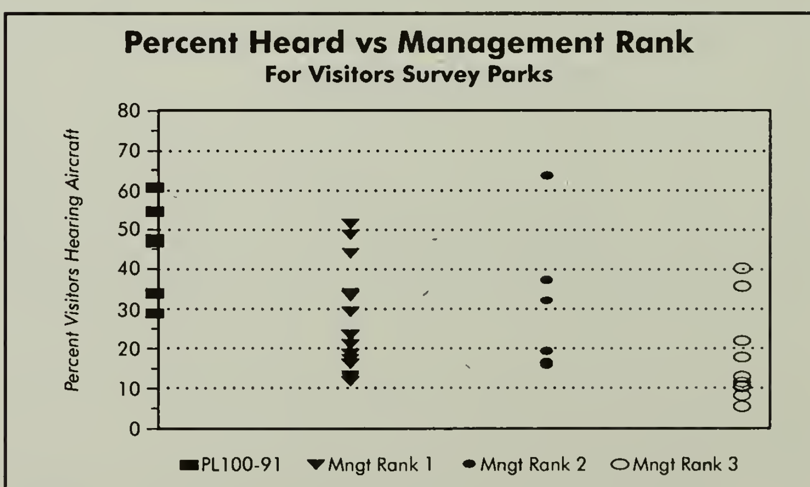

Figure 6.5: Comparison of NPS Management Rankings with Percent of Visitors Hearing Aircraft

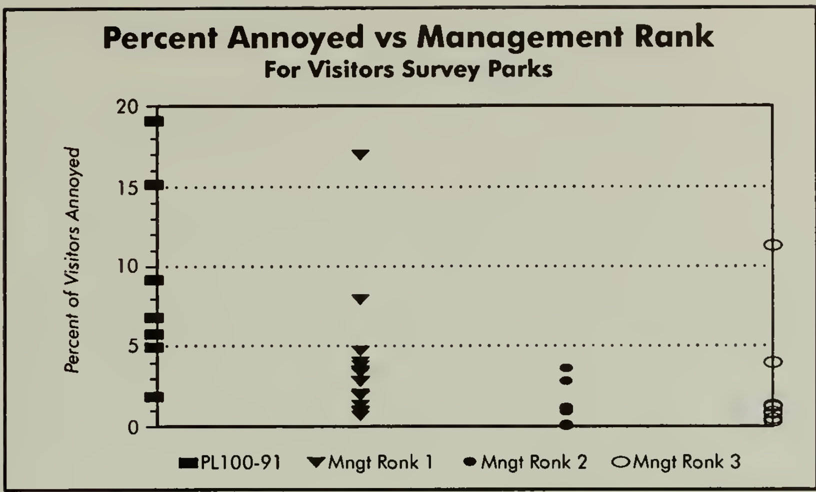

Figure 6.6 Comparison of NPS Management Rankings with Percent of Visitors Annoyed

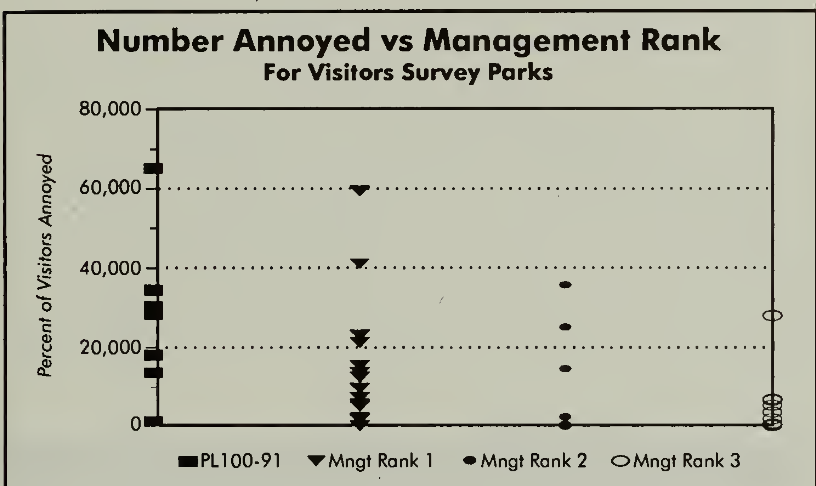

Figure 6.7: Comparison of NPS Management Rankings with Number of Visitors Annoyed

CONCLUSION 6.7:
NPS management rankings provide a reasonable approach to identifying parks with potential overflight problems, and the management perspective is likely to identify the parks with the most severe visitor impacts.

6.3.2 Impacts at Specific Sites

The preceding sections of this chapter presented visitor perceptions of overflight impacts for the park system as a whole, and showed the variation in visitor perceptions from park to park. Since the Visitor Survey could not identify what sound levels the visitors experienced, where they went in the parks, or how long they stayed in different areas of the park, there is no means for inferring this information, and no way to answer questions that would help quantify the relationship between visitor reports of impact and aircraft sound level. Since the Visitor Survey could not provide any information about sound levels experienced by visitors, the Dose-Response Study (described in Anderson *et al.* 1993) was designed and conducted to answer the following three questions.

1. Does impact as reported by visitors depend upon sound levels produced by aircraft overflights?

2. If so, what is the relationship between reported impact and aircraft sound levels?

3. What factors other than aircraft sound affect visitor impacts?

A dose-response relationship may be thought of as a curve on a graph that tells what percent of visitors report impact (their response) versus the "dose" of aircraft overflight sound. Dose-response relationships have long been used to help understand reactions to noise in communities around airports but, prior to this dose-response study, there were no data relating how visitors to national parks react to the sound of aircraft overflights.

Dose-response relationships were developed by measuring sound levels in an area of a park while simultaneously interviewing visitors who had passed through or visited the area. Preparation for data collection and analysis was lengthy, and was highly influenced by the knowledge that, although dose-response studies are common in urban airport environments, this exact type of study in a park environment had never before been attempted. Hence, decisions were made to maximize the likelihood that useful data would be acquired. Such an approach meant that variables needed to be limited, measurement techniques had to be as simple as possible, and that study areas had to be carefully chosen. Table 6.7 lists the specific areas studied, the park, the type of area, the dates of data collection, number of visitors interviewed and the approximate numbers of aircraft heard per hour.

TABLE 6.7: DOSE-RESPONSE DATA COLLECTION STUDY AREAS

National Park	Study Area	Type of Area	Dates of Data Collection	No. of Visitors Interviewed	Aircraft per Hour (approx.)
Grand Canyon	Havasu Creek	Backcountry, stopping point	27, 28, 29, 30 Aug.	30	9
Grand Canyon	Point Imperial	Frontcountry, overlook	5, 6 Sep.	124	22
Grand Canyon	Hermit Basin	Backcountry, trail segment	25 Aug. 1, 2, 3 Sep.	32	31
Grand Canyon	Lipan Point	Frontcountry, overlook	24, 26, 31 Aug.	193	24
Haleakala	Sliding Sands Trail	Frontcountry, short hike	2, 3, 4, 5 Oct.	213	8 to 10
Hawaii Volcanoes	Wahaula Temple	Frontcountry, short hike	8, 9, 10, 11 Oct.	180	9 to 10

The Dose-Response Curves

Figures 6.8 and 6.9 present dose-response curves that were developed from the data for each of the study areas[2]. In each, the horizontal axis gives the dose, while the vertical axis gives the response, and the curves show the relationship between the two. The two figures are for two doses and one response. The doses are percent of time aircraft are audible, and hourly equivalent level, $L_{eq,1hr}$ for audible aircraft[3]. The first, percent of time audible, was determined by logging the start and end times of all audible aircraft overflights. These logs were later correlated with the period of time each interviewed visitor was on site to determine the amount of time each visitor could have heard aircraft. The $L_{eq,1hr}$ was determined by continuously measuring sound levels, then computing for 1 hour periods for each visitor, the equivalent level of the sound levels that occurred when aircraft were audible (corrected for non-aircraft sound levels). The response is percent of visitors who said they were annoyed by aircraft noise while at the site[4]. The solid portion of the curve shows where the data lie, the dashed portions are extrapolations based on analysis.

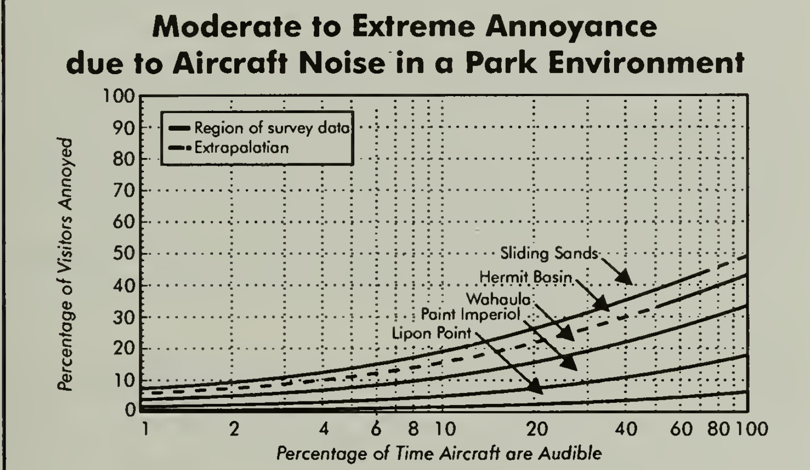

Figure 6.8: Dose-Response Curve for Visitor Annoyance vs Percent of Time Aircraft are Heard

2. *Because of the limited number of interviews at Havasu Creek and because aircraft sound levels were so close in level to the non-aircraft background levels that doses could not be computed, the Havasu Creek data could not be used in developing the dose-response curves.*

3. *Percent of time aircraft are audible, while simple to measure, is extremely difficult to predict. On the other hand, measurement of $L_{eq,1hr}$ of audible aircraft is somewhat difficult, but reasonably easy to predict with current available computer models. Hence, dose-response curves for both metrics have been developed to provide the tools necessary for measurement, analysis and mitigation of overflight noise problems in parks, see section 6.4. $L_{eq,1hr}$ is the computed dose that occurred during the hour that the visitor was at the site. Use of this dose for assessing a site assumes that the relationship between $L_{eq,1hr}$ and the actual dose received by the visitor at the site is similar to the relationship at the dose-response sites were the data were collected.*

4. *The response of annoyance rather than interference with enjoyment was chosen for two reasons. Primarily, annoyance is the metric of response that has been used for almost two decades to assess the impact of intruding sounds, and particularly aircraft sounds on humans. The use of annoyance thus continues a well-established approach. Second, visitor impact in terms of annoyance and in terms of interference with enjoyment have proven to be virtually identical, see for example Table 6.5. Curves were also developed for the dose of interference with the natural quiet and sounds of nature.*

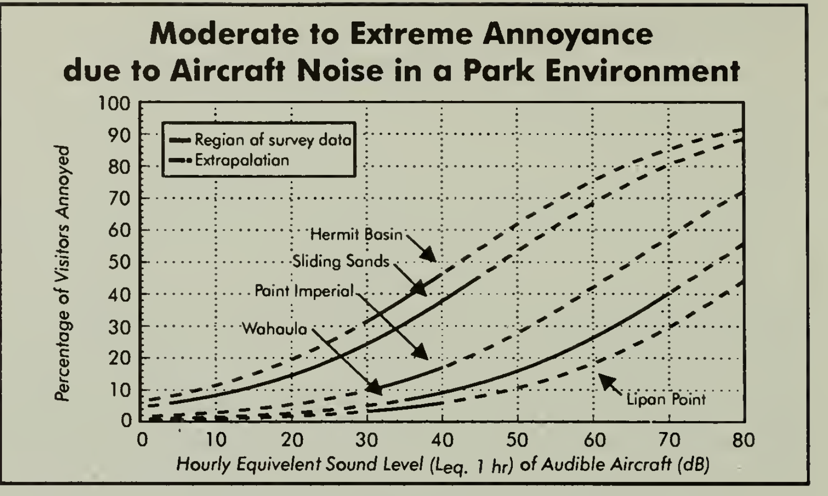

Figure 6.9: Dose-Response Curve for Visitor Annoyance vs Hourly Equivalent Sound Level

CONCLUSION 6.8:
Visitors report negative reoctions to the sound of oircroft ot specific sites, and these negative reports increose os exposure to oircroft sounds increase.

The dose-response curves, to the extent that they are applicable to a given site, can be used to predict visitor responses (impacts) by measuring (or predicting) dose. For example, if monitoring at a site similar to Sliding Sands shows aircraft audible about 30 percent of the time, then Figure 6.8 predicts that about 32 percent of the visitors will be annoyed. Alternatively, if $L_{eq,1hr}$ of 40 dB from audible aircraft were measured or predicted for the site, Figure 6.9 shows that about 37 percent of the visitors will be annoyed. Thus through measurement and/or prediction, the magnitude of the visitor impacts may be determined. Analytical methods can then be used to identify possible solutions. Section 6.4 below discusses such a monitoring, analysis and mitigation process in more detail.

CONCLUSION 6.9:
Dose-response curves quantify the relotionships between overflight sound levels ond visitor impocts. Not oll non-sound level foctors that influence visitor impacts can be identified, but sufficient informotion is ovoiloble that coreful use of the dose-response curves can identify sites likely to produce significont impocts on visitors.

These curves demonstrate that sound exposure, though an important variable, is not the sole determinant of impact on visitors. Not only do the impacts on visitors clearly vary considerably from one site to another, but statistical testing of the data has shown that several other specific factors affect visitor response. Though the importance of these factors varies depending upon which dose and which response are examined, some generalizations are possible. First time visitors to a site are less sensitive to aircraft sound than are repeat visitors; visitor "groups" of one or two people are more sensitive than are larger groups; visitors who thought enjoying the natural quiet and sounds of nature was a very or extremely important reason for visiting the site were more sensitive to aircraft sound than visitors who judged quiet and sounds of nature as less important. These three factors can have a significant effect on visitor response. Repeat visitors, or groups of 1 or 2, or visitors who rate quiet as very important respond as if the sound were about two to three times as long or about 20 dB louder when compared with first time visitors, larger groups, or visitors who do not so highly value quiet.

The dose-response data also suggest other factors that may be important in affecting how visitors respond, but lack of data prevented developing statistically verifiable results. The type of site is clearly important, since the curves vary from site to site; what is unknown is what characteristics of the site are important. For example, the non-aircraft sound levels at a site seem to affect response, the higher the non-aircraft sound levels, the less the visitor response. Sites that are more easily accessible seem to be visited by a population of visitors that are less sensitive to aircraft sounds; conversely, the less accessible sites, where visitors must walk some distance, may attract more sensitive groups of visitors. Virtually all overflights were light tour propeller and helicopter aircraft, flying at moderate altitudes (less than 1000 to 2000 feet, but generally higher than several hundred feet); visitor responses to aircraft at very high or very low altitudes, or to other types of aircraft, especially jets, are unknown. More data are needed if these factors are to be reliably identified and quantified.

6.4 Identification, Analysis and Mitigation of Impacts

When used in conjunction with NPS management judgement, the dose-response results provide a means for quantitatively identifying and rank ordering sites within parks that potentially produce significant impacts on visitors. This section presents in outline form a method that can be used for the process of identification, analysis and mitigation of the types of visitor impacts discussed in previous sections of this chapter.

6.4.1 Identification

NPS management judgement and priority setting provide the primary basis for initial identification of units of the National Park System likely to have areas where overflights are producing significant visitor impacts. Not only does the management perspective consider the purposes, resources and intended recreational opportunities of the parks but, as discussed above in section 6.3.1, the management perspective as reflected in the NPS management rankings of parks demonstrates some correlation with the impacts reported by visitors for the Visitor Survey parks. Hence, the first step in identification of potential problem areas is to use the management rankings of highest concern parks (50 to 100 parks), identify the top priority parks for problem solving, and then identify the most impacted sites within them.

Identifying candidate sites within the priority parks will require an orderly identification of site characteristics. Important criteria for consideration will include:

1. Frequency of Overflights – How many overflights per hour occur regularly during periods of visitation?
2. Visitation Rates – How many visitors per hour or per day pass through the candidate site?
3. Recreational Opportunity – What are the important dimensions of the intended opportunity: unobstructed views, solitude, remote location, transportation access, etc.?

Once candidate sites are identified, the dose-response curves based on the percent of time aircraft are audible can be used by park personnel to develop a quantitative evaluation of the site. Percent of time audible data can be easily collected and compared with an appropriate dose-response curve for the site. Ideally, the curve used would be the one derived from the dose-response site most similar to the site in question. However, to simplify selection of the appropriate curve, Figures 6.10 and 6.11 have been developed. Each provides a curve for two generic types of sites: short-hike (or backcountry) and overlooks (or front country) sites. The "Short-hike Sites" curves are derived from the results obtained at Hermit Basin, Sliding Sands Trail and Wahaula Temple, weighted for sample size and statistical reliability. The "Overlooks curves" are similarly derived from the Point Imperial and Lipan Point data.

Figure 6.10 is to be used for sites where preservation of natural quiet is not one of the primary concerns, while Figure 6.11 provides curves to be used for sites where preservation of natural quiet is very important.

Park personnel would collect time audible data, using a carefully designed sampling procedure, and compare the results to the appropriate curve to estimate the degree of impact. The NPS would set criteria for acceptable degrees of impact, identifying both maximum acceptable percentages and maximum acceptable numbers of visitors impacted for each type of site or activity. If these maximums are exceeded, the NPS would initiate a process of analysis and interaction with aircraft operators and other agencies (eg., the FAA, DOD, etc.) to eliminate or reduce the impacts.

The criteria for maximum acceptable impact would be developed by the NPS in terms of both percent of visitors to a site and numbers of visitors to a site. In terms of percent of visitors, a maximum acceptable value might be between 20 and 30 percent. Then, for example, where park measurements show a dose that results in more than 25 percent of visitors impacted, analysis and mitigation efforts would commence. Maximum acceptable numbers of visitors impacted would also be identified.

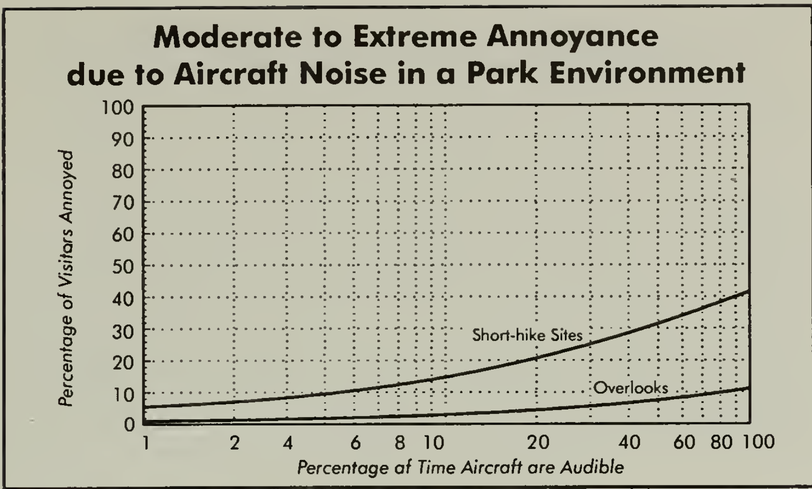

Figure 6.10: Dose-Response Curves for Estimating Impacts at Sites Preserving Visitor Enjoyment

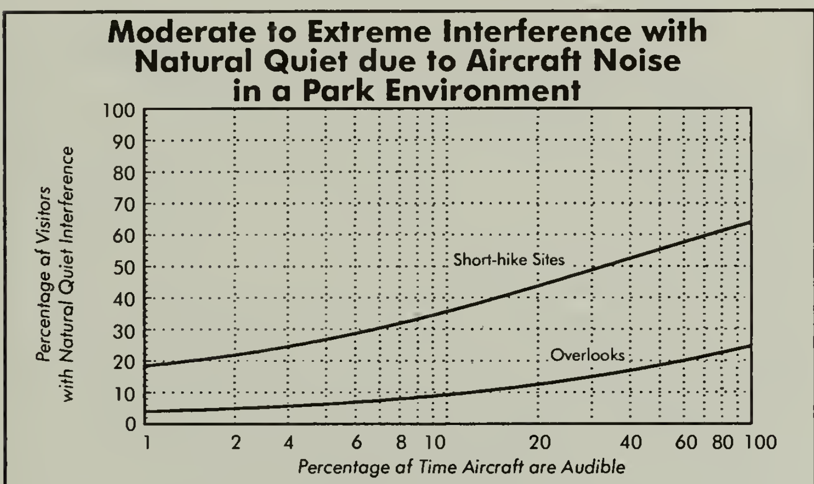

Figure 6.11: Dose-Response Curves for Estimating Impacts at Sites Preserving Natural Quiet

6.4.2 Analysis and Mitigation

A flexible approach to analysis and mitigation will be developed and pursued. In some cases, for example, discussions with aircraft operators may identify simple changes (for example re-routings of air tours) that can be tested, found to provide acceptable reductions of impact, and implemented. In other cases, detailed analyses of many alternatives may be necessary. In such cases, the simple time audible metric can no longer be used. This metric, as mentioned, is extremely difficult to predict, and the alternative dose-response curves using hourly equivalent sound level, $L_{eq,1hr}$, of audible aircraft will be employed.

Detailed analyses of aircraft produced sound levels have long been conducted for airports and military air facilities. These efforts have resulted in computer models that can predict, generally within acceptable tolerances, how sound levels on the ground will be altered by changes in airspace use. These models are being adapted or expanded to provide predictive capabilities for aircraft overflights of parks (Reddingius 1994). Using these computer models and information about airspace use including aircraft types, number of flights per day, location of flight corridors, altitudes of flights and terrain features, $L_{eq,1hr}$, can be computed for current operations and predicted for future or proposed operations, and Figures 6.12 or 6.13 can be used to estimate resulting visitor impacts.

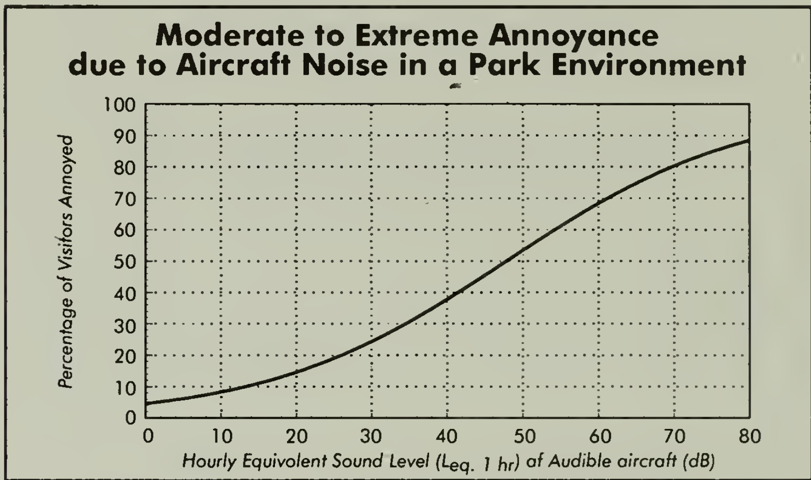

Figure 6.12: Dose-Response Curves for Analysis of Airspace at Sites Preserving Visitor Enjoyment

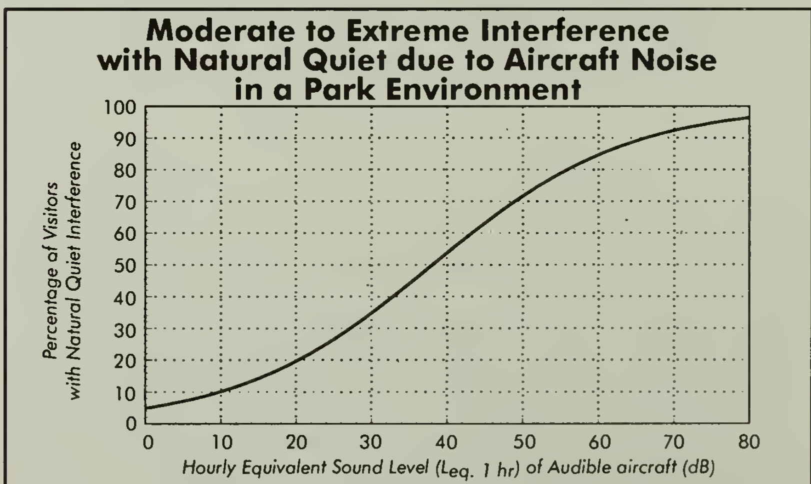

Figure 6.12: Dose-Response Curves for Analysis of Airspace at Sites Preserving Visitor Enjoyment

As discussed above, ideally the curve used would be the one derived from the dose-response site most similar to the site in question. However, since current understanding of all of the factors that distinguish one dose-response site from another is limited, the curves of Figures 6.12 and 6.13 are conservatively (in a protective sense) derived from the results for the study area that consistently had the highest level of visitor response for a given level of aircraft sound, Sliding Sands at Haleakala National Park. The curves for Sliding Sands are higher than those for Wahaula Temple, Point Imperial, and Lipan Point. The curves for Sliding Sands are slightly lower than those for Hermit Basin, but the Sliding Sands curves were chosen over those for Hermit Basin due to the larger sample size and greater range of $L_{eq,1hr}$ measured at Sliding Sands, see Table 6.7 and Figure 6.9.

Using the computer models, working with aircraft operators and appropriate other government agencies, NPS would quantify alternatives and identify effective, feasible changes that reduce visitor impacts to acceptable levels.

6.4.3 Limitations

There are some limitations to this approach to identification, analysis and mitigation, and these limitations derive from the limited data upon which the dose-response curves are based. NPS will recognize the following limitations in use of these curves.

1. **The curves are based on visits to specific areas, not visits to entire parks.** The study's data were collected on visitor reactions and sound levels in specific areas, and therefore should be applied to visits to specific areas only and not extended to an entire park visit. Many sites within a park may be individually considered, but there is no simple way to extend the results to overall visitor reactions that result at the end of a stay in a park.

2. **The curves are based on visits of relatively short duration.** All study areas were located where visitors were in the area for periods of 2 hours or less. The results have not been tested for visits of much longer duration, such as daylong or overnight stays, though sites with longer visit durations of up to four to five hours can probably be analyzed accurately.

3. **The curves apply to audible aircraft sounds only.** The dose-response curves, in terms of $L_{eq,1hr}$, are for use where aircraft are audible. Predictions of aircraft sound levels may not accurately account for all aspects of aircraft sound generation and propagation, so care must be used in developing estimates of $L_{eq,1hr}$ that take audibility into account. For example, moving aircraft flight corridors may result in some types of aircraft, or some portions of aircraft flight, becoming inaudible at a specific

site. This reduction in audibility must be incorporated into $L_{eq,1hr}$ if Figure 6.12 or 6.13 is to provide accurate estimates of impact.

4. **The curves are based on scenic parks.** The parks in which the data were collected all attract visitors for their scenic, natural qualities. At the selected study areas, visitors were hiking or sight-seeing outdoors. The background environments at these areas were primarily natural, although human noises and parking lot noises were present at the overlooks. The results can probably be used for other scenic natural parks with similar conditions, and for visitors participating in similar activities, but their applicability to sites with indoor activities or to strictly cultural or historic parks, or parks in urban or suburban areas has not been verified.

5. **The curves are based on tour aircraft in level flight.** Primarily light propeller and helicopter tour aircraft in level flight were observed during data collection. The results may be applied to similar conditions, but their applicability to jet aircraft, very large aircraft, or to areas where aircraft are noticeably climbing or descending has not been tested.

6.5 Summary

System-Wide

For the National Park System as a whole, about one-fifth of the visitors (88 million) report hearing or seeing aircraft, and 2 to 3 percent of all visitors (7 to 12 million visitors) report having their enjoyment interfered with, being annoyed or having their appreciation of natural quiet interfered with by the sound of aircraft. The NPS has a problem. It is not systemic with problems in every park. The number of parks and visitors impacted is limited. Rather, it is the case that serious problems are occurring in a limited number of parks scattered across the country in which pockets of visitors are impacted. It is a serious problem in search of a measured solution. The NPS considers it akin to the proverbial canary in the mine; finding solutions should not be delayed while the duration of the canary's song is measured.

Yet the complexity of park overflight problems does not lend itself to simple solutions such as setting minimum altitude restrictions for flights over all parks. A systematic approach is needed, but an approach that will focus on the most serious problems and have them understood in terms of impacts on visitors, individual parks, and specific locations within parks.

Individual Parks

Visitor impacts vary widely park to park. Low percentages of visitors impacted, however, cannot be taken to mean that there are no locations within a park where significant impacts occur. NPS management rankings show a modest, but recognizable correlation with visitor impacts.

The conclusion is that very different numbers of visitors report impacts from overflights, park to park, and that park management has been able to provide a reasonable rank ordering that shows some correspondence with these variations. Hence, out of a total of about 340 park units, there may actually be about 50 to 100 parks (6 PL 100-91 units, 49 Management Rank 1 units and 45 Management Rank 2 units) with overflight problems in need of investigation and remedy.

Specific Sites

All system-wide and park specific conclusions about impact on visitor enjoyment are based only on visitor responses with no knowledge of visitor exposure to aircraft sound. The site specific dose-response data provide both visitor response and aircraft sound exposure. These data show that visitors who are exposed to the sound of aircraft do report impacts, and that reports of impact increase with increasing exposure to aircraft sound. Further, reports of impact are dependent upon many factors that may or may not be related to the specific site. Such differences in response by sound exposure and by location have three major implications. First, lowering sound exposure will reduce impacts on visitors, meaning that some reduction of sound levels is beneficial even if total elimination of intruding aircraft sound cannot be achieved. Second, the NPS can set guidelines for minimizing impacts on visitors by selecting maximum acceptable percents and numbers of visitors impacted at a specific park site or for a specific recreational opportunity. Third, some areas and visitor activities are more important to isolate from overflights than others, meaning that moving overflights to less sensitive areas of a park may be warranted.

Chapter 7

AIRCRAFT OVERFLIGHTS AND SAFETY

Section 1(c) of Public Law 100-91 mandates that the National Park Service assess the safety of on-ground visitors relative to aircraft overflights:

> *"The research at each such [park] unit shall provide information and an evaluation regarding each of the following:*
>
> > *(1) the impacts of aircraft noise on the safety of the park system users, including hikers, rock-climbers, and boaters. . . ."*

The NPS addressed this question through the Park Manager Survey, the system-wide Visitor Survey, and by contacting numerous outdoor recreation organizations who might have knowledge of the issue. Results are discussed in the following sections.

7.1 Concerns of Park Management

Visitor safety is a major concern of NPS managers and park staff. In order to obtain the broadest possible perspective about these concerns as they may be related to aircraft overflights, the Park Manager Survey (HBRS, Inc., 1993) included questions about aircraft and visitor safety. Questionnaires were sent to 98 park managers whose units had previously been identified as having aircraft overflight concerns. Of the 98 parks, 91 provided detailed responses. The responses provided by these managers give insight into the nature and extent of the perceived problem in the National Park System. Although statistical inference cannot be made to the entire system, the NPS is confident that this information is representative of the nature and extent of agency concerns and certainly reflects those situations where aircraft overflights have generated a level of management concern.

Managers were asked their opinion on how much of a problem aircraft overflights posed to visitor and staff safety at their park. Figure 7.1 reports the results. Of the 91 parks responding, 62 percent of the managers either said that overflights were not a safety problem, or that they were only a slight problem. Another 20 percent indicated overflights were a moderate safety problem. The remaining 18 percent, however, responded that overflights were a serious or very serious safety problem. Table 7.1 identifies the parks where serious and very serious problems are perceived.

In the same survey, managers were also asked to provide some detail as to the nature of their safety concerns. Table 7.2 provides an alphabetical listing of the parks from Table 7.1, the nature of management's safety concerns, and the type of aircraft typically involved. This table shows a diverse range of safety issues. The NPS recommends that these situations be investigated by the FAA.

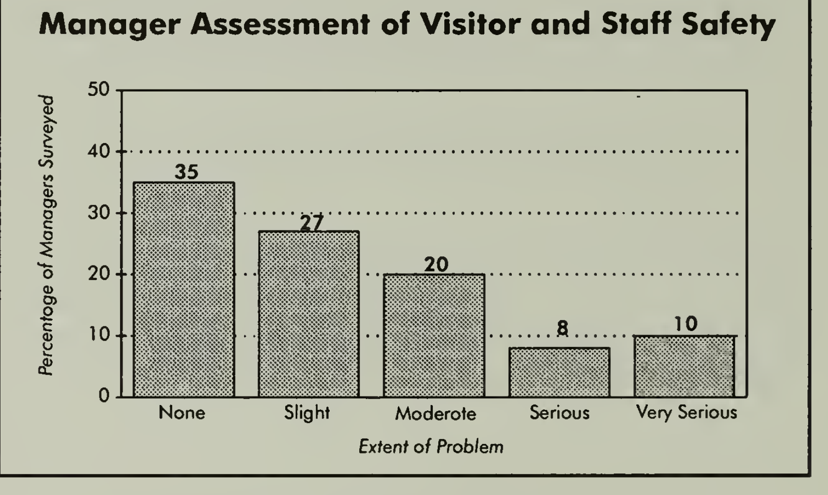

Figure 7.1: Manager Assessment of Visitor and Staff Safety

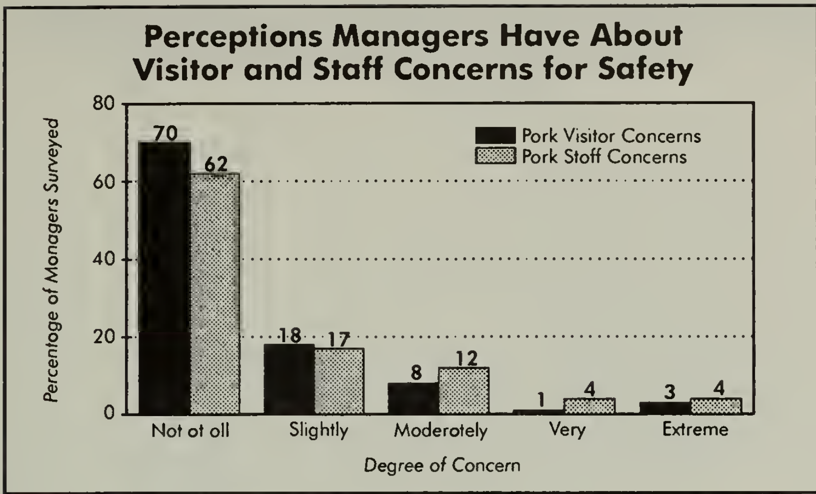

Figure 7.2: Perceptions Managers Have About Visitor and Staff Concerns for Safety

TABLE 7.1 PARKS WHERE SAFETY IS PERCEIVED AS A SERIOUS, OR VERY SERIOUS PROBLEM
VERY SERIOUS PROBLEM
Chaco Culture National Historic Park
City of Rocks National Reserve
Fort Vancouver National Historic Site
Gateway National Recreation Area
Glen Canyon National Recreation Area
Sequoia & Kings Canyon National Parks
Pipe Spring National Monument
Prince William Forest Park
Statue of Liberty National Monument
SERIOUS PROBLEM
Big Bend National Park
Bryce Canyon National Park
Channel Islands National Park
Fire Island National Seashore
Gulf Islands National Seashore
John Day Fossil Beds National Monument
Perry's Victory & International Peace Memorial

TABLE 7.2 VISITOR SAFETY CONCERNS REPORTED TO PARK MANAGEMENT DURING FY 1992		
PARK	SAFETY CONCERN	AIRCRAFT
Chaco Cultural National Historic Park	Low-flying aircraft	Propeller
City of Rocks National Preserve	Low-flying aircraft	Jet/Propeller
Fort Vancouver National Historic Site	Low-flying aircraft	Jet/Propeller
Gateway National Recreation Area	Visitor Safety & Aircraft Crashes	Helicopter
Glen Canyon National Recreation Area	Risk of Collision	Helo/Prop
Sequoia & Kings Canyon National Parks	Low-flying aircraft	Jet/Helo
Pipe Spring National Monument	Low-flying aircraft	Jet
Prince William Forest Park	Low-flying aircraft	Helo/Jet
Statue of Liberty National Monument	Visitor Safety & damage to monument	Helicopter
Great Smokey Mountains National Park	Low-flying aircraft spooked trail horses Collision Risk	Helicopter Helicopter
Big Bend National Park	Low flying aircraft spooked trail horses	Jet
Bryce Canyon National Park	Low-flying aircraft	Helicopter
Channel Islands National Park	Low flying aircraft	Propeller
Fire Island National Seashore	Low flying aircraft	Propeller
Gulf Islands National Seashore	Aircraft landing in park	Helicopter
John Day Fossil Beds Nat'l Monument	Low-flying aircraft	Jet/Prop
Perry's Victory & International Peace Memorial	Aircraft flying dangerously close to landmark	Helo/Prop

The NPS needs to further evaluate situations where moderate problems are perceived to exist. Moderate problem priorities would include Hawaii Volcanoes National Park where aircraft are believed to be flying dangerously low over visitors and molten lava and where visitors have been struck by gravel, wind, and rotor wash and the Great Smoky Mountains National Park where helicopters have been reported to have spooked trail horses and the superintendent is concerned about a possible mid-air collision.

The FAA is already looking at the safety situation in Hawaii where from 1991-1993 there have been 46 sightseeing aircraft and rotorcraft accidents resulting in 46 injuries and 37 fatalities. FAA inspectors have accompanied park rangers and resource managers to document instances of inappropriate and dangerous flying over Hawaii Volcanoes National Park, including flying through volcanic fumes and low over molten lava.

Managers were also asked to indicate the degree to which they perceive visitors and park staff are concerned about their own safety as a result of aircraft overflights over their park. The results are shown in Figure 7.2. In general, the result shows that managers believe visitor and staff concerns to be about the same. About 74 percent of the managers felt that staff and visitors were not concerned or were only slightly concerned about personal safety. Approximately 10 percent felt these two groups were moderately concerned; only 6 percent of the managers felt that visitors and staff were very or extremely concerned about safety in their park.

The difference in perception between managers and visitors is, in part, a function of the managers' responsibility for visitor safety, but it also may reflect the number of crashes that have occurred in NPS areas.[1] Through the survey, managers provided a listing of aircraft incidents (crashes) that occurred in their parks during the past 5 years. A summary of the information provided is presented in Figure 7.3. The figure shows the number of incidents, in terms of type of activity, reported by the managers. This figure shows blocks of varying heights which indicate the total number of incidents. Propeller-driven general aviation airplanes, propeller-driven sightseeing airplanes, and military jets were the types of aircraft most frequently involved.[2]

CONCLUSION 7.1:
Relatively few park managers perceive safety concerns to park visitors and staff from aircraft overflying their parks. Attention needs to be given to those few parks where serious or very serious safety issues are perceived.

7.2 Concerns of Park Visitors

Similar questions were included in the survey of park visitors that was conducted in 1992 (McDonald *et al.* 1994) at 39 parks representing the National Park System (excluding Alaska). In the mail survey that was sent to selected survey participants were questions relating to visitors' perceptions on safety from aircraft flying overhead.

In one series of questions, visitors were asked how hearing or seeing aircraft affected their visit to the park. A specific question asked how concerned they were about their safety from aircraft flying overhead. The responses are shown in Figure 7.4. Visitors indicated their degree of concern by selecting one of the five categories shown at the bottom of the graph. The figure shows that 99 percent of the respondents were either not at all or only slightly concerned. Just 1 percent of the visitors reported being moderately concerned about their safety, and none reported being very or extremely concerned. This is a good indicator that any safety problems are occurring in relatively few places and very infrequently at that. The greater degree of concern among managers as compared to visitors is also undoubtedly related to a long term exposure to overflight incidents and their overall responsibility for visitor safety. Short-term visitors simply don't have that exposure or responsibility.

1. *It is the understanding of the NPS that all these incidents were reported to the FAA and investigated by the National Transportation Safety Board (NTSB).*

2. *Miscellaneous incidents include those involving ultra-light aircraft, a glider, a hot air balloon, and a blimp whose tether line struck the Statue of Liberty.*

In a counter-question, visitors were also asked if aircraft overflights made them *feel safer* in case they needed rescue. Figure 7.5 shows the responses. For this question, 90 percent of the respondents said that aircraft proximity did not increase their feeling of safety, or if so only slightly. However, 10 percent of the visitors *did* report an increased feeling of safety, to a "moderate", "very", or "extreme" degree.

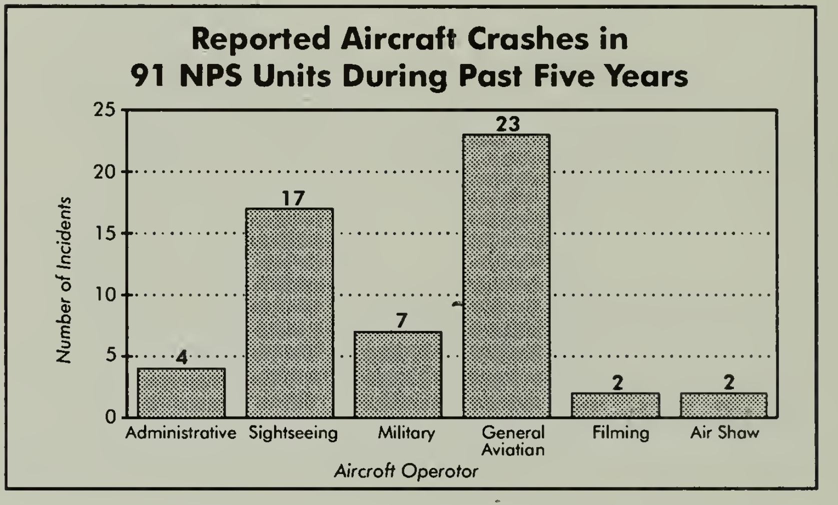

Figure 7.3: Reported Aircraft Crashes in 91 NPS Units During the Past Five Years

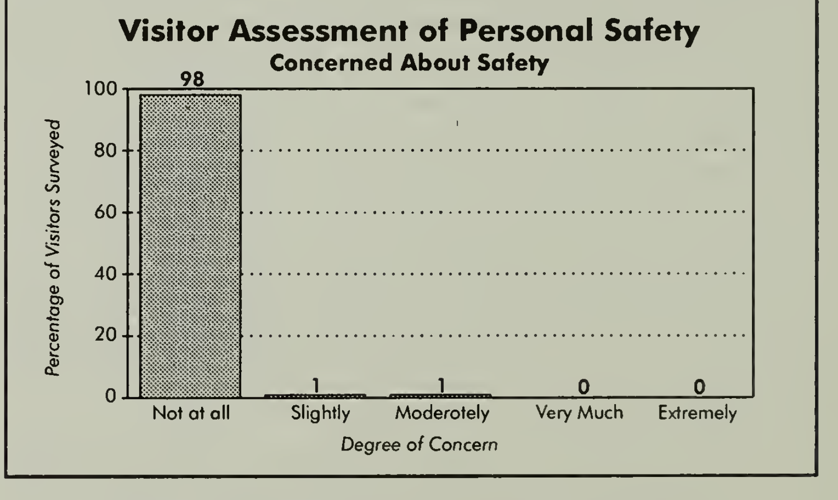

Figure 7.4: Visitor Assessment of Decreased Feelings of Safety Due to Aircraft Operations

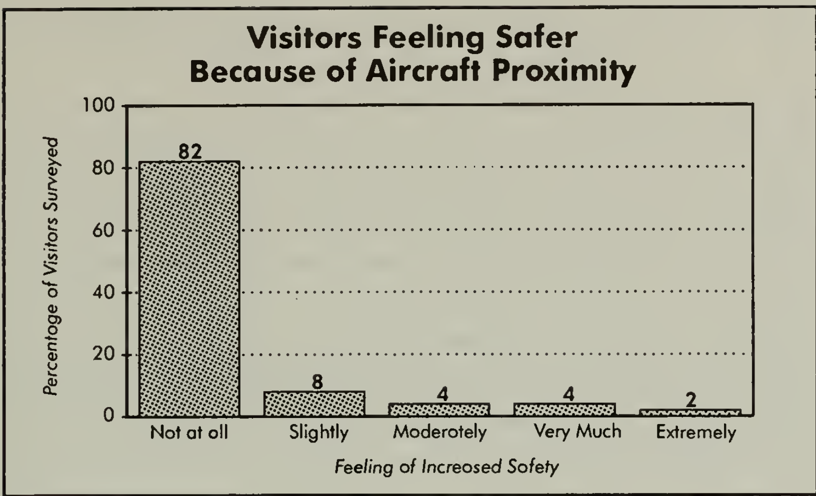

Figure 7.5: Visitor Assessment of Increased Feelings of Safety From Aircraft Overflights

CONCLUSION 7.2:
Virtually no visitors perceive concern for their safety from aircraft overflights, an indicator suggesting that any safety problems are occurring in relatively few places and infrequently.

7.3 Outdoor Recreation Community Concerns

In 1993 the NPS wrote to a broad array of outdoor recreation groups to inquire whether they could identify any on-the-ground safety issues related to aircraft overflights of the National Park System during the last 10 years. Groups contacted included, among others, the following organizations:

American Alpine Club
The Wilderness Society
Colorado Mountain Club
Sierra Club
American Mountain Guides Association
National Outdoor Leadership School
Colorado Outward Bound
Backcountry Horseman of America

A limited number of written and verbal responses were received. Most of the comments dealt with the startle effect of aircraft on themselves, clients, or friends. No serious or lasting injuries were reported. Several comments dealt with the inherent incompatibility of horses and helicopters and offered examples of this incompatibility. The writers of the letters also used the opportunity to voice concern about wildlife harassment by aircraft and the impact of aircraft on visitors' experience in remote areas of parks.

CONCLUSION 7.3:
Although some outdoor recreation organizations indicated a low level of concern on safety related to aircraft overflights, this level again suggests local or infrequent problems as well as concerns for other types of impacts. Ensuring a segregation between helicopters and horse traffic in some situations may be desirable.

7.4 Temporary Flight Restriction (TFR) Problems

Low-level airspace over public lands can sometimes be very busy. This airspace can be attractive to air tour operators as well as to general aviation. It is at these altitudes that much military tactical training occurs. They are the same altitudes where the NPS and other land management agencies conduct wildlife surveys, animal capture and control flights, law enforcement flights and aerial firefighting. The potential for conflict is significant, especially in bad fire years. In 1992, 59 airspace conflicts involving Department of the Interior aircraft were reported. Of these, 39 were near mid-air collisions —11 with military aircraft and 28 with civilian aircraft. Characteristically, conflicts with military aircraft generally occur in the Western United States where there is a concentration of military training routes and military operations areas. Conflicts with civilian aircraft more often occur in the higher density air traffic areas along the Eastern seaboard.

The FAA, Department of Defense, and Department of the Interior have already begun to work on this issue. Apparently the key to resolving this safety problem is dissemination of the Temporary Flight Restriction (TFR) information to pilots who are already in the air when the notice is issued. TFR's are issued through the FAA (Federal Aviation Regulation 91.37A) and distributed to pilots using FAA's "Notice to Airmen" (NOTAM) system. Great numbers of these NOTAMs are issued every day dealing with a myriad of topics which make it difficult for pilots to identify which ones will affect their routes. This is especially true of military pilots who may be flying across the country.

Communication is the crux of the issue. Direct coordination, especially with the military would help, but it is difficult for the NPS and other land management agencies to know with whom they should talk. A simple, national level system is needed to rapidly disseminate airspace information to all pilots. Progress has been made:

CONCLUSION 7.4:
As airspace over public lands becomes more congested, the potential for conflicts is increasing. Although progress is being made in resolving these airspace issues, the 39 near-misses in 1992 indicate the need for improved communication links at an operational level between FAA, Department of Defense agencies, the NPS and other land management agencies.

- The Bureau of Land Management and the Forest Service are developing a "Computer-aided Aviation Hazard Identification System" (CAHIS) to assist natural resource agencies in planning air operations in areas which have a high volume of military activity.
- The Department of the Interior has petitioned the FAA to create a separate and distinct transponder code to be used by natural resource aircraft for radar identification. This transponder code would be available in the near future.
- The Department of Defense is exploring communication links for scheduling military training routes and special use airspace.

7.5 Summary

There is no evidence of any serious or wide spread safety problem for on-ground visitors or park employees tied to aircraft overflight. There are problems in a limited number of areas that should to be addressed. Problems in a number of other areas should be evaluated further. Only a few managers and virtually no visitors perceived any safety problem related to aircraft overflight. Some elements in the outdoor recreation community expressed concern, but the incidents triggering these concerns are probably isolated and could be dealt with in the context of a better reporting system. Procedures and communications are currently lacking, and this is a problem that the involved agencies can address if they are willing to work together to prevent problems. The potential seriousness of the situation should not, however, be ignored. On the Pacific Crest Trail in 1988, an Oregon couple were thrown from their horses as a result of a low-level flight; the man had a fractured skull and his wife broke her back, collarbone, and a rib.

The NPS and other land management agencies should work with the DOD and FAA to develop procedures for use in dealing with the airspace/park use issues that occur in complex airspace (i.e special use airspace, military operations areas and military training routes) especially during fire fighting or other major incidents. Important steps have been taken, but communications at an operational level should be significantly improved.

Chapter
8

VALUES ASSOCIATED WITH AIRCRAFT OVERFLIGHTS

Section 1 of Public Law 100-91 mandates that the National Park Service assess the values associated with aircraft overflights of parks:

> *"The research at each such [park] unit shall provide information and an evaluation regarding each of the following. . .*
>
> > *"(4) the values associated with aircraft flights over such units of the National Park System in terms of visitor enjoyment, the protection of persons or property, search and rescue operations and fire fighting."*[1]

The NPS interpreted this to mean that it should assess the values associated with administrative and air-tour overflights, and that military, commercial, and general aviation flight activity should not be included within the scope of investigation. Consequently, this chapter reports on four topics: the values accruing to parks and park visitors from the NPS administrative overflights, the values associated with air tour flights of parks, the value of the air tour industry to local economies, and the values associated with aerial movie filming.

8.1 Values Associated with Administrative Use of Aircraft

Many units of the National Park System use aircraft to assist with management activities. Whether chartered, leased, or owned by the NPS, these aircraft must overfly the park by the very nature of their duties. Across the National Park System, in a twelve month period between 1992 and 1993, the NPS logged 19,133 hours of aircraft use. The Park Manager Survey (HBRS, Inc., 1993) to the subset of 98 parks indicating some type of aircraft overflight problem provides more insight about the NPS use of aircraft. The responses from the 91 parks that returned completed questionnaires are examined in this section.

In the survey, managers were first asked whether their park ever used aircraft in an administrative capacity; sixty-five percent of the parks surveyed reported using aircraft, almost twice as many as did not. Querying further, the questionnaire asked those managers answering in the affirmative what type of aircraft were used (helicopter or fixed-wing). Virtually all the parks surveyed used helicopters, and approximately 3/4 of the parks surveyed use fixed-wing aircraft. The majority of parks use both types of aircraft. (For the National Park System as a whole, administrative uses of aircraft accounted for 11,595 hours in fixed-wing aircraft and 7,548 hours in helicopters.)

Managers were then asked what sorts of management activities most often employed the use of aircraft. Seven activities were consistently named by managers. Figure 8.1 identifies these activities. The figure also shows the percentage of parks that use aircraft in support of each activity. For each of the seven activities, over 50 percent of the parks used aircraft in support of the activity during the prior year. The two most frequently mentioned activities were search and rescue, and resource management. [Compared to systemwide flying, parks in this sampled subset of parks did more flying for fire fighting and law enforcement and less for administrative, maintenance, and search and rescue purposes.]

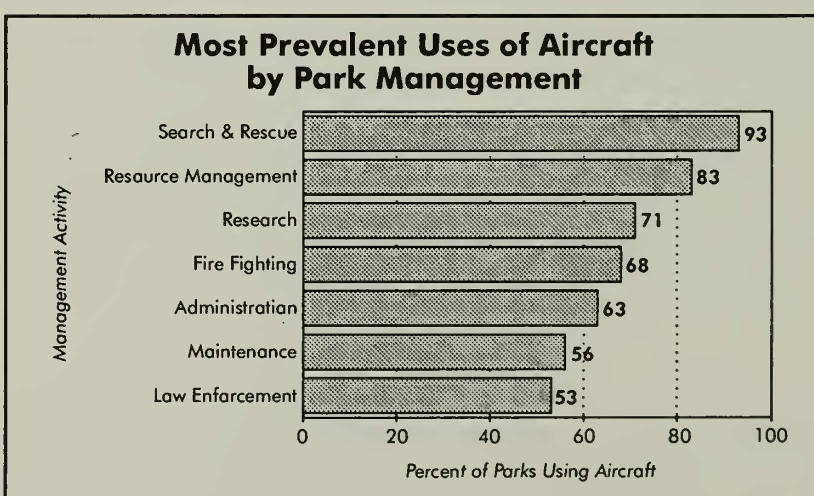

Figure 8.1: Most Prevalent Uses of Aircraft by NPS Park Management

To ascertain the extent to which aircraft are used for these management activities by individual parks, managers were asked to provide the number of flying hours their park logged in support of each activity. Figures 8.2 and 8.3 summarize the manager's responses. Figure 8.2 shows annual helicopter flight hours, and Figure 8.3 shows annual fixed-wing flight hours. Each of the averages for each management activity were obtained by including the hours of just those parks reporting the use of aircraft in support of that activity. Hence, for those parks that use helicopters to assist in law enforcement, the average reported number of annual flying hours was 27. For parks using fixed-wing aircraft for law enforcement, the average number of flying hours was 39. It should be noted that in general managers reported the overflights by aircraft on park business (for management purposes or emergencies) make up a small fraction of all overflights (see Chapter 2, Section 2.1.1).

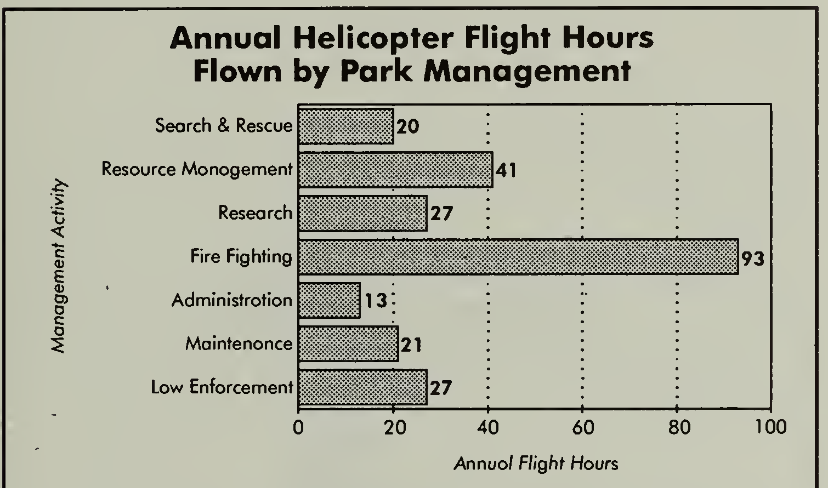

Figure 8.2: Annual Helicopter Flight Hours Flown by NPS Park Management

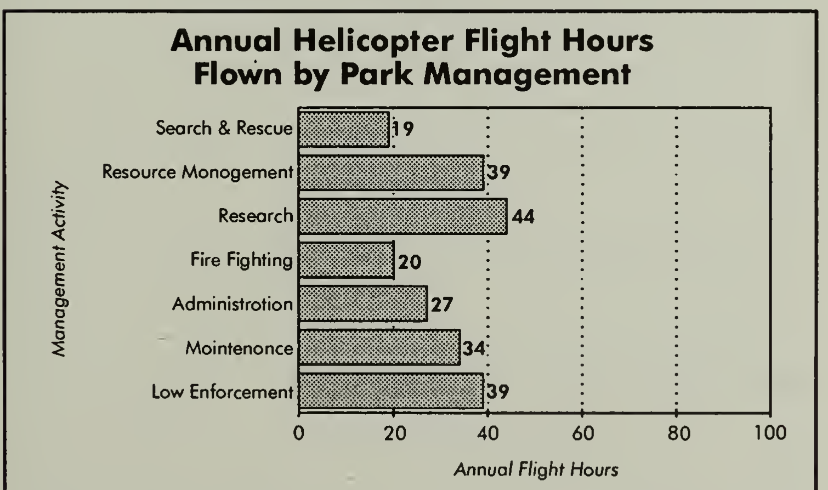

Figure 8.3: Annual Fixed Wing Flight Hours Flown by NPS Park Management

CONCLUSION 8.1: NPS managers believe that aviation is essential to the management of many national parks. Parks and visitors benefit from the administrative use of aircraft for search and rescue, science and resource management, firefighting, law enforcement, maintenance, etc.

Fire fighting clearly involved the greatest number of flying hours, with helicopters rather than fixed-wing showing the bulk of the hours. The remainder of the management activities involve substantially less use of aircraft.

8.2 Values Associated with Aerial Tourism

Historically, air tour passengers have not been formally considered as "park visitors." Nonetheless, a large number of people do see Grand Canyon, Haleakala, Hawaii Volcanoes, and other national parks from the air. This section explores the results of a survey of air tour passengers from the Grand Canyon, Haleakala, and Hawaii Volcanoes National Parks (McDonald *et al.* 1994). Figure 8.4 shows estimates of annual visitation by land and by air for these parks. Bars show the ground visitation (number of people entering the park through roadway entrance stations). The other bars show air visitation (the number of air tour passenger-trips, to the extent that it can be estimated). The figure suggest that a sizable minority of visitors take advantage of the opportunity to view these parks, especially the Grand Canyon, by air.

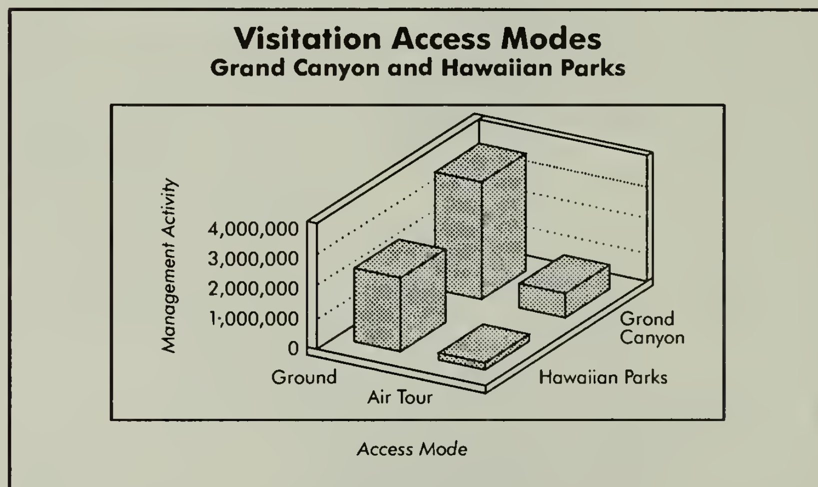

Figure 8.4: Relative Visitation Access Modes for Grand Canyon and Hawaiian Parks

8.2.1 Tour Passenger Survey Results

The Air Tour Passenger Survey results must be interpreted with great caution because of sampling problems that occurred during the study. During the fall of 1992 a survey of air tour passengers was conducted for these three parks.

A questionnaire was mailed to randomly selected passengers after they completed their flights. But the extent to which inference can be made to air tour passengers over these parks is suspect due to a lack of cooperation by major segments of the air tour industry. The manner in which cooperating air tour companies collected names (asking for volunteers from their clients rather than providing the NPS a complete list of clients from which to sample) introduced the possibility of bias in the sample. As a result, the NPS abandoned an attempt to survey air tour passenger elsewhere in the country during the summer of 1993. The following results from the survey should be read and understood in that context.

Enjoyment and Appreciation of Park. The results of the survey showed that overall enjoyment was rated high by most passengers. Figure 8.5 shows that over 95 percent of the passengers felt their flights were “moderately,” “very,” or “extremely” enjoyable. Almost 50 percent of the passengers rated enjoyment in the “extreme” category alone.

When asked how much their appreciation of the park had increased as a result of their flight, passengers showed similar feelings of enthusiasm. Figure 8.6 shows that over 95 percent of the passengers reported their appreciation had been increased by a moderate to an extreme degree. When asked if they would recommend the flight to others, the trend continued, with over 95 percent of the passengers providing positive responses (Figure 8.7). Perhaps a part of this enthusiasm can be explained by the fact that this was the first air tour for most of the passengers surveyed. Figure 8.8 shows that over 95 percent of the passengers were experiencing their first air tour of a national park.

Reasons for Taking Air Tours. The survey asked passengers the main reason they took an air tour. Figure 8.9 shows that more than one-half of the passengers reported the unique perspective afforded by the tour to be the primary reason. The second most frequently mentioned main reason was that the air tour afforded a fast means for seeing large expanses of the park. The third most frequently cited reason was the novelty of the air tour. Fourth, health or physical disabilities were identified, as well as a variety of other reasons.

The survey also asked passengers about other factors that influenced their decision to take an air tour. Figures 8.10, 8.11 and 8.12 show the reported importance of time constraints, a desire for a unique perspective, and health limitations. The unique perspective was the most important reason given for making the flight.

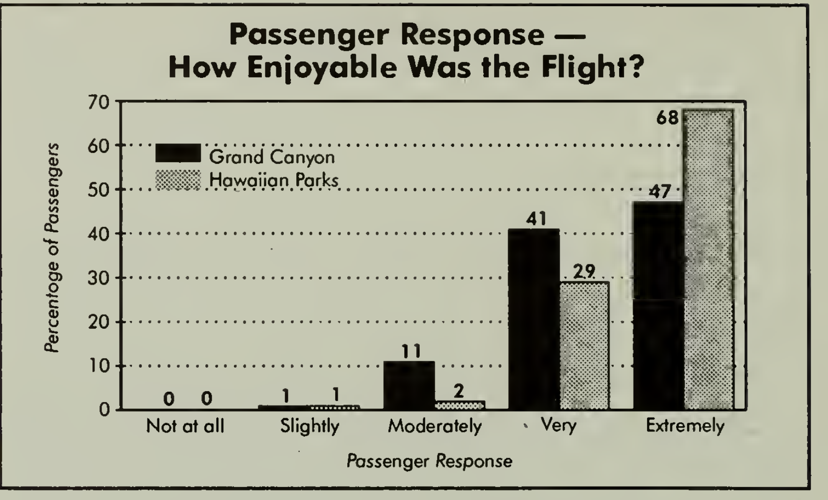

Figure 8.5: Passenger Reports of Air Tour Enjoyment

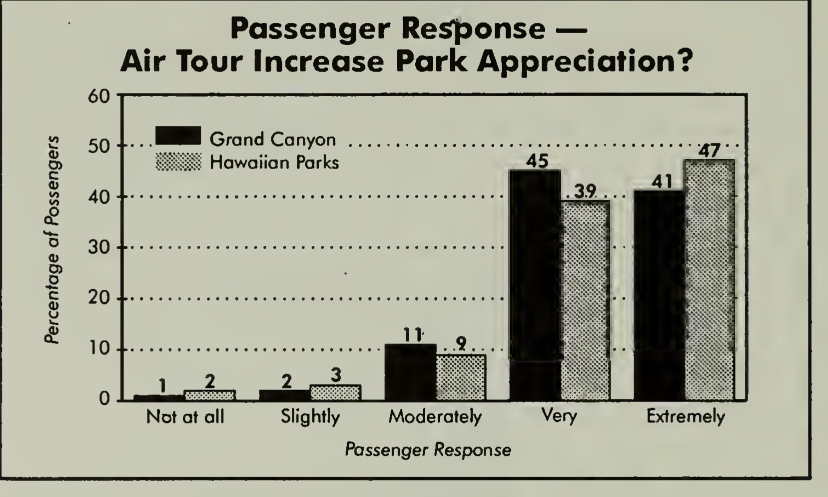

Figure 8.6: Passenger Reports of Increased Appreciation of Park from Air Tours

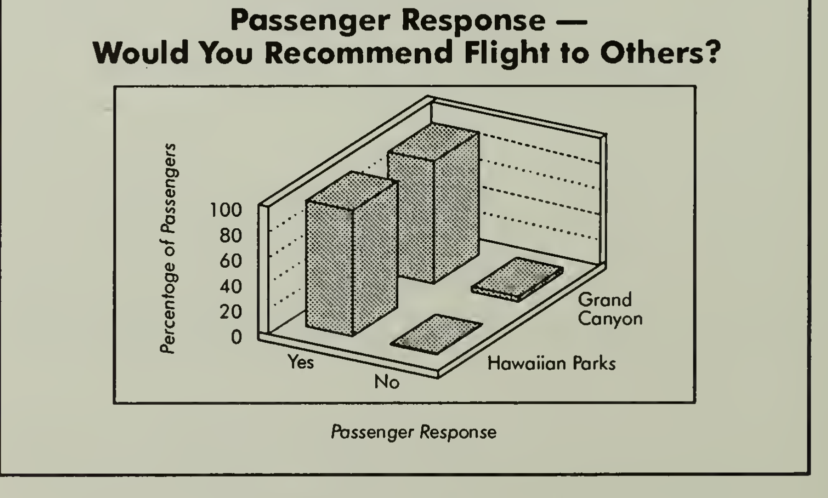

Figure 8.7: Passenger Willingness to Recommend Air Tours to Others

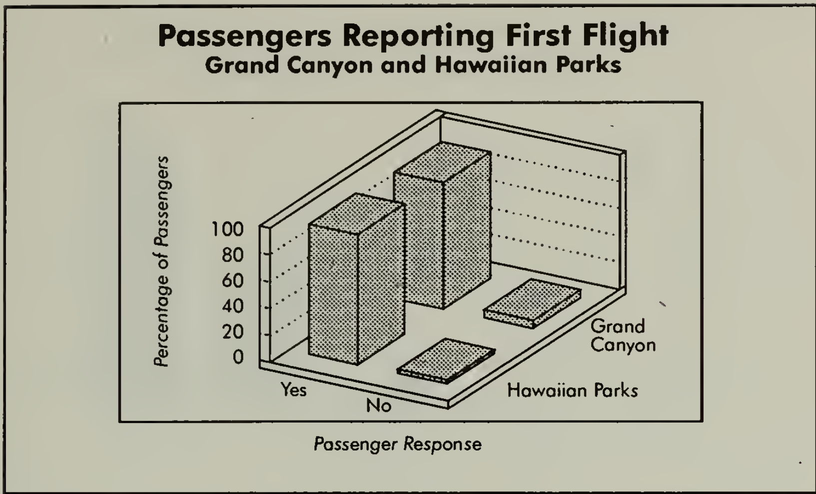

Figure 8.8: Percentage of First Time Passengers on Air Tours

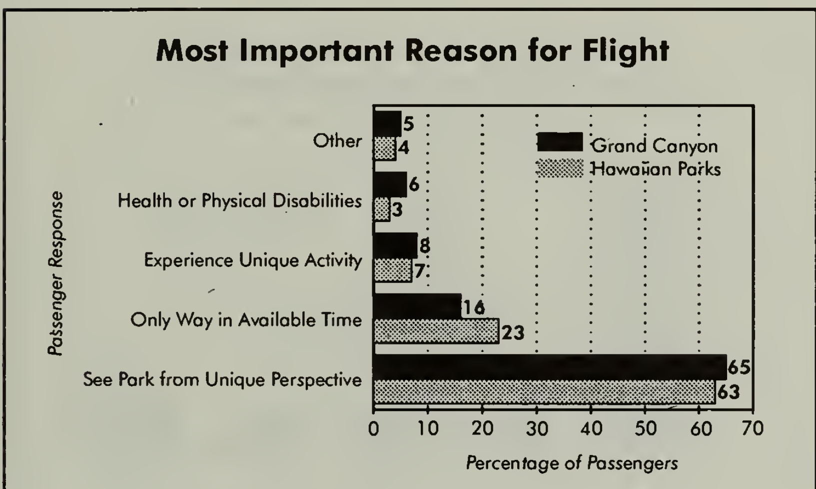

Figure 8.9: Passengers' Primary Reasons for Taking Air Tour

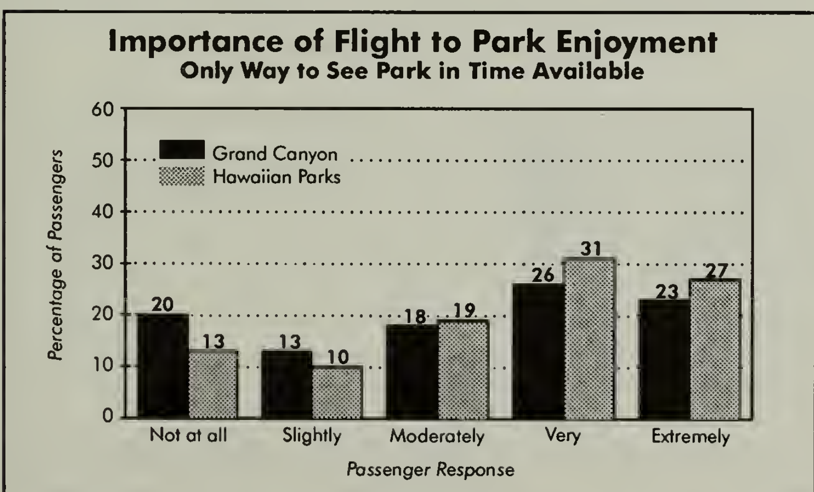

Figure 8.10: Importance of Time Constraints as a Reason for Taking Air Tour

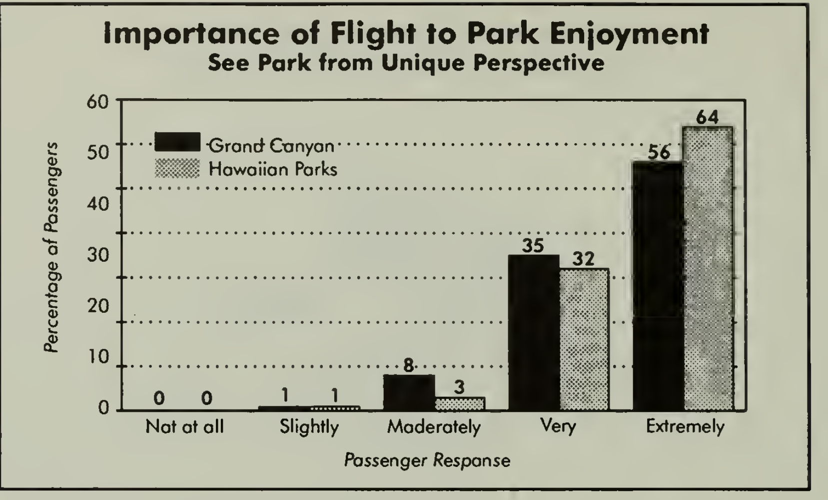

Figure 8.11: Importance of Unique Perspective as a Reason for Taking Air Tour

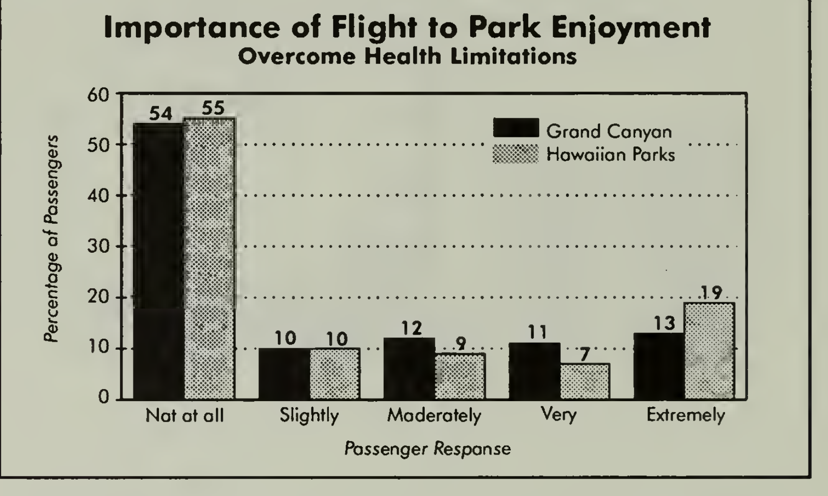

Figure 8.12: Importance of Health Limitations as a Reason for Taking Air Tour

Visiting the Park on the Ground. The findings presented thus far show reasonable consistency between the Hawaiian parks and Grand Canyon. One finding of the survey which was *not* consistent across the parks was the proportion of tour passengers who had (or were about to) tour the park on the ground. The results differed significantly. Figure 8.13 shows that the proportion of Grand Canyon passengers also touring on the ground to be about 90 percent. In the Hawaii parks, however, this proportion drops to about 30 percent.

Air tour passengers who were also touring the park on the ground during their visit were asked to rate separately the importance of the air tour and the importance of the ground tour to their overall enjoyment of the park.

Figures 8.14 and 8.15, respectively, show the passengers' responses. Over 90 percent of passengers reported moderate to extreme importance for both visitation modes, with little preference for one mode over the other. Neither was there a dramatic difference in preference between the Grand Canyon and the Hawaiian parks, though the Grand Canyon passengers show a slight weighting toward the importance of the ground tour versus the air tour, while the Hawaiian passengers report somewhat more importance for the air tour.

Judgments of Impacts to Visitors on the Ground. Finally, passengers were asked about their impressions of how disruptive air tour flights were to visitors on the ground. Figure 8.16 shows that approximately 75 percent of air tour passengers feel these flights are minimally disruptive ("Not at all" or "Slightly"). Only 10 percent expressed the opinion that air tour flights were moderately to extremely disruptive.

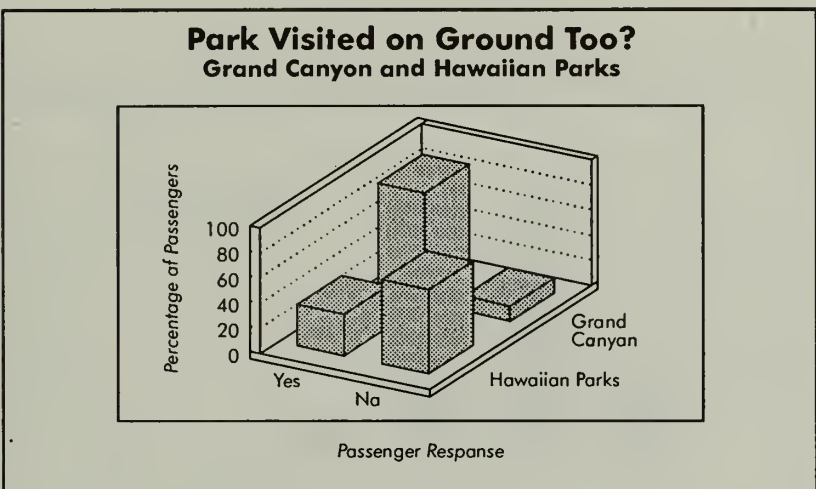

Figure 8.13: Passengers' Plans for Touring Park on the Ground as Well

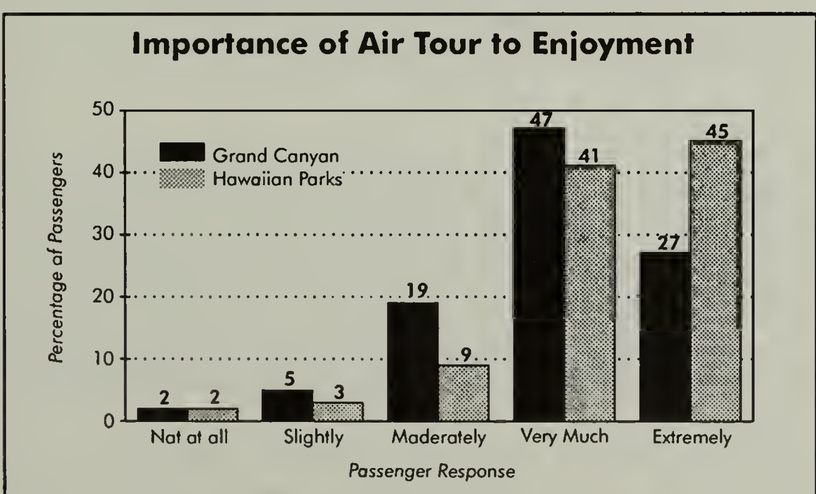

Figure 8.14: Passenger Reports of Importance of Air Tour to Overall Enjoyment of the Park

CONCLUSION 8.2:
Air tour passengers surveyed indicated immense enjoyment from their tour experiences, would recommend the tour to others, and believed it increased their appreciation of the park.

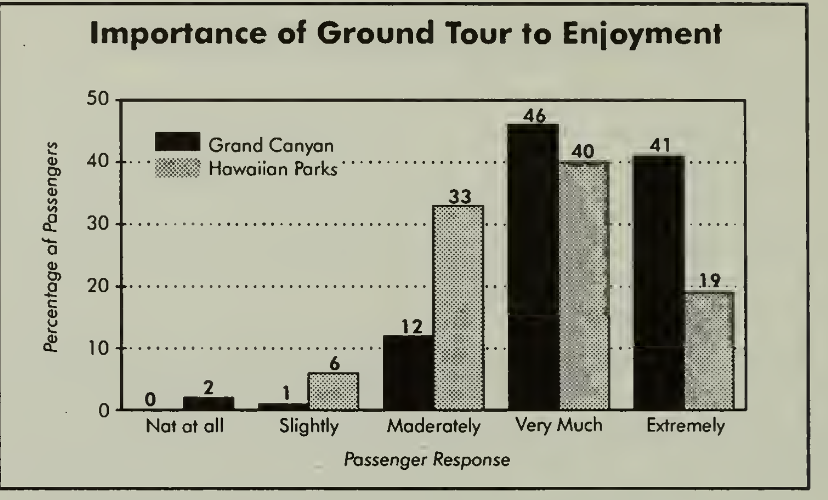

Figure 8.15: Passenger Reports of Importance of Ground Tour to Overall Enjoyment of the Park

CONCLUSION 8.3:
Unique perspective and time constraints were the most important reasons for taking flights over parks. Health reasons were less important though not an insignificant consideration.

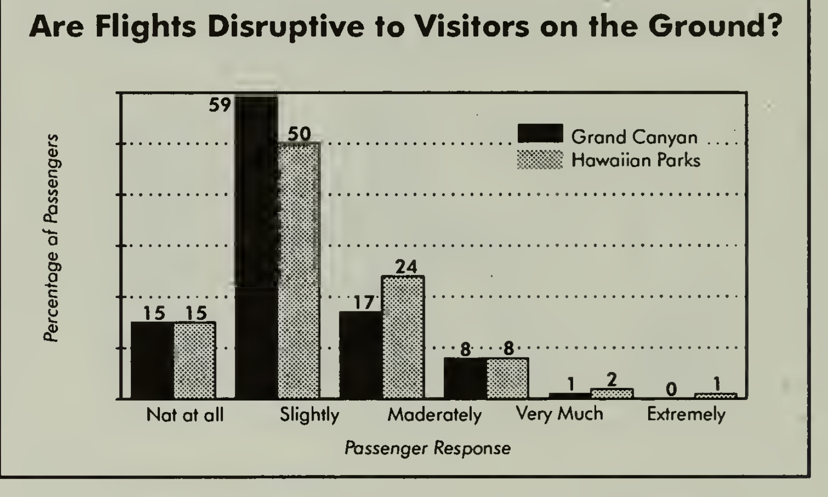

Figure 8.16: Passengers' Assessment of Disruptive Impact of Air Tours to Ground Visitors

CONCLUSION 8.4:
Air tour passengers over the Grand Canyon typically also visit that park using ground transportation, while those in Hawaii do not.

Figure 8.17 shows passengers' opinions about the tradeoff between the benefits of air tours and the disruptive effects they may cause on the ground. Passengers were asked to respond to the statement that "Benefits to tour passengers outweigh disturbances on the ground." Approximately 30 percent gave a neutral response. On either side of neutral, about 55 percent agreed or strongly agreed with the statement, and only about 15 percent disagreed or strongly disagreed.

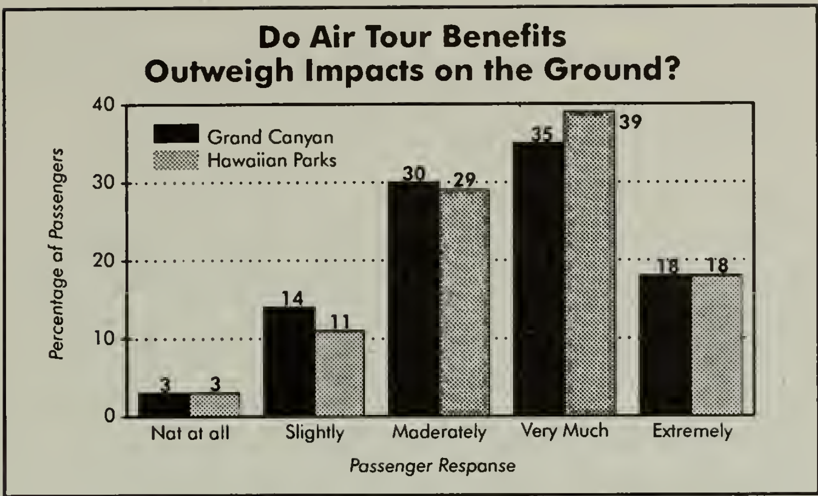

Figure 8.17: Passengers' Assessment of Whether Air Tour Benefits Outweigh Impacts on the Ground

CONCLUSION 8.5:
Air tour passengers do not think tours cause an impact to visitors on the ground.

8.2.2 Are Air Tour Passengers Park Visitors?

To the extent that these results are accurate, they confirm what tour operators assert: most air tour passengers enjoy immensely their tour experiences, would recommend such tours to others, and believe the tours significantly increased their appreciation of the park. In a sense, these passengers enjoy some of the same qualities the park has to offer on-ground park visitors. Some air tour operators assert that their passengers are indeed park visitors and these operators are proud of their contribution to visitor enjoyment of parks.

But for the NPS, there is a difference. For all ground visitors, the NPS is able to regulate numbers and types of visitor activities in the parks in order to preserve resources and ensure quality visitor experiences. Numbers of raft trips in the Grand Canyon and other parks are limited, with waiting lists of many years.

The number of backcountry use permits issued each year is limited. The number of camp sites is limited as are numbers of hotel or lodge rooms or cabins. The purpose of these NPS activities is to limit the adverse impacts one visitor activity has on others and on the park itself. The purpose of parks is to preserve resources and ensure that succeeding generations have a chance to experience the same types of opportunities. Anything less is an abrogation of NPS responsibility to preserve and protect the parks.

Air tour operators have consistently objected to NPS efforts to work with the FAA in protecting park values and resources. They argue that the NPS has no right or responsibility to be involved in influencing airspace management.

They also proclaim that air tours cause the fewest environmental impacts of all methods by which the parks may be seen or appreciated, ignoring the fact that many air tour passengers impact the park twice — first from the air and later when they visit on the ground.

The NPS perspective is that there are impacts to visitors from aircraft overflights, as discussed in Chapter 6. These impacts vary depending upon location, visitor activity, aircraft-produced sound exposure, ambient sound levels, and other factors, but roughly 30 to 40 percent of Grand Canyon backcountry visitors reported moderate to extreme annoyance with the sound of aircraft, and 40 to 50 percent reported that the sound of aircraft interfered with their appreciation of natural quiet, see Figure 6.1. Additionally, Chapter 3 showed that, primarily because of the low non-aircraft ambient sound levels in parks, even distant aircraft can be easily heard. Hence, overflights do produce impacts, both directly on visitors as well as on the natural quiet resource provided by parks to ground-based visitors.

Perhaps this dichotomy between people who enjoy air tours over national parks and people who find that overflights impair their enjoyment of the parks is ironically summarized by the responses to one of the questions in the Visitors Survey discussed in Chapter 6. Upon being asked how hearing or seeing aircraft affected their visit to the park, about 20 percent said they felt like complaining to somebody, and about 20 percent said it made them want to view the park from the air (McDonald *et al.* 1994).

Air tours do offer access to parks and provide for enjoyment of those parks. But the access produces impacts on other visitors and on the park. While the NPS has traditionally managed visitor use to conserve the parks and provide for their enjoyment by current and future generations of visitors, the FAA has sole control over all airspace and over the activities of aircraft owners and operators. The NPS and the FAA face two basic choices for dealing with this situation:

Cooperation: The two agencies can cooperate in reducing the impacts of air tours on parks and maintaining the benefits provided by air tours in a way that maximizes the safe and efficient use of the airspace. An example of this would be an FAA permit process for air tour operations utilizing and marketing NPS resources in which the NPS superintendent would be required to sign off that the operation was beneficial to park visitors and park transportation needs, and/or not an impact to the park or park visitors in the locations proposed.

Legislation: The alternative is that "cooperation" can be legislatively accomplished when the problem reaches unmanageable proportions. Evidence that some do not have confidence in the ability of the two agencies to cooperate is evidenced by three proposals for legislation (See Appendix C):

> ***H.R. 1696:*** Hawaii Overflight Protection Act, a bill that would protect the parks in Hawaii by requiring specified stand-off distances and minimum altitude zones over those parks;
>
> ***H.R. 4163:*** National Park Scenic Overflight Concessions Act of 1994, a bill to enable the Park Service to regulate, or prohibit, scenic commercial overflights at units of the National Park System as it does other services provided in parks;
>
> ***S. 2428:*** National Parks Airspace Management Act of 1994, a bill that would provide for the regulation of the airspace over National Park Service lands in the United States by the FAA in consultation with the NPS.

As a part of this study, a legal review of FAA and NPS authorities was conducted (See Appendix D). Between the two agencies, legal authorities appear to be adequate to address the impacts identified in this report. So the real question is whether and how these authorities are applied to the identified impacts.

8.3 Value of Overflights to Local Economies

Limited information is available on the economics of air tourism in the United States, especially over national parks. It is privileged economic data that the FAA does not collect. Based on industry reports, the economic impact of Grand Canyon air tours alone is two hundred and fifty million dollars ($250,000,000). The industry in Hawaii is apparently very nearly as large, and there is a sizable industry in other parts of the country including New York, St. Louis, and Southeastern Alaska. The FAA estimates that there are at least 187 air tours operators across the nation. This suggests the total economic impact of the industry is in the range of one-half to three-quarters of a billion dollars a year.

8.4 Values and Impacts of Aerial Filming

A substantial amount of aerial filming is completed in units of the National Park System, although again, there is no readily accessible information on its extent. The NPS tends to be responsive to filming requests of all types that are non-degrading to the parks or the visitor experience. Yet it is worth noting that overflight impacts can occur as a result of these activities as well. An example is illustrative.

In October, 1993, a regional film company was issued a commercial film permit to make an IMAX-style film that focused heavily on one of the national parks in Utah. In order to protect park values of silence and solitude and to protect threatened and endangered species, the permit from the park contained a stipulation that no filming by fixed wing or helicopter would be allowed. A $25,000 performance bond was posted and then returned when the filming was completed. In early March, 1994, park rangers noted unauthorized filming by this same company over the park and surrounding areas using helicopters. The park had no legal recourse since neither NPS nor FAA regulations were broken. Nonetheless, the park considers the disregard of permit conditions in the filming permit to be an example of an abuse that should not be permitted to continue. [The FAA is initiating a change to internal policy regarding issuance of waivers dealing with movie production as a result of the Zion incident].

8.5 Summary

National parks and park visitors benefit from the use of aviation: visitors are aided through search and rescue flights; parks and the nation benefit from fire fighting's use of aircraft; and aviation aids research, resource management, and law enforcement in parks. Air tour passengers also benefit from aviation. Passengers find their experiences to be very rewarding, both in terms of overall enjoyment as well as in providing an enhanced appreciation for the park. Aviation is also a major economic factor in some places, most notably around the Grand Canyon and in Hawaii. However, the potential exists for expanded operations in many parks.

Perhaps the most important conclusion, though it must be inferred, is the likelihood that there will be increasing airspace issues over the National Park System. The high degree of satisfaction with air tours expressed by passengers, the willingness of tourists to spend the money for air tours, and regulations that provide FAA with sole authority to control airspace use, all suggest that air tour operations will increase, while the NPS will continue to live with the consequences — until a cooperative process is developed for limiting the impacts produced by these overflights. The NPS concludes that a process, binding upon all parties, must be designed and implemented to identify, measure and limit overflight produced problems in units of the National Park System. Voluntary agreements may be part of this process, but they cannot stand alone because of their limited effectiveness.

Chapter 9

RESTORATION OF NATURAL QUIET

Section 2 of the National Parks Overflights Act (P.L. 100-91) set specific minimum altitude requirements for aircraft overflights of Yosemite and Haleakala National Parks. The intent of the law was to determine the extent to which minimum altitudes for overflights could restore natural quiet. Prior to the passage of the Act, aircraft had been reported flying within a few hundred feet of the ground in these two parks. Hence, increasing the minimum distance above the terrain to 2,000 feet in Yosemite, and almost the same amount in Haleakala, should produce a noticeable difference in the aircraft sound environment, even if not fully restoring natural quiet.

Section 3 of the Act discusses the aircraft overflights issue at Grand Canyon National Park (GCNP). That section states that:

> *(a) "Noise associated with aircraft overflights at the Grand Canyon National Park is causing a significant adverse effect on the natural quiet and experience of the park. . . ."*

This section further states that recommendations submitted to the Administrator of the Federal Aviation Administration (FAA) would:

> *"provide for substantial restoration of the natural quiet and experience of the park and protection of public health and safety from adverse effects associated with aircraft overflight."*

The Section then states that:

> *". . . the Secretary [of Interior] shall submit to the Congress a report discussing — (A) whether the plan has succeeded in substantially restoring the natural quiet in the park;. . . ."*

The following sections contain the NPS response to the questions posed in Sections 2 and 3 of the Act.

9.1 Report on Section 2 Requirements — Yosemite and Haleakala National Parks

9.1.1 Yosemite National Park

> *"Sec. 2(a) Yosemite National Park — During the study and review periods provided in subsection (c), it shall be unlawful for any fixed wing aircraft or helicopter flying under visual flight rules to fly at an altitude of less than 2,000 feet over the surface of Yosemite National Park. For purposes of this subsection, the term "surface" refers to the highest terrain within the park which is within 2,000 feet laterally of the route of flight and with respect to Yosemite Valley such term refers to the upper-most rim of the valley."*

In Yosemite, management reported the major complaints about overflights came from wilderness trail users (at higher elevations of the park), as opposed to visitors on the valley floor. Management felt that the minimum altitude requirement had helped significantly in reducing complaints. This has not meant a restoration of natural quiet. The sample of acoustic measurements made in Yosemite in 1993, Figure 2.17 part 3, showed aircraft to be audible 30-60 percent of the time. Regarding compliance, management felt that pilots who were *aware of the restriction* generally complied with the law.

Measurements were made at four sites in Yosemite: Rafferty Creek (judged to be a location where visitors have a high expectation of experiencing quiet); Soda Springs Road (higher expectation of quiet than in the valley, but fairly congested with a nearby campground store area and concessionaire stables); Mirror Lake (only part of the valley floor that is closed to traffic, but traffic noise from the rest of the valley is audible); Glacier Point (one of most popular destinations in park and often crowded, with voices audible). In general, high altitude jets were the most commonly audible aircraft heard at the rate of about 10 to 30 per hour. Private propeller airplanes (general aviation) were heard at the rate of about two to four per hour.

9.1.2 Haleakala National Park

> *"Sec. 2(b) Haleakala National Park — During the study and review periods provided in subsection (c), it shall be unlawful for any fixed wing aircraft or helicopter flying under visual flight rules to fly at an altitude below 9,500 feet above mean sea level over the surface of any of the following areas in Haleakala National Park: Haleakala Crater, Crater Cabins, the Scientific Research Reserve, Halemauu Trail, Kaupo Gap Trail, or any designated tourist viewpoint."*

Prior to passage of PL 100-91, management reported that commercial tour helicopters flew within the crater down to levels 300 feet above the crater floor. Noise generated by tour helicopter overflights greatly impacted the wilderness users' enjoyment of Haleakala Crater. Management further stated that Haleakala was famous for its natural quiet, but this quality deteriorated as overflights increased.

Management felt that the altitude restriction of PL 100-91 somewhat reduced the noise levels on the crater floor. However, since the passage of the Act, the number of overflights has increased significantly, thus negating improvements the restriction might have made. Acoustic measurements made at four sites in Haleakala in 1992, Figure 2.17 part 3, showed that aircraft were audible 38-76 percent of the time. Aircraft heard were predominantly helicopters, heard at rates of about eight to ten per hour (Anderson et al. 1993, Horonjeff et al. 1993)

CONCLUSION 9.1

The lessons learned from Yosemite and Haleakala may be summarized as follows:

- *Raising the minimum altitude to 2,000 feet (the long standing FAA advisory altitude for overflying parks) reduces egregious impacts and may reduce complaints, but does not effectively restore natural quiet. Not only are the lower altitude aircraft audible, but high-altitude jets and the sound levels they produce are unaffected by such minimum altitudes. Nevertheless, a 2000-foot minimum altitude can be effective in limiting some adverse effects on natural quiet.*

- *Numbers of overflights have an important impact on length of time visitors have an opportunity to experience natural quiet. Unabated increases in numbers can negate gains made through increasing the distance between aircraft and visitors.*

- *As part of their management strategy, park resource managers must carefully consider when and where to preserve natural quiet, devising management strategies for FAA action.*

- *Impacts on natural quiet are likely to be unique at each park, and the solutions equally unique. Approaches to problem solving need to be flexible to produce effective solutions.*

9.2 Report on Section 3 Requirements: Grand Canyon National Park

This section provides for the definition of a substantial restoration of natural quiet, an explanation of SFAR 50-2, the description of the studies used in the evaluation, and the conclusions reached. It is important to note that during the course of these evaluative studies, air tours have increased significantly over the Canyon. Existing and forecast operations at the Grand Canyon National Park Airport are a useful indicator of the trends in increasing overflights. For example in 1987, there were 120,180 operations at that airport alone. In 1993, operations at the airport were 187,444, already exceeding those forecast in the airport master plan for the year 2000. By the year 2010, 240,100 operations are forecast. It is vital that this evaluation of Special Federal Aviation Regulation (SFAR) 50-2 be understood in the context of this growth pattern.

9.2.1 Defining a Substantial Restoration of Natural Quiet

CONCLUSION 9.2
A substantial restoration of natural quiet in the Grand Canyon will require that there be natural quiet in half or more of the park for most of the day.

Before overflights began, natural quiet existed over most of park, virtually all of the time. Aircraft sound intrusions are a significant source of mechanical noise that eliminate natural quiet. Since the legislative history of Public Law 100-91 indicates that flight-free zones are to be large areas where visitors can experience the park essentially free from aircraft sound intrusions, and where the sound from aircraft traveling adjacent to the flight-free zone is not detectable from most locations within the zone, the primary measure of restoration is the percentage of time that aircraft are audible. Based on this definition from the legislative history, the policy decision of Grand Canyon National Park (GCNP) is that a **substantial restoration requires that 50% or more of the park achieve "natural quiet" (i.e., no aircraft audible) for 75-100 percent of the day.**

9.2.2 Special Federal Aviation Regulations 50-2

The NPS and the FAA have attempted through SFAR 50-2 to accomplish the substantial restoration of natural quiet. The regulation established flight-free zones and specific flight corridors and routes for air tours and general aviation flights. It also established minimum altitude restrictions on all types of flights including air tours, general aviation, high altitude commercial and military aircraft (see Figure 9.1).

Design and implementation of SFAR 50-2 was a major accomplishment in that it is the first attempt by the FAA to regulate airspace for environmental and safety reasons to such an extent over a national park. Four flight-free zones cover 45% of the park and have a ceiling of 14,499 feet Mean Sea Level (MSL). Four flight corridors were established to help aircraft navigate the Special Use Airspace while avoiding the flight-free zones. Approximately 29 aerial tour routes were created by the Federal Aviation Administration's Flight Standards District Office in Las Vegas to allow commercial tour aircraft access to that portion of the Special Flight Rules Area (55%) not restricted by flight-free zones. [At 14,500 feet MSL the entire park is accessible to overflights].

9.2.3 Evaluation of Restoration Efforts (SFAR 50-2)

The determination as to whether SFAR 50-2 has been effective in substantially restoring natural quiet is based on a series of studies and modeling exercises. Among the questions asked are: Do its flight-free zones and altitude restrictions substantially restore natural quiet? How effective is the SFAR? Are there areas where improvements are possible?

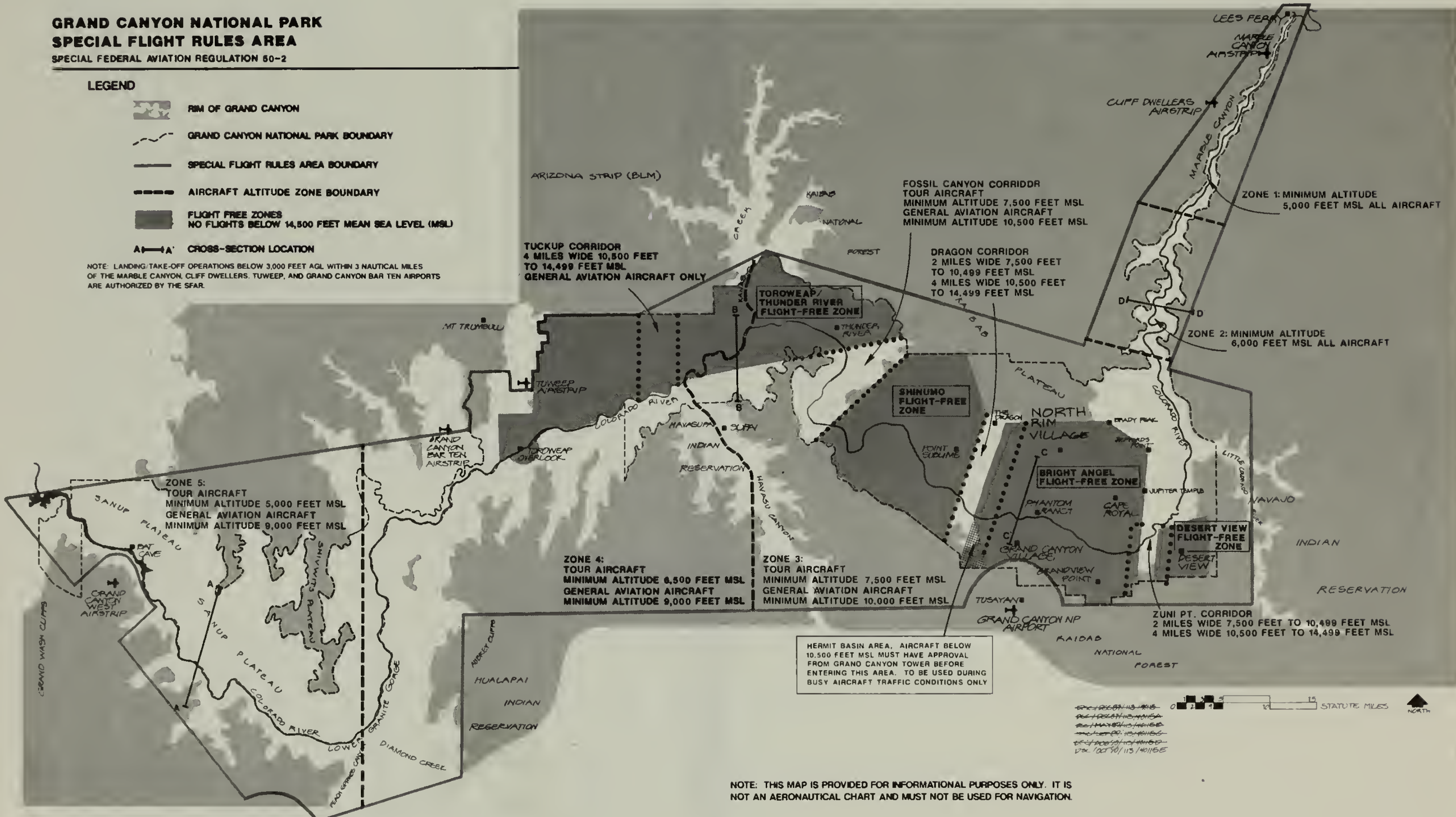

Figure 9.1: Grand Canyon National Park Special Flight Rules Area

Management Objectives

First, the NPS reviewed its mandates, regulations, policies, and plans related to the protection of natural quiet and the provision of various visitor experience opportunities. From this review, a statement of management goals and objectives was developed to further assist in the evaluation of the effectiveness of SFAR 50-2. This statement describes the goals and Table 9.1 summarizes the specific management objectives for each of five management zones in the park.

Goals for aircraft overflight management listed in the GCNP's policy paper are:

1. Substantially restore natural quiet as a natural resource.
2. Provide recreation opportunities and experiences for park visitors, consistent with park policies, where the opportunity for natural quiet is an important component.
3. Mitigate any aircraft-related impacts on other natural and cultural resources.
4. Address issues of health, safety and welfare of on-ground visitors and employees.

TABLE 9.1 GRAND CANYON NATIONAL PARK MANAGEMENT OBJECTIVES

OBJECTIVE	PERTINENT ZONE(S)
a. Restore and maintain natural quiet by protecting the wilderness character of remote areas.	Backcountry Use Zone River Corridor Use Zone
b. Provide primitive recreation opportunities without aircraft intrusions in most backcountry areas, most locations on the river and at destination points accessed by both.	Backcountry Use Zone River Corridor Use Zone Corridor Trail System Use Zone
c. Provide developed recreation opportunities with limited aircraft intrusions for visitors at rim developed areas and major frontcountry destination points accessible by road.	Frontcountry (Paved Access) Use Zone
d. Provide for protection of sensitive wildlife habitat areas or cultural resources.	Backcountry Use Zone River Corridor Use Zone Corridor Trail System Use Zone Frontcountry (Paved Access) Use Zone
e. Provide for welfare and safety of below-rim, backcountry, and rim visitors.	Backcountry Use Zone River Corridor Use Zone Corridor Trail System Use Zone Frontcountry (Paved Access) Use Zone
f. Provide a quality aerial viewing experience while protecting park resources (including natural quiet) and minimizing conflicts with other park visitors.	Air Tour Use Zone Backcountry Use Zone River Corridor Use Zone Corridor Trail System Use Zone Frontcountry (Paved Access) Use Zone

Evaluation

The evaluation of the restoration of natural quiet is based on the following six categories of studies, monitoring, and modeling exercises.

1. GCNP's Monitoring and Visitor Complaints: The NPS has considered information provided by visitor complaints and by the park's aircraft monitoring program. Although complaints have been reduced in number since SFAR 50-2, complaints received now focus on specific areas. That is, complaints are usually correlated to areas that are impacted acoustically which are generally located below the rim. Arguments have been made that the reduction in complaints means that natural quiet has been substantially restored. Even though the NPS values visitor complaints and uses them to help confirm problem areas, a relationship cannot be drawn between reduction in complaints and the restoration of natural quiet, which must be acoustically determined. Congress did not request a substantial reduction of visitor complaints; the NPS manages parks to protect resources rather than simply respond to visitor complaints.

The monitoring program logs flights on a yearly basis to determine aircraft use along routes and compliance with the regulation. Monitoring data provide additional confirmation regarding areas of heavy aircraft activity over areas with popular on-the-ground use. For instance, the Hermit Trail, which lies under the Dragon Flight Corridor, was found to experience an average of 35 aircraft overflights per hour. With aircraft passing over any number of points along the trail at this frequency, the sound of aircraft can be constant. Other "areas of concern" include Point Sublime, also under the Dragon Corridor; Point Imperial, the Nankoweap trail and the mouth of the Little Colorado River, under the Zuni Point Flight Corridor routes; and the Toroweap Overlook, close to eastbound routes from Las Vegas.

Results of the monitoring confirm an extremely high rate of compliance by air tour operators and other aircraft users flying over the area. The compliance is a compliment to the managers and users of the airspace over Grand Canyon.

2. Acoustic Monitoring Study: Acoustic monitoring was conducted at 23 sites in the Canyon during August and September of 1992 (Horonjeff et al. 1993). Sites were chosen on the north and south rims and along the river, under both flight corridors and flight-free zones, and Figure 9.2 shows where these sound level measurement sites were located.

The data were collected in a manner that yielded not only decibel levels, but information about the amount of time aircraft overflights could be heard at each site. A detailed analysis of the data provides estimates of the percentages of time the aircraft of various operators could be heard (Robert et al. *). Tables 9.2 and 9.3 present the results from the monitoring. At most sites

CONCLUSION 9.3

Flight-free zones can limit the areas where aircraft, especially tour aircraft, are audible high percentages of the time. But aircraft of all types may still be heard for some percent of the time at virtually all areas where sound data were collected, notably within a few miles of the edges of some of the flight-free zones. These results suggest that a substantial restoration of natural quiet has not been achieved for large segments of the Canyon.

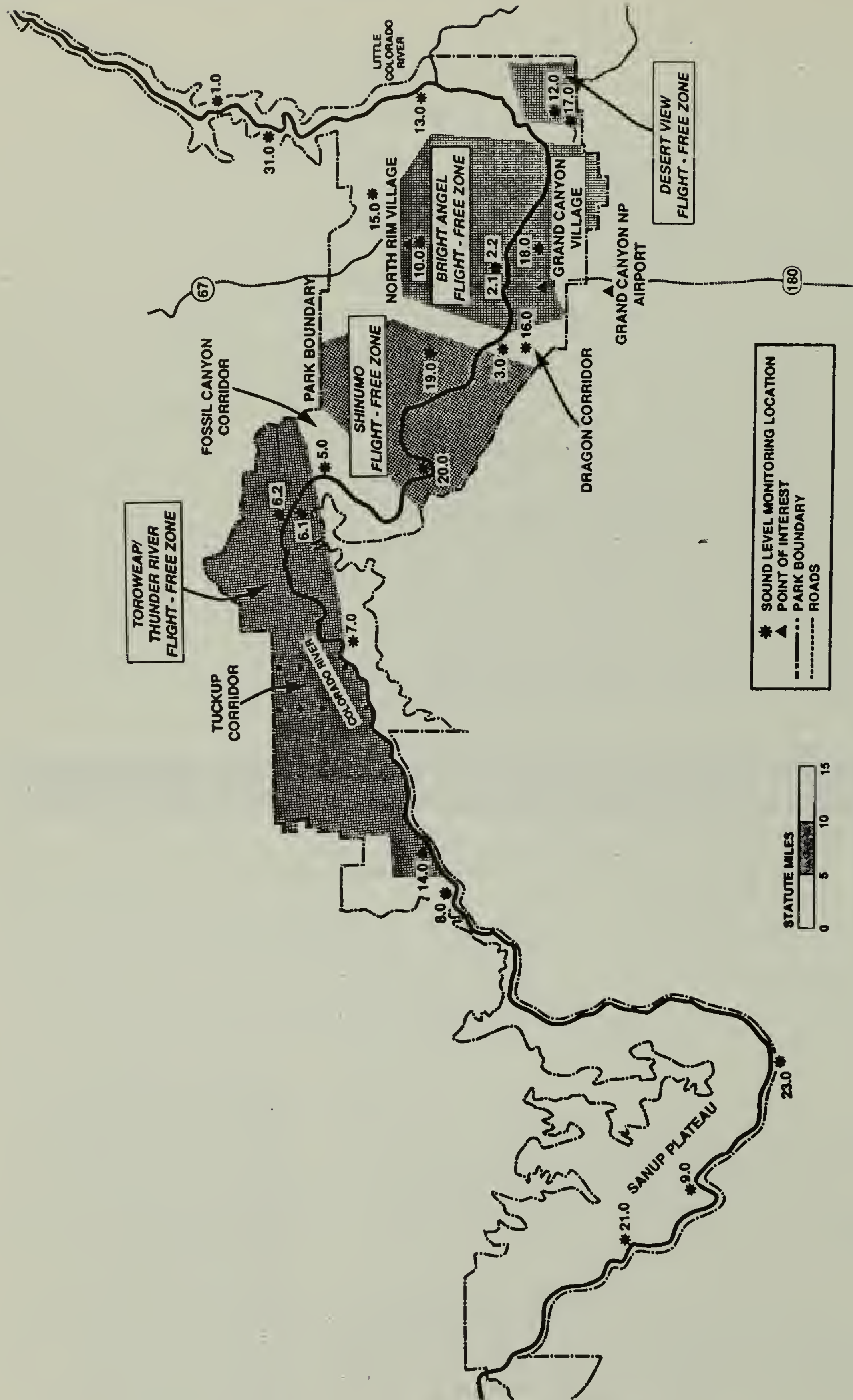

Figure 9.2: Grand Canyon National Park Acoustic Monitoring Sites

under flight-free zones, aircraft were audible for lower percentages of the time than was the case under the flight corridors. Generally, within flight-free zones (Phantom Ranch, Bright Angel Point, Yaki Point), tour aircraft were audible ten percent of the time or less, while near the edges (Desert View, Lipan Point, Point Sublime), these aircraft were audible for considerably greater amounts of time. Commercial jets (high altitude overflights) were generally audible less than about 15 percent of the time, but could be heard at most locations. Very few general aviation or military aircraft were heard.

3. Dose-Response Studies: In order to quantify how visitors feel about the sound of aircraft overflights, the NPS conducted data collection of a type never before done in a recreational setting: "dose-response" measurements. Simultaneous measurement of aircraft sound levels and surveys of visitors permitted development of "dose-response" relationships that estimate what percent of people are affected by a given amount of aircraft overflight sound (Anderson et al. 1993). Only in residential communities have such data ever been acquired,and never with such close coordination between the measured "dose" of sound that was present and the individual responses. Extreme care was taken in the data collection and analysis, and some specific conclusions are possible.

TABLE 9.2: PERCENT OF TIME AIRCRAFT WERE AUDIBLE

Site Number (See Fig. 9.2)	Description	Measured Percent of Time Aircraft are Audible*	Estimated Percent of Time Aircraft are Audible by Operator			
			Tour	Comm Jet	G/A	Military
Desert View Flight-Free Zone						
12.0	Desert View	20	14	6	1	0
17.0	Lipan Point	43	30	14	1	0
Bright Angel Flight-Free Zone						
2.1	Phantom Ranch Overlook (Edge)	19	7	11	0	0
2.2	Phantom Ranch Overlook	11	8	4	0	0
10.0	Bright Angel Point	20	6	13	1	0
18.0	Yaki Point	12	5	7	0	0
Shinumo Flight-Free Zone						
19.0	Point Sublime	76	69	12	0	1
20.0	117.4 Mile Camp	4	0	4	0	1
Toroweap/Thunder River Flight-Free Zone						
6.1	Deer Creek Falls	9	2	7	0	0
6.2	Deer Creek Falls (1/2 Mi. NE)	7	4	0	3	0
14.0	Toroweap Overlook	54	44	11	0	1

* The measured percent of time audible will not always equal the sum of percents by operator because aircraft of different operators were sometimes audible at the same time.

TABLE 9.2: PERCENT OF TIME AIRCRAFT WERE AUDIBLE (continued)						
Site Number (See Fig. 9.2)	Description	Measured Percent of Time Aircraft are Audible*	Estimated Percent of Time Aircraft are Audible by Operator			
			Tour	Comm Jet	G/A	Military
Dragon Flight Corridor						
3.0	96 Mile Camp	52	51	1	0	0
16.0	Hermit Basin	83	79	18	1	0
Fossil Canyon Flight Corridor						
5.0	Stone Creek Camp	6	2	4	0	0
7.0	Havasu Creek	12	9	1	2	0
Areas Under Minimum Altitude Zones						
1.0	Marble Canyon	13	5	7	0	0
31.0	Marble Canyon / Buck Farm	7	1	6	0	0
13.0	Little Colorado River	50	47	3	0	0
15.0	Pt. Imperial	66	61	8	1	0
8.0	Whitmore Rapids	20	20	1	0	0
23.0	Diamond Creek	13	7	2	0	4
9.0	Separation Canyon	20	16	3	0	0
21.0	Burnt Springs Canyon	50	48	3	0	0

* The measured percent of time audible will not always equal the sum of percents by operator because aircraft of different operators were sometimes audible at the same time.

CONCLUSION 9.4:
The percent of time aircraft are audible correlates with how visitors feel about aircraft sound. Even when aircraft are audible for relatively low percentages of time, a percentage of the visitors can notice the aircraft, and believe that the sound has interfered with their appreciation of natural quiet. Further, it is likely that visitors who hike away from auto accessible locations are more sensitive to intruding aircraft sounds than are visitors who do not. Hence, the NPS concludes that preservation of natural quiet is of significant value to visitors, especially for the backcountry, river corridor and Cross Canyon Corridor trail system use zones at GCNP.

For overflights of tour aircraft, the measure of sound that best predicts visitors' reactions is the percent of time aircraft are audible. The results show that visitors have very different sensitivity to aircraft sound, depending upon the site where data are collected. At the two frontcountry "overlook" sites, Lipan Point and Point Imperial, for a given level of aircraft sound, considerably fewer visitors reported annoyance or interference with natural quiet than reported these effects at the three "short-hike" sites of Hermit Basin in the Grand Canyon and Sliding Sands and Wahaula Temple in Hawaii. Though many factors likely influence this sensitivity, it is reasonable to conclude that as visitors pursue activities that take them away from their cars and other visitor activities, they are likely to be more sensitive to the sound of aircraft overflights – tour aircraft in the case of this study. For visitors to the short-hike sites, roughly 30 to 40 percent can be expected to report moderate to extreme interference with their appreciation of natural quiet when aircraft are audible ten percent of the time[1].

1. *See (Anderson, G.S., et al, 1993) Figure E.3 or Figures H.8 and H.9.*

4. Bennett-Cox Study: The Air Access Coalition (an association of air tour operators) retained Bennett/ Cox, Consultants, to sample sound exposure at 22 sites before (in 1988) and after (in 1993) SFAR 50-2 was implemented over the Grand Canyon (Bennett et al. 1994). The consultants used methods that permitted separate identification of maximum sound levels for different aircraft types and ranges of non-aircraft sound levels. One of the measurement sites chosen, Point Sublime, was also a site where NPS had acoustic information collected in September 1992[2]. The Bennett / Cox data show considerable reduction of (maximum) A-weighted sound levels from 1988 to 1993, attributable to SFAR 50-2. In fact, the Bennett / Cox 1993 aircraft sound levels are entirely consistent with the NPS NPOA Report No. 93-4 levels for Point Sublime, and the NPS acknowledges that SFAR 50-2 has produced significant reductions in aircraft sound levels for this location. The Air Access Coalition would like to use 1988 sound levels as a baseline to compare changes in sound levels; 1988 was already too noisy for the NPS which uses natural quiet as the baseline for comparison.

However, the Bennett / Cox presentation fails to report two other important aspects of the Point Sublime sound environment, one an omission, one probably an error. First, the presentation gives no account of how much of the time aircraft could be heard or how many were heard. Over approximately a five-hour period, the NPS data report roughly 20 to 30 aircraft per hour were heard, and aircraft were audible an average of 76 percent of the time (See Table 9.2). Second, Bennett / Cox report the non-aircraft background sound levels as between approximately 20 and 40 dBA. Though such background levels are certainly possible, particularly if there was fairly continuous wind or bird and insect sounds, it is likely that the equipment used was not capable of accurately measuring the low sound levels present at this location. During the NPS-sponsored measurements, non-aircraft sound levels were between approximately 10 and 20 dBA roughly 75 percent of the time when aircraft were not audible. Standard sound measuring instrumentation used in community noise measurements will not accurately measure below 20 to 25 dBA. Special "low-noise" instruments were designed and constructed for the NPS measurements (Horonjeff et al. 1993)[3]. Thus, though the Bennett / Cox presentation reasonably depicts the changes in (maximum) aircraft sound levels, it fails to address two aspects of the sound environment that are critical for judging the restoration of natural quiet: the extreme quiet present at some locations, and the amount that this quiet is disrupted by the sound of aircraft overflights.

CONCLUSION 9.5:
The Air Access Coalition-sponsored data demonstrate that SFAR 50-2 has reduced aircraft sound levels significantly at some locations. However, these data do not address restoration of natural quiet, since no information is given about how much of the time aircraft can be heard, and reported non-aircraft sound levels are probably inaccurately high.

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2. *Site 19.0 reported in NPOA 93-4, page 150 ff.*

3. *See page 9 and NPOA Report 93-6, Appendix C for descriptions of the instrumentation used.*

CONCLUSION 9.6: *For some categories of visitors, specifically river users and fall backcountry visitors, natural quiet is almost as important a reason for visiting the Grand Canyon as is viewing the scenery. Enjoying natural quiet is extremely important to many visitors to the Grand Canyon.*

5. Visitor Survey: A mail survey was conducted of randomly sampled visitors to the Grand Canyon. These visitors were separately identified in five categories: frontcountry visitors, summer and fall backcountry visitors, river users in motorized boats, and river users in oar-powered boats (Baumgartner et al. 1994). Figures 9.3 and 9.4 show how these visitors ranked various reasons for their trip to the Canyon. Visitors were asked to rate (not important at all, slightly important, moderately important, very important, extremely important) eight different reasons[4]. Five of these categories (representing the range of responses) are shown in Figures 9.3 and 9.4. Figure 9.3 shows the percent who rated the reasons as moderately, very or extremely important. Clearly, all these reasons are important in this figure.

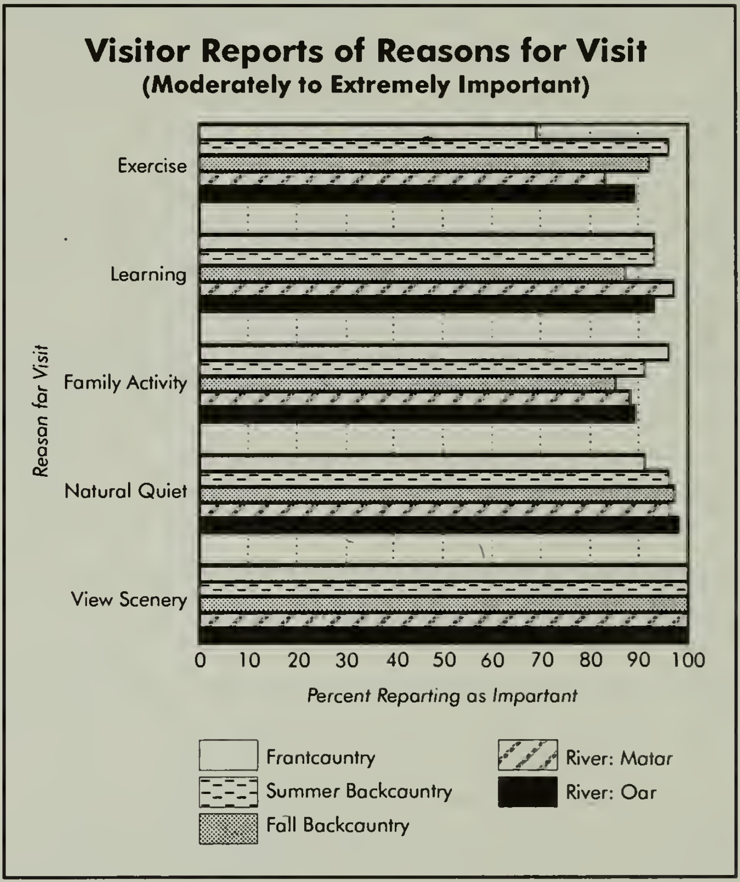


Figure 9.3: Visitor Reports of Reasons for Visiting the Canyon

However, Figure 9.4 shows just those who rated the reasons as extremely important. Natural quiet, for river and fall backcountry visitors is almost as important as viewing the scenery, while the other reasons are less important.

4. *View the natural scenery, enjoy the natural quiet, appreciate the history and/or cultural significance of the park, do things with family, experience peace and quiet, see new and different things, learn about things in the park, get some physical exercise.*

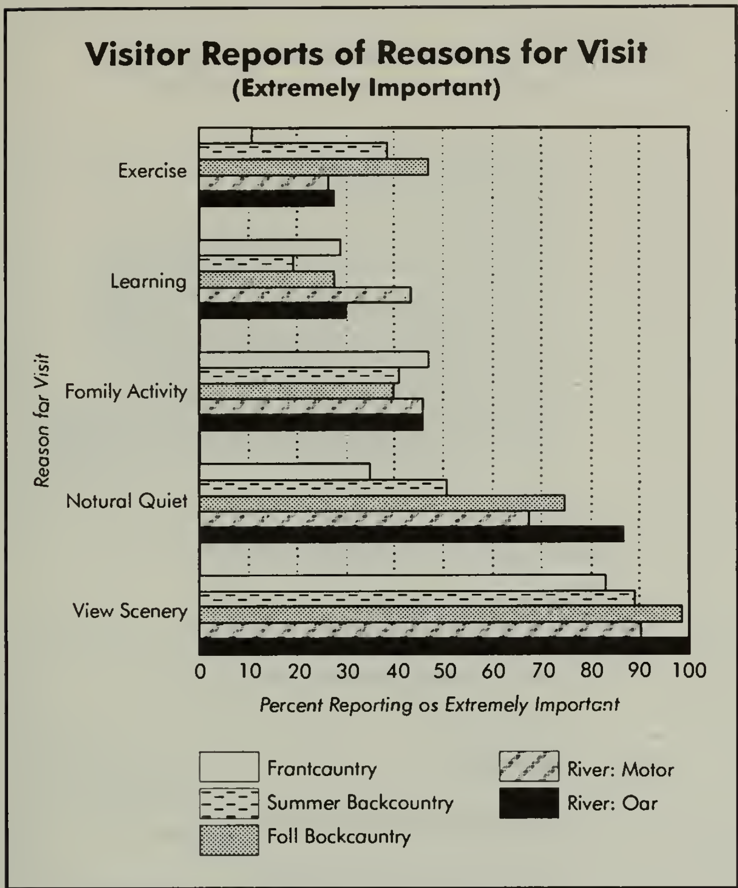


Figure 9.4: Visitor Reports of the Most Important Reasons

Of these different categories of visitors, how many reported hearing aircraft? Figure 9.5 gives the percentages. For all categories, half or more than half of the surveyed visitors remembered hearing aircraft. Figure 9.6 (identical to Figure 3.4) shows what percentages of these visitors reported moderate, very or extreme impacts from the overflights.

Figure 9.7 shows how inappropriate the five categories of visitors thought six different types of overflights to be when within hearing or sight of visitors. Clearly, most visitors find military training and private aircraft somewhat or very inappropriate over National Park areas. Tour aircraft overflights and "transporting commercial passengers between cities" are judged inappropriate by roughly comparable percentages of visitors, depending upon visitor category. Finally, few visitors judge park "management, research, and maintenance" or "emergency services, like fire fighting or search and rescue" as inappropriate.

CONCLUSION 9.7:
Different categories of visitors report different degrees of adverse effects, but for all categories sampled, more visitors report that aircraft interfere with their appreciation of natural quiet than report interference with enjoyment or annoyance.

CONCLUSION 9.8:
Except for park management and emergency-related overflights, large percentages of Grand Canyon visitors regard aircraft overflights within sight or hearing of visitors on the ground as somewhat or very inappropriate over National Park areas.

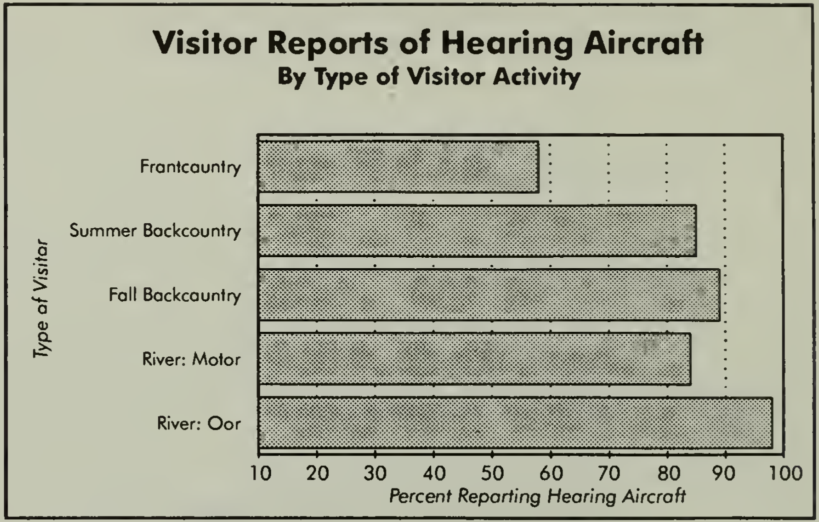


Figure 9.5: Visitor Reports of Hearing Aircraft

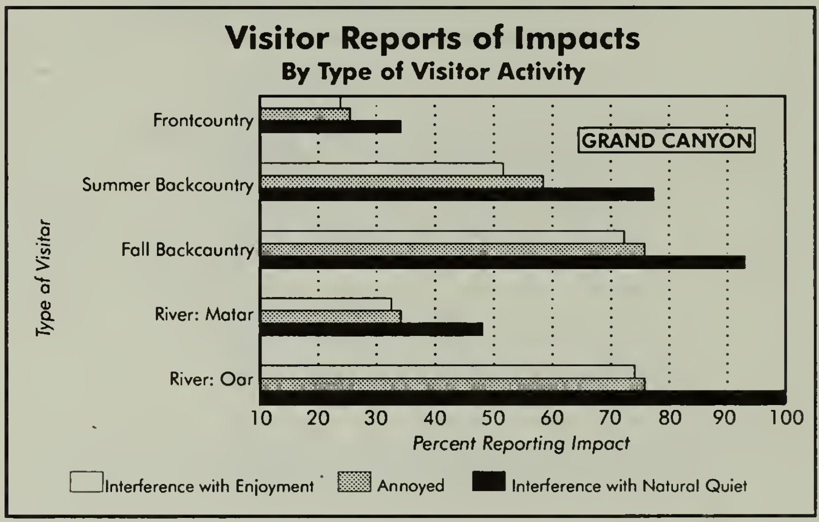


Figure 9.6: Visitor Reports of Impacts

CONCLUSION 9.9:
There is little support among the five categories of Grand Canyon visitors for a "do nothing" policy or a "reasonable growth" policy. Maintenance of the current level, or reduction/elimination are preferred policies.

The mail survey asked:

> *"Considering the advantages and disadvantages of aircraft flying over National Park areas, what do you think the National Park policy should be for aircraft activity for the following aircraft flight purposes?"*

Figure 9.8 presents the responses for "sightseeing tour flights". The great majority of respondents neither support "reasonable growth" nor "do nothing." They want to see the activity stay at current levels or be reduced/eliminated. Virtually all of the river/oar and fall backcountry visitors support reduction or elimination of sightseeing tour flights.

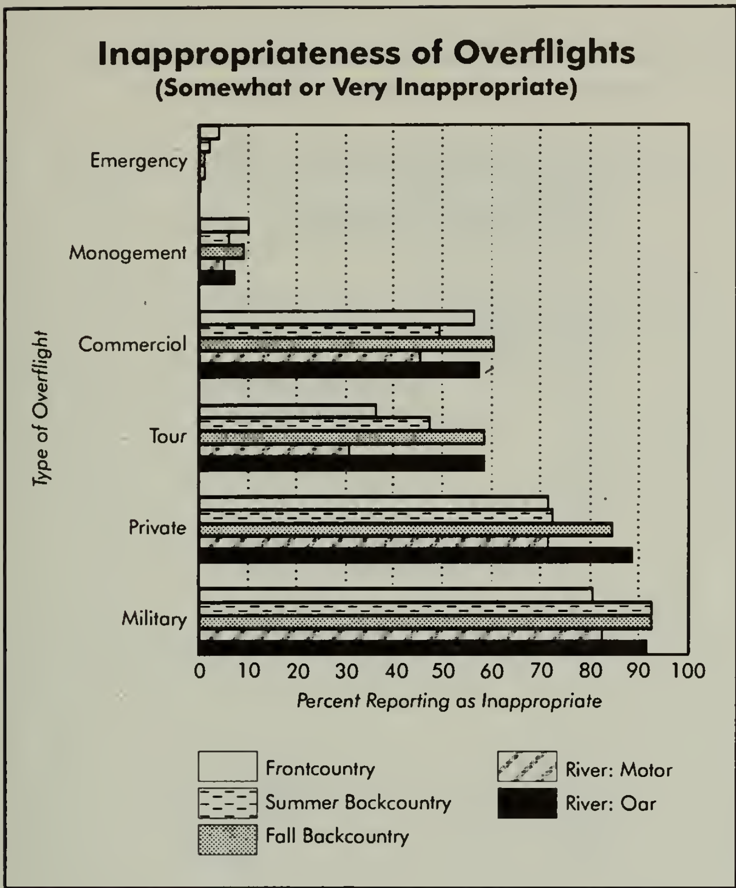


Figure 9.7: Inoppropriotenesss of Overflights

Finally, the survey asked:

> ***"If aircraft activity got to the point where restrictions were thought to be necessary on aircraft flights over a National Park, how much would you support each of the following . . . restrictions on sightseeing tour flights?"***

Figure 9.9 shows percentages of visitors, by visitor category, who support or strongly support seven types of limitations. Visitor support varies with visitor category, but over half of all visitors would support encouraging the use of quieter aircraft, restricting the number of flights that are permitted to fly over the park, establishing times of the day when aircraft are not permitted to fly over the park, establishing areas in the park where aircraft are prohibited, as well as areas where they are allowed to fly.

CONCLUSION 9.10:
A mojority of visitors to the Grond Conyon would support severol specific types of limitotions on oir tour overflights.

6. Acoustic Modeling/ Quiet Aircraft Study: Computerized acoustic modeling is a commonly used approach to depict sound levels or sound exposure over large geographic areas. On-site sound measurements are

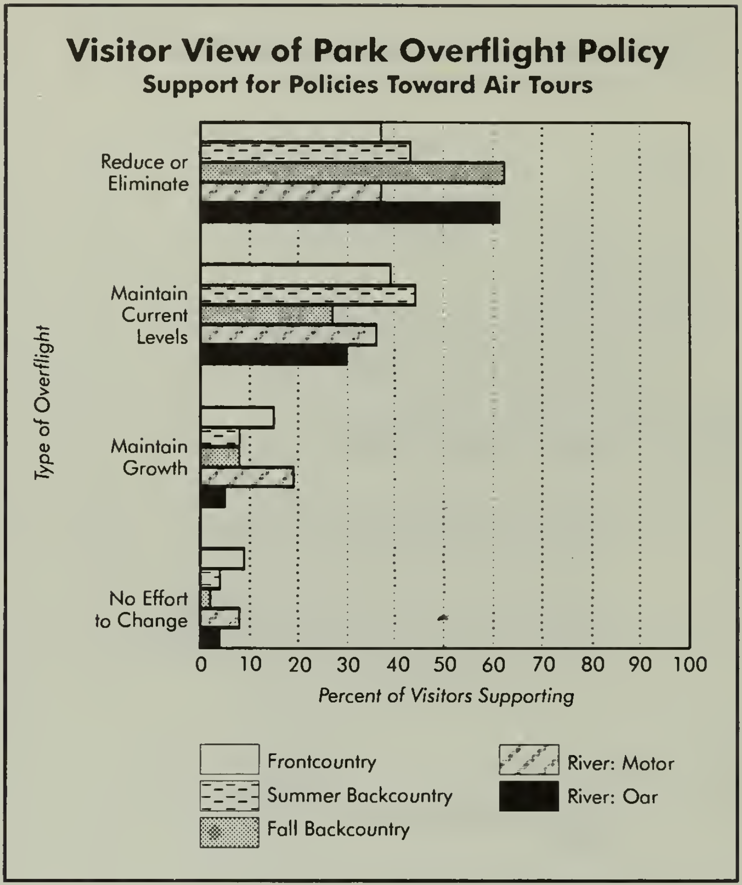


Figure 9.8: Visitor View of Park Overflight Policy

CONCLUSION 9.11: *Computer modeling supports the conclusion that natural quiet has not been substantially restored, that very few areas currently experience natural quiet, and that the areas of natural quiet will diminish considerably if no quiet aircraft are introduced and if tour operations are permitted to increase. The acoustic profiles tend to verify the computed results.*

expensive, generally difficult, time consuming, and can be conducted at only a few specific locations, hence computer modeling of sound exposure is necessary in order to understand sound levels area-wide. The NPS sponsored development of a computer model (the National Park Service Overflight Decision Support System or NODSS) (Reddingius 1994) that can calculate various sound metrics across parks, including time-above a specified threshold (e.g. natural quiet). The program computes sound levels for large areas of a park, using information about types, numbers and altitudes of aircraft flown, locations of flight tracks and geographic terrain information. The results of the computations included in this report can be interpreted in terms of "natural quiet" (white), areas where natural quiet has been "substantially restored" (green), and "remainder of park"(red), and hence provide a visualization of the status of natural quiet in GCNP.

Using the numbers, routes, altitudes, and equipment types indicated in a 1989 FAA survey conducted on behalf of the NPS, the NODSS modeling software produced Figure 9.10 (1989 Levels). The combined colors of white

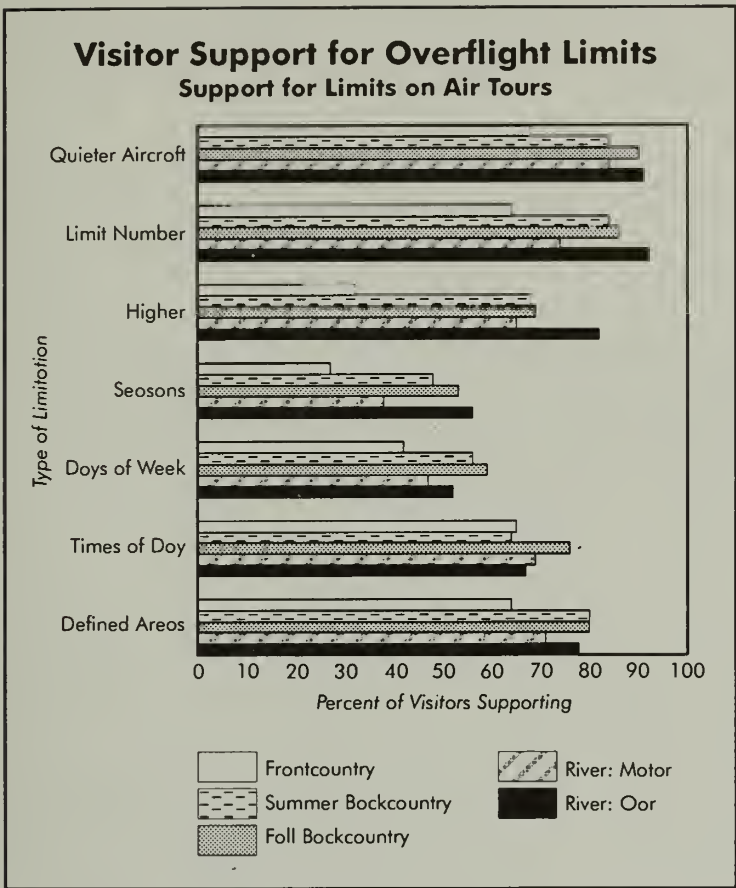


Figure 9.9: Visitor Support for Overflight Limits

and green cover about 34% of the park (white is 0.49% and green is 33.94%). If no quiet aircraft are introduced, and operations continue to increase as forecast in the Grand Canyon National Park Airport Master Plan, Figure 9.11 results (2010 No Action). This figure graphically depicts the progress lost in the restoration of natural quiet that could occur by the year 2010 if conditions remain unchanged. The combined colors of white and green cover only about 10% of the park (white is 0.39% and green is 9.97%). This clearly suggests that increasing use will result in a degradation of natural quiet in the GCNP; this is clearly unacceptable.

9.2.4. Summary of Section 3 Requirements

Though significant reductions in aircraft sound have occurred for areas of the Grand Canyon, and though compliance with SFAR 50-2 has been excellent, natural quiet is not yet substantially restored to GCNP. This lack of natural quiet affects some visitor groups much more than others, with backcountry users and river/oar users more affected and frontcountry visitors less

Conclusion 9.12:
There has not been a substantial restoration of natural quiet in Grand Canyon, although the NPS acknowledges the value of the SFAR and the improvement it has brought.

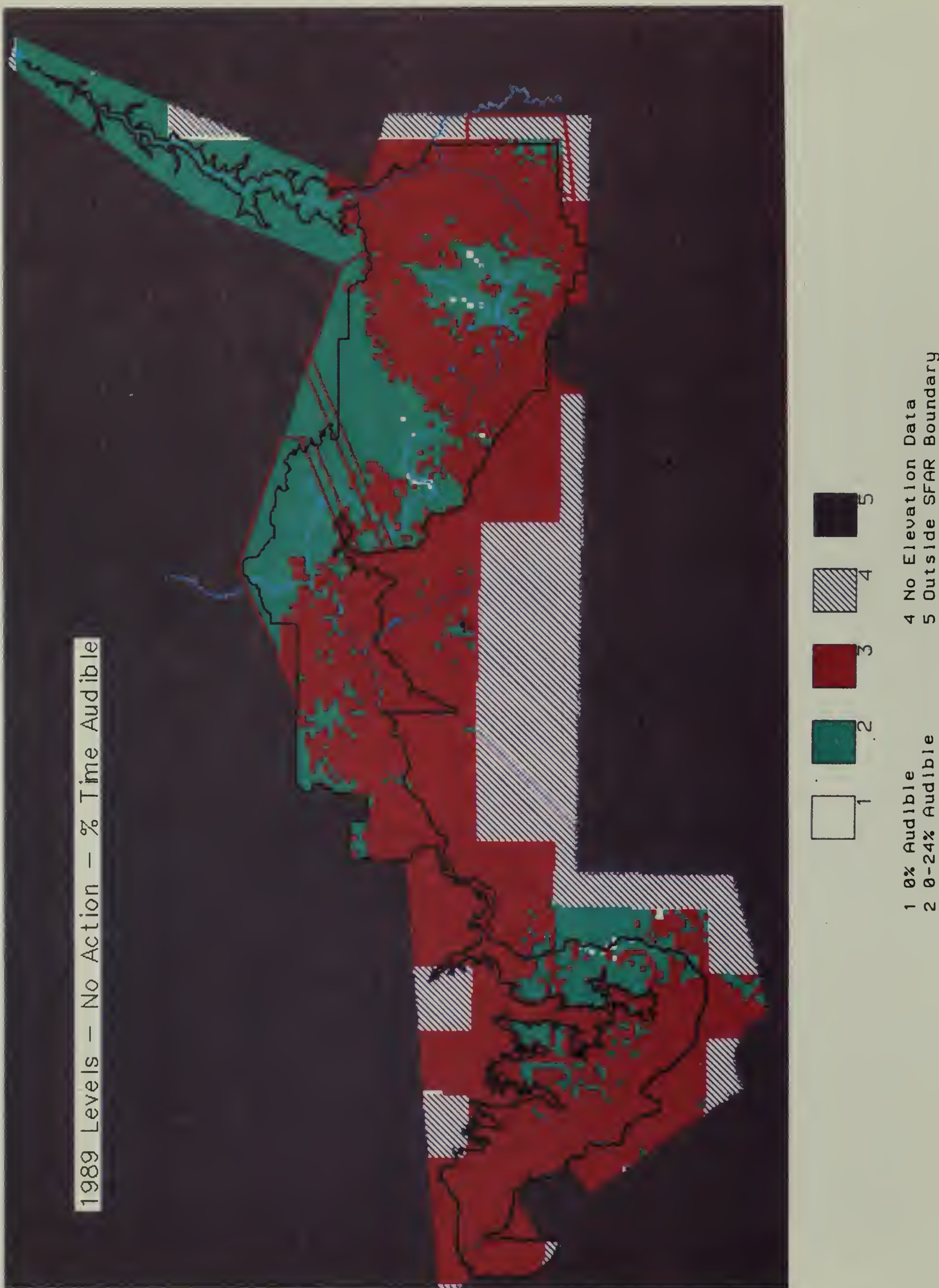
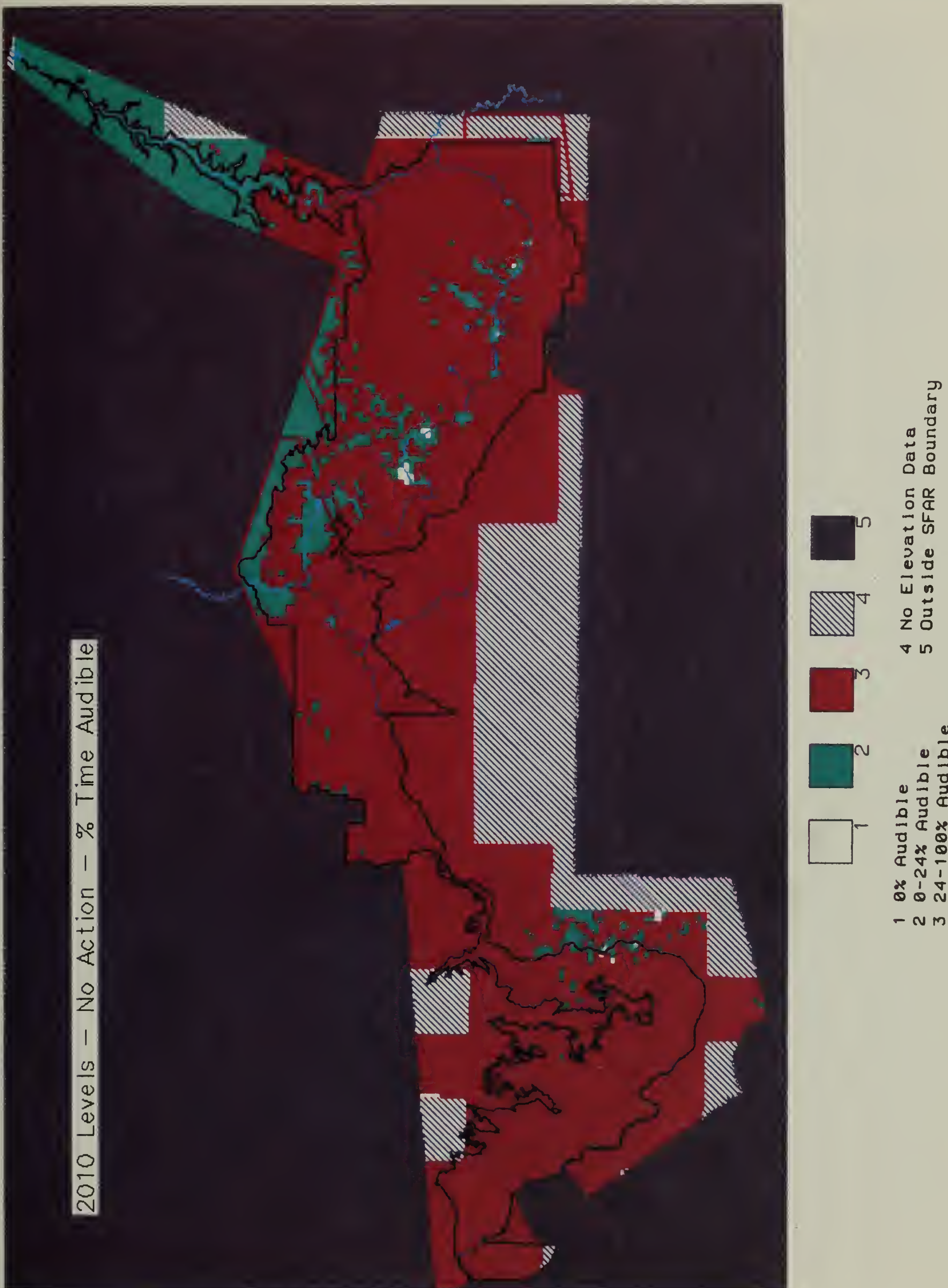


Figure 9.10: Computer Modeled Natural Quiet Restoration — 1989 Tour Operations


2010 Levels - No Action - % Time Audible
1
2
3
4
5
1 0% Audible
2 0-24% Audible
3 24-100% Audible
4 No Elevation Data
5 Outside SFAR Boundary

CONCLUSION 9.13:
If no changes are made to the SFAR, progress to date in the restoration of natural quiet will be lost. Projections suggest that without further improvements, the loss of natural quiet will accelerate to an unacceptable level.

CONCLUSION 9.14:
The NPS recommends that SFAR 50-2 be revised to effect a greater restoration of natural quiet.

affected. All studies point to these same conclusions, and the NPS is obligated, in pursuit of both its Congressionally mandated and defined management responsibilities, to seek a further restoration of natural quiet. Most visitors support keeping air tour operations numbers at current levels or reducing them.

9.3 What are the Opportunities for Solutions?

Overflights that impact natural quiet may be divided into two types:

- Flights of very low altitude (altitudes of a few hundred feet or less, flown primarily by helicopters) which go well beyond the issue of natural quiet and enter areas of personal safety, appropriateness in a park setting, concern for effects on wildlife, and so forth.
- Flights of somewhat higher altitude or greater lateral distance from the visitor which primarily impact natural quiet or the acoustic/aesthetic character of the setting, but little else.

It is the latter of these two types which is addressed here.

9.3.1 Realistic Expectations

The findings of many different studies all strongly indicate that if aircraft fly over a national park where quiet is a resource, there will never be complete natural quiet at all times and in all places within the park. Instituting "flight-free" zones, such as was done under SFAR 50-2 at Grand Canyon National Park, may create some areas where aircraft are not audible, but to be effective in restoring natural quiet to large areas, flight-free zones will need to be very large – on the order of 20 to 30 miles, in minimum dimension. Directly below authorized flight corridors no reasonable minimum altitude either for tour aircraft or for higher altitude commercial jet traffic can completely restore natural quiet. Quieter aircraft may help restore natural quiet to greater land areas to the side of the flight corridor, but not directly beneath it. Beneath the corridor, quieter aircraft can reduce the degree of impact, but not eliminate it.

Reducing the numbers of overflights or increasing the number of passengers per aircraft reduces the frequency of the intrusions, and in turn increases the uninterrupted periods of time visitors may experience natural quiet. It is likely that very large reductions would be required at seriously affected parks before visitors within one to two miles of flight corridors would experience only infrequent impacts to the natural quiet of the environment.

Moving the locations of flight corridors needs to be carefully analyzed so that the noise burden is not simply shifted to another area that is just as valued by another segment of the visitor population. Natural quiet may be improved in one area of the park, but degraded in another. To the extent that visitors are geographically distributed over large areas of the park, gains and losses from moved flight corridors must be carefully considered. Commercial interests may be economically affected by changes in air corridors, and there may be safety and regulatory implications as well.

9.3.2 Realistic Opportunities

If the FAA and NPS act cooperatively, there are opportunities for problem solving. Where aircraft overflights are over or immediately adjacent to park boundaries, management must define where it is important to preserve natural quiet and what opportunities they seek to provide park visitors. They must also ascertain the critical areas of the park and times of day these opportunities can be provided, and work with the affected parties to reach compromise on achieving their goals. At a minimum, the affected parties will include the FAA, air tour operators, and park management.

Separation of Visitors and Overflights. Defining certain areas of the park for tour overflights is likely to be the first step. In so doing, natural quiet under and to the side of corridors will be degraded. The loss of natural quiet is the consequence of accommodating aircraft overflights. Mitigation opportunities in the land areas adjacent to flight areas or corridors will be park specific, and may take advantage of natural attenuation opportunities.

Exploiting Natural Attenuation. To the extent that altitudes can be minimized (without going below reasonable minimums), park terrain can sometimes be used to acoustically shield flight-free areas from aircraft noise. If hills or ridges are available, lowering aircraft altitudes may be a consideration. By lowering altitudes, areas directly beneath flight corridors that are already impacted will have impacts intensified, but if local terrain features are present, land areas where the protection of natural quiet is important may be increased. Breaking the line-of-sight between the visitor and aircraft can reduce maximum noise levels by an amount that would otherwise be gained only by a near doubling of the distance between aircraft and the visitor.

In flat or open areas where terrain shielding cannot effectively be used, distance (either in altitude or laterally) is a mitigation option. Very large distance changes may be necessary to achieve natural quiet, however. To a first approximation, 10 decibels of reduction can be expected for every doubling of distance between the visitor and aircraft at its closest point of approach. Thus, to obtain the first 10 decibels of reduction, the existing distance between aircraft and the nearest visitor would have to be doubled.

To obtain 20 decibels of reduction the distance would have to be quadrupled, and to obtain 30 decibels of reduction, the distance would have to be increased by a factor of eight.

Encouraging Noise Reduction at the Source. Another mitigation measure is encouraging and phasing in quieter aircraft, or retrofitting existing aircraft. Aircraft speed, power, and propeller pitch on fixed-wing aircraft, and flight regimes which eliminate blade slap for helicopters are also effective mitigation measures to be taken at the source of the noise. Relationships between these variables and aircraft noise levels will be aircraft specific, and may require additional study. The NPS believes that quiet aircraft will, over time, contribute to the mandated substantial restoration of natural quiet at GCNP. Figure 9.12 shows a comparison between observer-based audibility contours for quieter aircraft (a deHavilland DHC-6-300 Twin Otter and the McDonnell Douglas MD-900 NOTAR Helicopter) vs. louder aircraft (Cessna 207/402 and a Bell Jet Ranger helicopter). This graphic shows clearly the critical need to reduce noise at the source.

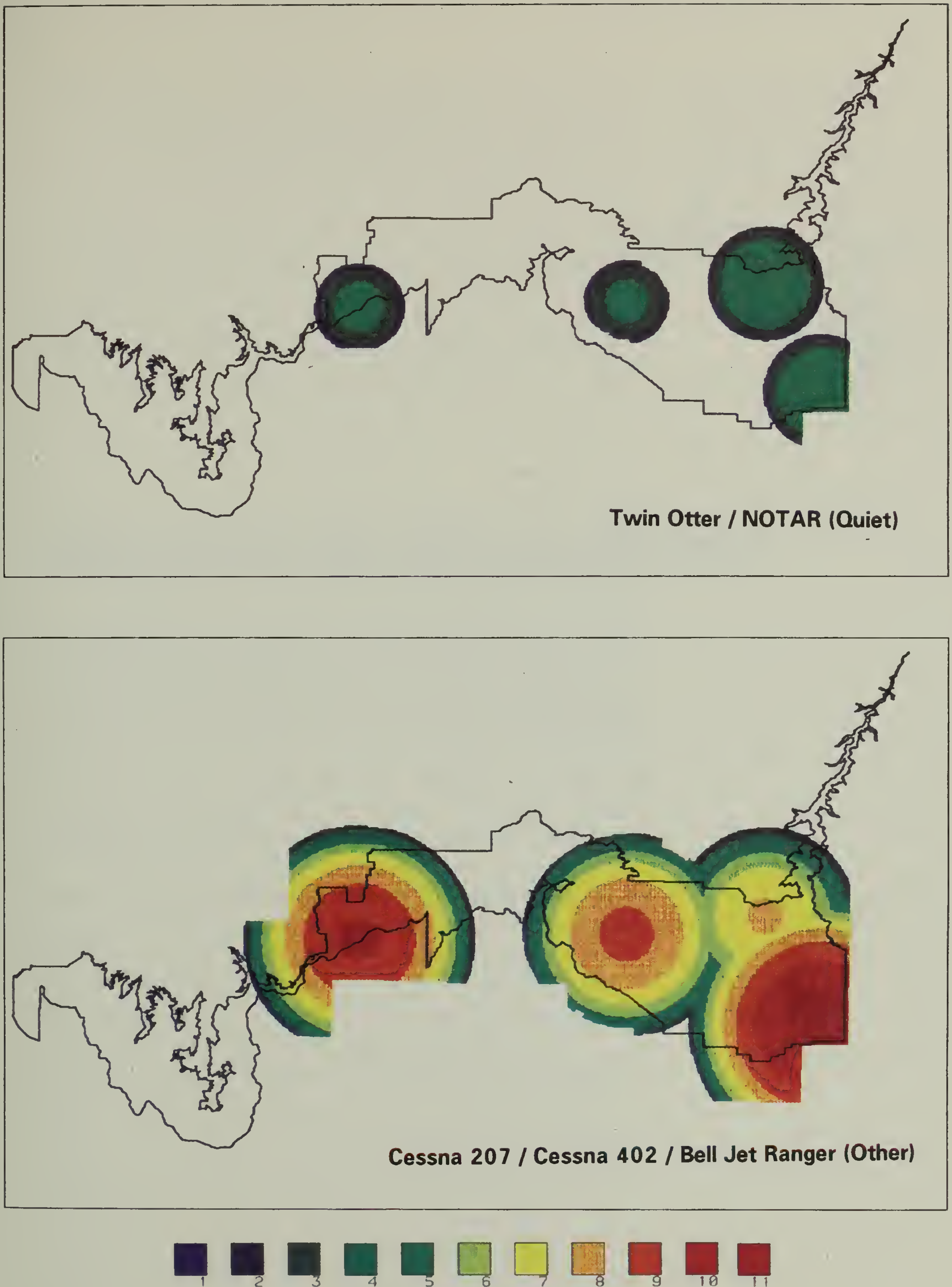
Reducing Duration of Noise Intrusions. Limiting times of day may be another mitigation alternative, but this measure may result in a greater intensity of flying during other portions of the day. This alternative may not be met with enthusiasm from air tour operators, however, since their investment in aircraft could remain unproductive for periods of time.

Encouraging Use of Greater Payload Aircraft. Tour aircraft which can accept greater numbers of passengers without substantial increases in noise level emissions may be an attractive step toward mitigation in some circumstances. With larger numbers of people per flight, and fewer flights, the percentage of time that natural quiet is compromised would be reduced.

9.3.3 Environment Needed for Effective Comprehensive Solutions

CONCLUSION 9.15:
The uniqueness of individual park units, their visitation areas, and their opportunities for mitigation to improve natural quiet strongly suggests that in a systematic approach to problem solving, flexibility will be essential to get to productive park-level solutions.

Some parks have the unique resource of natural quiet to be protected. This resource may be concentrated in limited areas of some parks, or distributed over large areas of others. Each park also has unique air tour attractions. In some parks, these attractions are fixed in location. In others, such as Hawaii Volcanoes NP, areas of air tour interest change weekly or even daily. Parks also have unique mitigation options which affect how sound propagates from aircraft to areas where natural quiet is to be protected. These parks need unique airspace management plans approved by the FAA.



1 0 to 10000 ft
2 10000 to 20000
3 20000 to 30000
4 30000 to 40000
5 40000 to 50000
6 50000 to 60000
7 60000 to 70000
8 70000 to 80000
9 80000 to 90000
10 90000 to 100000
11 100000 to 110000

Figure 9.12: Observer-Based Audibility Contours Comparing Quiet and Other Aircraft

CONCLUSION 9.16: *Interagency airspace management coordination guidelines are needed to outline agency responsibilities and interfaces on overflight issues.*

For these reasons, effective solutions to restoring the natural quiet in parks must be sought at a local level. A national-level framework or process is necessary to facilitate this. Tools for identifying opportunities for improvements, and tools for evaluating the effectiveness of improvements must be provided to local park management. They must also be equipped with a set of procedures for using these tools that will guide them through the process to satisfactory solutions. As part of the 1992 park manager's survey, management was asked how strongly they would support a formal set of procedures to resolve overflight issues. Over 80 percent of the managers indicated a moderate to extreme support for formal procedures.

9.4 Summary

Simple limitations on altitude can diminish the impacts of overflights, but it is unlikely that those limitations alone will effectively restore natural quiet. In the case of Grand Canyon, even SFAR 50-2 could not produce a substantial restoration of natural quiet, although its value is recognized. Visitors are sensitive to the diminution of natural quiet, and many rate experiencing natural quiet as an important reason for visiting the Grand Canyon. Visitors to other parks also rate experiencing natural quiet as an important part of their visits.

The failure to substantially restore natural quiet should not be interpreted as an indication of the failure of any group to take appropriate action. It is an indication of the difficulty of finding solutions that will make the effective use of airspace and preserve park resources simultaneously. The NPS recommends that SFAR 50-2 be revised by the FAA to contribute to a more effective restoration and maintenance of natural quiet over time.

Chapter 10

CONCLUSIONS AND RECOMMENDATIONS

The information and analyses provided in the previous chapters lead first to general conclusions about the type and extent of impacts produced by overflights, and about the values associated with overflights. These general conclusions in turn lead to identification of issues that are addressed through NPS recommendations to Congress as requested in Public Law 100-91.

10.1 Conclusions

Nature and Scope of Problem: Aircraft overflights can and do produce impacts both on visitors and on park resources. These impacts, however, do not occur evenly throughout the park system, but occur at some parks to a considerably greater extent than at others. This was confirmed by the NPS Manager's Survey and the Visitor Survey. Based on the Visitor Survey for the National Park System where there was congruence between visitor and manager perceptions of problems in 29 of the 39 parks sampled, it is likely that there could be as many as 50 to 100 units of the park system where overflight problems are likely or certain to exist. (See Chapter 2). NPS managers have consistently identified 30-40 parks as priorities for research and problem solving for nearly a decade. Because of the congruence in perspective between visitors and managers, also confirmed in part by acoustic research, it is possible to conclude that there are significant overflight problems that need to be addressed in 15-30% of the National Park System.

Commercial and sightseeing operations are more common than other types of overflights. Military and park administrative overflights are the least common. Helicopters and low-level jets are more likely to be of concern to park managers than other types of aircraft. The nature of effects on parks is varied, as described below. Many relate to aerial sightseeing, others to low-level military overflights. Some are noise-related, some are visitor experience-related, and others are safety-related.

Effects on Natural Quiet: Natural quiet is an important natural resource in units of the National Park System. The indigenous sound levels in national parks, are often considerably lower than sound levels commonly experienced in most residential areas. In such park areas of low ambient sound levels, even distant aircraft can be easily heard. Complete preservation of natural quiet under these circumstances can mean that aircraft must fly several miles from the area to be protected. Natural quiet is an increasingly scarce resource in America. The NPS needs to protect some of these uniquely quiet places.

Effects on Cultural Resources: Cultural and historical resources, sacred sites, and ceremonies can be affected by the sight and sound of overflights. The setting, ambiance, feeling or association can be disrupted, and vibrations may be induced that can be damaging to structures. If helicopters come too close to cliff dwellings, there is a potential for loss of cultural resource context and materials (pollen, small artifacts, etc.). Potential for impact depends upon the proximity of the aircraft overflight to the resource, the frequency of overflight, and, for vibration impacts, the frequency-dependent responses of the resource to impinging sound or pressure waves. Resources should be examined on a case-by-case basis, but general guidelines suggest that historic structures exposed either to sonic booms or to helicopter flight at close range may be at risk of weakening or damage and should be examined to determine levels of sound-induced vibration. In the absence of such detailed information, eliminating sonic booms or keeping helicopters distant (probably about 2000 feet vertically and horizontally) should serve to protect most structures.

Effects on Wildlife: In general, wild animals respond to low-altitude aircraft overflights, although the manner in which they do so depends on life-history characteristics of the species, characteristics of the aircraft, flight activities, and a variety of factors such as habitat type and previous exposure to aircraft. Of most concern in parks are 1) low-altitude overflights by military aircraft, and 2) light, fixed-wing aircraft and helicopter activities related to tourism. The primary concern stemming from these low-level overflights related to wildlife is that the flights may cause physiological and/or behavioral responses that in turn reduce the wildlife's fitness or ability to survive. Overflights may cause excessive arousal and alertness or stress. If chronic, stress can compromise the general health of animals. Overflights may interfere with raising young, habitat use, and physiological energy budgets. Indirect effects on wildlife such as accidental injury, energy losses, habitat avoidance and abandonment are very difficult to detect, but some experts suspect they occur.

Recent concerns have focused on the significance of overflight impacts as they affect wildlife populations. Based on a limited number of studies it can be concluded that impacts to wildlife populations can occur from low level aircraft overflights. It would be valuable to have additional research to fully address population impacts, but waiting for and relying on future research results for current policy decisions is not possible. Criteria are identified in this report that the NPS proposes to use to trigger mitigation or prevention efforts.

Effects on Park Visitors: Visitors report impacts (interference with enjoyment, annoyance, and interference with appreciation of natural quiet), depending upon the levels of overflight sound which the visitors may have experienced. However, reported impacts are highly variable from location to location, and the results of the dose-response work and the survey of Grand Canyon visitors suggest that visitor sensitivity to overflight-produced sound is greater for activities where visitors remove themselves from automotive transportation and, possibly, from other visitors. Backcountry visitors, people on oar-powered river trips, and visitors who take short hikes away from their cars, consistently show greater sensitivity to the sound of overflights than do frontcountry visitors, including visitors at easily accessible overlooks. These findings lend credence to the need for a systematic approach to problem solving of park overflight issues, but one which can target specific problems in specific areas.

Overflights and Safety: Although there is no evidence of serious or wide spread safety problems for on-ground visitors or park employees tied to aircraft overflights, there are at least 18 parks where safety from an on-ground perspective needs further investigation and evaluation. Virtually no visitors perceived a threat to their safety from overflights. Some organizations and individuals in the outdoor recreation community expressed concerns, but the overflight incidents triggering these concerns may be isolated incidents or reactions to other types of impacts. As in the case with other overflight impacts, identifying and correcting safety problems should be done on a park-by-park basis. The NPS needs to clearly communicate the FAA process by which park managers should identify, document and request assistance from the FAA to resolve these issues.

Airspace over public lands is in demand from many sources — military operations, general aviation, air tourism operations, and by land management agencies that operate the second largest fleet of aircraft in the country. The potential for conflict, especially during fire fighting or other major incidents, is real and growing. The NPS and other land management agencies need to work with DOD and FAA to develop procedures that will resolve these airspace/park management issues in complex airspace. Improving communication links is vital.

Values Associated with Aircraft Overflights: Aviation helps the NPS effectively administer the National Park System, many visitors enjoy the experience of seeing parks from a different perspective, and it is a special opportunity for the disabled, elderly, and infirm. But given the potential for impacts to on-ground visitors and park resources, air tour passenger enjoyment adds to the complexity of the situation. Should the NPS consider air tour passengers as park visitors since their enjoyment derives from the resources that park preserves? Unlike other visitors where the NPS controls visitor activity to prevent or minimize degradation of park resources and experience opportunities, the impacts of these "visitors" are not controlled by the NPS. This situation is a source of great frustration to NPS managers that needs to be appreciated by the FAA. It is essential that the FAA and NPS find a way to mitigate these impacts.

The marketability of air tours also adds to the complexity of the situation because it suggests continued growth of tours over parks. The willingness of vacationers to take air tours, and to endorse that "product" suggests to entrepreneurs that there may be opportunities for expanded air tour services. This, in turn, suggests that problems may get worse.

The NPS believes that these "aerial visitors" should be treated as park visitors, subject to similar benefits and restrictions as other visitors. (Grand Canyon National Park has considered air tour passengers as park visitors since 1993). This is only possible if there is a way to feasibly mitigate or regulate the effects of these users.

Overall NPS Conclusion: Aircraft overflights can cause impacts to park resources and values. For certain visitors, for visitors engaging in certain activities, and for certain areas, there is a very real potential for overflights to impact parks' natural and cultural resources, visitor experiences, and solitude and tranquillity — the very fabric of many national parks. A systematic framework for addressing these problems is a first step; it should be flexible enough to address the unique airspace/park use issues identified in this report. NPS priorities should be used to effectively focus problem-solving efforts. At the same time, aviation confers benefits to the parks and to some park visitors. The NPS needs the assistance of FAA and the Department of Defense so that the scarce resources of natural quiet and airspace can be most effectively conserved for the common good and benefit of the American public, while also preserving the benefits provided by aviation. All of the involved agencies have very different missions with little tradition for working together for effective solutions. This needs to change, and there is some evidence that this is possible.

The issue is not whether there is an impact, but rather how much impact does there have to be before NPS can be assured of relief. Through this report, the NPS has made an important first step at defining how significant these impacts can become before they should "trigger" FAA action. The NPS recommends that these definitions of impact be accepted as a starting point, ones that can be refined over time as research and experience in application dictate.

Aircraft overflights of national parks are variable in number and nature. Solutions to airspace/park use issues are likely to be equally diverse. There may be solutions or partial solutions to many problems identified in this report; however, the NPS recognizes that resolution may not be possible for some issues at this time. Getting to solutions dictates that issues be clearly identified and addressed by the agencies involved.

10.2 Airspace Management Issues: The NPS Perspective

Public Law 100-91 studies and investigations conducted by the NPS suggest that the following issues should be addressed:

- **Lack of Airspace/Park Use Issue Resolution Process:** The majority of issues identified in this report occur at the regulatory interface of two Federal agencies. There has been no process or systematic basis for dealing with issues on an interagency basis. With park resources, including natural quiet and visitor experience, and airspace becoming scarce resources, the FAA, NPS, and the military services need to develop an airspace/park use issue resolution process that respects the authorities and mandates of involved agencies. This is a situation where government should be "re-invented".

  The **process** for identifying problems, developing, testing and implementing solutions, and monitoring outcomes should be uniform throughout the National Park System. The NPS must have the authority to trigger the process for resolution of airspace/park use issues. Sufficient experience, information and analytical tools are available to assess whether impact reduction methods are effective, feasible and verifiable, and whether developing the basic outlines for a conflict resolution process is possible.

- **Aerial Commercial Use of National Parks:** The scenic resources of national parks are used for commercial purposes by sightseeing tours, commercial filming and others. There are commercial air tour operations over 30-40 national parks. Several operate under NPS concession contracts where the airstrip or airport is inside the park; the others do not. Where park resources or visitors are being affected by these operations, it is vital that there be a means to prevent or minimize impacts. In the same context, the NPS needs more effective control over low-level commercial filming over national parks.

- **Inability to Protect Natural Quiet:** The NPS believes there should be national parks where natural quiet can be preserved and experienced by visitors. Both the NPS and the FAA have regulatory authorities that can be used to protect natural quiet in national parks, but to date these have not been effectively employed for that purpose.

- **Lack of a Substantial Restoration of Natural Quiet in Grand Canyon National Park:** SFAR 50-2 has made important progress in restoring natural quiet despite a **significant** increase in air traffic. In spite of the best efforts of all involved, the regulation has not resulted in a substantial restoration of natural quiet in Grand Canyon National Park and the continuing growth in air traffic may diminish or negate progress to date. The NPS believes that improvements to the SFAR are necessary.

- **Lack of Methods to Prevent Problems:** To date the NPS and FAA have not developed the methods to effectively **prevent** airspace/park use conflicts. Communication, training and planning need to be greatly improved for skills to be developed in this arena. This will be vital as the demand for airspace continues to grow. The NPS believes that over time, problem prevention will be more effective than problem solving.

10.2.1 The FAA and The NPS: Learning How to Work Together

On December 22, 1993, Secretary of Transportation Federico Pena and Secretary of the Interior Bruce Babbitt, in an important act of reinventing government, committed the FAA and the NPS to learning how to work together to resolve airspace/park use issues. In March, 1994, the two agencies issued a joint Advance Notice of Proposed Rulemaking (ANPRM) in the Federal Register[1] soliciting public ideas on how to reduce adverse effects from commercial air sightseeing tours on parks such as the Grand Canyon,

1. *"Overflights of Units of the National Park System", Federal Register Volume 59, No. 52, Thursday, March 17, 1994.*

Hawaii Volcanoes and others (See Appendix D). Questions were solicited on a number of policy and technical questions that will be important to guiding the two agencies on how to proceed on this issue.

10.2.2 Military Airspace/Park Use Issues: Prospects for Change

There are some encouraging signs that the military services may be more amenable to resolving airspace/park use issues than has been the case in the past. The following provides evidence of this trend:

- **Long-Range Airspace Planning**

  In recognition of the need to improve long-range airspace planning, the Air National Guard (ANG) implemented a coordinated airspace planning process in the Northwest Mountain FAA Region in 1988. It then initiated a regional process in the New England FAA Region in 1989, primarily at the unit level. To improve the process and ensure appropriate levels of planning and coordination and to bring a national perspective to unit, local, state, and regional airspace issues, the ANG involved its leadership and extended the regional approach to the remaining FAA regions so that all ANG activity within the United States is covered.

  In April, 1993, the ANG established the national-level ANG Airspace Steering Committee. The members of the Committee are the chairpersons of the regional committees. Acting as the executive agent of the Director of the Air National Guard, the Steering Committee is charged with guiding the overall airspace planning and management process for the ANG. This process involves: 1) identifying, validating and ranking airspace requirements on a regional basis; 2) defining and selecting preferred solutions; and 3) developing a coordinated implementation plan.

  This planning process provides the ANG a guide for decisions and actions and ensures that airspace will be available to meet ANG training requirements in the next 5-10 years. The process is evolving and relies on the involvement of senior ANG leaders from each state. In addition, the FAA, Air Staff, Major Commands, Air Force Reserve, Army National Guard, Army, Navy, and Marines are becoming part of the process.

  NPS and the other land management agencies, for the first time, have clearly defined and centralized points of contact to deal with on airspace issues that involve the ANG. To the extent that this approach to airspace management is adopted by the Department of Defense as a whole, it will facilitate both problem solving and problem avoidance.

- **Policies of the Air National Guard and Navy:** In 1990 the ANG instituted an overflights policy on federally designated wilderness and wild and scenic rivers (See Appendix E). The policy requires ANG units to plan new airspace in a manner that considers these areas as sensitive and to be avoided whenever possible. If avoidance is not possible then overflights will occur at 2000 feet above ground level or higher. Also the U.S. Navy policy on "noise sensitive areas" such as national parks is that these areas shall be avoided when at altitudes of less than 3,000 AGL, except when in compliance with an approved traffic or approach pattern, visual or instrument route, or special use air space. Noise sensitive areas are also to be avoided in the development of routes and special use airspace unless the 3,000-foot criteria can be observed. If adopted by all DOD agencies, these types of policies could facilitate problem solving and problem avoidance.

- **Formation of the Federal Interagency Airspace/Natural Resource Coordination Group and DOD Report to Congress:** In January, 1994, an ad-hoc group from the Department of Defense (U.S. Air Force, U.S. Navy, U.S. Army, U.S. Marine Corps, Air National Guard, Air Force Reserve, Army National Guard, and other Department of Defense officials), Department of the Interior (NPS, Fish and Wildlife Service, Bureau of Land Management, and Bureau of Indian Affairs), and from the Department of Agriculture (U.S. Forest Service) met and agreed to establish the Federal Interagency Airspace/Natural Resource Coordination Group as the vehicle for addressing airspace conflicts over public lands. In May, 1994, the group agreed to a "Statement of Principles for a Partnership for Action to Protect, Restore and Maintain the Nation's Airspace and Federally Protected Land Resources" (Appendix F) and established five permanent subcommittees:

  Operations and Safety
  NEPA Planning and Compliance
  Education and Awareness
  Environmental Effects
  Coordination and Procedures

  As part of this effort, the ANG temporarily placed a liaison officer with the U.S. Fish and Wildlife Service (Refuge Division) to explore solutions to five aircraft overflight issues in the National Wildlife Refuge System. The following examples characterize the types of resource impacts and solutions that have been so far addressed:

- offsetting aircraft by one-half mile avoided disturbance of nesting piping plovers, a threatened species, on the Edwin B. Forsythe National Wildlife Refuge in New Jersey;
- shifting flight routes one mile offshore reduced disturbance of nesting wood storks, an endangered species, on the Savannah Coastal Refuge Complex in Georgia;
- enforcing a 2,000-foot altitude restriction above Cross Creeks National Wildlife Refuge in Tennessee eliminated disturbance of nesting bald eagles;
- eliminating the dropping of flares below 2,000-feet elevation eliminated the potential for wildfire and associated impacts to endangered species on the Buenos Aires National Wildlife Refuge in Arizona; and
- establishing operational safety protocols on the Charles M. Russell National Wildlife Refuge in Montana to reduce the potential for airspace conflicts.

In addition, military and Fish and Wildlife Service representatives identified field-level contacts to facilitate implementation of agreements and to address additional problems as they occur. The solutions are being monitored to ascertain how to ensure that these processes are permanently established. All parties understand that good communication is critical to sustain these agreements.

In a response to the Senate Armed Services Committee Report on the National Defense Authorization Act for Fiscal Year 1994, Report No. 103-112, the Department of Defense reported that the coordinating group may be an important vehicle for establishing procedures and dispute resolution mechanisms between the Department of Defense and the Department of the Interior. (See Appendix G). The Department of Defense has committed to reporting to the Senate Armed Services Committee by January 1, 1995 on airspace resolution procedures and recommendations developed by this ad-hoc coordinating group.

10.3 NPS Recommendations to Congress

10.3.1 RECOMMENDATION 1

Develop Airspace/Park Use Issue Resolution Processes

The NPS recommends that the Department of Transportation–Department of the Interior Interagency Working Group be maintained as a functioning entity to manage interagency problem solving through to the operational level of both agencies. Their priorities should be to identify and document processes that can be clearly communicated to field offices where problem solving should occur. Although many of the recommendations that follow are tied to this process, there may be some airspace/park use issues that go beyond the scope of the following recommendations. The general shape of this process should be as follows:

- Define and report issues in a format agreed upon by the agencies, including definitions of impacts outlined in this report.
- Forward information to points of contact in NPS and FAA who would be expected to seek resolution of the issues.
- Specify the time period during which a resolution must be achieved.
- Issue a joint report to the Interagency Working Group on success of resolution or mitigation efforts. If resolution is not possible, the issues would be addressed by the policy group.
- Issues not resolvable by the Interagency Working Group would be forwarded to the Secretaries of Transportation and Interior for final resolution.

The NPS also recommends that NPS and DOD use the newly established Federal Interagency Airspace/Natural Resources Coordination Group (See Section 10.3.2 and Appendix F) to develop similar issue resolution processes for low-level military overflights.

10.3.2 RECOMMENDATION 2

Establish and Maintain Agency Points of Contact

The NPS strongly recommends that agency points of contact be officially established and maintained as follows:

NPS: Deputy Director and Overflight Studies Coordinator

FAA: Air Traffic Operations (AAT), Flight Standards (AFS), and Environment and Energy (AEE).

DOD: To be requested through the new Federal Interagency Airspace/ Natural Resources Coordination Group.

10.3.3 RECOMMENDATION 3

Use the Full Range of Methods and Tools for Problem Solving

The NPS recommends that all reasonable methods and tools be used in airspace/park use issue resolution processes. The following is a partial list of methods, any of which might be reasonably effective, feasible, and verifiable for use on a specific situation. The NPS has developed tools that permit identification of locations impacted by overflights, that compute, in terms of sound levels, the effects of changes in aircraft operations and that can be used to measure the reductions in impacts that result from such changes. The tools are based on a number of studies including, dose-response results, simplified sound level measurement techniques and computer programs that estimate sound exposure results from aircraft overflights.

The partial list of methods includes the following:

Voluntary Agreements: Voluntary agreements can have a role in resolving or mitigating airspace/park use issues if some fundamental weaknesses can be addressed. The FAA, the NPS, and air tour operators need reasons to enter into these agreements. Furthermore, there are no enforcement or penalties involved should operators withdraw from or refuse to participate in agreements. If rulemaking or penalties would result when voluntary agreements did not work, then all parties would have incentives to make and comply with these agreements.

Incentives to Encourage Use of Quiet Aircraft: NPS research suggests that quieter aircraft can play an important role in substantially restoring or maintaining natural quiet in parks. Although there is no Federal requirement for air tour types of aircraft to be manufactured to produce less noise than Stage 3 standards for large commercial aircraft, some aircraft are significantly quieter than others and more appropriate for use in air tour operations. Because of the significant expense, incentives need to be developed to encourage air tour operators to replace equipment with quieter aircraft. Internally, the NPS will need to work with the Department of the Interior's Office of Aircraft Services to also provide incentives for parks to use quiet aircraft. P.L. 102-581, an "Act to amend the Airport and Airway Improvement Act of 1982 to authorize appropriations, and for other purposes," requires the FAA to identify "any measures to encourage or require the use of quiet aircraft technology by commercial air tour operators." The NPS defers to FAA expertise on this subject, but strongly recommends that FAA facilitate the introduction of quiet aircraft technology to benefit national parks, among many others.[2]

Spatial Zoning: Flight-free zones and flight corridors have been implemented in the Grand Canyon with some success. Experience has shown that, to preserve or restore natural quiet, flight-free zones must be quite large in extremely quiet places, approximately 20-30 miles minimum dimension. The problem, discussed in Chapter 3, is that some park environments are so quiet that the sound of aircraft can be heard at great distances from flight paths.

Altitude Restrictions: Minimum altitudes can help, but for tour aircraft or low-altitude military training, the altitudes necessary to significantly reduce impacts may essentially defeat the purpose of the overflight. On the other hand, altitude restrictions used in Yosemite and Haleakala have helped to reduce the most egregious impacts even though overflight impacts have not been eliminated.

Operating Specifications for Operators: As part of its certification processes, FAA may require operators to conform with certain operational requirements. These requirements generally identify the types of operations authorized, the types of airplanes permitted, airports authorized for use and time limitations for maintenance, and training. Operations specifications that relate directly to park overflight operations may provide a reasonable method to address some documented adverse effects of overflights.

Treatment of Air Tour Operations as Concessions: National parks treat all commercial services provided to visitors in parks as concessions (i.e. regulated industries) which insures services will conform to minimum standards, are not priced unreasonably, and are consistent with park values. In some ways, air tour operations are similar to ground-based services. In fact, where airstrips are inside parks, the NPS has several air tour operations under concession permit. If a joint FAA-NPS permitting process can be developed, similar arrangements may be possible where it is determined that air tour operations use the resources of the national parks. The purpose of this is to reduce resource impacts and to provide a specific visitor service.

Noise Budgets: Noise budgets have been used at some airports (Denver-Stapleton was one of the first) to allot responsibility for and control of noise among operators. Such budgets assume that the total

2. *The FAA is awaiting completion of the NPS Report to Congress before it completes the report required by the Airport and Airway Safety, Noise Improvement, and Intermodal Transportation Act of 1992.*

noise generated by the airport, and by each operator, can be quantified. Each operator can be allocated an amount of "noise," generally based on an existing or previous level of operations. If an operator uses quieter aircraft, through retrofit or new purchases, more flights can be conducted while staying within the budget. Budgets are negotiated rather than imposed. Noise budgets may provide a means for limiting growth in air tour traffic over parks in that they focus on the goal of limiting or reducing the impact of the sound of overflights, not on directly limiting the number or type of aircraft operations. A draw-back for park application may be the need for tracking numbers of operations by time and type of aircraft. Another drawback is that adverse effects to visitor experience may not necessarily be addressed.

Limits on Times of Operations Some sensitive areas on the ground may have cyclical daily, weekly or seasonal high and low visitation periods. Aircraft operations may be timed to coincide with low use periods. Alternatively, air tours may have slow days, periods or seasons, and visitors in search of tranquillity and natural quiet could be informed of the best times to visit the park and avoid significant numbers of overflights. Limited "No Fly" periods could provide visitors with certainty of natural quiet in some parks and should be further evaluated.

10.3.4 RECOMMENDATION 4

FAA to Address High Priority NPS Airspace/Park Use Issues

The NPS recommends that NPS/FAA/DOD jointly commit to resolving and mitigating airspace/park use issues beginning with identified priority areas. Such a commitment may enable the agencies to develop and more effectively communicate how issues can be resolved at the local level.

10.3.4.1 NPS Managerial Priorities

NPS believes its managers' identification of areas with aircraft overflight problems is a relatively accurate indicator of where airspace/park use issues exist. There is basic congruence between manager and visitor perceptions. Many of the 98 areas identified by managers have some type of overflight-related problem. Mitigation is possible for some areas and unlikely for others. The NPS seeks resolution of its top priorities and recognizes that the others (See Appendix B) merit further investigation as well. Based on top priority NPS areas for resolution of airspace issues include:

Grand Canyon National Park
Hawaii Volcanoes National Park
Haleakala National Park
Great Smoky Mountains National Park

Glacier National Park
Bryce Canyon National Park
Bandelier National Monument
Statue of Liberty National Monument

The NPS will further evaluate the complex air traffic patterns over Yosemite National Park and Cumberland Island National Seashore to see if mitigation appears to be possible and will then discuss those situations with FAA.

10.3.4.2 NPS Priorities for Protection of Natural Quiet

The following is a list of parks where the NPS believes maintaining or restoring natural quiet is an immediate priority. Natural quiet is an increasingly scarce resource in the United States. There ought to be national parks where this can be experienced. Criteria for the selection of these areas is listed in section 10.3.6. Highest priority areas meeting these criteria include:

Glacier National Park
Zion National Park
Southeast Utah Group Parks
Haleakala National Park
Crater Lake National Park
Isle Royale National Park
Mesa Verde National Park
Rocky Mountain National Park
Chaco Cultural National Historical Park

The NPS will work with the FAA to further refine the criteria and how they may apply to other parks.

10.3.4.3 NPS Priorities for Resolution of Safety Concerns

The NPS recommends that its perceived on-ground safety concerns related to overflights be investigated by FAA to see if these problems can be resolved or mitigated. The FAA and the NPS are cooperating in an effort to identify and put into effect recommended air tour patterns and altitudes that will enhance aviation safety around the Statue of Liberty and reduce other impacts there as well. Additionally, the FAA is developing a Special Federal Aviation Regulation that will improve the safety of commercial air tour operations in Hawaii. The priorities for the NPS include:

Statue of Liberty National Monument
Hawaii Volcanoes National Park
Perry's Victory Memorial & International Peace Park

The process exists for the FAA to use its authority and expertise to resolve reported safety issues. These and any other issues that are identified by park managers will be forwarded to the FAA for investigation and resolution through the FAA's compliance and enforcement program.

10.3.4.4 NPS Priorities for Problem Solving with Department of Defense

The NPS recommends that NPS and DOD agencies explore resolution of airspace issues at the following priority areas through the Federal Interagency Airspace/Natural Resources Coordination Group. It will be important for the FAA to be involved in this process as well. This group will report to their respective policy representatives by the end of 1994 on recommendations for resolving existing and potential airspace conflicts. NPS priorities for areas to be examined during this search for procedures include the following:

Congaree Swamp National Monument
Sequoia-Kings Canyon National Parks
Organ Pipe Cactus National Park
Death Valley National Park
Channel Islands National Park
Joshua Tree National Park
Petrified Forest National Park
Pu'ukohola Heiau National Historic Site
Gulf Islands National Seashore
Everglades National Park/Big Cypress National Preserve/ Dry Tortugas National Park

DOD is required to report back to the Senate Armed Services Committee on development of procedures to resolve airspace/park use issues by January 1, 1995. The NPS will also report to the Subcommittee on National Parks, Forests, and Public Lands as well as to the House and Senate Armed Services Committees on the success and utility of this approach to problem solving.

10.3.5 RECOMMENDATION 5

Develop an FAA Operational Rule Triggered by NPS

The NPS recommends that FAA develop an operational rule to regulate air tour operations where they have or may have adverse effects on national parks. If voluntary agreements are not adequate, the NPS should be able to trigger action by the FAA to delineate aerial sightseeing areas defined by FAA Handbook 92.01 for Principal Operations Inspectors, entitled Air Tour Sightseeing Operations. The NPS would forward recommendation on the size, altitudes and routes to effect noise abatement and mitigate impacts to persons and property on the ground in parks. The FAA may adjust the recommendations and incorporate them into tour operators' operation manuals. The rule would need to specify that tour operators operate in accordance with Part 135 FAA Regulations. Any request by an operator to the FAA to fly below 2,000 feet or within 2,000 feet horizontally of sensitive areas and structures would need clearance from the FAA only after coordination and concurrence by the park manager.

This rule would minimize the effect on other types of aviation by targeting specific problem areas. The rule's existence would facilitate the use of voluntary agreements. The NPS recommends FAA consider a special sub-part of 135 regulations to be developed for air tour operations.

Areas where this rule is most needed include the national parks in Hawaii, Glacier National Park, Canyonlands National Park, Great Smoky Mountains National Park, Zion National Park, Bryce Canyon National Park, and Rocky Mountain National Park.

10.3.6 RECOMMENDATION 6

Develop an FAA Rule to Facilitate Preservation of Natural Quiet

The NPS recommends that FAA, under the authority of Section 611 of the Federal Aviation Act,[3] implement a rule which would provide for the protection of natural quiet.

Several nationally applicable environmental statutes and regulations recognize that there are circumstances where special protection — beyond ordinary performance standards or requirements — may be necessary to adequately protect nationally significant resource values.

Class I Designations under the Clean Air Act require new air pollution sources which may affect designated airsheds — including many in national parks — to prevent significant deterioration of existing air quality so that resources including air quality-related values such as scenic vistas are not adversely affected. The absence of air pollution in some areas is what makes us aware of air pollution in others; if all areas are equally polluted, we have no way to know what is natural. Most Class I areas are at least 5,000 acres in size.

Outstanding National Resource Waters (ONRW) designations under the Clean Water Act often mean that no new point source discharges of pollutants are permitted in streams or other water bodies designated as ONRW. Waters in national parks are specifically referred to in the regulation that implements ONRW and several states have designated ONRW in parks. Their overall purpose is to keep the cleanest of the nation's waters clean.

The provisions of Section 522, **Designating Lands Unsuitable** for all or certain types of mining, of the Surface Mining Reclamation and Control Act, allow for the protection of unique resources, such as those in the National Park System, by prohibiting all or certain types of coal mining in certain areas. In one such designation, the Secretary of the Interior found some

3. *49 U.S.C. Section 44715. See also 49 U.S.C. 303 (a) and (c).*

federal lands adjacent to Bryce Canyon National Park to be unsuitable for surface mining because of the potential for adverse effects to scenic resources and quiet.

Each process shows that what is generally applicable may not adequately safeguard the unique resources and attributes of special, nationally significant lands and that as a consequence, designations or categories need to be implemented that establish a higher standard of protection. The NPS believes that there are parallels between these processes and overflight-related adverse impacts to units of the National Park System. Practices that are generally suitable for aircraft elsewhere may not be suitable in a limited number of cases where natural quiet or especially sensitive cultural resources or threatened or endangered species can be adversely affected by overflights. The NPS believes the following criteria can provide a starting point for establishing a similar process for outstanding natural quiet parks:

- Critical habitat for an endangered species known to be adversely affected by noise (e.g., the grizzly bear in the lower 48 states). Excessive and avoidable noise could be found to be an adverse modification of habitat.

- Seriousness and solemnity of purpose characterizes the park unit or a portion thereof and the sights and sounds of overflights can diminish the ability of visitors to experience —with respect and reverence — the resources and values embodied in selected Civil War battlefields or Mount Rushmore, for example.

- Natural quiet is a central resource value to the park and its absence imperils the totality of the visitor experience, especially when the visitor comes to the park expecting peace and quiet and enjoyment of nature and natural sounds. For example, an experience in a canyon in southern Utah is not complete without the call of a canyon wren or the sounds of wind. An experience of the northern lakes is not complete without the call of loons.

- Wilderness has been designated on all or part of the park, and given characteristics of the terrain and sound attenuation, opportunities for solitude would be substantially diminished by overflights. This requires the area to be at least 5,000 acres in size unless there are special circumstances.

In some cases these criteria could be used as the basis to petition the FAA to implement, through their rulemaking process, an aircraft management plan for that park to establish flight corridors or flight tracks that would keep areas naturally quiet and preserve the visitor experience of them.

10.3.7 RECOMMENDATION 7

Develop a Movie Waiver Policy

The NPS recommends that FAA amend its policy relating to the conditions and limitations for movie filming operations conducted in national parks. The new policy should require the operator flying the filming crew to have the following:

- An operating plan specific to the park where the filming is being done.
- Approval of the plan by the park superintendent
- Notification of the appropriate Flight Standards District Office (FSDO)

10.3.8 RECOMMENDATION 8

Develop an Interagency Airspace Coordination Guide/Training

The NPS recommends that the NPS, FAA, and the military services complete an Interagency Airspace Coordination Guide that would incorporate what the agencies learn about how to resolve airspace/park use conflicts. The NPS and the Air National Guard are currently developing a proposal to DOD's Legacy Program for that purpose. It is further recommended that this be the basis for training interagency planners from all the agencies involved, pilots from the Armed Services, etc.

10.3.9 RECOMMENDATION 9

Seek Continued Improvements in Safety and Interagency Planning Related to Airspace Management

The NPS makes the following recommendations with respect to safety and planning:

- FAA and NPS work together jointly to investigate the parks where serious safety issues may exist. FAA would take corrective actions if appropriate.
- FAA and NPS jointly develop a reporting format for safety issues to be used as part of interagency issue resolution processes. The NPS would use this format to report additional issues as they arise.
- Land management agencies, the FAA and the DOD need to give greater priority to identifying how to avoid collisions associated with the Temporary Flight Restrictions around forest fires. Department of

the Interior agencies need to support development and use of CAHIS (Computer-Aided Hazard Information System).

- Land management agencies, including the NPS, should provide the Armed Services with geographically-based databases of their noise sensitive areas for use in Armed Services planning.
- All the agencies need to explore how to get critical items highlighted in each others' planning processes.

10.3.10 RECOMMENDATION 10

Improve SFAR 50-2 to Effect and Maintain the Substantial Restoration of Natural Quiet at Grand Canyon National Park

Section 3(b)(3) of P.L. 100-91 requires the NPS to discuss:

> *. . . such other matters, including possible revisions in [Special Federal Aviation Regulation 50-2], as may be of interest.*

In Chapter 9, the NPS concluded that natural quiet in Grand Canyon National Park (GCNP) had not been substantially restored and recommended SFAR 50-2 be revised to effect a more substantial restoration. The following sections propose revisions to Special Federal Aviation Regulation 50-2 for the purpose of not only **achieving** substantial restoration of natural quiet but also for **maintaining** that restoration over time, as increases in the air tour industry occur. If the FAA determines that there are no safety concerns[4], these revisions can be introduced into the FAA rulemaking process where they would undergo analysis, public review and comment. The NPS is supportive of anything the FAA can do to lessen the regulatory burden of the SFAR.

Aircraft overflight activity at GCNP can be viewed as consisting of the following major elements:

- The structure of the GCNP Special Flight Rules Area (established by SFAR 50-2 in 1988), including the regulation boundary, flight-free zones, air tour routes, general aviation and air tour minimum sector altitudes, etc.
- Aircraft equipment used in the Special Flight Rules Area (SFRA).
- Aircraft operations (numbers of aircraft, times of day, etc.) in the SFRA.
- Aircraft flying above or adjacent to the SFRA.

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4. *Section 3(b)(2) of P.L. 100-91 requires the FAA to review NPS recommendations to determine whether implementing them would adversely affect aviation safety.*

This recommendation is organized by the same categories and is based on the following general concepts: simplification of the commercial tour route structure; expansion of flight-free zones; accommodation of the forecast growth in the air tour industry; phased in use of quiet aircraft technology; and institution of changes in approaches to park management.

One of the key changes in park management will be the establishment of an acoustic monitoring program by the NPS in coordination with the FAA. The NPS will replace its current monitoring program with one designed to measure sound levels on the ground where the agency seeks to protect natural quiet. The NPS will identify benchmark sites and establish a protocol for collecting acoustical data at those sites for the purpose of establishing "action triggers" (described in section 10.3.10.3). The "trigger" will specify a noise level that should not be exceeded. The consequences proposed for exceeding the trigger are also described in Section 10.3.10.3.

10.3.10.1 GCNP Airspace Structure Recommendations

The proposed airspace structure, including flight-free zones and flight corridors, recommended to effect a more substantial restoration of natural quiet for GCNP is displayed in Figure 10.1.

General

The NPS recommends that:

- The SFRA boundary be modified near the southeast corner of the Bright Angel Flight-Free Zone and the far western edge of the SFRA near the Grand Wash Cliffs. The purpose of these boundary adjustments is to ensure that almost all of GCNP lies within the SFRA. The FAA may have to modify the boundary elsewhere to guarantee that all commercial aircraft remain within the SFRA while conducting tours. The NPS also recommends that the SFRA boundary be realigned as originally proposed by NPS in 1987 near the Grand Canyon West Airport. A "notch" was cut out of the SFRA to accommodate this airport when it was constructed. The NPS recommends that traffic utilizing the Grand Canyon West Airport have the same caveat ("Landing/Take-off operations below 3,000' AGL within 3 NM of the airport are authorized by the SFAR") as other airports/airstrips located under or adjacent to the SFRA (e.g., Marble Canyon Airport, Cliff Dwellers Airstrip, Grand Canyon Bar Ten Airstrip, and Pearce Ferry Airstrip).

- It is additionally recommended that FAA study the air traffic in the range of 14,499 feet Mean Sea Level (MSL) to 17,999 feet MSL so that a determination can be made as to whether there is merit in an upward adjustment of the SFRA ceiling.

- "Minimum Altitude Sector" boundaries (for the five sectors within the GCNP SFRA) remain unchanged. The minimum altitudes within these boundaries are proposed to remain unchanged for general aviation aircraft, but will change for air tour aircraft as specified under "Routes" below.

- A new regulation superseding SFAR 50-2 should be considered a permanent Federal Aviation Regulation without an expiration date.

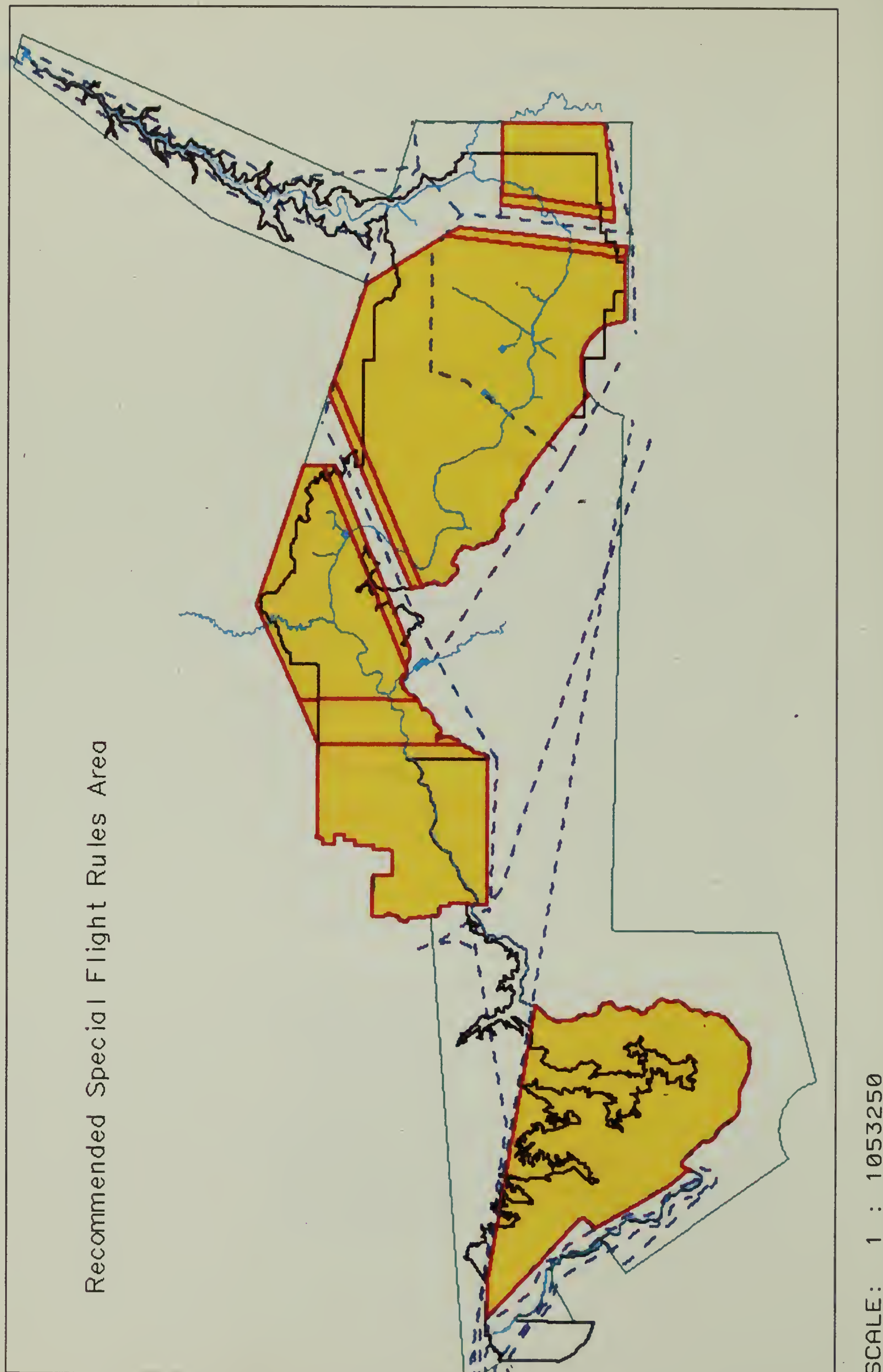
Flight-Free Zones

The NPS recommends that:

- Flight-free zones be expanded to reduce impacts to natural quiet, while still providing viable opportunities for air tours. Figure 10.1 provides a general description of the recommended modifications. The NPS will work with the FAA to develop the legal descriptions of the four flight-free zones. The current Bright Angel and Shinumo Flight-Free Zones would be combined and increased in area to the north (to the SFRA boundary); the current Desert View Flight-Free Zone would be expanded to the north and south (and to the east to the SFRA boundary); and the current Toroweap/Thunder River Flight-Free Zone would be expanded to the west and south (and to the north to the SFRA boundary). A new flight-free area, the Sanup Flight-Free Zone, would be created in western Grand Canyon. Flight-free zone boundaries are recommended to extend, in some cases, beyond the boundary of GCNP, to provide additional protection.

- The resulting four (4) flight-free zones be identified as follows (from east to west): Desert View, Bright Angel, Toroweap/Thunder River, and Sanup. These four zones would encompass approximately 987,200 acres or almost 82 percent of the total park area.

- FAA study air traffic over the flight-free zones in the range of 14,499 MSL to 17,999 MSL to evaluate the merit of raising the flight-free zone ceilings for the purpose of reducing the numbers of aircraft flying directly over flight-free zones, as well as reducing noise levels of those aircraft.


Recommended Special Flight Rules Area
SCALE: 1 : 1053250

Flight Corridors

The NPS recommends that:

- **Dragon Flight Corridor**. On the effective date of a new regulation superseding SFAR 50-2, the Dragon Flight Corridor would be abolished. However, the Black 1 Alpha (airplane) and Green 1 Alpha (helicopter) commercial tour routes (as designated under SFAR 50-2) would remain accessible for use by quiet commercial aircraft only (see the Aircraft Equipment Recommendation section below). These routes would be provided to offer an incentive for air tour companies to convert to quiet aircraft, and to reward those companies which have already converted. The routes are indicated by a dashed line in the center of the new Bright Angel Flight-Free Zone (Figure 10.1), and would be modified slightly to avoid overflying the Hermit Basin region. Five years after the effective date of the new regulation, these two quiet-aircraft routes would be eliminated. During the five-year period, traffic along these quiet-aircraft routes would be one-way only. Minimum altitudes along these routes would remain unchanged. General aviation aircraft, like non-quiet commercial tour aircraft, would no longer have access to the Dragon Flight Corridor since it would have ceased to exist.

- **Fossil Canyon Flight Corridor**. Five years after the effective date of a new regulation superseding SFAR 50-2, for commercial aircraft, the commercial tour routes within the Fossil Canyon Flight Corridor would be accessible only to quiet commercial aircraft (see section on Aircraft Equipment Recommendations). Minimum altitudes within this corridor for commercial tour and general aviation aircraft would remain the same. Effective immediately upon implementation of the new regulation, the dimensions of the corridor would be changed to conform with the structure of the Zuni Point Flight Corridor (i.e., 2 nautical miles wide for commercial tour and 4 nautical miles wide for general aviation aircraft). As with the Zuni Point Flight Corridor, the general aviation portion of the corridor would be centered directly over the commercial tour portion. Two-way traffic within the Fossil Canyon Flight Corridor by commercial tour aircraft would be prohibited. Two-way traffic within the Fossil Canyon Flight Corridor by general aviation aircraft would be permitted. Use of the Fossil Canyon Flight Corridor by quiet commercial tour and general aviation aircraft would continue unless results from the NPS acoustic monitoring program indicate a need for change (i.e., action triggers were met or exceeded).

- **Zuni Point Flight Corridor.** Ten years after the effective date of a new regulation superseding SFAR 50-2, for commercial aircraft, the commercial tour routes within the Zuni Point Flight Corridor would be accessible only to quiet commercial aircraft (see section on Aircraft Equipment Recommendations). Minimum altitudes within this corridor for commercial tour and general aviation aircraft would remain the same. The dimensions of the corridor (2 nautical miles wide for commercial tour and 4 nautical miles wide for general aviation aircraft) would remain unchanged. Two-way traffic within the Zuni Point Flight Corridor by commercial tour aircraft would be prohibited. Two-way traffic within the Zuni Point Flight Corridor by general aviation aircraft would be permitted. Use of the Zuni Point Flight Corridor by quiet commercial tour and general aviation aircraft would continue unless results from the NPS acoustic monitoring program indicate a need for change (i.e., action triggers were met or exceeded).

- **Tuckup Flight Corridor**. The Tuckup Flight Corridor would continue to be accessible only to general aviation aircraft. The alignment and dimensions of the corridor (4 nautical miles wide) would remain unchanged. However, the minimum altitude would be lowered from 10,500 feet MSL to 9,500 feet MSL. This altitude more closely approximates the minimum sector altitude (9,000 feet MSL) for general aviation aircraft in this area of the SFRA. Two-way traffic within the Tuckup Flight Corridor by general aviation aircraft would be permitted. General aviation use of the Tuckup Canyon Flight Corridor would continue unless results from the NPS acoustic monitoring programs indicate a need for change (i.e., action triggers were met or exceeded).

GCNP SFRA

The NPS recommends that:

- Fifteen years after the effective date of the new regulation superseding SFAR 50-2, commercial tour routes within the GCNP SFRA would be accessible only to quiet commercial aircraft (see the Aircraft Equipment Recommendation section below). That is, non-quiet commercial tour aircraft (including NPS aircraft) would have their access phased out. Access by general aviation and military aircraft would continue unless results from the NPS acoustic monitoring programs indicate a need for change (i.e., action triggers were met or exceeded).

Routes

The NPS recommends that:

- Routes and route segments available to the Grand Canyon air tour industry under SFAR 50-2 be simplified and reduced, with modifications to some of the remaining routes (see Figure 10.1).
- One-way traffic on commercial tour routes outside of flight corridors be instituted as much as possible. As discussed earlier, two-way traffic within flight corridors by commercial tour aircraft would be prohibited.
- Whitmore Canyon/Wash helicopter routes be treated the same as all other commercial tour routes within the GCNP SFRA (i.e., numbered, described, etc.), and procedures be identified in the FAA's and operators' Operations Specifications manuals. Noise abatement procedures would be instituted by the FAA after consultation with the NPS.
- In addition to the areas, routes and corridors within the SFRA limited to quiet aircraft (described under "Airspace Structure Recommendations"), quiet aircraft would be allowed to fly at lower altitudes than non-quiet aircraft where feasible (see section 10.3.10.2). That is, where the option exists, only quiet aircraft would be allowed to fly at the minimum altitudes specified for tour aircraft in SFAR 50-2. This may require FAA to adjust commercial tour route altitudes for non-quiet aircraft upward to meet necessary separation standards. This recommendation can be phased in over a short period of time (not to exceed 2 years) or instituted immediately if there are sufficient quiet aircraft already in service to make this recommendation viable while also ensuring that there are no adverse impacts to aviation safety.
- Tour flight route altitudes be adjusted to prohibit flight below the elevation of any canyon rim or feature within one mile (horizontally) of the route. Section 3(b)(1) of P.L. 100-91 states that *"the recommendations shall contain provisions prohibiting the flight of aircraft below the rim of the Canyon...."* The purpose of this recommendation is to prohibit flights below the rim of the Grand Canyon, and to ensure certain minimum altitudes when aircraft are accessing the Canyon, as between the GCNP Airport and the Zuni Point Flight Corridor, or when flying across the North Rim.

10.3.10.2 Aircraft Equipment Recommendations

NPS recommends that:

- FAA and NPS work cooperatively to develop a noise-based definition of "quiet aircraft" and identify the list of fixed-wing and rotorcraft (current technology) that would qualify for use in the Special Flight Rules Area. Existing FAA methodology for measuring aircraft sound levels for aircraft, contained in Title 14 of the Code of Federal Regulations, Part 36 (Noise Standards: Aircraft Type and Airworthiness Certification, including all subparts and appendices), may be applicable to developing this definition. NPS would expect that the quietest aircraft currently operating in the SFRA would qualify — the deHavilland DHC-6-300 Twin Otter ("Vistaliner" version), the Cessna 208 Caravan, as well as the McDonnell Douglas "No Tail Rotor" (NOTAR) helicopters and other quiet aircraft which would qualify to operate there. The definition should also be such that retrofitted aircraft are able to be added to the "quiet aircraft" category. This cooperative effort between the FAA and the NPS coincides with the spirit of the amendment to the National Environmental Technologies Act introduced by Senator John McCain (AZ) and recently passed by Congress.
- The development and implementation of incentives related to quiet aircraft be an important component of any proposed changes to the SFAR. Incentives would provide a positive balance to added restrictions such as increasing the size of flight-free zones or removing specific routes. Other incentives for the use of quiet aircraft besides allowing the use of "quiet aircraft only" corridors would need to be investigated and instituted to encourage companies to move forward in converting their fleet as soon as possible. A wide array of inducements or incentives may be possible; the FAA should appropriately comment on this. The NPS is supportive of making incentives available for this purpose.

10.3.10.3 Aircraft Operations Recommendations

Based on NPS experience in GCNP, it is apparent that a new regulation must also incorporate some form of use limits to accomplish a substantial restoration of natural quiet. It is very likely that part of the gain in noise abatement accomplished by SFAR 50-2 has been invalidated by the continuing increases in aircraft operations. The NPS has every reason to believe that this trend will continue.

Consequently, to ensure **maintaining the substantial restoration of natural quiet** once this recommendation is implemented, the NPS further recommends that:

- The FAA and the NPS work together to develop a process that would be initiated when "action triggers" are met as determined through the NPS acoustic monitoring program. That is, the FAA and the NPS would need to agree on the best course of action to ensure that the triggers are not exceeded again. This action must be completed within six months of meeting or exceeding the trigger. Limits on operations or noise, particularly in flight corridors, would be among the measures considered. The FAA would then develop an appropriate mechanism (noise budget, co-permitting, or other) that would implement this limitation after it has been triggered.
- A temporal restriction (a curfew or "no-fly" time period) for commercial tour aircraft be implemented on the effective date of a new regulation superseding SFAR 50-2. NPS recommends that this "no fly" time be from 6 p.m. - 8 a.m. each day.
- APIMS ("Aircraft Position Information Monitoring System") or similar tracking system be required on Part 135 tour aircraft operating in the SFRA for the purpose of tracking compliance, numbers of flights per route by time period, and so forth, to develop a data base which might be used to develop more effective noise abatement techniques.

10.3.10.4 Flights Outside the SFRA

The NPS recommends that:

- Due to the frequent deviations of high-altitude jets from normal routes for sight-seeing purposes, it is recommended that FAA not authorize any deviations from normal flight plans and cruising altitudes for aircraft on high-altitude jet routes over the Grand Canyon area for any reasons other than safety. An FAA study is recommended on high-altitude jet routes that may also have impacts on natural quiet in the park.

10.3.10.5 Miscellaneous Recommendations

The following miscellaneous recommendations are also made:

- In those instances where the FAA allows commercial tour aircraft to land and take off on lands adjacent to GCNP, the NPS recommends the FAA require those aircraft to be at the minimum sector altitude prior to crossing over park lands.

- The FAA, in consultation with the NPS, should revise the "Grand Canyon Visual Flight Rules (VFR) Aeronautical Chart" (1st Edition, April 4, 1991) at the appropriate time to reflect any changes to the SFRA resulting from the previously described recommendations.
- The NPS shall establish an interpretive message, exhibit or display(s) in key location(s) of the park to describe overflights to visitors, and to tell them where they can expect natural quiet and where they can expect to hear aircraft.
- In recognition of a need for continued cooperation between both the FAA and the NPS, a formal process (e.g., a Memorandum of Understanding) will need to be established for accommodating requests from air tour operators for route changes or other matters of interest.
- Acknowledging a continuing need for communication between all interested parties, the NPS and the FAA should be amenable to holding public meetings as needed.

10.3.10.6 Modeling The NPS Recommendation for GCNP

The NPS recommendation for GCNP was modeled for this report using the National Park Overflight Decision Support System—NODSS (Reddingius 1994). This same system was used previously in evaluating whether natural quiet had been substantially restored to GCNP (see Chapter 9, Section 9.2.3) (also Fidell, Sanford, *et. al.* 1994). Based on data from a 1989 FAA survey of Grand Canyon air tour operators, the NPS modeled the various phases of the recommendation. The modeling for each phase takes into account forecast increases in the Grand Canyon air tour industry over the next 15 years, with some conversions to quiet aircraft. The phases (Year 1, Year 5, Year 10, and Year 15) are summarized as follows:

- **Year 1** of the NPS recommendation expands existing flight-free zones from 45 to 82 percent of the park. Ceilings of the SFRA and flight-free zones are raised to 17,999 feet MSL. About half the current SFAR 50-2 tour routes and route segments are eliminated. The Dragon Flight Corridor is abolished, but two quiet aircraft routes (one for airplanes, one for helicopters) will exist in this area (the new Bright Angel Flight-Free Zone) for five years. The Fossil Canyon Flight Corridor has been realigned and two-way commercial tour traffic eliminated in all flight corridors. The minimum altitude for general aviation aircraft in the Tuckup Flight Corridor has been lowered from 10,500 feet MSL to 9,500 feet MSL.

- **Year 5** of the NPS recommendation limits the Fossil Canyon Flight Corridor to quiet commercial tour aircraft. Quiet aircraft routes within the new Bright Angel Flight-Free Zone are eliminated.

- **Year 10** of the NPS recommendation limits the Zuni Point Flight Corridor to quiet commercial tour aircraft.

- **Year 15** of the NPS recommendation limits the entire SFRA to quiet commercial tour aircraft.

By the year 2010, acoustical modeling predicts that the NPS recommendation could substantially restore natural quiet to approximately 64 percent of the park (Figure 10.2). As in Chapter 9, the white color in Figure 10.2 represents areas of the park where natural quiet has been restored 100 percent of the time, green depicts areas restored more than 75 percent of the time, and the color red portrays areas of the park where natural quiet exists 75 percent of the time or less. Regions of the park classified as "white" and "green" are areas where the NPS considers natural quiet to have been substantially restored.

Acoustic modeling also suggests that by the year 2010, nearly 45 percent of the park could experience natural quiet 100 percent ("white") of the time. Figure 10.3 depicts the steady improvement of "100 percent natural quiet" at each five-year phase in the form of a bar chart.

The improvement brought about by the NPS recommendation is especially obvious when compared to a "no action" scenario. Modeling this scenario for the year 2010 indicates that natural quiet ("white") has been reduced to less than 1 percent of the park, down from nearly 45 percent under the NPS recommendation.

10.3.10.7 Summary of GCNP Recommendation

As discussed in Chapter 9 (Section 9.2.3) and graphically compared in Figure 10.4, unless action is taken to effect the substantial restoration brought about by the NPS recommendation, the legislative mandate of P.L. 100 cannot be met.

It is clear that a "no action" alternative is unacceptable. It is equally clear that achieving the substantial restoration mandated by P.L. 100-91 can only be accomplished by the proposed restructuring of the space with its larger flight-free zones **and** the gradual conversion of the air tour fleet to quiet aircraft, a process already well under way. The 15-year phased approach is designed to allow the air tour industry time to acquire such technology, either through purchasing new equipment or retrofitting existing equipment.

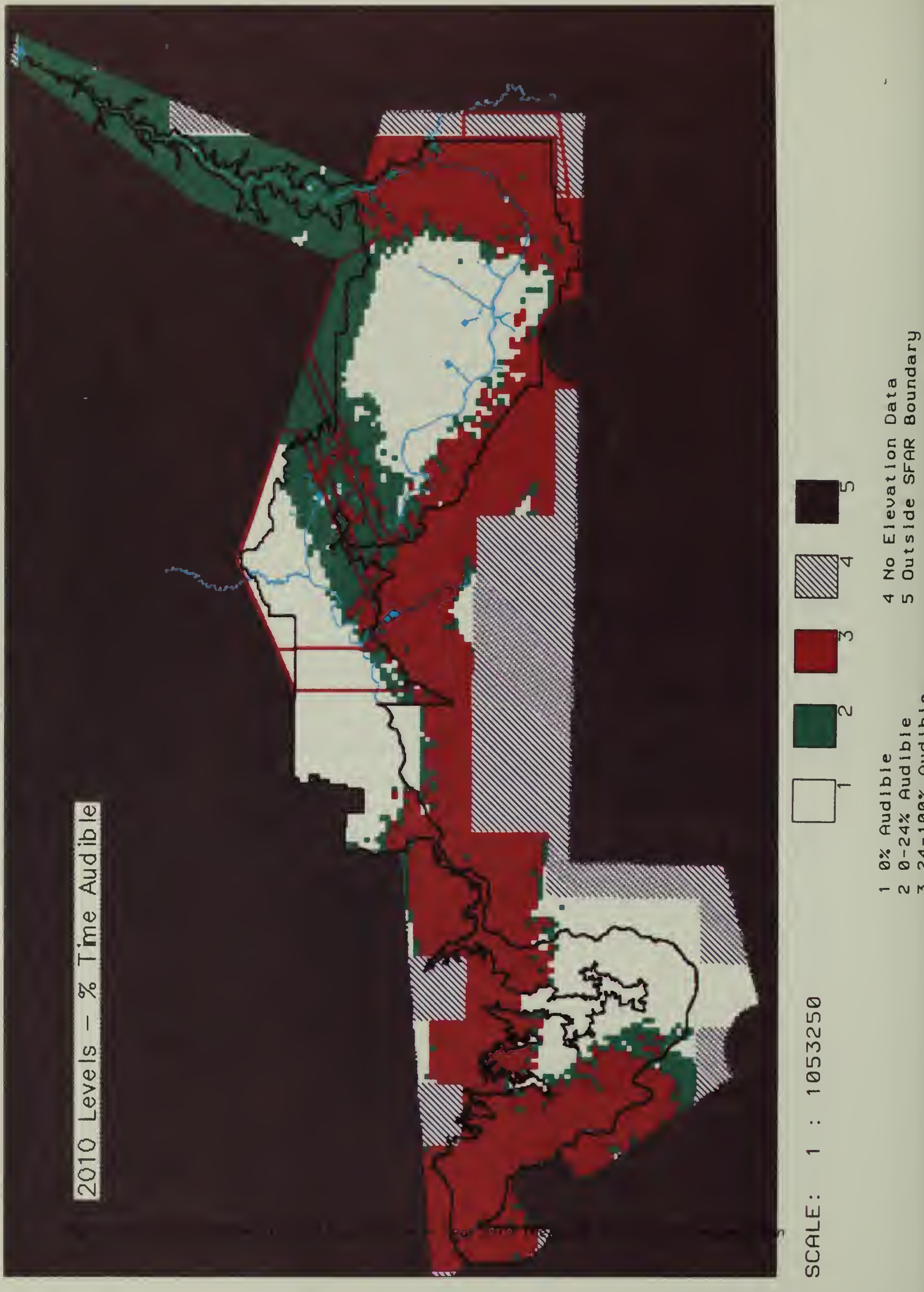


Figure 10.2: Substantial Restoration of Natural Quiet — Year 2010: The Result of the NPS Recommendation

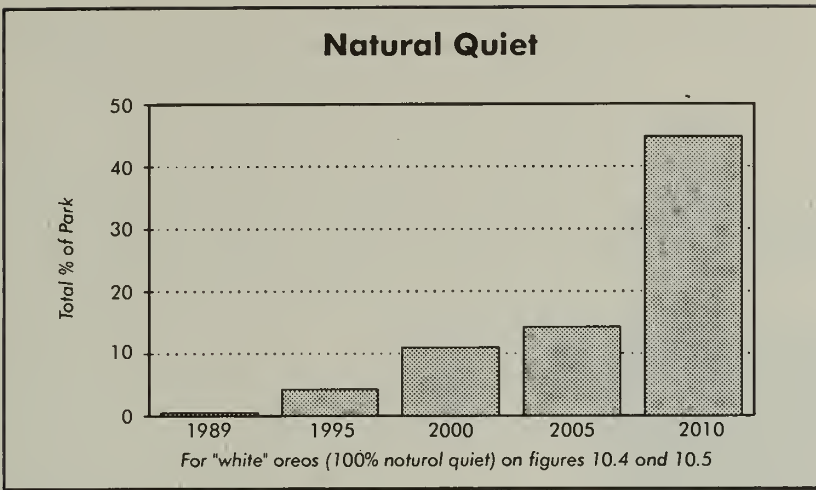


Figure 10.3: Percent of GCNP in Natural Quiet (100%

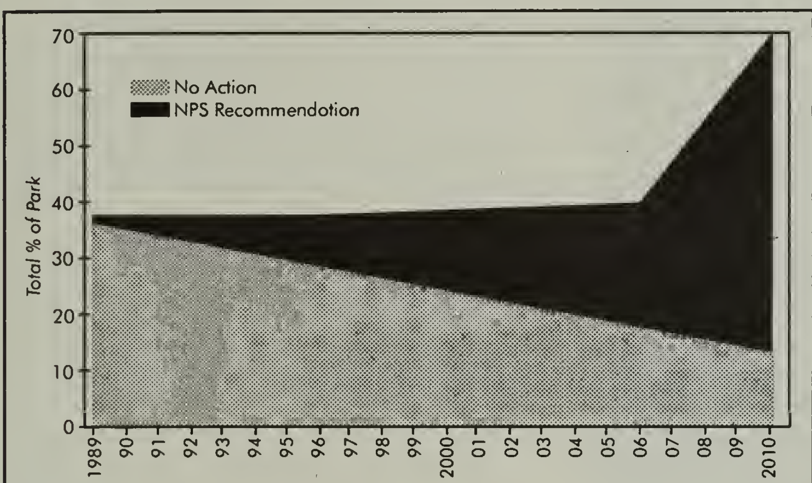


Figure 10.4: Percent of Park Where Natural Quiet Substantially Restored: A Comparison Between NPS Recommendation and No Action

The NPS recommendation extends prompt relief to some areas impacted most under SFAR 50-2 and ends with the substantial restoration to natural quiet mandated by Public Law 100-91. The NPS position is crafted carefully to maintain viable air tour access. The recommendation also offers immediate and long-term incentives and rewards to those companies which have voluntarily invested in quiet aircraft technology and to those companies willing to do so in a timely manner. Access to certain air tour routes over Grand Canyon, combined with other economic incentives, could very well result in equipment conversions or retrofitting to meet quiet aircraft standards within the 15-year time frame or sooner.

Results of the acoustic modeling indicate that the sum of the individual recommendations outlined in the preceding sections represent an effective approach to effecting and maintaining a substantial restoration of natural quiet for GCNP, the legislative mandate in Section 3 of P.L. 100-91. Phasing this restoration over time allows for equipment conversions while ensuring the continued economic viability of the air tour industry and the opportunity for visitors to the area to experience a quality aerial tour. The NPS recommendation strikes an appropriate balance between resource protection and visitor enjoyment.

Epilogue

Achieving an equitable balance between the impacts and benefits of aviation in parks is a difficult but desirable task, one that is still in its infancy. It is a long-term goal for both the NPS and FAA to seek that balance. Prior to the establishment of the Department of the Interior — Department of Transportation Interagency Working Group and the emerging dialogue between the FAA and the NPS, there was no method to address the issue. The NPS is confident that with FAA 's continued cooperation and good faith, that both agencies will be part of the balanced resolution of potential difficulties. It is a new way of doing business for both the NPS and the FAA and one that holds promise for the future.

Appendixes

APPENDIX A

Studies Conducted in Response to P.L. 100-91

Available Through National Technical Information Service

The following reports are available through the U.S. Department of Commerce, National Technical Information Service, Springfield, VA 22161, telephone (703) 487-4650. The prices and codes shown are accurate to the best of our knowledge, with a $3.00 handling charge for each order. Please contact the National Technical Information Service directly to verify current prices and codes.

Acoustic Measurements of Sonic Booms and Ambient Sound Levels in the Selway-Bitterroot Wilderness Area. NPOA Report No. 90-2.

NTIS Accession No. PB92-113505, Paper copy A05 $19.00, Microfiche A01 $9.00.

Recommendations for Design of Survey Instruments for Public Law 100-91 Field Studies for Summer, 1990. NPOA Report No. 90-3.

NTIS Accession No. PB92-112002, Paper copy A10 $35.00, Microfiche A03 $17.00.

Measurements and Analysis of the Indigenous Sound Environment of Coniferous Forests. NPOA Report No. 91-1.

NTIS Accession No. PB94-151149, Paper copy A05 $19.50, Microfiche A01 $9.00.

Short Term Effects of Aircraft Overflights on Outdoor Recreationists in Three Wildernesses. NPOA Report No. 91-2.

NTIS Accession No. PB93-144301, Paper copy A09 $27.00, Microfiche A02 $12.50.

Aircraft Noise Effects On Cultural Resources: Review of Technical Literature (3 volumes including Annotated Bibliography). NPOA Report No. 91-3.

NTIS Accession No. PB93-205300, Paper copy E99 $46.58, Microfiche E99 $23.00.

Effect of Aircraft Altitude Upon Sound Levels at the Ground. NPOA Report No. 91-4.

NTIS Accession No. PB93-144194, Paper copy A05 $19.50, Microfiche A01 $9.00.

Intermediate Term Effects of aircraft overflights on Outdoor Recreationists in Twelve Wildernesses. NPOA Report No. 91-5.

(NTIS Accession No. PB 94-151032, Paper Copy A05 $27.00, Microfiche A02 $12.50.

Aircraft Overflight Study Recommended Plan, Detailed Sampling, Data Collection and Data Analysis Plans for the Visitor Survey and the Dose-Response Survey. NPOA Report No. 91-6.

NTIS Accession No. PB93-144186, Paper copy A07 $27.00, Microfiche A02 $12.50.

Estimation of Aircraft Overflight Exposure in National Parks and Forest Service Wildernesses. NPOA Report No. 92-1.

NTIS Accession No. PB93-144293, Paper copy A07 $27.00, Microfiche A02 $12.50.

Detailed Sampling, Data Collection and Analysis Plan for: Air Tour Passenger Survey, NPS Manager Survey, General Population Survey. NPOA Report No. 92-3.

NTIS Accession No. PB93-144285, Paper copy A07, $27.00, Microfiche A02 $12.50.

Acoustic Data Collected at Grand Canyon, Haleakala and Hawaii Volcanoes National Parks. NPOA Report No. 93-4.

NTIS accession No. PB94-149986, Paper copy A13 $36.50, Microfiche A03 $17.50.

Grand Canyon Visitor Survey. NPOA Report No. 93-5.

NTIS Accession No. PB94-154804, Paper copy A11, $36.50, Microfiche A03, $17.50.

Dose-Response Relationships Derived from Data Collected at Grand Canyon, Haleakala and Hawaii Volcanoes National Parks. NPOA Report No. 93-6.

NTIS Accession No. PB94-151941, Paper copy A12, $36.50, Microfiche A03, $17.50.

Survey of National Park Service Managers Related To Aircraft Overflying National Parks. NPOA Report No. 93-7.

(NTIS Accession No. PB95-105896, Paper Copy A20, $52.00, Microfiche A04, $19.50.

Aircraft Overflight Effects on Wildlife Resources. NPOA Report No. 93-8.

NTIS Accession No. PB94-149994, Paper copy A05, $19.50, Microfiche A01, $9.00.

Aircraft Management Studies, Air Tour Passengers Survey. NPOA Report No. 94-1

(NTIS Accession No. PB95-104014, Paper Copy A12, $36.50, Microfiche A03, $17.50.

Available through NTIS

Evaluation of the Effectiveness of SFAR 50-2 in Restoring Natural Quiet to Grand Canyon National Park. NPOA Report No. 93-1.

Sent to NTIS, but no ordering information returned as of publication

Visitor Survey. NPOA Report No. 94-2. (Three documents: report and appendices in two volumes.)

Sent to NTIS, but no ordering information returned as of publication.

Review of the Effects of Aircraft Overflights on Wildlife: Annotated Bibliography. NPOA Report No. 95-1.

Sent to NTIS, but no ordering information returned as of publication.

Reports that will soon be available from NTIS

Selecting a simplified Method for Acoustic Sampling of Aircraft and Background Sound Levels in National Parks. HMMH Report No. 200940.24.

(Draft)

"Construction of a Low Noise Easy-to-Use Sound Level Data Collection System Including Simplified Guidelines Manual"

(Draft)

APPENDIX B

98 Parks Identified as Potentially Having Overflight Problems

Parks are listed with the management rank of 1, 2 or 3 (1 being assigned by management to parks in each region with the highest severity of aircraft overflight problems) or with an * indicating the park was identified in P.L. 100-91.

1. Agate Fossil Beds National Monument, 1
2. Antietam National Battlefield, 1
3. Apostle Islands National Lakeshore, 1
4. Assateague Island National Seashore, 1
5. Badlands National Park, 1
6. Bandelier National Monument, 1
7. Big Cypress National Preserve, 1
8. Big Bend National Park, 2
9. Biscayne National Park, 2
10. Black Canyon of the Gunnison National Monument, 2
11. Bryce Canyon National Park, 1
12. Cabrillo National Monument, 2
13. Canaveral National Seashore, 2
14. Canyon de Chelly National Monument, 1
15. Cape Lookout National Seashore, 1
16. Cape Cod National Seashore, 1
17. Cape Hatteras National Seashore, 2
18. Castillo de San Marcos National Monument, 2
19. Chaco Culture National Historical Park, 1
20. Channel Islands National Park, 2

21. Chattahoochee River National Recreation Area, 2
22. Chesapeake & Ohio Canal National Historical Park, 1
23. City of Rocks National Reserve, 2
24. Colonial National Historical Park, 2
25. Congaree Swamp National Monument, 2
26. Coulee Dam National Recreation Area, 2
27. Crater Lake National Park, 1
28. Craters of the Moon National Monument, 3
29. Cumberland Island National Seashore, *
30. Death Valley National Monument, 1
31. Devils Tower National Monument, 2
32. Dry Tortugas National Park, 1
33. Everglades National Park, 1
34. Fire Island National Seashore, 1
35. Fort Vancouver National Historic Site, 1
36. Fort Washington Park, 3
37. Fort Sumter National Monument, 2
38. Fort McHenry National Monument, 2
39. Fort Union National Monument, 2
40. Frederick Douglas National Historical Site, 3
41. Gateway National Recreation Area, 1
42. George Washington Memorial Parkway, 1
43. Gettysburg National Military Park, 1
44. Gila Cliff Dwellings National Monument, 2
45. Glacier National Park, *
46. Glen Canyon National Recreation Area, 1
47. Golden Gate National Recreation Area, 2
48. Grand Teton National Park, 1
49. Grand Canyon National Park, *
50. Great Smoky Mountains National Park, 1
51. Guadalupe Mountains National Park, 1
52. Gulf Islands National Seashore, 2
53. Hagerman Fossil Beds National Monument, 2
54. Haleakala National Park, *
55. Hawaii Volcanoes National Park, *
56. Isle Royale National Park, 1
57. John Day Fossil Beds National Monument, 2
58. Joshua Tree National Park, 1
59. Kalaupapa National Historical Park, 2
60. Kennesaw Mountain National Battlefield, 2
61. Kings Canyon & Sequoia National Parks, 1
62. Lake Chelan National Recreation Area, 1
63. Lake Mead National Recreation Area, 2
64. Lassen Volcanic National Park, 2

65. Mammoth Cave National Park, 2
66. Manassas National Battlefield Park, 1
67. Mesa Verde National Park, 2
68. Minute Man National Historical Park, 1
69. Mount Rushmore National Memorial, *
70. Mount Rainier National Park, 1
71. National Capital Parks – Central, 1
72. Navajo National Monument, 1
73. North Cascades National Park, 1
74. Olympic National Park, 1
75. Organ Pipe Cactus National Monument, 2
76. Perry's Victory & International Peace Memorial, 1
77. Pipe Spring National Monument, 2
78. Prince William Forest Park, 1
79. Pu'uhonua o Honaunau National Historical Park, 2
80. Puukohola Heiau National Historical Site, 2
81. Rainbow Bridge National Monument, 2
82. Redwood National Park, 2
83. Richmond National Battlefield Park, 2
84. Ross Lake National Recreation Area, 1
85. Saguaro National Monument, 1
86. Salinas Pueblo Missions National Monument, 2
87. San Antonio Missions National Historical Park, 2
88. Shenandoah National Park, 1
89. Sleeping Bear Dunes National Lakeshore, 2
90. Statue of Liberty National Monument, 1
91. Valley Forge National Historical Park, 1
92. Voyageurs National Park, 1
93. White Sands National Monument, 1
94. Wilson's Creek National Battlefield, 1
95. Wupatki National Monument, 2
96. Yosemite National Park, *
97. Zion National Park, 1
98. Virgin Islands National Park, 2

*(Identified in P.L 100-91)

APPENDIX C

Legislative Proposals to Control Airspace Over National Park Lands

H.R. 1696, H.R. 4163, S. 2428

103D CONGRESS
1ST SESSION

H. R. 1696

To provide for the regulation of the airspace over National Park System lands in the State of Hawaii by the Federal Aviation Administration and the National Park Service, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

APRIL 5, 1993

Mrs. MINK introduced the following bill; which was referred jointly to the Committees on Natural Resources and Public Works and Transportation

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A BILL

To provide for the regulation of the airspace over National Park System lands in the State of Hawaii by the Federal Aviation Administration and the National Park Service, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. FINDINGS.

The Congress finds the following:

(1) The National Park Service administers Federal parks, monuments, and reservations, to conserve the scenery, the natural and historic objects, and wildlife therein, and provides for the enjoyment of

the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

(2) It is the function of the Federal Aviation Administration to manage the safe and efficient use of the navigable airspace of the United States, as provided for in the Federal Aviation Act of 1958 (49 U.S.C. App. 1301 et seq.).

(3) The National Park Service lands in the State of Hawaii, consisting of Kaloko-Honokohau National Historical Park, Kalaupapa National Historical Park, Pu'u honua o Honaunau National Historical Park, Pu'u Kohola Heiau National Historic Site, Haleakala National Park, and Hawaii Volcanoes National Park, are managed for the purposes of wilderness preservation, protecting natural, cultural, historical, and wildlife resources, and for promotion of the public enjoyment and use of these resources.

(4) Haleakala and Hawaii Volcanoes National Parks are designated by the United Nations as International Biosphere Reserves because of their internationally significant scenery and plant and animal communities, and furthermore that Hawaii Volcanoes National Park is designated by the United

Nations as a World Heritage Site because of the significance of Mauna Loa and Kilauea Volcanoes.

(5) In recognition of the values for which National Park Service lands are managed, an above ground level (AGL) minimum altitude of 2,000 feet shall be established for aircraft flying in airspace over certain lands administered by the National Park Service.

(6) The auditory and visual intrusion of aircraft flying at low altitudes is the source of public complaint in certain areas administered by the National Park Service.

(7) Aircraft flying at low altitudes may pose a potential hazard to wildlife in certain areas administered by the National Park Service.

(8) Aircraft flying at low altitudes over large concentrations of migratory birds may pose a potential safety hazard to pilots and passengers in certain areas administered by the National Park Service.

(9) The Federal Aviation Administration and National Park Service shall act in cooperation to reduce the incidence of low-flying aircraft, including fixed-wing aircraft, helicopters, ultralight vehicles, balloons, and gliders over National Park Service administered land by complying with the 2,000 feet

AGL minimum altitude requirement, and to avoid flying over areas which the National Park Service designates as noise-sensitive, and to respect standoff distances away from areas which the National Park Service designates as primary visitor use areas.

SEC. 2. NATIONAL PARK SERVICE RESPONSIBILITIES.

The Director of the National Park Service shall be responsible for the following:

(1) IDENTIFICATION OF SPECIFIC AREAS.—Identifying specific areas where low-flying aircraft may constitute an adverse impact on resources and conveying specific information, including annotated maps, which indicate designated flight-free areas and primary visitor use areas, to the Federal Aviation Administration for appropriate action as described in section 3.

(2) LOW-FLYING REPORTING SYSTEM.—Developing and implementing a standardized reporting system acceptable to the Federal Aviation Administration to document instances of low-flying aircraft over National Park Service administered lands. This reporting system shall provide for transmittal of such documentation in a timely manner to the Honolulu Federal Aviation Administration Flight Standards district office.

(3) Training.—Developing training programs and instructional materials for National Park Service personnel to enable them to recognize and report instances of low-flying aircraft in a competent and professional manner. The appropriate training programs of the National Park Service shall expand to incorporate the subject matter into in-service training requirements. The Director of the National Park Service shall seek the assistance of the Federal Aviation Administration to help develop training curricula.

(4) Quarterly meeting.—Making personnel available from the National Park Service to meet quarterly with the Federal Aviation Administration and affected pilots to discuss resources management objectives and issues associated with low-flying aircraft.

SEC. 3. FEDERAL AVIATION RESPONSIBILITIES.

The Administrator of the Federal Aviation Administration shall be responsible for the following:

(1) Communication with pilots.—Communicating to pilots the concerns and objectives of the National Park Service about low-flying aircraft in specified areas, using advisories, bulletins, the Federal Aviation Administration publication The Fed-

eral Aviation News, the ongoing "Accident Prevention Program" for routine pilots' contact, and other means of communications with pilots, and to impress upon pilots that pilot participation is strongly encouraged to ensure protection of resources and the enjoyment of natural areas by the public.

(2) INVESTIGATIONS.—Investigating instances of pilot deviations from the Federal Aviation Administration requested minimum altitude over areas, and National Park Service-designated flight-free and primary visitor use areas in lands administered by the National Park Service, and taking action to discourage deviations with the objectives of reducing or eliminating such incidents in these areas.

(3) MILITARY AIRCRAFT.—Assisting the National Park Service in communicating with the various agencies of the Department of Defense with regard to military aircraft operations over National Park Service administered areas.

(4) AVAILABILITY OF STATUS AND RESULTS OF INVESTIGATIONS.—Making available to the National Park Service, at the Federal Aviation Administration Flight Standards district office, the status and results of the Federal Aviation Administration's in-

vestigation of instances reported by the National Park Service.

(5) SUPPORT OF AVIATION GROUPS.—Enlisting the support of all aviation groups and organizations by requesting they disseminate information about problems associated with aircraft operating at low altitudes over areas administered by the National Park Service.

(6) MEETINGS WITH NATIONAL PARK SERVICE.—Assisting the National Park Service in combating problems associated with low-flying aircraft by participating in appropriate meetings at field and regional levels.

SEC. 4. FLIGHT RESTRICTION DESIGNATIONS.

(a) KALOKO HONOKOHAU, PU'U HONUA O HONAUNAU, PU'U KOHOLA HEIAU, AND KALAUPAPA NATIONAL HISTORICAL PARKS.—Inasmuch as Kaloko Honokohau, Pu'u honua o Honaunau, Pu'u kohola Heiau, and Kalaupapa National Historical Parks are mandated to protect historical, cultural, and religious values, and other resources considered sacred to Hawaiian people, all, in their entirety are considered noise-sensitive and shall not be overflown by commercial tour aircraft. Commercial fixed-wing aircraft which are not on scenic tours may overfly Kaloko Honokohau when it is unsafe to use alternative approaches to Keahole Airport. Furthermore, inasmuch as those areas are small and are entirely primary visitor use areas, scenic tour aircraft shall maintain a 2-mile standoff distance.

(b) HALEAKALA NATIONAL PARK.—Inasmuch as Haleakala National Park is mandated to protect natural and cultural resources, and especially rare and endangered plant and animal species, magnificent scenery, and tranquil and unique wilderness, the Crater District and Kipahulu Valley, including adjacent rain forest areas within the Park, in their entirety, are considered noise-sensitive and shall not be overflown. Furthermore, inasmuch as the overlook near the Sliding Sands trailhead is a primary visitor use area where people often are assembled on the ground, a two-mile stand-off distance shall be maintained.

(c) HAWAII VOLCANOES NATIONAL PARK.—Inasmuch as Hawaii Volcanoes National Park is mandated to protect natural and cultural resources, and especially rare and endangered plant and animal species, magnificent scenery, and tranquil and unique wilderness, the designated wilderness areas, in their entirety, consisting of Mauna Loa, Ola's Forest, East Rift, and Kau Desert, and the summit of Kilauea, and the coastal area between Ka'aha and Kamoamoa are considered noise-sensitive and shall not be overflown. Furthermore, inasmuch as the Kilauea summit, the Chain of Craters corridor, and the Kamoamoa village sites are primary visitor use areas where people often are assembled on the ground, a 2-mile standoff distance shall be maintained.

(d) MINIMUM ALTITUDE RESTRICTION.—It shall be unlawful for any fixed wing aircraft or helicopter flying under visual flight rules to fly at an altitude of less than 2,000 feet over the surface of any National Park System lands in the State of Hawaii not subject to subsections (a) through (c) of this section. For purposes of this paragraph, the term "surface" refers to the highest terrain within such lands which is within 2,000 feet laterally of the route of flight. For purposes of enforcement, the prohibition pursuant to this subsection shall be treated as a requirement established pursuant to section 307 of the Federal Aviation Act of 1958. To provide information to pilots regarding the restrictions established under this subsection, the Administrator of the Federal Aviation Administration shall provide public notice of such restrictions in appropriate Federal Aviation Administration publications as soon as practicable after the enactment of this Act.

SEC. 5. FEDERAL AVIATION ADMINISTRATION AND NATIONAL PARK SERVICE JOINT RESPONSIBILITY.

The Administrator of the Federal Aviation Administration and the Director of the National Park Service shall jointly be responsible for the following:

(1) ADDITIONAL ASSESSMENTS.—Assess situations in addition to those specified in section 4 where impacts of aircraft operations upon human, cultural, or natural resources are sufficiently serious to warrant consideration of site-specific action by the Federal Aviation Administration to minimize or eliminate the causes of such problems.

(2) INFORMATIONAL MATERIALS AND SCIENTIFIC STUDIES.—Prepare public informational materials, including printed matter and audio-visual programs, for communication to pilots using existing Federal Aviation Administration pilot-contact meetings and programs, aviation periodicals, and other means of generating pilot understanding of National Park Service resources management objectives. Where appropriate, the Federal Aviation Administration and the National Park Service will share information on techniques of conducting scientific studies and data collection to facilitate understand-

ing of the impact of aircraft operations on affected resources.

(3) PROCEDURES.—Work together to define procedures for use at national headquarters and field office levels to address overflight issues over public land areas.

SEC. 6. APPLICABILITY OF CERTAIN REGULATIONS TO CERTAIN SIGHTSEEING FLIGHTS.

Parts 91 and 135 of title 14 of the Code of Federal Regulations, relating to general operating and flight rules and to air taxi operators and commercial operators, respectively, shall apply to nonstop sightseeing flights that begin and end at the same airport and are conducted within a 25 statute mile radius of the airport.

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103D CONGRESS
2D SESSION

H. R. 4163

To enable the Park Service to regulate, or prohibit, scenic commercial overflights at units of the National Park System.

IN THE HOUSE OF REPRESENTATIVES

MARCH 24, 1994

Mr. WILLIAMS (for himself, Mrs. MINK, Mr. DEFAZIO, Ms. SHEPHERD, Mr. UPTON, and Mr. STARK) introduced the following bill; which was referred jointly to the Committees on Natural Resources and Public Works and Transportation

---

A BILL

To enable the Park Service to regulate, or prohibit, scenic commercial overflights at units of the National Park System.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "National Park Scenic Overflight Concessions Act of 1994".

SEC. 2. PURPOSE AND FINDINGS.

(a) PURPOSE.—The purpose of this Act is to require all commercial air tour operators to hold a concessions permit with the Park Unit, and to provide Park Service authority to determine the appropriate level of commercial scenic tour overflight activity.

(b) FINDINGS.—The Congress finds that:

(1) The National Park Service administers Federal parks, monuments, and reservations, to conserve the scenery; natural, cultural and historic values; wilderness values, including natural quiet; and wildlife resources while providing for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations. In recognition of these values, many park units are recognized as internationally significant International Biosphere Reserves and World Heritage Sites.

(2) In order to manage National Park System units to achieve the purposes for which they were established by Congress, there is a need for National Park Service authority to regulate commercial scenic overflight enterprises operating over units of the National Park system.

(3) It is the function of the Federal Aviation Administration to manage the safe and efficient use of the navigable airspace of the United States, as provided for in the Federal Aviation Act of 1958 (49 U.S.C. App. 1391, et seq.); and to protect the envi-

ronment from adverse impacts in accord with sections 307(c) and 611 of the foregoing Act and section 4(f) of the Department of Transportation Act (49 U.S.C. 1653(f)).

(4) The auditory and visual intrusion of aircraft flying at low altitudes can be incompatible with the preservation and management of natural or cultural resources, the natural quiet, scenery, and/or the public's enjoyment of the resources on lands managed by the public land management agencies, notably such sensitive areas as parks, wildlife refuges, and wilderness areas.

(5) It is the joint responsibility of these agencies to resolve these incompatible situations or mitigate them to the fullest extent possible in order to maintain these public lands for the purposes for which they were established while recognizing the public's and the Government's need to transit navigable airspace.

(6) In recognition of the values for which National Park Service lands are managed, the Federal Aviation Administration and the National Park Service shall act cooperatively to reduce the incidence of low-flying aircraft impacts from commercial scenic tour overflights by helicopters, fixed-wing air-

craft, blimps, and balloons over sensitive lands administered by the National Park Service and to make these overflights compatible with park preservation objectives.

SEC. 3. COMMERCIAL AIR TOURS.

The Act of October 9, 1965 (16 U.S.C. 20–20g) commonly known as the National Park Service Concessions Policy Act is amended by adding the following new section at the end thereof:

"SEC. 10. COMMERCIAL AIR TOURS OVER NPS UNITS.

"(a) ISSUANCE OF PERMITS FOR COMMERCIAL AIR TOURS.—No person may fly an individual for compensation over any unit of the National Park System for the purpose of viewing any portion of such unit unless such person has in effect a valid commercial air tour permit issued by the Secretary. The Secretary may issue or deny such permits upon application of any person. Such permits may be issued subject to such conditions and restrictions as the Secretary deems necessary to protect the resources of such unit and to protect and enhance visitor enjoyment. Issuance or denial of a permit shall be consistent with the legislation establishing such unit, the guidelines under subsection (b), any applicable provisions of any general management plan in effect for such unit, and the provisions of law generally applicable to units of the national park system, including the Act of August 25, 1916 (39 Stat. 535; 16 U.S.C. 1, 2, 3, and 4) and the Act of August 21, 1935 (49 Stat. 666; 16 U.S.C. 461–467). Any person who flies an individual for compensation over any unit of the National Park System for the purpose of viewing any portion of such unit shall be treated as entering such unit and providing a service within such unit for purposes of this Act. This subsection shall take effect on the date one year after the enactment of the National Park Scenic Overflight Concessions Act of 1994 and shall apply to all flights described in this subsection made after such effective date.

"(b) GUIDELINES AND PLANNING.—Not later than 12 months after the enactment of this Act, the Secretary shall publish guidelines applicable to commercial air tour flights over national park system units providing for such flights where appropriate and restricting or prohibiting such flights where necessary in accordance with the provisions of law referred to in subsection (a). Each permit under subsection (a) for flights at any unit of the National Park System shall be based on such guidelines. Any such guidelines proposed by the Secretary shall be submitted to the Administrator of the Federal Aviation Administration for review prior to adoption. Within 60 days after his receipt of such proposed guidelines, the Administrator shall provide comments and recommendations to the Secretary regarding any effects such guidelines may have on aircraft safety. The Secretary shall incorporate the Administrator's recommendations regarding aircraft safety in the final guidelines.

"(c) GENERAL MANAGEMENT PLANS.—The Secretary may amend the general management plan for any national park system unit to establish air concessions requirements applicable to flights subject to the permit requirements of subsection (a). Such amendments shall be consistent with the provisions of law referred to in subsection (a) and the guidelines published under subsection (b). The amendments shall—

"(1) document the degree to which commercial scenic overflights may affect the natural resources of the park unit concerned;

"(2) document the effects of such overflights on the park visitor's experience; and

"(3) propose measures necessary to protect park resources and the visitor's experience from the adverse effects of commercial scenic overflights.

Each permit issued under subsection (a) for flights over any national park system unit after the effective date of general management plan amendments adopted under this subsection shall be consistent with such amendments.

"(d) PENALTY.—Any person who knowingly or willfully violates any requirement of this section or of any rule or regulation promulgated by the Secretary under this section shall be fined not more than $5,000 or imprisoned for not more than 5 years or both.".

SEC. 4. FEDERAL AVIATION ADMINISTRATION

(a) REPORTING AND TRAINING.—The Administrator of the Federal Aviation Administration (hereinafter in this section referred to as the "Administrator"), in cooperation with the Secretary of the Interior, shall—

(1) develop standardized reporting systems for the documentation of low flying aircraft incidents in air space over national park system units; and

(2) develop training programs and instructional materials for national park service personnel to enable them to recognize and report instance of low flying aircraft incidents in air space over national park system units.

(b) AIRCRAFT NOISE.—The Administrator shall amend the regulations of the Federal Aviation Administration to treat aircraft noise abatement at national park system units as in the public interest.

(c) REPORTS.—The Administrator and the Secretary of the Interior shall submit a joint report to the Congress within 3 years after the enactment of this Act containing

II

103D CONGRESS
2D SESSION

S. 2428

To provide for the management of the airspace over the units of the National Park System, and for other purposes.

IN THE SENATE OF THE UNITED STATES

AUGUST 25 (legislative day, AUGUST 18), 1994

Mr. AKAKA introduced the following bill; which was read twice and referred to the Committee on Commerce, Science, and Transportation

---

A BILL

To provide for the management of the airspace over the units of the National Park System, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "National Parks Airspace Management Act of 1994".

SEC. 2. FINDINGS.

Congress makes the following findings:

(1) Air tour flights over units of the National Park System may have adverse effects on such units.

2

(2) Congressional concern over the effects of low-level flights on the units of the National Park System led to the enactment of the Act entitled "An Act to require the Secretary of the Interior to conduct a study to determine the appropriate minimum altitude for aircraft flying over national park system units", approved August 18, 1987 (Public Law 100–91; 101 Stat. 674; 16 U.S.C. 1a–1 note). The Act required the Director to identify problems associated with flights by aircraft in the airspace over the units of the National Park System.

(3) The number of flights by aircraft over units of the National Park System has increased rapidly since the enactment of the Act, and the National Park Service continues to struggle to develop a policy which would achieve an acceptable balance between flights over such units by commercial air tour operators and the protection of the resources in such units and the experiences of visitors to such units.

(4) Visitors to certain units of the National Park System may reasonably expect quiet during their visits to such units, particularly visitors to units established with the specific goal of providing visitors to the units with an opportunity for solitude.

•S 2428 IS

(5) Natural quiet is an inherent resource of certain units of the National Park System. It is in the public interest that natural quiet at such units be conserved in the same manner as other resources under the care and jurisdiction of the National Park Service.

(6) The public has registered a significant number of complaints about commercial air tour flights over certain areas under the jurisdiction of the National Park Service.

(7) Such flights may degrade the experiences of visitors to the affected areas and may have adverse effects on wildlife and cultural resources in such areas.

(8) The Federal Aviation Administration continues to have difficulty controlling adequately commercial air tour flights by aircraft over units of the National Park System that are adversely affected by such flights.

(9) There are significant and continuing concerns about the safety of commercial air tour flights over some units of the National Park System, including concerns for the safety of occupants of the flights, of visitors to such units, of Federal Govern-

ment employees at such units, and of the general public.

SEC. 3. MINIMIZATION OF EFFECTS OF COMMERCIAL AIR TOUR FLIGHTS OVER UNITS OF THE NATIONAL PARK SYSTEM.

(a) PROHIBITION ON FLIGHTS BELOW CERTAIN ALTITUDES.—(1) Notwithstanding any other provision of law and subject to paragraph (2), a commercial air tour operator may not conduct the portion of a commercial air tour flight that takes place over a unit of the National Park System at an altitude that is less than 3,000 feet above ground level.

(2) The prohibition in paragraph (1) may not be construed to prohibit an agreement among a commercial air tour operator, the Administrator, and the Director which establishes a minimum flight altitude for commercial air tour flights of the operator over a particular unit of the National Park System that differs from the minimum flight altitude set forth in that paragraph.

(b) ADDITIONAL ACTIONS TO MINIMIZE EFFECTS.—Notwithstanding any other provision of law, the Administrator and the Director shall jointly take such actions as the Administrator and the Director determine appropriate in order—

(1) to determine the most practical and effective means of minimizing the effects of commercial air tour flights over units of the National Park System;

(2) to implement such means; and

(3) to conduct periodic training of the employees of the Federal Aviation Administration and the National Park Service on matters relating to the implementation of such means.

SEC. 4. DEVELOPMENT OF SINGLE STANDARD FOR CERTIFYING COMMERCIAL AIR TOUR OPERATORS.

(a) COMMENCEMENT OF RULEMAKING.—Not later than 90 days after the date of the enactment of this Act, the Administrator shall initiate formal rulemaking procedures for the purpose of prescribing a new subpart of part 135 of title 14, Code of Federal Regulations (relating to air taxi operators and commercial operators), which would specifically cover all commercial air tour operators (as that term will be defined by the Federal Aviation Administration under the subpart) that conduct commercial air tour flights over units of the National Park System.

(b) COVERED MATTERS.—The subpart prescribed under subsection (a) shall contain regulations that address safety and environmental issues with respect to commercial air tour flights over units of the National Park System. In prescribing the subpart, the Administrator shall attempt to minimize the financial and administrative burdens imposed on commercial air tour operators by such regulations.

(c) COMPLETION.—The Administrator shall—

(1) complete prescription of the regulations referred to in subsection (a) not later than the end of the 1-year period beginning on the date of the enactment of this Act; or

(2) if the Administrator does not complete the prescription by the end of that period, submit to Congress a report at the end of that period which report shall—

(A) provide an explanation of the failure of the Administrator to complete the prescription within that period; and

(B) describe the status of the regulations to be prescribed.

SEC. 5. DEVELOPMENT OF OPERATIONAL RULE FOR COMMERCIAL AIR TOUR OPERATIONS OVER UNITS OF THE NATIONAL PARK SYSTEM.

(a) REQUIREMENT.—(1) Except as provided in paragraph (2), the Administrator shall initiate formal rulemaking procedures for the purpose of prescribing a single operational rule which would govern the conduct of fixed-wing and rotorcraft flights by commercial air tour operators over the units of the National Park System. The Administrator shall initiate such procedures not later than 90 days after the date of the enactment of this Act.

(2) The Administrator may prescribe separate operational rules governing the conduct of flights by fixed-wing aircraft and by rotorcraft if the Administrator determines under subsection (b)(1) that separate rules are warranted.

(b) CONSIDERATIONS.—In developing an operational rule under subsection (a), the Administrator shall—

(1) consider whether differences in the characteristics and effects on the environment of fixed-wing aircraft and rotorcraft warrant the development of separate operational rules with respect to such craft;

(2) provide a mechanism for the Director to recommend individual units or geographically proximate groups of units to be designated as aerial sightseeing areas, as defined by Federal Aviation Administration Handbook 92.01, dated January 1992; and

(3) provide a mechanism for the Director to obtain immediate assistance from the Administrator in resolving issues relating to the use of airspace above

units which issues are of a critical, time-sensitive nature.

(c) COMPLETION.—The Administrator shall—

(1) complete prescription of the regulations referred to in subsection (a) not later than the end of the 1-year period beginning on the date of the enactment of this Act; or

(2) if the Administrator does not complete the prescription by the end of that period, submit to Congress a report at the end of that period which report shall—

(A) provide an explanation for the failure of the Administrator to complete the prescription within that period; and

(B) describe the status of the regulations to be prescribed.

(d) EFFECT ON AGREEMENTS.—Nothing in this section is intended to preclude the Administrator, the Director, and a commercial air tour operator from entering into an agreement under section 7 (including an agreement under subsection (c)(3) or (d)(1) of that section) on the conduct of air tour flights by the air tour operator over a particular unit of the National Park System under different terms and conditions than those imposed by the operational rule or rules prescribed under this section.

SEC. 6. FLIGHT-FREE PARKS.

(a) DESIGNATION OF UNITS.—Not later than 1 year after the date of the enactment of this Act, the Director, in consultation with the Administrator, shall—

(1) prescribe criteria to identify units of the National Park System where air tour flights by commercial air tour aircraft are incompatible with or injurious to the purposes and values for which such units were established;

(2) identify any units of the National Park System which meet such criteria; and

(3) designate such units as units of the National Park System covered by this section.

(b) REQUIREMENTS RELATING TO CRITERIA.—In prescribing criteria under subsection (a), the Director—

(1) shall ensure sufficient opportunity for public comment;

(2) shall give due consideration to the comments and recommendations of the National Park Overflight Advisory Council established under section 10 and of the Federal Interagency Airspace/Natural Resource Coordination Group, or any successor organization to that entity; and

(3) may utilize the authority to engage in negotiated rulemaking under subchapter III of chapter 5 of title 5, United States Code.

(c) Effect of Designation.—

(1) Prohibition.—Except as provided in paragraphs (2) and (3), commercial air tour flights may not be conducted in the airspace over any unit of the National Park System designated under subsection (a)(3).

(2) Operators conducting flights before 1994.—

(A) In general.—Subject to subparagraph (B) and paragraph (4), a commercial air tour operator that conducted commercial air tour flights in the airspace over a unit designated under subsection (a)(3) as of December 31, 1993, may continue to conduct flights in that airspace.

(B) Limitation.—The number of commercial air tour flights over a unit that a commercial air tour operator may conduct under this paragraph in any year after 1994 may not exceed the number of such flights that the operator conducted over the unit during 1993.

(3) Operators commencing flights after 1993.—

(A) In general.—Subject to subparagraph (B) and paragraph (4), a commercial air tour operator that commences, during the period beginning on January 1, 1994, and ending on the date of the enactment of this Act, the conduct of commercial air tour flights in the airspace over a unit designated under subsection (a)(3) may continue to conduct flights in that airspace.

(B) LIMITATION.—The number of commercial air tour flights over a unit that a commercial air tour operator may conduct under this paragraph in any month after December 1994 may not exceed the average number of flights per month that the operator conducted over the unit during the period referred to in subparagraph (A).

(4) EFFECT OF SALE OR DISCONTINUATION OF OPERATIONS.—

(A) PROHIBITION ON SALE.—The authority of a commercial air tour operator to conduct commercial air tour flights under paragraph (2) or (3) may not be sold, conveyed, or otherwise transferred.

(B) DISCONTINUATION.—Upon the discontinuation by a commercial air tour operator of commercial air tour flights over a unit of the

National Park System under paragraph (2) or (3), the authority of the air tour operator to conduct such flights over that unit shall terminate.

SEC. 7. FLIGHTS OVER OTHER UNITS OF THE NATIONAL PARK SYSTEM.

(a) NATIONAL PARK AIRSPACE MANAGEMENT PLANS.—

(1) IN GENERAL.—The Director and the Administrator shall establish in accordance with this subsection a plan for the management of the airspace above each unit of the National Park System not designated under section 6 that—

(A) is affected by commercial air tour flights to such an extent that the Director considers the unit to be a unit requiring an airspace management plan; or

(B) is a unit over which—

(i) no commercial air tour flights occurred on or before the date of the enactment of this Act; and

(ii) a commercial air tour operator proposes to conduct commercial air tour flights after that date.

(2) PLAN PURPOSE.—The purpose of a plan under this subsection is to minimize the adverse effects of commercial air tour flights on the resources of a unit of the National Park System.

(b) DEVELOPMENT OF AIRSPACE MANAGEMENT PLANS.—

(1) IN GENERAL.—

(A) AFFECTED UNITS.—The Director and the Administrator shall jointly develop a plan for the management of the airspace above a unit of the National Park System referred to in subsection (a)(1)(A) not later than 1 year after the date of the determination by the Director under that subsection that the unit requires such a plan.

(B) UNITS SUBJECT TO PROPOSED OPERATIONS.—In the case of a unit referred to in subsection (a)(1)(B), the Director and the Administrator shall jointly develop a plan for the management of the airspace over the unit not later than 180 days after the date on which a commercial air tour operator first submits to the Director a proposal referred to in that subsection. The proposal shall include any information that the Director and the Administrator consider necessary in order to evaluate fully the proposal.

(2) TREATMENT OF RELEVANT EXPERTISE.—In developing plans under paragraph (1), the Administrator shall defer to the Director in matters relating to the identification and protection of park resources, and the Director shall defer to the Administrator in matters relating to the safe and efficient management of airspace.

(3) NEGOTIATED RULEMAKING.—In developing a plan for a unit, the Director and the Administrator shall jointly—

(A) determine whether the utilization of negotiated rulemaking procedures under subchapter III of chapter 5 of title 5, United States Code, in the development of the plan is in the public interest; and

(B) if the Director and the Administrator determine that such utilization is in the public interest, develop the plan utilizing procedures for such rulemaking under that subchapter.

(4) COMMENT ON PLANS.—In developing a plan for a unit, the Director and the Administrator shall—

(A) ensure sufficient opportunity for public comment; and

(B) give due consideration to the comments and recommendations of the National Park Overflight Advisory Council established under section 10 and the Federal Interagency Airspace/Natural Resource Coordination Group, or any successor organization to that entity.

(5) RESOLUTION OF PLAN INADEQUACIES.—If the Director and the Administrator disagree with respect to any portion of a proposed plan under this subsection, the Director and the Administrator shall refer the proposed plan to the Secretary of the Interior and the Secretary of Transportation who shall jointly resolve the disagreement.

(6) ASSESSMENT OF EFFECTS OF OVERFLIGHTS.—The Director and the Administrator may jointly conduct any studies to ascertain the effects of low-level flights of commercial air tour aircraft over units of the National Park System that the Director and the Administrator consider necessary for the development of plans under this subsection.

(7) PERIODIC REVIEW.—The Director and the Administrator shall periodically review each plan de-

veloped under this subsection. The purpose of the review is to ensure that the plan continues to meet the purpose of the plan under this subsection. The Director and the Administrator may revise a plan if they determine based on such review that such revision is advisable.

(c) FLIGHTS OVER UNITS REQUIRING MANAGEMENT PLANS.—

(1) FLIGHTS OVER UNITS COVERED BY PLANS.—A commercial air tour operator may not conduct commercial air tour flights in the airspace over a unit of the National Park System covered by an airspace management plan developed under subsection (b) unless the commercial air tour operator enters into an agreement with respect to the conduct of such flights under paragraph (3).

(2) FLIGHTS PENDING DEVELOPMENT OF PLANS.—

(A) FLIGHTS BY EXISTING OPERATORS.—

(i) IN GENERAL.—A commercial air tour operator described in clause (ii) may conduct commercial air tour operations in the airspace over a unit described in that clause during the period of the development of an airspace management plan for the unit under this section. The number of such flights during any day in that period may not exceed the average daily number of commercial air tour flights conducted by the air tour operator during the 12-month period ending on the date of the commencement of the development of the plan under this section.

(ii) COVERED OPERATORS.—Clause (i) applies to any commercial air tour operator that conducts commercial air tour flights over a unit of the National Park System for which the Director determines under subsection (a) that an airspace management plan is required if the commercial air tour operator conducts such flights over the unit as of the date of that determination.

(B) FLIGHTS BY POTENTIAL OPERATORS.—Except as provided in subparagraph (A), a commercial air tour operator may not conduct commercial air tour flights over a unit of the National Park System referred to in clause (ii) of that subparagraph during the period referred to in clause (i) of that subparagraph.

(3) AGREEMENT.—An agreement referred to in paragraph (1) is an agreement among a commercial air tour operator, the Director, and the Administrator which provides for the application of relevant provisions of the airspace management plan for the unit concerned to the commercial air tour operator entering into the agreement.

(d) FLIGHT OVER UNITS NOT REQUIRING MANAGEMENT PLANS.—

(1) REQUIREMENT FOR AGREEMENT.—A commercial air tour operator may not conduct commercial air tour flights over a unit of the National Park System for which no airspace management plan is required under this section unless the commercial air tour operator enters into an agreement with the Director and the Administrator relating to the conduct of such flights. The terms and conditions of the agreement shall, to the maximum extent practicable, provide for the conduct of air tour flights by the air tour operator in a manner that minimizes the adverse effect of such air tour flights on the environment of the unit.

(2) FLIGHTS PENDING AGREEMENT.—A commercial air tour operator that conducts commercial air tour flights over a unit referred to in paragraph (1) on the date of the enactment of this Act may continue to conduct such flights during negotiations for the agreement referred to in paragraph (1). The number of such flights during any day in that period may not exceed the average daily number of commercial air tour flights conducted by the air tour operator during the 12-month period ending on the date of the commencement of negotiations for the agreement.

(e) RESOLUTION OF DISPUTES IN ENTERING INTO AGREEMENTS.—

(1) RESOLUTION.—In the event of a dispute between a commercial air tour operator and the Director and the Administrator during entry into an agreement under subsection (c) or (d), the Director, the Administrator, and the air tour operator shall attempt to resolve the dispute using the dispute resolution proceedings authorized under subchapter IV of chapter 5 of title 5, United States Code.

(2) FAILURE OF RESOLUTION.—If the Director, the Administrator, and a commercial air tour operator are unable to resolve a dispute referred to in

paragraph (1) using the dispute resolution procedures referred to in that paragraph, the Administrator shall prescribe an operational rule for the unit of the National Park System concerned in accordance with subsection (f)(3).

(f) OVERSIGHT.—

(1) ASSESSMENT OF EFFECTIVENESS OF AGREEMENTS.—The Director shall periodically carry out such studies as are necessary to determine if agreements entered into under subsections (c) and (d) are adequate to minimize the adverse effects of commercial air tour flights on the resources of the units of the National Park System covered by such agreements.

(2) RESPONSE TO INADEQUACY.—If the Director determines under paragraph (1) that one or more agreements referred to in that paragraph are inadequate to minimize the effects referred to in that paragraph, the Director shall—

(A) notify the Administrator and the commercial air tour operator concerned of that determination; and

(B) attempt to resolve the inadequacy utilizing the dispute resolution procedures authorized under subchapter IV of chapter 5 of title 5, United States Code.

(3) ADDITIONAL RESOLUTION AUTHORITY.—

(A) OPERATIONAL RULE.—If the Director, the Administrator, and a commercial air tour operator are unable to resolve an inadequacy in an agreement utilizing the dispute resolution procedures referred to in paragraph (2)(B), the Administrator shall prescribe an operational rule for the unit concerned. The purpose of the rule shall be to minimize the adverse effects of commercial air tour flights on the resources of the unit concerned.

(B) DISPUTES RELATING TO RULE.—If the Director determines that the implementation of an operational rule, and the enforcement thereof by the Administrator, is inadequate in whole or in part to minimize the adverse effects of commercial air tour flights on the resources of the unit concerned, the Director shall—

(i) notify the Administrator and the commercial air tour operator or operators concerned of that determination; and

(ii) attempt to resolve the inadequacy utilizing the dispute resolution procedures authorized under subchapter IV of chapter 5 of title 5, United States Code.

(C) FINAL RESOLUTION.—If the Director, the Administrator, and the commercial air tour operator or operators concerned are unable to resolve an inadequacy in an operational rule under subparagraph (B), the Administrator shall develop a Special Federal Aviation Regulation (SFAR) covering the unit concerned.

SEC. 8. FLIGHTS BY OTHER AIRCRAFT OVER UNITS OF THE NATIONAL PARK SYSTEM.

(a) FLIGHT EMERGENCIES.—No provision of this Act shall apply to an aircraft experiencing an in-flight emergency.

(b) FLIGHTS BY MILITARY AIRCRAFT.—Notwithstanding any other provision of law, military aircraft may not conduct flights in the airspace over a unit of the National Park System below an altitude that is 3,000 above ground level, except as provided for in a Memorandum of Understanding between the Director and the Secretary of Defense.

(c) FLIGHTS FOR COMMERCIAL AERIAL PHOTOGRAPHY.—

(1) IN GENERAL.—An aircraft or rotorcraft engaged in commercial aerial photography may not

conduct flights in the airspace over a unit of the National Park Service below an altitude that is 3,000 feet above ground level unless the pilot of the aircraft or rotorcraft receives advance written permission from the appropriate Flight Standards District Office of the Federal Aviation Administration and from the superintendent of the unit of the National Park System concerned.

(2) FEES.—The superintendents of the units of the National Park System may collect fees from the operators of aircraft and rotorcraft engaged in commercial aerial photography. The fees shall be set at such amount as the Director determines necessary to ensure that the United States will receive fair market value for the use of the area concerned and shall, at a minimum, cover all administrative and other costs of providing necessary services associated with commercial aerial photography at such units.

SEC. 9. AIRCRAFT SAFETY.

(a) AIRCRAFT MARKINGS.—

(1) REQUIREMENT.—Each operator of commercial air tour aircraft shall display on each air tour aircraft of the operator the identification marks described in paragraph (2).

(2) IDENTIFICATION MARKS.—The identification marks for the aircraft of a commercial air tour operator shall—

(A) be unique to the operator;

(B) be not less than 36 inches in length (or a size consistent with the natural configuration of the aircraft fuselage);

(C) appear on both sides of the air tour aircraft of the air tour operator and on the underside of the aircraft; and

(D) be applied to the air tour aircraft of the air tour operator in a highly visible color that contrasts sharply with the original base color paint scheme of the aircraft.

(b) FLIGHT MONITORING SYSTEMS.—

(1) REQUIREMENT FOR STUDY.—Not later than 1 year after the date of the enactment of this Act, the Administrator shall carry out a study of the feasibility and advisability of requiring that aircraft and rotorcraft operating in the airspace over units of the National Park System have onboard an automatic flight tracking system capable of monitoring the altitude and ground position of the aircraft and rotorcraft.

(2) INSTALLATION OF FLIGHT MONITORING SYSTEM.—If the Administrator determines under the study required under paragraph (1) that the use of automatic flight tracking system in aircraft and rotorcraft is feasible and advisable, then not later than 2 years after the date of the enactment of this Act, each commercial air tour operator that conducts air tour flights in the airspace above a unit of the National Park System shall have an automatic flight tracking system onboard each aircraft and rotorcraft of such air tour operator that conducts such air tour flights.

(3) MONITORING THROUGH SYSTEMS.—

(A) MONITORING.—The Director shall ensure that appropriate personnel of the National Park Service monitor the altitude and position of aircraft and rotorcraft, if any, having a system required under paragraph (2) for purposes of determining that the aircraft and rotorcraft comply with all laws, regulations, and agreements on flights in the airspace over units of the National Park System.

(B) VIOLATIONS.—The Director shall ensure that personnel referred to in subparagraph (A) report to the Federal Aviation Administration any apparent violations of the laws and regulations referred to in that subparagraph.

(c) AERONAUTICAL CHARTS.—The Administrator shall ensure that the boundaries of each unit of the National Park System and the provisions of the airspace management plan, operational rule, or Special Federal Aviation Regulation (SFAR), if any, with respect to each such unit are accurately reflected on aeronautical charts.

(d) PARK VISITOR EDUCATION.—The Director shall develop educational materials for public distribution on air tour flights over units of the National Park System by commercial air tour operators. Such materials shall include the most common flight patterns and routes of such flights.

(e) DATA COLLECTION.—

(1) IN GENERAL.—The Administrator shall collect and publish each year statistical data on commercial air tour flights over the units of the National Park System.

(2) REQUIREMENT FOR INFORMATION.—The information collected under paragraph (1) shall include the following:

(A) The units at which such flights occurred.

(B) The flight hours flown during such flights.

(C) The number of passengers carried during such flights.

(D) The number and type of aircraft safety violations that occurred during such flights.

(E) The number and type of accidents or other incidents involving air tour aircraft that occurred during such flights.

(F) The number and type of disciplinary actions, if any, taken against the pilots of such aircraft with respect to such flights.

SEC. 10. NATIONAL PARK OVERFLIGHT ADVISORY COUNCIL.

(a) ESTABLISHMENT.—There is hereby established a commission to be known as the National Park Overflight Advisory Council (in this section referred to as the "Council").

(b) MEMBERSHIP.—

(1) VOTING MEMBERS.—The Council shall be composed of 20 voting members appointed jointly by the Director and the Administrator as follows:

(A) Five representatives of environmental or conservation organizations, citizens' groups, and other groups with similar interests.

(B) Five representatives of the commercial air tour industry and organizations with similar interests.

(C) Five individuals from the private sector who—

(i) have an interest in the effects on the units of the National Park System of commercial air tour flights in the airspace over such units;

(ii) are not affiliated with the organizations or groups referred to in subparagraph (A) or the industry or organizations referred to in subparagraph (B); and

(iii) have no substantial financial interest in the management of the airspace over units of the National Park System.

(D) Five representatives of departments or agencies of the Federal Government (other than individuals associated with the Department of the Interior and the Department of Transportation), with the consent of the head of the department or agency concerned, who have regulatory responsibility over land management matters, airspace management matters, or both.

(2) EX OFFICIO MEMBERS.—The Director, or the designee of the Director, and the Administrator, or the designee of the Administrator, shall be ex officio members of the Council.

(3) APPOINTMENT DATE.—Members of the Council shall be appointed under this subsection not later than 90 days after the date of the enactment of this Act.

(4) SELECTION OF CHAIR.—The Council shall elect a Chairperson from among the voting members of the Council.

(5) MEETINGS.—The Council shall first meet not later than 180 days after the date of the enactment of this Act and shall meet thereafter at the call of a majority of the members of the Council.

(c) DUTIES.—The Council shall have the following duties:

(1) To determine the effects on the environment of units of the National Park System of commercial air tour flights in the airspace over such units.

(2) To determine the economic effects of restrictions or prohibitions on such flights.

(3) To solicit and receive comments from interested individuals and groups on such flights.

(4) To develop recommendations for means of reducing the adverse effects of such flights on such units.

(5) To explore financial and other incentives which could encourage manufacturers to advance the state-of-the-art in quiet aircraft and rotorcraft technology and encourage commercial air tour operators to implement such technology in flights over park units.

(6) To provide comments and recommendations to the Director and the Administrator under sections 6 and 7.

(7) To provide advice or recommendations to the Director, the Administrator, and other appropriate individuals and groups on matters relating to such flights.

(8) To carry out such other activities as the Director and the Administrator jointly consider appropriate.

(d) ADMINISTRATION.—

(1) COMPENSATION OF NON-FEDERAL MEMBERS.—Members of the Council who are not officers or employees of the Federal Government shall serve

without compensation for their work on the Council, but shall be allowed travel expenses, including per diem in lieu of subsistence, in the same manner as persons employed intermittently in the Government service under section 5703(b) of title 5, United States Code, to the extent funds are available therefor.

(2) COMPENSATION OF FEDERAL MEMBERS.—Members of the Council who are officers or employees of the Federal Government shall serve without compensation for their work on the Council other than that compensation received in their regular public employment, but shall be allowed travel expenses, including per diem in lieu of subsistence, as authorized by law, to the extent funds are available therefor.

(3) ADMINISTRATIVE SUPPORT.—The Director and the Administrator shall, to the extent permitted by law, provide the Council with such administrative services, funds, facilities, staff and other support services as may be necessary for the performance of its functions.

(e) REPORTS.—The Council shall annually submit to Congress, the Administrator, and the Director a report that—

(1) describes the activities of the Council under this section during the preceding year; and

(2) sets forth the findings and recommendations of the Council on matters related to the mitigation of the effects on the units of the National Park System of flights of commercial air tour operators over such units.

(f) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated such sums as may be necessary to carry out the provisions of this section.

SEC. 11. DEFINITIONS.

In this Act:

(1) The term "Administrator" means the Administrator of the Federal Aviation Administration.

(2) The term "air tour aircraft" means an aircraft (including a fixed-wing aircraft or a rotorcraft) that makes air tour flights.

(3) The term "air tour flight" means a passenger flight conducted by aircraft (including by fixed-wing aircraft or by rotorcraft) for the purpose of permitting a passenger to the flight to view an area over which the flight occurs.

(4) Except as defined by the Federal Aviation Administration under section 4, the term "commercial air tour operator" means a company, corpora-

tion, partnership, individual, or other entity that provides air tour flights for hire to the public.

(5) The term "Director" means the Director of the National Park Service.

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APPENDIX D

Advanced Notice of Proposed Rulemaking Issued Jointly by Federal Aviation Administration and National Park Service

federal register

Thursday
March 17, 1994

Part IV

Department of Transportation

Federal Aviation Administration

14 CFR Parts 91 and 135

Department of the Interior

National Park Service

36 CFR Part 1, et al.
Overflights of Units of the National Park System; Proposed Rule

12740 Federal Register / Vol. 59, No. 52 / Thursday, March 17, 1994 / Proposed Rules

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 91 and 135

DEPARTMENT OF THE INTERIOR

National Park Service

36 CFR Parts 1, 2, 3, 4, 5, 6 and 7

[Docket No. 27643; Notice No. 94-4]

Overflights of Units of the National Park System

AGENCY: National Park Service (NPS), DOI and Federal Aviation Administration (FAA), DOT.

ACTION: Advanced notice of proposed rulemaking (ANPRM).

SUMMARY: This notice seeks public comment on general policy and specific recommendations for voluntary and regulatory actions to address the effects of aircraft overflights on national parks.

On December 22, 1993, Transportation Secretary Federico Peña and Interior Secretary Bruce Babbitt announced the formation of an interagency working group to explore ways to limit or reduce impacts from overflights on national parks. Secretary Babbitt and Secretary Peña concur that increased flight operations at the Grand Canyon and other national parks have significantly diminished the national park experience for park visitors, and that measures can and should be taken to preserve a quality park experience for visitors. The Secretaries see the formation of the working group, and the mutual commitment to addressing the impacts of park overflights, as the initial steps in a new spirit of cooperation between the two departments.

National parks are unique national resources that have been provided special protection by law. The National Park Service (NPS) and the Federal Aviation Administration (FAA) recognize that excessive noise from commercial air tours and other flights over units of the national parks system can interfere with NPS efforts to achieve a natural park experience for visitors and to preserve other park values. Through the interagency working group, the NPS and FAA will cooperate in developing measures to resolve current noise impacts and prevent potential future impacts from overflights at national parks. The purpose of this ANPRM is twofold. First, the ANPRM addresses overflights of Grand Canyon National Park and national parks in the State of Hawaii, with particular emphasis on overflights by commercial tour operators. Second, the ANPRM solicits policy views and recommendations on more general issues as part of an effort to form a comprehensive policy on preventing, minimizing, or eliminating impacts of aircraft overflights.

This notice presents options that may be considered as means to minimize the adverse effects of commercial air tour operations and other overflights on units of the national park system, and seeks public comments and suggestions on voluntary and regulatory actions to deal with noise and other overflight issues that may affect national parks.

DATES: Comments on this ANPRM must be received on or before June 15, 1994.

ADDRESSES: Comments on this advance notice should be mailed, in triplicate, to: Federal Aviation Administration, Office of Chief Counsel, Attention: Rules Docket (AGC-200), Docket No. 27643, 800 Independence Avenue, SW., Washington, DC 20591. Comments delivered must be marked Docket No. 27643. Comments may be examined in room 915G weekdays between 8:30 a.m. and 5 p.m., except on Federal holidays.

FOR FURTHER INFORMATION CONTACT: David L. Bennett, Office of Chief Counsel, AGC-600, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, DC 20591, telephone (202) 267-3473, or Michael M. Tiernan, Office of the Solicitor, Department of Interior (DOI), 18th and C Streets, NW., Washington, DC 20240, telephone (202) 208-7597.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in this advance notice of proposed rulemaking by submitting such written data, views, or arguments as they may desire. Comments relating to the policy, environmental, energy, federalism, or economic impact that might result from considering the options in this advance notice are also invited. Comments should identify the regulatory docket number and should be submitted in triplicate to the Rules Docket address specified above. All comments received on or before the specified closing date for comments will be considered by NPS and FAA before taking action on this advanced notice of proposed rulemaking. All comments received will be available, both before and after the closing date for comments, in the Rules Docket for examination by interested persons. Commenters wishing the FAA or NPS to acknowledge receipt of their comments submitted in response to this notice must include a preaddressed, stamped postcard on which the following statement is made: "Comments to Docket No. 27643." The postcard will be date stamped and mailed to the commenter.

Availability of ANPRM

Any person may obtain a copy of this ANPRM by submitting a request to the Federal Aviation Administration, Office of Public Affairs, Attention: Public Inquiry Center, APA-200, 800 Independence Avenue, SW., Washington, DC 20591, or by calling (202) 267-3485. Communications must identify the notice number of this ANPRM.

Background

The management of the national park system is guided by the Constitution, public laws (Pub. L.), proclamations, executive orders, rules and regulations, and directives of the Secretary of the Interior and the Assistant Secretary for Fish and Wildlife and Parks. The Act of August 25, 1916, otherwise known as the NPS Organic Act, established the NPS and serves as the touchstone for national park system management philosophy and policy. The Act created the NPS to promote and regulate national parks, monuments, and reservations in accordance with the fundamental purpose of said parks, monuments, and reservations, which is "to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." (16 U.S.C. 1). Subsequent legislation further states that any authorized activity "shall not be exercised in derogation of the values and purposes" of a park area or the national park system, except as may have been or shall be directly and specifically provided by Congress. (16 U.S.C. 1a-1).

Thus, "unimpairment" is joined by a responsibility to avoid derogation not only of the purposes of a park area but also the values for which the national park system and its individual units have been established.

In 1987, the Congress enacted the NPS Overflights Act because it recognized that aircraft overflights can adversely affect national parks. The Act specifically found that noise associated with aircraft overflight at the Grand Canyon National Park was causing "a significant adverse effect on the natural quiet and experience of the park and current operations at the Grand Canyon National Park have raised serious concerns regarding safety of park users." (Pub. L. 100-91, section 3(a)). The Act mandated a number of studies related to the effects of overflights on parks. The studies have taken longer than was originally anticipated because many of the issues with which they deal are on the cutting edge of technical and scientific capability. Measuring degrees of quiet and perception of quiet is very different from measuring amounts of noise. Since the Overflights Act was passed, the adverse effects associated with the numbers and extent of commercial air sightseeing tours have continued to expand.

The general and over-arching responsibilities for park management by NPS may be modified by specific direction in individual enabling legislation and proclamations. The individual statutes and proclamations for some units of the national park system make it clear that the units were established to provide visitors with natural quiet, an opportunity for solitude, and other attributes that are not necessarily compatible with the noise of commercial air tour sightseeing flights. Some people simply find commercial sightseeing tours over parks inappropriate and incompatible with protection of certain park values and resources. On the other hand, a commercial air tour may provide an opportunity for people to see some park resources in ways not otherwise attainable.

As is pointed out in the Management Policies (NPS 1988):

> Over the years, legislative and administrative actions have been taking place that have brought some measure of change to these components of our national parks. Such actions impact park resources, yet they are not necessarily deemed to have impaired resources for the enjoyment of future generations. Whether an individual action is or is not an "impairment" is a management determination based on NPS policy. In reaching it, the manager should consider such factors as the spatial and temporal extent of the impacts, the resources being impacted and their ability to adjust to those impacts, the relation of the impacted resources to other park resources, and the cumulative as well as the individual effects.

Both physical resources, such as wildlife or geologic features or cultural resources, and intangible values, such as natural quiet solitude, and the experience of wilderness, can be impaired.

Impacts to Parks

In the case of commercial air tour sightseeing flights operating over and near units of the national park system, the NPS believes that significant park resources are being impaired in some units. Managers of almost one-third of national park system units perceive a problem with some aspect of already existing aircraft overflights. The sound of aircraft is regarded as the primary impact. A survey of park managers confirmed that mechanical noise is among the more serious problems in parks and aircraft noise is the most prominent among these. The perception of noise and adverse effects in units of the national park system may be related to the fact that parks tend to be quieter places in general and that typical sources of noise found in urban and suburban settings are absent in most parks. The potential exists for impairment of park resources and values by the noise and visual intrusion associated with commercial air tour/ sightseeing operations in other units where the air tour sightseeing industry is not yet established or developed.

Given the changes in our population distribution, patterns of use of our national parks, and other factors related to transportation, it is no longer sufficient for park managers to consider strategies and actions solely within park boundaries to protect parks and their resources. Overflights are a case in point. Most overflights of units of the national park system begin and end at airports outside parks; the attractions the overflights offer are the resources of the parks themselves. Technically, the park overflight passenger is not a park visitor even though there may be significant adverse effects from noise on the park. In recognition of this fact, the FAA and the NPS are working more closely to use the FAA's plenary authority for regulation of aviation in support of NPS management objectives.

FAA Authorities

The FAA has broad authority and responsibility to regulate the operation of aircraft and the use of the navigable airspace, and to establish safety standards for and regulate the certification of airmen, aircraft, and air carriers. (Federal Aviation Act of 1958, as amended (FAAct), Section 307(a) and (c); Title VI.) The FAAct provides guidance to the Administrator in carrying out this responsibility. Section 102 of the FAAct states that the Administrator will consider the public interest to include among other things, regulation for safety and efficiency of both civil and military operations, promotion of the development of civil aviation, fulfillment of the requirements of national defense, and operation of a common system of air traffic control for civil and military aircraft. Section 104 provides to each citizen of the United States a public right of transit through the navigable airspace of the United States. Section 305 directs and authorizes the Administrator to encourage and foster the development of civil aeronautics and air commerce. Section 306 requires the Administrator in exercising his authority, to give full consideration to the requirements of national defense, commercial and general aviation, and to the public right of freedom of transit through the navigable airspace.

The FAA's authority is not limited to regulation for aviation safety, efficiency, and development. Subsection 307(c) of the FAAct provides that FAA air traffic rules and flight regulations may be adopted "for the protection of persons and property on the ground." The FAA considers this protection to extend to environmental values on the surface as well as to the safety of persons and property. Section 611 of the FAAct, "in order to afford present and future relief to the public health and welfare from aircraft noise," directs the Administrator to adopt regulations "as the FAA may find necessary for the control and abatement of aircraft noise," including application of such regulations to any of the various certificates issued under Title VI. Finally, it is the general policy of the Federal government that the FAA, like other agencies, will exercise its authority in a manner that will enhance the environment, and that the FAA will make a special effort to preserve the natural beauty of public park and recreation lands, wilderness areas, and wildlife refuges. Section 101 of the National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321; Section 4(f) of the Department of Transportation Act, 49 U.S.C. 303; and Executive Order 11514, as amended by Executive Order 11991. In addition, the DOT has further authority to regulate services by commercial operators.

Fees

The Budget Reconciliation Act of 1993 (Pub. L. 103–66, August 10, 1993) amended Section 4 of the Land and Water Conservation Fund Act of 1965 (16 U.S.C. 4601–6a) requiring the NPS to impose a commercial tour use fee on each vehicle entering a unit of the national park system, that presently charges an entrance fee, for the purpose of providing commercial tour services.

In addition to surface transportation, this commercial use fee applies to aircraft entering "the airspace of units of the National Park System" identified in sections 2(b) and 3 of Public Law 100.91 (Grand Canyon National Park and Haleakala National Park) as well as any other park areas where the level of commercial aircraft services are equal to or greater than these two identified areas.

The actual fees established by the legislation are as follows:

- $25 per vehicle with a capacity of 25 people or less, and
- $50 per vehicle with a capacity greater than 25 people. The legislation also gives the Secretary the authority to make reasonable adjustments to these recommended commercial tour fees. Currently, there are no additional NPS areas that charge entrance fees, and also have a level of commercial aircraft services equal or greater to Grand Canyon or Haleakala National Parks. As a result of the legislation, the NPS will need to monitor the number of air tour operations over the affected parks.

Grand Canyon National Park

At Grand Canyon, 42 companies offer aerial tours operating from five states (Arizona, California, Nevada, Utah, and New Mexico). These companies provide air tours of the Grand Canyon to about 750,000 people and generate revenues in excess of $100 million. During peak summer months, the number of tours exceeds 10,000 each month. On June 5, 1987, the FAA issued Special Federal Aviation Regulation (SFAR) No. 50–1 (52 FR 22734, June 15, 1987) which provided rules to enhance safety of overflight operations in the vicinity of the Grand Canyon National Park. Section 3 of Public Law 100–91 required the Secretary of the Department of the Interior (DOI) to submit to the FAA Administrator recommendations for the protection of resources in the Grand Canyon from adverse impacts associated with aircraft overflights. The recommendations were to provide for substantial restoration of the natural quiet and experience of the Grand Canyon. With limited exceptions, the recommendations were to prohibit the flight of aircraft below the rim of the Canyon and to designate zones that were flight free except for purposes of administration of underlying lands and emergency operations.

Public Law 100–91 further required the Secretary of the Interior to prepare and issue a final plan for the management of air traffic above the Grand Canyon. In December 1987, the DOI submitted recommendations to the FAA for an aircraft management plan at the Grand Canyon. The recommendations included both rulemaking and non-rulemaking actions. On May 27, 1988, the FAA issued SFAR No. 50–2 (53 FR 20264, June 2, 1988) which revises the procedures for operation of aircraft in the airspace above the Grand Canyon. The rule implements the preliminary recommendations of the Secretary of the Interior for an aircraft management plan at the Grand Canyon with some modifications that the FAA initiated in the interest of aviation safety. SFAR No. 50–2 establishes a Special Flight Rules Area from the surface to 14,500 feet above mean sea level (MSL) in the area of the Grand Canyon. The SFAR prohibits flight below a certain altitude in each of five sectors of this area with some exceptions. The SFAR also establishes flight free zones from the surface to 14,500 feet msl above large areas of the park. The "flight free zones" cover virtually all of the visitors to the North and South Rims and about 90 percent of backcountry users. The SFAR also provided special routes for commercial tour operators and transient operators through the canyon area. Commercial air tour operations are required to be conducted as air taxi and commercial operations under part 135 with stringent requirements including special operations specifications for Grand Canyon. The NPS believes the SFAR has been successful in limiting some noise-associated adverse impacts to the park but most, if not all, of the gain has been, or may be, lost as a result of the exponential growth in numbers of flights over the canyon.

Virtually every class of visitor activity at Grand Canyon National Park is limited or controlled in some way by the NPS to insure that there will be no derogation or impairment of resources and values. Each raft trip on the Colorado River through Grand Canyon National Park must have a permit and the number of permits is limited for both commercial and private rafters. For some private raft trips, a permit may take 4 or 5 years to obtain. Each overnight visitor in the backcountry must have a backcountry permit; the demand for such permits far exceeds the supply. The waiting list for trips by mule into the inner canyon runs into years for some times of the year. There are a limited number of hotel rooms in the park and there are a limited number of parking spaces. In contrast, the commercial air tour sector has experienced unlimited growth at Grand Canyon National Park in the last 10 years. This is so even though Congress found noise associated with overflights to be significantly and adversely affecting the park in the 1987 Overflights Act. In addition, the NPS believes there is ample evidence that the uncontrolled and unregulated growth in this sector is in derogation of the resources and values of the park. NPS studies to that effect will be published later this year.

Grand Canyon—Actions to Date

Public Law 100–91 directed the DOI to substantially restore "natural quiet" to the Grand Canyon National Park. Public Law 100–91 also required a study of aircraft noise impacts at a number of national parks and imposed flight restrictions at three parks: Grand Canyon National Park, Yosemite National Park in California, and Haleakala National Park in Hawaii. Public Law 100–91 also required the DOI to conduct a study, with the technical assistance of the Secretary of Transportation, to determine the proper minimum altitude to be maintained by aircraft when flying over units of the national park system. The research was to include an evaluation of the noise levels associated with overflights. Before submission to Congress, the DOI is to provide a draft report (containing the results of its studies) and recommendations for legislative and regulatory action to the FAA for review. The FAA is to notify the DOI of any adverse effects these recommendations would have on the safety of aircraft operations. The FAA is to consult with the DOI to resolve these issues. The final report must include a finding by the FAA that implementation of the DOI recommendations will not have adverse effects on the safety of aircraft operations, or, in the alternative, a statement of the reasons why the recommendations will have an adverse effect. The DOI expects to complete the report by early summer, 1994.

Haleakala and Hawaii Volcanoes National Parks

The national parks in Hawaii—Hawaii Volcanoes and Haleakala—have similar problems with commercial air sightseeing tours, principally noise associated with helicopters. The FAA held a series of public hearings in January 1994 to elicit public comments and recommendations for regulatory or policy action related to overflights, including their effects on parks. There are 9 tour operators on the island of Hawaii, and there are approximately 60 commercial air tours a day over Hawaii Volcanoes National Park. At Haleakala, which was established to preserve resources in "natural condition," (39 Stat. 432, section 4), seven companies based on the island of Maui offer helicopter tours. On clear days, helicopters fly over the park during all hours of daylight so that helicopter noise is audible over 30 minutes of every daylight hour (personal communication, Haleakala National Park). Interpretive talks, wildlife observations and censuses, ceremonies, and other normal activities are interrupted by air tour overflights. The NPS recognizes that the commercial air tour industry is important to the economy of Hawaii but also believes that the tourism industry benefits from the continued NPS protection of the superlative resources of its national parks, unimpaired.

Hawaii—Actions to Date

The majority of flights conducted by helicopter companies in Hawaii are commercial air tour/sightseeing operations. Both the NPS and FAA have received numerous complaints of commercial air sightseeing tour flights over residential communities, national parks, wildlife refuge areas, State natural reserve areas, sanctuaries and areas of significant historic or cultural value. Issues raised by the growth of air tour sightseeing activity and the associated increase in the number of flights conducted over a given area include aircraft noise, flight noise, flight safety, and airport site constraints near scenic areas. It may be necessary to determine if there are thresholds of adverse effects that have been met in terms of impacts to the parks.

The FAA has taken several steps to address the overflight issues in Hawaii. In 1986, the FAA conducted a study of helicopter sightseeing operations in Hawaii. As a result of that study, recommendations were made to the State and to operators in Hawaii to improve safety and community relations. Also in 1986, the FAA conducted a joint study with the State on heliport and airport access. A result of that study was a helicopter operating plan for Hawaii. Numerous meetings have since been held with NPS personnel, industry, and local communities, including four public meetings conducted in January 1994.

Impacts to Parks and Their Resources

At some parks, including Grand Canyon National Park, Hawaii Volcanoes National Park, and Haleakala National Park, the temporal and spatial extent of commercial air tours are, in the judgment of NPS managers, impairing park resources and visitor experiance. While the NPS and FAA are interested in evaluating potential solutions to the problems at these parks, they are also seeking solutions that will make it possible to avert problems in the future throughout the national park system as have developed at these parks.

Cultural Resources

Very limited information is available on the response of structures to subsonic aircraft and helicopters. The greatest potential risk to historic structures and cultural resources in units of the national park system is from helicopters. The noise characteristics of helicopters are such that they tend to excite nearby structural elements at their resonance frequency, causing low frequency vibrations, rattle, and in some cases, damage. The sound pressure is greatest at structures in the plane of the main rotor, such as could be the case for a helicopter approaching cliff dwellings. When representative cultural resources were reviewed for probability of damage, most were found to be at some risk from commercial air sightseeing tours. Mesa Verde (Colorado) and Canyonlands National Parks (Utah), among others, protest fragile prehistoric stone and adobe structures, including granaries and cliff dwellings, as well as associated cultural materials that are susceptible to damage from helicopter-induced noise and rotor wash. The cultural and spiritual values commemorated in units of the national park system like San Antonio Missions National Historical Parks and the battlefields of the Civil War can be wholly lost by frequent and intrusive commercial air sightseeing tour overflights.

As further examples of areas impacted by aircraft overflights, Mount Rushmore National Memorial and the Statue of Liberty National Monument are cultural icons that can be adversely affected in significant ways be commercial air tour overflights. At the Statue of Liberty, an impending aircraft service would take off and land helicopters from a floating raft less than one-half mile from the statue. This service would be added to two existing commercial sightseeing helicopter operators that account for 115 flights per day and a service that operates four fixed-wing aircraft on air tours. Similarly, the experience of Mount Rushmore National Memorial for the visitors on the ground can be irretrievably lost as a consequence of the aircraft flights close to memorial.

Wildlife Effects

A comprehensive study of the adverse effects of commercial air sightseeing tours on wildlife in parks has yet to be concluded. Studies to date indicate that aircraft can be associated with stress responses on a number of animals, including migratory birds. Endangered species, like the grizzly bear in Glacier National Park, can be harassed by commercial air tour operators unaware of the potential adverse effects of flying too close to them. Other mammals like desert bighorn sheep, deer, and elk that have found refuge in parks can be panicked and stressed by low-flying aircraft, as well. No studies that evaluate long-term effects on wildlife, including population level impacts of commercial air sightseeing tours, have been conducted. As with any potential impact associated with activities in parks, the NPS policy is to err on the side of resource protection until conclusive information is available that would indicate otherwise.

Assessing Noise Impacts

The FAA is working with the NPS to define acceptable noise levels as the basis for any proposed limitations on aircraft overflights. This process involves identifying areas with the highest levels of noise sensitivity. Highly sensitive areas potentially would be subject to lower noise limits than would apply to other areas with higher ambient noise levels, based on resource values, types of use, or other factors. Depending on local conditions, alternative approaches may be employed in different areas to achieve the same noise goal.

Current FAA policy and guidelines designate the yearly day-night average sound level (DNL) as the single noise metric for measuring aviation impacts on people in and around airports. This traditional metric alone may not be appropriate for assessing aviation noise impacts in parks and wilderness areas. Three supplemental metrics other than DNL are proven and appear particularly suitable for site-specific assessments. These are Equivalent Sound Level (L_{eq}), Sound Exposure Level (SEL) and Time Above a dBA Threshold (TA). Additionally, defining a change of 5 dB as significant at any initial DNL level may be appropriate for specifying further noise analysis in parks and wilderness areas.

The ongoing NPS studies have identified two potential (dose-response relationships that also may be appropriate for assessing aircraft noise impacts. These are "Annoyance vs. Percent Time Heard" and "Interference with Quiet vs. Percent Time Heard." These relationships are preliminary and must be subjected to rigorous analysis for further determination of their potential application.

Policy Considerations

In reviewing potential alternatives for achieving NPS and FAA purposes, the FAA has considered a number of measures within its authority under the FAAct that would have the potential to address the problems identified by the NPS. In determining whether a particular action would be beneficial for this purpose and otherwise feasible, the FAA and NPS must take into account a number of legal and policy considerations.

The action, if regulatory, must be consistent with Administration rulemaking principles as set forth in Executive Order 12866. These principles include requirements that regulations be drafted in the most cost-effective manner to achieve the objective; that regulations be based on the best reasonably obtainable scientific, technical, economic, and other information concerning the need for and consequences of the action to be taken; and that regulations be tailored to impose the least burden on society, including individuals, businesses, and communities, consistent with obtaining the regulatory objective.

The action must have no adverse effect on aviation safety. The action should have the minimum possible adverse effect on the efficiency of air navigation, consistent with the regulatory objective, and should not unduly burden interstate commerce. It must also meet NPS requirements for protecting resources, assuring that there is no impairment, and that there is no derogation, to park resources and values.

The action should focus directly on the problem rather than indirectly. For example, if the issue is the adverse impacts of overflights of a unit of the national park system, then the agency action will address those overflights directly, rather than seek to influence them through regulation of takeoffs and landings at a nearby airport.

Options for Evaluation

The FAA and NPS believe that each of the following measures may have some utility, in certain circumstances, as a measure to mitigate the adverse effects of commercial air sightseeing tour overflights of units of the national park system. Inasmuch as some of the measures have not been used before, neither the FAA nor NPS has concluded that such actions would meet the legal and policy considerations summarized above, and specific comment is requested on the benefits, costs, and impacts of each.

Voluntary Measures

Voluntary, non-regulatory measures that mitigate noise impacts would impose the minimum burden on operators and can be effective. An example is the recommended minimum altitude of 2,000 feet above ground level described in FAA Advisory Circular 91-36C, which is honored by most transient operators. Another option would be expansion of the existing Interagency Agreement among the FAA, the NPS, the Fish and Wildlife Service, and the Bureau of Land Management. Through that agreement the proponents agree to assess severe situations where impact of aircraft operations upon human, cultural, or natural resources are sufficiently serious to warrant consideration of site-specific action by the FAA to minimize or eliminate the causes of such problems. Expansion of the Interagency Agreement could provide for additional non-regulatory actions by the agencies to mitigate overflight impacts. The agencies seek comments on the relative merits of voluntary measures generally, and specific suggestions for other voluntary measures not currently used by the FAA or NPS.

Grand Canyon Model

One option is to follow a model similar to that in use at Grand Canyon, with extensive regulation of airspace, routes, and minimum altitudes as discussed separately below. Such an approach may not adequately consider the fact that the total number and frequency of flights, and the steady growth in numbers of flights, are not currently addressed under that regulatory framework.

Prohibition of Flights During Flight-Free Time Periods

A prohibition could be established on use of some or all of the airspace above parks at certain times; e.g., 1 hour per day, 1 day per week, or 2–4 weeks per year. The "quiet times" would be published well in advance both for air tour operator scheduling and for planning by park visitors. In terms of noise mitigation, non-flying quiet periods would present an unusual approach to the balance between air access and the interest in restoring some degree of the natural quiet in Grand Canyon National Park. At some cost in inconvenience and lost business for air tour operators and temporarily reduced access to air tours for their passengers, the park would enjoy a virtual absence of aircraft noise in sensitive areas for specific periods. The agencies specifically request comment on the potential efficacy of these approaches in meeting FAA and NPS goals.

Altitude Restrictions

SFAR No. 50–2 at Grand Canyon currently specifies a minimum altitude for flight over the different areas of the park as high as 14,500 feet msl. It also specifies minimum altitudes for operation in the flight corridors between the flight-free zones. Different altitudes are specified for transient general aviation operations and for air tour operators, to separate high-frequency tour flights from one-time transient flights. Different altitudes are also specified for fixed-wing aircraft and helicopter tour flights, for safety and efficiency reasons. The tour operation altitudes are at canyon rim level or above (although some are slightly below the minimum altitude requested by NPS as "rim level" in 1987). A relatively high minimum altitude in a particular area limits access to the airspace over that area by many general aviation aircraft because of performance limitations. Generally, noise mitigation is achieved through higher minimum altitudes because the greater the slant-range distance from an aircraft to a point on the surface, the lower the sound level on the surface from aircraft noise. However, this mitigation can be offset or reversed based on attenuation factors such as hills, heavily wooded areas, and "soft ground" terrain.

Flight Free Zones/Flight Corridors

SFAR No. 50–2 at Grand Canyon now describes specific "flight-free" zones to an altitude of 14,500 feet msl above the park. The remaining airspace is defined as corridors for operations over the park by both general aviation and commercial air tour operators. Impact mitigation is achieved through specifying corridors for flight over the park that assure there are no overflights of large areas of the park below the current minimum altitude of 14,500 feet msl. The current corridors and flight-free zones could be amended to address concerns about effects on particular areas of the park.

Restrictions on Noise Through Allocation of Aircraft Noise Equivalencies

A noise budget is a mechanism for limiting total aircraft noise impact on the park by assigning each air tour operator an individual limit on noise impact. This would allow individual air tour operators the flexibility to decide what combination of equipment and flight frequency they will use to attain the target noise level. The noise budget would apply only to air tour sightseeing operators and not to transient general aviation operations. The noise budget concept assumes that the FAA and NPS could determine (1) the acceptable amount of aircraft noise exposure on the park surface, and (2) the number of aircraft operations under various mixes of aircraft types that could operate within the total noise budget.

While complex to develop and administer, the noise budget could achieve noise mitigation through directly addressing the issue of noise impact but would not address the impacts other than noise Once the "budget" is established based on target noise levels in various areas of the park, air tour operators would have substantial flexibility to adjust their business operations without exceeding those levels. The noise budget could act as a practical limit on the amount of aviation activity, but would not impose limits on the number of operations. A noise budget would also represent an Incentive for operators to acquire relatively quiet aircraft to avoid a penalty on the number of operations that could be conducted within each operator's target noise level.

Individual allocations under a noise budget could be established by designating maximum noise levels for each operator. This could be done by "grandfathering" the current noise contribution by each air tour operator, or by some other administrative means.

Incentives To Encourage Use of Quiet Aircraft

Air tour operators could be encouraged to use relatively quiet aircraft on park overflights. For example, a flight corridor with a good scenic view of the canyon could be limited to aircraft meeting certain noise emission standards. An air tour operator could find it advantageous to convert its entire fleet to such quiet aircraft to incorporate that corridor in its tours. While there is no Federal requirement for aircraft to be manufactured to produce less noise than Stage 3 standards, some aircraft appropriate for air tour operations are quieter than Stage 3. Increased use of such aircraft in air tours would achieve noise mitigation through reducing noise levels on the surface of the park, although this option does not address issues other than noise.

Questions

The NPS and FAA also solicit comments on several questions related to air tour sightseeing operations in and adjacent to units of the national park system.

Policy

1. Should commercial sightseeing flights be prohibited over certain national parks? If so, what criteria should be used in determining which parks should not have such tours?

2. Should action pertaining to aircraft overflights in national parks be considered only for air tour/sightseeing operations? What circumstances would include other categories of overflights?

3. What factors should be considered by NPS and FAA in evaluating recommendations for addressing aircraft overflight issues?

Technical

1. Is the use of quiet technology aircraft a viable alternative for reducing noise from commercial air tour/sightseeing operations in national parks?

2. Should all commercial air tour/sightseeing operations be conducted under air carrier rules of FAR part 135 and/or 121?

3. Should air carrier operators be required to have special operations specifications for conducting sightseeing flights?

4. Should there be special airspace rules for identified units of the national park system?

5. Should the measures developed for Grand Canyon and Hawaii become models for more general use at parks with actual or potential overflight impacts?

Request for Comments

The FAA and NPS solicit comments and information from all segments of the public interested in aviation and national parks and their relationship. The primary focus of this advance notice is commercial air sightseeing tours, rather than military or general aviation operations. It is anticipated that any regulations eventually developed would be general in nature and applicable to the entire national park system. It is not the intent of the NPS or FAA to develop regulations specific to any one park at this time. However, examples of aviation activities observed in one park may be used to support an opinion on overall aviation management issues.

All comments received by FAA and NPS at the addresses and by the dates listed above will be reviewed and utilized in any development of proposed regulations. Comments received pursuant to this Advance Notice of Proposed Rulemaking will be analyzed and discussed in the preamble to the Proposed Rule. Any proposed rulemaking will also be made available for public review and comment.

Regulatory Process Matters

Economic Impact

The FAA and NPS are unable to determine at this point the likely costs of imposing regulations affecting overflights of national parks or the annual effect on the economy. Following a review of the comments submitted to this ANPRM, the FAA and NPS will determine what regulatory requirements will be proposed, if any, and will review the potential costs and benefits, as required by Executive Order 12866.

Significance

This anticipated rulemaking is not a "significant regulatory action" as defined in Executive Order 12866. The FAA has determined that the ANPRM is not significant under the Regulatory Policies and Procedures of the Department of Transportation (44 FR 11034, February 2, 1979).

Other Regulatory Matters

At this preliminary stage it is not yet possible to determine whether there will be a significant economic impact on a number of small entities or what the paperwork burden might be. These regulatory matters will be addressed at the time of publication of any NPRM on this subject.

List of Subjects

36 CFR Parts 1 through 7

Grand Canyon National Park, Haleakala National Park, Hawaii Volcanoes National Park.

14 CFR Parts 91 and 135

Aircraft, Airmen, Airports, Air taxis, Air traffic control, Aviation safety, Noise control.

Issued in Washington, DC on March 11, 1994.

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[FR Doc. 94-6216 Filed 3-14-94; 12:28 pm]

BILLING CODE 4910-13-M

APPENDIX E

AIR NATIONAL GUARD

Policy on Overflights of Designated Wilderness and Wild and Scenic Rivers

Policy on Air National Guard Overflights of Designated Wilderness and Wild and Scenic Sites

INTRODUCTION

The Air National Guard recognizes the intent of Congress in establishing Wilderness and the Wild and Scenic River Systems, and the benefits of recreation and other activities to be derived from these areas. As defined in the lain, wilderness is an area where the earth and its community of life are untrammeled by people, and inhere people are visitors. Despite this general operating framework, the Congress has authorized many activities, e.g. recreation, commercial outfitting, guide services, and livestock grazing. Many other activities are also permitted, including administrative structures and installations, development of privately owned minerals, fire control, and insect and disease control. In some cases the use of airstrips and motorboats are also authorized. Commercial and military aircraft overflights of Wilderness and Wild and Scenic Rivers are not excluded under the legislation. The ANG has potential to impact these areas; therefore this policy is put forth with the recognition of the importance of these national assets.

POLICY STATEMENT

The following assumptions and facts affect the ANG position on overflights:

- There is an increasing awareness and interest on the part of the public regarding management of wilderness. This is evidenced by a recent GAO report on wilderness preservation, an MOU between DOD and the U.S. Forest Service, the Nevada Wilderness Act, and the National Park Overflights Act.
- The Wilderness System constitutes about 91 million acres, 34.2 million of which is located in 42 of the contiguous states and accounts for one (1) out of every six (6) acres of Forest Service land.
- Additional land will be added to both the Wilderness System and the Wild and Scenic Rivers System.
- Legal action has been taken against the ANG at the Boundary Waters Canoe Area Wilderness regarding overflights.
- Wilderness and Wild and Scenic Rivers were designated for several uses not just recreational. The establishment of these areas will allow natural processes to operate freely within wilderness.
- Overflights, both commercial and military, were taking place prior to designation of Wilderness and Wild and Scenic Rivers.
- The ANG is concerned about its overflight activity on these areas, and the potential impact on visitors.
- The only FAA policy on overflight activity of these areas is a 2000 ft AGL flight advisory.
- The ANG requires various types of airspace in which to safely conduct its operations and therefore prefers to use lightly populated areas such as those that may contain wilderness. Many of the existing ANG MOAs and MTRs are located over existing Wilderness and Wild and Scenic River corridors.

Given this framework, it is ANG policy:

- To comply with all FAA regulations and applicable federal legislation.

- To not plan any ANG ground activity on designated Wilderness or Wild or Scenic River areas, to include air drops and troop activity.
- Newly proposed airspace and modification of existing airspace will be planned to avoid these areas unless mission constraints dictate otherwise.
- The Operational and Resources Study (OARS) shall identify the rationale, and provide justification for Wilderness and Wild and Scenic River overflights.
- Wilderness will be overflown at 2000 ft AGL or higher whenever possible to comply with the intent of the FAA advisory on overflights.
- There will not be any type of ANG structure, either temporary or permanent, within these areas, e.g. radar sites or communication sites.
- The units will coordinate with the appropriate manager of a Wilderness or Wild and Scenic River in terms of solving specific problems associated with ANG use of that airspace. This may include defining prohibited areas, altitude above terrain reservations, and areas of partial or seasonal closure.
- Newly proposed overflight activity will go through the appropriate Environmental Impact Analysis Process (EIAP) to identify environmental impacts, and to insure the proper coordination with interested agencies.

CONCLUSION

The ANG can be viewed as a visitor, in the air, to these areas. The impact, although of concern to a wilderness user because of its potential to impact their solitude, is of short duration, infrequent, and often not visible. Various environmental assessments completed for airspace have indicated that impacts on wildlife and air quality are minimal. These impacts will become even less of a factor as the ANG continues to convert its forces to quieter and cleaner aircraft. The ANG mission requires the use of loin altitude airspace in remote areas to avoid more densely populated areas, and to operate in a safe manner. In light of the vastness and distribution of the Wilderness and Wild and Scenic Rivers systems it is inevitable that overflights be conducted. ANG overflights will not preclude other uses for these areas, and in most cases will provide less of an impact on the system than on ground recreational use. Natural processes can continue to operate freely, as they have in the past.

Regardless, it will be ANG policy to plan its airspace to avoid these areas as much as possible. Where it is not possible, this criteria will be used. The ANG will continue to recognize its role in preserving our nation's pristine areas, and do what it can to enhance them.

APPENDIX F

Interagency Airspace/Natural Resource Coordination Group (IANRCG)

Statement of Principles for a Partnership For Action to Protect, Restore and Maintain the Nation's Airspace and Federally Protected Land Resources

Statement of Principle

To engage in a partnership to identify issues and facilitate cooperative problem resolution concerning use of airspace over federally protected lands.

Background

The Departments of Agriculture (Forest Service), Defense (DOD) and Interior (DOI) have legal responsibilities to manage or use important land-based resources to meet national interests, mandates, and responsibilities. These agencies also use airspace which the Federal Aviation Administration (FAA) manages. Currently and for the foreseeable future, the Department of Defense will require access to suitable airspace in which aircrews can train realistically to meet national security objectives. The Departments of Agriculture and Interior also require access to airspace overlying the lands they manage to provide mandated natural resource protection.

Much of the FAA-approved airspace for DOD flight training, and many non-DOD training and operational flights, traverse federally protected lands. These federally protected lands include units of the National Park System, National Wilderness Preservation System, National Wildlife Refuge System, National Forest System, and National Wild and Scenic River Systems, and national refuge areas. Collectively, the National Park Service, Forest Service, Bureau of Land Management, and the Fish and Wildlife Service manage over 500 million acres of public land. In addition, Indian Affairs protects trust resources associated with 53 million acres of non-public land for the use and benefit of Indian beneficiaries. Additionally, the DoD has stewardship responsibility for 25 million acres of land. While each agency's responsibility varies to some degree, each agency has legal responsibility including the preservation of wilderness areas, protection of natural and cultural resources, and promotion of public enjoyment and use of these resources.

Management and administration of federally managed lands for these purposes may encounter competing/conflicting interests. To ensure the public's interests are served equitably, representatives from each agency will meet as often as necessary to resolve issues to ensure national interests, mandates, and aviation operational, training and safety objectives are being met. Further, this interagency group, known as the Interagency Airspace/Natural Resources Coordination Group (IANRCG or Coordination Group), will engage in a cooperative effort to identify issues, recommend procedures, and facilitate a process to resolve these issues.

Statutory Basis

The Coordination Group will operate within existing authorities and serve to identify and fulfill the many Federal statutes that affect air and land resources. Some of these statutes include the Wilderness Act, Wild and Scenic Rivers Act, Federal Land Policy and Management Act, Endangered Species Act, National Environmental Policy Act, the Federal Aviation Act of 1958, and the American Indian Religious Freedom Act. The Coordination Group will make recommendations to their principal agencies but it has no enforcement or regulatory authority.

Purpose

The purpose of the Coordination Group is to assist in protecting, conserving, and restoring the Nation's airspace and federally protected land areas through existing Federal capabilities and authorities; establish lines of communication to identify and facilitate problem/issue resolution related to airspace and land use; establish a cooperative stewardship of air and land resources by working in partnership with other Federal agencies; enhance aviation safety and operational deconfliction; integrate Federal actions and programs with state, local, and non-governmental efforts; and to provide a framework for action that effectively focuses agency expertise and resources on jointly identified problems to facilitate demonstrable environmental and programmatic results that may serve as models for effective management of air and land resources. The Coordination Group will work to identify and facilitate potential issue and conflict resolution at the preliminary stages of planning and develop recommendations for joint military training and information sharing opportunities.

General Scope

The Coordination Group provides a forum for interagency discussion, integrated planning, collaborative dispute resolution, and facilitation of local and regional issues concerning the use of the nation's federally protected land resources and airspace. Initial efforts of the Coordination Group will focus on issues and conflicts among airspace and land managers which have been identified.

Coordination Group membership may include representatives from the Departments of the Air Force, Army, Navy (including the Marine Corps), their respective reserve components, Federal Aviation Administration, Bureau of Land Management, Department of the Interior, Assistant Secretary -Indian Affairs, Fish and Wildlife Service, National Park Service, Forest Service, and other interested Federal agencies or organizations which have jurisdiction, mandates, responsibilities, or interests in federally protected lands and airspace.

Responsibilities

The coordination group will:

- Meet regularly to identify conflicts early in the airspace and land use planning process and facilitate resolving conflicts at the lowest practical level.
- Foster a continuous dialogue between representatives and contribute to a cooperative environment in which conflicts can be avoided or, failing that, facilitate resolving conflicts so as to achieve mutual goals.
- Provide an effective forum for operational feedback and information sharing.
- Provide a stewardship role toward all airspace for military use and all federally designated protected land, as tasked within the control of the Departments of Agriculture (Forest Service), Defense and Interior.
- Adopt a proactive role with respect to lands, wildlife, waterways and airspace, and protect, as much as possible, the welfare of the environment and sensitivities of concerned citizens.
- Establish sub-committees as necessary to staff issues.
- Institute management procedures to serve as the basis for future interagency airspace and land planning coordination.
- Whenever feasible, take intra-agency action to resolve problems identified by other agencies.
- Identify ways to conserve, revise, and/or delete, monitor, and otherwise protect airspace and land assets to meet future military training needs and be responsive to other public interests..
- Strive to increase aviation safety and provide operational deconfliction
- Identify opportunities for training, education, and research needs for land managers and airspace planners

Reports

The Coordination Group will document the recommendations and proceedings of each meeting and send copies to each agency representative as soon as practical following the meeting. The Coordination Group may prepare a comprehensive annual report that documents the management actions accomplished and evaluates the effectiveness of programmatic decisions and recommendations and other reports as appropriate and mutually agreed to.

APPENDIX G

Deputy Under Secretary of Defense (Environmental Security)

Response to the Senate Armed Services Committee Report 103-112

OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON
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ACQUISITION AND
TECHNOLOGY

07 OCT 1994

OCT 26

Honorable Sam Nunn
Chairman, Committee on Armed Services
United States Senate
Washington, DC 20510-6050

Dear Mr. Chairman:

This letter is in response to the Senate Armed Services Committee Report 103-112, National Defense Authorization Act of FY 1994, which directs the Secretaries of Defense and Interior to provide a report on what procedures have been developed to achieve their mutual goals of training and stewardship.

We have prepared the enclosed interim report in conjunction with the Department of the Interior. It reflects agreement between our two agencies that a recently established informal coordination group could be the model for a mechanism to resolve disputes, and such a group may be incorporated into procedures we are presently developing to achieve our mutual goals. We have begun an expanded interagency dialogue that has already resulted in the drafting of a Memorandum of Understanding, through which DoD and DoI would communicate, cooperate, and coordinate on national defense and natural resources concerns. When we complete our development of the procedure directed by the SASC, we will provide a final report that describes it in detail.

Very truly yours,

Sherri W. Goodman
Deputy Under Secretary of Defense
(Environmental Security)

Enclosure

cc:
Honorable Strom Thurmond
Ranking Republican

Environmental Security *Defending Our Future*

REPORT TO THE COMMITTEE ON ARMED SERVICES

UNITED STATES SENATE

The Department of Defense mission is to maintain national security by maintaining combat readiness. Readiness depends on well equipped and well trained fighting forces. The requirement to train the forces is determined both by the weapons and tactics expected to be employed in battle, and by the conditions and terrain of the battlefield. In our training, we emphasize realism and results, and to find these we have had to move some of our activities to the national forests and public lands managed by the Departments of Agriculture and Interior. If the committee is interested, we have a videotape describing this training that we would like to share with you, at your request.

Our agencies know that the Congress, the general public, and national and local natural resource and wildlife advocacy groups are concerned with military ground operations and overflights, because they believe we are disturbing the ecology of these forests and lands. We realize that we have a common interest in such areas, and we are committed to cooperating in an effort to conserve or enhance our natural heritage, and to assure a satisfactory national defense. Over the past several months, our agencies, as well as the Department of Transportation and the Federal Aviation Administration, have participated in discussions of several legislative initiatives affecting overflights and refuges. From this interchange, an informal group now known as the Interagency Airspace and Natural Resources Coordination Group (IANRCG) evolved.

This newly formed group met for the first time in late January, 1994, at Andrews Air Force Base, Maryland at the invitation of Air National Guard personnel who hosted and facilitated the meeting. The group is composed of military airspace users and Federal land managers, and it met a second time in May to continue the January dialogue and address airspace and land issues.

The following agencies were represented at the May meeting:

- Department of Defense
  - Deputy Under Secretary of Defense (Environmental Security)
  - Department of Army
  - Department of Navy
  - Department of Air Force
  - Headquarters U.S. Marine Corps
  - Army National Guard
  - Air National Guard
  - Air Force Reserve

2

- Department of Agriculture
  - U.S. Forest Service

- Department of Interior
  - Assistant Secretary - Indian Affairs
  - Bureau of Land Management
  - National Park Service
  - Office of Aircraft Services
  - U.S. Fish and Wildlife Service

The group discussed the Senate Armed Services Committee (SASC) Report #103-112, National Defense Authorization Act for FY 1994. "It directs the Secretary of Defense and the Secretary of Interior to establish a procedure, including a mechanism for dispute resolution, by which DoD and DoI can achieve their mutual goals of training and stewardship.

Attendees agreed that the informal group, or IANRCG, could facilitate establishment of the procedure sought by the Committee, in that staff and mid-level managers of the interested agencies have recognized and accepted it. And, between the January and May meetings of the group, DoD and DoI representatives were successful in resolving longstanding problems the agencies had identified in January. This process may be a model for the dispute resolution mechanism desired by the SASC; but it should only complement existing agency organizations and processes through which our agencies presently accommodate national defense and natural resources needs.

Encouraged by the successful resolution of these problems, the IANRCG formed five subcommittees to consider and propose solutions to common problem areas, on a continuing basis:

- Coordination and Procedure
- Education and Awareness
- Environmental Effects
- NEPA Planning and Compliance
- Operations and Safety

Although DoD already has its own Policy Board on Federal Aviation for dealing with airspace issues, it is also considering establishment of an interagency group that would recommend policy on both airspace and natural resources, the Airspace and Natural Resources Steering Group. The new group should meet once or twice a year, and members may be *ex officio* Assistant or Deputy Under Secretaries of Federal agencies, or leaders of selected natural resources and wildlife advocacy groups.

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Publication services were provided by the Branch of Publications and Graphic Design of the Denver Service Center.

NPS D-1062 July 1995

United States Department of the Interior / National Park Service