A Method for Estimating the Economic Effects of Habitat Protection

Final Report

U.S. Department of the Interior
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Final Report

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Preface

Actions by the U.S. Fish and Wildlife Service (Service) to protect the habitat of threatened or endangered species can have complex impacts on the local, regional, and national economies. Few, if any, of the past studies of these impacts have embraced the full range of this complexity, however, focusing instead on the potential short-run dislocation of firms, workers, and communities that might occur as the designation curtails the habitat-degrading activities of a resource-extraction or land-development industry.

In July, 1993, the Service's Portland Field Office contracted with ECO Northwest to develop a method for evaluating the full range of the potential economic effects of one type of habitat protection, the designation of critical habitat for a threatened or endangered species. Specifically, our task is to provide the Service with a framework for assessing a designation's long-run impacts as well as its short-run impacts, its impacts on the habitat-degrading industry as well as its impacts on industries that incur spillover costs from habitat degradation, and impacts on an area's quality of life as well as its impacts on the area's industries.

Our charge does not include the development of an analytical method *de novo* and *in toto*. Instead, our objective is to provide the Service with guidance for expanding the scope of its current policies and procedures governing the analysis of the economic effects of a critical-habitat designation. In Chapter 1 we introduce the problem and outline the logic underlying our recommendations for responding to it. In Chapters 2 - 5 we present analytical guidelines we recommend the Service use to modify its current policies and procedures so they embrace the full set of economic effects that might accompany a critical-habitat designation. In Chapter 3 we also outline a multi-sector model for estimating a designation's long-run effects on a local or regional economy.

This is our final report. It was prepared by Ernie Niemi, Art O'Sullivan, and Ed Whitelaw. We gratefully acknowledge the assistance of Robin Bown and Josh Millman at the Portland Field Office, as well as the invaluable comments and insights of Paul Courant and a panel of reviewers:

Tim Bartik	Elizabeth Davis	Louise Fortmann
Ed Gramlich	Joel Hamilton	Rob Mendelsohn
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Despite this assistance, one should not attribute any flaws in this report to anyone other than the authors.

Chapter 1

Introduction

As the number of threatened or endangered species afforded protection under the Endangered Species Act (ESA) grows, so does the public's concern that actions to protect them will have major, negative economic effects. Much of this concern has been fueled over the past few years by numerous studies concluding that implementing the ESA to protect the northern spotted owl and other species will devastate the region's economy. These studies and their conclusions, however, rest on serious, systematic errors of logic and analysis – errors that reflect a simplistic view of economic development and environmental protection as separate, adversarial, activities.

In reality, the species and habitats protected by the ESA generally are not separate from an area's economy. They are integral to it, and they play diverse, complex roles that extend far beyond a simple comparison of, say, jobs and owls. These roles are especially diverse when a species and its habitat contribute significantly to the quality of life available to the area's residents. In such circumstances, implementation of the ESA does not have a single effect on the economy, negative or not, but multiple effects, some negative and some positive.

The various pieces of the theoretical framework for understanding these multiple effects, including the quality-of-life effects, of environmental-protection policies have existed for some time, but there exists no practical guide that integrates the pieces and applies them in the context of the ESA. This report attempts to fill much of this void by describing the process by which actions to protect species and habitat lead to changes in the economy, discussing guidelines for estimating the multiple economic effects of these actions, and outlining a multi-sector model for estimating the long-run effects on a local or regional economy.

We focus on one aspect of the ESA, the designation of critical habitat by the U.S. Fish and Wildlife Service (Service) for species listed as threatened or endangered. Such a designation extends the protection provided the species by the listing, itself, by prohibiting federal agencies from taking actions or supporting the actions of others that would materially degrade the habitat. The ESA requires the Service, using authority delegated by the Interior Secretary, to consider the potential economic effects of these restrictions before designating habitat as critical to the species' recovery.

This report integrates information from two sources. The first is the considerable literature on how economies develop and respond to changes in public policy. The second is the debate over the management of the old-growth forests in the Pacific Northwest, which has demonstrated both the complexity of the economic effects of the ESA and the confusion that

can occur when different studies look at only a subset of effects and reach widely varying conclusions.

This report is not intended as a handbook for Service personnel to take off the shelf and use as a step-by-step prescription for assessing the economic effects of a specific critical-habitat designation in the future. We have far too little understanding of the administrative requirements and details necessary to make such a handbook, and we have too little budget and time to present a detail-by-detail catalog of every variable the Service might analyze.[1] Instead, we offer a theoretically sound and pragmatic analytical framework the Service can use to expand its current policies and procedures for preparing economic analyses. Toward this end, rather than starting from scratch, we focus on broadening the scope of the analytical approach the Service applied in its analysis of the potential economic effects of designating critical habitat for the northern spotted owl, which concentrated primarily on describing the potential impacts on the region's timber production, timber-related jobs, and federal payments to counties.[2] For some issues we repeat the guidance found in that report; for other issues, we recommend specific corrections or extensions to the report, as appropriate.

A. The Multiple Economic Effects of the Endangered Species Act

Figure 1-1 shows the general process by which the Service's designation of critical habitat can cause multiple economic effects. The transformation occurs in four, general stages. *In the first stage*, the Service designates the critical habitat and, in response, federal agencies alter their behavior so they do not directly degrade habitat or contribute to the actions of others that would do so.

In the second stage, the designation sends economic signals to the local, regional, and national economies, indicating a change in the economic role of critical habitat. The signals have four major destinations. The first is the industry (or industries) that benefit from actions that degrade habitat and the second is the industry (or

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[1]For example, although we talk in general terms, as economists often do, about how firms, workers, and families will respond to the changes in prices, wages, and local quality of life stemming from a critical-habitat designation, we fully recognize that the specific response might vary widely across individual firms, workers, and families. We also recognize that this variation might be systematically related to socio-economic characteristics, such as the size of the firm, and the age, gender, and class of the worker or family.

[2]The report, *Economic Analysis of Critical Habitat Designation Effects for the Northern Spotted Owl* (hereinafter *Economic Analysis for the Northern Spotted Owl)*, also examined, but placed less emphasis on, the potential impacts on recreational values, anadromous fisheries, and the intrinsic value of owls and their habitat. The study, which has been designated by the Service as a model for subsequent analyses, generally builds on the guidance provided by the U.S. Water Resources Council, *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, 1983.

industries) that incur spillover costs from habitat degradation.[3] The signals headed toward these destinations say that the supply of habitat for degradation will be less than it otherwise would have been, and, accordingly, the spillover costs on other industries from habitat degradation also will be smaller. These signals may alter the investment and employment decisions of firms and workers in these sectors who are sensitive to the supply of habitat.

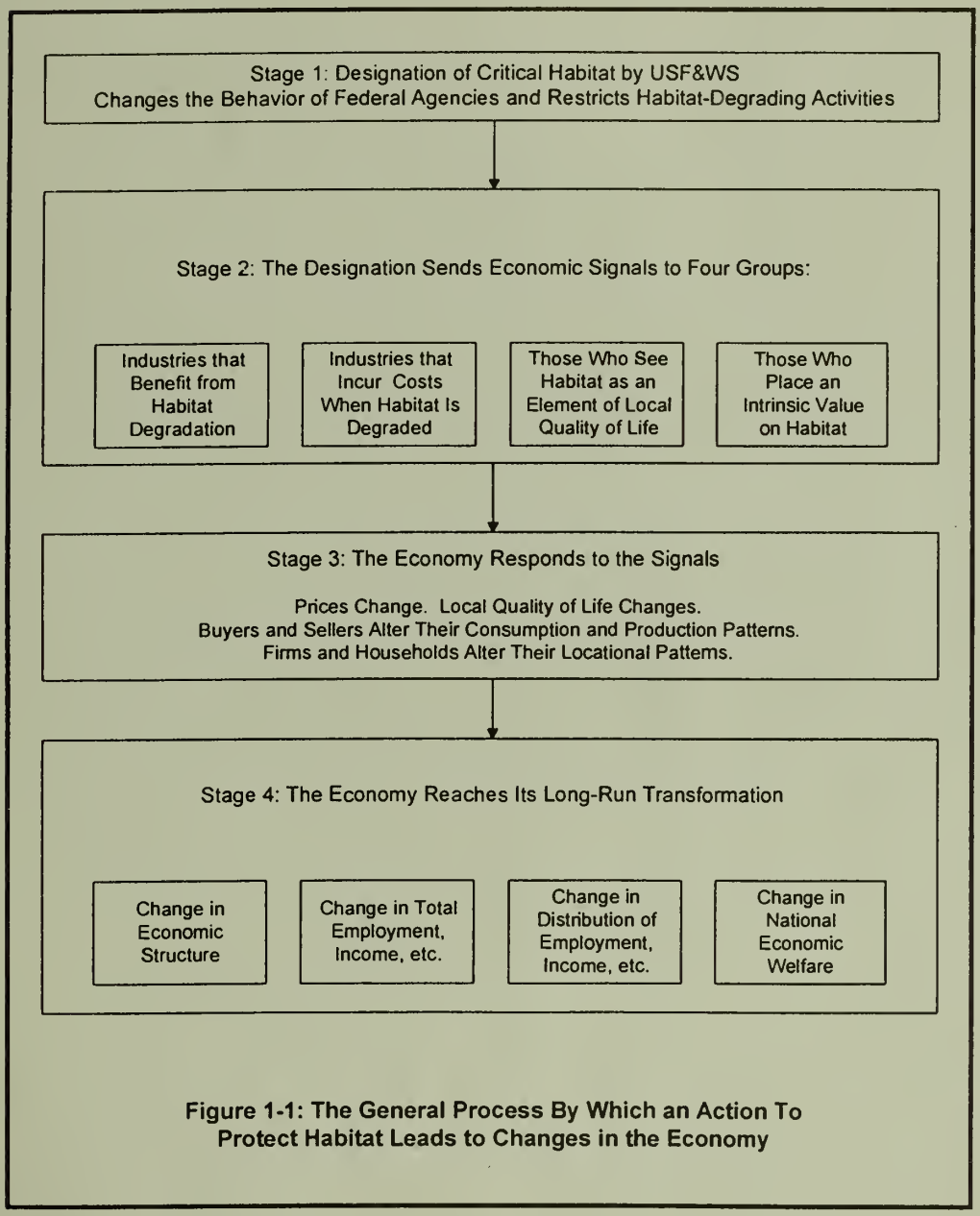


Figure 1-1: The General Process By Which an Action To Protect Habitat Leads to Changes in the Economy

The third destination consists of the local quality of life. When the Service designates critical habitat, it expresses a commitment to maintain and enhance, not just the habitat itself, but also any natural-resource amenities associated with the habitat. In some areas, this message and these amenities may have a significant impact on the quality of life available to local residents and visitors. This message potentially will alter the locational decisions of the business owners, workers, and households who are sensitive to these amenities.

The fourth destination is those who place an intrinsic

[3]The term, industry, represents all parties, corporate or otherwise, engaged in economic activities that lead to or are affected by habitat degradation. Thus, a reference to the industries that benefit from degradation of riparian habitat might embrace the activities of a logging company cutting a forest, a household building a new home at the urban fringe, and a local park district replacing the bushes in a riparian area with a manicured lawn extending to the edge of a stream.

value on the habitat and the species dependent on it. This group sees the habitat and species as wealth, similar to jewels in a bank's vault, but owned jointly by all of society. The Service's announcement of its intent to increase the protection afforded critical habitat potentially will increase the value of this wealth.

The designation of critical habitat for the northern spotted owl sent signals to all four types of destinations. When the Service designated the critical habitat, it sent signals to at least two industrial sectors, logging and commercial fishing, saying that the supply of old-growth habitat to be degraded by logging would be diminished and the supply of old-growth habitat for anadromous fish would be increased. To the extent that firms and workers in these sectors were sensitive to this information, they adjusted their economic plans accordingly, as we explain below. The designation also reassured those who prefer to live near old-growth forests that, if they reside in the region, they will be able to continue to enjoy the various amenities associated with these forests. This reassurance became input to the locational decisions of business owners and workers, as well as to those of households outside the workforce, such as retirees. Finally, the designation told people throughout the U.S. and the world that the federal government intended to maintain, and even enhance, the intrinsic value of the spotted owl and the associated flora and fauna.

In the third stage of the transformation, the economy responds to the economic signals. In general, this response involves changes in prices: the prices of goods and services rise or fall to levels that otherwise would not occur, and buyers and sellers adjust their behavior accordingly. The prices of some goods and services in some locations rise, in response to a reduction in supply or an increase in demand and, for the opposite reasons, the prices of some goods and services in some locations decline. Separate price-effects manifest themselves in the industrial sectors whose habitat-degrading activities are curtailed by the designation, in the sectors that incur spillover costs when habitat is degraded, and in the public's response to the change in the area's quality of life.

In the fourth stage, the various price-effects reach their ultimate resolution, and the economy exhibits the long-run effects of the designation. The designation alters the structure of the economy at the local, regional, and national levels, *i.e.*, the distribution of industrial activity and quality of life is different than it would have been without the critical-habitat designation. So are both the total level of jobs, incomes, and wealth, as well as their distribution within the local area and among the nation's regions.

On balance, the designation may increase or decrease the overall economic welfare of the nation, *i.e.*, it may yield net economic benefits or net economic costs. If the present value of the bundle of goods and services produced over time is greater with the designation than the

value of the bundle that would be produced without the designation, then the designation increases national economic welfare. If the relationship is the other way around, national economic welfare will decrease. When evaluating the different bundles, it is important to include all components of the economy: the industries that benefit from habitat degradation as well as those that incur spillover costs; the various components of local quality of life; and the intrinsic value of habitat and species.

B. The General Approach for Estimating the Multiple Economic Effects of Actions to Protect Habitat

We recommend the Service estimate the economic effects of a critical-habitat designation in the four steps shown in Figure 1-2. The four steps generally parallel the four stages of the economic-impact process shown in Figure 1-1, but the parallel structure is not exact, reflecting the fact that there exists no analytical tool that can trace the full effects of a critical-habitat designation on individual workers, firms, communities, and regions. Hence, it is necessary to look at the issue from several perspectives, piecing together a total picture of the designation's economic effects.

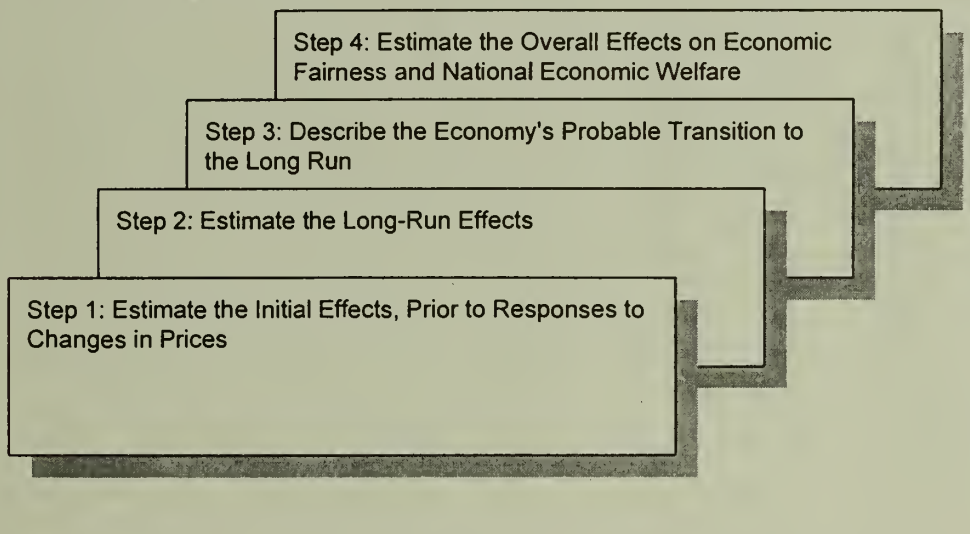


Figure 1-2: The Major Steps of the Recommended Analytical Approach

The first step is to estimate the initial effects, *i.e.*, the effects prior to the economy's response to changes in prices, by identifying the groups, firms, and communities most likely to realize immediate costs or benefits, or both, from the designation.[4] The next step is to estimate the long-run effects, looking at how the designation will affect production costs, prices, output,

[4]The definition of initial effects is necessarily imprecise, given the wide variation in the speed with which different parties and economic variables react to the designation. Some react immediately the designation, or even anticipate it in some instances, while others react more slowly. The definition of the initial effects of a given designation will depend, in part, on the analyst's understanding of the surrounding economy. The objective should be to describe the parties who are likely to see a change in their income or in the value of their capital stock directly because of the designation and within a short period of time.

employment, income, and quality of life in the local area or region and recognizing that people and capital may move in response to changes in prices and changes in an area's quality of life. The third step entails describing the transition between these two endpoints, focusing on identifying the factors that are likely to facilitate or, alternatively, impede the transition for certain groups. The final step is to interpret the findings of the previous three steps, showing the extent to which specific costs and benefits offset each other, accounting for various factors that distort prices, and explaining how the evaluation depends on who possesses the property rights to the affected habitat.

Our approach acknowledges that, while in the best of worlds there would be analytical tools for tracing the economic effects step-by-step from the designation to its long-run outcome, such tools do not exist. Instead, there are tools, such as input-output models, for estimating the initial effects, prior to behavioral changes in response to changes in price, and tools, such as equilibrium models, for estimating the long-run outcome, after the price-effects have played themselves out, but no tools for tracing individual firms, workers, and communities between these two endpoints. Hence, our approach has three steps for analyzing the process of economic change associated with actions to protect habitat: for the two endpoints and then for looking at the transition from the first to the second. We conclude with a fourth step, interpreting the analytical findings.

Our approach differs substantially from the past studies that have narrowly focused on the initial impact on the habitat-degrading industry that will be curtailed by actions to protect habitat. In some instances, practitioners have relaxed the focus to look at the multiplier, or ripple, effects radiating away from this initial impact; in others they have looked solely at the so-called direct effects, arguing that the ripple effect gets swamped by the churning of the larger economic ocean. Whether the ripple effect is included or not, these past studies have implied that the most important economic effects occur in the industries that benefit from habitat degradation and during the brief period following the critical-habitat designation, *i.e.*, at the beginning of the economy's response to the designation.

We recommend a different approach. Specifically, *we recommend that the Service weigh the economic effects of a critical-habitat designation by looking at the economy's entire response to the designation.* Our recommendation recognizes the dynamic character of the U.S. economy and takes into account the economy's ability to redeploy labor and other resources that might become unemployed because of actions to protect a species and its habitat. Because of this dynamism, buyers and sellers respond to price changes, firms and households adjust to changes in the local quality of life, and the ultimate outcome often bears little resemblance to the initial impacts that often have been the focus of past studies. We also recommend that the Service be explicit about who has

what economic interest in the actions to protect habitat. In particular, it should not assume, as many past studies have, that those in the habitat-degrading industry have a greater economic interest in the action than others, *e.g.*, that mill workers in Oregon whose incomes may decline shortly after the designation curtails logging in spotted-owl habitat have a greater interest than fishermen in Washington or mill workers in Tennessee whose incomes may increase some months later for the same reasons.

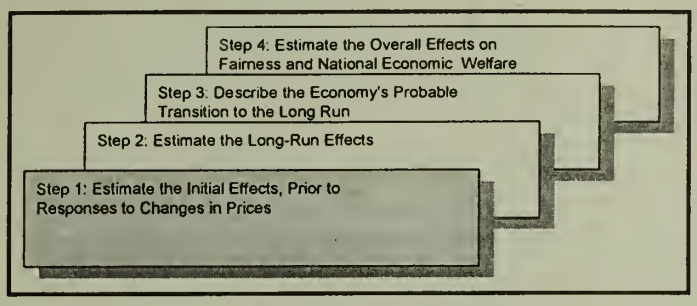
In Chapters 2-5 we present guidelines for completing each of the four steps, *i.e.*, for systematically acquiring a better understanding of the process of economic change, described in Figure 1-1, that will be triggered by any action to protect a species and its habitat. Each evaluation of economic effects, of course, will have its own unique set of characteristics, reflecting the magnitude of the designation, the immediate impact on the local and regional economies, and the facility with which these economies, and the national economy, adapt to these changes. Thus, future economic evaluations will vary in size, level of effort, industrial scope, data, and other dimensions. But, despite these differences, each should reflect the basic guidelines we describe below.

The guidelines incorporate several principles of sound economic-impact analysis. Specifically, regarding *the scope of the analysis*, the guidelines indicate that each future analysis of the economic effects of a critical-habitat designation should acknowledge that the designation is likely to have multiple effects: on multiple industries, on multiple components of economic welfare, on multiple communities and regions, and over multiple years. The analysis should explicitly examine the potential impact on the actual and perceived quality of life in the local area. To reflect the economy's dynamic character, the analysis should look at a sufficiently long period of time to show how it will respond to the economic signals described in Figure 1-1.

Regarding the *mechanics of the analysis,* the guidelines demonstrate that an analysis of the economic effects of a critical-habitat designation must look at the impact on prices and markets, *i.e.*, it must describe the price changes that will occur because of the designation as well as the response of the relevant market to each price change. The analysis similarly should examine the effects on goods and services not traded in markets, looking at how different relevant groups are likely to respond to changes in the demand for or supply of these goods and services. To assess the economic effects attributable solely to the designation, the analysis should compare and contrast two projections, one with and the other without the designation, taking into account the major sectoral trends, cyclical conditions, and public policies that provide the backdrop for the economy's response to the designation, *per se.* For each analytical tool it employs, the analysis should identify the assumptions underlying the tool and demonstrate that it has used the tool consistent with them.

Regarding the *interpretation of the analytical findings*, the guidelines indicate that the analysis should look at the impacts on both fairness and national economic welfare, showing as clearly as possible the distribution of costs and benefits among different groups. Given the potentially complex roles of habitat in the local, regional and national economies, the analysis should clearly set itself apart from studies of the economic costs of habitat protection that ignore its benefits, or the reverse; such studies should be seen as analytical incompetence, biased propaganda, or both. The analysis of the net effect on the national economic welfare should candidly acknowledge the uncertainties stemming from incomplete data and from market distortions, such as subsidies, spillover effects, taxes, and governmental regulations. The analysis also should be explicit about who holds what property rights affected by the designation. Given the ambiguous nature of the property rights associated with threatened or endangered species and their habitat, the analysis should carefully describe who holds what property rights or, short of that, what such ambiguity does to the results.

Chapter 2 Step 1: Estimate the Initial Effects



Each future analysis of the economic effects of a critical-habitat designation should describe the designation's initial stimulus to the economy; the scope of the individuals, firms, and communities that will initially feel this stimulus; and the major economic forces that will influence the dispersal of effects throughout the local, regional, and national economies.

Figure 2-1: Guidelines for Estimating the Initial Effects, Prior to Changes in Prices

Guideline #1: Describe each group with a significant, immediate, economic interest in the designation:

- Groups likely to incur significant costs from restrictions on habitat-degrading activity.
- Groups likely to realize significant benefits from restrictions on habitat-degrading activity.
- Groups that see actions to protect habitat as a significant change in the local quality of life.
- Groups that assign a significant intrinsic value to the habitat and the species dependent on it.

Guideline #2: Describe the economic forces that will influence each group's response to the change in status:

- National, regional, local trends.
- Quality of life.
- Trends within each industrial sector.

Guideline #3: Describe the relevant markets where significant responses to changes in prices will manifest themselves.

When the Service designates critical habitat for a listed species it sends economic signals to the many parties with an economic interest in the management of the habitat, telling them that habitat-degrading activities will be restricted. (The process by which the economy responds to these signals is described in Chapter 1 and represented schematically in Figure 1-1.) The economic signals cause an initial change in the economic status of each party. To those who would engage in habitat-degrading activities, the designation signals reduced demand, but to those who compete with habitat-degrading firms, it signals increased demand. To each industry that incurs spillover costs from habitat-degradation, it signals a reduction in these costs. To those sensitive to the contribution of habitat to the local quality of life, it signals an increase in this contribution. To those who place an intrinsic value on the habitat and the species associated with it, the designation signals an increase in the probability that habitat and species will persist.

In effect, these signals represent potential changes in the incomes of workers, the profits of firms, and the value of the assets of firms, households, and governments. Taken together, these signals plus the associated potential changes in incomes, profits, and asset values constitute the designation's initial economic effects. It is important to

recognize that these initial effects are the beginning, not the end, of the story and, hence, in this first step of the analysis, we focus on setting the stage for completing the story, using the guidelines shown in Figure 2-1.

Past analyses have focused on the stimulus to a single group, those who will incur initial costs from curtailment of the habitat-degrading industry. With future designations the Service should continue to describe the effects on this group, which tends to be visible and vocal, and, at the same time and insofar as possible, it also should describe the effects on other groups, who are less visible and vocal but have a commensurate economic interest in the designation. These groups typically are found in other sectors of the regional economy or in other regions. In short, it should identify each group with an essential economic interest in the designation, *i.e.*, each group that can anticipate a change in income, profit, or asset value simultaneous with or shortly following the designation, and estimate the expected magnitude of the potential change in the group's economic status.

Identifying all groups with an immediate economic interest in the designation, rather than focusing solely on one group, can help cement the notion that a designation has *multiple* economic effects.[5] As it describes the effects on, say, the land-developers on one side of town whose activities will be curtailed by the designation of critical habitat, the Service also should describe the effects on developers on the other side of town who will see increased demand for their services, as well as the effects on the landlords of existing housing in the neighboring town, who similarly will see an increase in demand.

To develop a better understanding of the potential change in income, profit, or asset value for each group, the Service should describe the economic setting within which this change will occur, isolating the designation's impact from those of other economic forces and factors. For each group the Service should describe (1) the market for the goods or services it buys or sells, and (2) the major secular and cyclical forces influencing this market. If the designation will affect workers in the local habitat-degrading industry, the description of this group should include a discussion of the local labor market and the forces that, with or without the designation, will affect the workers' ability to maintain their current wages and benefits. If the designation will affect the local residential property market, the description should include a discussion of the underlying trends in market housing prices and assess the extent to which the designation will impede, reinforce, or remain independent of these trends. The description similarly should assess the forces and

[5]Although it is analytically useful in this context to talk of separate groups whose members share common interests, one should bear in mind that this simplification overlooks the likelihood that at least some individuals hold interests characteristic of different groups. Some workers in a habitat-degrading industry also may place a high intrinsic value on the protection of habitat, for example.

trends associated with the markets for other goods or services, if any, affected by the designation.

The set of relevant markets, and their characteristics, may vary from designation to designation. In general, though, each analysis of economic effects should describe each relevant market so the Service and the public readily can see whether or not, for every party incurring a cost from a designation, there is another party positioned in the market to realize an offsetting benefit, more or less. This market description should place the initial impacts on local groups in the context of major regional and national trends influencing the rate of change in population, jobs, industry mix, income, and quality of life. It also should place the impact on local groups in the context of related impacts on other groups elsewhere.

In the following two sections we discuss two important issues that are likely to surface in the analysis of initial effects. The first is the applicability of the three analytical tools that commonly have been used to estimate the economic effects of actions to protect habitat. The second is the potential role quality of life may play in the economy's response to these actions.

A. Analytical Tools

There are three commonly employed analytical tools for describing the distribution of the initial, local effects among different industrial sectors: input-output models, simple fractions, and economic-base models. A full discussion of how and when to apply these models, which were developed for other purposes, to the protection of species and habitat would be a useful exercise, but it lies outside the scope of this effort. We do have some general observations, however.

We recommend the Service rely primarily on input-output models for estimating the distribution of initial, local effects among different industrial sectors, taking care to interpret the results strictly in accordance with the theory underlying this technique.[6] It is especially important to acknowledge that input-output models can show only the initial, potential effects of a designation, under strict assumptions about

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[6]There are many formulations of input-output models. For a discussion of the relative merits of some of the formulations, *see* M.H. Robison, J.R. Hamilton, K.P. Connaughton, N. Meyer, and R. Coupal. "Spatial Diffusion of Economic Impacts and Development Benefits in Hierarchically Structured Trade Regions: An Empirical Application of Central Place-Based Input-Output Analysis." *Review of Regional Studies*. Volume 23, No. 3. (forthcoming). Also, *see* H.M. Borgen and S.C. Cooke. *A Comparison of IMPLAN (Version 2.0) and RIMSII Income Multipliers for the State of Idaho*. Monograph. Department of Agricultural Economics and Rural Sociology, University of Idaho.

the relationships between different sectors. They do not show the designation's effects on prices and, hence, cannot yield reliable, extensive conclusions about how the economy will respond to these price-effects. Any attempt to derive long-run effects from an input-output model necessarily rests on some powerful assumptions that may contradict the theoretical foundation underlying the model, itself. It is incumbent on the analyst to define and justify any use of an input-output model to yield anything more than a description of the immediate effects on the extended family associated with a particular industry affected by a designation, and the Service should be skeptical of such efforts.

The simple-fractions technique entails estimating the percentage of the habitat-related raw material for a local industry that will be affected by a designation and applying this percentage to all related economic activity. Using this approach one would conclude that if, say, a designation of critical habitat would reduce the amount of irrigation water that can be taken from a river by 50 percent, then all related output, employment, and income would fall by the same percentage. In general one should not expect such conclusions to be valid and, hence, we generally discourage the use of the simple-fractions approach.

We also discourage the use of economic-base models to describe the initial effects of a critical-habitat designation, because the technique is so easily misapplied. At its heart, an economic-base model assumes a local economy has two types of industries: the basic industries form the foundation for the economy and support the non-basic industries. According to the model, actions that restrict a basic industry have multiple ramifications throughout the non-basic sector, but, in contrast, restrictions on a non-basic industry do not harm the local economy's underlying strength and structure.

In a typical application, the non-basic sector includes services – such as education, banking, public transportation, and advertising – that rest on the basic shoulders of manufacturing. This reasoning is simple and seductive, but it overlooks the role of these non-basic services in the economic-development process. Consider this observation by Wilbur Thompson, an urban and regional economist, from nearly 25 years ago:

> "... all products wax and wane, and so the long-range viability of any area must ultimately rest on its capacity to invent and/or innovate or otherwise acquire new export bases. The economic base on the larger metropolitan area is, then, the creativity of its universities and research parks, the sophistication of its engineering firms and financial institutions, the persuasiveness of its public relations and advertising agencies, the flexibility of its transportation networks and utility systems, and all other dimensions of infrastructure that facilitate the quick and orderly transfer from old dying bases to new growing ones."[7]

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[7]Wilbur R. Thompson. "Internal and External Factors in the Development of Urban Economies." in Perloff and Wingo (eds), *Issues in Urban Economics*. 1968. Resources for the Future.

If this reasoning accurately describes the process of economic development, and we believe it does, then the usual distinction between basic and non-basic, the underpinning of the economic-base model, becomes misleading when used to explain the evolution of a local economy over time. In a dynamic economy characterized by rapid changes in production processes and consumer demands, it is not the school that rests on the shoulders of the mill, but the other way around, for no enterprise, manufacturing or otherwise, and no local economy can prosper for long with a poorly-educated workforce. This example illustrates the difficulty in defining the basic and non-basic sectors appropriately. This difficulty renders the economic-base model susceptible to misuse and even chicanery, with analysts assuming their favorite industry, often one that entails habitat degradation, forms the base of a local economy and then using the model to confirm its importance. Not all analysts fall into this category, of course, and the model can yield some useful insights, in some contexts and when applied with rigorous attention to the assumptions underlying it. Given its history of misapplication, however, we recommend the Service generally forgo the use of this model outside of the limited context we describe in the next chapter.

B. QUALITY OF LIFE IS AN IMPORTANT ELEMENT OF EVERY LOCAL ECONOMY

Most economic-impact analyses are structured around the array of manufacturing and service-producing industries that commonly are used to depict the structure of a local, regional, or national economy. These industries are not the only components of an economy, however. A local economy consists of its industries *plus* the area's quality of life.

An area's quality of life comprises the various location-specific benefits and costs individuals enjoy or endure by living in the area. The benefits include access to social, cultural, and environmental amenities, such as scenic vistas and clean, free-flowing streams, that are not as readily available elsewhere.[8] The costs include exposure to social, cultural, and environmental disamenities, such as scarred, barren landscapes and sterile streams, in excess of what one finds elsewhere. The net quality-of-life benefits, assuming they are positive, are analogous to a second paycheck each resident receives, supplementing the first paycheck one receives from an employer or other source of income, so that

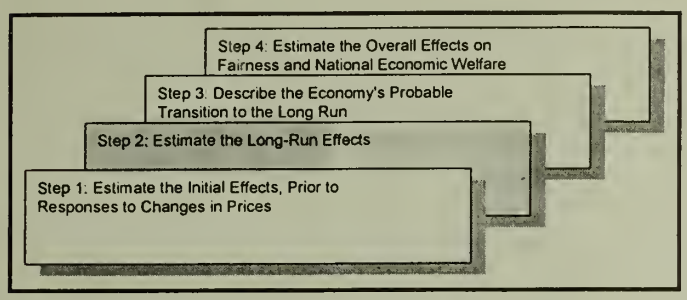
[8]To facilitate the exposition, we focus our discussion on those aspects of an area's quality of life associated with the area's natural-resource amenities. One should be fully aware, however, that quality of life can have many components, including: the sense of community; the quality of educational institutions; the sense of physical and psychological safety; the safety of working conditions; the availability of vocational and avocational opportunities; the degree of local control over local social, cultural, and economic decisions; and the degree of social, cultural, and economic differentiation.

the sum of the first and second paychecks determines the overall standard of living for the area's residents.

Through their impact on local quality of life, actions to protect species and habitat can have an initial effect on the economic welfare of local residents by changing the expected future value of the second paycheck, the expected future value of the first paycheck, or both. Changes in the environmental-amenity aspect of the expected future value of an area's second paycheck occur to the extent that greater protection of a species and its habitat reassures local residents that they will have greater access than they otherwise would have to the various environmental amenities derived from the habitat. Curtailing actions that degrade a river's riparian habitat, for example, might increase the amenities available to residents of a city downstream by reducing the level of toxic compounds and turbidity. Changes in the expected future value of the first paycheck occur to the extent that protection of the species and habitat is likely to induce changes in local job opportunities by influencing the geographic distribution of workers, consumers, and firms. This would occur, to continue the example, if the cleaner river induced families and firms to locate in the adjacent urban center rather than in the suburbs or in other cities.

We discuss the potential interaction between quality of life and economic structure in more detail in the following chapters.

Step 2:
Chapter 3 Estimate the Long-Run Effects



The analysis of the long-run effects of actions to protect habitat should be based on a comparison of two projections of the economy's future, one with and the other without the designation. The comparison should show the concurrent effects of all significant changes in prices and quantities occasioned by the designation, including the priceeffects that manifest themselves through changes in the area's quality of life. Each projection should include the industries and communities that will incur costs from the curtailment of habitat-degrading activities, those that will receive benefits from this curtailment, and those that will be affected by the designation's impact on the area's quality of life. The comparison should identify significant changes in price occasioned by the designation, demonstrate the economy's likely response to each price change, and discuss the reasonableness of the evidence and assumptions underlying the analysis.

Figure 3-1: Guidelines for Estimating the Long-Run Economic Effects

Guideline #4: Project future economic conditions with and without the proposed designation of critical habitat, using the model described in this chapter, or a substitute method that embodies similar logic and techniques.

Guideline #5: Examine the concurrent effects on the habitat-degrading industry, the industries that incur spillover costs from habitat degradation, and the area's quality of life.

Guideline #6: Focus on changes in prices and their consequences.

Guideline #7: Identify key assumptions and show how alternative assumptions affect the analysis.

One of the messages from this report is that the designation of a critical habitat affects a regional economy in many complex ways. A designation is likely to have direct effects on several sectors of the economy and indirect or secondary effects on many other sectors. For example, protecting spotted-owl habitat has direct effects on the wood-products industry, the fishing industry, the tourist industry, and industries whose workers value access to old-growth forests, as well as indirect effects on many other industries. In the absence of time and budgetary constraints, the appropriate model for projecting the regional effects of habitat designation is a general-equilibrium model of the regional economy. A general-equilibrium model incorporates the interactions among dozens of sectors of the regional economy, so it would capture all the direct and indirect effects, no matter how small, of a designation. At the heart of the general-equilibrium model are the prices of the region's inputs and outputs; for general equilibrium, these prices adjust to guarantee that all markets reach equilibrium (supply equals demand) simultaneously. In principle, one could use a general-

equilibrium model to project the effects of a habitat designation on the prices and quantities of all the sectors in a regional economy.

Unfortunately, a general-equilibrium model is impractical. As an alternative, we propose a multi-sector model of the regional economy. The multi-sector model differs from a general-equilibrium model in several ways. First, rather than modelling the entire regional economy, with dozens of sectors, the multi-sector approach identifies and studies a few key sectors that will experience significant effects from a habitat designation. Second, the multi-sector model does not capture the interactions among these key sectors of the economy, but instead adds up the effects across the key sectors. Third, the multi-sector model typically does not project all the characteristics of each key sector, but instead focuses on a single characteristic, often total employment. Fourth, the multi-sector model does not explore the spillover effects of the designation, i.e., the effects on people outside the region.

What are the advantages of the multi-sector approach? First, in contrast with the general-equilibrium approach, the multi-sector approach is feasible. Second, the multi-sector approach incorporates many effects of habitat designation that are ignored by the traditional, single-sector approach. The most important insight from the multi-sector approach is that the employment losses in one sector may be partly or fully offset by employment gains in other sectors. Third, in contrast with the traditional approach, the multi-sector approach explores the effects of a designation on the prices of inputs and outputs and the consequences of these price changes for the quantities of inputs and outputs, so it provides a more realistic representation of the regional economy.

In this chapter, we assemble the relevant pieces of analysis into a multi-sector model for estimating the long-run effects on the local or regional economy of an action to protect a species and its habitat. The model is based on the general guidelines shown in Figure 3-1. If adequate data are available, the model is capable of yielding reliable estimates of a designation's long-run effects on many variables within the local or regional economy, including: prices, production cost, industrial output, employment, wage level, income, quality of life, and cost of living. The general logic of the model applies to all designations, even when there are insufficient data or the scope of the designation is too small to support a full-blown application of the model. In such cases the Service should identify each of the key variables in the model and make one or more reasonable assumptions about its magnitude, reflecting the characteristics of the market for the good or service at issue.

No operational multi-regional model, analogous to the local-regional model we describe, exists for estimating a designation's full long-run effects beyond the local or regional area. For the timber industry and a few others there exist industry-specific models for estimating the inter-regional effects. To estimate the inter-regional effects on other

industries, including industries sensitive to changes in quality of life, the Service may have no choice but to rely on the informed judgment of its analysts.

In the remainder of this chapter we describe the multi-sector model for projecting the multiple, long-run employment effects within the local or regional area of a critical-habitat designation. The model addresses the interactive, multiple effects of curtailing the activities of a habitat-degrading industry, relieving other industries, including tourism, of the spillover costs of habitat degradation, and enhancing the habitat's contribution to the area's quality of life. The model is designed for critical-habitat designations that have either small or large effects on the relevant industries and, although it focuses on employment effects it also measures a designation's effects on production costs, prices, output, quality of life, and cost-of living. The components of our presentation include a discussion of the logic underlying the model, a description of the model's important variables, and illustrations of the data and assumptions one might employ to estimate the magnitude of each variable.

In Section A of this chapter we discuss several problems with the conventional, naive interpretation of traditional models of regional economic growth. In Section B we explain the methods we recommend for projecting future economic conditions in the area's economy *without* a critical-habitat designation. In the next two sections we explain the methods we recommend for projecting conditions *with* the designation, focusing on export industries that use the natural-resource inputs affected by the designation (Section C), and on the perceived quality of life (Section D). In Section E we demonstrate how to aggregate the effects of the habitat policy on the various sectors of the economy. In Section F we identify some additional potential long-run effects of a critical-habitat designation.

A. Problems with Naive Models of Regional Growth

The traditional approach to modeling a regional economy divides the economy into two sectors, the export sector and the local sector. The export sector is defined as the set of activities that produces goods and services sold to buyers outside the region; in contrast, the local sector produces goods and services for sale within the region. The export sector brings in money from the outside that is spent and respent on local goods. According to the naive interpretation of traditional regional economic models, the export sector is the "economic base" that "supports" the local sector, and the fate of the region's economy is in the hands of outsiders: the only way the welfare of local residents improves is if outsiders buy more of the region's exports.

The naive interpretation errs when it overlooks the importance of local economic conditions, the local sector, and local decisions. It overlooks the importance of local economic conditions when it assumes that an increase in revenues from the sale of exports is the only way to increase the welfare of local residents, ignoring the contribution of local natural-resource, social, and cultural amenities, collectively labeled the local quality of life. All else remaining unchanged, the welfare of local residents increases if, say, an improvement in riparian habitat makes the river water flowing through the middle of town less toxic, less murky, and less susceptible to flooding. A quality-of-life improvement also can affect the export sector itself. If the changes in the river stemming from the improvement in riparian habitat make the town more attractive to workers and their families, an export firm will be able either to hire more productive workers at the same wage or to hire equally productive workers at a lower wage, and the resulting decrease in unit labor costs will allow the firm to decrease its price, sell more of its product, and increase the amount of export-derived money through the economy.

The naive interpretation overlooks the importance of the local economic sector when it ignores the ability of this sector to contribute directly and indirectly to the welfare of local residents. For example, an improvement in the efficiency of the local sector — schools, roads, telecommunications, bakeries, etc. — directly increases welfare by giving local residents the same products at a lower cost or better products at the same cost. It similarly can lower the cost of locally-produced inputs for an exporting firm, increasing productivity and leading to increases in output, employment, and net revenues for the export sector.

Local actions, either public or private, can stimulate greater efficiency in the local sector in any number of ways: through cost-effective improvements in schools and roads; rational management of land use, or enhancement of the local quality of life. Quality-of-life enhancements entail increasing the consumer surplus residents enjoy from natural-resource, cultural, and social amenities. The increase in consumer surplus represents a direct increase in the residents' welfare; it also can make workers more willing to accept lower wages, thus increasing the competitiveness of export firms in national and world markets.

The local sector also can improve local welfare by displacing imports. A decrease in imports is equivalent to an increase in exports; a decrease in the flow of money out of the region is equivalent to an increase in the flow of money into the region. Local policies and actions that decrease the cost of producing goods within the region decreases local prices, causing consumers to substitute local goods for imports. This import substitution decreases the flow of money outside the economy and stimulates employment in the same way as an increase in exports.

This discussion highlights the importance of local decisions as a determinant of local welfare. With its focus on the export sector and its

assumption that a change in the export sector will have ramifications in the local sector but not the other way around, the naive interpretation of traditional regional economic models overlooks the importance of these decisions and incorrectly concludes that the fate of the economy is determined solely by people outside the region. Hence, it fails to appreciate the multiple ways in which an action, such as the protection of habitat, can affect the local or regional economy. It fails to see that if habitat protection improves the area's perceived quality of life and attracts people who work in local industries, unit labor costs and the prices of local goods — the local cost of living — should decline. The decrease in the cost of living should lower the wages export workers demand to maintain a given standard of living, decreasing the production costs of exporters and enabling them to increase output and employment.

The model we recommend corrects the problems associated with the naive interpretation of regional economic models. We consider the effects of changes in local conditions, *e.g.*, improvement in the perceived quality of life, on the export sector. In addition, we allow import substitution in response to changes in local prices. Finally, we explore the effects of changes in the local economy on the production costs, prices, output, and employment in the export sector.

We adopt the convention of separating the area's economy into two sectors, export and local, because doing so allows us to refer to and incorporate in our model various conventional tools, such as the econometric models others have developed for individual states and metropolitan areas. We do so reluctantly, fearing that, by using the distinction between the two sectors, readers will conclude that we endorse the view that the export sector is the "base" that "supports" the local sector. By adopting the convention, however, we are *not* adopting this naive interpretation of how regional economies function. Indeed, the point of this exercise is to explicate a practical alternative to this interpretation, to provide the Service with a model it can use to avoid the pitfalls and misleading conclusions this interpretation invariably yields.

B. Projecting Total Employment Without Designation

In this section, we explain how to project total employment in the absence of a critical-habitat designation. To project employment, we assume that a number of factors that affect employment in export sectors are held constant, including the perceived quality of life in the region, the quality and quantity of local public services, and the relative price of local goods. Therefore, the projected changes over time in the export sector result from changes in the underlying demand for the region's export goods. Later in the chapter, we explain how changes in the quality of life and local prices affect both the export and local sectors.

The projection of total employment in the absence of a habitat designation requires four steps. This section is divided into four subsections, one for each of these steps.

1. Project export employment for each export industry.
2. Project the changes in local employment attributable to each export industry.
3. Project the changes in local employment attributable to changes in the number and total income of non-workers, *i.e.*, persons, such as retirees, transfer recipients, and commuters, who do not work in the local area.
4. Calculate the change in total employment, which equals the sum of the changes in export employment, export-related local employment, and local employment related to non-workers.

B.1 Export Employment

The first step in projecting a county's export employment is to determine the current employment in different export industries. In a world with perfect information, we would determine, for each industry (each SIC), how many workers produce for export (for sale outside the county) and how many produce for local consumption (for sale within the county). In some counties, there may be sufficient data to accurately estimate export employment by SIC. In other counties, it will be necessary to use general rules of thumb to divide each industry's total employment into export and local employment.

The second step in projecting export employment is to specify a growth rate for each export industry in the county. In most counties, projected growth rates by industry will not be available. An alternative approach is to use the projected growth rates for the state's economy. The state of Oregon, for example, uses the Oregon Economic Model to predict statewide growth rates for each export industry. The predicted growth rates vary across industries, reflecting changes in the underlying structure of the economy. For example, the statewide model predicts rapid employment growth in electric and nonelectrical machinery, but slow growth in food and kindred products, and declines in lumber and wood products.

Table 3-1 shows a hypothetical example of projecting export employment. Column B shows the current (1992) employment for each industry, and Column C shows the assumed growth rates for each industry. Column D shows predicted employment in 1993, and Column E shows the predicted changes in export employment. Although Table 3-1 shows a one-year projection, the same exercise could be repeated for any period over which the relevant state economic model has generated predicted growth rates. For example, the most recent run of the

statewide model for Oregon predicts growth rates up through 1997, so this exercise could be repeated for the years 1994 through 1997.

Table 3-1: Projecting Export and Local Employment Attributable to Exports

	Employment							
Industry	1992	Growth Rate	1993	Predicted Change	Local Employ't Multiplier	Change in Local Emp't	Total Employ't Multiplier	Change in Total Emp't
Lumber & Wood Products	2,000	-0.010	1,980	-20	0.50	-10	1.50	-30
Electrical Machinery	1,600	0.030	1,648	48	0.50	24	1.50	72
Fishing & Fish Processing	600	0.010	606	6	0.50	3	1.50	9
Cattle Raising	400	0.010	404	4	0.50	2	1.50	6
Total	4,600	-0.004	4,638	-20		-10		-30

B.2 Local Employment Attributable to Export Employment

The local sector is defined as the activities that sell goods to people within the county. The more money brought into the economy from the export sector, the larger the spending on local goods and thus the greater the total employment in the local sector. To explain, suppose that export employment increases by 100 jobs, and that the extra workers spend $1.5 million per year on goods provided by local merchants, *e.g.*, haircuts and restaurant meals. Local merchants respond by hiring more workers (more barbers and cooks), who in turn spend a fraction of their income on local goods, causing further increases in local employment. The spending and respending of money means that the increase in export employment increases total employment by more than 100 jobs.

The relationship between export and local employment is summarized in employment multipliers. The total multiplier shows the change in total employment for each additional export job, and the local employment multiplier, equal to 1 less the total multiplier, shows the change in local employment per additional export job. For example, if the total multiplier is 2.5, the local multiplier is 1.5. In this case, each additional export job supports 1.50 local jobs, so total employment increases by 2.5 jobs for every additional export job. In our model, we must specify an employment multiplier for each export industry.

The data required to compute employment multipliers can come from several sources. Among the projection models that generate multipliers are [i] econometric models, [ii] input-output models, and [iii]

export base models. If a county has recently estimated and calibrated one of these models, we could draw the multipliers from the county's model, although we generally advise against using multipliers derived from an economic-base model because such models so often are incorrectly specified. Alternatively, we could use the employment multipliers from other counties that are similar in size and structure.

Table 1 shows a hypothetical example of the projected changes in local employment. Column E shows the predicted changes in export employment, and Columns F and H show the assumed employment multipliers (total and local). Column G shows the predicted changes in local employment resulting from the changes in export employment, equal to the change in export employment times the local multiplier. For example, if the local multiplier for lumber and wood products is 0.50, the loss of 38 jobs in lumber and wood products decreases local employment by 19 jobs. The last column, I, shows the predicted changes in total employment resulting from the changes in export employment. The change in total employment can be computed by either summing the changes in export and local employment (Columns E and G) or by multiplying the change in export employment (Column E) by the total multiplier (Column H).

B.3 Local Employment Attributable to Income of Non-Workers

Like workers in the export sector, non-workers who live in the region support jobs in local industries. For example, an increase in the total income of a county's retirees increases spending on local goods, increasing local employment. Similarly, an increase in the income of transfer recipients or of commuters who reside locally but work elsewhere increases local spending and employment. This section explains how to translate changes in the number of non-workers into changes in local employment. There are three steps in the process.

The first step in projecting local employment attributable to non-workers is to project total non-worker income. Given an estimate of current (1992) non-worker income (the current number of non-workers in the county times the average income per non-worker), and assuming that the average income is fixed, we can use the predicted growth rate of the number of non-workers to predict total non-worker income in some future year, *e.g.*, 1993.

The second step is to predict the changes in local income precipitated by changes in non-worker income. The relationship between non-worker income and local income is summarized in the local income multiplier, defined as the change in local income per additional dollar of income from outside the area. The data required to compute the income multiplier can come from an econometric model, an input-output model, or an export base model. If a county has recently estimated and calibrated one of

these models, we could draw the multipliers from the county's model. An alternative approach is to use the multipliers from a statewide model, *e.g.*, the Oregon Economic Model, as an upper bound on the county multiplier. The smaller the county, the smaller the fraction of income spent within the local economy, so the smaller the income multiplier. For example if, the local income multiplier is 0.40, every dollar of non-worker income increases local income by $0.40.

The third step is to translate the change in local income into a change in local employment. For this step, we need data to estimate the income per local job. For example, if income per local job is $20,000, local employment increases by 50 jobs per million dollars of local income.

B.4 Compute Total Employment

Total employment is the sum of export and local employment. Local employment is the sum of local jobs attributable to export employment and local jobs attributable to the income of non-workers. The predicted change in total employment is the sum of the changes in export employment, export-based local employment, and local employment related to the income of non-workers.

C. Industries Dependent on Controlled Natural Resources

This section explains the effects of critical-habitat designation on export industries that employ the natural-resource inputs that are directly affected by the designation. We describe two different models, with different assumptions about how large an effect the designation has on the export market and the local economy.

C.1. Fixed Output Prices

Consider first a habitat policy that has a relatively small effect on the availability of natural resources for the relevant export industries. The model has four key assumptions.

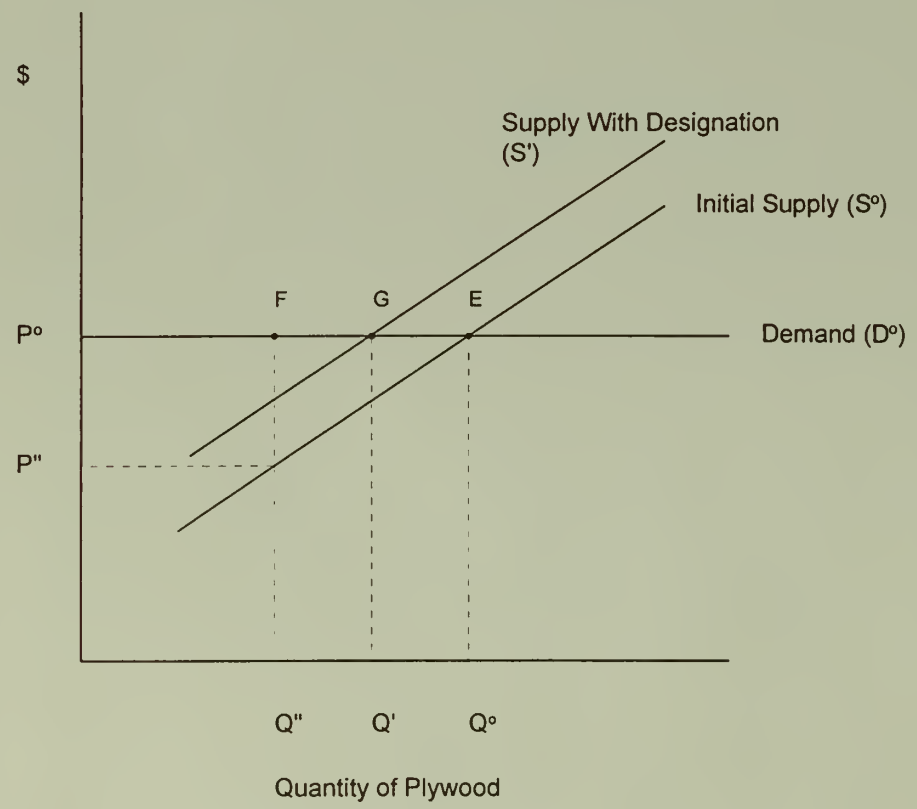
1. The prices of the county's export goods are fixed, i.e., they are not affected by the habitat policy.
2. The price of land is endogenous, i.e., the price of land increases with the level of economic activity in the county.
3. Production occurs with fixed factor proportions: for each export good, there is a fixed amount of each input (labor, capital, raw materials).

4. Capital and labor are perfectly mobile. In other words, the model is a long-run model, where the long run is defined as a period long enough that all resources are perfectly mobile.

The first assumption is appropriate if the critical-habitat designation has a relatively small effect on the quantity of natural-resources inputs used by a particular export industry. For example, the designation of a watershed as critical habitat to protect a fish may decrease the acreage available for grazing cattle, decreasing the national supply of cattle. If the watershed supplies a tiny fraction of the nation's supply of cattle, it is appropriate to assume that the decrease in the supply of cattle from the watershed will not affect the national price of beef.

The assumption of a fixed export price means that the demand curve facing the county's firms is horizontal. In Figure 3-2, the demand curve for plywood is horizontal: the county's exporters can sell all they want at the national (or world) price of plywood, and will sell nothing if they charge a higher price.

Figure 3-2: Habitat Policy and the Plywood Market, Fixed Plywood Price and Variable Land Costs



The second assumption generates a positively sloped supply curve for export goods. If the land price is endogenous, an increase in the size of the export sector (more output and total employment) increases the demand for land within the county, increasing its price. The increase in commercial land prices increases the production costs of the export sector. In addition, workers will demand higher wages to offset higher housing and land costs, so wages also increase with total output. Since the supply curve is a marginal-cost curve, increasing land prices – and increasing wages – mean that the supply curve is positively sloped. In

other words, the scarcity of land generates a positively sloped labor-supply curve and thus a positively sloped supply curve for the export good. The positively sloped supply curve is shown in Figure 3-2.

A habitat policy that decreases the quantity of natural-resource inputs available within the county decreases the equilibrium output and number of workers in the industry. In Figure 3-2, suppose the habitat policy decreases the quantity of natural-resource inputs (timber) in the county to half of its former level. The decrease in the quantity of logs increases the price of local logs (logs harvested within the county) as firms bid up the price of the scarce resource. The increase in the f.o.b. log price increases the marginal cost of production and shifts the supply curve upward. The equilibrium moves from point E to point G: the price of plywood does not change because the habitat policy does not affect the national (or world) price, but the quantity produced decreases from Q° to Q'. Assuming that plywood is produced with fixed factor proportions, the decrease in employment is proportional to the decrease in output.

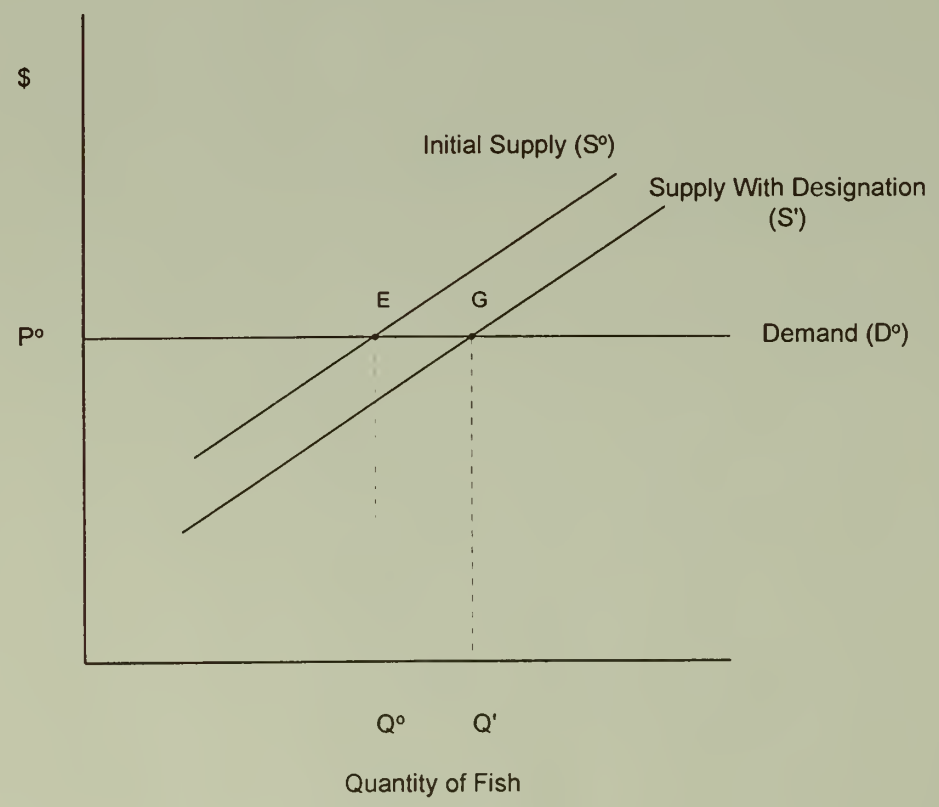
In Figure 3-2, the decrease in output and employment was about 25%, compared to a 50% decrease in the quantity of the natural-resource input. Why isn't point F (with a 50% reduction in output and employment) the new equilibrium? Point F is not an equilibrium if the price of land and the wage are endogenous. The shrinkage of the export industry decreases the demand for land as firms close plants and workers leave the city. The resulting decrease in the price of land decreases production costs directly (firms pay less for commercial land) and indirectly (given the lower price of housing and land, workers are just as well off with a lower nominal wage), causing movement downward along a given supply curve. From the original supply curve S°, marginal production cost at point F is only P", which is less than the fixed national price, so the county's plywood industry could profit by expanding output. As they do, they bid up the prices of labor, land, and the natural resources until equilibrium is restored at point G. The lesson from Figure 3-2 is that, in equilibrium, the decrease in quantity of output – and the decrease in the number of workers – is smaller than would be predicted under the assumption of fixed land and labor prices.

The results in Figure 3-2 may appear to be inconsistent with the assumption of fixed factor proportions. How can total output be greater than Q" if the habitat policy decreased the quantity of natural-resource inputs? The reason is that firms respond to the habitat policy by exploiting other sources of the natural-resource input. For example, if the quantity of federal timber available in a given county decreases, plywood mills in the county will substitute timber from private lands for the lost federal timber. In a market with rising marginal cost (positively sloped supply), this is possible even with a fixed output price because, given the decrease in the size of the local economy, land and labor prices are lower, so firms can pay higher prices for alternative sources of lumber and still make normal economic profit.

What data do we need to predict the change in the equilibrium output and employment? The vertical shift of the supply (marginal cost) curve is determined by [i] the decrease in the volume of timber harvested, [ii] the elasticity of the local log price with respect to the harvest rate (the percentage change in the price divided by the percentage change in the harvest rate), and [iii] the share of plywood costs attributable to logs. For example, suppose the habitat policy decreases the supply of logs by 100 million board feet per year, or 10% of the current harvest rate. If the elasticity of the log price is -0.60, the price of logs will increase by 6%. If logs are responsible for 20% of plywood costs, the marginal cost increases by 1.2%.

To relate the vertical shift of the supply curve to the horizontal shift (and the change in quantity), we need the slope of the supply curve, or the price elasticity of supply for plywood. The horizontal shift is inversely related to the slope (and the price elasticity of supply): if the slope equals 1.0, the horizontal shift equals the vertical shift; if the slope exceeds 1.0, the horizontal shift is less than the vertical shift. Given an estimate of the vertical shift and the price elasticity of supply, it is possible to estimate the change in output and employment.

Figure 3-3: Habitat Policy and the Fish Market, Fixed Fish Price and Variable Land Costs

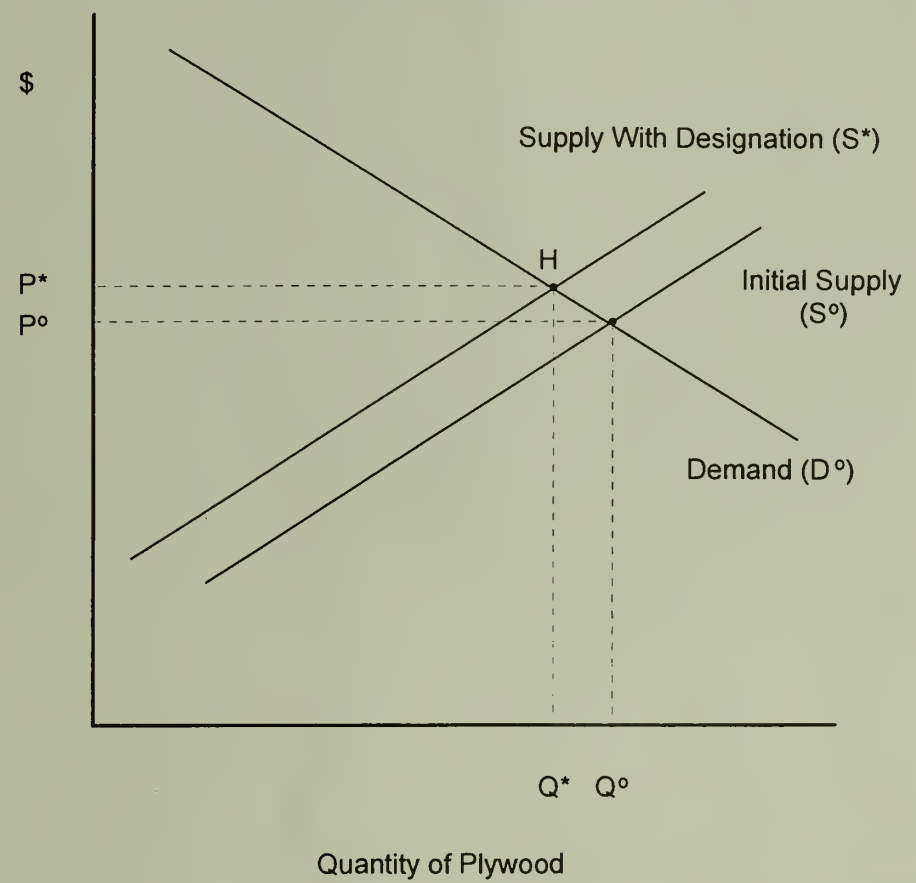


The same logic applies when the habitat policy increases the quantity of natural-resource inputs for an industry, *e.g.*, fishing. In Figure 3-3, the habitat policy shifts the supply curve to the right from S° to S', reflecting the change in the quantity of natural-resource inputs. If land and labor prices are endogenous, the percentage increase in output – and in the number of workers – is less than the percentage increase in the quantity of natural resources.

C.2. Endogenous Output Price

One way to change the model is to make the export price endogenous. Suppose that one of the region's export industries has a large share of the national market. For example, firms in the Pacific Northwest have a large share of the nation's plywood market. In this case, there is a negatively sloped demand for plywood, as shown in Figure 3-4. Given the positively sloped supply curve for plywood (assuming that land and other input prices increase with total output), the initial equilibrium price is P° and the equilibrium quantity is Q°.

Figure 3-4: Habitat Policy and the Plywood Market, Variable Plywood Price and Variable Land Costs



The habitat policy affects the plywood industry by decreasing the supply of logs and increasing the marginal cost of production. The increase in the price of logs increases the marginal cost of production, shifting the supply curve from S° to S*. A new equilibrium is restored with a higher plywood price (P* instead of P°) and a smaller quantity of plywood produced (Q* instead of Q°). If the amount of labor per unit of plywood is fixed, the percentage change in plywood employment equals the percentage change in the quantity of plywood produced.

The increase in the price of plywood mutes the employment effects of the habitat policy because firms substitute private timber for the timber previously harvested on federal lands. An increase in the plywood price means that it will be profitable to purchase timber from private lands and import timber from other regions, even if the price is higher than the pre-policy price of federal timber. The substitution of other timber partly

offsets the loss of federal timber, so total employment falls by a smaller amount.

In general, the habitat policy encourages the substitution of private timber for federal timber for two reasons. First, if the prices of labor and land are endogenous, the habitat policy decreases production costs (labor and land costs decrease as the local economy shrinks). Second, if the price of output is endogenous, the habitat policy increases the output price. Because unit costs are lower and price is higher, plywood firms can earn normal profits even if they pay higher prices for private timber.

What data do we need to predict the change in the equilibrium output and employment? As explained earlier, the vertical shift of the supply (marginal cost) curve is determined by [i] the decrease in the volume of federal timber harvested, [ii] the elasticity of the log price with respect to the harvest rate (the percentage change in the price divided by the percentage change in the harvest rate), and [iii] the share of plywood costs attributable to logs. To translate the vertical shift of the supply curve into a change in the equilibrium output, we need information on the price elasticity of supply and the price elasticity of demand for plywood.

The same logic applies to an industry that experiences an increase in the quantity of natural-resource inputs. The price of the input decreases, shifting the supply for the output from S' to S°, decreasing the equilibrium price and increasing the equilibrium quantity. To predict the employment and output effects, we need information on the vertical shift of the supply curve and the price elasticities of supply and demand.

C.3. Tiny Changes and No Price Effects

Consider a designation that has tiny effects on both the market for the export good and the local land market. If both of these effects are small, the shifts of the supply and demand curves in Figure 3-4 will be so small that the price effects will be negligible. In this case, the most sensible approach is to ignore the price effects.

In the absence of price effects, the prediction of the employment effects of a habitat policy is straightforward. The decrease in the quantity of the natural-resource input decreases output and employment. For example, if the habitat policy decreases the quantity of timber by 5 million board feet, output decreases by 5 times the output per million board feet of timber. Similarly, employment decreases by 5 times the number of jobs per million board feet, e.g., 5 times 7.0 is 35 jobs. Given the assumptions of fixed factor proportions and fixed input and output prices, the percentage change in the number of workers equals the percentage change in the quantity of the natural-resource input.

The same logic applies to an industry that gains natural-resource inputs as a result of the habitat policy, e.g., fishing. The habitat policy shifts increases output and employment: industry adds workers as it gains natural-resource inputs. Given the assumption of fixed factor proportions and fixed prices, the percentage change in workers equals the percentage change in the quantity of natural-resource inputs.

D. Habitat Policy and the Quality of Life

This section discusses the effects of a habitat-designation on the perceived quality of life and the implications of changes in the quality of life for employment in export and local industries.

D.1. Quality of Life and Export Industries

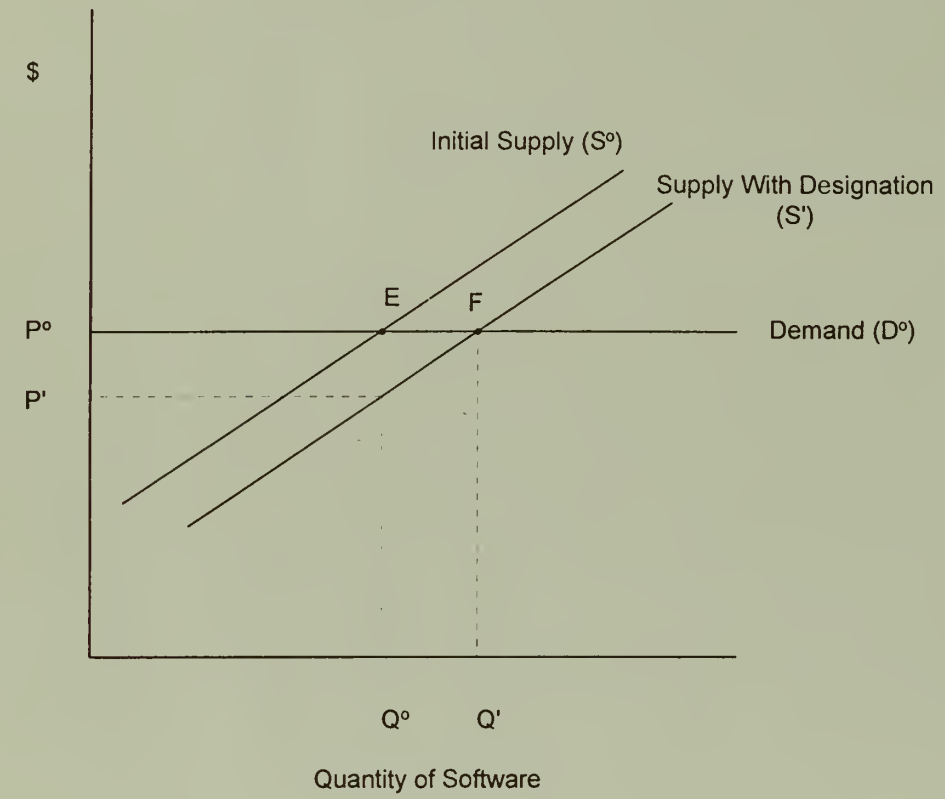
Consider first the effects of critical-habitat designation on export industries whose workers are sensitive to the quality of the natural environment. Suppose that the output price of a particular industry, *e.g.*, software, is fixed, meaning that the demand curve facing the county's industry is horizontal. In contrast, the prices of land and labor are endogenous, being determined by the size of the local economy.

Suppose that workers in the software industry are sensitive to the quality of the natural environment, and they migrate to regions with superior natural environments. Figure 3-5 shows the effects of the habitat policy under the assumption of endogenous land and labor prices. The supply curve is positively sloped because an increase in the size of the industry increases land and labor prices, increasing the marginal cost of production. The habitat policy increases the supply of software workers and decreases the equilibrium wage for a given size of the local economy (for a given land price). The decrease in the wage shifts the supply curve for software products to the right, from S° to S'. The equilibrium output increases from Q° to Q', and the equilibrium number of workers increases by the change in output (Q' - Q°) times the number of workers per unit of output.

What data are required to estimate the increase in output? The vertical shift of the supply curve equals the change in the marginal production cost generated by the lower wages in the more attractive county. The decrease in marginal cost equals the change in the equilibrium wage times labor's share of production costs. For example, if the wage decreases by 4% and labor is responsible for 75% of production cost, the marginal cost decreases by 3%. To relate the vertical shift to the horizontal shift, we need the slope of the supply curve, or the price elasticity of supply for software. To summarize, we need four pieces of data to estimate the change in software employment precipitated by an

improvement in the quality of life: [i] the percentage change in the perceived quality of life, [ii] the elasticity of the wage with respect to the quality of life, [iii] labor's share of production costs, and [iv] the price elasticity of supply for the final good.

Figure 3-5: Quality-of-Life Effects on the Software Market, Fixed Software Price and Variable Land Costs



Is it reasonable to assume that the changes in the perceived quality of life in a particular county will not affect the national prices of export goods? A habitat policy is unlikely to affect the national prices through its effects on the perceived quality of life for two reasons. First, any changes in labor supply will be spread over most or all the export sectors, so the labor stimulus to a particular sector will be relatively small. Second, if the county has a relatively small share of the national market for a particular good, the migration effects of the habitat policy are even smaller. The most sensible approach is to assume that the national prices are fixed.

D.2. Quality of Life and the Local Sector

Consider next the effects of the habitat policy on the sector of the economy that produces for local consumption. The model of the local sector has three key assumptions.

1. The demand curve for local goods is negatively sloped.
2. Production occurs with fixed factor proportions: for each output, there is a fixed amount of each input (labor, capital, raw materials).

3. Capital and labor are perfectly mobile.

These assumptions can be represented with a simple supply-demand model for the local sector. In Figure 3-6, the supply curve is positively sloped (reflecting increasing prices of land and labor as the economy grows), and the demand curve is negatively sloped.

Figure 3-6: Effects of Habitat Policy on the Supply of and Demand for Local Goods

Consider the effects of the habitat policy on the equilibrium price of local goods. If the habitat policy improves the perceived quality of life in the county or region, the migration of workers sensitive to natural amenities will decrease unit labor costs: firms will be able to hire equally productive workers at a lower wage or hire more productive workers at the same wage. In Figure 3-6, the decrease in the wage (or unit labor cost) decreases production costs, shifting the supply curve for local goods from S° to S'. As a result, the equilibrium price decreases and the equilibrium quantity of output increases. Although the migration of local workers increases the prices of housing and land, these changes are more than offset by decreases in local prices precipitated by decreases in local wages.

There are two employment effects associated with the increase in local labor supply. First, for a given number of export workers, the number of local workers increases. The decrease in the relative price of local goods (relative to imported goods) causes people in the county to spend a larger fraction of their income locally, so the local employment sector grows, even if the export sector does not change. In other words, the habitat policy promotes import substitution because it decreases the relative cost of local goods.

What data are required to predict the magnitude of the import-substitution effect? To predict the change in the equilibrium quantity of local goods, we need a prediction of the change in the local price and the price elasticity of demand for local goods. To predict the change in the local price, we need information on [i] the percentage change in the perceived quality of life, [ii] the elasticity of the wage with respect to the quality of life, [iii] labor's share of production costs, [iv] the price elasticity of supply for the local good, and [v] the price elasticity of demand for the local good. The first three pieces of information can be used to compute the vertical shift of the supply (marginal cost) curve, and the last two pieces of information is needed to translate the vertical shift into a change in the equilibrium price.

The second employment effect operates through the various industries in the export sector. The decrease in the cost of local goods decreases the local cost of living, increasing the real wages (nominal wages adjusted for local prices) of export workers in all industries. The migration of export workers increases employment in the export sector for reasons explained earlier. The implication is that export employment can increase even if export workers are insensitive to changes in natural amenities and the perceived quality of life, as long as local workers are sensitive to these characteristics.

D.3. Quality of Life and Tourism

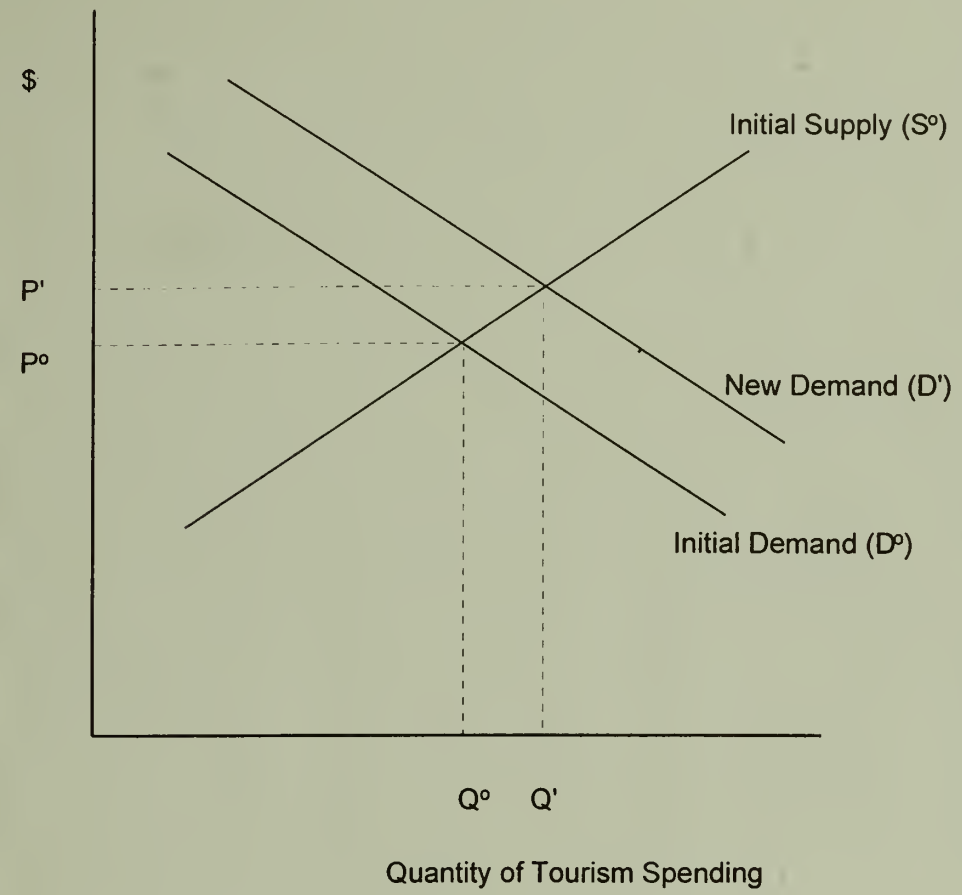
Consider next the effects of the habitat policy on the tourism industry. The model of the local sector has three key assumptions.

1. The demand curve for local goods is negatively sloped.
2. Production occurs with fixed factor proportions: for each output, there is a fixed amount of each input (labor, capital, raw materials).
3. Capital and labor are perfectly mobile.

These assumptions can be represented with a simple supply-demand model for the local sector. In Figure 3-7, the supply curve is positively sloped (reflecting increasing prices of land and labor as the economy grows), and the demand curve is negatively sloped.

If tourists are attracted by the natural environments protected by the habitat designation, the habitat policy shifts the demand curve for tourism from D° to D'. The equilibrium quantity of tourist spending increases from Q° to Q', and if factor proportions are fixed, total employment in the tourism industry increases by the same percentage amount.

Figure 3-7: Effects of Habitat Policy on the Supply of and Demand for Tourism



What information is required to predict the change in the equilibrium employment in the tourism industry? The magnitude of the shift in the demand curve is determined by the elasticity of export (as opposed to local) tourism spending with respect to the perceived quality of the natural environment. The magnitude of the change in quantity is determined by the price elasticity of demand (the slope of the demand curve) and the price elasticity of supply (the slope of the supply curve) for tourism.

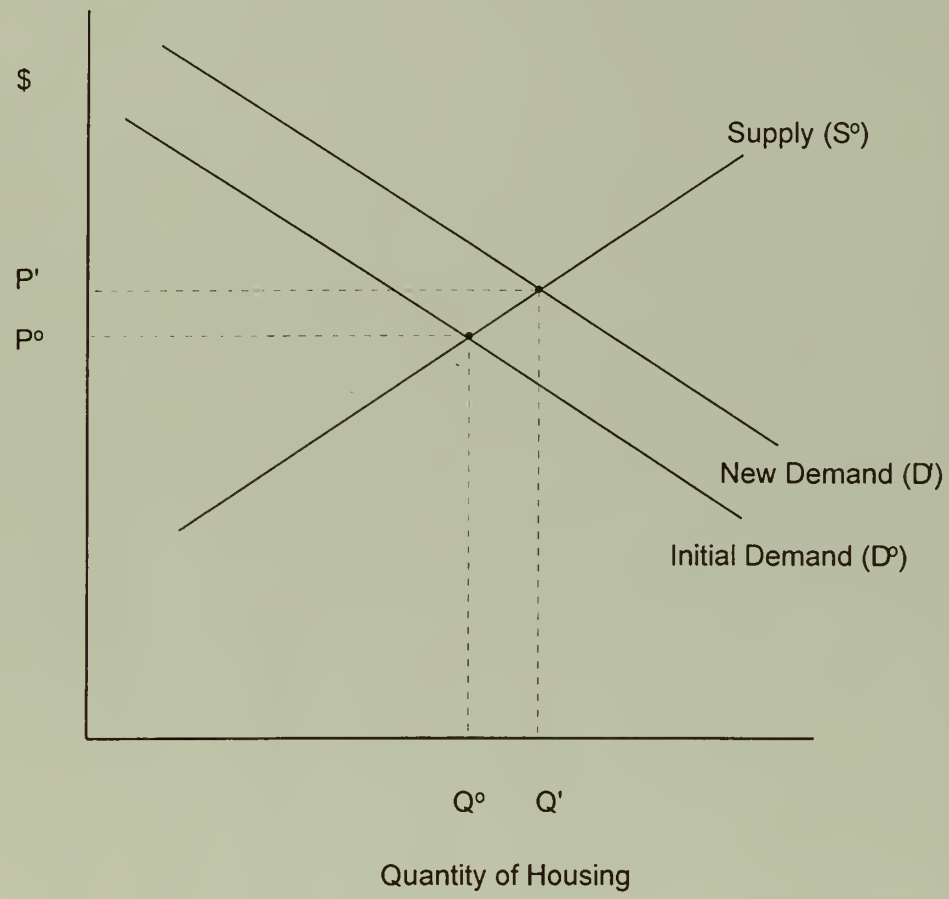
D.4. Quality of Life and the Income of Non-Workers

Another subtle effect of habitat-preservation is to increase the number and total income of non-workers residing in the county, such as retirees, recipients of transfer income, and commuters who work in another county. Like workers, non-workers are attracted to regions with low costs of living and plentiful natural amenities. As a result, a policy that preserves natural resources increases the number of non-workers because the policy decreases the cost of living (local workers accept lower wages) and improves the quality of life.

Figure 3-8 shows the effects of an improved quality of life on the demand for housing by non-workers. The improved quality of life attracts non-workers, shifting the demand curve to the right. The equilibrium

number of dwellings increases from Q° to Q' and the equilibrium price increases from P° to P'. The migration of non-workers is muted by the fact that as the population of the region grows, housing and land prices increase. The increase in housing and land costs partly offsets the decreases in the cost of living generated by lower local prices.

Figure 3-8: Effects of Habitat Policy on the Demand for Housing



What information is required to predict the change in the income of non-workers resulting from a habitat policy? In Figure 3-8, the horizontal shift of the demand curve is determined by [i] the change in the cost of living, [ii] the elasticity of the number of non-workers with respect to the cost of living, [iii] the change in the perceived quality of life, and [iv] the elasticity of the number of non-workers with respect to the perceived quality of life. To translate the horizontal shift of the demand curve into a change in the equilibrium quantity, we need the price elasticities of supply and demand for housing. To translate the change in the number of non-workers into total income of non-workers, we need the income per non-worker.

E. Projecting Local and Total Employment with Designation

Total employment is the sum of export employment and local employment. The predicted policy-induced change in total employment is the sum of the changes in [i] export employment, [ii] export-based local employment, [iii] local employment related to non-worker income, and

[iv] local employment resulting from import substitution. The changes in export employment were explained above, primarily in sections B.1, D.1.

Consider next the computation of export-based local employment. As explained in section B.2, an increase in export employment increases local employment. The relationship between export and local employment is summarized in the employment multiplier, which varies across export industries. For each export industry, we compute the change in local employment attributable to the change (positive or negative) in export employment. Summing the changes in local employment across all export industries, we can compute the total change in local employment attributable to the policy-induced changes in export employment.

Consider next the computation of local employment based on the income of non-workers. As explained in section B, income from non-workers supports local jobs, so an increase in non-worker income increases local employment. The relationship between non-worker income and local income is summarized in the local income multiplier. To translate changes in local income into changes in local employment, we divide the change in income by income per local job.

The final piece of employment data is the predicted change in local employment attributable to import substitution. As explained earlier, improvement in the local quality of life decreases local prices, increasing local production and sales at the expense of imports. Since it prevents the leakage of money from the local economy, import substitution has multiplier effects, just as an increase in export income does. To translate the initial increase in local employment into a change in total employment, we use the local income or employment multipliers.

F. Other Employment Effects of Habitat Designation

The analysis in this chapter focuses on habitat designations that decrease the natural-resource inputs available to export industries. The designation of a critical habitat could of course affect other activities within the region or county. Among the possible changes are the following.

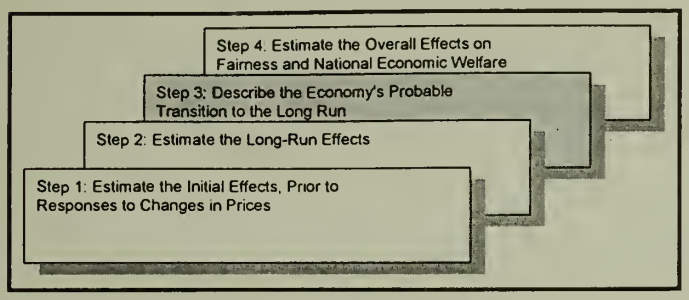
1. Decrease in the land available for the local sector. For example, a designation may prevent the development of retail activities on a particular site. This policy will increase the cost and price of local goods, which will increase the local cost of living, decrease the relative attractiveness of local goods, and cause the substitution of imports for local goods.

2. Decrease in the land available for local infrastructure. For example, a designation may prevent the building of a road in a

particular location. Assuming that the road was to be located in the most efficient spot, this policy will increase local transportation costs, increasing the cost of producing both export and local goods. The resulting increase in the price of export goods will decrease export output and employment, and the increase in the price of local goods will increase the local cost of living and cause the substitution of imports for local goods.

Step 3: Describe the Transition

Chapter 4



Each future analysis of the economic effects of a critical-habitat designation should describe the factors that are likely to facilitate or impede the ability of one or more groups to adjust to the designation efficiently. The analysis should estimate the length of time it will take different markets and groups to adjust to the designation.

The initial effects of a critical-habitat designation are important because they encompass the most visible ties between the designation and individual firms, workers, and communities. At the other end of the spectrum, the long-run effects are important because they represent the full economic consequences of the designation's price-effects. The gap between the two endpoints is the transition, *i.e.*, the adjustments by firms, workers, and communities over time to the designation. Figure 4-1 offers three guidelines for analyzing the transition.

Figure 4-1: Guidelines for Describing the Transition

Guideline #8: Describe the extent to which markets have anticipated the designation.

Guideline #9: Describe the extent to which some groups' inability or unwillingness to move exacerbates their adverse impacts.

Guideline #10: Describe safety-net programs that offset adverse impacts on specific groups.

The groups that incur the initial costs of the designation often find little solace when reassured that long-run adjustments in the economy will balance their costs, more or less, with benefits to others. These groups will have to adjust to the designation, and adjustment can be difficult and costly. The Service and the public generally have special concern for those with the greatest difficulty making the adjustment. One should not assume that the worst-case difficulties apply universally, however, as some groups will adjust smoothly, even profitably, and governmental programs cushion the impact on others.

In the long run, economists assume that labor and capital are mobile; if they lose employment opportunities in one location they will move to where prospects are stronger. For many workers, households, and firms this is a reasonable assumption. For others it is not: some will not have the skills, information, or financial resources necessary to undertake the move; others may prefer to stay where they are and accept the prospect of greater unemployment or underemployment rather than move. Many will anticipate the designation and respond accordingly, so that, for them, the transition may be accomplished, or be well under way,

when the Service makes the designation final.[9] Others will act only after considerable delay. Rarely will the onset of the transition period begin abruptly, with those who are adversely affected falling off an economic cliff, and those who benefit from it leaping to new heights all together in a single bound.

To the extent that workers dislocated by the designation remain unemployed or underemployed because they cannot overcome the hurdle of identifying and securing replacement jobs elsewhere, the costs stemming from the designation will be greater than they otherwise would be. To the extent that the designation prods some to overcome inertia that has kept them underemployed and to find more productive and remunerative employment elsewhere, the costs will be smaller. Some communities also have more difficulty than others making transitions, often because groups within the community cannot agree on how to proceed, so that the immobility of some groups is compounded by the inability of their communities to respond to the transition effectively.

Several governmental programs may reduce the cost some groups and communities incur as a result of the designation. Unemployment compensation, worker-retraining programs, job-search assistance, and other social-welfare programs generally provide some cushion for unemployed workers. The tax code may provide a cushion for firms that suffer a loss. Economic-development grants may underwrite a community's costs of adjusting to the transition away from a habitat-degrading industry. For those who receive benefits, these programs reduce the designation's costs; alternatively, they spread the costs to the general population of taxpayers.

Local residents may incur costs or receive benefits individually or collectively, with the latter occurring when the designation affects the value of collectively-owned resources, such as assets owned by municipal governments. If a designation's curtailment of a habitat-degrading industry leads to reduced demand for local labor and, hence, to an exodus of dislocated workers and their families, the local municipality may be left with excess capacity in its streets, water-treatment plant, and other facilities. Conversely, if it leads to a positive impact on the area's quality of life and, hence, to in-migration, the designation may leave the municipal government with too little capacity. The affected municipal assets may include physical plant and equipment; they also may include less tangible items, such as the knowledge and productivity of municipal employees and council members. Other potentially relevant intangible

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[9]Markets have considerable advance notice of a potential designation. During the designation process, which lasts at least several months, the Service communicates with other federal agencies regarding the potential impact of a designation on the agencies' operations, publishes a draft proposal, solicits public comments on the draft, and responds to the comments in the final designation. The designation process is presaged by the listing process, which can take more than a year.

assets may not be owned by a municipal government, *per se*, but may be important nonetheless. These include the social comity within neighborhoods, churches, schools, etc. that generally increase the social harmony and economic well-being of community members.

The transition also may include shifts in property values. The designation of critical habitat for the northern spotted owl, and the resulting curtailment of logging on federal lands, increased the value of other timberlands in the region and elsewhere. It also may have reduced the value of some residential, commercial, and industrial property in the region, and it may have increased the value of others.

There is a growing literature on economic transitions. Jacobson, LaLonde, and Sullivan, for example, provide a recent summary of past studies and report their own findings from a study of what happened to the earnings of high-tenure workers (workers with at least six years of employment with the same firm) in Pennsylvania who lost their jobs during or following mass layoffs.[10] Their analysis indicates that the transition is likely to be deepest and most protracted for workers (and their families) who are earning a wage premium associated with their long tenure with a single firm and in regional economies that are contracting generally: these workers' earnings begin to decline as much as three years prior to displacement, fall sharply immediately following displacement, and recover to only 75 percent of their predisplacement level.

The experience of workers affected by future critical-habitat designations may or may not resemble the experience reported by Jacobson, LaLonde, and Sullivan. The transition is likely to be different for workers (and their families) who do not fit the profile of those who were the subject of this study. The drop in earnings for workers who do not have sufficient tenure to receive a wage premium, for example, will not be as large. In general, though, where a designation leads to a mass layoff one should expect many displaced workers to experience a substantial, protracted decline in earnings.

When evaluating how different groups will fare during the transition, as they adjust to the designation, one should not abandon the with-without perspective. Some groups who, at first glance, appear to realize significant costs or benefits stemming from the designation, may be found to be relatively unaffected by the designation, *i.e.*, they would have experienced essentially the same outcome without the designation. This finding is especially likely to occur where there are other, more powerful factors exerting the same type of influence as the designation on a particular group, as when industrial realignment stemming from

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[10]L.S. Jacobson, R.L. LaLonde, and D.S. Sullivan. 1993. "Earnings of Displaced Workers." *The American Economic Review*. vol. 83, no. 4, pp. 685-709.

international competition reduces jobs and wages in an industry at the same time as a designation curtails the opportunities for the industry to degrade habitat. In such a situation, although the designation might trigger layoffs in firms that benefit from the degradation of habitat for an at-risk species, the net effect of the designation would be to accelerate layoffs that would have occurred anyway.[11]

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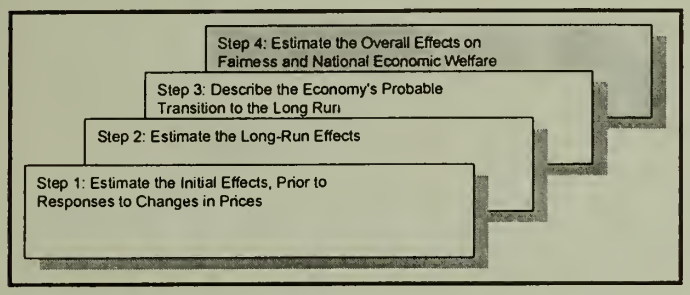
[11]For example, Richard Haynes, Program Manager for social and economic research at the Forest Service's Pacific Northwest Research Station, has argued that actions to protect the northern spotted owl accelerated changes already occurring in the region's timber industry:

> "[R]eductions in the sale of timber from federal lands stemming from changes in land management policies and efforts to protect the northern Spotted Owl . . . are contributing to changes in the structure and behavior of the industry. . . . One consequence of these events has been to compress changes expected in timber harvests in another decade into this year and next year. Where the transition from an old growth to second growth industry, thought to be about half completed, was expected to continue through this decade, it will be mostly completed in the next 3-4 years." Testimony to the Endangered Species Committee U.S. Department of the Interior, Office of Hearings and Appeals. 1991. p. 2.

Step 4:
Chapter 5 Estimate the Overall Effects



After estimating the potential initial and long-run effects, and examining the characteristics of the transition from the one to the other, the Service and society must interpret the overall importance of these effects. To what extent do the economic costs, to society as a whole or to groups within society, warrant setting aside proposed actions to protect species and habitat? Conversely, to what extent do the economic benefits reinforce the biological argument for such actions? In Figure 5-1 we offer three guidelines for responding to these questions about the impact on fairness and on national economic welfare, which commonly is referred to as the impact on economic efficiency.

Figure 5-1: Guidelines for Estimating the Overall Effects on Fairness and National Economic Welfare

Guideline #11: Match the group incurring each category of costs with the group receiving the corresponding category of benefits.

Guideline #12: Describe the fairness of the distribution of costs and benefits, showing the impact on property rights and looking at the impact on groups of special concern.

Guideline #13: Calculate net economic benefits, explicitly taking into account transfer payments, subsidies, taxes, spillovers, and regulations.

The first guideline addresses the linkages between individual costs and benefits. The U.S. economy is so complex that virtually all critical-habitat designations will have multiple, often offsetting, impacts. Sometimes the offsetting impacts accrue to the same group, other times they accrue to separate groups. Showing the linkages between these offsetting impacts is an important element of allowing the Service and the public to assess a proposed designation's overall effects primarily on fairness and economic efficiency.

The second and third guidelines address the conclusions one can draw about the fairness of the effects on different groups and the efficiency of the effects on the economy as a whole. We address each task separately.

A. Analysis of Fairness

The analysis of fairness generally entails assigning weights to the different costs or benefits to the different groups, with the weights reflecting society's sense of what is fair and what is unfair. The assignment of weights generally should include an examination of the

designation's impact on property rights. In general, American society seems to view as unfair policies that terminate a group's use of a natural resource if the group possesses property rights to the resource and is deprived of these rights without compensation.[12] Conversely, terminating a group's free use of a resource belonging to others may be seen, not just as fair, but also as overdue.

Critics of a critical-habitat designation often imply that the firms, workers, and communities that benefit from habitat degradation have the right to continue to degrade it and that the designation unfairly precludes them from realizing the benefits of their investments toward this end. Those seeking to protect the habitat generally assert that those groups have no right to continue, that they, in effect, have been trespassing on the property rights of others and have based their investments on unrealistic expectations about society's willingness to continue tolerating the trespass.

Property-rights issues are likely to arise with each designation, and with considerable controversy whenever the property rights to habitat are ambiguous. Within the context of disparate views of what is fair, the analysis of the fairness of the designation probably cannot be addressed fully until the Service states as explicitly as possible who holds what property rights to the habitat and the species dependent on it. In particular, the Service should determine the extent to which a habitat-degrading industry reasonably can assert that the curtailment of its activities is unfair because it is deprived of property rights that, in the absence of the designation, would allow it to degrade the habitat. The Service conversely should be explicit about the extent to which the designation will create or reinforce the property rights of others to the habitat. Where the Service cannot resolve the ambiguity regarding property rights, it should describe as clearly as possible the nature of the ambiguity and its implications for the analysis of the fairness of the designation.

The analysis of fairness also should look at the designation's impact on groups of special societal concern. The identity of these groups will vary from case to case, but in general the analysis should include an examination of the designation's impact on the poorest members of society. The analysis also should identify the groups where the costs or benefits are the most extreme, *e.g.*, the groups with the greatest cost or benefit as a percent of annual income or of investment in immobile

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[12]A comprehensive examination of property rights would look both at the distribution of formal property rights recognized by the courts and at less formal property claims, such as those that arise when the members of a group believe they have a right of some sort to use public land as their forebears did, or to monitor and protect the land and the flora and fauna it supports. See, *e.g.*, Louise Fortmann. "Locality and Custom: Non-Aboriginal Claims to Customary Usufructuary Rights as a Source of Rural Protest." *Journal of Rural Studies*. 1990. pp. 195-208.

assets. Where data exist, the analysis should examine the designation's effect on indicators of severe social and economic distress, *e.g.*, the incidence of poverty, malnutrition, infant mortality, domestic violence, drug and alcohol abuse, and morbidity. The analysis should incorporate an examination of impacts on minorities, as appropriate.

B. Analysis of National Economic Welfare

Conceptually, at least, one measures the impact on national economic welfare, or economic efficiency, by looking at the difference in the value society ascribes to two bundles of goods and services, one with and the other without the critical-habitat designation. One should not conclude, *a priori*, that the value of the bundle with the designation is larger or smaller than the value of the bundle without it. It is possible that the value of the bundle with the designation will have the greater value, given that the designation enhances the intrinsic value of the protected species and habitat and curtails the negative externalities from the actions of the habitat-degrading industry. The reverse outcome also is possible, given that the designation curtails the production of the products of habitat-degrading activities and reduces the productivity of resources that otherwise would be employed in these activities.

To quantify fully the amount and value of each good and service in each of the two bundles, especially for a designation that greatly alters patterns of economic activity, would require an extensive, detailed analysis of the initial, long-run, and transition effects described in the previous chapters. In many cases, the available time and data will not support such an effort and so we briefly discuss the major categories of costs and benefits shown in Table 5-1. As the table shows, each category of potential costs has its counterpart category of potential benefits.

Table 5-1: Major Categories of Potential Costs and Benefits of a Critical-Habitat Designation

Costs	Benefits
a. *The value of the resource no longer being exploited by the habitat-degrading industry.*	a. *The intrinsic value of the increase in protected habitat and the increase in expected survival it provides the species dependent on it.*
b. *The value of the reduction in the productivity of labor, capital, and other resources.*	b. *The value of the increase in the productivity of labor, capital, and other resources.*
c. *The reduction in the value of some elements of the local quality of life.*	c. *The increase in the value of some elements of the local quality of life.*

The most direct category of costs comes from forgoing the extraction or development of a natural resource as the result of the curtailment of the habitat-degrading industry. This category includes, *e.g.*, the value of the logs that will not be removed from federal lands in the Pacific Northwest because of the critical-habitat designation for the northern spotted owl, net of logging, road-construction, reforestation, and other costs associated with extracting the logs.

When the designation curtails the extraction or development of a resource it also curtails the employment of labor and other factors of production in the extractive or developmental process. These displaced factors generally will find some alternative employment, at least conceptually, but their productivity may be reduced. This reduction in productivity represents a cost to the worker or owner of the factor, and to society. The designation for the spotted owl may have reduced the productivity of labor that otherwise would have been employed in lumber mills processing old-growth logs from federal lands. It also may have reduced the productivity of municipalities by lowering the output of services provided by the same mix of inputs, *e.g.*, by reducing the level of social comity within a community.

The designation also may reduce the value of some components of the local quality of life. By disrupting a habitat-degrading industry of long standing, for example, a designation might lower the sense of history and community shared by local residents.

The most direct category of benefits comes from the intrinsic value society places on the habitat and species afforded protection by the designation. Specifically, the benefit equals the value associated with the protected habitat and the incremental protection it provides the species dependent on it. One should not attribute to the designation the intrinsic values that stem from other actions, *e.g.*, the listing of the at-risk species. Of concern here is the value of the increase in the population of the species dependent on the protected habitat and the increase in the likelihood that the at-risk species will survive.

In some cases the designation of critical habitat may increase the productivity of labor and other factors of production. This is most likely to occur when the designation, by curtailing the activity of the habitat-degrading industry thereby also curtails the spillover external costs imposed on other industries. Curtailing activities that degrade riparian habitat, for example, might increase the productivity of labor, capital, and other resources employed in commercial and recreational fishing, road maintenance, and the provision of municipal water.

The designation also may increase the value of some components of the local quality of life, specifically the natural-resource amenities,

relative to what would exists without the designation. This increase represents an economic benefit.

Although the impact of actions to protect species and habitat can affect the economic welfare of those who reside in the immediate vicinity, the overall effect on the national economy will be nil to the extent that one region's gain of a worker or entrepreneur is another region's loss. The gain will more than offset the loss, however, if the workers and firms attracted from throughout the country to a particular region by its quality of life are more productive collectively, because of their juxtaposition, than they would have been if they had remained dispersed, *i.e.*, if there are economies of scale or scope associated with the aggregation of workers and firms with a particular affinity for the region's quality-of-life attributes.[13]

In practice, the analysis of a designation's impacts on national economic welfare often is separated into one or more components by looking at a specific resource, such as labor, affected by the designation to see how the value of its contribution to the productive process where it is employed following the designation compares with its opportunity cost, *i.e.*, the value of its contribution to the productive process where it would be employed without the designation. This analytical approach is made difficult if the observable compensation – the wage or market price – paid the resource in each case differs substantially from the resource's true value to society. Unfortunately, differences between market prices and societal values are common throughout the economy, especially when one of the factors of production is habitat. There are many sources of this difference and we discuss three sources that are of particular concern: community assets and services, spillover effects, and ambiguity about property rights.

B.1. Community-Held Assets and Services

The analysis of a designation's overall impact on economic efficiency should address impacts on goods and services owned in common, *i.e.*, on

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[13]Such economies might include:

- Economies of scale derived, *e.g.*, from a concentration of skilled workers who, collectively, can render viable the expansion of a manufacturing firm that otherwise would be too small to remain profitable.
- Economies of agglomeration derived from a concentration of firms in multiple sectors, attracted by the region's quality-of-life.
- Economies of community specialization — the so-called Tiebout effect — that occur whenever preferences regarding the protection of habitat systematically coincide with preferences regarding the mix of local municipal services.

In general, a designation of critical habitat could cause an increase or decrease in these economies, and it will be difficult to discern the direction, let alone the magnitude, of the overall effect, if any.

municipal governments, as well as impacts on goods owned privately by the individual workers, firms, and households within the community. The Service should consider as a cost to the municipality any reduction in the value of the services the municipality's owners, *i.e.*, its citizens, would have received from the municipal assets, but for the designation. Conversely, it should consider as a benefit any increase in the value of these services as well as any additional services they receive because of the designation. It similarly should count as a cost or a benefit any decrease or increase in the value of municipal assets, respectively.

To illustrate this guidance, assume the Service defines the relevant group as the residents of a community immediately prior to the designation. If the designation causes the municipality to cope with the resulting transition by diverting the mayor from tasks she otherwise would have completed to new tasks of managing the community's response to the designation, the forgone services associated with the old tasks constitute a cost to the residents. The replacement services associated with the new tasks constitute a benefit to the federal government insofar as the mayor is helping the federal government implement its change in habitat-management policy. These replacement services constitute a benefit to local residents insofar as the mayor is helping the residents act more efficiently with respect to decisions they would have had to confront with or without the designation.

Evaluating the direction and magnitude of the impacts on municipal resources is made especially difficult because the composition of the community — the stockholders of the municipal corporation that owns municipal assets and provides municipal services — changes as people move in and out of town. An existing resident might see a reduction in the value of her share of the municipal corporation as a cost, a newcomer might see this as a bargain. There is no generally accepted rule for saying that one or the other should have preference and, where the designation's impact on migration is potentially large, the analysis of the overall costs and benefits should incorporate both perspectives.

B.2. Spillover Effects

Habitat protection, by preventing habitat degradation, may have spillover effects that alter the productivity of one or more industries or the economic welfare of one or more households. The analysis of a designation's net impact on national economic welfare should take these effects into account, quantifying them whenever possible, at least identifying them otherwise. We briefly identify several categories of potential spillover effects that commonly accompany an action to protect habitat.

Agricultural Crops, Timber, and Livestock: Protection of upstream riparian areas, for example, may affect the yield of agricultural activities and timberlands downstream.

Environmental-Cultural Icons: Some environmental resources play an important cultural or religious role that increases their value. For example, in the Pacific Northwest and elsewhere, considerable attention has been given to the viability of specific fish stocks, especially wild runs of salmon and other anadromous species. Much of this attention reflects concern about the impacts on biodiversity and on recreational opportunities, but there often seems to be an additional concerns reflecting the historical relationships between fish runs and the Pacific Northwest's cultural identity. This is especially so for the region's Native American communities. Here and elsewhere debates over resources that serve as environmental-cultural icons reveal that the symbolic values of such resources may be large.

Global Climate Change: The protection of habitat might affect both the rate of change and a particular area's response to the change. Protection of a forest ecosystem might increase or decrease the supply of greenhouse gases and the individual species that inhabit a particular place with the designation may be more or less sensitive to changes in temperature and humidity than the species that would inhabit the place without the designation.

Human Morbidity and Mortality: Habitat protection might affect human health in a number of ways, *e.g.*, by maintaining a viable population of a species that can contribute drugs, or by creating a wetland that removes toxics from a stream.

Land Use: Protecting habitat entails curtailment of activities that otherwise would degrade the habitat. This change in land use might have spillover effects on adjacent or distant lands, *e.g.*, when a critical-habitat designation stops lands development at one site and displaces it to another.

Materials: The impact of habitat protection on materials generally will be indirect. Habitat protection might affect the quality of water in a watershed and, hence the amount of treatment a community applies to the water in its municipal system, for example, or protection of riparian habitat might slow the velocity of water in a stream and reduce the scouring effect on bridges and roadways.

Recreation: Recreational impacts can occur in innumerable ways, *e.g.*, by protecting scenic vistas for occupants of motor vehicles on a highway, changing the population of game animals, and improving the quality of a stream flowing through a city park.

Regional Economic Structure: This category of spillover effects has surfaced primarily in the Pacific Northwest, where many regional

economists and policy makers have concluded that the region's quality of life, especially its natural-resource amenities, exerts a strong influence over the evolution of its economy. To the extent that habitat protection influences the natural-resource amenities of a place, it may lead to alterations in the region's quality of life and in its economic structure. The region's residents may assign a value to the change in economic structure, *per se*.

Visibility: Habitat protection may curtail actions associated with habitat degradation that affect visibility. For example, by restricting logging, the designation of critical habitat for spotted owls may have reduced the amount of dust in the air from log trucks traveling over unpaved roads and the amount of smoke in the air from slash burning.

Visual and Audio Aesthetics: The protection of habitat substitutes the sights and sounds of the habitat for those of habitat degradation. The beauty and, hence, the value of the substitution lie in the eye of the beholder and the ear of the listener.

B.3. Property Rights

Property rights affect the analysis of efficiency when the value of the habitat resources protected by a critical-habitat designation depends on who owns them. In general, the value of a particular piece of habitat is what society would be willing to exchange for it. One can approach this exchange from either of two perspectives: as buyer or as seller. From the buyer's perspective, the value of the habitat is the amount the buyer is willing to pay to acquire ownership. From the seller's perspective, its value is the amount the seller is willing to accept as compensation in return for giving-up ownership. These two perspectives of value are called the buyer's willingness to pay (WTP) to acquire ownership and the seller's willingness to accept compensation (WTA) in return for giving-up ownership.

When market conditions prevail, the buyer's WTP for a good or service equals the seller's WTA, and both equal the market-clearing price. The equality of WTP and WTA is a cornerstone of economic theory for market-based goods and services, and, until quite recently, economists theorized that it also applied to non-market situations. That is, there was general agreement that, if one determined an individual's WTP, as a buyer, to purchase a non-market item, such as protection for a species' critical habitat, and her WTA, as a seller, to sell the same, one would get the same number. Empirical studies have consistently found that WTA frequently is 2-10 times larger than WTP, however, even for goods commonly traded in markets, and theoreticians are debating the source of the discrepancy: Is it an artifact of empirical techniques that will

disappear as these techniques are refined, or a bona fide difference in value?

The issue has important implications for the Service because, whenever there is a discrepancy, whether real or an empirical artifact, between WTP and WTA, adoption of one or the other as the value of an critical habitat will embody a statement about who owns the habitat. Consider, for example, an irrigation project that has an adverse impact on a river and a listed fish species. If the Service, seeking to weigh the value of changing the project's operations against the value of protecting the fish's habitat, values the additional protection using a WTP approach, it implicitly is saying that the irrigators own the river, society must make payments to the owners if it wants to keep them from degrading the river, and the amount society is willing to pay indicates the value it places on the river and fish. Alternatively, if the Service adopts a value developed using a WTA approach, it is saying that society owns the river and fish, the irrigators must pay society for permission to degrade the resource, and the amount society demands in return indicates the value it places on the river and fish.

Property-rights issues also apply when weighing the economic interests of future groups against those of today's society. These issues arise primarily when a designation imposes economic costs today on one group so that another group can enjoy the benefits sometime in the future. Throughout the economy, in both the private and public sectors, society deals with similar circumstances by reducing the weight, all else equal, given to future effects. Society's apparent time preferences have important implications for the evaluation of any critical-habitat designation. To ensure an equal footing for the designation's various costs and benefits that are projected to occur at different times, most analysts would convert each future value to its equivalent, smaller present value before determining the designation's net benefits. The technical terms for these steps are discounting future values and calculating the designation's net present value.

Considerable controversy has arisen regarding the application of discounting to the evaluation of polices and actions aimed at protecting species. We recommend that the Service continue to apply the theory and techniques of discounting to its analysis of the economic-efficiency effects of a critical-habitat designation. In general, the application of discounting should reflect this reasoning, expressed by Robert Solow:[14]

> "[T]he notion of intergenerational equity . . . is that each generation is allowed to favor itself over the future, but not too much. Each generation can, in turn, discount the welfare of future generations, and each successive generation applies the same discount rate to the welfare of its successors.

[14]Robert Solow. *An Almost Practical Step Toward Sustainability.* 1992. Resources for the Future. pp. 9-10.

To make conservation an interesting proposition at all, the common discount rate should not be too large.

You may wonder why I allow discounting at all. I wonder too: no generation 'should' be favored over any other. The usual scholarly excuse – which relies on the idea that there is a small fixed probability that civilization will end during any little interval of time – sounds farfetched. We can think of intergenerational discounting as a concession to human weakness or as a technical assumption of convenience. . .. [W]e can just imagine [the rate of discount] to be small."