

A MARKET APPROACH TO PROTECTING HABITAT  
FOR ENDANGERED SPECIES

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As the Congressional debate rages over reauthorization of the Endangered Species Act, both property rights advocates and environmental activists agree that the key to balancing species protection with landowner rights is through the implementation of market-based incentives to preserve and create habitat. The incentive outlined by Texas Public Policy Foundation Senior Fellows John Merrifield and Duggan Flanakin forces the federal government to publicly defend its definition of "habitat" within each affected ecosystem as well as its decision as to how much land must be set aside as habitat; provides for preservation or restoration of sufficient habitat in time to save most species with minimal infringement on personal liberties; allows dormant land values to be realized by both HEC sellers and buyers; provides means for ascertaining the proper cost of the public's intrusion onto private property to exercise its claimed right in species preservation; and even allows some landowners to continue to enjoy property currently being encroached upon by development pressures.

This paper will be updated throughout 1995 as debate in Congress on Endangered Species Act reauthorization and related topics continues to unfold.

## **Executive Summary**

The Endangered Species Act, which is up for reauthorization this year, is a poorly conceived statute that has been ineffective in winning the cooperation of landowners in the national effort to maintain biodiversity. The primary error in the current scheme is that the administrative procedures implemented by the U.S. Fish and Wildlife Service do not make habitat a valuable land use for individual landowners; even worse, landowners regard wildlife habitat as a liability, and seem to be acting accordingly.

Almost as bad are the proposals for revising the ESA that were on the table during the 1994 reauthorization debate and remain part of the debate in 1995. Some of them would further encumber the FWS decision-making process, keeping landowners in limbo even longer. Proposals to beef up the FWS budget and enforcement authority would likely increase landowner incentives to conceal or destroy habitat. Most proposals to compensate landowners would involve either high costs or a further weakening of species protection. The recently announced initiative from the Clinton Administration also fails to solve the problems inherent in the current scheme.

This paper presents a market-based scheme suitable for a single species or ecosystem approach to biodiversity maintenance which could be used to prevent species from ever being threatened or to bring about recovery of already endangered species. This plan would also maximize opportunities for economic activity and habitat uses to coexist.

The proposed scheme would work through management agreements that would allow the purchase of "habitat elimination certificates" (HECs). Each HEC would allow its buyer to adopt land uses that eliminate habitat on one acre. HECs would be produced for sale or rent when landowners sign management agreements to protect habitat that already exists or to create new habitat on their property. The monetary price of HECs would be set by market forces.

The HEC market approach would assure that agreed-upon biologically sufficient minimum habitat levels are achieved and permanently maintained. It would raise property values where non-habitat use values are lowest, and would minimize the negative impact on property values where non-habitat use values are highest. If desired, landowners who suffered costs could be assisted through tax exemptions, credits, or rebates. The proposed scheme could also be applied to water uses that affect species, including effluent discharges and potentially harmful surface or ground water withdrawals during low-flow periods.

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## Key Concepts and Acronyms

- APH = Already protected habitat, including park and wildlife refuge acreage.
- ASH = Safe minimum additional secure habitat in units of land area.
- ESA = The Endangered Species Act of 1973 as amended.
- FWS = U.S. Fish and Wildlife Service.
- HEC = Habitat Elimination Certificate. Each HEC allows its buyer to eliminate one acre's worth of habitat.
- MA = Management Agreement. An MA would combine some mix of deed restrictions, mandated owner activities, and permission for other people to perform certain activities on affected land.
- NH = Land area that is not habitat, and could not be made suitable habitat at a reasonable cost.
- PH = Potential habitat in units of land area.
- PP = Physical price, expressed as newly protected units of habitat per eliminated unit of habitat.
- PP<sub>B</sub> = PP for species on the brink of extinction.
- UH = Unprotected habitat in units of land area.

# A MARKET-BASED APPROACH TO PROTECTING HABITAT FOR ENDANGERED SPECIES

By John Merrifield and Duggan Flanakin

"Thousands of small businesses, landowners, and threatened species are endangered by faulty regulation."

Mark Suwyn, *Wall Street Journal*

## Introduction

During the past several months Texas has been the center of a national firestorm over the Endangered Species Act (ESA) and other federal environmental laws. The controversy over a Richards Administration proposal to classify five Texas water bodies as "outstanding national resource waters" and the uproar over the proposed listing by the U.S. Fish and Wildlife Service (FWS) of 33 central Texas counties as critical habitat for the golden-cheeked warbler played major roles in the 1994 statewide elections, which ended in the resounding defeat of an otherwise popular Governor.

The problem for Gov. Richards was not so much that Texans oppose species protection but that they resent federal encroachments on their Constitutional liberties. The newly released Texas Environmental Survey,<sup>1</sup> conducted by Rice University sociology professor Stephen L. Klineberg, found that 56 percent of Texans favored spending more tax dollars to set aside and protect wilderness areas for endangered species in Texas, and that 64 percent agreed that some restrictions on property rights are justified to protect endangered species and wetlands. But a whopping 73 percent believed that the federal government interferes too much in our daily lives.

Widespread disillusionment with the ESA, both in Texas and around the nation, has led to the filing of a host of bills in Congress, along with a brand-new White House initiative, each of which would change the way the federal government administers the 22-year-old law. The debate over ESA reauthorization was placed on hold last year while Congress went to war over health care but has returned with a vengeance to center stage in Washington - and in Austin as well.

The chief reason for the continued debate is that current habitat protection policies are a disaster for everyone. Not only do they do a poor job of protecting and preserving threatened and endangered species, they also have the potential to do great economic harm to landowners and developers. The imbalances in the current law have fomented a backlash that could lead to a weakening, or even abandonment, of species protection efforts if hard-liners win the day.

The ESA was enacted in response to public demands that the federal government protect threatened and endangered species and their habitat. The 1973 law has been credited with saving

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<sup>1</sup>Rice University, Department of Sociology, "The Texas Environmental Survey (1990, 1992, 1994)" (Rice University, Houston), March 1995.

the American bald eagle - our very national symbol. The truth, however, is that only a handful of other endangered and threatened species have been helped by the ESA. This sad result is largely the result of the cumbersome, even counter-productive procedures the FWS has promulgated to implement the law. (The National Marine Fisheries Service has a smaller role, limited more to over-harvest prevention than habitat protection.) The ESA's record on maintaining the widely shared goal of biological diversity (or biodiversity) is not nearly good enough.

Many environmentalists have been frustrated with the slow pace of species protection, while others have used the ESA as a political tool to stop or force changes in some controversial projects. The snail darter, the spotted owl, the Kangaroo rat, the Barton Springs salamander (whose listing has been delayed for another six months at the request of Texas Governor George W. Bush), and the golden-cheeked warbler have become symbols of the seeming war between environmentalists and the American people, especially rural property owners.

Rural landowners have been especially angered by the inherently clumsy, costly, and uncertain procedures that underlie the ESA's dismal environmental record. Faced with the prospect of an expensive, time-consuming permitting process that could tie up their land for years (if not permanently), landowners are tempted to destroy potential endangered species habitat. If they can prevent discovery, they will avoid regulation and the property devaluation, even forfeiture, that goes with it.

For example, Marj Krueger told a Texas legislative panel<sup>2</sup> last year how she and her husband were denied the right to build a house on a lot in a Travis County subdivision for which they paid \$40,000 (and thousands more in expenses) after golden-cheeked warblers were found nearby; they still have to pay taxes on the lot, which FWS says retains "recreational value." Fellow Texan Margaret Rector explained that she had bought a 15-acre tract of land in 1973 that was appraised at \$900,000 in 1984; after FWS declared the property to be warbler habitat, the property value fell to \$30,380 in 1992 before rising to \$151,800 by 1994.

Indeed, on the basis of the counter-productive incentives, increasingly common "shoot, shovel, and shut-up" tales,<sup>3</sup> and the ESAs impact on the public's attitude toward environmentalism, a case could be made that the ESA has done more environmental harm than good. As noted by Douglas Chadwick,<sup>4</sup> "America's biological heritage is at risk, and one of the chief culprits is the ESA."<sup>5</sup> Scott Thurm and Bert Robinson, "Species Act Endangering Life in

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<sup>2</sup>State of Texas, House Committee on Natural Resources, "Interim Report to the 74th Texas Legislature," (November 1994), pp. 6-27.

<sup>3</sup>Wendy E. Hudson, ed., *Building Economic Incentives into the Endangered Species Act* (Defenders of Wildlife, Portland, Oregon) 2nd. ed., 1993. The authors of two chapters report that many landowners are inclined to "shoot, shovel, and shut-up" to avoid problems with the FWS.

<sup>4</sup>Charles C. Mann and Mark L. Plummer, "Showdown on Endangered Species," *New York Times*, May 11, 1992, p. A15.

<sup>5</sup>Tom Arrandale, "Endangered Species," *CQ Researcher* (June 21, 1991), pp. 395-415;

Michael Bean, "Economic Incentives for Endangered Species Recovery," Environmental Defense Fund Memo, October 14, 1992;

Timothy Egan, "Courts' Role as Land Manager Grows," *New York Times*, May 1, 1991;

Peter M. Emerson, "Spotted Owl: Bellwether or Climax to the Endangered Species Debate?," presented at the TAPPI Environmental Conference, San Antonio, Texas, April 8, 1991;

Reed F. Noss, "From Endangered Species to Biodiversity," chapter in *Balancing on the Brink of Extinction*, Kathryn A. Kohn, editor (Island Press, Washington, DC), 1991;

the West," *San Antonio Light*, May 1, 1992, pp. A1, A13.

As currently administered, the ESA greatly exaggerates the trade-offs between free enterprise, individual liberties, and biodiversity. Rather than the administrative tinkering promised by most current ESA reform proposals, this increasingly controversial law is in need of a major overhaul before it can truly protect species, habitat, and landowners on a broad scale.

This paper presents a market-based scheme for revising federal habitat protection policies that addresses the need for species and habitat preservation and the high cost and uncertainty involved in restricting land use to create and preserve habitat. The shortcomings of the existing ESA, as administered by the FWS, and of other current ESA reform proposals - including the brand-new Clinton Administration initiative - are discussed in Chapter 1. Chapter 2 explains why market-based incentives are the key to improving species protection and winning the cooperation of landowners in the effort. It also outlines the concept of "habitat elimination certificates," through which habitat becomes a valuable commodity and the likelihood of landowner participation in species protection plans increases. Chapter 3 discusses several issues related to implementing a habitat elimination certificates program. The technical aspects of the HEC concept are outlined in more detail in an appendix.

## **Chapter 1. Today's ESA and Current Reform Proposals**

The key to more effective species protection is to change the incentives underlying land use. Nowhere was the breadth of agreement on this point made more evident than during testimony provided during 1994 before the Committee on Natural Resources, Texas House of Representatives,<sup>6</sup> as that body sought input on how to mitigate conflicts between landowners' property rights and land use with federal and state policies for species protection. Among those supporting an incentives approach were Judy Carter and Ken Kramer of the Sierra Club's Lone Star Chapter; Sandra Skrei and Susan K. Hughes from the National Audubon Society; Larry McKinney, Director of Resource Protection for the Texas Parks and Wildlife Department; Bill Tullos representing the Texas Farm Bureau; and Mike Bradford of the Natural Resources Foundation of Texas.

The Endangered Species Act was enacted because the public saw species habitat as a valuable land use, but the command-and-control process that Congress chose for its implementation has proven to be overly costly and largely ineffective. Instead of encouraging the use of markets and private property incentives, command-and-control tends to oppose and erode them. While many other major environmental laws also work through command-and-control, the 1977 and 1990 amendments to the federal Clean Air Act incorporated a variety of incentives, in particular "emission reduction credits" (ERCs), which enable public or private entities to buy or sell credits earned for reducing air pollution in return for the right to open up new facilities or expand existing activities.

The chief reason for the ESA's ineffectiveness is that the FWS' implementation procedures fail to incorporate any effort to make habitat a valuable land use for individual

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Michael J. Scott, Blair Csuti, Kent Smith, J. E. Estes, and Steve Caicco, "Gap Analysis of Species Richness and Vegetative Cover: An Integrated Biodiversity Conservation Strategy," chapter in Kohn, *op. cit.*;

<sup>6</sup>*Op. cit.*

landowners. Instead, the presence of such habitat on private lands has been turned into a major liability. This defect should be corrected legislatively through the 1995 federal reauthorization effort. For a discussion of why a legislative fix is better than merely revising the FWS regulations, see Chapter 3.

In addition, under today's FWS procedures, species stabilization and recovery often begin too late, because habitat has usually become scarce long before species are endangered, or even threatened. Current FWS procedures are also based on a species-by-species approach to protection, although federal agencies have been trying to gradually shift to an ecosystem approach. As Sara Vickerman and other experts have pointed out, "they'll never have enough people, or enough money to deal with species one at a time."<sup>7</sup> Land use changes usually affect several species, and an ecosystem approach would render the ESA's lengthy, cumbersome listing process obsolete.

### **The Existing ESA Implementation Scheme**

Despite the ESA's well-documented defects, many environmentalists have wondered what all the fuss is about. For example, Hamilton reported that only one project cancellation had resulted from the current FWS administrative procedures.<sup>8</sup> A year later, Reid claimed that the FWS procedures had killed 19 projects out of 2,000 formal and 71,560 informal consultations.<sup>9</sup>

Unfortunately, project cancellation data mask many significant negative effects, including what the FWS procedures fail to do. Projects have had to be modified and delayed, or taken off the drawing board altogether, with the first hint that an ESA consultation would be required. Also, the statistics do not include impacts on private land, such as the effects of uncertainty on property values and eligibility for equity loans.

Perhaps the most serious flaw in today's species protection scheme is that, by cooperating with the FWS, landowners only subject themselves to potentially serious liabilities. Another concern is due to the fact that, while only those landowners who must consult with the FWS will be directly affected by the procedural prohibitions, all landowners in an area proposed for listing have to wait indefinitely to find out whether their land will be demanded as habitat. Moreover, by the time a species is listed as threatened or endangered, species recovery costs may be dramatically increased, or it may even be too late to save the species. There are also no incentives for landowners not forced to consult with the FWS to upgrade or create habitat, or even to offer to legally bind themselves to maintain existing habitat values.

The current scheme is also tougher on private land than public property. Section 10 of the ESA, which applies to non-federal projects, is much more demanding than Section 7, which applies to projects with a federal nexus.<sup>10</sup> Currently, over 50 percent of endangered species occur only on private lands.<sup>11</sup> The consultation and conservation planning process is especially

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<sup>7</sup>Arrandale, op. cit.

<sup>8</sup>Joan Hamilton, "The Species Axe: A Prized Conservation Law Lies on Congress' Chopping Block," *Sierra* (January/February 1992), pp. 29-31.

<sup>9</sup>Hudson, op. cit., pp. 68-74.

<sup>10</sup>Christopher H. M. Carter, "A Dual Track for Incidental Takings: Reexamining Sections 7 and 10 of the Endangered Species Act," *Environmental Affairs*, 19:135, 1991, pp. 135-171.

burdensome to small landowners.<sup>12</sup>

The costs, in time (2-year average) and money, of the required incidental take permit are also large and uncertain. For example, the cost for a permit in spotted owl habitat is about \$250,000,<sup>13</sup> while the average cost for a permit in the Hill Country of central Texas was about \$9,000 per acre in 1992.<sup>14</sup> Despite the high procedural expenses, there is no guarantee that a sought-after permit will ultimately be granted.

Even the proposed listing of a species can cause major delays and lower land values by creating uncertainty about allowable land uses.<sup>15</sup> Langford<sup>16</sup> and Klintberg<sup>17</sup> have asserted that environmental organizations have used the costly nature of FWS permitting system to acquire land at fire sale prices.

Other more subtle, but still significant, flaws come into play in regions where landowners are well aware of the FWS procedures. The uncertainties regarding future land use and the costs of complying with FWS procedures create incentives to hide the habitat of threatened species. A personal experience of the senior author's provides a good example of some of the resulting bizarre and regrettable behavior.

While he was on an outing that required permission to go on private land, the landowner, before giving permission, reviewed a list of the outing participants' names and occupations. The outing leader said that if Mr. Merrifield had listed himself as an environmental economist, the landowner would have been very likely to deny him permission to enter. The landowner, explained the outing leader, did not want his property rights limited by someone discovering an endangered species on his land, and "environmental economist" might sound too close to "biologist," someone certain to be denied access.

The ESA says that every species is priceless, but the FWS procedures give landowners a strong incentive to prevent the discovery of endangered species or their habitat. The high stakes described by Langford,<sup>18</sup> Mann and Plummer,<sup>19</sup> and Suwyn<sup>20</sup> make it likely that many do more

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<sup>11</sup>National Heritage Data Center Network, *Perspectives on Species Imperilment* (The Nature Conservancy, Arlington, Virginia), 1993.

<sup>12</sup>Mark Suwyn, "We Saved the Salamander - But It Wasn't Easy," *Wall Street Journal*, November 29, 1993, p. A12.

<sup>13</sup>Mann and Plummer, op. cit.

<sup>14</sup>George W. Gau and James E. Jarrett, "Economic Impact Study: Balcones Canyonlands Conservation Plan," Bureau of Business Research, University of Texas at Austin, 1992.

<sup>15</sup>Suwyn, op. cit.; David K. Langford, "Along the Back Sendero," *Texas Wildlife* (August 1991), p. 19.

<sup>16</sup>Op. cit.

<sup>17</sup>Patricia P. Klintberg, "Dances with Land Part 2: How Land Trusts Acquire Property," *Beef Today* (November/December 1991), pp. 10-12.

<sup>18</sup>Op. cit.

<sup>19</sup>Charles C. Mann and Mark L. Plummer, "The Butterfly Problem," *The Atlantic Monthly* (January 1992), pp. 47-70.

<sup>20</sup>Op. cit.

than conceal them; Mann and Plummer state that landowners may destroy species or allow natural forces to do the job. For such reasons, at least one state wildlife agency will not readily disclose where rare and endangered species are located.<sup>21</sup> With the perverse incentives created by the current FWS procedures, it is no wonder, as reported by Michael Bean,<sup>22</sup> a leading expert on the FWS procedures, that "increasingly, recovery strategies are effectively writing off private lands."

According to many environmentalists, including Bean, the FWS's poor performance can be mostly attributed to Congress' refusal to provide sufficient funds.<sup>23</sup> Nancy K. Kubasek and M. Neil Browne, "The Endangered Species Act: An Evaluation of Alternative Approaches," *Dickinson Environmental Law Journal* (forthcoming). This claim is common even though, as the *Wall Street Journal* reported,<sup>24</sup> the number of FWS regulators has doubled since 1985 and the agency's annual appropriation has increased from \$426 million in 1988 to \$764 million in 1992. No amount of additional money, though, would change the disincentives created by the FWS procedures - disincentives which make landowners try to keep anything that sounds close to a biologist off their land or which cause landowners to eliminate habitat before it is discovered.

Other problems stem from the fact that the FWS procedures can be manipulated such that regulators and their political bosses can work behind the scenes to frustrate species protection efforts while publicly avowing their importance. One tool has been to delay the listing of species until a project that threatened the species was completed.<sup>25</sup> Through such selective enforcement practices, bureaucrats can appease key lawmakers who could be hurt if projects in their districts were canceled or delayed.

Budgetary decisions and the leveraging of administrative options are the routes by which politics distorts what should be strictly scientific determinations.<sup>26</sup> According to Mann and Plummer,<sup>27</sup> FWS decision making has become highly politicized: "The agency, formerly a haven for guys who liked to work outdoors, is now a hot spot of sophisticated partisan arm-twisting."

It may be that the law and its implementing regulations were deliberately written to foster an environment conducive to influence-peddling. Alternatively, the extent of influence-peddling over ESA decisions may provide evidence that implementation is the weakest link in public policy making and its analysis.<sup>28</sup> Influence-peddling pressures may also explain why the FWS persistently ignores its own priority system and changes it so often.

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<sup>21</sup>Klintberg, op. cit.

<sup>22</sup>Op. cit.

<sup>23</sup>Tom Horton, "The Endangered Species Act: Too Tough, Too Weak, or Too Late?", *Audubon* (March/April 1992), pp. 68-74;

<sup>24</sup>*Wall Street Journal*, "Go Fish," November 8, 1993, p. A22.

<sup>25</sup>Michael Bean, "Looking Back over the First Fifteen Years," chapter in *Kohn*, op. cit.

<sup>26</sup>Peter Montgomery, "Science Friction: Playing Politics with Scientific Research" *Common Cause Magazine* (November/December 1990), pp. 24-29.

<sup>27</sup>Mann and Plummer, "The Butterfly Problem."

<sup>28</sup>Charles Wolf, Jr., *Markets or Governments: Choosing Between Imperfect Alternatives* (MIT Press, London), 1993.

## **Current ESA Reform Proposals**

As Kubasek and Browne<sup>29</sup> report, the 1994 congressional ESA reauthorization debate (and its counterpart in 1995) has not offered a basis for much optimism about the likely nature of ESA reauthorization legislation. None of the published proposals would maintain biodiversity with minimum costs to landowners (either monetarily or in loss of freedoms). Instead, each would further reduce the ESA's effectiveness, or increase landowners' burdens, or both. Unless, as some hope, the high costs of these proposals would terminate the public effort to maintain biodiversity, their implementation would also significantly increase the scope of government.

One set of proposals would further encumber the FWS with extra due process and decision-making criteria. These schemes would reduce the ESA's environmental effectiveness without assuring landowners any relief. By lengthening the decision-making process, these proposals could actually leave landowners in limbo even longer.

Another set of proposals, put forth by ESA supporters, would increase the FWS' enforcement powers and increase funding levels for listing and recovery efforts. This might shorten permitting timetables, but it would also strengthen the hand of the FWS, adding to landowners' burdens. The end result would likely magnify perverse incentives to conceal and destroy habitat.

A third set of proposals sought to require compensation for any landowner losses incurred as a result of the prohibition of activities that reduce biodiversity. Such proposals raise several issues: one is cost. Land acquisition, tax incentive, and fee approaches would create significant, permanent budgetary obligations and possibly lead to a major increase in federal land holdings. Administrative and philosophical issues might be even more troublesome. Should people be paid to refrain from socially harmful actions? We do not, for example, pay people not to emit pollutants on their property. It would be difficult to ascertain appropriate compensation, which would require a determination of what someone would otherwise have done, and a measure of what benefit their decisions would have netted them.

## **The Clinton ESA Initiative**

On March 7, 1995, Clinton Administration officials announced a major initiative to make the ESA more palatable to landowners.<sup>30</sup> Interior Secretary Bruce Babbitt and Dr. D. James Baker, Undersecretary of Commerce for Oceans and Atmosphere, explained that the Clinton plan would exempt small residential tracts of property (under 5 acres) from ESA restrictions for threatened species, increase participation by state regulatory bodies in ESA decision making, and mandate greater scrutiny of the scientific analysis supporting endangered species decisions.

According to Babbitt,<sup>31</sup> the initiative demonstrates that the Administration is "serious in

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<sup>29</sup>Op. cit.

<sup>30</sup>U.S. Fish and Wildlife Service, "Administration Proposes Endangered Species Act Exemptions for Small Landowners: 'Guideposts for Reform' Would Give More Authority to States," March 7, 1995, 21 pp.

<sup>31</sup>Op. cit.

its efforts to balance the rights of individual landowners with the community's right to a healthy environment." The 10-point package includes promises to provide quick, responsive answers and certainty to landowners; create incentives for landowners to conserve species; focus on groups of species dependent upon the same habitat; and prevent species from becoming endangered or threatened.

The Clinton plan does address most of the major complaints that citizens have lodged against the ESA. Unfortunately, the incentives package, as outlined, would apply only to those situations in which it is possible to measure a conservation benefit to a species from habitat improvements; the "carrot" is that landowners would not be penalized for making such improvements. Moreover, the proposal relies on regional habitat conservation plans, which lack a statutory foundation and are thus on shaky legal ground, as its primary tool in preventing species from becoming threatened or endangered.

## Summary

In summary, neither the existing ESA, nor the proposals put forth in 1994 as ESA reauthorization options (which are still on the table), nor the Clinton Administration's just-released 10-point plan provide adequate solutions to the problem of protecting threatened and endangered species and their habitat without endangering rural landowners and fueling the growing backlash against all federal species protection programs.

R. J. Smith, senior economist for the Competitive Enterprise Institute, has argued that the only appropriate fix for the problems with the ESA is a solution that provides incentives for landowners to house rare species.<sup>32</sup> Like many others, Smith says that the current ESA "harms people and private property as well as harming wildlife and wildlife habitat. It penalizes them for being good stewards and makes wildlife and wildlife habitat a liability instead of an asset." Much more testimony on the negative impacts of the current law is provided by the Texas House Committee on Natural Resources.<sup>33</sup>

## Chapter 2. A Market-Based Solution to Species Protection

To make the ESA a more effective species and habitat protection tool, habitat must be transformed, using market forces, into a valuable commodity that landowners "produce" or "consume." To assure that the amount of habitat stays above (or reaches) a biologically relevant safe minimum, it is important to carefully delineate the minimum amount of habitat that must be set aside or reclaimed.

Under an appropriate scheme, as in any market, habitat consumers would pay habitat producers a price per unit determined by the scarcity of habitat (as determined by the forces of supply and demand). The proper scheme would also maximize the opportunity for economic activity to coexist with flora and fauna. As noted in Chapter 1, the best way to enhance the likelihood of species protection is through an ecosystem approach that begins long before species

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<sup>32</sup>Valerie Richardson, "Add Species Act to Endangered List," *The Washington Times, National Weekly Edition*, February 13-19, 1995, p. 11.

<sup>33</sup>Op. cit.

are proposed for listing as threatened or endangered and that facilitates coexistence with economic activity to the maximum extent possible.

### **The Habitat Elimination Certificate**

In order to establish habitat as a valuable commodity, the authors propose the creation of a device that can be called a "habitat elimination certificate" (HEC). One HEC would allow its buyer to adopt land use practices on one acre that would be inconsistent with preserving that acre as habitat. The physical price of each HEC would be set by the government on an ecosystem basis as acres permanently maintained as habitat per habitat acre eliminated; the physical price would be set such that the amount of suitable habitat could not fall below a level that is sufficient from the standpoint of one or more species' biological requirements. The monetary price of a HEC would be set by market forces.

The HEC concept would operate through management agreements (see below) that are similar to tradable development rights and the marketable emission reduction credits (ERCs) authorized under the 1977 and 1990 amendments to the federal Clean Air Act. Under both schemes, an environmentally positive activity in one location (reducing emissions, creating or preserving habitat) generates rights that can be applied to an environmentally negative activity (new or continued emissions, habitat destruction) elsewhere.

The HEC market process also has similarities to the conservation plans that are a required element in the FWS procedures. Those plans include mitigation measures such as land acquisition and rehabilitation.<sup>34</sup> HEC management agreements would also involve property right transfers and habitat restoration.

Despite these similarities, the HEC market process differs significantly from ERCs as well as from current FWS procedures. First, within a given ecosystem, the ratio of habitat acres preserved as (or restored to) habitat per HEC is a known factor that is the same for everyone at any given time. Second, the purchase of a HEC would confer a right that could only be exercised once. Unlike ERCs, HECs could not be resold after the right conferred was exercised. While ERCs have a shelf life of several years, there is no expectation of future value (or price) of a HEC.

### **Advantages of the HEC Approach**

Even if particular HEC markets are not competitive, the HEC market approach would still have at least six advantages over the current FWS procedures and most published reform proposals.<sup>35</sup> First, the common interest in biodiversity could be pursued with a much smaller infringement on personal liberties.

Second, as explained in detail in the appendix, the HEC approach assures that agreed-upon safe biological minimums will not be violated. The number of acres within an

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<sup>34</sup>Carter, *op. cit.*

<sup>35</sup>Hudson, *op. cit.*; Kubasek and Browne, *op. cit.*

ecosystem that must be set aside as habitat, as well as the number of acres that must be protected in return for each acre available for HEC purchases, would be roughly determined in advance. As each of  $n$  HECs is purchased, an equivalent portion ( $1/n$ th) of the desired habitat maintenance outcome would be assured. This feature may help the HEC approach satisfy the U.S. Supreme Court's new "rough proportionality" test, outlined in the *Tigard* decision of June 24, 1994.<sup>36</sup> The Court, by a 5-4 vote, ruled that restrictions on developers amount to unconstitutional takings unless the government can show a "rough proportionality" between the restriction and the impact of the development.

Third, the HEC approach would compel the FWS, for each species or ecosystem, to make public and support with scientific documentation its definition of habitat, and its determination of how many acres meeting that definition would constitute a safe biological minimum. That would make it easier for Congress and the public to monitor the FWS' performance and much more difficult for anyone to selectively enforce the law for political gain. Politics would be confined to the broad issues where it belongs, and where the political process can work reasonably well, and kept out of the details, where it can only generate mischief and undercut public trust.

Fourth, while under the current scheme, the listing of a species lowers **all** affected property values, with the HEC process, each listing would raise land prices where the non-habitat use values are lowest. This would spread the economic benefits of development pressures such that a large fraction of landowners would cheer an imminent listing and eagerly reveal the presence of endangered species and the habitat or potential habitat on their land.

Fifth, though the value of property with high non-habitat use values could still be reduced in value by a listing, the decline would be smaller than under the current scheme, largely due to reduced delays (less uncertainty) and reduced procedural requirements (plans, surveys, etc.). Payment of the HEC's readily observable price would assure the right to proceed expeditiously with non-habitat uses. Moreover, HEC purchases could be subsidized (perhaps through tax credits or deductions) to the extent that the public is willing to share the cost of habitat protection and restoration.

Sixth, most landowners who enter into management agreements that generate HECs would retain title to the affected acreage, but the assessable value of that property (hence the landowner's property tax load) could fall significantly in some areas. This benefit would be especially welcomed by landowners who desire to remain on their homesteads despite development pressures (including ever-increasing property taxes).

Cost estimates in proposed regional habitat conservation plans (HCPs), such as the Balcones Canyonlands Conservation Plan<sup>37</sup> for central Texas, support the assertion that the HEC approach would be much less costly to developers. Under the Balcones HCP, habitat eliminators would help pay for refuge land in lieu of compliance with the ESA's Section 10(a) permitting process.

Gau and Jarrett<sup>38</sup> found that the proposed per-acre development fee could be set at a fraction of the per-acre cost to each landowner of complying with Section 10 (even without the

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<sup>36</sup>*Wall Street Journal*, op. cit.

<sup>37</sup>J. B. Ruhl, "Regional Habitat Conservation Planning under the ESA: Pushing the Legal and Practical Limits of Species Protection," *Southwestern Law Journal*, 44:4, 1991, pp. 1393-1425. See also Gau and Jarrett, op. cit.

<sup>38</sup>Op. cit.

big government and environmental group subsidies), and still generate enough funds for outright purchase of the targeted amount of refuge lands (habitat). In areas where the FWS procedures are being aggressively implemented, a switch to the HEC market would increase all property values, even where landowners were seeking permission to eliminate habitat.

## **HEC Management Agreements**

To create a HEC market within an ecosystem (or for a single species), the government would devise regionally standardized management agreements (similar to easements) aimed at protecting the habitat values of existing or newly created habitat on an ecosystem basis. Landowners would produce HECs by accepting these agreements, which would enable HEC purchasers to remove one acre per HEC from consideration as habitat.

An appropriate management agreement would include a mixture of required and banned activities, ranging from minimal land use constraints to active management, or even to outright purchase by the government for some extra-sensitive species. Through such agreements, many developers would be able to avoid out-of-pocket expenditures by producing the required HECs on some of their own acreage, thereby allowing them to eliminate habitat (consume HECs) elsewhere on their own property.

It would not be desirable, from either a biodiversity or an economic efficiency perspective, to mandate outright purchase in all cases. Such a mandate would actually be counter-productive, largely because the ability to maintain pristine ecosystems through outright purchase is minimal.<sup>39</sup> The challenge, then, is to define the terms under which humans and natural systems can coexist. As groups like The Nature Conservancy have demonstrated, deed restrictions (a type of management agreement) are usually enough.

The determination of physical price for HECs within an ecosystem would be largely, but not entirely, a scientific judgment. Biological requirements, while paramount, are not all-or-nothing. While it is true that the more stringent the requirements, the higher the probability of species survival, survival probabilities will always be less than 100 percent. Many extinctions occur without any human culpability, and attaining the last few percentage points toward greater certainty of species survival (through adding or upgrading habitat) could be prohibitively costly. The process of determining how much suitable habitat is enough requires a prior decision as to what constitutes acceptable probability for given species.

Like the determination of how much habitat is enough, both the selection of a definition for "habitat" and the determination of exactly which acres meet that definition are partly political questions. The correct definition of the property rights and the right physical price of HECs would depend on how habitat is defined and on three parameters, each expressed in units of land area: (1) Unprotected habitat (UH); (2) Safe minimum additional secure habitat (ASH); and (3) Potential habitat (PH). For details of how to calculate the minimum additional secure habitat (ASH) required for species preservation, see the appendix.

Management agreements can be updated to incorporate new information, such as biological discoveries or technical innovations. For example, say a relevant discovery is made in 1996. The management agreement necessary to create a HEC for sale after the discovery date could be revised to incorporate that new information. The new information could also be used to change the terms of management agreements that were part of a pre-1996 HEC transaction, but

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<sup>39</sup>Jan Ziegler, "Congress Seeks Action To Save Species," *New Scientist* (November 26, 1988), p. 21.

only if there is a willing buyer (the government) and a willing seller (a landowner bound to comply with the pre-1996 terms).

### **How HEC Markets Would Work**

Market forces would determine the dollar price (see Figure 1) of a HEC. The downward-sloping demand (D) line reflects the relative profitability of land use changes that eliminate habitat. For example, if a region's population began growing more rapidly, urban land uses would increase in value. That would raise the demand for HECs, thereby shifting D to the right, increasing the dollar price ( $P^*$ ) for a HEC and the number sold each year ( $Q^*$ ). Point A indicates each time period's highest return to such land use changes. Point B indicates how many acres of habitat would be eliminated if there was no policy. The upward-sloping supply (S) reflects the physical price, expected losses from foregoing land uses prohibited by the management agreement, and the costs of management practices that such agreements impose on landowners. The smaller the average size (over time) of  $Q^*$ , the longer it will take to set aside enough additional suitable habitat to sustain the species. Additional technical details are in the appendix.

By allowing a rental market for HECs, permanent habitat providers would not be the only landowners with an incentive to reveal and protect habitat. Landowners who expected to someday eliminate some of the habitat on their property could gain in the meantime. That would reduce their incentive to conceal or destroy species or their habitat, and it would also lower the probability that they would ultimately follow through with their habitat destruction plans. Once a rented HEC is taken from the market (by habitat elimination), the renter would have to replace it with another rental, or a purchase.

### **Figure 1. Determining the Dollar Price of HECs.**

The use of property rights and markets to retain biodiversity need not be limited to terrestrial plants and animals. Where air or water pollution threatens vulnerable species, effluent fees or tradable discharge permits could be used to fund mitigation measures or provide a safe level of minimum habitat. Where surface water or groundwater withdrawals during low flow periods threaten species habitat, water users could be required to share the expense of sustaining sufficient flows in the habitat areas, and or preserving the species in an artificial habitat until

normal flows resume.

Such a problem now exists in South Central Texas. Spring flows from the Edwards Aquifer sustain several endangered species. During a severe drought, pumpage could eliminate several species by temporarily destroying their habitat. Depending upon relative cost effectiveness, the right response is for aquifer users to pay for some combination of pumpage reduction through tradable firm and interruptible pumpage rights,<sup>40</sup> spring flow augmentation, and artificial habitat creation and maintenance.

Since no two acres are identical, the eliminated acre may be **better or worse** habitat than the area that will be protected to supply the HEC. Factors other than an area's physical features, including proximity to other habitat, are often important. To keep the HEC process from harming a species, an agency should be empowered to review, and perhaps modify or stop, HEC purchases challenged by a third party (government agency or citizen's group) on biological grounds. Such a government role is like a watermaster's power to modify or stop proposed water rights transfers challenged by another water user.

Since administrative procedures can be slow, costly, and vulnerable to being biased by special interest lobbying, review and modification powers should be statutorily limited to cases with clear, compelling scientific merit. The possible harm caused by not reviewing marginal cases could be expected to be offset by HEC transactions that have an above average species protection benefit. Such especially beneficial transactions are likely, because many activities that would require a HEC would not always render the impacted area entirely unsuitable for species use.

The HEC market process might also be more appropriate for government land than the current FWS procedures. Though agency directors might not react to market pressures in the same way as landowners, habitat-eliminating practices, through HEC purchase requirements, would still drive the acquisition of enough additional suitable habitat to protect a species.

Officials might frequently prefer the HEC process to the ESA Section 7 process that is available to virtually all government projects. Isolated examples - such as the Army buying red-cockaded woodpecker habitat to minimize the restrictions on their use of Fort Bragg<sup>41</sup> - hint that implementation of the HEC process could help government officials perform their tasks more efficiently.

### **Chapter 3. Bringing the HEC to Reality**

Given the premise that habitat elimination certificates would provide appropriate incentives for landowners to cooperate with federal and state regulatory officials in protecting and creating habitat for threatened and endangered species, there are still several questions to be answered regarding the best way to implement the concept of HEC markets.

#### **Why a Legislative Change Is Needed**

One question involves whether it is necessary to change the law at all. The ESA as

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<sup>40</sup>John Merrifield, "Groundwater Resources: The Transition from Capture to Allocation," working paper.

<sup>41</sup>Bean, Environmental Defense Fund Memo, 1992.

currently written does not prohibit the use of market mechanisms and incentives to reduce the elimination and increase the production of habitat. Regional habitat conservation plans, like that proposed for the Balcones Canyonlands in Texas, have not required any statutory changes, and the FWS could promulgate procedures to establish HEC markets without any statutory changes, either.

On the other hand, Ruhl<sup>42</sup> has pointed out that these regional habitat conservation plans stand on shaky legal ground, and by the same logic administratively created HEC markets would likely be a bad economic risk. The reason is that regulations not backed up by the force of law can be amended or even rescinded with changing political tides. Property rights granted administratively are therefore far less certain than rights undergirded by legislation.

Of equal importance, the current ESA comes into play only after a species has been proposed for listing as threatened or endangered. By amending the ESA so as to specifically authorize the creation of HEC markets, species could be protected within ecosystems prior to any proposed listing.

The HEC structure, which would vary widely depending on the extent and distribution of habitat, land ownership patterns, and development pressures, might not be fully competitive in some ecosystems. While (see Chapter 2) even an imperfectly competitive HEC market would be preferable to the existing FWS procedures, it is not necessary to abolish the Section 7 and Section 10 permitting procedures in the current law.

### **Implementation Steps for the FWS**

While the HEC process would reduce the paperwork needed for habitat protection (largely by eliminating case-by-case review), there would still be plenty of work for federal or state officials. To implement HEC markets, governmental agencies like the FWS would have the job of defining appropriate management agreement (MA) terms; estimating the amount of unprotected habitat (UH) and safe minimum additional secure habitat (ASH); ruling on contested HEC purchases; and enforcing HEC purchase requirements and the management agreements.

The FWS already does, or at least is required to do, the equivalent of defining and enforcing management agreements through its review of species recovery plans. With the recently begun National Biological Survey,<sup>43</sup> the FWS should soon be able to determine the values of UH and ASH for affected ecosystems. (Such a specific use of data obtained from the National Biological Survey in the HEC process should minimize fears that exist in some circles that the survey will be used as a land confiscation tool.) As noted in Chapter 2, the FWS could get by with a rough estimate of potential habitat (PH), which would require physical data and a restoration cost judgment.

The preferred ecosystems approach for HEC markets would eliminate the costly, lengthy, and politically sensitive listing process for thousands of potentially threatened or endangered species. Since the HEC process would relieve the FWS and landowners of the cost and uncertainty of case-by-case rulemaking, its implementation would not place greater demands on taxpayers. Indeed, the reverse is more likely.

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<sup>42</sup>Op. cit.

<sup>43</sup>*Wall Street Journal*, op. cit.

## Should Habitat Consumers Pay?

Two issues stand out in the debate over whether habitat preservation should be a burden on landowners. The first is the cost to the government of administering species protection programs; the second is the cost to the landowner of forfeiture of property rights in order to provide habitat.

A strong case can be made that the current FWS procedures are overly costly. After all, FWS appropriations increased nearly 80 percent from 1988 to 1992,<sup>44</sup> a time during which both landowners and environmentalists were becoming increasingly dissatisfied with the agency's performance. As explained in Chapter 2, the HEC market approach would be much less expensive to implement, especially if it is based on ecosystem management. In addition, the government's role in all but the most severely habitat-deficient areas would be limited to defining habitat, determining the amount of land within each ecosystem needed as habitat, defining appropriate management agreements for landowners considering producing HECs, and occasionally adjudicating disputes.

The HEC approach would also be far less expensive than forcing the government to reimburse landowners for taking their land for habitat without changing the FWS procedures and at the same time greatly increasing federal land holdings and associated land management costs. That is all that would be accomplished for landowners (and only those who suffer a minimum 20 percent value loss) through H.R. 925, a bill approved in February 1995 by the U.S. House of Representatives. The issue of "just compensation" for landowners whose property rights are compromised or forfeited under the current FWS procedures remains the chief focus of today's Congressional debate over ESA reauthorization.

On one side are landowners, who consider the habitat values of private land as a costless byproduct of land use practices that have left the values intact (or even created the habitat values), not as an unused right in the public domain.<sup>45</sup> Mark L. Pollot, *Grand Theft and Petit Larceny: Property Rights in America* (Pacific Research Institute for Public Policy, San Francisco), 1993. They believe the public should pay for the benefits once there is an opportunity cost.

On the other side are those who see uncompensated restrictions on habitat elimination as analogous to the widely accepted "polluter pays" principle. They argue that, if landowners are responsible for their share of impact on shared air and water, they should be responsible for their share of impact on biological diversity. According to that view, any restrictions on land to provide habitat do not entitle affected parties to compensation because they only represent a public claim of rights that landowners have left in the public domain.

The "polluter pays" analogy is rejected by some people because habitat elimination does not produce the kind of observable physical impairment of third-party property rights that pollutants do. The existence of public rights to protect species was established in the ESA, yet the law's failure to propose equitable means for allocating public costs for the assertion of those rights remains a chief obstacle to ending the range war between regulators and rural landowners.

The HEC approach actually provides a mechanism for resolving this dilemma. First, landowners will be able to capture the economic value in already-fallow land they agree to set

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<sup>44</sup>*Wall Street Journal*, op. cit.

<sup>45</sup>Yoram Barzel, *Economic Analysis of Property Rights* (Cambridge University Press, New York), 1989;

aside as habitat without in most cases ceding all their rights to the land. Second, HEC consumers would in most cases see the value of their own property rise as well, especially in areas where development pressures are highest.

The cost to the public for asserting its claimed public rights in these properties can be set as equal to the net loss in property value to both HEC producers and HEC consumers. Perhaps the government could compensate counties and other political subdivisions for the loss in tax revenues due to the lowered property values of land set aside as habitat. Another way to pay for this assertion of public rights would be to provide tax concessions to HEC purchasers who suffered a net loss (which should, of course, be automatic under the current tax code).

## Summary and Conclusions

The current FWS procedures for implementing the ESA do too little to protect species; they also threaten an unnecessarily high toll on some regional economies. The HEC market approach would create incentives to maintain and restore habitat and to avoid habitat elimination, and it would do so in a way that safe biological minimums could not be violated.

For landowners, the HEC approach would also represent an enormous improvement over the current system. Landowners with low-value non-habitat uses would be able to increase their incomes by supplying HECs. Landowners with valuable non-habitat uses would benefit by avoiding the costly, time-consuming, uncertain ESA Section 10(a) permitting process.

The HEC approach is designed to be consistent with the "polluter pays" principle, in that habitat eliminators (HEC consumers) would (when they do not produce HECs themselves) have to pay to for certain uses of their own property, while HEC providers would be rewarded for giving up certain property rights. While some property rights advocates may not be wholly appeased by this approach, it is far better than the current scheme in which all property rights in an area being considered for listing are in jeopardy and in limbo indefinitely. Moreover, by setting economic values on the rights being forfeited (the price of each HEC), the HEC approach also sets definable criteria for compensation of negatively affected landowners should Congress opt to provide for such reimbursement.

As noted earlier, the HEC approach has at least six advantages over the FWS' current procedures and most existing proposals (including the Clinton initiative). In addition, the proposed ESA revision could help avoid another unpleasant potential outcome of species protection efforts. Many natural scientists, including Reed F. Noss,<sup>46</sup> have concluded that "land use and human settlement patterns must be regulated, much more so than today." Measured in dollars or freedoms lost, what Noss suggests would be a much more costly approach than just specifying general outcomes, such as reducing the need for additional secure habitat to zero over time, and achieving them through economic incentives.

The greatest enemy of any reform proposal is inertia. Transition issues are always thorny, and people have proven willing to pay a high price to avoid the uncertainty that comes with change. They stick with the devil they know. A successful defense of the current FWS procedures against the proposed market-based reform, or replacement of the ESA with another command-and-control approach, would be a great tragedy.

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<sup>46</sup>Op. cit.

## Appendix: Technical Details

The correct definition of property rights and the right physical price of an HEC depends on how habitat is defined and on three parameters:

- (1) Unprotected habitat (UH);
- (2) Safe minimum additional secure habitat (ASH); and
- (3) Potential habitat (PH).

Each of these parameters is expressed in units of land area. Note that for any region:

$$\text{Total Area} = \text{PH} + \text{APH} + \text{UH} + \text{NH} \quad (\text{A-1})$$

$$\text{Minimum Suitable Habitat} = \text{APH} + \text{ASH} \quad (\text{A-2})$$

where APH = already protected habitat, including park and wildlife refuge acreage, and NH = land area that is not habitat, and that could not be made suitable habitat at a reasonable cost.

PH is the land area that cannot support the species now, but that could be made (at a reasonable cost) into habitat.  $\text{PH} > 0$  in most areas with a significant human population; for cost reasons, existing habitat (UH + APH) plus potential habitat (PH) is likely to be less than the amount of habitat that existed prior to human settlement.

A land use inventory would be needed to determine the values of UH and PH; a conservative estimate of PH would be sufficient. ASH depends on a species' behavioral characteristics and how much of its habitat is already protected, such as in parks or refuges. The objective of any species protection strategy should be to assure that enough land will remain as suitable habitat, or to make  $\text{ASH} = 0$ .

### Species Not Yet on the Brink of Extinction

By definition, a species is not on the brink of extinction (threatened or endangered) whenever  $\text{UH} > \text{ASH}$ . For expositional purposes, if  $\text{UH} = 1,200$  acres,  $\text{ASH} = 800$  acres, and  $\text{PH} = 200$  acres, another 800 acres must be assured of remaining suitable habitat to provide enough for the species to have a satisfactory chance to survive (or to protect a specified ecosystem). Those 800 acres would have to come through management agreements (MAs) for some combination of the 1,200 acres of existing, but unprotected habitat (UH) and restoration of some of the 200 acres of potential habitat (PH). To link habitat elimination and protection in a market, the 400 acres  $[(\text{UH} - \text{ASH}) = 1,200 - 800]$  that can still be eliminated without threatening the species must be used to bring about the protection of ASH of 800 more acres (equation A-3):

$$\text{ASH} = \text{PP} \times (\text{UH} - \text{ASH}) \quad (\text{A-3})$$

where PP = physical price, expressed as newly protected units of habitat per eliminated unit of habitat.

In this case, the physical price (PP) equates to 2 acres that must be protected per acre eliminated (Option A):

$$PP = ASH/(UH - ASH) \quad (A-4)$$

Alternatively, one non-habitat acre must be restored with an MA per acre eliminated (Option B).

There are two versions of pre-endangerment Option A. With the first version, appropriate MAs would be set up for 2.0 acres per acre of habitat eliminated. With the second, a total of 400 transferable HECs would be issued to landowners (public and private) in proportion to their share of unprotected habitat (UH), and an MA would be imposed on the remaining ASH acres. HEC sales would concentrate the habitat on the property where non-habitat land uses were the least valuable. The two versions of Option A would differ to the extent that MAs required active management.

With pre-endangerment Option B, landowners would obtain one HEC by purchasing a MA for one restored acre. Restoration would be more attractive as UH approaches ASH; that is, as the physical price increases [since  $PP = ASH/(UH - ASH)$ ]. If Option B were exercised, the physical price (PP) of Option A would decline because the conversion of an acre of potential habitat (PH) to habitat protected with a MA reduces ASH, but not UH.

To see how the physical price (PP) could change, use the numbers to examine the effect of purchasing 200 HECs, 100 each through Options A and B. The HEC purchases with Option A would shrink ASH by 200 acres and UH by 300 acres (100 eliminated, plus 200 protected), which by itself would leave  $ASH/(UH - ASH)$  unchanged at 2. But the use of Option B would further reduce ASH to 500, thereby changing PP to 1.25. Restoration of the other 100 acres of PH would lower the PP to 0.8. For administrative purposes, an annual update of the PP is sufficient. In cases where ASH and UH reach zero together, Option B would be the only remaining way to acquire a HEC.

### **Species on the Brink of Extinction**

The best time for government intervention to create and define property rights is before a species is endangered or threatened, or when  $UH > ASH$  (although a species could still be classed as "threatened" while  $UH > ASH$  based on the rate of decline of UH). Unfortunately, for many species, ASH already exceeds UH (though  $UH + PH$  may still be greater than ASH).

If ASH is roughly equal to  $(UH + PH)$ , there is nothing for market forces to allocate. The best approach in those instances, especially as PH's share of  $(UH + PH)$  increases, would be for the government to restore all of the PH acres, then to purchase a MA for all of the habitat. Short of that level of pro-active involvement, the current scheme is reasonably well-suited to such situations, which would be most likely to occur on small islands, isolated mountain summits, peninsulas, or other small, isolated habitats.

So long as  $(PH + UH) > ASH$ , it is possible to allocate up to  $[(PH + UH) - ASH]$  acres, and markets do that better than bureaus. To illustrate, let  $UH = 800$ ,  $ASH = 1,000$ , and  $PH = 400$  acres. Then the 200 acres  $[(PH + UH) - ASH]$  which can still be eliminated without threatening the species must be used to bring about the protection of 1,000 acres (ASH). (Timing is important; the restoration of new habitat must be completed before existing habitat is eliminated.) In other words,  $PP_B$  (the physical price when a species is on the brink of extinction) acres must be protected with a management agreement per acre eliminated.

$$(PH + UH - ASH) \times PP_B = ASH \quad (A-5)$$

or  $PP_B = ASH/(PH + UH - ASH)$  (A-6)

In this case,

$$PP_B = 5 [ASH/(PH + UH - ASH) = 1,000/(400 + 800 - 1,000) = 1,000/200].$$

Since it may be difficult to get a precise measure of PH, a conservative estimate of PH should be used in equations A-5 and A-6. The ratio

$$PH/(PH + UH), \text{ or } [200/(200 + 400) = (1/3)]$$

defines the share of  $PP_B$  that must be restored habitat. The remainder,

$$UH/(PH + UH), \text{ or } [400/(200 + 400) = 2/3],$$

of the acres to be covered by MAs could be existing habitat. If PH were large enough so that

$$PP_B \times [PH/(PH + UH)] < 1,$$

HEC transactions would produce a net habitat loss. To avoid that, the ratio of restored habitat to eliminated habitat should be no less than  $ASH/UH$  (or 1.25). In other words, when the amount of actual habitat is already too small, habitat elimination must be more than offset by restoration. Again, the eventual outcome of HEC purchases would be  $ASH = 0$ . Since habitat elimination would be more than offset by restoration, the policy would be analogous to the U.S. Environmental Protection Agency's (EPA) policy for areas with substandard air quality. EPA requires new polluters to more than offset their impact on air quality.

Using the numbers introduced already, suppose a developer wants to build homes on a 10-acre property. To acquire 10 HECs, he must pay the market value of a MA for at least 16.67 acres, or

$$10 \times PP_B \times PH/(UH + PH) = (10 \times 5 \times 1/3 = 50/3 \text{ acres},$$

of restored habitat, and MAs for up to the other 33.33 acres, or

$$10 \times PP_B \times [UH/(UH + PH)] = 10 \times 5 \times 2/3 = 100/3 \text{ acres},$$

for existing habitat. The net effect is a 43.33-acre decrease in UH (33.33 protected + 10 eliminated), and a 50-acre decrease in ASH, including 6.67 net new acres of habitat.

What if PH had been equal to 4,000, rather than 400? Then  $ASH/UH$  (1.25) is larger than

$$PP_B \times PH/(UH + PH) = 0.263 \times 0.833 = 0.219.$$

The 10-acre development would require a MA for 12.5 restored acres, and a MA for 0.44 acre, or

$$10 \times PP_B \times UH/(UH + PH) = 10 \times 0.263 \times 0.167,$$

A MARKET APPROACH TO PROTECTING HABITAT