

Three Paradoxes of Habitat Conservation Plans

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Abstract Habitat conservation plans (HCPs) are enabled under section 10(a) of the Endangered Species Act. The substantial increase since 1994 in the number of HCPs has motivated numerous critiques of nearly every aspect of HCPs. These critiques have overlooked several paradoxes that expose fundamental shortcomings of section 10(a) or its implementation. I refer to them as: the Trainwreck Paradox, the Jeopardy Paradox, and the Maximum Mitigation Paradox. The Trainwreck Paradox states that HCPs are needed to avert the listing of species as threatened or endangered, but federal listings are needed to motivate landowners to develop HCPs. The Jeopardy Paradox stems from the vague language of section 10(a) which allows an HCP to reduce the likelihood of a species' survival and recovery but establishes no objective limit on the magnitude of reduction. The Maximum Mitigation Paradox argues that if a landowner provides maximum mitigation at the onset of an HCP, then there will be no financial resources for adaptive management in the future, but if resources are reserved for adaptive management, then the landowner is not mitigating to the maximum extent practicable as required by section 10(a). The purpose of this article is to explain these paradoxes of HCPs and discuss potential remedies.

Keywords Endangered Species Act · Habitat conservation plans · HCP · Jeopardy

Introduction

The Endangered Species Act of 1973 (ESA, 16 U.S.C. §1531 et seq.) has been amended a number of times (Bean 1983). Arguably, the most radical amendment occurred in 1982 when the addition of section 10(a) enabled habitat conservation plans (HCPs). The purpose of this article is to expose paradoxes associated with section 10(a) and discuss potential remedies.

Prior to 1982, take of a federally-listed endangered or threatened species was absolutely prohibited. Section 10(a) permitted incidental take of federally-listed species subject to federal approval of an HCP. An HCP is the basis for a contract between an “applicant” (typically a private land owner) and the federal agencies responsible for protecting listed species, the U.S. Fish and Wildlife Service or the National Marine Fisheries Service (the Services). The contract (called an “implementation agreement”) allows a permittee (formerly the applicant) to degrade or destroy habitat in exchange for conservation measures that minimize and mitigate the habitat loss. According to section 10(a), issuance of an incidental take permit requires that: (1) the taking of federally listed species is incidental to otherwise lawful activities; (2) the taking is, to the maximum extent practicable, minimized and mitigated; (3) the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild; (4) adequate funding for the conservation plan is ensured; and (5) other measures required by the Services as being necessary and appropriate for the purposes of the plan are met.

Between 1983 and 1994 only 31 HCPs were approved (GAO 1994). HCPs were not as attractive to nonfederal landowners as Congress may have hoped. In 1994 the Clinton Administration established several policies designed to change this situation and garner support for the

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ESA (Moser 2000). The most significant and controversial of these policies was the “no-surprises” policy, which promised long-term regulatory certainty for approved HCPs. It stated that the Services would never require additional commitments of land or financial compensation beyond that agreed to under the terms of the HCP. Even if circumstances arose that could jeopardize the species survival, the permittee would not have to provide additional mitigation.

When the no-surprises policy was codified (USFWS and NMFS 1998b), the Services made a distinction between assurances for “changed circumstances” and assurances for “unforeseen circumstances” (50 C.F.R. §17.22). “Changed circumstances” are those “that can reasonably be anticipated” and “that can be planned for.” If additional mitigation is deemed necessary to respond to changed circumstances and such mitigation was provided for in the HCP, then the permittee would implement the additional mitigation as stipulated in the HCP. For instance, an HCP could require specific improvements to a particular conservation measure when monitoring shows that conservation measure is ineffective. However, if the HCP has no such provisions, then the permittee would not be obligated to any additional mitigation. “Unforeseen circumstances” are those “that could not reasonably have been anticipated.” If an unforeseen circumstance occurs, then changes to the HCP cannot involve additional land or financial compensation or additional land use restrictions.

The no-surprises policy proved to be very attractive to private landowners and led to a proliferation of HCPs. By the end of 1999, 259 HCPs had been approved and the Services were approving about 35 new HCPs per year (USFWS and NMFS 2000). The majority of HCPs have dealt with commercial forest management and real-estate development (Hood 1998). In 1999, the regulatory certainty provided by HCPs was formally expanded to cover non-listed species (USFWS 1999, 50 C.F.R. §17.22); such agreements are formally known as “candidate conservation agreements with assurances” (CCAAs), but they are still generically referred to as HCPs.

The substantial increase in HCPs motivated environmental organizations and scientists to focus a critical eye on HCPs. The result has been an extensive body of literature critiquing nearly every aspect of HCPs: regulatory assurances (Meffe and others 1996; Audubon 1997; Murphy and others 1997; Hood 1998); mitigation requirements (Bean and others 1991; Wilcove and others 1996; Audubon 1997; Hood 1998); adaptive management (Kareiva and others 1999; Thomas 2001a, b; Wilhere 2002); use of science (Noss and others 1997; Kareiva and others 1999; Harding and others 2001; Rahn and others 2006); public participation (Audubon 1997; Anderson and Yaffee 1998; Hood 1998, Thomas 2001a, b), and the planning process (Alagona and Pincetl 2008; Morrison 2000; Ostermeier and

others 2000; Smallwood 2000). These critiques have made important contributions to an ongoing dialogue regarding HCPs and the ESA; however, they have overlooked several paradoxes that expose fundamental shortcomings of section 10(a) or its implementation by the Services. I refer to them as: the Trainwreck Paradox, the Jeopardy Paradox, and the Maximum Mitigation Paradox.

The Trainwreck Paradox

Former Secretary of Interior Bruce Babbitt promoted HCPs as a means for avoiding “environmental and economic trainwrecks” (Dwyer and others 1995). The Secretary was referring to the collision of environmental and economic values often precipitated by the federal listing of threatened or endangered species. In theory, such trainwrecks could be avoided because HCPs would enable an equitable compromise between a landowner’s financial needs and the ecological needs of listed species. In reality, if a species is threatened or endangered with extinction, then the environmental trainwreck has already occurred. An HCP for a listed species is only a means for dealing with the wreckage.

In contrast, CCAAs provide a means for avoiding the trainwreck. Under the CCAA regulations (50 C.F.R. §17.22), the Services provide “no-surprises” assurances as an incentive for landowners to implement conservation measures for species that are proposed for listing under the ESA, candidates for listing, or are likely to become candidates in the near future. The CCAA policy is based on the following premises: (1) conservation measures are most effective and efficient when initiated early, i.e., well before federal listing is proposed; (2) private landowners want “no-surprises” assurances as an incentive for the conservation of declining species; (3) a sufficient number of CCAAs that remove or adequately reduce threats to a declining species can preclude the need to list that species; and (4) precluding the need to list a species will maintain land use and development flexibility for private landowners (USFWS and NMFS 1997).

In theory, CCAAs covering multiple landowners could protect enough habitat to avert listings in the future. In reality, however, landowners are typically much more concerned about economic trainwrecks than environmental ones. When a species is listed, the economic trainwreck for landowners is the federal prohibition on habitat destruction or degradation that severely reduces the financial value of their property. Hence, CCAAs are viewed by landowners as a means of proactively dealing with potential government regulations that cloud the future of their financial objectives. Consequently, most landowners will not seriously consider CCAAs until their financial objectives

appear to be threatened. Therein lays the Trainwreck Paradox: CCAAs are needed to avert the listing of species, but federal listings are needed to elicit CCAAs.

The circular causality of the Trainwreck Paradox is a logical outcome of economically rational decisions made by landowners. CCAAs are expensive, both their development and implementation. Hence, before engaging in a CCAA a smart landowner assesses his situation relative to the ESA, i.e., will his enterprise be more profitable with or without a CCAA (Fig. 1). A CCAA will be unattractive to a landowner who is not worried about future listings. If a declining species has already been displaced or its habitat has already been removed from his property, then the landowner has no need for a CCAA. If the federal listing process rarely results in new listings, then the ESA is unlikely to interfere with his business. If the presence of a listed species is unlikely to interfere with business activities, i.e., potential take prohibitions are expected to be lax or poorly enforced, then a CCAA is not worth the cost. The HCP approved for Simpson Timber Company in Washington State is an example (Simpson Timber 2000). The company’s lands are adjacent to federal lands which

currently support northern spotted owls (*Strix occidentalis caurina*), a federally-listed threatened species. Decades ago the company’s lands also supported numerous spotted owls. However, when their HCP was developed no spotted owls were known to occupy the company’s lands, and only about 5% of the 261,500 acres covered by the HCP might be classified as spotted owl habitat. Hence, the probability of future conflicts with spotted owls was negligible, and therefore, the Simpson Timber Company had no incentive to include any explicit provisions for spotted owls in their HCP. This was unfortunate because their HCP could have made a critical contribution to spotted owl conservation by connecting owl populations on the Olympic Peninsula and southwest Washington.

Landowners might also adopt a “wait-them-out” strategy. If the population of a federally listed or candidate species is declining, then the cost of waiting for that species to disappear or nearly disappear from the landowner’s property may be substantially less than the cost of an HCP or CCAA. In Washington, some timber companies constrained by the presence of spotted owls have expressed no interest in developing an HCP (Buchanan and Swedeen 2005). They seem to have adopted a wait-them-out strategy. In theory, a financially optimal strategy would have the landowner wait until the cost of an HCP is slightly less than the cost of continued waiting. One variable affecting this strategy is the rate at which the species is disappearing from the landowner’s property. A listed or candidate species with a rapidly declining population would encourage landowners to wait, but a relatively stable population would lead the landowner to do an HCP. Under this strategy, regulatory relief offered by an HCP could encourage landowners to travel further down the tracks toward the environmental trainwreck.

A landowner’s situation dictates the financially optimal strategy for dealing with the ESA; a strategy which may be contrary to species recovery. Hence, while section 10(a) was touted as the means to avoid trainwrecks, escaping the circular causality of the Trainwreck Paradox depends on other sections of the ESA: 4 and 9. How the Services implement or enforce these sections shape a landowner’s perception of their potential liabilities under the ESA. Section 4(b) describes the process for listing a species, and the Services execution of section 4(b) has been less than exemplary. A major problem with the listing process has been its slowness (Greenwald and others 2006). In 1992, the USFWS was sued for unreasonable delays in listing species (GAO 1993), and in 2003 the USFWS still had a backlog of about 250 candidate species in need of status review (GAO 2003). On numerous occasions courts have judged the Services’ failure to list a species to be “arbitrary and capricious” (Sidle 1998). Such judgments raised suspicions that some listing decisions were based more on politics than

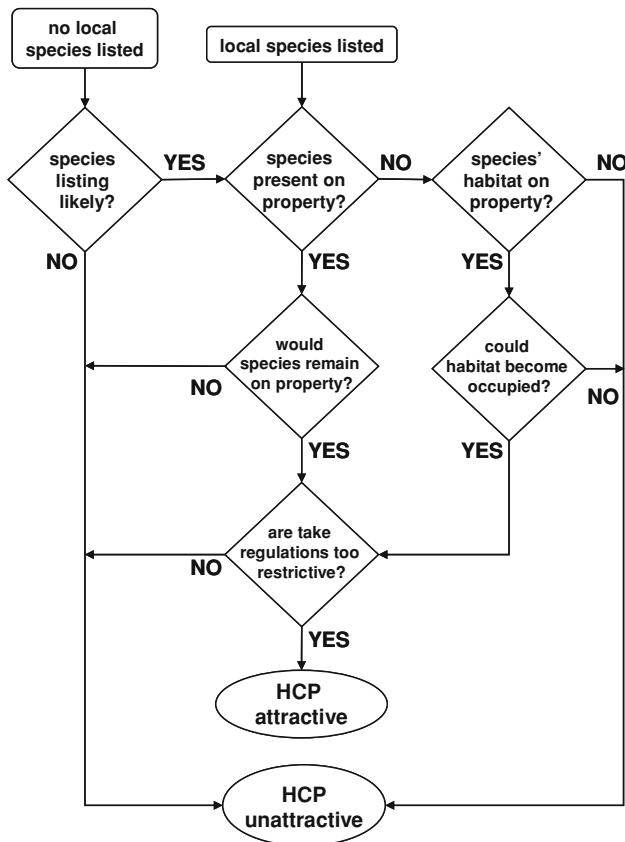


Fig. 1 Flowchart depicting a hypothetical decision process for private landowners determining whether they will benefit from an HCP or CCAA

science (Easter-Pilcher 1996; Ando 1999). However, the situation has improved. The General Accounting Office (2003) found that the vast majority of listing decisions issued during fiscal years 1999 through 2002 were scientifically sound. Nevertheless, the backlog of listing decisions and the lingering perception that the listing process can be politically influenced (Greenwald and others 2006), may reduce some landowners' anxiety regarding future listing of species. If that is so, then a CCAA may not be their most attractive option for dealing with the adverse economic impacts of potential future listings.

Section 9(a) prohibits the take of listed species. Take means to "harm, harass, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Harm or harass has been interpreted to include habitat modification (50 C.F.R. §17.3, *Babbitt v. Sweet Home* 1995). Enforcement of section 9(a) is difficult because: (1) the Services need to know the locations of listed species, and (2) proving harm by habitat modification is difficult (Polasky 1998). If the Services had the operational capacity and technical capabilities to overcome these two enforcement obstacles, then landowners' perceptions of potential liabilities under the ESA would be much greater than they are today. As a result, CCAs would be much more attractive to landowners and "environmental and economic trainwrecks" might actually be avoided.

The Jeopardy Paradox

Issuance of an incidental take permit requires that "the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild." Congress used this language to imply that permits issued under section 10(a) must also comply with section 7(a) of the ESA (U.S. Congress 1982). Section 7(a) mandates that each federal agency shall insure that any of their actions, including issuing permits, "is not likely to jeopardize the continued existence of any endangered or threatened species." The regulations promulgated by the Services to implement section 7(a) define "jeopardize the continued existence of" as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild" (50 C.F.R. §401.02). Hence, the permit issuance criterion of section 10(a) is essentially identical to the "jeopardy standard" of section 7(a) (USFWS and NMFS 1996).

According to the Services' definition of jeopardy, the incidental take permitted through an HCP can reduce the likelihood of survival and recovery, but not appreciably. But what is "appreciably"? NMFS provides this guidance (NMFS 2006, 2008a, b):

"The present risk faced by the [population] informs NMFS' determination of whether additional risk will 'appreciably reduce' the likelihood that the [population] will survive or recover in the wild. The greater the present risk, the more likely any additional risk resulting from the proposed action's effects on the abundance (population size), productivity, distribution, or genetic diversity of the [population] will be an appreciable reduction."

In other words, the amount of additional risk equal to an "appreciable" reduction depends on the present risk. Assuming we know the present risk, how much additional risk is "appreciable"? The aforementioned guidance, other guidance published by the Services (e.g., USFWS and NMFS 1998a), or the Services' policies do not say, and this vagueness results in a paradox—the Jeopardy Paradox.

The Jeopardy Paradox is a sorites paradox, which is a class of philosophical arguments that grapple with the concept of vagueness (Sorensen 2006). The paradox pertains to words that have indeterminate limits. "Sorites" is derived from a Greek word for "heap", a word with an indeterminate lower limit. We know that one grain of rice is not a heap. Adding another grain of rice still does not make a heap. We continue adding grains, but will adding just one grain of rice ever change a bunch of rice into a heap? If 99 grains are not a heap, can 100 grains be a heap? It seems that we can never create a heap of rice. However, we know that to be false; we can create a heap of rice.

The sorites paradox reveals the arbitrary nature of jeopardy standard. How much incidental take (grains of rice) will result in an appreciable reduction (a heap)? Lacking an operational definition of "appreciably", objective answers to this question are impossible. Jeopardy assessments are a scientifically challenging task for even the most well-studied species. Eliminating vagueness will not make this task any easier. It simply makes the task possible.

There is one straightforward solution to a sorites paradox—eliminate vagueness; and there are two ways to deal with the vagueness of the Jeopardy Paradox. First, the vague clause "will not appreciably reduce the likelihood" could be changed to "will not reduce the likelihood", "will not cause a net reduction in the likelihood", or "will not cause a long-term net reduction in the likelihood." These replacement clauses have an unambiguous threshold - zero reduction in likelihood. The second and third replacement clauses acknowledge the trade-offs inherent to HCPs and allow some flexibility for developing HCPs that are attractive to landowners. Many HCPs are already based on trades in which applicants promise to protect or restore habitat in some locations in exchange for permission to destroy habitat in other locations (e.g., WDNR 1997). The

third replacement clause allows such trades to occur in time as well as in space, however, “long-term” must be defined.

A “no net reduction” issuance criterion for HCPs would be difficult for applicants to satisfy. Therefore, the Services must do more to promote CCAAs. The Services believe that if CCAAs are implemented before a species and its habitats are imperiled, then conservation measures required of the applicant will be simpler and less costly (USFWS and NMFS 1997). If this is true, then landowners might reduce threats to a declining species while profiting from land use and development.

A second way to eliminate vagueness is through an operational definition. “Jeopardize” is currently defined in terms of “likelihood.” Likelihood is usually expressed as a probability. Vagueness could be eliminated by specifying a minimum probability for the survival and recovery of a listed species. There are three ways to do that: Congress could amend the ESA, the Services could revise 50 C.F.R. §401.02, or the Services could adopt a new policy. Expecting Congress to write a minimum survival probability into law is unrealistic. The ESA is already highly contentious. Therefore, the Services must act, and the Clean Air Act (CAA, 42 U.S.C. §7401 et seq.) provides a model for how to do it. The CAA states that emission standards must “provide an ample margin of safety to protect public health.” However, the CAA does not define “ample”—a situation similar to the Jeopardy Paradox. The U.S. Environmental Protection Agency (USEPA), which implements and enforces the CAA, directly addressed this issue by adopting quantitative objectives for acceptable risk: (1) protecting the greatest number of persons possible to an individual lifetime risk level no higher than approximately 1-in-1 million, and (2) limiting to no higher than approximately 1-in-10 thousand the estimated risk that a person living near a facility would have if he or she were exposed to the maximum pollutant concentration for 70 years (USEPA 1989). These acceptable risks are the USEPA’s interpretation of “ample” and are effectively USEPA policy (USEPA 2007).

In addition to developing an operational definition of acceptable risk, the USEPA has invested substantial resources in acquiring knowledge and developing methods for assessing environmental risks. Congress directed the USEPA to arrange for the National Academy of Sciences to review the USEPA’s risk assessment methodology (U.S.C. §7412(o)). The subsequent report (NRC 1994) and USEPA’s efforts thereafter (USEPA 1998, 2003, 2009 and over 40 USEPA reports cited therein) constitute an impressive body of knowledge and guidance for conducting risk assessments. In contrast, the Services have one report on procedures for section 7(a) consultations (USFWS and NMFS 1998a; C. Johnson NMFS, personal communication, 7 July 2009; C. Scafidi, USFWS, personal

communication 16 July 2009), and this report offers no guidance whatsoever on quantitative methods of risk assessment.

Assessing extinction risk for species in the wild is much more challenging than assessing health risks posed by air pollution. Empirical information on the autecology and population demography of listed species is often scarce, and therefore, conventional approaches to assessing extinction risk, such as population viability analysis, may be unworkable. However, approaches that supplement empirical data with expert judgment in a rigorous quantitative framework, such as Bayesian networks or fuzzy sets, have been used to assess species status and population viability (Akçakaya and others 2000; Regan and others 2000; Marcot and others 2001; Amstrup and others 2007). These approaches appear promising and warrant further investigation.

Given the technical challenges of assessing the likelihood of survival and recovery of species in the wild, the Services would do well to follow the USEPA’s example by (1) adopting a quantitative interpretation of “jeopardize”, (2) seeking a review of their jeopardy assessment methodology by an independent organization such as the National Academy of Sciences, and (3) developing the technical wherewithal for conducting quantitative risk assessments for listed species.

A quantitative interpretation of “jeopardize” would force a momentous policy debate on the value of biodiversity and society’s obligation to preserve it (Rohlf 2001). Determining a level of acceptable risk necessarily entails trade-offs between a variety of ecological, economic, and social factors (Wilhere 2008), and therefore, the debate would be highly contentious and potentially intractable. Nevertheless, if the USEPA can establish acceptable risks to humans, a decision no less controversial, than the Services should be able to do the same for other species.

The Maximum Mitigation Paradox

Issuance of an incidental take permit requires that (1) the impacts of such taking are, to the maximum extent practicable, minimized and mitigated, and (2) other measures required by the Services as being necessary and appropriate for the purposes of the plan are met. The extent to which an applicant can minimize and mitigate the impacts of take is essentially an economic matter. “Maximum extent practicable” demands that the cost of an HCP be the maximum that the applicant can practicably afford. At least three federal courts have affirmed this interpretation (*Sierra Club v. Babbitt* 1998; *National Wildlife Federation v. Babbitt* 2000; *Gerber v. Norton* 2002). In *National Wildlife Federation v. Babbitt* the court stated:

“... the record should provide some basis for concluding, not just that the chosen mitigation fee and land preservation ratio are practicable, but that a higher fee and ratio would be impracticable.”

and

“... ‘the maximum extent practicable’ is not satisfied by a fee set, as here, at the minimum amount necessary to meet the minimum biological necessities of the covered species. The record lacks adequate evidence and analysis of whether a fee higher than that initially proposed by the [Natomas Basin HCP] working group would be economically practical”

In other words, an HCP’s mitigation is the “maximum extent practicable” if, and only if, greater mitigation is economically impractical.

“Other measures required by the Services” gives the Services rather open-ended authority which they have wielded to require adaptive management for most HCPs. Adaptive management can be defined as the systematic acquisition and application of reliable information to improve management over time (Wilhere 2002). The fundamental purpose of adaptive management is to deal with uncertainty in natural resources management. HCPs and CCAAs often cover species that are poorly understood or for which we lack essential information (Kareiva and others 1999), and therefore, the Services often require some form of adaptive management. Monitoring done for adaptive management might indicate that an HCP is not achieving conservation objectives. As a consequence, adjustment of the HCP could be triggered through the “changed circumstances” provisions of the implementation agreement.

Adjustments triggered by changed circumstances could entail more mitigation and more mitigation invariably increases the cost of an HCP. Therefore, in order to respond to changed circumstances, the permittee must keep some financial resources in reserve. But, if the permittee has some financial resources in reserve, then he has not been mitigating take to the maximum extent practicable. On the other hand, if the permittee is mitigating take to the maximum extent practicable, then he has no financial resources with which to respond to changed circumstances. This is the Maximum Mitigation Paradox.

Consider these three examples of the Maximum Mitigation Paradox. First, in its findings on the Plum Creek Timber Company Native Fish HCP (USFWS 2000), the USFWS stated, “Plum Creek will minimize and mitigate impacts of their actions to the maximum extent practicable by: ... agreeing that if at any point in the future the Service determines that the improving trend in habitat quality is insufficient to remove threats to the permit species, the Service can ask Plum Creek to provide more minimization

and mitigation.” The USFWS clearly believes it could obtain more mitigation from the permittee. But, if Plum Creek can actually provide more mitigation, then Plum Creek is not mitigating to the maximum extent practicable. On the other hand, if Plum Creek did mitigate to the maximum extent practicable from the onset of the HCP, then Plum Creek could not afford more mitigation in the future.

Second, in the Washington Department of Natural Resources HCP (WDNR 1997), the permittee commits to providing at least 5% ground cover of down woody debris, an essential component of spotted owl habitat. In the implementation agreement, WDNR agrees to increase the amount of down woody debris when scientific data indicate that an increase is required, but the increase is limited to 15% ground cover. The implementation agreement clearly implies that WDNR believes it could financially afford to provide more downed woody debris. If WDNR can afford to provide more than 5% ground cover of downed woody debris, then it is not mitigating to the maximum extent practicable. On the other hand, if at the onset of the HCP WDNR provided 15% ground cover, could it then afford additional mitigation that might be triggered through adaptive management?

Third, the East Contra Costa County HCP (HCP Association 2006) promises a monitoring and adaptive management program that will evaluate the success of management in achieving preferred habitat conditions. The HCP forthrightly acknowledges that “monitoring may also indicate that some management measures are less effective than anticipated.” The permittee’s response to such circumstances is limited to “alternative or modified management measures... consistent with existing funding.” In other words, if monitoring indicates that the HCP is failing to meet its conservation objectives, then the cost of additional mitigation might not be borne by the permittee. If the East Contra Costa County HCP truly mitigates impacts to “maximum extent practicable”, then this arrangement is legitimate under the no-surprises policy (50 C.F.R. §17.22). However, the HCP does not explain what will be done when the HCP fails to meet conservation objectives and the cost of meeting those objectives exceeds “existing funding.” Less than 1 percent of this HCP’s total budget has been allocated for responses to “changed circumstance or the failure to meet performance standards” (USFWS 2007). If the East Contra Costa County HCP is found to be failing and funds for additional mitigation are not adequate, then the HCP would subject species to a greater risk of extinction.

One way to resolve with the Maximum Mitigation Paradox is to eliminate the “maximum extent practicable” clause from the issuance criterion. There are several reasons for doing this. First, and most importantly, the financial resources which a permittee devotes to an HCP

are not relevant to the purposes of the ESA. If an HCP satisfies the section 10 jeopardy criterion (in particular, a new unambiguous criterion), then the cost of mitigation is of little consequence to the species. Second, many applicants consider their financial situation to be confidential information. Forcing applicants to reveal how much mitigation they can afford could discourage the development of HCPs or CCAAs. And, subjecting applicants to an in-depth assessment of their financial wherewithal adds further complications and contention to an already complicated and contentious process. Third, eliminating this criterion would facilitate genuine adaptive management. If permittees are not required to mitigate to the maximum extent practicable at the onset of their HCP, then they can hold financial resources in reserve to respond to changed circumstances.

The fourth reason to eliminate the “maximum extent practicable” clause is that it is difficult to interpret. In *National Wildlife Federation v. Norton* (2004), the court noted that this issuance criterion is “ambiguous”, “joins together two somewhat opposing concepts, ‘maximum’ and ‘practicable’”, and that it could lead to “absurd results” such as “... a permit that allows disturbance of one acre of [listed species] habitat could require the developer to create and manage one thousand acres of replacement habitat if that was the maximum the developer could afford.”

When evaluating HCPs the Services’ have often avoided an explicit evaluation of the “maximum extent practicable” criterion. Instead, the Services have evaluated “whether the conservation measures are rationally related to the level of take anticipated under the plan” (e.g., USFWS 2006, 2007). The statutory basis for mitigation “rationally related to the level of take” is nowhere to be found in section 10(a). Nevertheless, in *National Wildlife Federation v. Norton* (2004) the court deferred to the Service’s construction of the statute because it was reasonable and avoided absurd results. In contrast, prior court rulings (*Sierra Club v. Babbitt* 1998; *National Wildlife Federation v. Babbitt* 2000; *Gerber v. Norton* 2002) followed a “plain language” interpretation: the mitigation of an HCP is the “maximum extent practicable” if, and only if, greater mitigation is economically impractical.

National Wildlife Federation v. Norton (2004) granted the Services’ deference in how they may interpret the “maximum extent practicable”, but it also created a potential source of future contention between the Services and HCP applicants. The court said, “The words ‘maximum extent practicable’ signify that the applicant may do something less than fully minimize and mitigate the impacts of the take where do to more would not be practicable.” The Services desire mitigation that is at least “commensurate with the impacts to the species” (e.g., USFWS 2006, 2007). This third interpretation may put the

Services at a disadvantage when negotiating with applicants. The divergent interpretations of “maximum extent practicable” demonstrate that the clause is ambiguous, and therefore, it should be revised or eliminated.

On the other hand, there is a reason for creating an issuance criterion similar to the “maximum extent practicable.” The Services need a mechanism for ensuring that a permittee has financial resources in reserve to cover the costs of additional mitigation triggered through adaptive management. Ensuring that a permittee maintains financial resources in reserve could be accomplished through an assurance bond. Mitigation requirements might consist of two parts: (1) the minimum mitigation needed to satisfy the jeopardy criterion (i.e., a new unambiguous criterion) and (2) an assurance bond equal to either (a) the predicted costs of potential worst-case damages or (b) the maximum the permittee can practicably afford. “Potential worst-case damages” could be expressed as the amount of unauthorized incidental take predicted to occur under a worst-case scenario. The cost of worst-case damages could equal the cost of mitigation necessary to fully compensate for the unauthorized incidental take. The applicant could specify which assurance bond option they wished to pursue, and offering these options avoids the absurd interpretation of “maximum extent practicable” described *National Wildlife Federation v. Norton* (2004). Most applicants would conceivably choose the first option to simply avoid opening their financial affairs to examination.

The assurance bond would be used to cover the costs of additional mitigation that may be necessary in the future, and the unspent portion of the bond would be returned with interest to the permittee after the permittee demonstrates through monitoring and adaptive management that the HCP has achieved its conservation objectives. When and how portions of the bond will be spent for additional mitigation would be specified in the changed circumstances provisions of the HCP’s implementation agreement. This assurance bond is similar to one proposed by Wilhere (2002) except that the current proposal limits the size of the bond to the maximum the permittee can practicably afford.

Conclusion

The ESA has been law for 36 years. Since 1973, the ESA has been reauthorized three times, most recently in 1988, and was due for reauthorization in 1992. It remains unreauthorized. The 17-year delay in reauthorization reflects the political controversy that continually surrounds the ESA. This controversy might only be allayed through political compromises that make major amendments to the ESA. I have identified and explained three paradoxes of

HCPs that will hopefully be addressed when the ESA is amended and finally reauthorized.

During the 27 years since the ESA was amended to enable HCPs, science has greatly advanced our understanding of population viability and has developed methods for assessing extinction risk. Rigorous quantitative methods for using expert judgment have also advanced during this time. The Services should follow the example of the USEPA and do the following. First, unambiguously define the vague words “jeopardize” and “appreciably” in terms of acceptable risk. As the Jeopardy Paradox demonstrates, objective determinations of jeopardy are currently impossible. An operational definition of jeopardy is necessary, and the process for developing that definition will be highly contentious. Nevertheless, an effort must be made. Second, develop the technical capability and institutional capacity for quantitatively assessing the likelihood of species survival. The science of species extinction risk is much less mature than the science of environmental human health risks, but one reason for this may be the comparatively scant resources which the Services have invested in risk assessment methodology. If the Services had expended one-tenth the effort the USEPA has expended on developing risk assessment methodologies, then methodologies for assessing extinction risk might be far more advanced than they are today.

Twenty-seven years ago adaptive management was a new concept that was practically unknown amongst natural resource managers. During the past 27 years managers have come to understand and acknowledge the need for adaptive management. Adaptive management is needed when outcomes are uncertain and the consequence of failure is the degradation or loss of valuable natural resources (Wilhere 2008). That describes the situation of most large HCPs—outcomes are uncertain and conservation measures could fail. Through adaptive management, failing conservation measures can be corrected, but some corrections will entail additional mitigation. Hence, permittees must have financial resources in reserve to cover the future costs of additional mitigation. The Maximum Mitigation Paradox points out that if a permittee is mitigating take to the maximum extent practicable at the onset of an HCP, then he has no financial resources with which to make future corrections to a failing HCP. An amended section 10(a) should eliminate the “maximum extent practicable” issuance criterion and allow a cost allocation between mitigation done at the onset of an HCP and potential future mitigation done as part of an adaptive management program. An assurance bond might be instituted to ensure that permittees hold financial resources in reserve to cover the costs of additional mitigation that may be necessary in the future.

HCPs and CCAAs are valuable tools for habitat conservation on nonfederal lands. However, according to the

Trainwreck Paradox, realizing the full potential of section 10(a) depends on other sections of the ESA, in particular, sections 4(b) and 9(a). Landowners engage in HCPs or CCAAs to avoid economic entanglements with the ESA, and such entanglements will become more apparent when sections 4 and 9 are conscientiously executed by the Services. If these sections of the ESA are undermined, then “environmental and economic trainwrecks” will not be avoided, and HCPs will be nothing more than a means for dealing with the environmental trainwreck that is an endangered or threatened species. CCAAs covering multiple landowners could protect enough habitat to avert listings in the future. Therefore, CCAAs, not HCPs, provide a means for avoiding the trainwreck.

Landowners may also be encouraged to develop HCPs or CCAAs through incentives. The no surprises policy created a highly attractive incentive that resulted in an HCP boom. Developing a conservation plan can be time consuming and expensive (Alagona and Pincetl 2008), and this may discourage many landowners from even considering an HCP or CCAA. To reduce this disincentive, the USFWS has established a funding program known as “Habitat Conservation Planning Assistance Grants” that support the development of HCPs and CCAAs. From 2002 to 2009 it dispersed, on average, \$7.7 million per year to about 20 plans per year (USFWS 2009). The Services should investigate whether more funding might increase the number and quality of CCAAs. Given that most federally-listed species have at least 80% of their habitat on non-federal land and at least one-third have all their known habitat on nonfederal land (GAO 1994), increasing the number and quality of HCPs and especially CCAAs may be the most effective way to conserve our nation’s biodiversity.

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