Treating Threatened and Endangered Species as a Common-Pool Resource: An Institutional Analysis of Wyoming and Colorado and the Challenges of Wildlife Conservation.

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December 1, 1999
Y673 Paper for class on empirical theory and methodology in the Workshop in Theory and Policy Analysis

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characteristic that biodiversity has, is the problem of exclusivity. This is due, in part, to the difficulty in establishing well-defined property rights for biological services.[1] For example, a wild animal may occupy space on a parcel of private land, and thus be temporarily subject to certain discretions of the landowner. However, landowners usually cannot employ legal mechanisms to exclude the animal from others by sequestering or restricting its movement. Wild animals are wild precisely because they lack such restrictions. Another property of wildlife is its general subtractability. For example, once a plant is burned or reaped, it is no longer available to others. Wildlife species are demonstrably renewable. But this manifests one of the characteristic challenges inextricably yoked to wildlife conservation; that is, habitat. For a plant or animal to exist and proliferate, it must have suitable environmental conditions to allow it to do so. Some species are robust, in the sense that they are minimally affected by human development. Indeed some species benefit from human presence, such as squirrels, crows, sparrows, pigeons, dandelions, "weeds", etc. But other species are much more sensitive to human activity, and these are the ones which are of concern in this paper.

Species conservation is perhaps one of the more complicated CPR situations because, like other large and global CPR situations, it often spans the entire scale of institutions, making coordination exacting. While some plants and animals are relatively sedentary and localized in distribution, a great many species migrate, roam, or simply wander across county, state, and even international lines of political jurisdiction (part of the exclusivity problem). This creates an opportunity, if not necessity, for cooperation across institutional boundaries - so that a single small-scale institution may have to

[1] Shogren (1998), p.48.

coordinate with other local, county, state, and national institutions. Things become extremely complicated when specific wildlife concerns are unique and endogenous to specific regions, and the regions themselves are divided into social and political cultures which are, themselves, unique and endogenous. Such a milieu makes it difficult to apply a large-scale universal policy with equal success, and coordination problems can be exaggerated within the tangle of scales.

The Value of Biota

Biota equals the sum total of plant and animal species inhabiting a prescribed area, such as a state. Using the terms of a great amount of research on CPRs, biota can justifiably be considered a common-pool resource.[2] Nevertheless, the value of biota as a resource contains in it some complexities and stratification. One is that game species, which are not always abundant, are viewed exactly as resources and their management and law enforcement for non-migratory species are done by state fish and wildlife departments by whatever name (e.g. DNR, State Fish and Wildlife Service, etc.). Market processes work considerably well in the management of game species. Millions of hunters, dispersed in every state throughout the country, ensure that steps are taken to preserve enough habitat and protection to allow for recreational harvest of game species. State institutions have a clear mandate to protect game species and habitat. They receive funds through state allocations but also through licensing permits, which serve as a reliable measure for the priority of an animal in that particular market. Thus, this part of

[2] I mean here the defining elements outlined by Elinor Ostrom and her colleagues in numerous publications. See specifically Ostrom, Gardner, and Walker (1994).

the biota is relatively well taken care of in the commons by that set of actors and agreements.

Another part of the biota is valued for other, less definable, reasons. For many species, conservation by market mechanisms becomes more problematic. For example, some value is assigned by some as signatures of nature, such as songbirds. Others are considered to be an essential part of an ecological balance but otherwise offer no direct aesthetic or easily observable benefit. The fact is, the majority of biota is abundant and unthreatened and is therefore ignored for the present.

But then there are the rare, threatened and endangered species. These generally have no tangible value as a resource; except as much as they impact other resources uses, such as mining, grazing, farming, logging, construction, which are limited by the presence of them. In such situations, these economic activities can decrease the abundance of these species; and inasmuch as the public wishes to preserve these species, this economic activity can be viewed as creating an externality. When a clearly economic activity comes into conflict with popular but amorphous ideology, market mechanisms often fail to achieve a satisfying equilibrium; and this is when government must often step in fray. And a substantial fray this has been.

Because of these dynamics, some attempts have been made to better define the value of endangered and threatened species. This is important because, although environmentalists have trouble providing convincing figures over the value of rare plant and animal species, businesses that come into conflict with environmental interest do not seem to have the same trouble. Ranchers, farmers, logging and mining industries have been quick to furnish the numbers, and claim millions in lost revenue due to

environmental regulations. These losses incurred, however, are also difficult to pinpoint exactly because they mostly rely upon estimates reflecting potential or probable projected revenue. Economist Jason Shogren finds that economic costs of such environmental policy to private property owners can be categorized into three broad areas: actual expenditures, opportunity costs of restricted land use, and opportunity costs of public expenditures on endangered species. Actual expenditures are transaction costs arising from time and money spent on applying for permits and licenses, redesigning plans, and paying legal fees. Opportunity costs measure foregone opportunities due to restrictions on the use of property caused by listings, designation of critical habitat, and recovery plans.[3] A vigorous campaign to preserve even one species can have tremendous impacts. In Washington and Oregon, it has been estimated that short-term economic losses will run about 1.2 billion in order to protect the northern spotted owl. These include costs incurred mainly by timber foregone, jobs lost, and displaced workers.[4] Some have shown that the costs of protecting species also have a tendency to grow geometrically. For example, it has also been estimated that a recovery plan that increases survival odds of the northern spotted owl to 91% for about 1,600 to 2,400 owl pairs will decrease economic welfare by $33 billion. And if the recovery plan attempts to increase the survival odds to 95%, welfare losses increase to $46 billion.[5]

In the face of such startling negative figures reflecting loss of economic activities, some efforts have been made to apply positive value to the existence of a species. This attempt has generally had to quantify the social value of species. Like charity, voting,

[3] Shogren (1998), p.55.
[4] Ibid, p.56.

and other largely civic activities, action taken on the basis of such preferences are difficult to explain with rational-choice models, and rely on what is called the "warm-glow" effect. It is a difficult task to measure biotic value; and the price that the public claims it is willing to pay will probably never match up to the price that industry claims it will lose. Nevertheless, a study conducted by J. Loomis and D. White reports that the average individual's lump sum willingness to pay ranges from $12.99 to avoid the loss of the sea turtle, to over $254 to increase the population of the bald eagle. It also ranges the average individual's annual willingness to pay from $6 to avoid loss of the striped shiner, to over $95 to avoid the loss of the northern spotted owl.[6] At the end of the day, however, the inability to exclude others from enjoying the benefits or suffering costs prevents the market price from sending the correct signal about the true value of the endangered species.[7]

Information and Communication

Two special concerns for those involved in species conservation issues are information and communication. This is true for all CPRs; however, conservation programs live and die by the effective collection and use of information. In economic terms, in order for a party to act in response to any externality, it must first realize that the externality is there. In the case of threatened or endangered species, the externality consists only of the knowledge that it is there. To illustrate, most people never see threatened and endangered wildlife. Most people never *expect* to see threatened or

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[5] Ibid.

endangered wildlife. In fact, for the most part, the only way that citizens become aware that a species is facing extinction is that they are told it is so. In order for the public to perceive that there is a problem, most people must be informed that there is a problem, they must informed on how serious the problem is, and they must be convinced, secondhand at best, that a problem is serious enough to warrant attention - and the pursuit of that warm glow. Depending on one's interests, efforts should be made to conceal or disseminate certain bits of information (such as where and how much a certain species manifests). In very real sense, wildlife conservation becomes a matter of perception. And thus, the collection and management of information is of great consequence to the whole affair.

The United States and Species Conservation

We are lucky enough, in this country, not to have to rely much on either wild plants or wild animals to meet our nutritional or resource needs. However, there has, over the years, been a steady mandate from the public for the conservation of natural wildlife species. Whether it is a warm glow or a perceived economic benefit, biodiversity has become a prominent and enduring issue in this country - as indeed it has for the world.

Whether or not institutions within the U.S. have made policy consistent with its public expression, there is little doubt that America's natural heritage has always been integral to its culture. For thinkers like Tocqueville, Emerson, and Thoreau, to writers

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[6] Ibid, p.62.
[7] Ibid, p.39.

like Hawthorne and Leopold, and American artists of all media, America in its wildness was a matter of great social consequence and usually a source of great pride. This is juxtaposed, of course, with the reality that species extinction has been (and is being) carried out at a blinding rate (in geological terms) in the United States for the span of its republican history - and this was not always due simply to neglect or oversight. However, the Federal and state governments made occasional but regular steps in response to threats to the nation's biotic heritage, starting most prominently with the passage of the Lacy Act in 1900, which prohibited the interstate exportation of game (see appendix).[8] It wasn't until 1973, with the passage of the Endangered Species Act (ESA), however, that enough pressure was brought to bear on the U.S. Federal government for the implementation of a comprehensive law concerning rare species preservation.

The Endangered Species Act

By recognizing the classification of "threatened," the ESA gave federal agencies the authority to act in response to the possible extinction of species before it was too late. It extended its existing authority for making and enforcing environmental policy; and it generally made the Federal government more instrumental in the effort to curtail the loss of the country's plant and animal resources. Congress passed the Act because it found that, "various species of fish, wildlife, and plants in the United States have been rendered extinct as a consequence of economic growth and development untempered by adequate concern and conservation " - sec.2(a)(2). They were considered worth saving because,

[8] Table 2.1 reprinted from Anderson (1998).

"these fish, wildlife, and plants are of aesthetic, ecological, educational, historical, recreational, and scientific value to the Nation and its people" - sec.2(a)(3).

Although the details concerning time frames, allocations, and reporting schedule, etc. are somewhat intricate, the *modus operandi* of the ESA is relatively straight-forward. The responsibility for overseeing the enforcement of the ESA is shared by the Department of Commerce (DOC) and the Department of the Interior (DOI). The DOC looks after most marine species while the DOI oversees all of the rest. By far, most of the issues related to the ESA occur under the authority of the DOI. Within the DOI, it is the responsibility of the United States Fish and Wildlife Service (USFW) to enact and enforce all policies made to the jurisdiction of the ESA. Any individual or party may submit a petition for the USFW, which has a legal obligation to review it (See fig.1). The USFW has just 90 days, from the day the petition was submitted, to report a decision of whether or not the claim in the petition is worth pursuing. If it decides it is not legitimate, then the process stops there. If it decides that the claim is justified, then it proceeds with a nine month review - at the end of which the Secretary of the Interior has a legal obligation to publish one of three judgments in the Federal Register: 1) the petitioned action is not warranted, 2) the petitioned action is warranted, or 3) the petitioned action is warranted but precluded because its priority is, as of yet, relatively low. If the Secretary, via the USFW, finds that the petitioned action is warranted, then it has one year, from the date on which the general notice was published, to "list" a species as having endangered or threatened status (this period may be extended up to six months if more information needs to be collected).

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Once a species is listed, the Secretary shall draw up and implement a "recovery plan," which authorizes the USFW to take whatever actions deemed necessary to ensure the, "conservation and survival of endangered species and threatened species listed..." - sec.4(f)(1). Such action may, and often does, lead to restrictions on land use of public and private property. At each step of the process, those responsible for listing species are required to take into account input from all involved parties. This includes local governments, interest groups (environmental and commodity producer), citizens, and the epistemic community. Each step founds its determination, "solely on the basis of the best scientific and commercial data [available]" - sec.4(b)(1)(A). This is another example of how the flow of information is of critical importance to this issue. Nevertheless, Congress' pledge to authorize only objective scientific data, the plausibility of government restrictions on land use provoke some of the most incendiary responses from citizens. To private landowners, especially, this action is considered economically backward, intrusive, and unconstitutional. To some, it represents the beginning of a slippery slope towards abolishment of private property.[9]

Cooperation, Incentives, and Preferences

Problems inherent in complex cooperative institutional relationships is often what leads to the extinction of a species in the first place. In order to counteract the further loss of wildlife species, the ESA was established, not only to provide appropriate

[9] This sentiment was expressed to the author by a private landowner, a politician, and a scientist, all within the context of personal contact (interviews).

incentives, but also to meliorate the relevant cooperation problems. All the same, the ESA's mode of operation itself has actually had a hand producing new cooperation dilemmas. Moreover, it has created new preference sets which can tend to militate against cooperation. To illustrate, the ESA's fundamental model for achieving conservation is as follows: if the USFW has reason to believe that a species is threatened or endangered, it will attempt to find out the location the remaining members of the species and place appropriate land use restrictions on that area (acquisition is also an option). This is a frightening prospect for those whose business or livelihood depends upon the harvest of natural resources. This proves especially odious to farmers, ranchers and other large tract land holders. To them, restrictions mean loss of economic opportunity, and to some extent, a meaningful loss of freedom. Thus avoiding having a species listed on one's land becomes a primary and somewhat urgent goal. So, these owners of large tracts of land expend much effort to do so. Under the incentive structure of the ESA, ranchers, farmers and others develop preferences to NOT have a rare or endangered species discovered on their land. If they feel strongly enough about it, they might take measures to ensure that such species are never found on their land - which may include an effort to eradicate the species. This phenomenon is often referred to as "shoot, shovel, and shut up." It is not necessarily as simple as this, however. To be sure, many private landowners, be they agriculturists or other, have preference sets that include things other than economic gain. Some find it important to view themselves as good stewards of their land, especially if they feel that there is some sort of owner/land connection. Nonetheless, it tends to occur that the more private landowners are faced with restrictions, the more they feel impelled to protect their personal interest.

Problems and Problem Solving

Another problem is flexibility. Wildlife species face different challenges in different areas of the country. It's very difficult to apply the same listing and recovery plans across all species, environments, and cultural venues. Moreover, many private landowners feel that they are left out of the policy-making process. Instead of being part of an arrangement they often feel that policies are imposed upon them - from outsiders, and without intimate knowledge of their land, or proper regard for unique characteristics of their natural and economic environment.[10] For these reasons, the ESA includes provisions for cooperation between Federal, state, and local agencies. And indeed, it energetically encourages cross-institutional cooperation with purposeful language. For instance, Sec. 6 begins, "In carrying out the program authorized by this Act, the Secretary shall cooperate to the *maximum* extent practicable with the States. Such cooperation shall include consultation with the States concerned before acquiring any land or water, or interest therein, for the purpose of conserving any endangered species or threatened species" - sec.6(a) (emphasis added). Under section 6(c)(1), a state, and its corporate governments, may avoid imposition of Federally regulated recovery plans if the state implements an adequate one of its own. Cooperative Agreements are a major component of the ESA, as many of those in the Federal agencies are understandably not enthusiastic about having to be involved. Federal and state Cooperative Agreements increase the flexibility that ESA conservation efforts have, by allowing smaller, more intimate, institutional units more participation in establishing policy.

Habitat Conservation Plans

Another way that the Federal government has been able to increase flexibility is by implementation of Habitat Conservation Plans (HCPs). Until 1982, there was no mechanism under the ESA to permit the "take" of listed species that might occur inadvertently during development or other activities by private landowners. But that year, Congress amended section 10(a)(1)(B) of the ESA, to allow issuance of "incidental take" permits authorizing take that, "is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity."[11] A "take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any species Federally listed. This includes destruction or modification of endangered species habitat. What this means specifically is that, after 1982, there was a way to have individual ranchers, businesses, and local governments appeal directly to the USFW for the purposes of getting leeway for activity in some protected areas. But what it has evolved into is a whole new process by which cooperative arrangements can be made between Federal/state agencies and the smaller, more intimate, institutions which are directly involved in the use of lands.

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The HCP process issues permits for incidental takes, but it is more than that. It also integrates development activities with endangered species conservation, provides a framework for broad-based conservation planning, and fosters a climate of cooperation between public and private sectors. Between 1983 and 1989, only three HCPs were

[10] This sentiment was expressed by private landowners in Wyoming; again in interviews.
[11] From USFW website (http://endangered.fws.gov/hcpapp.html.).

approved. However, the process evolved over time as the USFW and permit applicants adapted the approach for varying circumstances and leaned from experience. So that by 1995, over 300 HCPs were in various stages of development.[12] The HCP approach doesn't provide the magic solution. Resolving many large and complex issues is a grueling task, often taking years. Permit processing can also be difficult and time-consuming, as it involves publication in the Federal Register, a mandatory public comment period, National Environmental Policy Act (NEPA) compliance, and ESA review requirements. In other words, transaction costs are still potentially very high. However, HCPs do provide a way to help adapt institutions to better serve the interests of those who are involved in affairs related to wildlife conservation. But as one can see, this process requires a colossal amount of information.

Heritage Programs

In the 1970s, the Nature Conservancy (TNC) established what is called the Natural Heritage Network, within which were individual Natural Heritage Programs. These Programs were set up as databases of information pertaining to endangered plants, animals and ecological communities that contribute to the planet's biodiversity. The Programs sought to establish a common, standards-based methodology for the collection and organization of this data. The standardized information was then used to answer basic questions, such as what animals, plants, and ecological communities are facing problems, where do they occur, and how are they faring. The objective of the Heritage

[12] Ibid.

Programs is to build accurate, permanent, and continually updated knowledge bases on the world's biota - and to make this information available for conservation and development planning, environmental review, natural resource management, research, and education.[13] One of the key elements of Heritage Programs is that they rely on local scientific expertise on the philosophy (and practical strategy) that primary source data is best accomplished at the local level. There are currently 85 Heritage units, covering all 50 U.S. states. Perhaps the most interesting feature is the fact that most U.S. Heritage Programs (86% or 43/50 states) are affiliated with state government agencies. Others are housed in universities and, in a few cases, in the TNC's state offices. This means that the vast majority of these databases are under the control of state governments; and subsequently are infused with the political and social intinerary of the parent state. Yet this hasn't stopped private landowners from eyeing Heritage Programs with suspicion. For all these reasons, Heritage Programs have taken a center-stage role in almost all aspects of the threatened and endangered species issue.

Institutions and Culture

As discussed above, flexible methods of cooperation are extremely important to conservation issues. In order to provide adequate protection to a species, it is crucial to know and consider the particular needs of a species. But it is also important to have knowledge of the particular community within which action is required.[14] To be sure, it is difficult to overestimate the impact of regional characteristics in CPR situations.

[13] From the TNC webpage on the heritage Network (http:/www.heritage.tnc.org).
[14] Moran, Ostrom, and Randolph (1998).

Regional dynamics over control of resources and information becomes determinant to the success or failure of any CPR solution. Economist David Kreps speaks of institutions as consisting of a "corporate culture" which gives it cohesion through an identity and guiding principles.[15] This is a convenient way of looking at institutions because it shows how norms and expectations become part of, and affect, their deportment. It is helpful to observe that state institutions there also exists a sort of "corporate culture" - of which some familiarity can make a considerable difference for the application of conservation policies. In order to illustrate this point I will use an asymmetric comparison of Wyoming and Colorado as a case study; and I will base the rest of this paper on my findings thereupon.

Wyoming and Colorado (The Comparative Case Study)

It is an understatement to say that wildlife conservation is a big issue in the Western States. This is, in part, because there there are many farmers, ranchers, and large tracts of private land. It's also because there is the presence of much wildlife and undeveloped wilds because of its relatively late or relatively subsidiary development. As a result, it is also home to many outdoor recreators who wish to take advantage of hunting, fishing, skiing, rock-climbing, and sights and sounds of nature. In addition, one might argue that the American West is still pervaded by a particular wild and individualistic ethos as well. At any rate, these conditions make the American West a virtual battleground between natural resource (extractive) industries and environmental groups - and Wyoming and Colorado are right in the middle of it.

[15] David Kreps (1990), p.126.

Wyoming and Colorado are ideal for a comparison of species conservation situations. This is primarily because they share so many characteristics (especially natural ones). Wyoming and Colorado are contiguous Rocky Mountain states which have almost the exact same total square area. They both have a very high amount of land managed directly by state or federal agencies (57% Wyoming - 42% Colorado.[16] They have common economic and cultural histories with an emphasis on mining, farming, ranching, logging, and other natural resource industries. They have similar geological features and relatively approximate climates. Their borders contain analogous ecological signatures, with rivers, mountain ranges, and valleys overlapping into each other's. And perhaps most significant here, they share a great many (most) plant and animal species.

Both Wyoming and Colorado also have Heritage Programs; and it is in the context of the respective Heritage Programs that the most interesting results of the comparison are found. Even between the Heritage Programs, there are striking surface similarities - specifically in their nested hierarchical system. Wyoming Natural Diversity Database (WYNDD) is the name of Wyoming's Heritage Program. It is under the direct authority of the University of Wyoming in Laramie, Wyoming. The University is a land-grant institution under the direct supervision of the Wyoming legislature.

Only an hour away from Laramie, is the Colorado Natural Heritage Program (CNHP) in Fort Collins, Colorado. CNHP is also housed by, and funded through, a land-grant institution (Colorado State University), which, itself, is subject to the governance of its state legislature. So, there are two similarly situated Heritage Programs in two

[16] Wyoming statistics from Equality State Almanac (1998). Colorado statistics from Colorado State webpage (http://www.state.co.us.).

similarly situated state institutions, facing similar threats to similar plant and animal species. With these considerations, one might suspect that Wyoming and Colorado meet that challenge of threatened and endangered species with similar Heritage Programs and similar strategies. This does not, however, appear to be the case.

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It is difficult to get a reliable evaluation of the collective level of priority that species conservation holds in any state. This is because any indication of level of priority requires the context of a comparison; and the multitude of variables make it remarkably formidable to judge fairly how two states compare as far as how much *effort* is put into species conservation. All measurements, when taken singly, are somewhat weak.

Nevertheless, one assessment is the observable condition and welfare of protected species populations. This might be a possible assessment to make, especially if the two states being contrasted share habitat for that species. However, the inability to standardize circumstances, habitat, and human activity, make this an unreliable gauge. Furthermore, an evaluation of success as imputed to specific protective efforts is notoriously problematic. This is of central concern for the ESA itself, which continually faces its own extermination in political wrangling. The National Research Council, in 1995, concluded that, "it is impossible to quantify the ESA's biological effects - i.e.. how well it has prevented species from becoming extinct...[but] the ESA has successfully prevented some species from becoming extinct. Retention of the ESA would help

prevent species extinction."[17] Nevertheless, the call is out, and probably should be, for proof that costly efforts in the name of species conservation are being rewarded.

Another, more straightforward, method available is a measure of the allocation of funds expended towards environmental and species protection. However, for objectivity, this would have to be adjusted for percentage of total state budget, as well as taken in account with other variables, such as additional priorities which may be endemic to the state. Another measure yet, may be found in the structure of the state agencies themselves, such as the Heritage Programs. If the people and leaders of the state feel species conservation to be a high priority, it should probably be reflected in funding and prerogative granted to state agencies and programs whose responsibility it is collect data and regulate environmental policy.

Conservation Efforts in Wyoming and Colorado Compared

The state of Colorado spends about eight times more than Wyoming on state environmental agency budgets (see fig.6). Although worth considering, this figure is not overly telling - mainly because of two factors which make it difficult to assess the collective priority of species conservation. First, it is a marginally valuable comparison because the amount of money allocated to state environmental agencies doesn't do much to reflect the particular areas of focus that each state has in regard to environmental issues. Secondly, the spending figures simply end up about the same per capita. When adjusted for population, Colorado spends about $63.2 per state resident while Wyoming spends about $66.3. It is somewhat surprising, however, that Wyoming spends as much,

[17] Shogren (1998), p.51.

let alone more, on environmental agencies because of factors I bring up below. Nevertheless, it adds to the interesting dynamic between conservation efforts and actual results within the context of the Wyoming/Colorado comparison.

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As far as species protection goes, I already introduced, above, the problems with measuring conservation policy success. One simple measure, however, is the total number of plant and animal species listed by the USFW in each state (see fig.4).[18] As of 1999, the USFW has officially listed a total of twelve plant and animal species in Wyoming and a total of 30 species in Colorado. Wyoming contains eight species considered to be endangered and four considered threatened. Only one is a plant taxon. Colorado, on the other hand, has seventeen endangered species and thirteen listed as threatened. Twelve of them are plant while eighteen are animal. Of the twelve species in Wyoming with threatened or endangered status, a full ten of them are also on the Colorado list - this includes such big names as the grizzly bear, the whooping crane, the black-footed ferret, the gray wolf, and others. Although there is, indeed, a great amount of species that range in both Wyoming and Colorado, the total number of threatened and endangered species may not entirely reflect the success of conservation efforts. One should keep in mind other variables that might create a difference in conservation efficacy, such as the natural quality of habitat, or the nature of specific threats to certain species in one or the other state. This simply doesn't offer any reason *why* some species are doing well or badly. However, if taxa are relatively similar in both states, and if

[18] From USFW website and links: http://endangered.fws.gov/hcp/hcp.html.

tracking information is relatively comparable, this may offer limited evidence of conservation success.

This brings up the question of whether or not species-tracking information is comparable in Wyoming and Colorado. In order to find that out we now must look at the state Heritage Programs. Heritage Programs are solely responsible for tracking sensitive species - meaning threatened and endangered. There is no other state agency which collects and supplies this information.

Informational Institutions - WYNDD and CNHP

There are *distinct* differences between the Heritage Programs in Wyoming and Colorado. The Colorado Natural Heritage Program (CNHP) became affiliated with Colorado State University in 1992. It is staffed by 28 full-time specialists in administration, botany, zoology, ecology, conservation planning, and conservation bioinformatics. They make use of an annual budget of $1,538,236 (1998), $457,290 of which is carved from the state budget.[19] CNHP, the Wyoming Natural Diversity Database (WYNDD), and all Heritage Programs, for that matter, are, at essence, information sources or databases. But the information they provide can, and is, essential to management of wildlife conservation. CNHP's website underscores the potentiality of the Heritage Program's information-centered role in the following statement: "concentrating on site-specific data for each element of natural diversity, the accurate status of each element becomes known. By using the element ranks and the quality of

[19] Provided on request by CNHP staff.

each occurrence, priorities can be established for the protection of the most sensitive or imperiled sites. It is by having an updated locational database and priority-setting system that CNHP can provide its most effective, proactive land-planning tools."[20]

WYNDD's website succinctly expresses its goal in the following manner: "WYNDD's mission is to provide information needed by policy makers, land managers, and the public to make the best possible decisions regarding natural resources." It stresses the point that, "WYNDD is a *neutral*, centralized repository of credible information on the distribution and biology of Wyoming's rarest plant and animal species and plant communities."[21] WYNDD representatives stress its neutrality because its tenuous existence relies on maintenance of it. The total annual budget for WYNDD is a fraction of CNHP's at $326,788 (1999), with only $175,000 from the State budget (see fig.5).[22]

-(Place figure 5 about here)-

Instead of 28 full-time staff, WYNDD supports only eight. The incorporation of WYNDD into the State's only four-year university (the University of Wyoming) is a tortuous and interesting tale in itself (the fact that the State only has one university puts more pressure to provide state services and serve state interests). But it is enough for the purposes of this paper to add that, when it did gain acceptance in 1998, its inclusion was stipulated by four major provisions. Which were, first and most significant, WYNDD could not collect any data from private land or use any data it already had for private land without written permission. Second, an advisory committee consisting of state interests

[20] http://www.cnhp.colostate.edu/index.html.
[21] http://uwadmnweb.uwyo.edu/wyndd/. (emphasis added).

must be formed in cooperation. Third, WYNDD could not be involved in policy-making process or decisions in any way. Fourth, the then director of the Program must step down and be replaced.

The data for tracked plant and animal species, like data for listed species, do not by themselves make a comprehensive comparison. Nevertheless, a sense of how many plants animals being tracked, along with the number of location records for tracked species, may offer some idea as to the level of energy directed towards information side of sensitive species protection. WYNDD tracks a total of 1027 plant, animal, and community types. It's total number of location records for tracked species and communities is 4,505. By plant and animal classifications, it averages out to be about 13.3 locations per animal and 4.2 locations per plant. WYNDD had to delete about 15% of its animal locations from its database and about 13% of plant locations.[23] CNHP tracks a slightly higher number of species –1296, total - but has more than double the site locations at 11,435. This averages out to about 18.3 sites per animal taxon and 8.9 sites per plant.[24] CNHP's data is divided in half; ½ collected from public land and ½ from private land. In addition to a larger staff, a much bigger budget, and better access to data from private land, CNHP does not have restrictions on making recommendations for policy. WYNDD is explicitly prohibited from taking such measures.

The reason for the differences between the Wyoming and Colorado Heritage Programs is not incidental, and it's not because of different biological challenges of their respective wildlife conservation CPR situations. It is because of consequential

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[22] Furnished on request by WYNDD staff.
[23] BCD database statistics, Sept.21,1999. - Provided on request by WYNDD staff.

differences in the state institutions - meaning the social, economic and cultural prejudices of the inhabitants. An analysis of these differences goes to show that regional considerations *must* be made part of effective wildlife conservation solutions as well as other CPR solutions.

Comparison of the State Institutions

The best explanative variables in the difference between Wyoming and Colorado's cultures-of-conservation are perhaps economic and demographic characteristics. Among many of the two states' similarities, demographics and economic indicators offer a stark contrast. As stated above, both have approximately the same total area with about half the land in private hands and half in public. Incidentally, Wyoming has the 6th greatest percentage of land under Federal management while Colorado has the 10th. Both states have much more land under Federal jurisdiction than most states do; with the average being about 21% - skewed heavily by the 15 or so Western states which have large tracts under Federal management. As stated earlier, Wyoming and Colorado have considerable physical comparability in their latitude ranges, and the continuity of north-south mountain ranges dividing the grassland dominated plains on the eastern tiers from the intermountain shrubland-dominated basins to the West. As well, there is a very high overlap of floras and faunas in the two states. As far as political interests are concerned, both states experience a high activity of both agricultural and environmental groups. They also both have extremely profitable hunting and fishing industries. Hunters

[24] BCD database statistics, Nov.28, 1999. - Provided on request by CNHP staff.

and fishers spend over 1/3 billion dollars in Wyoming each year, and spend over one billion per year in Colorado.

But here are the crucial differences. The population of Colorado, which is almost 4 million, is about eight times that of Wyoming (see fig.6). The average population growth in Colorado is usually between 2-4% while Wyoming's hovers around zero with frequent small declines. The average income per household for Colorado in 1998, was almost $43 ½ thousand, and Wyoming's was $33 ½ thousand (up almost three thousand from the year before). What primarily is responsible for this contrast is the commercial and industrial composition of the two states. Wyoming's Gross State Product (GSP) at $16,847 (1998), is about one sixth that of Colorado's at $95,237 million (1998) - which doesn't seem so bad considering that Colorado has eight times the number of inhabitants. Nevertheless, as shown above, this does into translate into a higher per household income for Wyoming, but a lower one. The pivotal factor in Colorado's economic advantage is diversity of industry. Colorado's GSP is evenly distributed among a variety of economic enterprises. It has a broad foundation of industries, such as tourism, education, banking, other services, and "clean" and hi-tech industries. It is home to major national companies such as Sun Microsystems, Level 3 Communications, Primestar, Ryder TRS, Ashland Chemical. But it is also dotted with thousands of vibrant small business.

Wyoming's GSP, on the other hand is dominated by one thing: mining. In Colorado, mining accounts for less than two percent of the GSP. In Wyoming it accounts for almost 32%. The percentage of GSP accounted for by Wyoming's service industry is about half that of Colorado's. The same goes for the combined categories of retail and wholesale trade. Mining, alone, enables Wyoming residents to avoid paying any state

Figure 6 – (Compiled from statistics presented in CO website, WY website, Siegl (1998), and Wyoming Almanac).

	Wyoming	Colorado
Total Area	97,670 Sq. Miles	103,730 Sq. Miles
% Public land	57	42
% Private land	43	58
% Federal Land	48.1	35.2
Population	453,588 (1998)	3,895,524 (1998)
% Population Growth Per Year	< 0	> 2
Avg. Income Per Household	$33,423 (1997)	$43,233 (1997)
Avg. Income Per Capita	$23,225 (1998)	$28,821 (1998)
Per Capita Federal and State Tax Burden	$7,683 (1998)	$10,216 (1998)
Gross State Product (GSP)	$16,847 million	$95,237 million
As % of GSP		
Private Industry	-----	89.36
Agriculture, Forestry and Fisheries	2.1	1.7
Mining	31.6	1.9
Transportation & Utilities	14.2	11.2
Finance, Insurance & Real Estate	10.3	16.6
Services	9.5	20.2
Retail Trade	6.6	10.2
Wholesale Trade	3.2	6.5
Government	12.9	13.8
Construction	3.7	5.1
State Hunter and Fisher Expenditures	$349,202, 501 (1997)	Over $1 billion (1998)
State Environmental Agency Budget	$30,072, 734 (1996)	$246,111, 338 (1997)

income taxes. Yet Wyomingites are notoriously vocal against tax burdens of any kind. Why is this? In short, because the state is culturally dominated by agriculture (ranching/farming). Even though agriculture directly contributes only just over two percent of the State's GSP, the majority of the services, utilities, trade and other activities go towards serving and maintaining the agricultural industry.

Wyoming is duly classified as a rural state. The population is dispersed rather evenly throughout its area. The biggest city is just over 50,000 residents. The second biggest city is slightly smaller. The third, fourth, fifth, and subsequent biggest cities drop sharply in population after that. The majority of the over-all area in Colorado has approximately the same concentration of people and economic activity. The contrast, however, is found in the heavy concentration of people along what is called the "Front Range." This is a narrow residential and industrial corridor that runs along Interstate-25, containing Denver, Greeley, Loveland, Fort Collins, and a few other highly concentrated and inter-connected cities. A full 81% of Colorado's residents live along this Front Range. Most of them are not involved in agriculture, but with these other diverse industries - of which their availability offers residents a fairly complete and comfortable quality of life in Colorado.

The "good jobs" in Wyoming, on the other hand, are found pretty much only in mining and agricultural venues. Jobs provided by other supporting industries are often temporary, offer relatively little pay, and are limited in terms of opportunity for advancement. *This* is why agricultural interests dominate Wyoming State politics. Mining has considerable influence in Wyoming too, but there is a different dynamic at work there. For one thing, there lacks a feeling of ties to the land or stewardship within

the mining "community." For the most part, individual miners do not own the land they mine. There are also comparably few "mining families." Plus, miners usually don't own the business for which they work. They simply go where they are assigned and extract mineral resources for large, sometimes out-of-state firms. This isn't to say that mining workers and representatives are viewed negatively in Wyoming. They are not; largely because of the shear amount of jobs and wealth mineral companies bring to the state. But there isn't as much of a permanency or intimacy in order to establish a pervasive mining cultural ethos like the kind one sees with ranching.

Economic Interests and Politics

The incentive structures created by the ESA, along with local circumstances, has engendered a curious influence on the mining industries and their role in the goings-on of wildlife conservation. Like commodity-producer organizations associated with agriculture, commodity-producer organizations associated with mining share an interest in minimizing governmental regulation of lands. Mining interests probably have even more to lose when their operations are restricted by the presence of some esoteric subspecies of plant or animal. Nevertheless, Wyoming's mining industries helped gain acceptance for the plan that incorporated the Heritage Program into the state university (the ranchers were united against it). It is the ESA, itself, to which mining industries protest. But as long as the ESA and similar policies are in place, extractive companies are forced to spend hundreds of thousands on private environmental consulting firms before, during, and after all mining activity. Heritage Programs like WYNDD, receive

the largest section of their budget from the state coffers and charge a relative pittance of $60 an hour for extremely valuable data that would have been incredibly expensive and time-consuming for environmental consultants to collect. If this data collection were left up to the private environmental consultants, this cost would translate into eminently higher costs for the mining industries. This is why mining interests currently actually favor the presence of Heritage Programs, like WYNDD.

On another note, it is a point of fact that environmental regulation which has directly contributed to the profitability of mining lands in Wyoming. National Environmental Policy has dictated and created the demand for "clean-burning" coal, with which Wyoming is abundant. It is worth noting the composition of the clientele of WYNDD. Of the 37 entities that requested informational services from WYNDD in 1998, five were educational institutions, eight were public agencies, and 24 or 65% were private organizations (see fig.3).

With mining interests, in a sense, cancelled out of wildlife conservation issues, Wyoming's political identity is defined chiefly by a polarity between private landowners and environmental interests. Agricultural influences dominate all state politics for the most part. But when it comes specifically to environmental issues, there is some resistance. How much resistance depends on to which Wyoming resident one speaks. There is considerable contention in Wyoming over environmental issues, yet, from the comparative make-up of its Heritage Program and other politico-cultural indications, Wyoming agriculturists maintain precedency. Western agricultural preference sets are fairly feasible to predict. In general terms, they want the right to use their land as they

see fit, they want to make a profit, they want to maintain their lifestyle, and they oppose government regulation - except when it comes to subsidies.

Colorado's demographic concentration translates into a different preference set, which subsequently translate into political power. For most of the Front Range's 81% of the state's population, the sweeping plains, pristine deserts, grasslands, forests, streams, and mountains are their playground, not their business. Colorado's natural beauty is a major factor in the decision of many young professionals to move there. They care more about the preservation of the "natural" qualities of the surrounding lands, than about government regulation of private land; just as long as nobody touches the patch that their house stands on - or the view that their location provides.

Is Information a Limiting Factor is Species Conservation? Do the Differences make a Difference?

Protection of sensitive species, once identified as needed, lies with land management, whether by farmers or ranchers, by Federal land managing agencies, or by private organizations holding easements on private property such as TNC, - the parent organization to the Heritage Programs. For the most part, conservation or recovery plans are developed by the USFW as the key agency within the Department of Interior. Thus, there is a separation between obtaining and promulgating information about species, and about management steps actually being taken. But do the gaps between Wyoming and Colorado's informational institutions, serve as a limiting factor for effective species conservation? This is ultimately unverifiable. However, if anything, the statistics

evidence that species in Wyoming are faring quite well compared to the rest of the country - and at least no worse than in Colorado. The species that are listed as facing extinction in Wyoming are few. Furthermore, many of the taxa listed as threatened or endangered are also listed in a number of other states.

The Element of Perceived Abundance

Within just the last year or two, recent new location sites have led researchers at WYNDD to reconsider the status of several species considered to be sensitive. It is being found that quite a many of these species are extant in much more abundance than previous data indicated.[25] In the context of species conservation in Wyoming and Colorado, there may be sort of a U-shaped curve at work. Other studies have shown that in some areas of the world there may be a correlation between the environmental quality and the level of economic advancement within an institution. Some of the studies have found that there some indications of environmental quality, such as lower levels of pollution, are associated with high levels of economic development.[26] The "U-shaped curve" may also have some application for describing condition of sensitive species as a function of economic development among state institutions. In this case, by some indications, Wyoming's situation is somewhat better than Colorado's. But Colorado's situation is fairly good compared to the rest of the country; and it is clear that Colorado puts much more effort and money into the conservation process. If the situation can be described this way, however, it means that Wyoming has yet to experience a

developmental surge; and it is behind the rest of the country considerably when it comes to development. The case for this could certainly be made. One might imagine Wyoming as being high on the conservation end and low on the economic end. While Colorado might be placed quite a bit higher on the economic end and just slightly lower on the conservation end (see fig.7).

-(Place figure 7 about here)-

If Wyoming is enjoying greater proliferation of sensitive species, it is a possibility that it is to the credit of conscientious private landowners. This may be the case, however, it is also likely that species may thrive because, as the U-shaped curve implies, the preservation of habitat is precisely the result of the *lack* of human activity and its impact - not necessarily because of conservation efforts. There are clear indications that, within the context of other priorities, private landowners in Wyoming do not place much value on the preservation of those species which do not directly enhance the landowners' marginal utility. Which isn't at all to say that they prefer that all extraneous wildlife be non-existent. They certainly do not, but in the face of conflicting economic priorities, domestic organims usually win out. If the full materialization of modern industry were to suddenly fall upon the residents of Wyoming, sensitive species would probably not come out extremely well. Eventually, the splendor of modern industry will, by most odds, arrive in Wyoming. This is just one of the reasons why it is important to make deliberate efforts to protect threatened and endangered species habitat now. Perhaps most importantly, this includes establishing cooperative efforts between the epistemic

[25] From conversations with WYNDD staff – especially zoologist, Gary Beauvais and acting director, William Reiners.

(scientific) community, policy-makers, environmental interest groups, and private landowners.

Wyoming and Species Conservation: The Action Arena

The action situation in Wyoming is essentially a situation in which private landowners are able to exert tremendous influence on the way things are done in the state. If one hopes to implement conservation policies, one is going to have to take into account the preferences and sensitivities of private landowners. It would be counterproductive to forcefully impose regulations externally. Wyoming encompasses a region where the policy of "shoot, shovel, and shut-up" is likely to be put into action. If ranchers, farmers, and others who embrace that lifestyle don't think that you have their interests in mind, indelicately imposed policies are all but certain to fail. It will prove much more productive to work from within the local and regional institutions.

Considerations in dealing with such dilemmas are not, I think, only relevant for Wyoming. The world is full of private landowners, and indeed democratic institutions and their useful incentive mechanisms depend on the fact. Lessons can be learned from the way that Wyoming works to protect its endangered species that can apply to other areas, and indeed, other CPR situations.

For reference, a few of the most significant actors in this action situation are the following:

Government and Government Agencies

Federal Government

Department of Interior

[26] Arrow et al., (1995).

USFW
Federal Land Management Agencies
U.S. Forest Service
Bureau of Land Management (BLM)
Bureau of Land Reclamation
Wyoming Game and Fish Service
Wyoming State Legislature
University of Wyoming
WYNDD

Epistemic Community **(in Wyoming this is mostly associated with the University of Wyoming)**
County Governments

Commodity Producers
Mineral Producers
Petroleum Association of Wyoming
Wyoming Mining Association
Agricultural Commodity Producers
Wyoming Stock Growers Association (WSGA)
Wyoming Wool Growers Association (WWGA)
Wyoming Farm Bureau

Utilities
Pipeline, sewer, roads, etc.

Environmental Groups
Wyoming Outdoor Council
Friends of the Bow
Biodiversity Association
Sierra Club (Wyoming chapter)

Risks, Incentives, and Preferences

For landowners in Wyoming, the best case scenario is that the ESA will be repealed, and nothing else like it will be put in its place. This is the goal for many; and perhaps it is even a possible outcome. Scores of lobbyists and grass roots efforts importune national leaders, year round, in hopes that pressure will build to the point that the ESA will topple to its foundations. It looks, in all probability though, that the Act itself will remain for some years, although it may be subject to alterations. As it stands now, however, its effects, as they are filtered into the action arena of Wyoming, make for some significant behavioral dynamics. Consider, for example, the element of perceived abundance. As stated before, for the average private landowner in Wyoming, the best case scenarios would be that the ESA would no longer dictate policy (or perhaps, they

would be adequately compensated for their economic sacrifice). But under the present circumstances the best case is that no sensitive species reside on one's own private land. This is the logic behind the shoot, shovel and shut-up strategy. Yet, some private landowners have problems with that path of action - for ideological reasons, or for fear of consequences for being caught. Nonetheless, a primary goal of the private landowner is to keep species on their land from being listed (or keep listed species from being on their land).

The simple truth is, however, that a species would avoid being listed at all if it were perceived to be abundant! Moreover, scientists from WYNDD are, in fact, finding that more and more species populations, once thought to be imperiled, are actually in pretty good shape.[27] But finding out if a plant or animal is abundant requires information, such as site locations and other data. The dilemma is apparent. Under the present circumstance, ranchers, farmers, and other private landowners benefit from perceived abundance. But a state of perceived abundance requires information - especially that information that is hidden from data collectors with WYNDD by the fact that it is on private land.

It is extremely important to add that policy makers, under the direction of the ESA - those who determine the listing status of species - are obliged to err on the side of caution. If they suspect that a species is not as badly off as they once thought, but they don't have data to prove it, then they must place restrictions across a wider area of land. For example, there may be habitat on a parcel of land where a sensitive species is thriving, but they may blanket a large area, even the "healthy" area, because they don't

have enough information about. In principle, the less the information, the more extended Federal control of land becomes.

The Element of Communication

WYNDD zoologist, Gary Beauvais, often meets with agricultural commodity producer groups such as the Wyoming Farm Bureau (WFB), the Wyoming Stock Growers Association (WSGA), and the Wyoming Wool Growers association (WWGA). One of his responsibilities is to establish communication and coordination with such state interests. He has seen that in many cases, it is in the landowners' best interests to allow data to be collected from their lands because it contributes to a perceived abundance - which ultimately leads to species avoiding the listing process. Moreover, it may even lead to some species being delisted! Beauvais has found that the communication of this message can make all the difference. Communicating this effectively is not always the easiest process, but he reports that after some opportunities to present this information (*i.e.* the high probability of abundance), some landowners will actually approach him to ask when data can be collected from their lands. Beauvais notes that there seems to be a "critical mass" of information, after which landowners become prepared to share data from their property. I have visually described this phenomenon, in figure 8, as having the properties of a logit model. One can imagine that such an analysis would show that at some point in the perceived abundance of a sensitive species, the probability of ranchers' willingness to cooperate will translate into a change from no cooperation to cooperation.

[27] Related in interviews with local epistemic community.

-(Place figure 8 about here)-

Yet, from the landowner's point of view, information itself isn't necessarily create enough of an incentive to share data from one's land. Landowners take a risk in sharing data from their land. The landowner's benefit of perceived abundance comes only with careful coordination with other landowners. This is because it takes many landowners, at once, to contribute enough data to create a perception of abundance. If one landowner offers his/her land up for inspection of the condition of sensitive species, and the data collectors find that there is indeed sensitive species living on his/her property, then he/she relies on others to corroborate with similar data. If others are unwilling to do this, then that landowner has made the mistake of pointing out that there is a population of endangered species on his/her land, and he/she will shoulder the lion's share of species conservation, resulting in restrictions or acquisition. This is the dilemma.

Cooperation Games

I have attempted to recreate this in a cooperation game where a single landowner is faced with a coordination game played with many other landowners in a specie's range (see fig.9). All assigned values are negative to account for the fact that general conservation policy under the current ESA results in some average economic loss due to governmental restriction of land use. So the goal in this game is to incur the lowest cost. The prediction here is that even though it would be better for each rancher to cooperate and take the -1 in each round, the rational rancher(s) will end up taking the -3. This is because, even faced with a relatively high degree of perceived abundance, the single

rational actor, and thus all the actors, will probably choose to defect. This is because, 1) if everyone else cooperates, it is still better to defect, but mostly, 2) the price of cooperating when others defect is extremely high and not worth the risk. The values are based on the factor of perceived abundance. For example, **(CC)** if all cooperate, then information provided by perceived abundance will reduce the economic loss due to governmental restriction, and will yield an average value of -1. If no one cooperates **(DD)**, then policy-makers err on the side of caution and restrict a greater number of species over a greater expansion of land, yielding an average individual value of -3. If the individual rancher cooperates and none of the other do **(CD)**, then, finding sensitive species on his/her land and not anyone else's, the individual rancher shoulders the lion's share of the conservation efforts, which yields an average value of -9 for the individual rancher and a little less (-2 each) for the others. On the other hand, if the individual rancher withholds data from his/ her land while the others offer it up **(DC)**, the individual rancher saves a little bit by letting the others shoulder the burden, yet because the USFW didn't have the benefit of his/her data the individual rancher still takes a little loss yielding -.25, while the others yield a slightly higher loss than they would have if they all cooperated (-1.5).

-(Place figure 9 about here)-

Security Protocol

The important cell in the above cooperation game is the top right **(CD)**. This one establishes why no individual rancher would want to take the risk of being the only one to

surrender data. This logic will follow for each rancher and thus no one will cooperate, yielding a higher loss than if they all would have coordinated.

The non-cooperation equilibrium was, and still is, frequently a real outcome in Wyoming. Even when faced with the knowledge that individual ranchers may contribute to the perceived abundance, someone has to start the whole process; and because of the potential personal cost, getting it started has been a rare prospect. In the past, starting this process usually had to be determined by positive data from derived from public land. Representatives of WYNDD observed this dilemma, however, and in order to mitigate the risk of individual ranchers, WYNDD adopted a "sensitive data security protocol" - in May, 1999.[28] What this did is establish the legal means by which WYNDD would be able to protect the release of any information about the whereabouts of politically "sensitive" data. WYNDD could still report the data as it contributed to the overall knowledge of certain species' condition, but the particular source of this private land data would not be given out without the landowner's permission - even to Federal agencies! This way a private landowners could offer data from their land, which may contribute to the perceived abundance, but not risk that any data found there will bring on regulatory action specifically aimed at his/her land.

After security protocol the informational cooperation game looks mostly the same; but the change in the top right cell makes all the difference (see fig.10). Cooperation on the part of the individual rancher now always yields a lower cost than all-defect would. It applies whether the others cooperate or not. The individual rancher is less likely to defect because the he/she will experience no extra loss, even if no one else

cooperates. No matter what, the individual rancher cannot be individually penalized for offering data for his land. Therefore, the rancher will be more willing to offer data from his/her land to contribute to the accretion of perceived abundance. Defecting while everyone else cooperates is still the best outcome, but total cooperation is, at least, more likely when faced with the prospect of contributing to the delisting of a species without any risk of being singled out.

-(Place figure 10 about here)-

The application of cooperation games for this issue are probably limited. One reason is that there is evidence that commodity producer agriculturists, like ranchers, do not act that separately. To be sure, private landowners like this, belong to a number of commodity producer groups. These groups can tend to be extremely hierarchical and tend to exhibit a well-defined corporate culture. Furthermore, there is a feeling for some in Wyoming that one of the biggest obstacles to creating cooperative solutions to conservation problems is the demagoguery of a retrograde "old-boy" leadership and its disparity with a more moderate majority within agricultural organizations. This does, indeed, imply that many of them already function in a highly coordinated way. On the other hand, maybe group cohesion increases the application of these games as it cohesion may contribute to the explanation of why ranchers may choose to cooperate in the second cooperation game - even though defecting is still slightly less costly. Nevertheless, the narrative of some landowners voluntarily offering access to their land does indicate some independence of action. At any rate, I hope that these cooperation models help to show

[28] WYNDD staff (1999).

the value of communication and coordination in at least some aspects of these circumstances.

Conclusion

Some prospects for wildlife conservation in the future look promising while others look more bleak. On the positive side, threatened and endangered species policies are fast adapting to local and regional needs. They are increasingly being managed at lower, more intimate, institutional levels thanks to Cooperative Agreements, Habitat Conservation Plans, Heritage Programs, security protocol, and other developments. There are still several major problems that need to be addressed, though.

First, it is evident that some environmental groups are taking advantage of the listing procedure. Recently in Colorado, an environmental group petitioned for protection of a particular species in order to halt development and provide them with the opportunity to acquire that land. The USFW must honor every petition, and although there may been environmental reasons for acquiring that land, it wasn't because of the species in question. This has been occurring in several areas of the country and the ESA has yet to deal effectively with these contingencies. Yet, the fact remains that environmental groups have the incentive to make the plight of a species seem as dire as possible and this will probably always be part of any institutional solution to wildlife conservation problems.[29]

[29] The issue in Colorado was related by interviewees.

Secondly, the Department of Interior and the USFW is expected to do far too much with far too small a staff and far too little resources. For every evaluation period in the listing process, and for every type of case, the USFW has the legal obligation to come to a decision by the time outlined in the ESA. If they fail to come to a decision by this time, they immediately get sued. Thus we get some hurried decisions, and some organizations (mostly environmental) constantly suing the USFW which drains their, already limited, resources. Commodity producer groups also end up suing the USFW. But the fact is, in many cases, if the USFW had more time and resources, they would be able to see that many species are not in as much trouble as they could understandably perceive otherwise; and therefore, fewer species would probably get listed.[30] So funding for the USFW and other conservation agencies should reexamined, and probably increased.

Thirdly, Some areas of the country, like Wyoming, are actually inheriting threatened and endangered species problems from other areas. For example, the bird called the Mountain Plover existed for thousands of years on the short grass plains of the Western High Plains (i.e. most western regions of Kansas, Nebraska, western North Dakota, South Dakota). It also existed in Wyoming but because the habitat was only marginal, it showed up there in smaller numbers. Because the Mountain Plover likes to lay its eggs in short prairie grass, it does so over in the plowed farm fields of its original range. But when farm machines work back through these areas the eggs are destroyed and the population dwindles. A small population of Mountain Plover also inhabit eastern Wyoming where, although less ideal habitat, different land use allows for the of the

[30]df

species to proliferate. Because most of the last Mountain Plover is found in this area, restrictions, meant to protect the bird, are placed on Wyoming landowners who's activity has not led to the decline of the species[31]. Private landowners and other citizens of these areas should not be punished for destructive activities in other areas. There is a provision in the ESA which allows for regional protection only, but much more information needs to be gathered so that it can be assessed which activities and areas are contributing to the loss of a species, and which areas are simply a last refuge. And more serious energy needs to be directed towards putting this provision into action.

Fourthly, why not pay private landowners to preserve habitat (or at least share more directly in the cost)? The incentive structure right now leads to private landowners wanting to exterminate the sensitive species. They would probably be much more willing to engage in habitat preservation practices if they were financially compensated for actual, opportunity, and transactional costs. Although the variables expressed above point out the problems with creating market values for endangered and threatened species, it seems that if the public is serious about having these plants and animals around, they should find a way to pay for it. Some have. Game species, for example, have plenty of public support. In their case, through licensing and other organizations, market mechanisms are usually enough to sustain their populations. For other extremely popular non-game but species, like the Gray Wolf, privately endowed funds have been established out of which ranchers and others affected by Gray Wolf activity are compensated. But this compensation process has to be made easy for ranchers or it will not create enough incentive to stop them from employing poisoning and other methods of

31

dealing with predators. The biggest problem here is that most species aren't popular enough to invite this level of private investment. But if we want them around, maybe we should *make* them popular enough. There is plenty of precedence for paying private landowners not to use their land or to limit its use (from non-governmental *and* governmental funds). This practice has been established for wetlands in the northern Midwest, for soil conservation reasons in the South, and land all over the country simply for the pretext of controlling market prices. If having biodiversity is an important enough concern, then we might think about establishing a more effective system of incentives for sensitive species conservation.

Finally, I hope this paper showed how important information, communication, and interinstitutional cooperation is for the management of threatened and endangered wildlife. A broad over-arching national policy like the ESA is a good and useful reference to other institutions also dealing with these issues. Yet it is clearly not enough. The problem itself is so large and pervasive that we are all impacted by it. But specific problems that arise with preserving our natural heritage are so varied and complex, that one universal policy cannot hope to deal effectively with even a just few of our biodiversity matters. Instead we should continue to develop institutional alliances of lower and mid level institutions, which together may provide solutions to global problems.

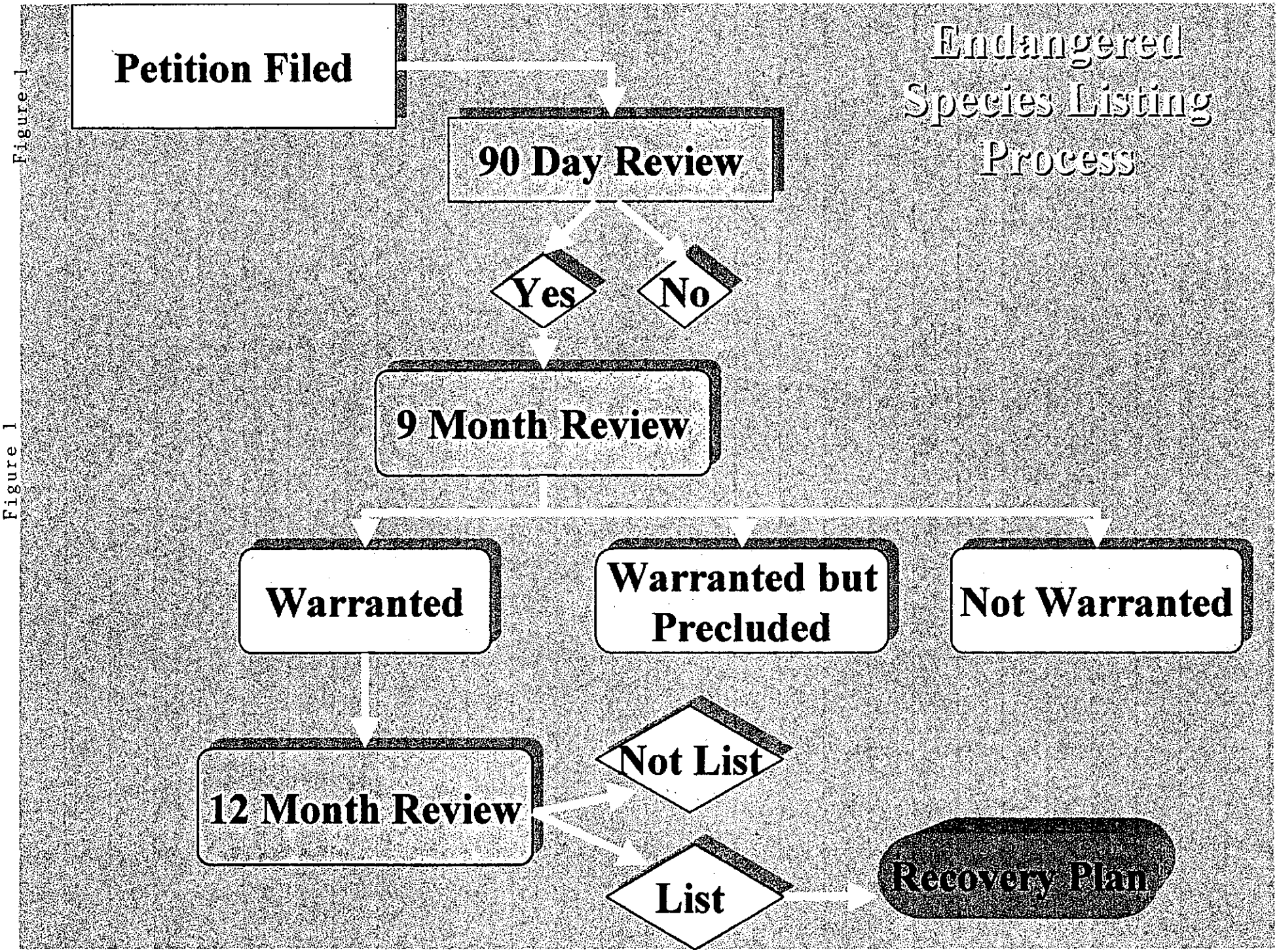
Endangered Species Listing Process
Petition Filed
90 Day Review
Yes
No
9 Month Review
Warranted
Warranted but Precluded
Not Warranted
12 Month Review
Not List
List
Recovery Plan

Figure 1

Figure 2

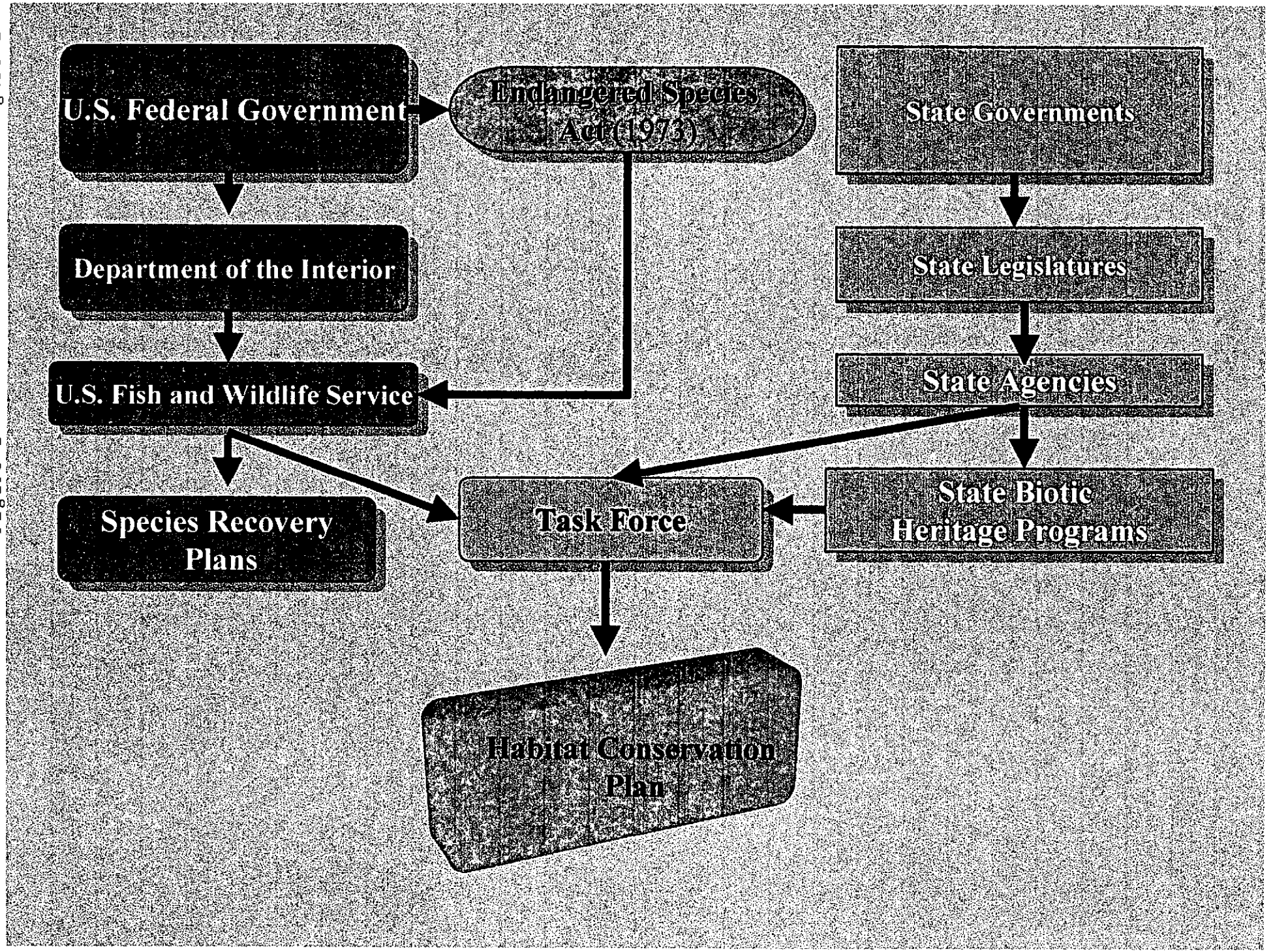

Figure 2

Figure 3

Figure 3

Figure 3

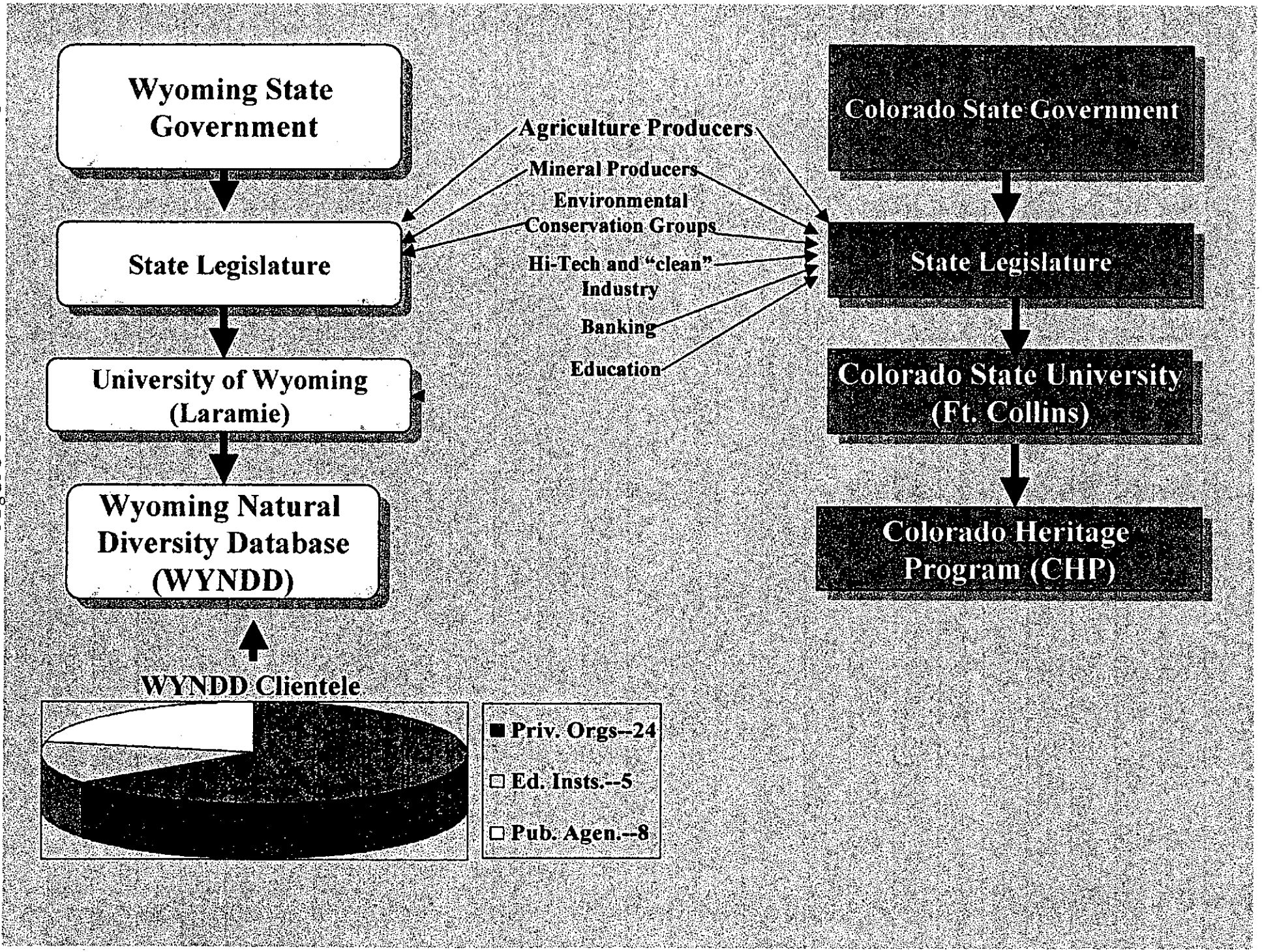

Figure 4

Species Listed as Threatened or Endangered by the USFW

Wyoming--12 species

Animals--11 species
T -- Bear, grizzly (Ursus arctos)
E -- Crane, whooping (Grus americana)
E -- Dace, Kendall Warm Springs (Rhinichthys osculus thermalis)
T -- Eagle, bald (Haliaeetus leucocephalus)
E -- Falcon, American peregrine (Falco peregrinus anatum)
E -- Ferret, black-footed (Mustela nigripes)
T -- Mouse, Preble's meadow jumping (Zapus hudsonius preblei)
E -- Pikeminnow (=squawfish), Colorado (Ptychocheilus lucius)
E -- Sucker, razorback (Xyrauchen texanus)
E -- Toad, Wyoming (Bufo hemiophrys baxteri)
E -- Wolf, gray (Canis lupus)
Plants--1 species
T -- Ute ladies'-tresses (Spiranthes diluvialis)

Colorado--30 species

Animals--18 species
T -- Bear, grizzly (Ursus arctos)
E -- Butterfly, Uncompahgre fritillary (Boloria acrocnema)
E -- Chub, bonytail (Gila elegans)
E -- Chub, humpback (Gila cypha)
E -- Crane, whooping (Grus americana)
T -- Eagle, bald (Haliaeetus leucocephalus)
E -- Falcon, American peregrine (Falco peregrinus anatum)
E -- Ferret, black-footed (Mustela nigripes)
E -- Flycatcher, Southwestern willow (Empidonax traillii extimus)
T -- Mouse, Preble's meadow jumping (Zapus hudsonius preblei)
T -- Owl, Mexican spotted (Strix occidentalis lucida)
E -- Pikeminnow (=squawfish), Colorado (Ptychocheilus lucius)
T -- Plover, piping (Charadrius melodus)
T -- Skipper, Pawnee montane (Hesperia leonardus (=pawnee) montana)
E -- Sucker, razorback (Xyrauchen texanus)
E -- Tern, least (Sterna antillarum)
T -- Trout, greenback cutthroat (Oncorhynchus (=Salmo) clarki stomias)
E -- Wolf, gray (Canis lupus)
Plants--12 species
E -- Mancos milk-vetch (Astragalus humillimus)
E -- Osterhout milk-vetch (Astragalus osterhoutii)
E -- Clay-loving wild-buckwheat (Eriogonum pelinophilum)
T -- Penland alpine fen mustard (Eutrema penlandii)
T -- Dudley Bluffs bladderpod (Lesquerella congesta)
E -- Knowlton cactus (Pediocactus knowltonii)
E -- Penland beardtongue (Penstemon penlandii)
E -- North Park phacelia (Phacelia formosula)
T -- Dudley Bluffs twinpod (Physaria obcordata)
T -- Uinta Basin hookless cactus (Sclerocactus glaucus)
T -- Mesa Verde cactus (Sclerocactus mesae-verdae)

Figure 4

Figure 5

Figure 5

Figure 5

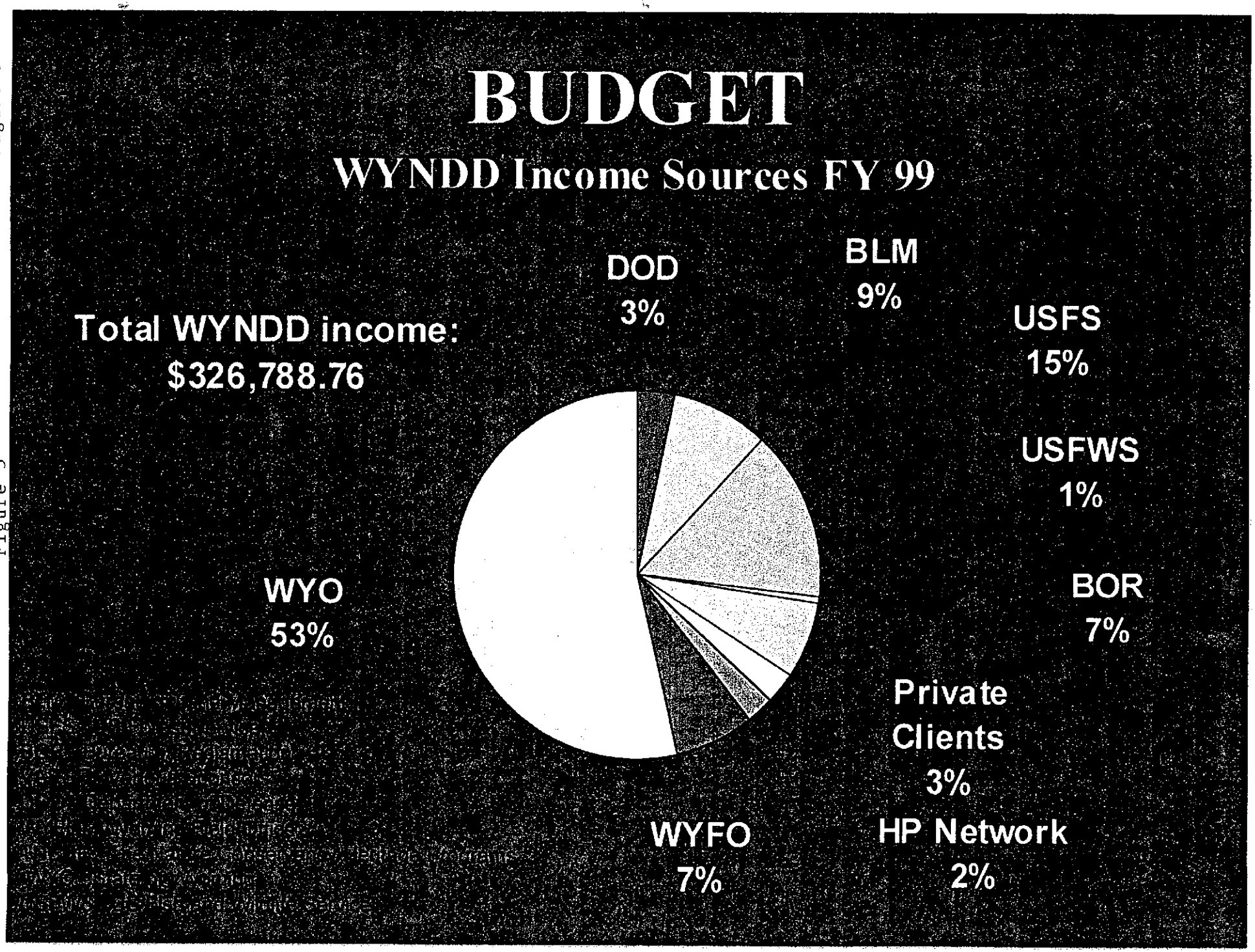

Figure 7

Figure 7

Hypothetical U-Shaped Curve

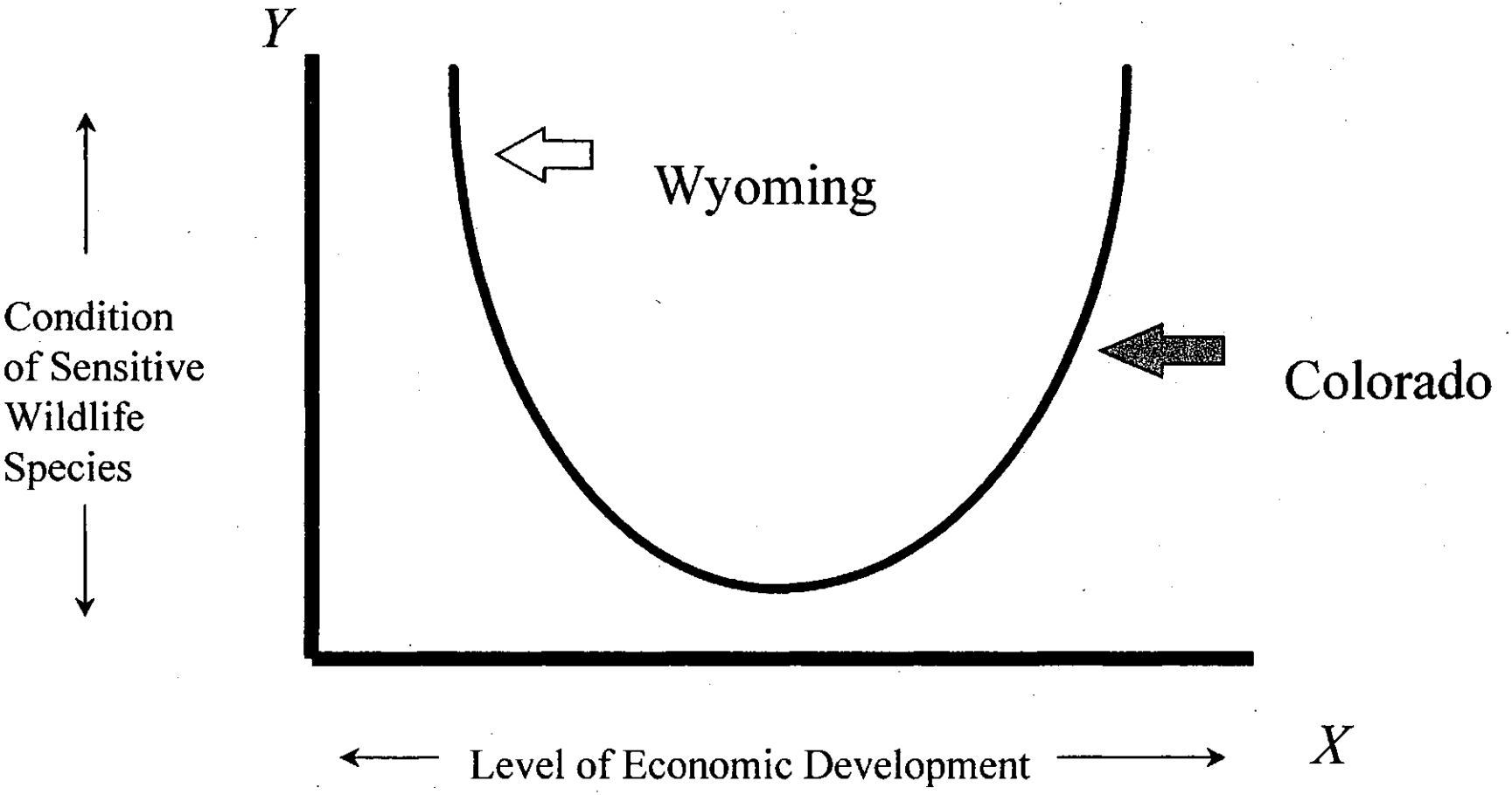

Figure 8

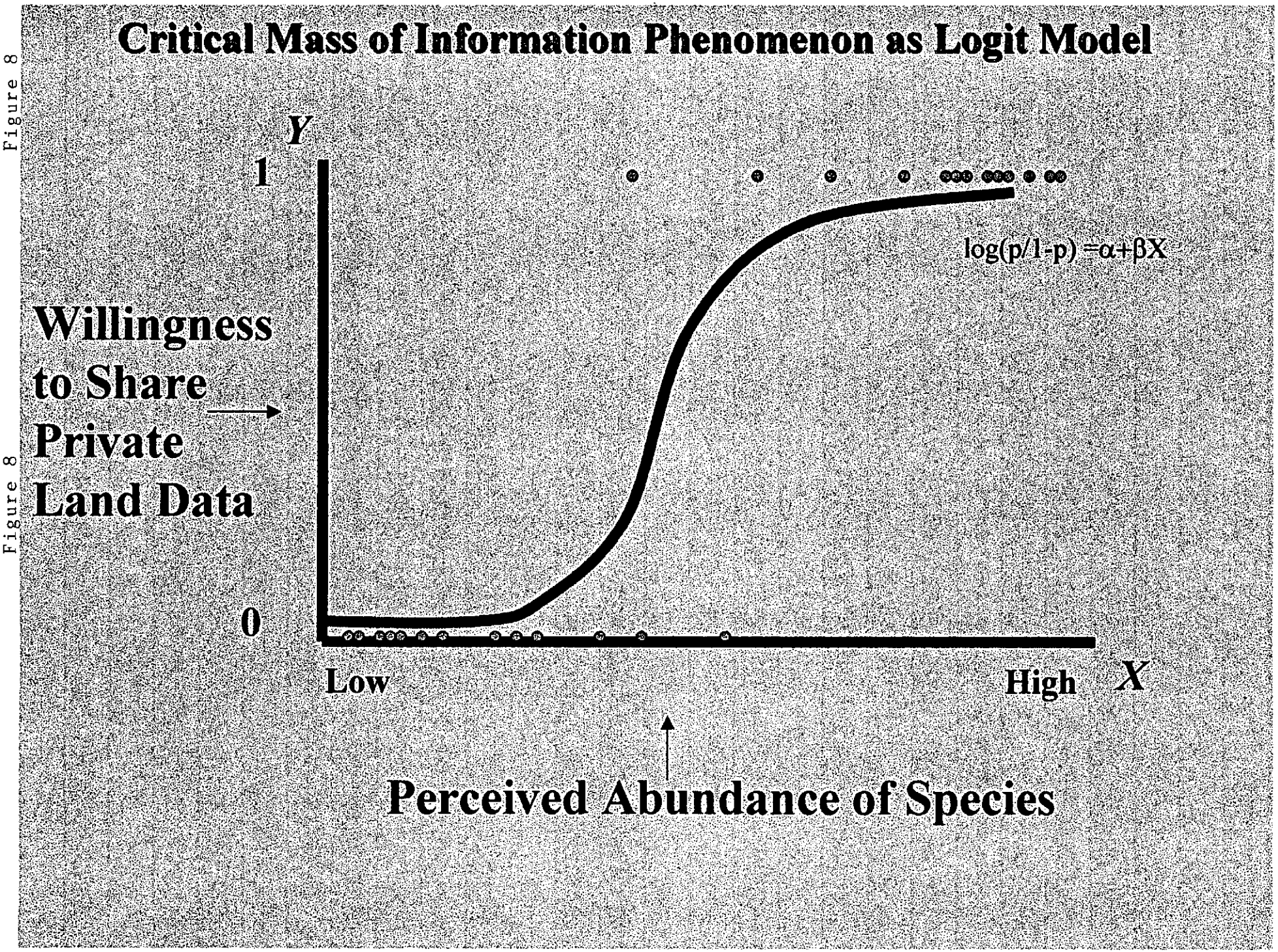

Figure 8

Figure 9

Cooperation game before data security protocol

Figure 9

		Every Other Rancher in State or Region	
		C	D
Rancher	C	-1,-1	-9,-2
	D	-.5,-1.5	-3,-3

Figure 10

Cooperation game after data security protocol

Every Other Rancher in State or Region

Rancher	C	D
C	-1,-1	-2,-2
D	-.5,-1.5	-3,-3

Appendix

Table 2.1. *History of Wildlife and Endangered Species Regulation in the United States*

1900
Passage of the Lacey Act, which prohibited the interstate transportation of "any wild animals or birds" killed in violation of state law. The act upheld the authority of a state to prohibit the export of game lawfully killed in the state and allowed the states to prohibit the importation of game. It also authorized the secretary of agriculture to adopt measures necessary for the "preservation, distribution, introduction, and restoration of game birds and other wild birds," subject to laws of the various states and territories.

1916
The Convention for the Protection of Migratory Birds was signed between the United States and Great Britain (signing for Canada). A group of migratory birds listed with the convention was specifically protected. The convention allowed for the establishment of open hunting seasons on game birds and provided protection for nongame birds. It prohibited taking nests or eggs except for scientific or propagation purposes.

1926
The Black Bass Act was passed and later amended to regulate importation and transportation of black bass and other fish.

1934
Passage of the Fish and Wildlife Coordination Act, which specifically emphasized the impact of water development projects on wildlife.

1936
Treaty for the conservation of migratory birds, similar to the 1916 treaty with Great Britain, signed with Mexico.

1940
A convention on the nature, protection, and preservation of wildlife in the Western Hemisphere was signed by the United States and eleven other American republics. This treaty expressed the wish of governments to "protect and conserve their natural habitats for wildlife and to preserve representatives of all species in general of their native flora and fauna including migratory birds" and to protect regions and natural areas of scientific value. The nations agreed to take certain actions to achieve these objectives, including "appropriate measures for the protection of migratory birds of economic or aesthetic value or to prevent the threatened extinction of any given species."

Appendix

1964
The FWS organized a Rare and Endangered Species Committee, which prepared the first U.S. "redbook" on *Rare and Endangered Fish and Wildlife of the United States* (Washington, D.C.: Bureau of Sport Fisheries and Wildlife, 1966). Although no formal legal status or protection was afforded to species included in this book, the Committee's efforts served to inform people of the plight of selected animals and give federal recognition to the problem.

1966
Passage of the Endangered Species Preservation Act, which directed the FWS to prepare and maintain an official list of endangered native animals. Although this act provided no authority to regulate taking or trade, it did authorize funds for management and research for listed species. Land and water conservation funds were made available to acquire endangered species habitat.

1967
Establishment of the Office of Endangered Species to administer the Endangered Species Preservation Act. The first official list of endangered native animals, consisting of seventy-eight vertebrates, was published.

1969
The 1966 act was amended by passage of the Endangered Species Conservation Act, which gave the FWS new authority to list mollusks and foreign species and to regulate their import. Protection was also soon provided for listed native species. The secretaries of agriculture, defense, and the interior were directed to use their authority consistent with other mandates to conserve and protect endangered species. The FWS initiated a process of recovery plans in the early 1970s. The implementing document was designed to outline a step-by-step program for recovery of a species.

1969
Passage of the National Environmental Policy Act (NEPA), establishing the policy that federal decision making should include evaluating the effects of federal actions on the quality of the human environment.

1972
Treaty for the conservation of migratory birds, similar to the 1916 treaty with Great Britain, signed with Japan.

1973
Ratification of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Appendix

1973

Passage of the Endangered Species Act, which brought U.S. policy into line with CITES, and greatly increased the authority and scope of the U.S. program. Responsibility for implementing the ESA was divided between the secretary of commerce (for most marine species) and the secretary of the interior (for all other species). The secretary of agriculture was given responsibility for enforcement of import/export controls for listed plants.

The ESA recognized "threatened" species, to provide protection for species before they were in imminent danger of extinction. The ESA also provided listing of any vertebrate or invertebrate, not just members of selected classes, as in the 1969 act. Listing of plant species was allowed, as was listing of animal populations, not just specific species or subspecies.

Public participation was encouraged in the listing or delisting process. The ESA allowed people to request a public hearing in addition to the normal public comment period. It also allowed any person to bring action in the U.S. District Court for alleged violation of the ESA. The court may prohibit any person or agency (including the FWS) from conducting acts deemed harmful to endangered species.

The purposes of the ESA are to conserve ecosystems upon which endangered and threatened species depend, to provide a program for the conservation of such endangered and threatened species, and to take appropriate steps to achieve the purposes of the treaties and conventions set forth in the ESA.

1977

FWS clarifies treaties on migratory birds by publishing a list of species covered.

1978

A convention with the Union of Soviet Socialist Republics on the Conservation of Migratory Birds and Their Environment was concluded.

Reprinted from Anderson (1998)

Acknowledgments

This project relied heavily on valuable information provided by personal contacts and interviews. It would not have been possible without the generous availability, insight, and input from many actors in the state and local arena which constitutes the volatile issue of endangered species conservation. This includes environmental group leaders, ranchers, biologists, politicians, and others. A special thanks to University of Wyoming professor of zoology, Gary Beauvais, former Wyoming governor's aide, Richard Lindsey, Wyoming State senator, Mike Massie (D), Wyoming House representative, Tom Rardin (R), acting director of Wyoming Natural Diversity Database (WYNDD), William Reiners, and the staffs at both WYNDD and the Colorado Heritage Program (CNHP).

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