Endangered and Threatened Species Listing Criteria:

A Review of Agency and Organizational Experiences

Ericka K. Scarpace
Bureau of Endangered Resources

and

Jeff A. Schimpff
Bureau of Integrated Science Services

Bureau of Integrated Science Services
Wisconsin Department of Natural Resources
P.O. Box 7921
Madison, WI 53707-7921

Special Publication PUB-SS-957 2001

Abstract

This report documents the endangered and threatened resources listing criteria, guidelines and processes of states, nations, and non-governmental organizations. This documentation is for use by the Wisconsin Department of Natural Resources' (DNR) Bureau of Endangered Resources (BER) for evaluating the potential for developing and using listing criteria. Methods used for detailing these listing processes include contacting state government agencies, interviewing internal Wisconsin DNR staff, and reviewing published literature and organizational websites. Interviews with internal DNR staff indicate a lack of experience working with listing guidelines or criteria. Results from the literature review and state surveys show substantial variation in the types of criteria, guidelines, and processes used by states. The literature search results indicate an overall paucity of published information about listing criteria and guidelines. Most published literature tended to focus on conservation status assessments. Literature research of other nations and non-governmental organizations using criteria indicates a substantial reliance on the quantitative forms of criteria. Close analysis of state survey communications reveals a trend among states away from quantitative criteria towards more qualitative processes.

Table of Contents

Introduction and Background

This study documents existing Wisconsin Department of Natural Resources (DNR) procedures to list species as endangered or threatened under Wisconsin's endangered species laws, and reviews and evaluates a number of methods used by other state and federal governmental agencies and non-governmental organizations. The Department's Bureau of Endangered Resources (BER) will use the findings of this report as a resource as they deliberate the use of formal criteria for developing listing recommendations. This is part of an ongoing effort to use the best scientific methods for these decisions and to appropriately document these methods in statutes, codes, and internal guidance documents.

The study consisted of two parts: (1) a literature review to gather information on listing criteria from published sources, and (2) a survey of state agencies to gather information on their experiences in developing and using criteria as well as information on the actual criteria used. Although listing criteria were the focus of the study, information on other approaches was also gathered and is reported here as well. Information on the Department's past procedures for listing species is provided as background. Much of this information was gleaned from interviews of Department staff and a review of agency files.

Categorizing or classifying species, for protection under endangered species acts, for assessing species rarity or endangerment, or for determining appropriate management strategies, is sometimes done using criteria, guidelines, or conservation status ranking systems. It is important to note that criteria, guidelines, and conservation status ranking systems are different tools with different purposes and goals. Unfortunately, these terms have varying meanings across agencies, states, and nations and in the published literature. "Listing criteria," for the purpose of this report, refers to codified requirements used to determine species placement on a regulatory list, such as an endangered or protected species list. The term "guidelines" refers to non-codified criteria used to determine the species placement on a regulatory or non-regulatory list. Guidelines are mostly used as agency tools. "Conservation status ranking systems" refers to quantitative and/or qualitative analyses used to determine the relative risk of extinction of species or habitats.

National and International Trends

While broad trends regarding listing, listing criteria and species assessments are not well documented, one broad trend emerged upon discussions with WDNR staff and agency staff of other states. It appears the initial shift was a move away analyzing species' "probability of extinction" and towards looking at species rarity. This may be due in part to the development and use of the Natural Heritage methodology across the United States. Heritage methodology looks at rarity in the form of number of element occurrence (distinct populations) and then ranks species according to rarity. The most recent trend appears to be a shift towards looking at population trends of species over time. This trend may be a direct result of years of data gathering for Natural Heritage ranking. After several years of Natural Heritage programs tracking species, many states are now finding they have compiled enough data to use for preliminarily looking at species trends. Agencies and biologists are now using these trends to assist in making listing decisions.

The literature search phase of this project yielded insufficient basis for identifying any national trends among states in the U.S. Almost nothing published in biological science and related journals provides insight into trends in state use of criteria in endangered resources listing

processes. Internationally, the trend appears to be one of adopting, often with some modifications, the revised criteria developed by the International Union for the Conservation of Nature (IUCN) in 1995. Great Britain, Australia, and Canada all have done or are working toward this. A number of authors have evaluated the usefulness of these criteria and have found that they work, at least on a global or national scale, and sometimes with taxon-specific alterations, for a wide range of taxonomic groups.

Wisconsin Endangered Species Legislation

Section 29.604, *Wis. Stats*., and Chapter NR 27, Wis. Adm. Code, are the legislative mandates authorizing legal protection for rare plant and animal species in Wisconsin. S. 29.604, *Wis. Stats.*, was approved by the legislature in 1971 and Chapter NR 27 was enacted 1 October 1979. S. 29.604, *Wis. Stats*., provides for the protection of endangered and threatened animals on both public and private land and for the protection of plants on public land. Subsections of 29.604 describe the purpose of such legislation, list definitions for terms including "endangered" and "threatened", outline the protection and restrictions associated with listed species, and describe the setup and revision of the actual endangered and threatened species list. Other than qualitative definitions for "endangered" and "threatened," the statute does not contain any listing criteria or guidelines, nor does it direct the DNR to establish any rule containing guidelines or criteria. Chapter NR 27, which provides administrative rules for implementation of s. 29.604, *Wis. Stats*., contains the actual state endangered and threatened species list. Chapter NR 27 does not, however, contain any criteria or guidelines. The current list contains 238 species including 100 animal species and 138 plant species.

Wisconsin DNR Listing Methods and Past Listing Guidelines – To date, the Wisconsin Department of Natural Resources has undertaken nine listings. The first listing became effective 1 October 1972. The eight list revisions following the initial listing were approved 1 October 1975, 1 May 1978, 1 October 1979, 1 November 1981, 1 December 1982, 1 April 1985, 1 August 1989, and 1 August 1997. Separate from the full list revisions there have been a few species-specific list revisions such as the delisting of the Timber Wolf in October 1999. The species-specific list revisions have been undertaken for species whose listing or delisting may have substantial implications for major stakeholders.

Over the past several decades, the BER has used multiple techniques for determining the species in need of listing as endangered of threatened in the state including the Natural Heritage Inventory ranking methodology, listing guidelines, and biological assessments. Techniques have evolved and developed with the maturation and development of the Endangered Resources Program. Compared to the first listings, recent listings have tended to require more up-front analysis of the need for listing rare species. A major tool used consistently by the Endangered Resources Program is the Natural Heritage Inventory ranking methodology. The Natural Heritage Inventory Section is responsible for maintaining the Heritage database for the State of Wisconsin. The primary focus of the Natural Heritage program is species inventory and assessment. However, the data and ranks generated as a result of the Heritage program are one of several tools used by BER staff to determine which species are in need of placement on Wisconsin's Endangered and Threatened Species List. More details regarding the Natural Heritage Ranking Methodology are provided in the literature review portion of this report.

In the mid-1980's, BER staff developed draft guidelines that were used for the listing finalized in 1989. These guidelines were further updated in the late 1980s and the early 1990's. These guidelines were based heavily on guidelines used by the State of Michigan for endangered and

threatened species listing in that state. The guidelines from the mid-1980s were established for endangered, threatened and extirpated species. The guidelines for endangered and threatened looked at: federal status, reintroductions, previously listed extirpated but now present, viable population numbers, individual numbers, number of sites, population decline, endemism, vulnerability to exploitation, habitat specialization and habitat vulnerability. The endangered and threatened category requirements differ by the numerical values associated with the population variables. A copy of these guidelines can be found in Appendix E.

For the most recent listing finalized in 1997, professional judgment and biological assessment were used to determine which species should be listed. Biological assessments are based upon a variety of scientific information such as element occurrences, data from surveys by DNR staff and outside sources, consultation with experts, The Nature Conservancy and other Natural Heritage programs, and published literature. While the biological assessment does not have any definitive criteria, there are certain factors that staff review for each species. These factors are analyzed based on the information gathered from the aforementioned sources. The factors are:

- Estimated number of viable populations or occurrences in the state.
- Population trends.
- Status of the species throughout its range.
- Wisconsin's geographic position relative to the range of the species.
- Habitat specificity and sensitivity of species.
- Habitat loss.
- Species exploitation.
- Other biological factors including genetic erosion, predation, pollinator loss, and success of propagule dispersal.

After obtaining the information and looking at the factors, the NHI staff make decisions regarding which species are in need of listing. A previous Supreme Court ruling in the case, *Barnes vs Wisconsin DNR*, regarding a decision made by the DNR not to list the bobcat, upheld the use of professional judgment, in the absence of compelling data, for determining whether or not to list a species. This ruling slowed the need for the BER to focus immediate efforts on developing specific listing criteria.

To better understand the breadth of experience with listing guidelines or criteria of internal DNR staff, we interviewed staff from the Bureaus of Endangered Resources and Integrated Science Services. We chose these individuals based upon their previous involvement with endangered species listings. The individuals interviewed were Eric Epstein, Don Fago, Greg Butcher, Bob Hay, Rich Henderson with Scott Sauer and Eric Maurer, Randy Jurewicz, Kelly Kearns, Lisie Kitchel, Dick Lillie, John Lyons, Mike Mossman, Robert Rolley, Dave Sample, Bill Smith, and Bill Tans. These interviews took place between 7 March 2001 and 8 May 2001. The assistance of these individuals is greatly appreciated. We used the same set of questions in each interview. See Appendix C for a copy of the questions. These questions attempted to elucidate the experiences that staff had working with the BER guidelines or other criteria. In addition, staff also offered other ideas and reflections about guidelines or criteria. This section discusses the actual past experiences with BER guidelines or similar criteria. Our interview results indicate that while ISS and BER staff have been involved in the listing process they have limited experience with listing criteria itself. Those with experience developing and using guidelines or criteria shared with us the lessons they learned. While listing guidelines were at one point used in the BER, few BER staff recall involvement in the creation or utilization of these guidelines. Some staff have not worked directly with the BER guidelines, but have experience with other types of criteria or criteria utilized in other states.

Staff Recollections from direct experience using BER Guidelines or similar criteria include:

- Listings done without guidelines could have used some guidelines to act as a guiding hand.
- Often the data or information required in guidelines is unavailable.
- Flexibility in the guidelines or criteria is essential in order to accommodate unique taxa or species situations that arise.
- Criteria works best when it is used in combination with panels of experts.
- For criteria with scoring and ranking, this scoring should be broken down into categories and species should get an overall score but also a score for each section. This elucidates which species need listing because of a combination of factors and which species need listing due to one major factor.
- Guidelines used in previous listings were a useful tool.

Staff also had ideas regarding guidelines and criteria that while not directly related to their experiences with criteria, represent important experiences and lessons learned from other work with rare species. These ideas are presented in Appendix C.

Literature Review of Articles on State, Federal, and NGO Listing Criteria

Review Methods and Sources

DNR staff made extensive searches of electronic abstract databases to locate published materials addressing the use of criteria for listing endangered and threatened resources. These databases included *Biological Abstracts, Zoological Record, Bioline, Fish and Fisheries Worldwide, Wildlife Worldwide*, and *Environmental Law Review*. These abstract databases provide access to a wide range of reviewed journal articles on topics pertaining to endangered resources listing criteria.

This electronic search was made using many combinations of applicable keywords and phrases (including "listing," "criteria," "conservation," "status," "endangered," "threatened," and "species"). Staff of the Wisconsin DNR central library, and the University of Wisconsin Agricultural and Life Sciences (Steenbock) Library and the Biological Sciences (Birge Hall) Library provided their expertise to ensure that the authors would find as many applicable sources as possible. Their assistance is gratefully acknowledged.

Books produced by state endangered resources programs that describe a state's endangered biota were checked for any information on listing criteria. These publications included books produced by endangered resources programs in Illinois, Michigan, Minnesota, and other states.

Inquiries of Science Services and BER program staff in Wisconsin, and endangered resources program staff in other states, produced a few additional relevant articles and papers. Internal administrative documents gathered from states are included under the section of this report that reviews state listing procedures and guidelines.

Finally, we conducted keyword searches of the World Wide Web using the same groups of words and phrases used to search the abstract databases. We engaged AltaVista, Excite, GoTo.com, Lycos, MSN Search, and Northern Light search engines.

Several hundred citations and abstracts appeared during these electronic searches. The authors screened these for their applicability to the topic of "listing criteria or guidelines." Approximately 115 papers and other sources were selected as relating directly or tangentially to listing criteria, though most of these deal with conservation priority ranking systems rather than formal listing. Only a small portion of these, less than 25 percent, contained any discussion of formal listing criteria. These 115 papers and other sources were obtained for analysis in this report. (See citations and abstracts in Appendix B.)

Most of the other several hundred references located were not closely related to listing, being species life history, management, or general conservation biology articles. Among this group, only those (20 in number) that seemed most relevant to listing, or most representative of these types of papers as a whole appear in Appendix B.

Agency and institutional sites with general information on endangered and threatened resources programs are plentiful. However, very few scientific papers regarding listing criteria were located via general search engines on the World Wide Web. Most WWW articles pertaining to listing criteria described various state, national or sub-national endangered resources programs. Few provided any substantial discussion of criteria used, with the exception of IUCN or IUCN-derived criteria (Environment Australia 2001, Environment Canada 2000, IUCN 2000).

Review Results

Listing Criteria Use and Experiences of States of the U. S.

Overall, we found far fewer articles published on criteria developed or used by states than by non-governmental organizations. The fact that we found such a low number of published articles (nine) and Web site documents (four) describing criteria used by state programs surprised us.

Published journal and book articles pertaining to the use of listing criteria by state endangered resources programs were as scarce as some of the endangered and threatened natural resources themselves. Academicians and other non-government researchers produced the bulk of materials located in our literature search. Most of these were analyses of the status of species within the author's realm of expertise. We located no articles synthesizing existing information on the use of criteria in listing species or communities in need of conservation action.

Most of these papers did not address questions or issues regarding use of criteria in any formal endangered resources listing process. Instead, they address three major questions:

- "Where along the continuum of 'rarity' does species X lie?,"
- "Is the rarity or risk-of-extinction status of taxonomic group Y suitable to use as an indicator of the conservation priority ranking of its habitat?"; and
- "What is the conservation status of species Z?"

Only a few articles or World Wide Web presentations written by state agencies or others mention the use of state criteria or guidelines in making listing or delisting decisions (Brauning 1995, Nebraska Game & Parks 1999, Kirkland et al. 1990, Bowles 1999). The books published by state endangered and threatened resources programs contained useful thumbnail sketches of listed species, but no descriptions of criteria that may have been used to assign conservation status

Most of the balance of authors located have published articles that discuss a species' or taxonomic group's conservation status within specific states or interstate regions, but do not mention any link to listing criteria used by any state or non-governmental agencies or institutions. At the state level, these include a summary of the conservation status or extinction risks to the chorus frog in Illinois (Burrows 1996), flying squirrel in Pennsylvania (Mahan 1999), aquatic vertebrates and communities in Texas (Edwards et al. 1989), freshwater fish in North Carolina (Menhinick 1986), and venomous snakes in North Carolina (Ripa 2000).

The few articles we found describing any state-wide criteria for endangered species listing were primarily confined to major taxonomic groups: birds in Pennsylvania (Brauning 1995), mammals in Pennsylvania (Kirkland, 1990) and fish and wildlife in Florida (Milsap 1990). See Table 1 for a summary of these findings. The taxonomic span of these papers leaves enormous gaps in coverage of species by taxonomic group, under the topic of listing criteria.

Table 1. Taxonomic Coverage of Papers Related to State Listing Criteria

State	Qualitative or Quantitative	Taxa	Source
Florida (Game and Freshwater Fish Comm., Nongame Wildlife Program)	Quantitative *guidelines*	Vertebrates	Milsap 1990
Illinois (Illinois Endangered Species Protection Board)	Quantitative criteria for down-listing or de-listing, but not yet adopted for general use	Plants (5 prairie species); may be applicable to many more.	Bowles 1999
Massachusetts	Not revealed in paper	All plants	Sorrie 1987
North Carolina (Amphibian and Reptile Scientific Council)	Qualitative, subjective, but not detailed in paper	Venomous snakes	Ripa 2000
Pennsylvania (Pennsylvania Biological Survey – Ornithological Technical Committee)	Quantitative, objective ranking	Birds	Brauning 1995
Nebraska (Game and Parks Commission - Natural Heritage Program)	Part Quantitative, part Qualitative	"Wildlife and plants"	Nebraska Game & Parks Comm. 1990

Papers Pertaining to State Listing Authority

The **Pennsylvania** Biological Survey's (PABS) Ornithological Technical Committee (OTC) used the Kirkland and Krim (1990) ranking procedure, combined with data from the state's Breeding Bird Atlas, the USFWS Breeding Bird Survey, published literature, and personal knowledge to update the state's list of special concern **birds** (Brauning 1995). The 18-member OTC conducted this process "in open discussion." Collection of new data by atlas volunteers was instrumental in developing more accurate, revised conservation status classifications and listings of birds in the state.

Florida (Milsap 1990) developed a numerical scoring system to rank and establish priorities for **vertebrate species and subspecies** conservation. This system uses seven biological variables:

- population size,
- population trend,
- range size,
- distribution trend,
- population concentration,
- reproductive potential for recovery, and
- ecological specialization.

There are four action scores (that reflect the current state of knowledge about the taxon): (1) distribution, (2) population trend, (3) limiting factors affecting populations, and (4) ongoing conservation management. Five supplemental variables are used to sort and categorize taxa to "answer specific biological and political questions:" (1) system significance, (2) percent of total taxon range that occurs in Florida, (3) trend of Florida's population of that taxa, (4) period of occurrence in Florida, and (5) harvest data for Florida.

Using this system enables resource managers to determine which orders have the greatest survey and monitoring needs, and which geographic regions and ecological communities have the highest concentrations of taxa with the greatest need for conservation action.

Nebraska uses four factors encompassing ten listing criteria, to implement its **endangered species** protection law (Nebraska Game, Fish and Parks, 1997). The factors are: (1) population abundance and trend, (2) importance of Nebraska populations, (3) threats, and (4) species resilience and ecological specificity. These largely qualitative criteria are evaluated by means of a point/ranking system and apparently apply across all native taxonomic groups.

One additional listing criterion Nebraska uses is the recognition of federally listed species. Section 37-806 (1) of the state Nongame and Endangered Species Conservation Act states that species listed as endangered or threatened under the federal Endangered Species Act are automatically treated as being listed by the state. The state may choose to list a federally threatened species as endangered in the state, if its status in the state so warrants, but may not list a federally endangered species as threatened in the state.

In **Illinois**, arboretum staff proposed guidelines for reclassifying or de-listing five species of endangered native **plants** once it appears their populations have recovered or actions have stabilized their habitats (Bowles 2000). These guidelines assess a plant population's viability by factoring in population size, growth trends, habitat size, protection status, and land management conditions. The guidelines are in reports that have been furnished to the Illinois Endangered Species Protection Board. This body makes the final recommendations regarding a species' classification under state endangered species law.

Bowles (2000) developed reclassification and delisting criteria for five state- (and federal) listed Illinois prairie and sand-blow plant species. These guidelines are applicable to populations around the entire state. They are structured to incorporate future advances in knowledge about plant species and their management. He assessed distribution and abundance, life history characteristics, population demography, and ecological requirements. Information sources included published papers, recovery plans, and data from ongoing monitoring and restoration research (Bowles 2000).

He used this data to index the viability of each species population in each Illinois natural division within the species' range. The criteria include a range of values for a number of variables that determine population viability. These include:

- population size,
- population growth trend,
- effective population size based on genotypes,
- habitat size,
- habitat condition and successional stage,
- protection status, and
- habitat management conditions.

Finally, he produced tables for each species that show the numbers of moderately viable and highly viable populations in each of the natural divisions that would need to be established in order to reach the goal of populations secure enough to down-list and to de-list the species within the State of Illinois.

Extensive species information is included with each species report. Bowles stated that the cost to him of developing these criteria was nearly $2000 per species, under a contract that paid him $5,000.

Ripa (2000) heavily criticized **North Carolina's** lack of reliable data and out-of-context interpretation of available data, in that state's Amphibian and Reptile Scientific Council decision to list two **venomous snakes** under the state's endangered species act. The Council used as its main abundance indicator a drop in the number of confirmed sightings by field staff, and a concern for some unspecified amount of habitat loss.

Ripa notes that the observed population decline over the past 50 years reflects an artificial abundance of snakes in the 1950s and 1960s. This he says was due to a crash in raptor populations due to pesticide use and indiscriminate shooting of raptors. The snake population trend since then, as raptor populations have increased through better public acceptance, should be interpreted as a return to a more normal level.

He offers observations on high numbers of road kills and snakebite cases that indicate these snakes are too abundant to warrant the ban on collecting that would result from listing. For example, North Carolina has a rate of venomous snakebite (18.8 reported bites per 100,000 people) three times higher than the rate in Virginia, the eastern state with the next-highest level.

Even though he does not bring the Scientific Council's specific data sets and listing guidelines into his argument, he notes that data used does not reflect a systematic survey of species, and notes that at most times of the year, venomous snakes are very difficult to accurately survey due to their secretive nature and wide dispersion across a densely foliated landscape. In the absence of

detail on the complete rationale behind the listing proposal, his views do appear to reflect a more realistic view of the status of the eastern diamondback and timber rattlesnakes in North Carolina

Ripa (2000) suggests that habitat protections and restrictions on take, similar to those used in regulating populations of game animals and game fish, would provide adequate protection for these snakes.

Since 1978 the **Massachusetts** Natural Heritage Program has conducted an inventory of rare species throughout the state of Massachusetts (Sorrie 1987). This inventory provides information on 286 rare **vascular plant taxa**, including current nomenclature, number of stations, *endangerment status*, range extensions, habitat preference, and identification. Discussion of endangerment status, however, does not include any discussion of criteria that may have been used to determine the noted status.

Papers Not Related to State Listing Authority

Species Status Assessments – Virginia and Pennsylvania, states with common borders and species appear to be contemplating using common listing criteria. Kirkland (1990) experimented with the Virginia "BOVA Project" ranking methodology to unofficially survey the conservation status of **mammals** believed to be secure in **Pennsylvania**. This scoring system incorporates data on population status, habitat, threats, biological characteristics, and taxonomy.

Based on the score provided by this system and a review by Kirkland's study team, species were assigned a status ranging from "Secure" to "Endangered." These species status classifications were then compared to those assigned to species under a 1985 study.

The major difference between these two status classification systems was that the 1990 modified **Virginia** system eliminated a "Status Undetermined" classification from all but one of 16 species given that classification in 1985. This was due to the collection of additional information on most of these species, stricter definitions of the status categories than were used in 1985, and the author's inclination "to restrict the use of Status Undetermined to taxa about which there is a genuine question as to their status in Pennsylvania." Kirkland (1990) did not report upon any attempts to convince the Virginia endangered and threatened resources management program to adopt these criteria or to use his results as the basis for any listing proposal.

In an assessment of the status of the **flying squirrel** in **Pennsylvania**, Mahan (1999) used criteria similar or identical to that used in Virginia. Using these criteria, her team was able to conclude that the species may be in "severe decline" and in need of conservation action. This status assessment was not performed as part of any state listing activity.

Ranking Species or Habitats for Conservation Priority – Researchers in **Texas** (Edwards 1989) devised a system to rank **aquatic habitats** in conservation priority order. They identified and mapped 11 primary aquatic habitat types, and 7 major biotic provinces across Texas. Next, they identified almost 80,000 miles of stream channel within those habitat types. They then overlaid on this mosaic the distribution of all endangered and threatened **vertebrate** species within those habitats and provinces, as indicated by data from the Texas Organization for Endangered Species. This provided a picture of which aquatic habitat types and areas were most vital to overall biological conservation. The Chihuahuan (desert) biotic province supports the most imperiled aquatic biota in Texas, with 56 percent of its native fishes in danger of extinction.

Nevada cutthroat trout in need of conservation action were identified using stream fragmentation and stream segment isolation as the only guideline (Dunham 1997). Dunham concluded that habitat fragmentation of aquatic habitats may be a significant contributor to the increased risk of local extinctions, because it reduces the potential for trout to recolonize stream segments from which they have been extirpated.

Menhinick (1986) proposed for **North Carolina** a numerical method for ranking **aquatic species**' susceptibility to extinction. This system relies heavily upon distributional information. This resolves problems related to lack of life history data and is an improvement upon other methods viewed as too subjective. Specific variables scored include: (1) number of sites a species is found along a stream, (2) number of streams or lakes a species occurs in, and (3) relative size of total range. These criteria include proximity factors related to vulnerability, weighting factors related to size of streams, lakes and reservoirs, as well as vulnerability to pollution, and an uncertainty factor reflecting lack of survey effort. This method could be expanded with species values from different states to yield regional or national values. Menhinick (1986) believes this method should also be applicable to other animal species that have "limited distributional powers."

He (Menhinick 1986) applied his proposed ranking system to **North Carolina freshwater fish** species, and compared the results with a 1977 exercise in categorizing threatened species using other criteria. This 1986 application led to classifying most of 68 species in risk categories different from their present (based on the1977 analysis) classification. This result emerged due to two factors. First, the criteria used in this ranking system were less subjective that the method used earlier. Second, in the intervening years, researchers had been able to collect more data needed in order to meet the requirements of the criteria, so that Menhinick (1986) was able to more definitively assess the conservation status of many species.

Shepard (1997) notes that Westslope **cutthroat trout** in **Montana** now occupy less than 5% of their historical range in the upper Missouri River basin. He developed a *population viability assessment* model using life history and population data to determine the extinction risk of 144 known populations. Risk assessment parameters used in the Bayesian model were:

- spawning habitat availability,
- eggs/female,
- incubation success,
- maximum fry survival,
- fry capacity,
- juvenile survival,
- adult survival,
- age at first maturity,
- initial adult population,
- coefficient of variation of fry survival, and
- risk of catastrophe.

The model helped lead Shepard (1997) to conclude that livestock grazing, mining, angling pressure, and the presence of non-native fish present the greatest threats to the persistence of remaining, isolated Westslope cutthroat trout populations. Rather than being used to list cutthroats in a threatened category, Shepard's work has galvanized concerned citizenry to seek resource management solutions to the threats that pose a risk to the species' survival.

Data Sources Used – Population trends in Pennsylvania avian species are reviewed using data from the Pennsylvania Breeding Bird Survey, for distributional data, and the USFWS Breeding Bird Survey (BBS), for relative abundance and major trend data. Nevada and Montana fish researchers and managers used recent and historic occurrence data. Nebraska relies on its Natural Heritage Inventory data, staff expertise, and a panel of 23 outside reviewers.

Socio-economic Factors Considered – Socio-economic factors were not mentioned as being used to list a species, except to the extent that human actions are jeopardizing virtually all species classified somewhere along the continuum of "special concern" to "endangered." Socio-economic factors are therefore weighed as threats to the continued existence of species.

Lessons Learned – Two major caveats regarding the use of listing criteria appear in the papers we located. First, states must either make sure they have access to the data they will need to implement criteria, or build in some means of dealing with absent or deficient data. Second, hiring outside help to develop criteria and perform status assessments related to listing/delisting could strain an agency's budget.

Listing by Federal Agencies under the Endangered Species Act

At least 30 papers located address various aspects of the U.S. Endangered Species Act (ESA). Some articles address listing decisions (Anon. 2000, Meylan 1999, Zink 2000), some explain, propose, or critique listing guidelines (Nicholopoulos 1997), others suggest a variety of changes to the ESA (Anon. 2000, Bogert 1994, NESARC 1997, Undated, Western Governors' Association 1997), and a few discuss the conservation status of status of species, such as the Uncompahgre fritillary butterfly in Colorado (Britten et al. 1999).

Finally, a large number or papers found during our search dealt with conservation biology, life history studies, or conservation strategies for species known or believed to be rare. Only a few of these made any mention of the use of any criteria for assessing rarity or any formal conservation status (Navarrete-Heredia 1996, Koch et al. 2000).

Nicholopoulos (1999) lists the five "factors" that federal agencies are to evaluate in making recommendations to list or not to list species as endangered or threatened:

(1) "the present or threatened destruction, modification or curtailment of the species' habitat or range;
(2) over utilization for commercial, recreational, scientific, or educational purposes;
(3) disease or predation;
(4) the inadequacy of existing regulatory mechanisms; and
(5) other natural or man-made factors affecting the species' continued existence."

The U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service, the agencies with listing authority under the ESA, are to consider the "best scientific and commercial data available" in evaluating a species' conservation status. However the Federal ESA of 1973, as amended, does not include a set of criteria for use in determining either whether to list a species, or into what classification of endangerment a species should be listed. The USFWS has developed a ***priority system*** for directing its resources toward conserving the plant and animal species in the greatest need of protection. The guidelines used are: (1) the magnitude of threat, (2) the immediacy of the threat, and (3) the taxonomic distinctiveness of the species

Determining the Conservation Status of Avian Species – In the absence of any formally adopted criteria, the USFWS used a five-step process to apply the five general criteria of the ESA to identify avian species of concern:

(1) a modified group decision-making exercise (Delphi),
(2) a review of Breeding Bird Survey data,
(3) a review of Audubon Christmas Bird Count data,
(4) a review of Partners in Flight prioritized regional lists of Neotropical migrant landbirds, and
(5) a review of the U.S. Fish and Wildlife Service's (USFWS) "candidate" species list.

To qualify for national listing, a species had to meet at least one of the following selection criteria:

(1) A Delphi score of Moderate or High concern by more than 50% of all respondents,
(2) a long-term (1966-1993) population decline documented by the Breeding Bird Survey that equals or exceeds 2.5% per year,
(3) a long-term (1959-1988) population decline documented by the Audubon Christmas Bird Count that equals or exceeds 2.5%/year,
(4) a composite Partners in Flight rank score of at least 24 in (a) 2 or more USFWS regions or (b) the USFWS region that contains at least 50% of the U.S. breeding range or population, or
(5) a Category 1 or Category 2 "candidate" species in a geographical area covering at least 10% of the U.S. breeding range.

Species-based Regional Conservation Priorities – USFWS Region 3 developed a list of priority species to use in focusing their program resources on those species in greatest need. Choosing this species-based approach to identifying key habits rather than a habitat-focused approach is advocated by The Nature Conservancy in its publication *River of Life* (see Master et al. 1998).

Working with the ESA – The ESA's *lack of criteria* results in "widely inconsistent" listing and recovery proposals and actions (Gerber 1998). High-quality population assessments are lacking and listing criteria are "arbitrary and non-quantitative." Recovery goals for federally listed species are sometimes at or below existing population size. Gerber proposes a new approach to determining classification criteria, focusing on the **North Pacific humpback whale**. This approach attempts to explicitly incorporate biological uncertainty into the definitions of "endangered" and "threatened," using data that either already exist, or are attainable in the foreseeable future.

For Gerber (1998), “the key idea is that endangerment depends on two critical aspects of a population: population size and trends in populations size due to intrinsic variability in population growth rates. The way to combine these features is to …identify a population size and a range of population growth rates above which there is a negligible probability that the population would fall below a level from which extinction is inevitable.”

Several papers criticized various aspects of the ESA, itself, particularly those produced by industry associations whose members are inconvenienced by requirements to protect species (Western Governors' Association 1997, NESARC Undated). These associations desire a greater degree of certainty regarding listing decisions and their regulatory aftermath, but often call for shifting all costs of compliance onto the public, or advocating other changes in implementation that would tend to render the Act worthless to species conservation.

The Ecological Society of America (1996) had ten members review the topic of listing and concluded that:

(a) "the most important priorities in deciding which candidate species to list" are: number of other species to benefit from the listing, ecological role of the species, recovery potential, and taxonomic distinctiveness;
(b) Population viability analysis "offers a method to identify how" to maximize a specie's survival potential;
(c) Endangered species recovery is enhanced when: recovery plans call for population distribution across the landscape, plans are "developed and implemented expeditiously," and
(d) Ecosystem-level (habitat) protections are a proactive approach that would provide effective protection of biodiversity at a lower long-term cost than waiting until species' extinction risk becomes great enough to warrant listing under ESA.

On the other hand, Doremus (1997) notes that close examination of the ESA shows that many of the most troubling issues are not truly scientific. For that reason, excessive reliance on science has not improved policy decisions under the ESA.

The need for criteria under the ESA appears to be addressed on a species-by-species basis, as exemplified by Smallwood (1999), Cone (2001), Kushlan (1988), Kirsch and Sidle (1999), and Ralls et al. (1996). Kirsch and Sidle (1999) developed recovery goals for populations of the interior populations of the least tern.

Ralls et al. developed an “effective population size” (Ne) for the **southern sea otter**, necessary to guard against catastrophic population crashes. She computed the actual number of individuals to achieve Ne to be 1850 (this number later became the "Threatened" status threshold). Then, she modeled the likely impacts of the greatest threat to otter populations - a range of potential oil spills of varied volume, frequency and location. Her team reached a consensus that roughly 800 otters would die in a 90-percentile worst cast spill. Adding this to Ne yielded 2650 as the minimum otter population size to maintain over three consecutive years before the otter could be delisted.

Implementation of the ESA by federal agencies has sometimes been criticized by people of generally opposing views. For example, Sidle (1998) commented on two 1997 federal District Court decisions concluding that failure by USFWS to list the **Barton Springs salamander** and the **Canada lynx** was "arbitrary and capricious" due to political meddling in the decision. He notes that "ESA requires that decisions be based upon the *best available data* and not the more stringent standard of conclusive evidence." He also notes that voluntary conservation agreements, while increasingly popular, "are not as compelling as the listing of a species, and the track record of conservation agreements is poor," according to a U.S. GAO report. He believes that any new mechanism for species conservation must be free of political influence.

Data Sources Used – For birds, the Breeding Bird Survey (BBS) and Audubon Christmas Bird Count were the most used data sources. Noss (1995) relied on state land cover maps and state natural heritage data in developing an ecosystem assessment.

Socio-economic Factors Considered – The USFWS (USFWS 1995) revealed a desire to "ease the impacts of ESA on private landowners," and to "minimize any negative social or economic impacts resulting from ESA activities." These considerations are not intended to override biological information in making a listing, but to minimize the social and economic impact *once a species has been listed.* The intent is to involve affected landowners and others in developing

recovery plans. Also, the ESA will not apply to small tracts occupied by a single household, to one-time activities on 5 acres or less that were acquired before a species was listed, and activities that would have a negligible impact on the species.

Lessons Learned – The ESA has been and undoubtedly will continue to be subject to a wide variety of commentary from a wide spectrum of viewpoints. Critics and supporters have expounded upon several problems and have been generous in offering various solutions.

In the wake of court cases rejecting listing proposals on the grounds that the science behind the agency decisions was inadequate, Bogert (2000) suggests that "if listing decisions are to be driven solely by biological consideration," species listing decisions must be "based on data that is verifiable, accountable, responsible, and available." He suggests "field testing" of data, and "full public disclosure of all data that is collected," to enable interested parties to make an informed comment on listing decisions.

States are learning that it may be better to take action to protect species within their borders than to wait for federal listing, as exemplified by the case of the prairie dog (Van Putten and Miler, 1999). Western states are drafting a conservation strategy in an attempt to head off federal listing of this once abundant, but now beleaguered plains keystone species.

A related activity is underway on federal lands across the West to protect the lynx (Anon. 2000). The major threat cited in the listing notice is the "lack of guidance to conserve the species in federal land management plans." The BLM and National Park Service have agreed to introduce lynx habitat conservation elements into the management plans for the lands under their jurisdiction, as the Forest Service has already agreed to do. The agricultural, mining, alpine skiing, and other industries that rely heavily on public lands fear restrictions on their activities as a result of this listing. This may prompt development of industry-government partnerships in the future, promoting a more proactive approach in public lands management.

Relying on a single species approach for protecting threatened habitats may not be wise, as illustrated by the case of the federally endangered California gnatcatcher. Zink (2000) concluded that "not all currently recognized subspecies are equivalent to evolutionarily significant units and illustrates the danger of focusing conservation efforts for threatened habitats on a single species."

Listing Criteria Use and Experiences of Other Nations

As noted previously, other nations or their political subdivisions have adopted slightly modified versions of the IUCN criteria as their own national, provincial, or territorial criteria, such as Australian Capitol Territory (ACT 1995), Canada (Crins 1997), and British Columbia (Munro 1993). In Canada, formal criteria has been adopted by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Canadian Wildlife Service 2000, Environment Canada 1999, 2000, Shank 2000).

Australia - To implement its July, 2000 Environmental Protection and Biodiversity Conservation Act, Australia uses criteria that are generally non-quantitative for listing threatened **species**, threatened ecological **communities**, and **'key threatening processes**.' Measurements for all criteria but "probability of extinction" are left to interpretation, as "very severe," "substantial," "low," etc. For plants and animals, these include degree of reduction in numbers, restrictions in

geographic distribution, total breeding population and rate of population decline, total breeding population regardless of population decline, and probability of extinction in the wild (within numeric ranges).

For **plant communities**, the criteria include geographic distribution in light of vulnerability to potential threats, decline in geographic distribution, decline of a native species important to its biotic community, coupled with probability of restoration, reduction in integrity across its range, in light of community degradation, rate of ongoing detrimental change and indicators thereof, and probability of extinction or "extreme degradation" across its range (within numeric ranges).

English (1999) worked to develop criteria for listing threatened plant communities in Western Australia. He adapted terminology, categories and criteria from those recommended by the IUCN in 1994 for threatened species.

Australia - Australian Capitol Territory (ACT) - ACT Flora and Fauna Committee (FFC) has developed criteria for implementing the Nature Conservation Act of 1980 (ACT 1995). The criteria used appear to reflect the Australian national criteria, with the major exception that there are no numerical bounds for defining "premature extinction." There seems to be no explicit requirement that these terms be defined in relation to life history, population dynamics of other topics. This leaves a great deal of room for professional judgment (but these criteria may also be more vulnerable to legal or technical challenge than IUCN-type numerical limits).

Melzer (2000) applied Australia's criteria to koala populations in four states of Australia. In Queensland and New South Wales, he found that declines are continuing due to habitat loss, hunting, disease, fire, and drought. In contrast, dense koala populations in habitat isolates in Victoria and South Australia are managed to reduce population size and browse damage. Despite this, the koala as a species did not meet the criteria for a threatened species. Melzer recommends that a species management plan be implemented to prevent the koala from meeting the listing criteria in the future.

In Australia, as in the United States, some threatened species advocates feel that listing decisions proceed too slowly. Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) conducted a pilot project to examine the feasibility of listing sites of the National Estate Register, based on invertebrates values (Greenslade 1994). This resulted in the nomination of 30 sites for protection.

Criteria used include species' importance to:

- evolution of Australian fauna,
- maintaining existing processes or natural systems at the regional or national scale,
- unusual richness or diversity of fauna; rare, endangered, or uncommon fauna, communities, ecosystems, or phenomena,
- demonstrating the principal characteristics of the range of ecosystems, the attributes of which identify them as being characteristics of their class,
- close associations with individuals whose activities have been significant within the history of the nation, state, or region,
- community educational associations, and
- information contributing to wider understanding of Australian natural history by virtue of their use as research sites, teaching sites, type localities, reference, or benchmark sites.

This exercise resulted in the selection of small (half are < 10 hectares), discreet habitats such as caves and mountain tops containing rare species. Threats to these sites included tourism,

recreation, and alteration of hydrological characteristics. This method of protecting rare species is faster than legislating for the protection of one species at a time, and it alerts citizens of the sites' values.

Australia - New South Wales – The implementation of the New South Wales Endangered Species Conservation Act has been assailed by at least one critic. Lim (1997) has criticized the Scientific Committee of 10 scientists, created under the Act to make listing decisions. Lim questions whether this body has authority under the NSW constitution to engage in this role.

He notes that for species and communities listed so far, biological information, mapping and other data is inadequate. This makes it impossible (for consultants, the reader can assume) to conduct the "8-Point Test" required under the 1979 NSW Environmental Planning and Assessment Act. Lim questions in particular the proper way to list edge-of-range species, and proposes that the IUCN classification of "Insufficiently Known" be used instead of current emergency designations as "Provisionally Endangered or Threatened."

Canada – The Wildlife Minister's Council of Canada reconfigured its Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Environment Canada, 2000). This is the body that has listing authority on the national level in Canada. However, listing species in Canada does not currently carry with it any regulatory protections for species or habitats.

Formerly, COSEWIC listed species on a very informal basis, and listings of endangered species in Canada triggered no legal consequences. Proposed legislation would place this committee under the direction of the Canadian Endangered Species Conservation Council (CESCC). New guidance is intended to ensure that COSEWIC produces scientifically sound species status assessments.

Assessments would be made by ***eight*** Species Specialist Groups (SSG), with each group responsible for reviewing the status of ***specific taxonomic groups***. The assessment process promotes use of international assessments by IUCN, CITES, and The Nature Conservancy, and considers input from a wide variety of other qualified sources. SSG's prepare final reports for COSEWIC for review and inclusion in their annual status assessment. Provinces and territories would use the COSEWIC process in national species status assessments, and are free to adopt their own procedures for provincial and local assessments.

Canada is reassessing its list using "a modified version" of the of the *quantitative criteria* developed by IUCN (Environment Canada 1999). The new assessment criteria are intended to make the listing of species more consistent and to provide a standard method of reporting assessments. Six Canadian provinces have Natural Heritage Programs (British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec) which accumulate and supply data on the status, distribution, demographics, ecological requirements, and threats to species within their borders (Crins 1997).

The Mollusk Working Group (MWG) provides an example of the function of the various species specialist groups. It was formed in 1995 to determine the status of **Canadian mollusk species** at risk (Metcalfe-Smith 1998). The first task of the MWG was to prepare a preliminary list of candidate species to be considered for national status designation by COSEWIC. Reviewers used a risk factor analysis approach to identify the most imperiled species of freshwater mussels in the Canadian waters of the lower Great Lakes drainage basin.

Metcalf-Smith (1998) describes the work of the Canadian Mollusk Working Group. A database of over 4100 occurrence records for 40 species collected between 1860 and 1996 was compiled for this purpose. Results showed that nearly 40% of these species would likely fall into the extirpated, endangered, or threatened risk categories as defined by COSEWIC. A prioritized list of nine species was proposed for national status designation by COSEWIC.

COSEWIC has also completed work on listing **bird species** (Munro 1993) using their IUCN-derived criteria. Its avian specialist working group will meet periodically to review this listing.

Lessons Learned in Canada – Canadian provinces are periodically reviewing and revising the criteria they use to assess rarity. The trend is toward increased quantification of status, inclusion of more ecological information, fuller consideration of threats to populations, and standardization among jurisdictions within North America (Crins 1997).

United Kingdom – Avery (1995) has proposed a three-dimensional, 27-category conservation status ranking procedure for birds. He advocates assigning priorities for conservation action in the U.K. (Britain and Northern Ireland) using three biological axes: national threat (measured as rarity, localized distribution and population decline in the U.K.), international importance (the proportion of the European population in the U.K.) and international threat (European/global conservation status). This system provides more finely-tuned assessments than a two-axis system considered in 1990.

Each of these axes has been sub-divided into high, medium, and low categories using quantitative thresholds. This produces a national 'conservation cube' (three axes, each with three categories and thus 27 cells). Data permitting, every species in the U.K. can be allocated to one of these cells. They suggest that species high on either (or both) of the national or international threat axes be considered as species of high conservation priority (the red fist) and that among the remainder those that rank at least medium on one of the axes be considered as of medium conservation priority (the amber list). All other species are of low conservation priority (the green list). Avery suggests that this three-axis model could be applicable to other taxa and countries.

Netherlands – In the Netherlands**,** old data and seemingly incompatible data has been used successfully to evaluate conservation status using adopted international criteria (see IUCN discussion, later). Some data collected over time and by different means can be adjusted to make varied data sets compatible and useful for comparing species' population trends over time. Working on the Netherlands' national "Red List," Maes (1997) devised a means to correct for data that reflects differences in Lepidoptera mapping intensity over time.

He used reference species that are homogeneously distributed over the country, that have always been fairly common and that did not fluctuate in abundance too much during the 20th Century. For all resident species, he calculated a relative presence in two compared periods, using the average number of grid cells in which these reference species were recorded, as a correction factor.

Maes concludes that "the use of a standardized method and well-defined quantitative criteria makes national Red Lists more objective and easier to re-evaluate in the future, and facilitates the comparison of Red Lists among countries and among different organisms. The technique applied to correct for mapping intensity could be useful to other organisms when there is a large difference in mapping intensity between two time periods.

Israel – Cameron (1998) used Israel's conservation priority index to rank land mollusks in the tropics. This index emphasizes a range-size criterion for rarity. As in many other taxa, the majority of rare species are found in the tropics, but site diversities there are not consistently higher than those elsewhere. In the tropics, mean range sizes are small. A biodiversity 'hotspot' policy would not be effective in the tropics. Cameron suggests a hierarchy of criteria for conservation priorities, giving precedence to range-related rarity.

Socio-economic Factors Considered – None of the papers addressing listing issues in countries outside the United States mentioned the use of socioeconomic factors as listing criteria. Listing decisions appear to made only on the basis of biological parameters.

Listing or Conservation Priority Ranking Criteria of Non-governmental Organizations

The greatest number of papers and articles addressing the use of formal criteria (20) address issues regarding the IUCN classification criteria. A number of other papers, as well as Web sites, discuss the listing guidelines used by groups such as Partners in Flight, The Nature Conservancy, and a host of biologists not affiliated with any major conservation group. A few articles and books describe non-governmental agency (NGO) criteria or species conservation priority ranking systems other than IUCN's (Beissinger 2000, Borges 2000, Michaels and Mendel 1998, Carter 2000, Stein et al. 2000).

International Union for the Conservation of Nature (IUCN) – The IUCN, also known as The World Conservation Union, was "founded in 1948 and brings together 78 states, 112 government agencies, 735 NGOs, 35 affiliates, and some 10,000 scientists and experts from 181 countries in a unique worldwide partnership" (IUCN 2000).

Its mission is "to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable" (IUCN 2000). Through global conventions, IUCN has helped over 75 countries to prepare and implement national conservation and biological diversity strategies.

The IUCN has no legally binding listing authority within the meaning of "listing" as used in this report. Approximately 10,000 volunteer IUCN scientists from all member nations and institutions are organized into six commissions and a variety of taxonomic Specialist Groups. These groups contribute data and other input and develop the annual ***IUCN Red List*** update. The IUCN is initiating the use of Red List Authorities to conduct all future status reviews. In most cases, the Red List Authority will also be the taxonomic Specialist Groups. (One exception is that the authority for birds will be Bird Life International.) No new species will be listed until it has been evaluated by an appointed Red List Authority. All species on the list must be re-evaluated at least once every 10 years.

IUCN criteria are used widely to produce an international "Red List" (www.redlist.org), which the IUCN describes as "the world's most comprehensive inventory of the global conservation status of plant and animal species." It uses a set of criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are "relevant to all species and all regions of the world." Because it is based heavily on the best data available, the IUCN says its Red List is "recognized as the most authoritative guide to the status of biological diversity." The purpose of

the Red List is to "convey the urgency and scale of conservation problems to the public and policy makers, and to motivate the global community to try to reduce species extinctions" (IUCN, 2000).

The IUCN on its website describes its current criteria for ranking species in terms extinction risk, and assigning species to applicable **conservation status categories**. These categories range from "Extinct" to "Lower Risk" to "Not Evaluated." Three of these are categories of threat - Critically Endangered, Endangered, and Vulnerable, which are all determined by quantitative criteria.

For each of the categories of threat there are five criteria (A-E), which are based on variables closely associated with extinction risk. The criteria A-D also have subcriteria that are used to justify the listing of a species under a given category and criteria. The five criteria are:

A. Declining population (past or projected)
B. Small distribution and decline or fluctuation
C. Small population size and decline
D. Very small population or very restricted distribution
E. Quantitative analysis (e.g., population viability analysis)

Details on the categories and criteria are available at http://iucn.org/themes/ssc/redlist/ ssc-rl-c.htm. Papers examining the applicability of these criteria generally seem to indicate that with adequate data and some taxon-specific modifications, it is feasible to classify every species in the world according to its conservation status under the IUCN system.

Papers related to IUCN criteria reflect the wide variety of biological diversity needs and interests around the world. In some cases, the authors discuss species in a particular nation, while others discuss criteria with respect to particular species or taxonomic groups occurring world-wide or within a large region (Avery 1995, Dansky 2000, Defler 1996). Others reveal that some nations or their political subdivisions have adopted slightly modified versions of the IUCN criteria as their own national or provincial criteria, such as Australian Capitol Territory (ACT 1995), Canada (Crins 1997), and British Columbia (Munro 1993). We briefly touched upon these adoptions and adaptations in an earlier section on criteria of other nations.

Jungius (1978) developed very general guidelines for reintroducing native deer into parts of their former range, long before the development of the current Red List criteria.

Mace and Lande (1991) reviewed IUCN criteria in use at the time, and concluded they were “too subjective.” They suggested additional criteria and other improvements for IUCN to adopt. The IUCN announced revised criteria three years later (IUCN 1994). Classifications used by the IUCN now span the full spectrum from "Least Concern" to "Critically Endangered." IUCN criteria, sometimes with some modification to fit particular taxa, have been used in a wide variety of species' conservation status evaluations.

These new criteria are part of a *conservation status classification system* that is based on extinction risk that is: (1) simpler, with few categories, (2) flexible in its data requirements for assessing extinction probabilities, (3) flexible regarding to which population units it can be applied, (4) clearer in its terminology describing risk, (5) based on sound, objective science, yet leaves room to factor in uncertainty, and (6) based on a finite time scale.

The older and most recent IUCN status classification systems have been scrutinized by others, regarding their effectiveness in evaluating the conservation status of primates in Columbia

(Defler 1996), bryophytes in Sweden (Hallingback 1998), diatoms in central Europe (Lange 1996), mollusks in Europe and elsewhere (Seddon 1998), sandstone cave invertebrates in South Africa (Sharratt 2000), raptors in Kazakhstan (Skylarenko 1996), Southern Hemisphere birds (Stattersfield 1998), hawksbill turtles in the Pacific (Meylan 1999), and an assortment of long-lived reptiles (Webb-Grahme 2000).

Webb-Grahme (2000) identifies *eight flaws* with IUCN criteria or their application to long-lived reptiles:

(1) Time scales do not fit, in that 3 generations (~100 years) is "far too long for assessing status reliably."
(2) Using scientific precaution by not over-interpreting data conflicts with using conservation precaution by exaggerating risks to attain enhanced conservation action.
(3) The criteria do not factor in ongoing conservation actions, thereby overestimating risk of extinction.
(4) The criteria do not a clear means to factor in the existence of secure populations that effectively prevent extinction.
(5) The criteria need to provide clear direction on how to account for the fact that some national populations of a species contribute more to global population security for one species than for other species.
(6) Extent of historical decline over three generations may be unrelated to future risk of global extinction.
(7) Verification procedures and use of expert panels for assessing conservation status are not required, so the highest level of accuracy is not assured.
(8) Using only the IUCN criteria exaggerates extinction risk relative to real risk, and the wrong criteria are sometimes deliberately selected in order to maximize conservation action.

Defler (1996) cautions against the inclination of some nations to adopt simply the international IUCN threatened status categories for those populations of threatened species within their borders. Scientists must include regional factors, such as threats from hunting, habitat encroachment, or lower quality habitat, when evaluating species' status within any particular nation. He cites examples of a number of primate species in Colombia that are more threatened within that nation that they are in South America as a whole.

To address the special circumstances inherent in assessing the status of marine fishes, the IUCN issued its own guidelines for applying the criteria to these species (IUCN, 2000). According to the IUCN, these guidelines should apply also to other marine and aquatic taxonomic groups.

McIntyre (1995) investigated setting conservation priorities using rare plant lists developed using IUCN criteria. He noted some problems with "both defining rarity and documenting plant distributions, " which can lead to bias in the lists. As one example, in New South Wales, using an IUCN-based classification, species of restricted range or habitat dominated the rare plant list. "Criteria used to develop the list may favor these plants over species with widespread but declining ranges. Lack of information on range trends may cause the latter group to be underestimated." Conservation priorities developed from this list may misdirect conservation efforts, so conservationists must deal with this type of bias.

Meas (1997) reflected on the use of IUCN criteria to list butterflies in Belgium and the Netherlands. He noted that "the use of a standardized method and well-defined quantitative criteria makes national Red Lists more objective and easier to re-evaluate in the future and facilitates the comparison of Red Lists among countries and among different organisms." He

devised a technique to correct for mapping intensity, which "could be useful to other organisms when there is a large difference in mapping intensity between two periods."

To deal with some of the uncertainties inherent in a lack of the rigorous data sets best fitting the IUCN criteria, a software company has developed a program to assist conservationists in evaluating their data while using these criteria (RAMAS, 2000). The program will output the IUCN conservation status category appropriate for each species for which data is input.

Gignon (2000) proposes another twist on the Red List, which he terms the "Blue List." He envisions the Blue List as a list of species that are recovering due to protections employed as a result of species having been placed earlier on the Red List. This list would be developed using criteria and data similar to that used in developing the Red List. It could serve as a beacon of encouragement to all those people working or helping in whatever capacity to conserve species and prevent extinctions around the world.

While overall the IUCN system seems to work well, a number of shortcomings are evident. Lack of sufficient data has in the past prompted the Red-Listing of some species that more recent studies have shown to be less jeopardized than originally believed. Population trend data is difficult to obtain for longer-lived species. In general, investigators believe these problems can be addressed over time with better data concerning species life history, distribution, abundance, and population trends.

Socio-economic Considerations by the IUCN – The IUCN does not factor in economic concerns of land holders whose land supports threatened species, when they assess conservation status. However, IUCN acknowledges that "the success of our work relates to the degree to which it contributes to the well-being of people and to the maintenance and preservation of biodiversity and ecosystems. Social security, diversity and stability are foundations for sustainable conservation and management of natural resources, and they rely on increased social equity among all stakeholders."

Partners in Flight – Partners in Flight is concerned with ranking U.S. *non-game landbirds* in priority order of conservation action needs (Beissinger 2000, Carter 2000, Partners in Flight 2000**).** Partners in Flight is "a consortium of hundreds of private organizations, natural resource agencies, private businesses, industry associations, private landowners, foundations, universities, and individual citizens dedicated to maintaining healthy bird populations in the United States and throughout the Western Hemisphere. PIF is dedicated to **'Keeping Common Birds Common,'** but many of their efforts are also aimed at less common species and at developing ways to avoid collision between wildlife conservation and economic development.

PIF uses a ranking system to determine which avian species have the greatest need for conservation action. PIF staff has revised their ranking system to address some of the issues identified by a reviewing committee. Changes include:

- giving a higher priority to unknown factors,
- revising the threshold for significant population decline,
- revising the method for rating distribution within range,
- relying on Christmas Bird Count (CBC) data equally with Breeding Bird Survey (BBS) data,
- factoring in distribution of Old World birds that also occur in the Western Hemisphere to avoid ranking introduced species as rare,

- reconciling the U.S. and Canadian means of weighing habitat importance to a species' conservation,
- revising the means of assigning threats, and
- using absolute abundance rather than relative abundance.

Further, PIF decided to continue using all valid historical data, not just that from the past 30 years.

PIF has developed a numerical ranking system to assign a conservation priority to avian species. This system uses a combination of seven local and global parameters. Each parameter is assigned a numerical score (1-5) that reflects the need for conservation attention. The seven parameters are:

- breeding distribution,
- non-breeding distribution,
- relative abundance,
- threats to breeding,
- threats to non-breeding,
- population trend, and
- area importance.

The Nature Conservancy and Association for Biodiversity Information – The Nature Conservancy (TNC) has been instrumental in initiating, disseminating and improving conservation status ranking criteria. TNC was an early leader in ranking the conservation status of flora, fauna, and the ecosystems they compose. The Nature Conservancy helped establish the Natural Heritage Inventory Network (NHI) for assembling data on rare species and communities, and ranking them on the basis of conservation status (or degree of endangerment).

The Natural Heritage Network is made up of Natural Heritage programs across the United States and in Latin America, South America, and Canada. Natural Heritage programs undertake Natural Heritage inventory, data management, and data dissemination. Heritage data is used to make decisions regarding the protection and management of plant and animal species. A major part of the heritage inventory involves the use of NHI ranking methodology. Each species tracked is given a "conservation status" which is determined based on several "factors reflecting their extinction potential, particularly their levels of rarity, decline and threat" (Stein, et al. 2000). According to Stein, et al. (2000), the "criteria used in assessing conservation status" includes:

- Occurrences: number of distinct populations or subpopulations
- Condition: viability of extant populations
- Population size: number of extant individuals
- Area of occupancy: total area of occupied habitat across range
- Range: extent of geographic range
- Trends: short- and long-term increase or decrease in population numbers, area of occupancy, or condition or occurrences
- Threats: known or suspected current threats, or likely future threats
- Fragility: inherent susceptibility to threats due to intrinsic biological factors
- Protected occurrences: number of adequately *protected populations"*

Using these factors, heritage biologists assign each species a global and state rank.

The NHI Global Ranks are outlined in Stein, et al. (2000) and include:

- GX Presumed Extinct: Not located despite intensive searches
- GH Possibly Extinct: Of historical occurrence; missing but still some hope of rediscovery
- G1 Critically Imperiled: Typically 5 or fewer occurrences or 1,000 or fewer individuals
- G2 Imperiled: Typically 6 to 20 occurrences or 1,000 to 3,000 individuals
- G3 Vulnerable: Rare; typically 21 to 100 occurrences or 3,000 to 10,000 individuals
- G4 Apparently Secure: Uncommon but not rare; some cause for long-term concern; usually more than 100 occurrences and 10,000 individuals
- G5 Secure: Common; widespread and abundant

The ranks used at the state level are similar to the Global Ranks with slight variations from state to state. These ranks and definitions are used throughout the United States and Canada at some stage in the listing process. These ranks are often used to assist in making decisions regarding which species to place on a regulatory list. It is important to note, however, that Heritage ranks are rarely used as the sole basis for regulatory listing decisions. The purpose of Heritage ranks is not to provide regulatory agencies with a system for determining which species to list. The Heritage ranking system is primarily for developing working lists of target species for inventory and assessment.

In 2000, the Association for Biodiversity Information (ABI) emerged to take over this data management function. In 2000, TNC and ABI jointly produced *Precious Heritage - The Status of Biodiversity in the United States* (Stein, et al. 2000), the "most comprehensive analysis to date of biodiversity in the United States." While we found many papers on numerous conservation biology sub-topics, none dealt with TNC, NHI, or ABI conservation priority ranking systems.

Convention on International Trade in Endangered Species (CITES) – Only four papers deal with CITES proposals (Bringsoe 1998, Dansky 1999, Favre 1998, Sakamoto 1995). CITES is an international agreement among member governments to prohibit or restrict the sale or other trade of any part or product of an endangered species. Its goal is to reduce the economic incentive to destroy species at risk of extinction for commercial gain. However, the species covered by CITES are identified using the IUCN or similar criteria that assign species' conservation status.

Individual Guidelines: Non-Governmental Researchers – Many more papers deal with individual researcher's guidelines for assessing rarity and conservation status of species as well as habitats. Ongoing general conservation biology research not specifically related to the development of criteria may possibly be useful in refining criteria for determining species' conservation status. These efforts include assessing butterflies in Morocco (Thomas 1985) and ranking habitats in the Azores Islands based on presence of endemic beetles (Borges 2000).

Bibby (1994) notes that "most recent extinctions of birds have been caused by habitat loss or by human or introduced predators, and have been on islands." Bock (1984) notes that geography and habitat specialization plays a major role in determining abundance and distribution.

Gulliver (1990) used the “Atlas of the British Flora” to provide an objective definition of *rarity* in assessing which Yorkshire, England plant species have shown the greatest survival rates. Extinctions appeared to be due to changes in land use rather than any other factor. This insight into the plant-loss/land-use relationship goes back more than 200 years, because accurate site records were initiated by two early botanists, Teesdale and Ibbotson, beginning in 1794.

Michaels (1998) evaluated the distribution and abundance of carabid beetles of selected grassy ecosystems, wet and dry sclerophyll forests, and wet heaths in the Eastern Tiers, Tasmania. He assessed the conservation values of the sites by using evaluation criteria typically applied to vegetation (i.e., representativeness, typicalness, diversity, and rarity) to both the carabid fauna data and the vegetation data. He identified and compared sites of high conservation value for carabids and vegetation. Sites that ranked highest in terms of the carabid fauna on all conservation criteria were not the sites that ranked highest based on the vegetation. He concluded that "conservation based solely on vegetation attributes will therefore not necessarily conserve a rich and/or representative carabid fauna. If the objective to conserve a representative range of all biota is to be met, the use of additional taxa such as carabids in conservation assessments is desirable."

One consideration in assessing the nature conservation importance of a site is the presence of 'rare' species. Sanderson (1996) discusses how pragmatic concepts of 'rarity' can be applied to ***marine benthos*** in a national context for conservation and coastal zone management. He developed a means of assessing *rarity*, based on the total number of units of area where the species is known to occur within the 3-mile limit of British territorial waters.. Using a uniform grid to record occurrences, Sanderson defines "nationally **rare**" as occurring in 8 or fewer (.5%) of the 1546 10 km x 10 km squares in the grid, within the 3-mile territorial limit. "Nationally **scarce**" means occurring in 9 to 55 (3.5%) of the total grid squares. Coastal marine species can therefore be assessed quantitatively using a consistent methodology comparable to terrestrial assessments in Britain. Application of the criteria has required the collation and analysis of data on a national scale and involved wide consultation. Apparently, this is the first time that rarity criteria have been developed for application in the marine benthos on a national scale.

Usher (1980) considered the question of which criteria are useful in *assessing the conservation value of land*. He concentrates on land area, diversity of species and habitats, relationships between area and number of species especially in relation to limestone pavements, naturalness and typicalness of the site, presence of rare species, and the interpretation of expressions such as fragility and stability. He applied these criteria to an important conservation area, the Malham-Arncliffe S.S.S.I. (site of special scientific interest). He found that only “size, diversity of species and habitats, and rarity are useful in assessing the importance of parts of a large area of overall importance.” He noted "conceptual differences between some criteria, which can be measured or estimated by scientific means, and other criteria, that are dependent upon value judgments of the assessor."

Data Sources Used by NGOs – As noted earlier, sources of data sufficient to fully use criteria are often lacking, especially in developing countries with substantial biological diversity. However, for North American, European, and some other species, a great deal of useful data does exist.

Partners in Flight (PIF) has decided to continue using all valid historical Christmas Bird Count (CBC) and Breeding Bird Survey (BBS) data, not just that from the past 30 years. Their criteria reviewers concluded that ignoring data once it becomes 30 years old (a cut-off point suggested by come) would create a loss of ability to analyze important long-term trends that can be identified with older data, most of which (for avian species) is rated as being highly reliable.

Socio-economic Factors Considered by NGOs – Most criteria take into account socioeconomic factors, but in almost all cases these are factored in only as threats to species. These factors include killing for food for humans, killing for monetary profit (as with elephants and ivory, or

bears and various esteemed body parts), killing to protect farm crops or livestock, drainage of wetlands, water pollution (as in the case of some coral reef destruction), land use or land cover conversion that destroys a species' habitat, burning fossil fuels to create climatic changes or intensify "normal" atmospheric processes, and other human actions.

Bigalke (1984) lists socioeconomic concerns, such as landowner acceptance and conflicts with existing land uses, as a one criteria in planning reintroductions of large mammals. Numerous proposals to include economic and other concerns in listing decisions have been proposed for the ESA in the U.S.

Collar (2000) investigated what criteria would be most useful to identify **parrot** species at risk across the **Pacific island nations** and **South America**. He found that a great majority (currently 93%) of threatened parrots are *forest* species, most (75 species, 83%) have *populations* estimated at *less than 10,000 mature individuals*, and many (37 species, 41%) have *ranges* $< 20,000\ km^2$. Habitat destruction (notably the loss of nest-sites), trade, hunting, and introduced species are the most significant threats to the survival of parrot species.

Lessons Learned through NGO Listing – The most common refrain from all papers on the use of criteria is that "adequate data is often lacking." Using specific criteria is a very data-intensive exercise. For most species and virtually all governments and NGOs, there is a serious shortage of funds for carrying out the surveys necessary to fully satisfy the data needs of most criteria schemes (Beissinger 2000, Taylor 1995, Thomas 1985).

To handle the uncertainty created when data deemed necessary for making a species status determination with a high degree of confidence, there are at least two strategies. The first and perhaps more common is to place the species in a category called "insufficient data" or something similar (ACT 1995, Brauning 1995, Shank 2000). The other is to use a ranking system with a heavy weighting factor for criteria variables for which data is lacking. The often results in classifying the species in a category providing some degree of protection, at least until researchers can obtain additional data. Bogert (1994) takes the stance that in such cases, the species should not be listed at all under the federal ESA.

New (1999) has a great deal to say about the use of criteria to conserve insect species, and this insight may be useful for other taxonomic groups, as well. He notes "there are few experts familiar with many of the insect taxonomic groups. Expert panel consensus on the conservation status of various species is therefore difficult to achieve, for it may not be possible to assemble a panel in the first place. Many listing proposals are neither definitive nor comprehensive, in large part because species of conservation concern are difficult to study."

He (New 1999) warns against making conservation priority decisions too hastily, because "premature listing may steal attention and resources from species that truly are in need of conservation action." Lack of sufficient data to meet the needs of IUCN criteria, plus the perception that little funding would be available to promote recovery of listed insects, stifles development of listing proposals. Trans-national species are often subject to conflicting regulation that may not acknowledge secure status in adjacent nations. For example, New Zealand has five major and 16 sub-criteria for determining threatened species recovery priorities while the SPECS program (Species of European Conservation Concern) uses four criteria.

An integrated, broader view can overcome the expense of species-level insect conservation. Listing charismatic "flagship" (indicator) insect species, such as butterflies, helps gain public support, define habitat conservation priorities, and focus conservation actions. Insects can best be

conserved by a process similar to that of the Centers of Plant Diversity Project, which identifies areas to conserve that would "safeguard the greatest numbers of plant species."

Dennis (1997) notes that changing taxonomic status of **butterfly** species appears to be inflating the numbers of species being listed in **Europe**. There are increases in the number and proportion of endemics and of rare species, and a regional excess of species and endemics for southern Europe compared to northern Europe. He believes "the potential conservation load for European butterflies is inflated at species level… , more particularly if rarity and endemism are found to equate with threat of extinction. Second, the inflation in rarity and endemism suggests that there is a trend to promote ever more local populations (races, subspecies) to species. The taxonomic status of species being added to the list, a quarter of which are regarded as doubtful, is increasingly difficult to determine. Consequently, there is a danger that this may call into question the validity and objectivity of taxonomic practices, and of databases dependent on them, used by conservation." He calls for swift revisions in European butterfly taxa to head off problems of credibility.

Ellis (1999) measured the rank abundance of small **butterflies** in the **Netherlands**, using data collected since 1850. He found that rare species are receding in abundance relative to the common ones, and that the composition of the fauna is "strongly dynamic." His results imply that "monitoring a few endangered species provides only incomplete information about the condition of nature."

Eyre (1989) generated rarity indices and typicalness measurements for sites within habitat groups defined by classifications of **water** and **ground beetle** communities, in north-east **England**. He found that including an *extra weighting for associations of rare species* helped identify sites to conserve that were "likely to have the highest conservation potential being more easily distinguished."

In **Sweden**, Gotmark (1986) also experimented with rarity indices, this time for **birds**. He tested five conservation indices suggested for birds. The censused sites were first evaluated and ranked by the authors, then ranked according to each of the indices. Two indices based on species diversity (H' or lambda) showed a poor agreement with his evaluation.

Gotmark (1986) suggests that they should not be used for ranking of sites of ornithological interest. Three indices based on rarity showed a better agreement with his evaluation, but these were influenced by the size of the geographical area for which rarity was assessed. None of the five indices takes into account all of the relevant aspects for an evaluation of the bird fauna at the different sites. Before constructing further indices, conservationists, he notes, must reach agreement on which evaluation criteria to use, and how to use them. He says that "It may, however, not be feasible to construct a single index; a better strategy might be to construct indices only for single evaluation criteria."

Gringera and Ubeda (2000) tried a similar strategy, ranking habitat areas in a national park in Argentina. They concluded that ranking of environments on the basis of their fauna was valid, "given that the conservation of fauna implies conservation of their habitats."

Freitag (1997) investigated a means of developing regional conservation priorities. He noted that the "equal weightings given to the four components of 'rarity' ensures that species achieving a high score in any of these categories will be considered for regional priority listing. This approach is simple, explicit, and repeatable, circumventing problems of scale."

Summary of Published Observations and Studies Regarding Listing Criteria

The literature search resulted in very little information that was useful in addressing our questions regarding the suitability of state criteria for listing endangered and threatened resources. On the international and NGO level, we found more and more useful papers addressing issues of interest to an agency investigating the adoption of listing criteria.

A common thread to a large number of articles is that a substantial amount of quantitative data is still needed in order to dispel concerns about uncertainty regarding a number of parameters used to discern a species' status (Ripa 2000, Crins 1997, Avery 1995, ACT 1995). Until sufficient, reliable data is obtained, a number of authors recognize the need to factor in various kinds of uncertainty when making listing decisions.

This issue of adequate data must serve as a major focal point for any state contemplating adoption of listing criteria. Either the state agency must ensure it has or can reasonably obtain data necessary to satisfy the needs of those implementing criteria, or criteria must include one or more mechanisms for adequately addressing the uncertainty posed by incomplete or inadequate data sets.

A number of potential problems exist in using species to rank sites for conservation action priority. Some of these shortcomings can be overcome, but others appear to need additional investigation to devise solutions.

National and International Trends Reflected in Published Literature – The literature search phase of this project yielded insufficient basis for identifying any national trends. Almost nothing published in biological science and related journals provides insight into trends in state use of criteria in endangered resources listing processes. Internationally, the trend appears to be toward adopting more quantitative criteria. A number of nations have adopted, with some modifications, the revised criteria developed by IUCN in 1995. Great Britain, Australia, and Canada all have done this. A number of authors have evaluated the usefulness of these criteria and have found that they work, at least on a global or national scale, and sometimes with taxon-specific alterations, for many taxonomic groups.

Survey of Listing Criteria and Experiences of Other States' Agencies

Survey Methods

Part of this listing criteria review involved contacting other states agencies responsible for listing rare plants and animals. This process was initiated by Integrated Science Services staff during the summer of 2000. ISS staff distributed a survey to the contact for each state agency responsible for listing for their respective state. These contacts were determined based upon a contact list for State Fish and Wildlife Agency Wildlife Diversity Program Contacts (Johnson 2000). In January of 2001, we reviewed and summarized the results from the preliminary contact effort. The states were then broken up into the following categories:

- No further contact due to no law or no listing,
- No further contact due to a "No Criteria" response from first contact,
- Contact needed due to no initial contact, and
- Follow-up contact from initial contact.

The states with no initial contact received were contacted first and then the states requiring follow-up contact were completed. The appropriate contacts for states from the "no initial contact received" category were determined using the State Fish and Wildlife Agency Wildlife Diversity Program Contacts (Johnson 2000), the Association for Biodiversity Information website containing the Natural Heritage Directory, and various state websites. The same survey form was used for each interview. This survey form was a modified version of the original survey form developed and used initially by ISS staff. We added several questions to address the following topics: plans to modify the criteria, effectiveness of the criteria, presence of support or opposition to the criteria, and other advice from the agency. This survey form is provided in Appendix C. Contact of the states occurred between February and June of 2001. A total of 45 states was contacted. For states with plant and wildlife listings in separate agencies, an attempt was made to contact both agencies. In some cases, however, contact will all agencies was not possible. The assistance from the individuals we contacted is gratefully acknowledged. The information and experiences shared are an invaluable resource.

Survey Results

Results of this survey indicate that there exists substantial variation in the listing methods used among state agencies in listing rare species. The results broke down into three main categories: (1) states using quantitative criteria/guidelines, (2) qualitative criteria/guidelines, and (3) other listing processes. Several states are highlighted below as case studies. For each case study, the regulatory authority and the legal status of the criteria are indicated. "Regulatory authority" for the purpose of this report refers to the authority to list and restrict taking of plant and or animal species. For each state provided as a case study, it is indicated whether that state has regulatory authority over animals or plants or both. "Legal status of criteria" for the purpose of this report refers to whether the criteria is maintained in the states' statutes, administrative code, or agency policy. In most cases, the criteria is legally binding if it is in the statute or administrative code. If the criteria or guidelines are "agency policy or procedure" then they are usually just an agency tool and are not legally binding. It is important to note that states not using formal criteria or guidelines but using a process, including expert groups or sets of certain variables they look at, are considered, for the purpose of this report, to have a qualitative process. The states presented as case studies were chosen because they exemplify distinct listing processes or experiences. All states contacted had important information to share regarding the process used in their respective

state, however, for brevity purposes, extensive summaries of every state's process could not be provided. The results from contacts with all the states are summarized in Table 2.

Several important statistics emerge upon close analysis of the results of the state surveys. Approximately 28% of states mentioned that they have no real criteria at all. Approximately 24% of the states surveyed currently use a quantitative process for listing both plants and animals, and 39% of the states surveyed use qualitative process at present. While these statistics indicate general trends, an enhanced perspective is gained from reviewing the state case studies below and the state summaries provided in Table 2. It is also important to note, that in some cases the listing processes used are the result of the state governmental organizations. For example, several states use different processes for listing plants and animals. This is due mostly to the responsibilities for listing plants and animals being split between agencies or divisions.

Table 2. Summary of State Contacts

The “Type of Criteria or Guidelines” was determined using the definition for “criteria” and “guidelines” set forth in this report (see page 3 and glossary). Some states described definitions and other items as criteria or guidelines. These are not considered criteria or guidelines for the purposes of this report and are noted as "None" in the “Type of Criteria or Guidelines” category in the table.

State	Regulatory Authority	Status of Criteria/Guidelines	Type of Criteria or Guidelines	Taxa Covered by Criteria/Guidelines	Other Notes
Alabama	Animals	None	None		
Alaska	Animals	None	None		Minimal listing.
Arizona	Plants	None	None		Animal list is non-regulatory. Plant list is based on vulnerability to theft/threats.
Arkansas	Animals	None	None		Only list federally listed animals.
California	Both	Code, petition requirements	Qualitative		
Colorado	Animals	Policy/Procedure	Quantitative	vertebrates	No authority for listing plants.
Delaware	Animals	Wildlife regulations	Quantitative Heritage	amphibians, birds, fish, insects, mammals, mollusks and reptiles	No authority for listing plants.
Florida	Both	Policy for animals	Quantitative		Plants are listed by Agriculture Dept.
Georgia	Both	Rule has a federal mimic	Qualitative	mammals, birds, reptiles, amphibians, fish, inverts and plants	Only criteria is a federal mimic
Hawaii	Both	Statute has a fed. mimic	Qualitative		Not listing, Many federal species.
Idaho	None	Federal mimic	None		Only criteria are a federal mimic, no state ESA.
Illinois	Both	Policy/Procedure	Qualitative	invertebrates (including sponges and mollusks), vertebrates (including fish, amphibians, reptiles, birds and mammals) and plants (including algae, fungi, bryophytes, ferns etc.)	Have certain things they look at.
Indiana	Animals	None	None	Separate technical committees for vertebrates, mammals, birds and fish.	Use Committees to review species.

Iowa	Both	Policy/Procedure	Quantitative	Vertebrates. Possible future use for some invertebrates such as butterflies and dragonflies.	
Kansas	Animals	Procedure, petition requirements	Qualitative	invertebrates, fish, amphibians, birds, mammals and reptiles	Only guidelines are the petition requirements.
Kentucky	None	Some for plants	Quantitative		Use Heritage methodology for animals, and for plants have federal mimic and additional criteria.
Louisiana	Animals (federally listed)	Code has federal mimic	Qualitative		Only criteria are a federal mimic, mainly list federal, could list others.
Maine	Animals	Federal mimic in statute, other criteria in code	Qualitative	One set of criteria covers plants. One other set of criteria used for fish, invertebrates, reptiles, mammals, birds and amphibians.	Several sets of criteria and worksheet.
Maryland	Both	Federal mimic in statute, other criteria in code	Qualitative	Reptiles, amphibians, crustaceans, mollusks, wildlife and finfish. Another set of criteria covers plants.	
Massachusetts	Both	Statute and regulations	Qualitative	One set of criteria for plants, mammals, birds, reptiles, amphibians, fish, mollusks, crustaceans, arthropod and other invertebrates.	
Michigan	Both	Procedure	Quantitative	Plants and animals have same set of criteria. Animals covered are mammals, fish, amphibians, mollusks, crustaceans, arthropods and other invertebrates.	Guidelines for categories, for use by technical advisory committees.
Minnesota	Both	Policy/Procedure	Quantitative	Plants (lichens, mosses, vascular plants), mammals, fish, mollusks, birds, amphibians, reptiles, butterflies, moths, invertebrates and fungi.	Use a Scoring, ranking system.
Mississippi	Animals	None	None		
Missouri	Both	None	None		Had quantitative now use simplified process.

Montana		Statute, federal mimic	Qualitative	Mammals, birds, reptiles, amphibians, fish, mollusk, and crustaceans.	Not currently listing.
Nebraska	Both	Policy/Procedure	Quantitative to Qualitative		Quantitative not very useful, moving to qualitative.
Nevada	Both	Animal criteria in code	Qualitative		
New Jersey	Both				
New York	Both	Minimal criteria for animals in statute, Mostly procedure	Quantitative to Qualitative	Invertebrates, fish, herps, birds and mammals.	Had quantitative now use qualitative.
North Carolina	Both	Statutes-federal mimic	Qualitative	Separate councils for amphibians/ reptiles, birds, freshwater fish, mammals, and mollusks. Each council use separate criteria. Plants have separate criteria.	Federal mimic in statutes, no other criteria. Use councils for animals. Separate agencies.
Ohio	Both	Plants in Rule/Code, Animal criteria as Policy/Procedure	Quantitative and Qualitative		
Oklahoma	Animals	Code, petition requirements	Qualitative		Code has petition requirements and other criteria.
Oregon	Both	Statute, Rule	Qualitative	Separate sets of criteria for invertebrates, terrestrial vertebrates, aquatic vertebrates and plants	Rule has criteria in addition to petition requirements. Listing in separate agencies.
Pennsylvania	Both	Policy-of PA Biological Survey not State Agency	Quantitative		Separate agencies
Rhode Island	Both	Policy/Procedure	Quantitative		
South Carolina	Animals	None	None		Mainly list federally listed species. Plants list non-regulatory.
South Dakota	Animals	None	None		
Tennessee	Both	Code-fed mimic, also policy	Qualitative	Plants have separate criteria.	
Texas	Animals and Federally Listed Plants	None	None		Texas only lists federal plants and mainly federal animals, few state animals.
Utah	Animals	None	None		List federal species and have special concern list

Vermont	Both	Statute-fed mimic, other-Policy	Quantitative	Same criteria cover vascular plants, non-vascular plants, invertebrates, fish, reptiles, amphibians, birds, and mammals.	
Virginia	Both				Plants listed by Ag. Animals listed by Fish and Game. Minimal plant listing.
Washington	Animals	Animal criteria in code	Qualitative	Same criteria used for all animals.	Plants non-regulatory but have things they look at.
West Virginia	Federally listed species	None	None		Only lists federal species, have old criteria for special concern.
Wyoming		None	None		

Use of Quantitative Criteria

Several states including Colorado, Iowa, Minnesota, Missouri, Nebraska, and New York recently used a quantitative species ranking system. Some of these states developed unique systems, while other states simply modified ranking systems of other states. These species ranking systems take the form of a series of questions or variables with several possible response choices. These choices each have a numerical value associated with them. These numerical values are then totaled. In some cases, the total is an overall total, which is then broken down into totals for different sections such as populations, threats, biological variables, etc. The final score is then used as an indicator of the status of a species.

Case Study: Colorado

Regulatory Authority: Animals
Legal Status of Criteria: Agency Tool
Details of Criteria:
Colorado uses a system termed the Colorado Vertebrate Ranking System (COVERS) as a tool for a first cut in determining the status of a species. If a species scores high in the COVERS system, this does not necessarily mean it will be listed. COVERS is used as a first step in determining which species need to be investigated further for potential listing. Currently, the COVERS system is divided up into Stage I Evaluating Species Risk with categories for Biological Variables and Action Variables; and Stage II Identifying High Priority Species with the categories, Additional Biological Variables, Importance of Colorado Populations and Social Considerations. Points range from 10 to 0, with 10 meaning few numbers or individuals or populations, substantial population decline, etc. For certain questions the highest number score is less than ten. This allows for some variables to carry more weight than others. These scores are then applied to the categorization for endangered, threatened, or special concern. For each categorization there is a set of criteria, some of which require the results from the COVERS ranking variables for determination. For each categorization, the species need only meet one of the criteria to qualify for that status. The categorization and COVERS are maintained in the Administrative Directive. The agency also consults with state experts to determine if the COVERS variables for a particular species accurately characterize the species status.

The systems developed by several states including Iowa, Minnesota, Missouri, Nebraska and New York also involve a scoring system. For various reasons, Missouri, Nebraska and New York no longer rely on these quantitative systems and have shifted to qualitative processes. While the actual variables making up the criteria vary by state the process remains more or less the same. The criteria consist of different variables with different points assigned to different responses of these variables. For example, all three states criteria have a variable that asks for the number of species occurrences within the state. The smaller the number of occurrences the larger the points. Species with high total scores are potentially indicative of a species in need of listing.

Case Study: Iowa

Regulatory Authority: Both Plants and Animals
Legal Status of Criteria: Agency Procedure
Details of Criteria:
Iowa uses the aforementioned process for animals, a similar process has not yet been developed for plants, due to workload constraints. Iowa's process differs in how it accounts for uncertainties. This process multiplies the points for each variable by an uncertainty factor. The certainty factor is 1 if the response has well documented data to support it and .6 at the other extreme if the response is based mostly on expert knowledge/opinion. In Iowa, the criteria results are used to compare species within certain groups. For example, the scores are compared between birds not across all vertebrates. The Iowa criteria is currently only used for vertebrates but may be used for invertebrates in the future.

Case Study: Minnesota

Regulatory Authority: Both Plants and Animals
Legal Status of Criteria: Agency Procedure
Details of Criteria:
Minnesota uses the ranking process as one of several tools for evaluating a species status. Part of this ranking process involves a scoring worksheet. The scoring worksheet has ten different factors to score. The factors are: "population decline", "habitat loss/degradation", "local extinction", "regional extinction", "loss of significant population", "global extinction', "exceptional mortality factors", "small population genetics", "lack of demographic/ behavioral resilience and "resource specificity/adaptability". Each factor has three to five answer choices ranging in points from zero to 30. Some factors have a maximum of ten points while other factors have a maximum of thirty points. This allows weighting of certain factors. Minnesota evaluates uncertainty by a system that divides up the points between certain and uncertain and then compares the percent of uncertain points out of the total points (Baker 2001).

Case Study: Missouri

Regulatory Authority: Both Plants and Animals
Legal Status of Criteria: Agency Procedure
Details of Criteria:
Missouri has recently made the transition from detailed quantitative criteria to a more qualitative process. The previous quantitative criteria for Missouri are similar to those of Minnesota, Nebraska and Iowa. Differences include giving variables with unknowns, an automatic score of 5, on a scale of 0-10. This replaces the uncertainty variable used in the other states. Missouri has moved away from this detailed quantitative criteria and now uses a system that reviews species on a case-by-case basis. The old quantitative criteria may now be used as guidelines for factors to take into account during the case-by-case review.

Case Study: Nebraska

Regulatory Authority: Both Plants and Animals
Legal Status of Criteria: Agency Procedure
Details of Criteria:
Nebraska uses the same uncertainty factor process as used in Iowa. Nebraska now uses their criteria qualitatively as more of a guide. In the past, this criteria was sent out to experts for completion. Due to differences in expert interpretation, lack of information and incompleteness of some forms, the results from the criteria were not as quantitative as expected.

Case Study: New York

Regulatory Authority: Both Plants and Animals
Legal Status of Criteria: Agency Procedure
Details of Criteria:
Like Missouri and Nebraska, New York's listing process has shifted from using quantitative analysis to using a more qualitative process. New York's transition to more qualitative system for listing is based on the observation that the quantitative did not accurately categorize the species need for protection. The previous quantitative analysis (Landry et al. 1979) is a complex ranking system based on criteria developed by but never utilized by the Federal Government. While the basic principles remain the same, this ranking system is quite different from the those of the aforementioned states. The variables involved are: degree of threat, regional uniqueness and socio-ecological-economic issues. The first step is to calculate the status index=3(degree of threat factor) + 2(regional uniqueness factor) + social-ecological-economic factor. There is no set cutoff for which status indices would mean threatened and endangered. After determining which species are endangered, the program success index was then determined using the equation: program success index = status index X recovery potential factor (Landry et al. 1979). For the most recent state listing, New York shifted to a more qualitative process, which uses expert review committees to determine which species are in need of listing.

Florida uses a quantitative system that incorporates numeric criteria but does not utilize a ranking system.

Case Study: Florida

Regulatory Authority: Both Plants and Animals
Legal Status of Criteria: Agency Procedure
Details of Criteria:
The Florida Fish and Wildlife Conservation Commission recently developed a formal listing process for listing animals. This new process will replace the informal process previously used. The description of the new listing process includes definitions for endangered, threatened, and special concern species. Imbedded in each of the definitions are criteria for each status designation. The criteria include five categories of requirements, one of which must be met for the species to be considered for that particular listing designation. The categories look at "population reduction", "extent of occurrence", individual numbers, population trend, and probability of extinction analysis results. Most of these categories have a numerical cutoff associated with them.

Another type of quantitative species criteria involves utilizing the Natural Heritage Element Ranks. While these ranks are more commonly used for non-regulatory lists some states do use them for legal endangered and threatened listings. Delaware uses Heritage Ranks as their main listing criteria.

Case Study: Delaware

Regulatory Authority: Animals
Legal Status of Criteria: Agency Regulations
Details of Criteria:
A species is listed if, it is on the Federal Endangered Species list or it is rare in the Delaware and rare in the Mid-atlantic Coastal Plain. Staff use the Heritage ranks to flag rare species. Delaware lists only S1 species. These criteria are not used for delisting at this point. In order to deal with S1 ranked species that are edge of range species in Delaware, the status of the species within its entire range in the Mid-atlantic Coastal Plain is also looked at.

Use of Qualitative Criteria

Of the states that actively engage in listing, many choose a more qualitative approach for determining which species are in need of listing. In place of specific listing criteria, several states have certain factors that are analyzed for each species, non-numeric criteria, and/or expert committees.

Illinois, California and Kansas all evaluate species for listing by looking at certain factors. In some cases these factors are mentioned in the laws or regulations while in other states they are incorporated as part of the listing petition. These factors have no numerical cutoffs or thresholds. These factors serve as guidance to assure that the same important factors are consistently reviewed for each species.

Case Study: Illinois

Regulatory Authority: Both Plants and Animals
Legal Status of Criteria: Agency Procedure
Details of Criteria:
The Illinois statute requires that the basis for listing must be scientific evidence. For the Illinois Endangered Species Board this means utilizing a combination of data and expert evaluation. Illinois lists some criteria at the beginning of the Illinois Endangered and Threatened Species List. This criteria notes that to be listed a species must be on the Federal list, proposed for Federal listing, extirpated from Illinois due to “habitat destruction, collecting, or other pressures”, species with restricted geographic ranges, species with restricted habitat or small populations or species with disjunct populations. Mostly though, the Illinois Endangered Species Board relies on looking at certain factors for each species. These include: number of occurrences, number of quads, number of counties, known protected occurrences, known threats, number of watersheds for aquatics and number of individuals for plants. Reviewing the number of counties with occurrences indicates the range of the species. Data on known protected occurrences sheds light on the level of protection that the species may already be receiving. Illinois previously looked into using criteria by modifying criteria from other states. The use of this criteria was rejected by in-house staff due to an uneasiness about locking into numbers and the inability of criteria to deal with certain species.

Both Kansas and California do not have the factors as set criteria. Both states rely on the information required by the listing petition to serve as guidance for listing species.

Case Study: California

Regulatory Authority: Both Plants and Animals
Legal Status of Criteria: Administrative Code for Petition Requirements
Details of Criteria:
The law in California gives the agency the option to develop specific criteria but does not require it. The agency chose not to develop criteria because there are too many possible species scenarios that could not be accounted for in criteria. The California Fish and Game Code does indicate what information must be included in a petition for listing. The required information is: "population trend, range, distribution, abundance, and life history of a species, the factors affecting the ability of the population to survive and reproduce, the degree and immediacy of the threat, the impact of existing management efforts, suggestions for future management, and the availability and sources of information…kind of habitat necessary for species survival and detailed distribution map." According to the agency contact, this process is successful in getting the appropriate species listed. California also uses peer-review to verify that the information presented warrants the proposed listing status.

Case Study: Kansas

Regulatory Authority: Animals
Legal Status of Criteria: Agency Procedure
Details of Criteria:
While Kansas has criteria in the Kansas regulations it is simply a mimic of the federal criteria. However, the "Petition for Species Review", that must be filed with a proposed listing, has a required set of information including distribution, trends in distribution and population, reproductive status, habitat needs and destruction, specialization, vulnerability and recovery potential.

For listing animals, Indiana and North Carolina rely primarily on the convening and analysis of expert committees to evaluate species listing needs. Indiana is highlighted in a later section due to differences in the state for listing plants and animals.

Case Study: North Carolina

Regulatory Authority: Both Plants and Animals
Legal Status of Criteria/Process: Agency Procedure
Details of Criteria:
North Carolina uses councils to develop the state animal lists. Each council may establish its own criteria and different councils choose to place importance on different aspects. The use of councils in listing species is noted in the state law. The purpose of using councils is to improve the objectivity of the listing by taking some of the control out of the hands of the state agency. The councils are made up mostly of outside experts and each council may have one or two agency staff people if those people themselves are respected experts for certain taxa. North Carolina also has a mimic of the federal criteria in statute.

North Carolina's Plant Conservation Program in the Department of Agriculture and Consumer Services, uses a similar process for listing plants. A Plant Conservation Board presides over the listing of plants. This board receives listing recommendations from a Scientific Committee made up of various experts. According to one member of the committee, there is no required process for determining which species to propose for listing. Factors taken into account include rarity as noted by heritage ranks and threats.

Maryland, Maine, Michigan, and Oklahoma have certain requirements that serve as criteria. These requirements are not part of a ranking system and do not necessarily have numbers associated with them. In some cases these criteria are maintained in statute or code.

Case Study: Maryland

Regulatory Authority: Both Plants and Animals
Legal Status of Criteria: Agency Regulations
Details of Criteria:
The act in Maryland has a mimic of the Federal criteria. Maryland also has some additional criteria in the regulations. The criteria in the regulations are divided up into: requirements for petition, criteria for wildlife, reptiles, amphibians, mollusks, crustaceans and finfish, criteria for plants, criteria for extirpated species and criteria for Species in Need of Conservation. The criteria are also useful for delisting species. These criteria are described as "factors that shall be considered for listing". The criteria look at geographic range, population trends, habitat trends and vulnerability, and species vulnerability. While the criteria are not the Heritage ranks, the listings, according to agency staff, usually break down along S1=endangered, S2=threatened and S3=some threatened listings.

Case Study: Maine

Regulatory Authority: Animals
Legal Status of Criteria: Statute, Code and Agency Procedure
Details of Criteria:
Maine's legislation has a mimic of the federal criteria in it. Plants and animals are listed separately in Maine and the plant list is non-regulatory. Maine's plant list is built based upon seven biological criteria. These criteria are: endemism, few populations, few individuals, special habitat, limit of range, population declining and population vulnerability. There are no numerical breakdowns for these criteria. While these criteria are sometimes limited by lack of data, the Maine botanist finds them extremely useful for analyzing the status of species based upon available knowledge. This criteria with slight modifications is in the legislation for the Maine Natural Areas Program.

For animals, the agency rule for the Department of Inland Fisheries and Wildlife contains a "Qualifications for Consideration for Listing" section which indicates that to be considered for listing, a species must be native and may not be exotic, accidental, or reintroduced. It also contains "Population Guidelines for Risk of Extinction" section that mentions population characteristics that will be reviewed. These include population viability, population size, population trend, population distribution, population fragmentation and endemism. Last, the rule includes an "Other Factors" section that mentions briefly other considerations such as habitat loss. The agency also has agency policy, which has "listing guidelines" and a "Listing Review Work Sheet". The guidelines indicate that a species will be listed endangered, threatened or special concern when it meets certain criteria, which differ for each category. For each listing category, the criteria is broken up into: national status and population viability analysis results, population characteristics, and other factors. The criteria contain number ranges for population size, trend, distribution, and fragmentation. However, the "listing guidelines" specifically indicate that these numbers are to be used only as guidelines. The aforementioned worksheet takes a step by step deduction approach to determining the appropriate status for a species. The worksheet is basically a mimic of the "Listing Guidelines" but the criteria for all categories are combined. The results marked by the expert completing the worksheet lead the expert to the appropriate listing category.

Case Study: Massachusetts

Regulatory Authority: Both Plants and Animals
Legal Status of Criteria: Statute and Regulations
Details of Criteria:
The Statute provides a list of the "biological data" that the criteria must be based upon. The regulations also contain the same qualitative criteria list. The regulations also indicate which information is required in a listing petition. The state uses a standard listing proposal form which requests information based upon the criteria mentioned in the regulations. There are no numerical values associated with any of the criteria.

Case Study: Michigan

Regulatory Authority: Both Plants and Animals
Legal Status of Criteria: Agency Procedure
Details of Criteria:
Michigan does not have any criteria in statute or code. For plants and animals, Michigan has guidelines used for listing species as endangered, threatened, "probably extirpated" and special concern. Each listing designation has its own guidelines. The first guideline for endangered and threatened relates to the species status at the Federal level. The other guidelines for endangered and threatened look at: rarity, endemism, population trends, threats, and habitat vulnerability. These guidelines are used by technical committees made up of outside scientists who are responsible for reviewing and proposing species. There are some numbers associated with rarity and population numbers, however, these numbers are not strict cutoffs.

Case Study: Oklahoma

Regulatory Authority: Animals
Legal Status of Criteria: Administrative Code
Details of Criteria:
Oklahoma has criteria maintained in administrative code. The code first presents the variables that must be analyzed and documented when petitioning for listing. The code then provides the criteria for determining a species status as endangered or threatened. A second set of criteria for special concern species is also noted in code. Both sets of criteria are qualitative and just reference having documentation of habitat threats, changes in populations and other "biological characteristics". No numbers are associated with the criteria.

Use of Other Listing Processes

Several states utilize different listing processes for plants and animals. In most cases, this is likely due to the responsibilities for the listings being split between different government agencies or agency divisions. In order to keep these state activities together, the states with these situations are discussed here.

Case Study: Ohio

Regulatory Authority: Both Plants and Animals
Legal Status of Criteria: Administrative Rule and Agency Policy
Details of Criteria:
Ohio lists both plants and animals but the listing responsibility is split between two different divisions. As a result, the criteria for listing plants are different from

the guidelines used for listing animals. For plant listing, the criteria are maintained in administrative rule. The criteria are quantitative by way that they provide numerical values for population occurrences, range size and number of individuals. The numbers are different for endangered and threatened. Given that this is an administrative rule, the numerical cutoffs are firm. According to Ohio Natural Areas and Preserves Division staff, this criteria setup has been effective for listing plants. The only potential complication involves using number of occurrences because an occurrence could mean one plant or one thousand plants and still count as one single occurrence. This means listed plants could vary widely in the number of actual individuals. On the other hand, this criteria setup is highly successful in minimizing expert biases and assuring that there is sufficient data supporting listing decisions. An advisory panel of outside experts is also convened to analyze proposed species and possibly propose additional species.

For the animal list, there are no formal criteria. However, with each listing, an extensive packet of materials is sent out to experts. In this packet are separate "Status Determination Forms" for invertebrates, terrestrial vertebrates and aquatic vertebrates. The invertebrate form is divided up into four sections: population status, habitat, threats, and biological characteristics. Under each section are several questions and possible responses of yes, no or unknown. Besides questions requesting information on number of years, there are no numerical portions on this form. The terrestrial vertebrate form is broken down into the same categories. However, the questions have responses with more detailed and occasionally numeric response options. For each question there are four or five response options. The aquatic vertebrate species form is not divided up under certain headings and most of the questions require hand-written responses. Several of the questions ask for numeric data.

Case Study: Indiana

Regulatory Authority: Animals
Legal Status of Criteria/Process: Agency Procedure
Details of Criteria:
The listing of animals in Indiana is the responsibility of the Division of Fish and Wildlife in the Indiana Department of Natural Resources. For vertebrate and crustaceans, a technical advisory committee meets to determine which species to list. Experts on this committee are from all over the state and have an idea of how the species are doing and what their current distribution is. To make a determination regarding listing a species, staff look closely at historical distribution and population size versus current status. Indiana also looks at current threats to the species. The mammal committee is currently looking into a systematic approach for determining which species to list. The bird team deals with many periphery range situations and has now focused on listing the breeding birds. Strict criteria are not utilized in Indiana because the knowledge available for taxa and species varies and the best data is not always workable for criteria.

Plants are listed by the Division of Nature Preserves in the Department of Natural Resources. The list generated is a non-regulatory list. The division does use numeric criteria for the breakdown of endangered, threatened and rare plants. The criteria for each are based upon the number of extant sites. The breakdown is one to five sites for endangered, six to ten sites for threatened and eleven to twenty for the rare category. These numbers are not strict cutoffs but serve as rough guidelines. Staff also look at available habitat, number of previous surveys performed and the number of sites that are protected or managed property.

Discussion

While the summaries of individual states provide a close look at of the activities occurring within each state, several important trends become apparent when comparing the states to one another. One trend noted involves the changeover from detailed quantitative criteria to a more qualitative listing process in several states, such as, Missouri, Nebraska and New York. These three states at one point each had a system of ranking and scoring. Missouri decided that this ranking process was more complex than necessary and it was replaced with a simpler process. The new process focuses on listing federal species and then reviewing potential state species on a case-by-case basis using a team of experts. The old quantitative criteria may still be used occasionally as a guide. Nebraska was not completely satisfied with the results from the use of quantitative criteria. The resulting numbers in many cases were misleading due to lack of completion and varying expert interpretations. For future listings, Nebraska like Missouri intends to use the criteria more as a guide for factors to take into account and not for calculating scores. New York had a similar experience to Missouri and Nebraska in noting that the results from the quantitative process did not necessarily accurately categorize the status of a species. New York like Missouri now focuses more on utilizing expert teams to analyze species.

As evidenced by New York and Missouri's changeover, the use of expert teams or committees for reviewing and proposing species for listing appears to be a successful emerging technique. Indiana and North Carolina's rely primarily on expert committees for animal listings and both are satisfied with effectiveness of this procedure. Several states such as Colorado, Minnesota, and Iowa which use a quantitative ranking system still rely heavily on outside experts and expert teams to review species, use the quantitative ranking system or analyze the resulting ranks. Furthermore, several other states such as Idaho, Ohio, Massachusetts and Michigan mention the important role experts play in proposing and reviewing species. Over and over, it appears that experts play a crucial role in determining the listing of species.

States having experience using quantitative processes either currently or in the past, have some similarities but also differ in important ways. Most states with quantitative criteria of any sort do not have it in administrative code, however, a few states do have some quantitative criteria in code. All of the states that use a ranking system do not have it codified and tend to emphasize its role as one tool among several that assist in determining species in need of listing. Furthermore, states with quantitative criteria not in code emphasize that numerical cutoffs are used as guidelines and are not strict breakdowns. In some states, agency staff uses quantitative assessments only, while in other states these quantitative assessments are distributed to experts statewide. Several states with the assessments used solely by agency staff, still engage experts in the process, however, they have chosen to do so in a different capacity. In some cases, the results of the agency's quantitative assessment are then passed on to experts for review and consultation.

Finally, states often had comments, opinions or advice to offer regarding criteria. The comments included in this section are the ones that are most often heard and appear to have the most relevance. These comments are included as they provide important insight into the existing sentiments regarding criteria, guidelines and the process in general. Many states, including those without criteria, mentioned that having some type of

criteria, guidelines or established set of factors to look at, is useful. Several state agency staff recommend not locking into criteria in code form. Staff also expressed concern over the lack of data that criteria and guidelines often demand. Last, while few states actually have it, many recognize the need for different criteria for plants and animals.

Glossary

These terms are defined solely for consistency and clarity in this report. Definitions do not reflect any accepted or concrete definition.

Agency policy/agency tool/agency procedure: terms used to describe how guidelines or criteria are used by a state. This use designation indicates that the guidelines or criteria are not maintained in rule or code. The word choice is mostly reflective of the chosen designation of the agency. These usually apply to guidelines as they are usually one tool among several used to determine listing.

Criteria: guidelines in rule or code for determining species for listing. However, the term criteria is also used by many state agencies to refer to non-regulatory guidelines. In this report 'criteria' is used to refer to both regulatory and non-regulatory guidelines. As a general rule, criteria tend to be more closely adhered to than non-regulatory guidelines.

Guidelines: written descriptions of factors looked at or requirements to be met in determining species for listing. Guidelines serve as tools but are usually not legally binding in rules or code. In many cases, the term guidelines is used in place of criteria to denote its use as one tool among several and not as the binding authority for determining listing.

Listing: the process by which an authorized public agency uses an established procedure to evaluate the conservation status of a species or population, and designates that species or population as requiring special regulatory status, as provided by law. Listing can apply to placing species on non-regulatory lists, but the term is most commonly used to denote the placing of species on an endangered or threatened list at the state, federal, or national level.

Population viability analysis: the use of qualitative methods to forecast the most probable future status of a population or a collection of populations of a species of conservation concern.

Appendix A. References Consulted and Citations and Abstracts of Selected Relevant Documents

This appendix consists of two parts:

- Part 1 – A list of references consulted, with citations and abstracts of selected documents,
- Part 2 – A list of references sorted by topic.

Part 2 of this appendix begins on page 93.

Part 1 – References Consulted, Citations and Abstracts

NOTE: Some of these abstracts are reproduced from copyrighted electronic document search services. The use of these abstracts for this research is greatly appreciated, but future investigators should consult the abstracting services to avoid plagiarism concerns.

Anders, P.J. **Conservation aquaculture and endangered species: can objective science prevail over risk anxiety?** *Fisheries: Bulletin of the American Fisheries Society* 23(11):28-31 (1998). Conservation aquaculture in some cases is necessary to prevent species extinction. Its goal is to "conserve wild fish populations along with their locally adapted gene pools and characteristic phenotypes and behaviors." It is important to initiate such a program well before the effective population (N_e) falls below the level of a minimum viable population (which level may be a subject of great uncertainty). A conservation aquaculture program will succeed only if a successful and concerted habitat restoration program accompanies it.

Anon. **Canada Lynx listed as threatened in USA.** *Cat News* 32:13-14 (Spring, 2000). The U.S. Fish and Wildlife Service (USFWS) listed the Canada lynx as a threatened species in the U.S. (outside of Alaska) in March, 2000. The major threat cited in the listing notice is the "lack of guidance to conserve the species in federal land management plans." The BLM and National Park Service have agreed to introduce lynx habitat conservation elements into the management plans for the lands under their jurisdiction, as the Forest Service has already agreed to do. No major habitat region in the contiguous U.S. was judged to meet the ESA's "Distinct Population Segment" criteria for separate listing. However, the Northern Rockies/Cascades region is the primary area necessary for the long-term existence of the lynx. Leaders in the agricultural, mining, alpine skiing and other industries that rely heavily on public lands fear restrictions on their activities as a result of this listing. A hunter who shot a lynx in Colorado recently was fined $18,000, had his ATV and rifle confiscated, and has been banned from ever again hunting in that state.

Anon. **Criteria for determination of Red Data Book and notable species status.** *Heteroptera Study Group Newsletter* No. 8: 4-7 (1988).

Arita, H.T. et al. **Rarity in neotropical forest mammals and its ecological correlates**. *Conservation Biology* 4(2): 181-192 (1990). Local density and size of distributional range have been used to characterize rarity, but conclusions are weakened by their possible lack of independence. The usefulness and validity of using these two variables were tested with data on distribution, local density, body size, and feeding habits for a set of 100 Neotropical forest mammals. In a bivariate plot of distributional range against local density, species

clustered according to their trophic or taxonomic groups. This indicates that diet and phylogenetic history have an influence on rarity. A negative correlation was found between distribution and abundance. However, this correlation was weaker within trophic or taxonomic groups, and vanished when body size was held constant. These results show that both distribution and abundance are valid and independent estimators of rarity when comparing species with similar sizes and ecological traits. Regression analysis showed that larger animals tend to have lower densities and wider distributional ranges. Rarity is clearly associated with body size. A dichotomous classification of rarity based on area of distribution and local density is suitable for Neotropical forest mammals. Species in each of four categories created by such a scheme require different conservation and management policies that are determined by the ecological characteristics of the species. Final conservation strategies must also be shaped by political and economic constraints.

Avery, Mark, et al. **Revising the British Red Data list for birds: the biological basis of U.K. conservation priorities.** *Ibis* 137 (SUPPL. 1): S232-S239 (1995). The list of British Red Data birds (Batten et al. 1990) includes 117 species, 109 of which qualified on one or more quantitative criteria referring to rarity, localized distribution, population decline and international importance. A wealth of data on bird population levels and trends in the United Kingdom and Europe has recently become available, allowing refinement and improvement of the criteria for qualification. Avery proposes that in assigning priorities for conservation action in the U.K. (Britain and Northern Ireland), three biological axes need to be considered. These are national threat (measured as rarity, localized distribution and population decline in the U.K.), international importance (the proportion of the European population in the U.K.) and international threat (European/global conservation status). Batten et al. (1990) considered only the first two of these axes. Each of these axes has been sub-divided into high, medium and low categories using quantitative thresholds, and from this Avery produce a national 'conservation cube' (three axes, each with three categories and thus 27 cells). Data permitting, every species in the U.K. can be allocated to one of these cells. Avery suggests that species high on either (or both) of the national or international threat axes be considered as species of high conservation priority (the red list). Among the remainder, those that rank at least medium on one of the axes be considered as of medium conservation priority (the amber list). All other species are of low conservation priority (the green list). Avery suggests that this three-axis model could be applicable to other taxa and countries.

Australian Capitol Territory Parks and Conservation Service. **Threatened species & communities in the ACT - criteria for assessment.** Unpubl. 29 pp. ACT Flora and Fauna Committee, Tuggeranong, ACT (1995). The ACT Flora and Fauna Committee (FFC) has developed criteria for implementing the Nature Conservation Act of 1980. Australian Capitol Territory (ACT) uses species and community status categories that mirror those of the Australian national government. Species may be declared *vulnerable* or *endangered*. An ecological community may be declared *endangered*. A process may be declared ecologically *threatening*. The FFC has in addition developed the working categories of lower *risk* for ecological communities, *rare* for species and ecological communities, and *insufficiently known* for species, ecological communities and processes. The criteria used somewhat reflect the IUCN, with the major exception that there are no numerical bounds to terms like "premature extinction," "near future," "small" population, "continuing" decline, and others. This leaves a great deal of room for professional judgment (but may also be more vulnerable to legal or technical challenge than IUCN-type numerical limits).

Baker, Richard J. **Process for evaluating a species' vulnerability to extinction.** *Unpub*. (1993).

Beissinger, Steven et al. **Report of the AOU Conservation Committee on the Partners in Flight species prioritization plan.** *The Auk* 117(2): 549-61 (2000). Partners in Flight (PIF) requested that the American Ornithologists' Union (AOU) review their ranking scheme which is intended to list bird species in priority order, based on their relative risk of extinction. The PIF scheme assigns values to seven variables related to relative risk of extinction (see Carter et al.). An AOU committee made 15 observations and recommendations regarding the PIF ranking scheme, including: 1) the overall concept and approach is useful; 2) considering species' status south or north of the U.S. border may not be useful, due a lack of reliable data from the south and a potentially incompatible priority scheme in Canada, 3) the conservation status of introduced and exotic species should not be evaluated, 4) "threats" variables should be revised, 5) mixing quantitative with qualitative rankings may cause irreconcilable biases, 6) "Phylogenetic Uniqueness" may be a useful criterion and should be investigated, 7) an "uncertainty" variable should be useful in identifying research needs, 8) PIF should develop confidence intervals for important variables, 9) document rank assignments by species, 10) develop and periodically review a method for using the results of the process of developing priority rankings, 11) it would be more useful to assign species to conservation priority categories, rather than simply providing a numerical score, and 12) species rankings should be reviewed every three to five years.

Bibby, Colin J. **Recent past and future extinctions in birds**. IN *Philosophical Transactions of the Royal Society of London, Biological Sciences* 344 (1307): 35-40 (1994). Most recent extinctions of birds have been caused by habitat loss or by human or introduced predators and have been on islands. Local losses of species in habitat patches are particularly prevalent amongst various specialist feeders and species occurring in small numbers. Future candidates for global extinction are hard to pick from lists of species with indicators of susceptibility. Population modeling should help, but data are generally lacking. A review of threatened birds in the Americas shows that declines and rarity are often inferred from habitat loss and infrequent records, in the absence of quantitative data. The most threatened species often occur in very few places, where their future is likely to be determined. Safeguarding protected areas within centers of endemism offers a pragmatic response for a high proportion of globally threatened birds and probably other taxa as well.

Bigalke, R.C. **Criteria and their application in the reintroduction of large mammals.** *Acta Zoologica Fennica* No. 172: 165-168 (1984). Resource managers may want to reintroduce large mammals to reestablish extirpated species, restore rare and threatened species, establish a huntable population, establish a commercially viable population, or establish a population of animals to enhance tourism attractions. Selection criteria should include biological considerations (choice of taxa, original presence, and habitat suitability) as well as socioeconomic considerations (neighbor landowner acceptance and accommodating conflicts between reserve functions). Other concerns to address include minimum population size (avoiding genetically inbred populations and maintaining self-sustaining behavioral traits), size and composition of founder populations, season of release, adaptation to new surroundings or food sources, and diseases and parasites. Bigalke recommends reintroducing established social groups during a season favorable to the population's survival.

Bock, C.E. **Geographical correlates of abundance vs. rarity in some North American winter landbirds.** *Auk* 101(2): 266-273 (1984). Using Audubon Society Christmas Bird Count (CBC) data, range sizes and within-range abundance of 70 spp. of apodiform, piciform and passerine landbirds, whose ranges are 75% or more restricted in winter to the contiguous USA and southern Canada, were compared. Range size was computed as the number of occupied 5-degree latitude-longitude blocks. Three abundance measures were calculated: mean birds counted/census h across all occupied blocks, maximum birds/h in a single block and maximum birds/h on a single CBC. Range size was positively but weakly correlated with each abundance measure, and the abundance measures were very strongly correlated with one another. Geography was a powerful predictor of the species' positions in a 2-dimensional space defined by the axes of range size and average within-range abundance. Taxa that breed and winter at higher latitudes had larger total populations and had significantly larger ranges and average local abundance. Species grouped by longitudinal areas of greatest local abundance had distinct range sizes but did not differ in average within-range abundance. Eastern species had larger ranges than comparably abundant western forms, probably because the eastern USA is characterized by relatively widespread habitat types. A species' within -range abundance is influenced by the degree of its habitat generalization: its range size will be larger if it is a habitat generalist or a specialist on widespread habitats. Because individual CBC's include many habitats, the same ecological attribute habitat generalization, could cause species to be both widespread and abundant inside CBC circles. Carefully standardized within-habitat censuses will be required to determine whether or not these generalist species also dominate the individual habitats occupied by their more specialized and narrowly distributed relatives.

Bogert, Laurence M. **That's my story and I'm stickin' to it: Is the "best available" science *any* available science under the Endangered Species Act?** *Idaho Law Review* 13(1): 85-150. Bogert provides an excellent overview of the ESA' s purpose, implementation, consequences, and some perceived shortcomings. He describes two cases where listing decisions were overturned in court on the basis that the science behind them was faulty or incomplete. "If listing decisions are to be driven solely by biological consideration," species listing decisions must be "based on data that is verifiable, accountable, responsible, and available." Data supporting a listing decision must be field tested to assure sound scientific methodology that is "based on reality." He believes there must also be "full public disclosure of all the raw data that is collected," so it can be scrutinized publicly. These data and procedural requirements must be amended into the ESA by Congress.

Borges, P.A. **Ranking the Azorean Natural Forest Reserves for conservation using their endemic arthropods**. *Journal of Insect-Conservation* [print] 4(2): 129-147 (June, 2000). Endemic arthropods were used to evaluate the conservation value of the 16 Natural Forest Reserves (NFRs) of the Azores (Macaronesia). For each of the 280 known Azorean endemic species of arthropods, a rarity index was calculated, using distribution and abundance data obtained from the literature. In addition, several scoring indices were used to rank the 16 NFRs. Frequency distributions of the rarity index indicated that there was a tendency for a greater proportion of the commonest species being represented in the NFRs, in contrast with a lower representation of the rarest species. About 60% of the endemic arthropod species that were recorded from the NFRs are 'single NFR endemics', that is, are known from only one of the 16 NFRs. Species richness was considered to be a very good surrogate measure of the conservation value of the 16 NFRs under study.

The fact that the six highest ranked NFRs (using a composite multi-criteria index) are located in different islands has some important conservation management implications; to preserve a large proportion of the Azorean arthropod biodiversity there is a need to protect

sites in all islands. If the five highest ranked NFRs are correctly managed in terms of conservation, then at least 80% of the endemic arthropods known from the NFRs could be protected. Most of the tested taxa (Acari-Oribatei; Lepidoptera; Diptera; Coleoptera) e good surrogates of the overall total set of species present in the 16 NFRs when using a species richness index.

Bowles, Martin and T. Bell. **Establishing recovery targets for Illinois plants - a report to the Illinois endangered species protection board.** Unpub. manuscript, 20 pp. (with five individual "Recovery Target" reports) (1999). Bowles developed reclassification and delisting criteria for five state and federal-listed Illinois prairie and sand-blow plant species. He assessed distribution and abundance, life history characteristics, population demography, and ecological requirements. Information sources included published papers, recovery plans, and data from ongoing monitoring and restoration research. He used this data to index the viability of each species population in each Illinois natural division within the species' range. The criteria include a range values for a number of variables that determine population viability. These include: population size; population growth trend; effective population size based on genotypes; habitat size; habitat condition and successional stage; protection status; and habitat management conditions. Finally, he produced tables for each species that show the numbers of moderately viable and highly viable population in each of the natural divisions that would need to be established in order to reach the goal of a population that was secure enough to downlist and to de-list the species within the State of Illinois. Extensive species information is included with each species report. Bowles stated that the cost to him of developing these criteria was nearly $2000 per species, under a contract that paid him $5,000.

Brauning, Daniel, M. Brittingham, et al. **Pennsylvania breeding birds of special concern: a listing rationale and status update.** *Journal of the Pennsylvania Academy of Science* 68(1): 3-28 (1995). Pennsylvania uses an Ornithological Technical Committee (OTC) to revise its list of breeding birds of "special concern" (which includes the categories of "threatened," "endangered," "extirpated," "extinct," and "candidate species." "Rare,' "at-risk," and "undetermined" are sub-classifications under "candidate species" status. As of 1991, there were 18 OTC members, four more than in the initial OTC. The OTC reviews a structured "Species Status Review Form" for each species under consideration. There are six major points of review: Legal status in surrounding states; Species distribution; Population size and trends; Habitat features in Pennsylvania; Population biology; and Taxonomic status. OTC relies on the Pennsylvania Breeding Bird Survey and the USFWS Breeding Bird Survey (BBS) for major trend data. Trend data, in-state habitat requirements, and biological needs data are used to give each species an objective ranking of species' status. This ranking procedure was developed by Kirkland the Krim (1990). OTC then meets to assign a conservation status to each species.

Bringsoe, Henrik. **Quo Vadis? Three American CITES proposals for American reptiles.** *Herptological Review* 29(2):70-71, 1998. The U.S. proposed adding three native species (alligator snapping turtle, eastern timber rattlesnake, and map turtle) to the CITES Appendix II for protection by banning international trade. However, with the possible exception of the map turtle, the species are in decline due to habitat destruction, pollution, and excessive take for local use. Criticism led to the withdrawal or two species, and the rejection of the third, on the basis that international trade was not a significant threat for any of these species.

Britten, Hugh B., et al. **The impending extinction of the Uncompahgre fritillary butterfly.** This listed species has been known for only 23 years and is considered a relict species, inhabiting alpine willow habitat above 12,000 feet in southern Colorado. Extensive field and laboratory research indicates this species has poor genetic diversity, and despite an end to threats posed by collecting and sheep grazing, may not persist through predicted regional warming trends. A risk of extinction assessment included transect counts, mark-recapture studies, and collection, to compile data on the species' distribution, abundance, population trend, and genetic variation. While discussing no numeric criteria for describing the status of the species, the authors agree it deserves protected status. However, they assert the species' fate may most practically be left up to the vagaries of climate variability or change, without the use of costly and perhaps futile human intervention. (See Seidl, Amy, and P. Opler, *Cons. Biol* 8(4):1156-57, for a different conclusion based on independent population studies. This underscores the difficulty in deciding which population estimates and trends data to use in listing decisions.)

Brown Loren E. **The trend toward extinction in the unusual forward burrowing Illinois chorus frog.** *Reptile & Amphibian Magazine* 43:70-73 (1996). The Illinois chorus frog burrows using its forelimbs rather than its hind feet. This frog appears to be on the verge of extirpation from many of its current sites. Agricultural row-cropping impacts from tilling, soil compaction, and a host of agricultural chemicals are suspected culprits, as well as the soil-denuding and frog-eating behaviors of hogs. Continued wetland and floodplain drainage, as well as stream impoundments also present threats of extinction of this species. Sand mining and residential development constitute further threats.

Cameron, R. A. **Dilemmas of rarity: Biogeographic insights and conservation priorities for land mollusca.** *Journal of Conchology*, SPECIAL PUBL. (2):51-60 (June, 1998). Land mollusks do not feature prominently in general discussions of rarity and conservation priorities. One national index for prioritization (Israel) is discussed in detail, and its range-size criterion for rarity applied to other faunas. As in many other taxa, the majority of rare species are found in the tropics, but site diversities there are not consistently higher than those elsewhere. Mean range sizes are small in the tropics. Consideration of various faunas highlights the occurrence of local radiations of closely related species in some, but not all families and genera, and the contribution this makes to molluscan biodiversity. Prioritization of taxonomic isolation would devalue such radiations. In higher latitudes, by contrast, ranges are generally larger, but sometimes intermittent. A 'hotspot' policy will be effective in such cases, but not in the tropics. A hierarchy of criteria for conservation priorities is suggested, giving precedence to range-related rarity.

Canadian Wildlife Service. **Committee adopting new criteria.** COSEWIC Update, Environment Canada Website [www.cws-scf.ec.gc.ca/es/recovery/july00/eng/cosewic.htm (July, 2000).The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in May, 2000 announced it is adopting "quantitative criteria based on those developed by the World Conservation Union (IUCN)." These criteria will be used to reassess the List of Canadian Species at Risk. COSEWIC chair David Green believes these modified IUCN criteria will make the listing of species more consistent and will provide more confidence in the accuracy and objectivity of listing determinations.

Carroll, R. et al. **Strengthening the use of science in achieving the goals of the Endangered Species Act: an assessment by the Ecological Society of America.** *Ecological Applications* 6(1):1-11 (1996). The Endangered Species Act of 1973 provides little guidance on how to use science to achieve its goals. The current system uses three "***criteria***": 1)

magnitude of threat; 2) immediacy of threat; and 3) taxonomic status. A committee of ten Society members reviewed the topic and concluded that (A) "the most important priorities in deciding which candidate species to list" are: number of other species to benefit from the listing; ecological role of the species; recovery potential; and taxonomic distinctiveness; (B) Population viability analysis ""offers a method to identify how" to maximize a specie's survival potential; (C) Endangered species recovery is enhanced when: recovery plans call for population distribution across the landscape; plans are "developed and implemented expeditiously;" and (D) Ecosystem-level (habitat) protections are a proactive approach that would provide effective protection of biodiversity at a lower long-term cost than waiting until species' extinction risk becomes great enough to warrant listing under ESA.

Carter. Michael F. et al. **Setting conservation priorities for landbirds on the United Sates: the Partners in Flight approach.** *The Auk*, 117(2):541-548, 2000. Partners in Flight (PIF) has been working to conserve non-game landbirds. They have developed a numerical system to assign a conservation priority to avian species. This system uses a combination of seven local and global parameters. Each parameter is assigned a numerical score (1-5) that reflects the need for conservation attention The seven parameters are: Breeding Distribution; Non-breeding Distribution; Relative Abundance; Threats to Breeding; Threats to Non-breeding; Population trend; and Area Importance. Details on determining priority scores, and other information is available at www.cbobirds.org.

Collar, N.J. **Globally threatened parrots: Criteria, characteristics and cures.** *International Zoo Yearbook*, 37: 21-35 (2000). Ninety (26%) of the world's parrot species are threatened with extinction. While this figure will vary with deteriorating circumstances, taxonomic insight and assessment of new evidence, the great majority (currently 93%) of threatened parrots are forest species, most (75 species, 83%) have populations estimated at less than 10,000 mature individuals, and many (37 species, 41%) have ranges <20,000 km2. Habitat destruction (notably the loss of nest-sites), trade, hunting and introduced species are significant threats. Indonesia, Australia, Brazil, the Philippines, Colombia and Mexico support two-thirds (60 species) of all threatened parrots. Conservation of sites with sympatric threatened parrots is required, alongside research and awareness programs that enable site and species management.

Cone, Marla. **A Disturbing Whale Watch in Northwest.** *Seattle Times*, Feb. 22, 2001. The concentrations of industrial chemicals in orcas off Washington state and Vancouver Island are the highest found in any living mammal, according to marine scientists. Scientists wonder if the industrial poisons accumulating in their bodies are beginning to take a toll on their survival, impairing their ability to fight disease and to reproduce successfully.

Another theory is that whale watchers in yachts, kayaks and motorboats are causing harmful levels of stress. The decline in salmon--a diet staple for many orca pods--also may be harming them. Most likely, scientists say, the orcas are being harmed by a combination of the urban threats they face.

At measured pollutant concentrations, the whales "greatly exceeded many toxic thresholds for mammals." PCBs block formation of vitamin A, a hormone. Calves can receive a large dose in their mothers' milk, so calf survival and calving rates "are the kinds of things that might be affected" by PCB contamination. Based on the recent population trends, Doug DeMaster, a marine mammal expert at the fisheries service, says there is a 50-50 chance that the agency will list the orcas as endangered.

Until the orca discovery, scientists had thought that beluga whales off Quebec, which are stricken with tumors and reproductive problems, were the world's most chemical-laden marine mammals. The only animals known to contain more PCBs than the Pacific

Northwest's orcas are dead--Mediterranean dolphins that died en masse from a virus epidemic. PCBs have affected dolphins, belugas and European harbor seals, and could also be jeopardizing orcas by creating vulnerability to disease.

Corn, M. Lynn. **The listing of a species: legal definitions and biological realities.** Congressional Research Service, Dec. 15, 1992**.** As of 1992, the ESA provided the strongest level of protection to vertebrates, next to invertebrates, and the weakest protection to plants. In defining populations and species, the ACT ignores the difficulty biologists face in dealing with the subtleties of their distinctions and difficulties sometimes involved in differentiating between various species and populations. Biological realities seem to require that the reverse be true, in order to protect the process of solar energy conversion that supports all animal life.

However, protection of some vertebrates (e.g. spotted owl) can confer protection on essential habitat and associated species (its ecosystem). Unfortunately, not all ecosystems have a vertebrate indicator species, and protecting animals does not protect rare plants upon which the animals do not depend (such as certain cacti). Marbled murrelets and bald eagles represent the difficulties and short-comings of listing populations according to reproduction interactions and geographic range, respectively. Changes in laws or rules pertaining to listing endangered species need to take into account the sometimes subtle distinctions that biologists must make.

Crins, William J. **Rare and endangered plants and their habitats in Canada**. *Canadian Field Naturalist* 111(3):506-519 (1997). Approximately one-third of the native vascular plant taxa known to occur in Canada (1009 of 3269 taxa) were classified as being nationally rare by Argus and Pryer (1990). Of these, 147 taxa are endemic species, and 68 are in urgent need of conservation. Most provinces and territories also have lists of species that are considered to be rare within those jurisdictions. Where Natural Heritage Programs exist (e.g., British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec), detailed work on the status, distribution, demographics, ecological requirements, and threats is being conducted, and this work, in conjunction with that by interested field botanists and researchers, has resulted in revisions to the provincial list, of rarities.

Refinements have also occurred in the criteria by which rarity is assessed, with the ***trends being toward increased quantification of status, inclusion of more ecological information, fuller consideration of threats to populations, and standardization among jurisdictions within North America.*** However, legislative tools for ensuring the protection of these rare species and their habitats are generally inadequate. Very little work has been done on determining the status of non-vascular plants anywhere in Canada. Also, far less work has been done on rare habitats than on their constituent species. This situation is changing slowly (e.g., extensive work on alvar communities in Ontario, Lake Athabasca dunes in Alberta and Saskatchewan, Atlantic Coastal Plain shoreline communities in Nova Scotia and Ontario). However, there are numerous habitats that require detailed attention, some of these being rare or diminishing (tall-grass prairies), while others are more common but support populations of rare plant species (calcareous cliffs, flats, shores, and peatlands).

Dansky, Shawn M. **The CITES "objective" listing criteria: are they "objective" enough to protect the African elephant?** *Tulane Law Review* 73(3):961-979 (1999). A program to control elephant mortality through regulation of the ivory trade during the 1970s and '80s failed to stem a growing slaughter by poachers. The U.S. banned all commercial ivory shipments. The international community followed suit in 1990, and elephant numbers began to rebound as the price of ivory plummeted. However, conflicts with human populations that were settling in former elephant habitat increased. In 1994, IUCN adopted more objective

criteria to list endangered species that would be harmed by international trade than it had previously been using under CITES. Elephant range nations argued that elephants and other species must "pay their own way" and successfully argued for the resumption of the ivory trade, in part as a means to fund conservation efforts. Dansky feels bowing to these cultural and political pressures subverts the biological objectivity of the criteria. He argues for these changes to the criteria: 1) require a population trend analysis with data from the past 50 to 100 years; 2) give greater weight to effects of trade; 3) require "positive scientific evidence that the plant or animal can withstand exploitation" as a condition of delisting; 4) add a provision for immediate re-listing if nations responsible for enforcing restrictions necessary for protecting a species fail to enforce them.

Defenders of Wildlife. **State endangered species acts: past, present, and future.** WWW presentation at www.defenders.org/pubs/sesa09.html (Feb. 2001). Forty five states have some sort of endangered species protection law. Appendix C. of this report is a large table summarizing states' laws, but it contains no summary of any listing criteria that states use. The authors suggest that states provide more opportunity for public involvement in listing decisions, but there is no substantive discussion of criteria.

They observe that "most state acts exclude cost-benefit considerations from the decision about whether or not to list a species for protection. In general, the rationale is that socio-economic impacts can be considered when protective regulations actually are implemented and that an honest accounting of the state's biota is owed to the public."

"Three state statutes do require that species be listed, but then provide significant exceptions to the rule. In Oregon, the Fish and Wildlife Commission can decide not to list if the species is secure outside the state and is not of 'cultural, scientific or commercial significance to the state.' The Virginia act protecting plants and insects requires listing unless a determination is made that such listing is 'not to be in the best interest of man.' And in Kentucky, the listing of plants 'shall not serve to impede the development or use of private or public lands.'"

Defenders of Wildlife. **State endangered species acts: past, present, and future.** WWW presentation at http://www.defenders.org/pb-bstes.html. July, 1996. "Overall, the status of state endangered species acts is extremely weak. California is the only state with an act as comprehensive as the federal act. To date, 43 states have enacted some form of endangered species provision or law. On the opposite end of the spectrum, seven states have no laws whatsoever dealing with endangered species.

State laws generally fall far short of the protection required or offered by the federal act. Thirty-four states simply prohibit "taking" of or trafficking in an endangered species and provide a mechanism for listing. None of these laws require programs for managing and protecting endangered species. Eight states have laws that prohibit taking and mandate protection efforts.

The California Endangered Species Act is clearly the most comprehensive of its kind. It protects both plants and animals and requires recovery plans, critical habitat designation and agency consultation on the impact on endangered species of proposed state agency projects. The law also exempts private landowners from liability when the state surveys or attempts to restore species on private land with the hope of encouraging such efforts."

This report does not address the implementation of any state endangered resources programs by the use of criteria.

Defler, T.R. **An IUCN classification for the primates of Colombia.** *Neotropical Primates* 4(3):77-78 (September 1996). Defler asserts the national conservation status classification list of primates needs to reflect the species' status in Columbia, and not represent a simple reiteration of the international status. In some cases, Defler classifies species at a higher level of risk in Columbia than internationally, because only a small population, and generally a small portion of the total known population, resides within that country. The major threats to species in Columbia that demand a higher risk classification are human colonization, , lower population densities due to less available preferred foods, and hunting for meat by [reportedly] indigenous people. Defler expects that future census work will change the conservation status of some species over time. He used the standard IUCN status categories and definitions of Lower Risk, Data Deficient, Vulnerable, Endangered, and Critically Endangered.

Demauro, Marcella M. **Relationship of breeding system to rarity in the lakeside daisy (Hymenoxys acaulis var. glabra).** *Conservation-Biology* 7(3): 542-550 (1993). The breeding system of a rare Great Lakes endemic, the lakeside daisy (Hymenoxys acaulis var. glabra), was investigated when plants from a remnant Illinois population produced no seeds for over 15 years. To determine if the Lakeside daisy was self-incompatible, 20 plants from two populations, Illinois and Ohio, were selfed and out-crossed. Seed/ovule ratios were compared among the different treatments and the location of the incompatibility reaction was identified Lakeside daisy was found to be self-incompatible (sporophytic). The last Illinois population was effectively extinct because the remaining plants belonged to the same mating type (N-e, = 1) and only produced seeds when out-crossed to the Ohio plants. Cross-incompatibility was also observed among Ohio plants; suggesting that within large populations, compatible mating types may be rare locally. In addition, inbreeding depression (lower seed/ovule ratios in inbred than in outcrosses) was observed after one generation of inbreeding. Small populations of self-incompatible species are vulnerable to extinction if the number of self-incompatibility alleles; either as a result of a bottleneck or of genetic drift falls below the number needed for the breeding system to function. Recovery protocols based on these genetic considerations were developed and implemented in 1988 when Lakeside daisy populations were established at three Illinois nature preserves.

Dennis, Roger L.H . **An inflated conservation load for European butterflies: Increases in rarity and endemism accompany increases in species richness.** *Journal of Insect Conservation* 1(1): 43-62 (1997). The addition of species to the European butterfly list since 1983 has resulted in a number of highly significant changes. Most important are the increases in the number and proportion of endemics and of rare species, and a regional excess of species and endemics for southern Europe compared to northern Europe. There is also a surplus of Lycaenidae and Satyridae compared to other families, and an increase in species per genus associated with the reduction in genera. These additions raise two issues. First, the potential conservation load for European butterflies is inflated at species level. This is especially the case for southern Europe, which has disproportionate increases in rare and endemic species, more particularly if rarity and endemism are found to equate with threat of extinction. Second, the inflation in rarity and endemism suggests that there is a trend to promote ever more local populations (races, subspecies) to species. The taxonomic status of species being added to the list, a quarter of which are regarded as doubtful, is increasingly difficult to determine. Consequently, there is a danger that this may call into question the validity and objectivity of taxonomic practices, and of databases dependent on them, used by conservation. Revision of higher and lower butterfly taxa is urgently required.

Doremus, Holly. **Delisting endangered species: an aspirational goal, not a realistic expectation.** *Environmental Law Review* 30(6): 10434-10454 (2000). The number of species formally listed as endangered or threatened has increased dramatically since 1967. The fact that few species are delisted creates criticisms that either the law cannot work, or its recovery provisions must be strengthened. In response to these criticisms, USDI declared that delisting species would become a priority. This strategy misinterprets the ESA's conservation purpose. Premature delisting would leave species vulnerable to extinction. Many species may need to remain listed "indefinitely" because their recovery potential has already been severely limited. Delisting will not eliminate the need for long-term conservation measures. Delisting is not merely a matter of biological science, but is as much a matter of effecting long-term social change and controlling human behavior. A major barrier to delisting is the "lack of effective regulatory protection outside the ESA," which is needed to control the two most significant threats to species: habitat degradation and the spread of alien species. Viewing delisting as unlikely for most species should prompt states and federal agencies to *"take steps to protect species before they qualify as federally endangered or threatened."*

Doremus, Holly. **Listing decisions under the Endangered Species Act: why better science isn't always better policy**. *Washington University Law Quarterly* 75(3): 1029-1153 (1997). Better science, Doremus says, "does not automatically produce better policy decisions. Rather than genuflecting ritually before the altar of science, Doremus should ask whether science can solve the difficult policy questions we face. Close examination of the ESA shows that many of the most troubling issues are not truly scientific. For that reason, excessive reliance on science has not improved policy decisions under the ESA. In fact, the impossible legislative demand that ESA listing determinations rest solely on scientific information has produced a number of undesirable effects. It has encouraged the agencies to conceal the true bases for their decisions; led them to ignore several of the values Congress intended to protect through the ESA; caused them to miss several opportunities to educate and inform the general public; made their decisions appears deceptively certain and objective, and ultimately undermined political support " for protecting endangered species through science. Doremus suggests that the peer review is redundant of the overall public review and should be eliminated, and more public education must be achieved by the listing process.

Dunham, J.B. et al. **Habitat fragmentation and extinction risk in Lahontan cutthroat trout.** *North American Journal of Fisheries Management* 17(4):1126-1133 (1997). The Lahontan Basin strain of native cutthroat in Nevada occupies only about 10% of its pre-settlement range. Habitat fragmentation was the only variable identified as being correlated to absence of trout in stream tributaries, but there may other factors that simply did not show up in the study of stream survey records. Almost 90% of stream basins connected to another stream basin containing cutthroat trout also contained trout, while only 32% of isolated streams supported this species. Isolation of local populations may result from drought, and water diversions and other human-caused habitat degradation. This habitat fragmentation of aquatic habitats may be a significant contributor to the increased risk of local extinctions, because it reduces the potential for trout to recolonize stream segments from which they have been extirpated.

Edwards, R.J. et al. **A classification of Texas aquatic communities with special consideration toward the conservation of endangered and threatened taxa.** *Texas Journal of Science* 41(3): 231-240 (1989). A committee of members of the Texas Organization for Endangered Species (TOES) identified and mapped 11 primary aquatic habitat types, and 7 major biotic

provinces across Texas. They identified almost 80,000 miles of stream channel. They then considered the distribution of all endangered and threatened *vertebrate* species within those habitats and provinces. Habitats associated with spring systems (aquifers, springs and spring-runs) supported a majority of the endangered invertebrates in the central and western region of the state, mirroring the human overuse of groundwater in the more arid parts of the state. Large rivers and streams harbored the greatest number of endangered species in the eastern part of the state, reflecting human manipulation of these river systems. The committee concludes that only enlightened protection of these water resources will protect the species they support.

Ellis, Willem N. et al. **Changes in rank abundance of Microlepidoptera in the Netherlands.** *Entomologische*, Berichten, Amsterdam (9): 129-137 (1999). Ellis investigated whether the pattern of abundance of 895 species of Microlepidoptera in The Netherlands has changes since 1850, and if such a change could be brought into relation with rarity, phenology and climatic effects. As a measure of abundance, Ellis used the number of records in the Tinea database since 1850, in ten progressively shorter periods. The species' abundances differed between the periods. He ranked the abundance of the species in each period separately, and calculated their change in rank (maximal-minimal observed rank). The median change was 441; in general common species (with highest average rank) have least changed rank, species of intermediate rarity the most. A positive correlation was found between a species' commonness and the slope of the regression of its rank values on the time, suggesting that over the whole study period rare species are receding relatively to the common ones. The pattern of change of rank abundance differs both among the spring-, early summer-, late summer- and autumn-flying species, and among the main families. Ellis cautions that the randomness of the collection data in the database is limited, especially for the older material. He tentatively predicts that a sample of moths taken today will contain less rare species than an equally sized sample in the past. Moreover, the composition of the fauna is strongly dynamic, implying that monitoring a few endangered species provides only incomplete information about the condition of nature.

English, V. and J. Blyth. **Development and application of procedures to identify and conserve threatened ecological communities in the South-west Botanical Province of Western Australia.** *Pacific Conservation Biology* 5 (2):124-138 (Sept. 1999). A two year project was conducted to: (i) produce definitions, criteria and procedures for identifying threatened ecological communities (TECs) and assigning them to categories that define conservation status; (ii) develop a minimum data set for allocating TECs to one of these categories; (iii) establish a database and enter on it TECs, and associated data, of the South-west Botanical Province of Western Australia; and (iv) assess each community and make recommendations for actions to conserve them. The procedures described allow assessment of whether a particular biological assemblage can be described as an ecological community, and whether it meets the definitions and criteria for a TEC. "Threatened" (with destruction) includes "totally destroyed", "critically endangered (CR)", "endangered (EN)" and "vulnerable (VU)". Ecological communities that do not meet the criteria as "threatened" may be classified "data deficient" if there is insufficient information to assign a category, or "lower risk" if the community is not under significant threat. Other assemblages are termed "not evaluated".

The terminology, categories and criteria are adapted from those recommended for threatened species by the World Conservation Union (IUCN). Thirty-eight ecological communities, including those based on assemblages of terrestrial and aquatic plants, cave and mound-spring invertebrates, and structure-forming microbes were entered on the database. Of these, 16 were assessed as CR, seven as EN, ten as VU and five as data

deficient. The project established methods that are applicable to data on a broad range of community types at a broad range of scales. It also initiated many recovery actions including preparation of interim recovery plans, land acquisition, fencing, weed control and public liaison. Such actions are intended to cause allocation of communities to a lower category of threat when reevaluated against the criteria. [Full @ DNR GEF2 LB]

Environment Australia. **About the environmental protection and biodiversity conservation act - Part 7 - Division 7.1 Listing.** Environment Australia Web presentation, last updated Mar. 26, 2001 (http://www.environment.gov.au/ epbc/about/index.html). To implement its July, 2000 Environmental Protection and Biodiversity Conservation Act, Australia uses criteria that are generally non-quantitative for listing threatened *species*, threatened ecological *communities*, and *'key threatening processes.'* Measurements for all criteria but "probability of extinction" are left to interpretation, as "very severe," "substantial," "low," etc. For plants and animals, these include degree of reduction in numbers; restrictions in geographic distribution; total breeding population and rate of population decline; total breeding population regardless of population decline; and probability of extinction in the wild (within numeric ranges).

For plant communities, the criteria include geographic distribution in light of vulnerability to potential threats; decline in geographic distribution; decline of a native species important to its biotic community, coupled with probability of restoration; reduction in integrity across its range, in light of community degradation; rate of ongoing detrimental change and indicators thereof; and probability of extinction or "extreme degradation" across its range (within numeric ranges).

Environment Canada. **Assessing the status of species that may be at risk in Canada.** Environment Canada Web presentation, last updated Nov. 3, 1999 (www.cws-scf.ec.gc/es/legis/uassess.thm). The Wildlife Minister's Council of Canada reconfigured its Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Formerly, COSEWIC listed species on a very informal basis, and listings of endangered species in Canada triggered no legal consequences. Proposed legislation would place this committee under the direction of the Canadian Endangered Species Conservation Council (CESCC). New guidance will ensure that COSEWIC produces scientifically sound species status assessments. Assessments would be made by eight Species Specialist Groups (SSG), with each group responsible for reviewing the status a of specific taxonomic groups. The assessment process promotes use of international assessments by IUCN, CITES, and The Nature Conservancy, and considers input from a wide variety of other qualified sources. SSG's prepare final reports for COSEWIC for review and inclusion in their annual status assessment. Provinces and territories would use the COSEWIC process in national species status assessments, and are free to adopt their own procedures for provincial and local assessments.

Environment Canada. **COSEWIC update - committee adopting new criteria**. Environment Canada Web presentation - July, 2000. Canada has increased its listing of Species at Risk to 353 species, as of May, 2000. Canada is reassessing its list using "a modified version" of the of the quantitative criteria developed by IUCN. The new assessment criteria are intended to make the listing of species more consistent and to provide a standard method of reporting assessments. [http://www.cws-scf.ec.gc.ca/es/ recovery/july00/eng/cosewic.html]

Eyre, M.D. and S.P. Rushton. **Quantification of conservation criteria using invertebrates**. *Journal of Applied Ecology* 26(1): 159-172, 1989. (1)Rarity indices and typicalness measurements were generated for sites within habitat groups defined by classifications of water and ground beetle communities in north-east England (UK). (2) Differences in the rarity values of sites were most easily interpreted when a geometric scale was used to calculate species rarity scores and when the estimate was standardized by the number of species. (3) Inclusion of an extra weighting for associations of rare species led to sites that were likely to have the highest conservation potential being more easily distinguished. (4) Measurements of site typicalness were made using ordination scores derived from de-trended correspondence analysis. Of the two methods attempted, the most appropriate calculations of site typicalness were those based on ordination cores derived from analyses of individual habitat group data rather than those derived from analyses of all data. (5) No consistent relationship between measurements of site rarity value and typicalness was found, in contrast to accepted thought.

Favre, David S**. The risk of extinction: a risk analysis of the Endangered Species Act as compared to CITES.** *New York University Environmental Law Journal* 6(2): 341-366 (1998). Favre characterizes the ESA as an "all-encompassing" law that seeks to deal with the full range of threats to species' survival. By contrast, he views CITES as dealing only with only one component of extinction risk-international trade. In the US, the primary species conflict …is the tension between habitat preservation and economic development of private lands." He advocates answering the question of under what circumstances does ESA limit economic development when federal permits are needed to change land use. The answer to this question will guide the few small changes to the ESA that may be necessary to maintain its usefulness over the next 25 years.

Federal Register. **Endangered and threatened wildlife and plants: designation of the freshwater mussel, the fanshell, as an endangered species.** 55:25591-25595 (1990). Most life history information on this mollusk remains unknown, including life span and parasitic host. USFWS has concluded that "the distribution and reproductive capacity of this species has been severely impacted by the construction of impoundments and navigation facilities, dredging for channel maintenance, sand and gravel mining, and water pollution.." The reviewing agency consulted with more than 20 mollusk authorities within the historic range of this species to obtain distributional and threat information. This information yielded an analysis of the species' status in light of each of the five listing factors described in the ESA and discussed by Nicholopoulos, (below).

Fekete, G., et al. **Application of three approaches to evaluate abundance and rarity in a sand grassland community.** *Coenoses* 10:(1) 29-38 (1995). This paper gives an account of causal analyses of populations, which are sharply different in relative abundances in the perennial drought limited sand grassland Festucetum vaginatae. Three complementary approaches were pursued: 1. Sociological, based on spatial associations between species-pairs to find species sensitive or indifferent to the common ecological factors extracted by factor analysis. 2. "Traditional", rooted in niche theory using the parameters of niche width, and overlap between species in pairs and multiplets. All calculations were based on measurements of soil moisture content and depth of maximal root mass. 3. Experimental, involving investigations on the physiological tolerance and adaptation mechanisms of populations to interpret results obtained by approaches 1 and 2. We found a positive relationship between abundance and niche width. The dominant species, Festuca vaginata, has the largest niche width and highest average overlap value. Regarding the role of species in niche space measurements concerning photosynthesis ecology and biochemistry indicate

that the rank order of species based on mesophyll succulence is informative and that in continental open grassland communities with summer drought, species with C-4 and/or C-3-C-4 intermediate photosynthesis type have the best chance to achieve competitive superiority in the role of a generalist.

Fleishman, Erica , et al. **A new method for selection of umbrella species for conservation planning.** *Ecological Applications*. [print] 10(2): 569-579 (April, 2000). Umbrella species, species whose protection serves to protect many co-occurring species, have been proposed as a shortcut for conservation planning. Potential criteria for selection of umbrella species include rarity, sensitivity to human disturbance, and mean percentage of co-occurring species. Using butterflies in montane canyons in the Great Basin (USA) as a case study, Fleishman examined correlations among those three selection methods. We also developed a new index that specifically ranks species according to their potential to serve as umbrellas for their taxonomic group. Different methods for prioritizing species generally produced divergent rankings. Although rare butterflies tended to co-occur with more species than widespread butterflies, rare species may be poor umbrellas because their distributions are too highly restricted and often cannot be influenced by managers. Umbrella species are useful in meeting certain conservation challenges, particularly prioritization of habitat remnants for conservation or other land uses. Our work demonstrates that a subset of a fauna may serve as an effective umbrella for a larger ecological community, and therefore play an important role in contemporary management planning.

Freitag, Stefanie and A.S. Van Jaarsveld. **Relative occupancy, endemism, taxonomic distinctiveness and vulnerability: Prioritizing regional conservation actions.** *Biodiversity and Conservation* 6 (2):211-232 (1997). A method is presented whereby ***regional species*** are scored and ranked in order of regional conservation importance according to a number of different but complementary 'rarity' criteria. Approaches for determining regional occupancy (RO), relative taxonomic distinctiveness (RTD), relative endemism (RE) and relative vulnerability (RV) rankings for regional faunas are proposed. The continuous variable approach and resultant positively skewed 'rarity' scores suggest easy identification of regional priority species. These methods are collectively applied to a ***regional mammalian fauna*** in order to prioritize species for conservation action using a regional priority score (RPS). The proposed method is a comparative relational approach aimed at determining which species require the establishment of viable populations within a regional context. The two species afforded highest RPSs for the Transvaal region, **South Africa**, are Gunning's golden mole (Amblysomus gunningi) and Juliana's golden mole (A. julianae). These two species are truy endemic, with geographic ranges completely restricted to the region. Also of high regional conservation importance are the four-toed elephant shrew (Petrodromus tetradactylus), pangolin (Manis temminckii) and aardvark (Orycteropus afer). Although these species have low RE scores, they have high RTD and RV scores. The equal weightings given to the four components of 'rarity' ensures that species achieving a high score in any of these categories will be considered for regional priority listing. This approach is simple, explicit and repeatable, circumventing problems of scale.

Gardenfors, U. **A closer look at the IUCN Red List categories: the regional perspective.** *Species* (25):34-36 (1995).

Gerber, Leah. **Seeking a rational approach to setting conservation priorities for marine mammals.** *Integrative Biology* 1(3):90-98 (1998). The ESA's lack of criteria results in "widely inconsistent" listing and recovery proposals and actions. High-quality population assessments are lacking and listing criteria are arbitrary and non-quantitative. Recovery

goals for federally-listed species are sometimes at or below existing population size. The authors propose a new approach to determining classification criteria, focusing on the ***North Pacific humpback whale***. This approach attempts to explicitly incorporate biological uncertainty into the definitions of "endangered" and "threatened," using data that either already exist, or are attainable in the foreseeable future. For Gerber, "the key idea is that endangerment depends on two critical aspects of a population: population size and trends in populations size due to intrinsic variability in population growth rates. The way to combine these features is to …identify a population size and a range of population growth rates above which there is a negligible probability that the population would fall below a level from which extinction is inevitable."

IUCN criteria, while increasing the scientific rigor of listing many terrestrial species, do not apply well to marine or other wide-ranging aquatic species. This is because, in the oceans, the concept of habitat fragmentation does not generally apply. The authors focused on the key concept that "endangerment depends upon population size, and trends in population size due to intrinsic variability in population growth rates. They propose very general criteria to downlist this species to threatened when, over the next 10 years, there is a high probability that abundance will remain above a specified critical level (N_q), and an international protection regime is in force; and to delist when there is a high probability that, over the next 25 years, abundance will remain above the threshold for endangered status (N_{end}), and the international management scheme remains in force.

Gibbs, James P. and John Faaborg. **Estimating the viability of ovenbird and Kentucky warbler population in forest fragments.** *Conservation Biology* 4(2):193-196 (1990). Gibbs and Faaborg compared proportions of pared vs. unpaired territorial ovenbirds within isolated, fragmented vs. large, contiguous forest tracts. Densities of paired ovenbirds were significantly greater in the larger tracts (>500 ha) than in the smaller tracts (<140 ha). This same relationship was not found when analyzing Kentucky warbler populations.

Gigon, Andreas, et al**. Blue lists of threatened species with stabilized or increasing abundance: A new instrument for conservation.** *Conservation Biology* 14 (2):402-413 (April, 2000). To counter the often depressing information contained in Red Lists and similar lists of threatened species, Gigon proposes the use of Blue Lists that enumerate those red-list species experiencing lasting overall stabilization or an increase in abundance in the region considered. Blue lists are (mostly) a subset of the Red Lists. We defined three main categories for blue-listed species: (1) those whose increases merit delisting from the Red List; (2) those increasing in abundance, but not enough to warrant delisting; and (3) those whose abundance is stable. Remaining categories outside the Blue List include (1) decrease; (2) (local) extinction; and (3) change in abundance unknown. For practical use, information on conservation or recovery techniques necessary for maintaining or promoting the species could be added to the lists. In a test region of 3431 km2 in northern Switzerland, representative of hilly and densely populated areas in central Europe, Gigon enumerated Blue Lists for 122 species of all the vertebrate classes and 722 vascular plant species, all of which are on the regional Red Lists. Large differences exist between these systematic groups in the proportions of species in the different categories. Overall, Blue Lists comprise approximately one-third of the red-listed species considered. For a further 50%, nature conservation techniques for maintenance or promotion are known but have not yet been applied effectively. If all known techniques were applied to a greater extent, the persistent decline of most of the species in the region could be stopped or reversed. We discuss the scientific and psychological weaknesses and strengths of the Blue Lists. They can strengthen public motivation for conservation and advance self-confidence among conservationists by quantifying and stressing successes in species conservation, by giving this positive

information an identity, by showing promising possibilities for action, and by providing a useful public relations tool. The Blue List concept can also be applied to species covered by the U.S. Endangered Species Act and by The Nature Conservancy's ranking system on the global, national, or regional scale.

Gotmark, F., et al. **Are indices reliable for assessing conservation value of natural areas?: An avian case study.** *Biological Conservation* 38(1):55-74 (1986). Bird censuses in two wetland habitats (bogs and wet meadows) in SW Sweden were used to test the applicability of five conservation indices suggested for birds. The censused sites were first evaluated and ranked by the authors, then ranked according to each of the indices. Two indices based on species diversity (H' or lambda) showed a poor agreement with our evaluation; Gotmark suggests that they should not be used for ranking of sites of ornithological interest. Three indices based on rarity showed a better agreement with our evaluation, but were influenced by the size of the geographical area for which rarity was assessed. None of the five indices takes into account all of the relevant aspects for an evaluation of the bird fauna at the different sites. Before constructing further indices, conservationists must reach agreement on which evaluation criteria to use, and how to use them. *It may, however, not be feasible to construct a single index; a better strategy might be to construct indices only for single evaluation criteria.*

Greenslade, Penelope. **Heritage listing of invertebrate sites in southeastern Australia.** *Memoirs of the Queensland Museum* 36(1):67-76 (1994). Taxonomic technicalities, a lack of data on species ecology and distribution, and the sheer number of species to study has hampered protection of invertebrates in Australia. Greenslade investigated the feasibility of registering sites for protection on the National Estate Register by using criteria that evaluated their habitat value to invertebrates. ***Criteria*** used include species' importance to: evolution of Australian fauna; maintaining existing processes or natural systems at the regional or national scale; unusual richness or diversity of fauna; rare, endangered, or uncommon fauna, communities, ecosystems or phenomena; demonstrating the principal characteristics of the range of ecosystems, the attributes of which identify them as being characteristics of their class; close associations with individuals whose activities have been significant within the history of the nation, state or region; community educational associations; and information contributing to wider understanding of Australian natural history by virtue of their use as research sites, teaching sites, type localities, reference, or benchmark sites.

Taxa that are not site-specific cannot easily be protected via National Estate listing. However, listing has value in that "it gives a measure of protection to habitats and alerts the wider community to their value. It has advantages over protecting individual species because, in practice, it is possible to legislate for only a few species and such legislation does not simultaneously confer protection on the species' habitat."

Grigera, Dora and Garmen Ubeda. **Vertebrate fauna as a criterion for ranking natural environments by their conservation value: A study case.** *Medio Ambiente* [print] 13(2):50-61 (2000). Procedures for ranking natural environments within an area on the basis of the conservation value of the vertebrate fauna are presented and applied to the Nahuel Huapi National Park, Argentina. Forty environments were identified in the area of the National Park, which is inhabited by 177 native species of vertebrates and 12 exotic species. In order to ponder these environments the following features or criteria were considered: number of species, specific density (number of species in relation to the environment surface), number of families, number of stenotopic species, number of endemic species, number of threatened species, and conservation average value. Ranking of the environments

was made on the basis of each of these criteria separately and on the basis of a combination of all criteria. When specific richness was the key criterion, environments of a higher structural heterogeneity occupied the first positions. The use of the number of families as a ranking criterion adds woodlands and lentic environments of transitional zone to the list of top-priorities. Conservation status, stenotopy and endemisms give top priority to forests, aquatic environments of the National Park's most humid areas, and the high Andean environments. Conservation average value put four of the high Andean environments first in the ranking. Integrating all ranking criteria, woodlands, water bodies of the most humid area, and the shrub/steppe mosaic, were ranked in top positions. The procedures described here may be applied, for instance, to land use planning, design and location of nature reserves, partitioning of already delimited areas, and to compare the conservation value of different areas. Additional variables can be taken into account to perform a wider evaluation, although the ranking of environments on the basis of their fauna may also be of interest, given that the conservation of fauna implies conservation of their habitats.

Gulliver, R.L**. The rare plants of the Howardian Hills, North Yorkshire (England, UK) 1794-1988.** *Watsonia* 18(1): 69-79 (1990). The lists of rare plants growing in the Howardian Hills compiled by Robert Teesdale and Henry Ibbotson have been pooled to provide a picture of the plant life in the area for the period 1794-1843. Modern records have been examined and extensive field work carried out to determine the fate of the rare plants post-1943. The Atlas of the British flora was used to provide an objective definition of rarity. Woodland species have shown the greatest survival; plants of other habitats, including arable, showed the poorest survival; plants of 1) grassland, 2) aquatic habitats and river margins, and 3) mire occupy intermediate positions. The number of sites occupied by surviving species had declined. Two very rich sites, Terrington Carr and Malton Fields, have each lost 100% of their rare flora. Extinctions appear to be due to changes in land use rather than any other factors, emphasizing the need for conservation of threatened habitats, especially arable ones. This insight into the plant-loss/land-use relationship is only possible because accurate site records were made by Teesdale and Ibbotson.

Hallingback, Tomas. **The new IUCN threat categories tested on Swedish bryophytes.** *Lindbergia* 23(1): 13-27 (1998). Hallingback provides an insightful view into practical considerations in using the 1994 IUCN criteria. Forty species were selected from the Swedish Bryophyte Red List in order to test the new IUCN Criteria with help from the guidelines proposed in this issue of Lindbergia. The species were selected to represent different distribution types, morphology types, life strategies, habitats and threats. The results show that out of 40 species selected from the old Red List (following the old IUCN categories), all but one of the Data Deficient species were now considered to be Red List species, according to the new IUCN system. Among the old 25 "Threatened" species (E, V, R) 18 (72%) are still classified as "Threatened". Among the 14 species formerly considered to be "Care demanding", eight were now considered truly "Threatened" (CR, EN, VU) according to the new system. The remaining species met the criteria for Lower Risk (nt). This indicates that using the new system may result in somewhat longer Red Lists than the old one. Most problems with the application of the new system to bryophytes concern the interpretation of the terms 'area of occupancy', 'length of generation', and how to define an 'individual'. The way bryophytes often reproduce by cloning and other forms of asexual dispersal makes them difficult to fit into a category system that pays so much attention to mature individuals and length of generations. Rate of decline was discussed and a frequently used option was to estimate the decline of habitat quality and/or contraction of habitats important for the survival of species. Aspects of reproductive capability and dispersal ability would have been important to consider but are missing in the system. Hallingback concludes

that the new IUCN threat categories are applicable to bryophytes. The most useful options seem to be to predict decline and estimate rarity with help from distribution and habitat data.

Hensley, Harriet. **The role of state conservation plans in the listing of endangered and threatened species.** *The Advocate* 42(10): 8-12 (1999). Federal listings intrude on state sovereignty in managing fish and wildlife. Legal and social conflicts have prompted Idaho to retain as strong a role as possible in managing species at risk. Federal courts, however, have limited the types of state conservation programs that the federal listing agencies may legally rely upon in making listing decisions. This has thwarted state attempts to forestall federal endangered species listing and reintroduction programs. Court decisions have not provided any clarity in determining what combination of state law, regulation and policy would preempt federal listing. The author concludes that for the time being, states must take advantage of every opportunity to enter into partnership with federal agencies to assist in the recovery of imperiled species. She describes the example of attempts to recover bull trout populations in Idaho.

Herkert, J.R. (Ed.) **Endangered and threatened species of Illinois: status and distribution, volume 2 - animals.** Illinois Endangered Species Protection Board, Springfield, IL. 142 pp. (!992). The Illinois Endangered Species Protection Board engages its Endangered Species Technical Advisory Committees to make listing reviews and recommendations for the Board's final action. The Board reviews information on each species describing its 1) range in the state; 2) abundance in state; 3) number of known populations or sites; 4) number of known sites under protection; 5) types of threats; and 6) sensitivity to disturbance.

Hill, Kevin D. **The Endangered Species Act: what do we mean by species?** *Boston College Environmental Affairs Law Review*, 20(2): 239-264, Winter 1993. Failure to use the Biological Species Concept is undermining the Endangered Species Act's purpose of identifying endangered species and funding programs to prevent their extinction. The act's imprecise classification problem can be seen by the government's protection of the red wolf, a subspecies or a hybrid, and its lack of protection for the dusky seaside sparrow, a species which has bred with other sparrows. Amendments to the act have been proposed as part of its reauthorization.

Hodgson, J.G. **Commonness and rarity in plants with special reference to the Sheffield Flora (UK): Part II: The relative importance of climate, soils and land use.** *Biological Conservation* 36(3):253-274 (1986). Although the flora of the Sheffield region was initially shaped by climatic and edaphic forces, at this present time land use appears to be by far the most significant determinant of the commonness and rarity of individual species. Differences between major habitats of the region with respect to their proportion of rare species (aquatic vs. mire vs. woodland vs. grassland vs. open habitats vs arable) can be attributed simply to differences in the vulnerability of the vegetation of the various habitats to changing patterns of land use. The greater levels of fertility and disturbance associated with modern land use is resulting in the creation of a new flora with the replacement of communities of stress-tolerant species (sensu Grime, 1974) by those with competitive or ruderal strategies. These changes, apparent in the Sheffield region, are probably an accurate reflection of those which are occurring within Britain as a whole.

IUCN. **2000 IUCN Red List - Background.** The International Union for the Conservation of Nature (IUCN, or World Conservation Union) released its "2000 Red List of Threatened Species." The Red List (www.redlist .org) holds the names of more than 11,000 plants and animals that scientists have documented to be "facing a high risk of extinction in the near

future, in almost all cases as a result of human activities." IUCN partner scientists devised these criteria to be relevant to "all species and all regions of the world." The Red List places these plants and animals into one of 8 categories, ranging from "Extinct" through "Not Evaluated."

About 7,000 biologists and others comprise the IUCN Species Survival Commission (SSC), which implements species' status reviews, measuring each species' circumstances against these criteria: population size; rate of population decline; area of geographic distribution; and degree of population and distribution fragmentation. Species are assessed using the best available information on the status and known threats, and the results are presented as a category of threat, which equates to a predicted risk of global extinction within a given time frame.

Red List Authorities, comprised of taxonomic group experts from the SSC, are responsible for reviewing the status of all species within their defined taxonomic group. Experience with reviews completed since the release of the 1994 criteria is contributing to a further refinement of the criteria, which should further improve documentation, data management, and scientific credibility. More detailed descriptions of these criteria and their application are available at http://iucn.org/themes/scc/redlists/criteria, and http://iucn.org/redlist/2000/background.

IUCN. **Threatened fish? Initial Guidelines for applying the IUCN Red List criteria to marine fishes.** IUCN and several other organizations have produced initial guidelines for adopting Red List criteria to the specific circumstances of marine fish populations. These may also be applicable to assessing the risk of extinction to other species. First, scientists need to define the population component to which observed population reductions apply. Declines in biomass may be more accurate an indicator than reductions in numbers. For sex-changing species, changes in sex ratio may be a more appropriate indicator. For heavily exploited populations, declining generation times may require that reviewers use the mean age of adults in the unexploited state, if that can be determined and is different than the men age of parents in exploited populations. Reductions in generation time and life span of long-lived species are important factors. Limited habitat use over a large geographic range is often more accurate than simply considering the range alone. Area of habitat occupancy, considering the three-dimensional nature of species movement during seasonal of life-stage responses, is an important factor. Status of distinct stocks (as with salmon) affects extinction risk determinations. Species taxonomy must be clarified if necessary, especially if a species is under consideration for renaming.

IUCN Species Survival Commission. **IUCN Red List categories.** International Union for the Conservation of Nature (IUCN), Gland, Switzerland (Nov. 30, 1994). Recognizing the need to revise its threatened species categories, the Commission has proposed revised new definitions and criteria for Red List categories. The revision has the goals of providing a classification/listing system that: 1) can be applied consistently by different people; 2) has improved objectivity in evaluating factors affecting risk of extinction; 3) will make it easier to compare extinction risk across widely different taxa; and 4) makes it easier for users of threatened species lists to understand how individual species were classified. *Categories of extinction risk run a full range* from "Least Concern" to "Critically Endangered." ***Criteria*** used are: A - Rapid Population Decline; B - Small Range; C - Small and Declining Population; D1 - Very Small Population; D2) - Very Small Range; and E - Results of a formal Population Viability Analysis. This article includes a criteria summary sheet that delineates ranges of extinction risk, factors that affect extinction risk, and numerical ranges of criteria that correspond to the full spectrum of extinction threat.

Johnson, Terry B. **State fish and game agency wildlife diversity program contacts.** Arizona Department of Wildlife (2000).

Jungius, H . **Criteria for the reintroduction of threatened species into parts of their former range. Threatened deer. Proceedings of a working meeting of the Deer Specialist Group of the Survival Services Commission.** International Union for Conservation of Nature and Natural Resources, Morges, Switzerland [434pp]: 342-352 (1978). Jungius describes a few ecological disasters resulting from the introduction of non-native deer. He does note a few success, and in the case of the fallow deer native to Iran and Turkey, establishment of a central European population may prevent extinction of this species. His "criteria" for reintroducing a depleted or extirpated species are very general. He advocates collecting and incorporating full life history and other biological data, making an assessment of adequate habitat area (including summer and winter range), use of enclosures prior to release (as used with elk in Wisconsin), addressing health and genetic diversity concerns, providing naturally balanced age and sex ratios in the release population, adherence to CITES and other regulations, and tagging or collaring for follow-up tracking and monitoring. He notes there were at least ten species of deer world-wide that were candidates then for reintroduction due there perilous conservation status. [Available via UW Steenbock Library]

Kattan, G.H. **Rarity and vulnerability: The birds of the Cordillera Central of Colombia**. *Conservation Biology* 6(1):64-70 (1992). The rarity of an organism is widely accepted as a good predictor of vulnerability, but rarity has been interpreted in a variety of ways, Rabinowitz et al. (1986) defined three dimensions of rarity for an analysis of the flora of the British Isles (UK) geographic distribution, habitat specificity, and local population size. They found the three factors to be independent, that is, each factor provides information not provided by the other two. In this paper, the method of Rabinowitz et al. is used to analyze the vulnerability of the cloud forest avifauna of the Cordillera Central of Colombia. The method is extended by assigning a vulnerability index to each form of rarity and analyzing its taxonomic and ecological correlates. I found that the three factors are not independent. Species with wide geographic distribution tend to have broad habitat specificity and high population densities. One third of the species have low population density, and most of these have restricted habitat specificity and narrow geographic ranges. Forty-five percent of the birds in this sample are highly vulnerable because they have narrow distributions and require forest habitats. The taxonomic and ecological analyses reveal that some groups of species are particularly vulnerable. Among insectivorous birds, woodcreepers, spinetails, and antbirds seen to be very vulnerable because they depend on forest habitats. Raptors show no clear pattern, but for frugivores a clear pattern emerges. Some families (e.g., parrots, cotingas), seem to be consistently vulnerable, independent of body size. Tanagers show a significant correlation between body size and vulnerability. An analysis of local vulnerability (determined by habitat specificity and population size, regardless of distribution) reveals that frugivorous birds restricted habitat specificity are significantly larger. Similar findings have been reported by other studies. The three-dimensional classification of rarity used in this study provides a rapid, albeit preliminary, approach to identifying vulnerable species. To develop management practices adapted to each particular case, careful analysis of life history traits and detailed population and community studies are required. [Full @ DNR GEF2 LB]

Kirkland, Gordon L., et al. **Survey of the statuses of the mammals of Pennsylvania.** *Journal of the Pennsylvania Academy of Science* 64(1):33-45 (1990). Kirkland and his team evaluated the conservation status of 70 taxa of native and introduced mammal, using the Virginia "BOVA Project" system. This scoring system incorporates data on population status, habitat, threats, biological characteristics, and taxonomy. Kirkland used a maximum species score of 100, rather than the 1000 used in Virginia.

Based on the score provided by this system and a review by this study team, species were assigned a status ranging from "Secure" to "Endangered." These species status classifications were then compared to those assigned to species under a 1985 study. The major difference between these two status classification systems was that the 1990 modified Virginia system eliminated a "Status Undetermined" classification from all but two of 16 species given that classification in 1985. This was due to the collection of additional information on most of these species, stricter definitions of the status categories than were used in 1985, and the author's inclination "to restrict the use of Status Undetermined to taxa about which there is a genuine question as to their status in Pennsylvania.

Kirsch, Eileen and John G. Sidle. **Status of the interior population of least tern.** *Journal of Wildlife Management* 63(2):470-483 (1999). The interior population of least tern was listed in 1985 and is under a recovery plan. The plan calls for meeting ***minimum population goals*** in number of local areas and an overall population goal of 7,000 individuals for at least ten years. The plan also calls for a ***minimum average fledge success rate*** of 0.51 fledglings per pair. Population data from on-the-ground nest surveys gathered at peak breeding period was considered valid, but not counts from fixed-wing aircraft, which tend to be under-counts. Data is compiled and evaluated at three scales: 1) local river segment or reservoir (there are 37), 2) major drainage basin (there are 3), and 3) the entire population. Even though the *total* population now exceeds the recovery goal, numerous local populations and two major drainage populations have not met the recovery goal.

Koch, S. O., S. L. Chown, et al. **Conservation strategies for poorly surveyed taxa: A dung beetle (Coleoptera, Scarabaeidae) case study from southern Africa.** *Journal of Insect Conservation*. [print] 4(1): 45-56 (March, 2000). Despite being the focus of an international research effort spanning decades, the spatial distribution of southern African scarab beetles remains poorly documented. As well as reinforcing the magnitude of the challenge facing biodiversity scientists, this raises real concerns about best practice conservation strategies in the absence of detailed distribution information. However, dung beetles appear to be well represented in established conservation areas. This apparent contradiction could be ascribed to anthropogenic transformation, successful conservation efforts, the presence of dung generalists and reserve-biased or mesic-biased dung beetle collection efforts.

Koch suggests that all of the above contribute to the observed pattern to varying degrees. The implications of selecting areas that are either rich in species, contain rare species or contain taxonomically distinct species from a group whose taxonomy is well known but for which inadequate distribution data exist are explored. Best practice, in the face of inadequate data, appears to revolve around a subtle interplay between advantages and disadvantages associated with data interpolation techniques, reserve selection algorithms that use criteria more robust than database rarity (such as taxonomic distinctiveness) and the long-term economic costs of proceeding with the data at hand versus investing in biological surveys.

Kushlan, J.A. **Conservation and management of the American crocodile.** *Environmental Management* 12(6):777-790 (1988). The American crocodile is a rare and endangered species, the range of which has contracted to disjunct locations such as Hispaniola, Jamaica, Cuba, Panama and southern Florida. In an attempt to determine what factors might be limiting population growth, an extensive collaborative research program was conducted in 1978-82 in southern Florida. Limiting factors explicitly studied included climate, hurricanes, population dispersion, nesting habitat, fertility, predation, nest chamber environment, juvenile survivorship, artificial mortality, disturbance, and environmental contamination. No single natural factor limits the population, although in concert various factors result in low adult recruitment rates. Such natural limitations explain the natural rarity of this tropical species at the temperate limits of its range. Two artificial sources of mortality are death of adults on roads and the flooding of nests by high groundwater tables. These sources of mortality are potentially controllable by the appropriate management agencies. Active management, by such means as protection of individuals, habitat preservation and enhancement, nest site protection, and captive breeding, is also appropriate for assuring the survival of a rare species. The American crocodile has survived in southern Florida in face of extensive human occupancy of parts of its former nesting habitat, demonstrating the resilience of a threatened species. This case history illustrates the efficacy of conducting research aimed at testing specific management hypotheses, the importance of considering biographical constraints limiting population status in peripheral populations, the need for active management of rare species, and the role of multiple reserves in a conservation and management strategy.

Landry, Judith L. **A rating system for threatened and endangered species of wildlife.** *New York Fish and Game Journal* 26:11-21 (1979).

Lange-Bertalot, Horst. **A first "red list" of endangered taxa in the diatom flora of Germany and of Central Europe: Interpretation and comparison.** IN: Mayama, S. et al., Proceedings of the Fourteenth International Diatom Symposium (Tokyo, Japan, September 2-8, 1996): 345-351. Koeltz Scientific Publishers, Champaign, Illinois, 1999.

Leon-Cortes, Jorge L, et al. **The distribution and decline of a widespread butterfly Lycaena phlaeas in a pastoral landscape.** *Ecological Entomology* [print] 25(3): 285-294 (August, 2000). Ecological specialists are often regarded as most likely to be threatened by anthropogenic habitat changes but few relevant data are available on changes in the status of widespread species. Grid square distribution maps have been used widely to measure rates of decline and target conservation resources but it is known that coarse grain mapping is not appropriate to identify declines in widespread species that initially contain numerous local populations per grid cell. Changes in the status of widespread species need to be quantified. Present-day habitat associations, determined from over 2000 transect counts, combined with data on historical and present-day habitat distributions, reveal that the area of occupancy and population-level rate of decline of the Small Copper butterfly Lycaena phlaeas is likely to have been of the order of 92 and 89% respectively, in 35 km2 of North Wales. Similar data on the species' major host plants Rumex acetosa and R. acetosella indicate possible declines in area occupied of 48 and 91%. If a 1-km2 grid was applied to the landscape, and if L. phlaeas, R. acetosa, and R. acetosella had occupied all 1-km2 cells in the study area in 1901 (non-limestone cells for R. acetosella only), their declines would only have been recorded as 15, 9, and 35% respectively. 4. Many declining ecological specialists are threatened with extinction because of their initial rarity. At a population level, however, they may or may not be declining faster than less specialised species. The results presented here illustrate that some widespread species may have declined as much as many of Britain's rarities.

Lim, Leong. **The 10 lords of the universe - the New South Wales TSC Act's scientific committee.** *Pacific Conservation Biology* 3(1):4-12 (Feb. 1997). New South Wales is implementing its Endangered Species Conservation Act. A Scientific Committee of 10 scientists, created under the Act, makes listing decisions. Lim questions whether this body has authority under the NSW constitution to engage in this role. He notes that for species and communities listed so far, biological information, mapping and other data is inadequate. This makes it impossible (for consultants, the reader can assume) to conduct the "8-Point Test" required under the 1979 NSW Environmental Planning and Assessment Act. Lim questions in particular the proper way to list edge-of-range species, and proposes that the IUCN classification of "Insufficiently Known" be used instead of current emergency designations as "Provisionally Endangered or Threatened."

Linder, H.P. **Setting conservation priorities: the importance of endemism and phylogeny in the southern African orchid genus Herschelia**. *Conservation Biology* 9 (3):585-595 (1995). The southern and south-central African terrestrial orchid genus Herschelia contains several rare and endangered species. The distribution patterns of the species were assessed and classified into the Rabinowitz rarity categories. The degree of rarity was correlated with habitat types and with the phylogenetic history. Of the 16 species recognized, two are too poorly known to be assessed further. Of the remainder, three species are shown to be "metaspecies", which can be interpreted as being ancestral to five narrowly endemic species. A strong correlation between the age of the habitats, the relative age of the species, and the degree of rarity was demonstrated. I review the phylogenetic criteria for prioritizing species for conservation, and I develop a new criterion, the ability of a species to speciate into "new" environments. This suggests that it might be better to conserve metaspecies, which are found in the mountains, rather than the autapomorphic daughter species, which are found in the ephemeral habitats of the lowlands. [Full @ DNR GEF2 LB]

Lovett, Jon C et al. **Patterns of plant diversity in Africa south of the Sahara and their implications for conservation management.** *Biodiversity and Conservation* 9(1):37-46 (Jan., 2000) Plant species richness and range-size rarity in Africa south of the Sahara is concentrated in centres of plant diversity and endemism. Distribution patterns of plants mapped in the Distributiones Plantarum Africanum series and selected taxonomic monographs are analysed using the computer programme WORLDMAP. The plants are divided into four groups: herbaceous geophytes, mesophytic herbs, light-demanding shrubs and woody genera. Each group has peaks of species richness and range-size rarity at locations different to the other groups. Herbaceous geophytes and mesophytic herbs have their peaks of species richness and range-size rarity in the same location, the western Cape for geophytes and the Crystal Mountain for mesophytic herbs, whereas light-demanding shrubs and woody genera have peaks in different places. The results are discussed in relation to possible factors determining species richness and endemism and their likely conservation significance.

Mace, Georgina M. and R. Lande. **Assessing extinction threats: toward a reevaluation of IUCN threatened species categories.** *Conservation Biology* 5(2):148-157 (1991). Definitions of IUCN threat categories as of 1991 were too subjective, these authors say. They propose a system that is 1) simple, with few categories; 2) flexible in its data requirements for assessing extinction probabilities, 3) flexible regarding to which population units it can be applied, 4) users clearer terminology in describing risk, 5) based on sound, objective science, but leaves room to factor in uncertainty, and 6) based on a finite time scale. The system they propose has the following categories of threat: a) "Critical," 50%

extinction probability within the longer of 5 years or two generations; b) "Endangered," 20% probability of extinction within the longer of 20 years or 10 generations; and c) "Vulnerable," 10% probability of extinction within 100 years. The authors include additional population and trend-based criteria under each classification. They acknowledge that their criteria may be most appropriate for "large vertebrates." *Article contains numerous PVA and other population analysis references.*

Maes, Dirk and C. Van Swaay. **A new methodology for compiling national Red Lists applied to butterflies (Lepidoptera, Rhopalocera) in Flanders (N-Belgium) and the Netherlands.** *Journal of Insect Conservation* 1(2):113-124 (June, 1997). The compilation of the Red Lists of butterflies in Flanders and the Netherlands was based on two criteria: a trend criterion (degree of decline) and a rarity criterion (actual distribution area). However, due to the large difference in mapping intensity in the two compared periods, a straightforward comparison of the number of grid cells in which each species was recorded, appeared inappropriate. To correct for mapping intensity Maes used reference species that are homogeneously distributed over the country, that have always been fairly common and that did not fluctuate in abundance too much during this century. For all resident species a relative presence in two compared periods was calculated, using the average number of grid cells in which these reference species were recorded as a correction factor. The use of a standardized method and well-defined quantitative criteria makes national Red Lists more objective and easier to re-evaluate in the future and facilitates the comparison of Red Lists among countries and among different organisms. The technique applied to correct for mapping intensity could be useful to other organisms when there is a large difference in mapping intensity between two periods.

Mahan, Carolyn G., et al. **The status of the northern flying squirrel (Glaucomys sabrinus) in Pennsylvania.** *Journal of the Pennsylvania Academy of Science* 73(1):15-21 (1999). Researchers used the following to evaluate the status of the flying squirrel: historic data from museum records and published literature; current distribution data from trapping and recent literature; and a ranking system adapted from that of Virginia. They concluded the flying squirrel "may be in severe decline" due to loss and fragmentation of old-growth forest, and that the species should be listed as "threatened" in the state. The research team recommends specific research needs and conservation actions to prevent increasing this species' risk of extirpation.

Master, et al. **Rivers of Life.** The Nature Conservancy (1998). [http://consci.tnc.org/library/pubs/rivers/rivers.pdf]

McIntyre, S. **Risks associated with setting of conservation priorities from rare plant species lists.** *Biological Conservation* 60:31-37 (1991). Difficulties with both defining rarity and documenting plant distributions can lead to bias in the lists. For example, in New South Wales, using an IUCN-based classification, an analysis showed that species of restricted range or habitat dominated the rare plant list. Criteria used to develop the list may favor these plants over species with widespread but declining ranges. Lack of information on range trends may cause the latter group to be underestimated. Conservation priorities developed from this list may lead to a skewed perception of conservation priorities, so conservationists must beware of such biases.

Meier, A.J.et al. **Criteria for the introduction of the St. Croix ground lizard.** *New York State Museum Bulletin* No. 471: 154-156 (1990).

Melzer, Alistair, et al. **Overview, critical assessment, and conservation implications of koala distribution and abundance**. *Conservation Biology* 14 (3):619-628 (June, 2000). Regional and national surveys provide a broadscale description of the koala's present distribution in Australia. A detailed understanding of its distribution is precluded, however, by past and continuing land clearing across large parts of the koala's range. Koala population density increased in some regions during the late 1800s and then declined dramatically in the early 1900s. The decline was associated with habitat loss, hunting, disease, fire, and drought. Declines are continuing in Queensland and New South Wales. In contrast, dense koala populations in habitat isolates in Victoria and South Australia are managed to reduce population size and browse damage. Current understanding of koala distribution and abundance suggests that the species does not meet ***Australian criteria as endangered or vulnerable fauna***. Its conservation status needs to be reviewed, however, in light of the extensive land clearing in New South Wales and Queensland since the last (1980s) broadscale surveys. Consequently, Melzer recommends that broadacre clearing be curtailed in New South Wales and Queensland and that regular, comprehensive, standardized, national koala surveys be undertaken. Given the fragmentation of koala habitat and regional differences in the status of the koala, Melzer further recommends that studies on regional variation in the koala be intensified and that koala ecology in fragmented and naturally restricted habitats be developed. More generally, the National Koala Conservation Strategy should be implemented. *(See Environment Australia.)*

Menges, E.S. **Evaluating extinction risks in plant populations.** Pp. 49-65 in: P.L. Fiedler, and P.M. Kareiva, eds. *Conservation Biology: For the Coming Decade*. Second edition. Chapman & Hall/ITP. New York, NY (1998).

Menges, E.S. **The application of minimum viable population theory to plants.** Pp. 45-61 in: D.A. Falk and K.E. Holsinger, eds. *Genetics and Conservation of Rare Plants*, Oxford University Press. New York, NY (1991).

Menhinick, E. F. **A numerical method for ranking of endangered species and its application to North Carolina freshwater fishes**. *Journal of the Elisha Mitchell Scientific Society* 102(2): 54-86 (1986 [1987]). Menhinick proposes a numerical method for ranking aquatic species' susceptibility to extinction that relies heavily upon distributional information. He believes this solves problems related to lack of life history data and is an improvement upon other methods he views as too subjective. Specific variables scored include 1) number of sites a species is found along a stream, 2) number of streams or lakes a species occurs in, and 3) relative size of total range. These criteria include proximity factors related to vulnerability, weighting factors related to size of streams, lakes and reservoirs, as well as vulnerability to pollution, and an uncertainty factor reflecting lack of survey effort. This method could be expanded with species values from different states to yield regional or national values. This method should also be applicable to other animal species that have "limited distributional powers." He applied his proposed ranking system upon North Carolina freshwater fish species, to compare the results with a 1977 exercise in categorizing threatened species This application led to classifying most of 68 species in risk categories different from their present (based on the1977 analysis) classification.

Menon, A.G.K. **Criteria for determining the status of threatened categories of Indian freshwater fishes.** IN: Dehadrai, P.V., et al. [Eds], Threatened fishes of India: proceedings of the National Seminar on Endangered Fishes of India held at National Bureau of Fish Genetic Resources, Allahabad, 25 and 26 April, 1992. Nature Conservators, Muzaffarnagar (1994).

Metcalfe-Smith, Janice, et al**. Selection of candidate species of freshwater mussels (Bivalvia: Unionidae) to the considered for national status designation by COSEWIC**. *Canadian Field Naturalist*, 112 (3):425-440 (July-Sept., 1998). Severe declines in the diversity and abundance of freshwater mussels have been documented over the past century in the United States. Although similar trends might be expected in Canada, mussels (and in fact invertebrates in general) have received little attention to date. This imbalance was first addressed in 1994 when the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) expanded its mandate to include invertebrates. A Mollusk Working Group (MWG) was formed in 1995 to determine the status of Canadian mollusk species at risk. The first task of the MWG was to prepare a preliminary list of candidate species to be considered for national status designation by COSEWIC. In this paper, a risk factor analysis approach was used to identify the most imperiled species of freshwater mussels in the Canadian waters of the lower Great Lakes drainage basin. This region was chosen because it historically supported the most diverse and unique mussel fauna in Canada. Species were evaluated on the basis of their current conservation status ranks, distribution patterns, vulnerability to zebra mussels, host specificity and evidence of decline over time in the study area. A database of over 4100 occurrence records for 40 species collected between 1860 and 1996 was compiled for this purpose. Results showed that nearly 40% of these species would likely fall into the Extirpated, Endangered or Threatened risk categories as defined by COSEWIC. A prioritized list of nine species was proposed for national status designation by COSEWIC.

Meylan, Anne B. **Status justification for listing the hawksbill turtle (Eretmochelys imbricata) as critically endangered on the 1996 IUCN Red List of threatened animals.** Chelonian *Conservation and Biology* 3(2):200-224 (April, 1999). Previously abundant, hawksbills have declined precipitously throughout their extensive range. Three generations of population decline have occurred due to intensified harvest by humans over the past 100 years, and more recently, by their association with declining coral reefs. Population declines are forecast to continue over the next three generations. Most populations are declining, depleted, or remnants of formerly much larger aggregations. International trade remains the most serious threat. IUCN criteria regarding population declines of 80% or more over last 10 years or three generations, whichever is longer, was the basis of this listing.

Michaels, Karyl and Louise Mendel. **Carabid beetle and vegetation associations in the Tasmanian Eastern Tiers: Implications for conservation.** *Pacific Conservation Biology* 4(3): 240-249 (1998). The distribution and abundance of the carabid beetle fauna of selected grassy ecosystems, wet and dry sclerophyll forests, and wet heaths in the Eastern Tiers, Tasmania was examined using pitfall traps. The conservation values of the sites were assessed by applying evaluation criteria typically used for vegetation (i.e., representativeness, typicalness, diversity and rarity) to both the carabid fauna data and the vegetation data. Sites of high conservation value for carabids and vegetation were identified and compared. Sites that ranked highest in terms of the carabid fauna on all conservation criteria were not the sites that ranked highest based on the vegetation. Classification of sites produced different results depending on whether plant or carabid data were used. Conservation based solely on vegetation attributes will therefore not necessarily conserve a rich and/or representative carabid fauna. If the objective to conserve a representative range of all biota is to be met, the use of additional taxa such as carabids in conservation assessments is desirable.

Milsap. Brian A., et al. **Setting priorities for the conservation of fish and wildlife species in Florida.** *Wildlife Monographs*, 111, 1-57, July, 1990. Florida has developed a numerical scoring system to establish priorities for vertebrate species and subspecies conservation. This system uses seven biological variables: population size, population trend, range size, distribution trend, population concentration, reproductive potential for recovery, and ecological specialization. There are four action scores (that reflect the current state of knowledge about the taxon): distribution, population trend, limiting factors affecting populations, and ongoing conservation management. Five supplemental variables are used to sort and categorize taxa to "answer specific biological and political questions": system significance, percent of total taxon range that occurs in Florida, trend of Florida's population of that taxa, period of occurrence in Florida, and harvest data for Florida.

Using this system enabled resource managers to determine which orders had the greatest survey and monitoring needs, and which geographic regions and ecological communities have the highest concentrations of taxa with the greatest need for conservation action.

Morris, William, et al. **A practical handbook for population viability analysis.** The Nature Conservancy, April, 1999, 80 pp. The authors review a range of practicable alternative methods of quantitatively determining the probable future status of plant and animal populations at the end of a given time period. The methods are somewhat tailored to the nature of the data that is available. The authors include guidelines on determining whether enough data exists to enable researchers to conduct a valid viability analysis.

Munro, W.T. **COSEWIC, and B.C. bird species designated by COSEWIC.** *British Columbia Birds* 1(1): 2-8 (December 1991):1993

National Endangered Species Act Reform Coalition. **How has the ESA impacted people?** Undated Web presentation (www.nesarc.org/esamain.htm), (after July, 1997). NESARC offers out-of-context examples of real of imagined economic harm resulting from ESA implementation. The eight examples given highlight the need to develop habitat conservation plans using thorough documentation and the best available science information on the species under management. This critique implies the questions: "Is *potential* ER habitat deserving of ESA protection?" Are human-built landscape features, such as flood control levees, that may provide future habitat subject to the ESA, if biologists can show that the floodplain disruption caused by the structures is supplanting useable habitat that would have otherwise existed?" The examples underscore the problems inherent in a lack of communication among ER managers, local government planners and elected bodies, and others. They highlight the need for land use planning by broad, inclusionary groups supplied with a full scope of natural resource facts.

National Endangered Species Act Reform Coalition. **NESARC's principles for ESA reform in the 106th Congress.** Undated Web presentation (www.nesarc.org/ esamain.htm). NESARC is a coalition composed primarily of large-volume users of water from public storage projects in the western U.S. They proposed a number of "reforms" to the federal ESA, including providing incentives, including "regulatory certainty," so private land owners to voluntarily participate in habitat conservation rather than destruction; stakeholder participation in conservation decisions; financial compensation to landowners whose land use changes may be restricted by ESA; adopting the lowest-cost recovery plan suitable; adopting minimum scientific standards; public funding of the cost burdens to landowners imposed by ESA; and legislatively recognizing the "primacy of state water law."

Navarrete-Heredia, Jose L. **Is the apparent rarity of Liatongus monstrosus (Bates) (Coleoptera: Scarabaeidae) real or an artifact of collecting?** *Coleopterists Bulletin* 50(3): 216-220 (1996). Liatongus monstrosus (Bates), previously considered as a rare or even an extinct species, was recently collected from localities in Jalisco State, Mexico. The information provided in this paper increases the previously known distribution and also the importance to develop strategies to preserve it and to determine the current state of this threatened species. The author speculates that this species has been deemed rare in large part due to lack of concerted attempts to find it.

Nebraska Game and Parks Commission - Natural Heritage Program. **Recommendations for revisions to the state list of threatened and endangered species - appendix A - criteria for evaluating species.** Unpublished Web manuscript: http://bighorn.ngpc.state.ne.us/TandE/Appendix_A.htm (October, 1999). Nebraska Revised Statutes secs. 37-430 to -438 ("Nongame and Endangered Species Conservation Act") is implemented in part by four factors encompassing ten listing criteria. The factors are Population Abundance and Trend; Importance of Nebraska Populations; Threats; and Species Resilience and Ecological Specificity. The criteria are evaluated by means of a point/ranking system.

New, T.R. **Limits to species focusing in insect conservation.** *Annals of the Entomological Society of America* 92(6):853-860 (Nov. 1999). There are few experts familiar with many of the insect taxonomic groups. Expert panel consensus on the conservation status of various species is therefore difficult to achieve, for it may not be possible to assemble a panel in the first place. Many listing proposals are neither definitive nor comprehensive, in large part because species of conservation concern are difficult to study. Premature listing may steal attention and resources from species that truly are in need of conservation action. Lack of sufficient data to meet the needs of IUCN criteria, plus the perception that little funding would be available to promote recovery of listed insects, stifles development of listing proposals. Trans-national species are often subject to conflicting regulation that may not acknowledge secure status in adjacent nations. New Zealand has 5 major and 16 sub-criteria for determining threatened species recovery priorities while the SPECS program (Species of European Conservation Concern) uses 4 criteria.

An integrated, broader view can overcome the expense of species-level insect conservation. Listing charismatic "flagship" (indicator) insect species, such as butterflies, helps gain public support, define habitat conservation priorities, and focus conservation actions. Insects can best be conserved by a process similar to that of the Centers of Plant Diversity Project, which identifies areas to conserve that would "safeguard the greatest numbers of plant species."

Nicholopoulos, Joy. **The endangered species listing program.** *Endangered Species Bulletin* xxiv(6):6-16 (Nov./Dec. 1999). Listing of species for federal protection occurs either by petition submitted by "any interested person," or through a "candidate assessment process" conducted by U.S. Fish and Wildlife Service staff. Five factors will determine whether a species will be list: 1) habitat condition and trends; 2) excessive taking by humans; 3) excessive disease or predation losses; 4) adequacy of existing regulatory protections; and 5) other factors that affect the species' continued existence. Proposals must contain species life history and status information, threats to the species, critical habitat designation, a survey of potential conservation measures, and prohibited and permitted actions resulting from listing. Proposals are reviewed within the F&WLS, and then are independently peer reviewed. Approved listing proposals are published in the Federal Register and a F&WLS provides a public review period. The F&WLS Director may grant final approval, after which the U.S. Congress may review the listing, and presumably modify or block its provisions.

Noss, Reed F. et al. **Endangered ecosystems in the United States: a preliminary assessment of loss and degradation.** USGS Biological Resources Division - website document (www.biology.usgs.gov/pubs/ecosys.htm), 83 pp.. (1995 or later.) Noss relied on measurements of decline and threat to compile a review of ecosystem loss and degradation in the United States. Hs report classifies ecosystem status in terms of percent decline since the initiation of European settlement in what is now the U.S. These ecosystem classifications are: critically endangered (.98% decline); endangered (85-98% decline); and threatened (70-84% decline). Wing to a lack of reliable land cover maps for all states, Noss based his evaluations on information provided by state natural heritage program staff and similar sources.

Partners in Flight. **Partners in Flight species prioritization process.** Unpub. report. (Oct, 2000). Published reviews (see Beissinger et al., 2000 and Carter et al. 2000) included suggested improvements in the Partners in Flight criteria for ranking bird species in a priority order reflecting need for conservation action. PIF has revised their ranking system to address some of the issues identified by the reviewing committee. Changes include: giving a higher priority to unknown factors; revising the threshold for significant population decline; revising the method for rating distribution within range; relying on Christmas Bird Count (CBC) data equally with Breeding Bird Survey (BBS) data; factoring in distribution of Old World birds that also occur in the Western Hemisphere to avoid ranking introduced species as rare; reconciling the U.S. and Canadian means of weighing habitat importance to a species' conservation; revising the means of assigning threats; and using absolute abundance rather than relative abundance. Further, PIF decided to continue using all valid historical data, not just that from the past 30 years.

Poulsen-Bent,Otto and N. Krabbe. **Avian rarity in ten cloud-forest communities in the Andes of Ecuador: Implications for conservation.** *Biodiversity and Conservation* 6 (10):1365-1375 (1997). Avian rarity was investigated in ten high-altitude cloud forests in the Andes of Ecuador. Data on species compositions and abundances were obtained by a fully standardized method (standardization for area, altitude, habitat, effort and seasonality). The rare species were isolated from rank-abundance plots on the basis of the quartile definition of rarity. A positive correlation between mean abundances of species and number of sites occupied suggests that high-altitude bird species classified rare by abundance generally can also be classified rare by range. However, it is necessary to be cautious using this result in ranking conservation priorities since the generality is not obeyed by all species. Within the two abundance classes (contains one and two individuals, respectively) represented among the rare species, the one-individual class had significantly more species than the two-individual class. The quantitative rarity of taxa and ecological groupings produced similar results for all sites, while pair-wise similarity of rare species between sites was very low. Together with the difficulty of identifying species that are truly rare by abundance, these results imply that sites selected for conservation preferably should be based upon a qualitative evaluation of lists of species referred to vulnerability categories such as endemic, restricted-range, CITES or IUCN threatened/near-threatened species. However, it is necessary also to incorporate other aspects of biodiversity to cover a full range of biotic diversity.

Powles, Howard, et al. **Assessing and protecting endangered marine species**. *ICES-Journal of Marine Science*, 57(3):669-676 (June, 2000). Documented extinctions of marine and anadromous species are rare, but extinction of species and extirpation of major populations have occurred - there are cases of near extinction - and there may be undocumented

extinctions. Factors associated with known extinctions and near extinctions include specific life-history characteristics (e.g. low fecundity, high age at maturity, low mobility), habitat degradation, high value and high susceptibility to harvesting, ecological specialization. Harvesting mortality, targeted or incidental, is implicated in some known extinctions or near extinctions, and may act synergistically with other threats. Criteria to make assessments of risk of extinction more consistent have been developed, but given the limited experience to date with extinctions in the marine environment there have been questions about applying these to some marine species. The wide range of life history characteristics in marine species suggests that a range of approaches to assessing extinction risk will be needed. Protocols for defining significant population units are also required since protection of populations is part of protecting endangered species. Keeping species and populations well away from endangered status should be the main goal of conservation programs. Implementation of precautionary conservation frameworks for exploited species could be a sound approach to preventing "endangerment".

Ralls, Katerine, et al. **Developing a criterion for delisting the southern sea otter under the U.S. Endangered Species Act.** *Conservation Biology* 10(6):1528-1537. A review of recovery plans developed under the ESA lead to a conclusion that species recovery goals are generally too low. The numbers agreed to by the recovery teams can often not be supported by sound scientific evaluation. Seventy three percent of recovery plans for vertebrates "set population goals so low that the species would remain in a vulnerable state even if recovery goals were achieved." The authors imply that this may be due in part to the fact that, on average, recovery teams are composed of 77% state and federal agency employees, who may be under outside pressure to minimize recovery populations.

The authors describe the population data available and the process of developing a recovery plan for the southern sea otter. They needed to produce a scientifically defensible population number to use as a final recovery goal. This was doubly important in light of the fact that USFWS added a number of "stakeholders" who acted as "technical consultants" to the team. A majority of these represented the oil industry and commercial harvesters of the otters' principal large invertebrate food items. An extensive literature review led the team to choose 500 as the minimum "effective population size" (Ne) necessary to guard against catastrophic population crashes. They computed the actual number of individuals to achieve Ne to be 1850 (this number later became the "Threatened" status threshold). Then, they modeled the likely impacts of the greatest threat to otter populations - a range of potential oil spills of varied volume, frequency and location. The team reached a consensus that roughly 800 otters would die in a 90-percentile worst-cast spill. Adding this to Ne yielded 2650 as the minimum otter population size to require over three consecutive years before the otter could be delisted. After delisting, this population would still be protected and managed under a conservation plan required by the federal Marine Mammal Conservation Act.

Regarding composition of recovery (and presumably, listing) teams, the most important consideration *"is to appoint a recovery team that is both technically well qualified and unconstrained by pressures from management agencies."* The authors emphasize also that any guidelines or criteria used to (de)list species must be flexible to allow for dealing with specific situations.

RAMAS Software. **RAMAS RedList: Threatened species classification under uncertainty.** Ramas Software, 2000. RAMAS Red List (computer modeling software) implements IUCN threatened species criteria. The IUCN rules are based on information about such characteristics as number and distribution of individuals, fluctuations and decline in abundance and distribution, and risk of extinction. These characteristics are used as input

data; the output is a classification into one of the categories, such as Critically Endangered, Endangered, Vulnerable, or Lower Risk.

RAMAS Red List implements the rules as used by the IUCN, but also allows *explicitly incorporating uncertainties* in the input data. Input data such as the number of mature individuals can be specified either as a number, or as a range of numbers, or a range of numbers plus a best estimate. RAMAS Red List propagates these uncertainties. Depending on the uncertainties, the resulting classification can be a single category, or a range of plausible categories. The RAMAS Ecological & Environmental Software web site includes a product review by Don Waller, UW-Madison Dept. of Botany.

Reed, J.M. **The dynamics of red-cockaded woodpecker rarity and conservation.** Sveriges Lantbruksuniversitet Institutionen for Viltekologi Rapport No. 17: 37-56 (1990).

Ripa, Dean. **Degenerated science: a critique of proposed new laws protecting venomous snakes in North Carolina, and a request for science and factuality in the evaluation of animals for the endangered species act.** *Bull Chicago Herp. Soc.* 35(5):93-134, 2000. Mr. Ripa criticizes a North Carolina state Amphibian and Reptile Scientific Council report calling for a ban on collecting several species of venomous snakes native to North Carolina. He argues there is no valid scientific data supporting assertions that these snakes are scarce and that this scarcity is caused by herptile collectors. He provides an analysis, itself unsupported by field data, that indicates these snakes are in fact abundant. He relies upon the fact that many of these snakes are still caught annually for the commercial trade, that thousands appear to be killed annually by motor vehicle drivers, and that the number of snake bite cases in the state remains higher than in any other state. He argues that habitat protections, coupled with take quotas and restrictions on methods of take, similar to those used to manage wild turkeys and other game species, are best for the survival of the species in question and for accommodating the rights of landowners who are stewards of snake habitat.

Rolley, Robert E. et al. **Wisconsin's bobcat harvest management program.** Wisconsin Department of Natural Resources, Monona, WI. Unpublished report, August, 2000. In 1990, a citizen petition requested that DNR list the bobcat as threatened. DNR wildlife and research staff prepared an environmental analysis (EA) of its now 30-year-old program of managing bobcats by permitted take. This EA included a population status review. Staff completed this review by soliciting the opinion of a variety of scientific experts and conducting a careful review of data on harvest, reproductive rates, and age- and sex-structure of the population. The validity of the population trend review within this status report was upheld in state court. Ongoing management includes mandatory harvest registration, carcass analyses, harvester and agency questionnaires, snow-track surveys, and population modeling.

Rylands, A.B., et al. **A species list for the New World primates (Platyrrhini): distribution by country, endemism, and conservation status according to the Mace-Lande system.** *Neotropical Primates* 3(suppl.):113-160 (1995).

Sakamoto, M. **The present trend of CITES and new listing criteria.** Biological Sciences (Tokyo) 47(3):141-154 (Oct. 1995).

Sample, David and M Mossman. **Identifying bird species of management concern and priority habitats for Wisconsin.** *In* Managing Habitat for Grassland Birds, D. Sample and M. Mossman, Wisconsin DNR, 1997, pp. 20-44. The authors established criteria to determine which grassland-dependent species in Wisconsin have the "greatest need of management attention." They used 15 criteria, with 7 weighted more than the others. The weighted criteria applied to each species were: Abundance in Wisconsin relative to elsewhere in its range; Population trend in Wisconsin; Population trend in USFWS Region 3; Relationship of Wisconsin to the center of the range; Breeding season threats; Habitat specificity; and Minimum area requirements. The other criteria are: Global abundance; population trends (1) in the eastern U.S. and (2) across North America; Breeding ad winter range size; Breeding range trend; Benefits from current management; and Degree of knowledge of specie's life history and ecology. Both the Breeding Bird Survey and Partners in Flight data were consulted in using this ranking system.

Sanderson, William G. **The rarity of marine benthic species in Great Britain: development and application of assessment criteria.** *Aquatic Conservation* 6(4):245-256 (1996). One consideration in assessing the nature conservation importance of a site is the presence of 'rare' species. Sanderson discusses how pragmatic concepts of 'rarity' can be applied to the marine benthos in a national context for conservation and coastal zone management purpose. ***A means of assessing rarity, based on the total number of units of area where the species is known to occur within the 3-mile limit of British territorial waters***, has been developed. Using a uniform grid to record occurrences, Sanderson defines "nationally **rare**" as occurring in 8 or fewer (.5%) of the 1546 10 km x 10 km squares in the grid, within the 3-mile territorial limit. "Nationally **scarce**" means occurring in 9 to 55 (3.5%) of the total grid squares. Coastal marine species can therefore be assessed quantitatively using a consistent methodology comparable to terrestrial assessments in Britain. Application of the criteria has required the collation and analysis of data on a national scale and involved wide consultation. Examples are given of species considered to be nationally rare or scarce (using the technique). The way the information has been disseminated is described. The reasoning behind the work is discussed and some of the applications and limitations of the criteria and results are examined. Apparently this is the first time that rarity criteria have been developed for application in the marine benthos on a national scale.

Scott, J. Michael, et al. **Gap analysis: A geographic approach to protection of biological diversity.** *Wildlife Monographs* 0 (123):1-41 (1993). The conventional approach to maintaining biological diversity generally has been to proceed species by species and threat by threat. Scott suggests that piecemeal approaches are not adequate by themselves to address the accelerating extinction crisis and, furthermore, they contribute to an unpredictable ecological and economic environment. Scott describes a methodology called Gap Analysis, which identifies the gaps in representation of biological diversity (biodiversity) in areas managed exclusively or primarily for the long-term maintenance of populations of native species and natural ecosystems (hereinafter referred to as biodiversity management areas). Once identified, gaps are filled through new reserve acquisitions or designations, or through changes in management practices. The goal is to ensure that all ecosystems and areas rich in species diversity are represented adequately in biodiversity management areas. Scott believes this proactive strategy will eliminate the need to list many species as threatened or endangered in the future. Gap Analysis uses vegetation types and vertebrate and butterfly species (and/or other taxa, such as vascular plants, if adequate distributional data are available) as indicators of biodiversity.

Maps of existing vegetation are prepared from satellite imagery (LANDSAT) and other sources and entered into a geographic information system (GIS). Because entire states or

regions are mapped, the smallest area identified on vegetation maps is 100 ha. Vegetation maps are verified through field checks and examination of aerial photographs. Predicted species distributions are based on existing range maps and other distributional data, combined with information on the habitat affinities of each species. Distribution maps for individual species are overlaid in the GIS to produce maps of species richness, which can be created for any group of species of biological or political interest. An additional GIS layer of land ownership and management status allows identification of gaps in the representation of vegetation types and centers of species richness in biodiversity management areas through a comparison of the vegetation and species richness maps with ownership and management status maps. Underrepresented plant communities (e.g., present on only 1 or 2 biodiversity management areas or with a small total acreage primarily managed for biodiversity) also can be identified in this manner.

Realization of the full potential of Gap Analysis requires regional compatibility among state data bases and region-wide use of the data in resource management and planning. Gap Analysis is a powerful and efficient first step toward setting land management priorities. It provides focus, direction, and accountability for conservation efforts. Areas identified as important through Gap Analysis can then be examined more closely for their biological qualities and management needs. As a coarse-filter approach to conservation evaluation, Gap Analysis is not a panacea. Limitations related to minimum mapping unit size (where small habitat patches are missed), failure to distinguish among most seral stages, failure to indicate gradual ecotones, and other factors must be recognized so that Gap Analysis can be supplemented by more intensive inventories.

Seddon, M.B. **Red listing for mollusks: A tool for conservation?** *Journal of Conchology*, special publ. (2):27-44 (1998). There are over 2000 mollusks on the 1996 Red List of Globally Threatened animals, with 946 species falling into the 'higher risk' categories. This represents 20% of all the animals listed as Threatened. Most of the mollusks under threat are terrestrial or freshwater species, although there are some from marine environments. The lists also shows that since 1600 AD there have been 228 recorded molluscan extinctions. This apparent reduction in extinctions since the 1994 list is due to the change of definition of extinct, some of the species categorized as 'Extinct?' in 1994 are defined as Critically Endangered in the present list.

The new categories also list the source of threats of extinction and mollusks are most commonly under threat through: habitat loss (e.g. deforestation, canalization, dam creation schemes); alien species (either predators or competitors); habitat modification and lastly, of least significance is trade. The status of these endangered species is reviewed every three to four years, enabling changes in status to be identified. The last review demonstrated that there have been species which have become extinct in the last five years, in extreme cases moving from Near Threatened to Extinct. Other species have, as the result of conservation action, increased populations and now have a less threatened status.

At a regional level, the recent revisions of the Red Lists have had little impact on the species listed for regional and national legislation. In particular the European Union Habitats & Species Directive molluscan list is largely based on species viewed as 'at risk' in 1979. In some cases the 1996 Red Listing shows that these species are still at substantial risk, but in other cases further research has shown that the species are at lower risk, sometimes to a level where the taxa have been removed from recent Red Lists.

Shank, Christopher. **The Committee on the Status of Endangered Wildlife in Canada (COSEWIC): A 21-year retrospective.** *Canadian Field Naturalist* 113 (2): 318-341 (April-June, 1999). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) first designated risk status to Canadian species in 1978. Shank summarizes the

past 21 years of COSEWIC's existence by describing the past and current structure and function of the Committee, by analyzing the list of species that have been designated status, and by highlighting currently outstanding issues. COSEWIC is comprised of representatives from governments, national conservation organizations, and technical experts but operates at "arm's length" from its member institutions.

Designation of risk by COSEWIC carries no legal implications. COSEWIC maintains five non-quantitative "at-risk" categories (Extinct, Extirpated, Endangered, Threatened, Vulnerable). Two other categories (Not At Risk and Indeterminate) exist but do not appear on the list of Canadian Species At Risk. Designations are made at annual meetings based upon peer-reviewed status reports usually prepared under contract by independent experts. By 1998, COSEWIC had designated status to 447 species, subspecies and populations, 307 of which occur in the five at-risk categories. Analysis of the COSEWIC list of Canadian Species At Risk suggests that its composition is influenced by pragmatic matters such as existence of scientific knowledge, availability of knowledgeable authors, funding for report preparation, and differential public attitudes towards various taxa. Accordingly, the list's primary utility is at the level of the individual species rather than as a metric of biodiversity loss in Canada.

Under proposed federal endangered species legislation, COSEWIC's role is expected to be assumed by a new entity. This "new COSEWIC" will be challenged to address several significant issues: treatment of species with ranges barely extending into Canada (peripherals), ***development of quantitative guidelines*** for at-risk categories, and the definition of nationally significant populations eligible for designation.

Sharratt, Norma J., et al. **The invertebrate fauna of the sandstone caves of the Cape Peninsula (South Africa): Patterns of endemism and conservation priorities**. *Biodiversity and Conservation* 9(1): 107-143 (Jan., 2000). The temperate sandstone caves of the Cape Peninsula, South Africa, support 85 cavernicolous invertebrate species across six phyla. Six of these, including two blind and depigmented species of insects (Dermaptera) and spiders (Araneae: Hahniidae) were previously unknown. Twenty-one species are endemic to the Peninsula. Thirteen of these are presumed troglobitic Gondwanan relicts, including highly specialized, phylogenetically unique, rare species with restricted distributions and specialized habitat requirements. According to the criteria listed in the IUCN Red List Categories (1994), the onychophoran Peripatopsis alba and crustacean Spelaeogriphus lepidops should be considered Critically Endangered, their extents of occurrence being less than 100 km2. Furthermore, Data Deficient species, such as the freshwater shrimps Protojanira leleupi and Paramelita barnardi, the spider Hahnia sp. nov., the earwig Dermaptera sp.nov. and the centipede Cryptops stupendus, are likely to be additional Critically Endangered species on account of their exceptional rarity or restricted distributions. The remaining endemic cavernicoles are considered Endangered on account of their limited distributions (extent of occurrence <5000 km2). Therefore, conservation considerations are clearly an urgent priority and appropriate recommendations are provided. Management-orientated research, long-term population monitoring and the conservation of pseudokarst areas, are urgent requirements for the conservation of these rare and threatened evolutionary relicts in their isolated island-like habitats.

Shepard, Bradley B. et al. **Status and risk of extinction for Westslope cutthroat trout in the upper Missouri River basin, Montana.** *North American Journal of Fisheries Management* 17(4):1158-1172 (1997). Westslope cutthroat trout in Montana now occupy less than 5% of their historical range in the upper Missouri River basin. A population viability assessment model used life history and population data to determine the extinction risk of 144 known populations. Risk assessment parameters used in the Bayesian model were: spawning habitat

availability; eggs/female; incubation success; maximum fry survival; fry capacity; juvenile survival; adult survival; age at first maturity; initial adult population; coefficient of variation of fry survival; and risk of catastrophe. Livestock grazing, mining, angling pressure, and the presence of non-native fish present the greatest threats to the persistence of remaining, isolated Westslope cutthroat trout populations.

Sidle, John G. **Arbitrary and capricious species conservation.** 12(1): 248-249 (1998) commented on two 1997 federal District Court decisions concluding that failure by USFWS to list the Barton Springs salamander and the lynx was "arbitrary and capricious" due to political meddling in the decision. He notes that "ESA requires that decisions be based upon the *best available data* and not the more stringent standard of conclusive evidence." USFWS employees are "frequently reminded to have little direct contact with members of Congress and their staff, or with state and other politicians…to stay clear of politics." He also notes that voluntary conservation agreements, while increasingly popular, "are not as compelling as the listing of a species, and the track record of conservation agreements is poor," according to a U.S. GAO report. He believes that any new mechanism for species conservation must be free of political influence.

Sklyarenko, Sergei. **Rare raptors of Kazakhstan and their status.** *Newsletter on the World Working Group on Birds of Prey and Owls* No. 23/24:30-31 (1996). Sixteen of the 54 species of raptor in Kazakhstan are listed in the IUCN Red Data Book. "Illegal export to Arabian countries" constitutes the greatest threat to some of these species. Conservation priorities are based largely upon the known number of breeding pairs, population trend, and IUCN Red Data Book category. Data on raptors is generally incomplete or lacking, but wildlife managers in that nation have recently completed a program plan for restoration and conservation.

Smallwood, K. Shawn. **On the evidence needed for listing northern goshawks (Accipiter gentilis) under the Endangered Species Act. - a reply to Kennedy.** *Journal of Raptor Research* 32(4):323-329 (Dec. 1999).

Sorrie, B.A . **Notes on the rare flora of Massachusetts.** *Rhodora* 89(858): 113-196 (1987). Since 1978 the Massachusetts Natural Heritage Program has conducted an inventory of rare species throughout the state of Massachusetts. For 286 rare vascular plant taxa, information is provided on current nomenclature, number of stations, endangerment status, range extensions, habitat preference, and identification.

Stattersfield, A.J. **Identifying threatened species in the "south" using new criteria.** *Pacific Conservation Biology* 4(1):33-38 (1998). Stattersfield applied IUCN 1994 criteria to a host of bird species across the southern hemisphere (except Antarctica). He concludes that "the new IUCN system for identifying [threatened species] should help [promote conservation action] because clear criteria will help to reduce subjectivity, thereby rendering the red-listing process more accountable and accurate. However, given that numerical data are lacking for the majority of species, classification of species will continue to rely on inference, albeit guided by a more objective system." Stattersfield used the IUCN criteria to identify those areas of the southern hemisphere where conservation actions are most urgently needed: Indonesia, Brazil, and Papua New Guinea. He notes that "for the majority of threatened species the only real prospect for the future is through protection of sites" where the greatest numbers of all threatened plants and animals co-occur.

Stein, Bruce A., et al., eds. **Precious heritage - the status of biodiversity in the United States.** The Nature Conservancy and Association for Biodiversity Information. Oxford University Press, New York. 2000. 399 pp. Precious Heritage summarizes the work of the Natural Heritage Network, a nationwide biological inventory. The network identifies natural heritage inventory needs, and provides a repository for biodiversity information. The species about which information is entered into the nationwide biodiversity data system is then ranked according to degree of threat of extinction faces the species. This ranking system then can form the basis for present and future conservation action decisions. State Natural Heritage databases assemble information on what species and ecological communities exist in each state; their conservation status or extinction risk; their characteristics; their location; and land ownership information. Species-level information gathered includes taxonomy, distribution, identification and evaluation of priority taxa, population- trends, ecological relationships, and habitat requirements. Conservation status of species and habitats is ranked on a seven-class system ranging from extinct to common.

Suckling, Kieran, N. Greenwald, et al. **Petition to list the yellow-billed cuckoo *Coccyzus americanus* as a federally endangered species.** The Center for Biological Diversity, *Endangered Species Report* No. 36, Feb. 2 1998. In assessing the status of the yellow-billed cuckoo, petitioners used the following criteria: habitat specialization; decline in habitat over time; extirpation of species populations across its entire range; lack of minimum viable populations; historic and on-going land use impacts; and lack of suitable or adequate regulatory mechanisms. No absolute or objective criteria are proposed for listing, but petitioners cite an extensive review of studies by field biologists whose observations and conclusions support the petitioners' position.

Sullins, Tony A. **Endangered species act - judicial review of an emergency listing - A wasteful allocation of resources? *City of Las Vegas v. Lujan*, 891 F.2d 927 (D.C. Cir. 1989).** *Land and Water Law Review* 26:619-632 (1991). In 1989, the Secretary of Interior issued an emergency listing order for the desert tortoise (Mojave population, but not the Sonoran population). Immediate threats to the continued existence of the tortoise were described as "habitat destruction, predation, vandalism, and the presence of Respiratory Distress Syndrome." The City of Las Vegas and developers intent on developing ore than 22,000 acres of land filed suit against the Department of the Interior on the grounds that the emergency listing was "arbitrary and capricious," and not based on sound science. Sullins notes the case was settled with USDI issuing an incidental take permit to clear the land in question of tortoises, which were to be turned over to a research center funded as part of the settlement. A tortoise management area was established on 4000,000 acres of nearby federal land. "The disposition of City of Las Vegas v. Lujan neither alleviates nor escalates the degree of conflict associated with emergency listings under the ESA. Instead, the case serves to encourage creative resolution of such conflicts as they arise." He further notes that money used in the litigation would have been much better spent on initiating a Habitat Conservation Plan at the time the emergency listing order was issued..

Taylor, B.L. **The reliability of using population viability estimates for risk classification of species.** *Conservation Biology* 9(3): 551-558 (1995). Taylor addressed the question of "whether or not it is appropriate to use extinction probabilities generated by population viability analyses, based on best estimates of model parameters, as criteria for listing species in Red Data Book categories, as recently proposed" by IUCN. Using the Stellar sea lion as a test case revealed that models may not be constructed to handle the inherent uncertainties encountered when some parameters must be estimated due to a lack of concise data. Taylor

concludes with the observation that "testing classification schemes with simulations using quantitative performance objectives should precede adoption of quantitative listing criteria."

Tear, T.H., et al. **Recovery plans and the endangered species act: are criticisms supported by data?** *Conservation Biology* 9(1):182-192. An evaluation of all recovery plans approved by USFWS and NMFS through 1991 revealed that overall, they lack detailed biological information about the species in question. Information included, in decreasing order of frequency of occurrence in the plans, consists of species distribution, abundance, population demographics, and population dynamics. There was no evidence of any differentiation in the recovery goals between species listed as endangered and those listed as threatened. Only 60%-73% of the species covered in the plans would recover to the point of qualifying for a change to a classification denoting a reduced risk of extinction. Plans contained a taxonomic bias regarding recovery, favoring animals over plants, vertebrates over invertebrates, and birds and mammals over fish, reptiles and amphibians. [Full @ DNR GEF2 LB]

Thomas, C.D. **Rarity, species richness and conservation: Butterflies of the Atlas mountains in Morocco**. *Biological Conservation* 33(2):95-118 (1985). A study was made of the butterflies associated with different biotopes in the Atlas mountains in Morocco. Geographically restricted species were found to be biotope specialists. These tend to be vulnerable species which warrant conservation measures, and are not necessarily the species which appear low in a rank species abundance curve. Butterfly species richness was correlated with plant species richness, and butterfly density with percentage ground cover of the vegetation. Many butterflies were restricted to particular seral stages. A comparison is made of the potential effectiveness of species versus ecosystem conservation in Morocco. As most species are poorly studied, probably the best ***conservation strategy*** for butterflies is to protect as wide a variety of biotopes as possible. Subsequently a species approach may be applied to species not encompassed by this policy.

Thompson, Frank R., et al. **Status of neotropical migrant landbirds in the Midwest: identifying species of management concern.** IN: Finch, Debra M. and Peter Stangel, eds. Status and Management of Neotropical Migratory Birds; 1992 September 21-25; Estes Park, CO. Gen.Tech. Rep. RM-229, Fort Collins, CO:USDA - Forest Service, Rocky Mountain Forest and Range Experiment Station. 422 p. A group of Midwest biologists used Breeding Bird Survey data to develop a priority ranking of migrant birds' conservation needs and a companion list of Midwestern habitats "most in need of management attention." They advocate ecosystem-level management rather than species management. The *seven criteria* are: global abundance; winter distribution; severity of threats on wintering grounds and migration routes; breeding distribution; severity of threats on breeding grounds in the Midwest; importance of Midwest region to the species; and population trend in the Midwest.

USDA - Forest Service. **Chapter 2670 - threatened, endangered and sensitive plants and animals.** Forest Service Manual 2600 - Wildlife, Fish and Rare Plant Habitat Management R9 Supplement 2600-2000-1, Eastern Region, Milwaukee, WI (Jan. 28, 2000). The U.S. Forest Service has a policy of ensuring the "viability of sensitive species" and precluding "trends toward federal listing under the Endangered Species Act (ESA)." Some criteria are used to maintain a Regional Forester Sensitive Species list." Species are added or removed from this list on the basis of either USFWS listing and TNC rank, or a Forest Service "Risk Evaluation." Risk Evaluation criteria include: abundance; distribution; population trend; habitat integrity; and population vulnerability. Presence of sensitive species on Forest

Service lands prompts development of conservation assessments, strategies, and agreements. A conservation action priority matrix is available to use as a work planning tool.

U.S. Fish and Wildlife Service. **Region 3 fish and wildlife resource conservation priorities.** USDI - FWS, Region 3 (Sept. 1999). A group of USFWS employees established guidance to enable them to determine which fish and wildlife species are "in the greatest need of attention under the Service's full span of authorities." The list of 161 species produced in this exercise will be used for planning Region 3 conservation programs. This is more a work-planning document than an evaluation of species' conservation status. The criteria used to "identify the Region's endangered species resource priorities" are:

- Listed, proposed and candidate species for which Region 3 maintains national lead responsibility.
- Rare/declining species for which:
- decisions on candidate elevation are near completion;
- status assessments are currently underway;
- conservation agreements are in place to implement actions that will sustain populations; or
- current ranges of commercially harvested species overlap widely distributed but rare/declining freshwater aquatic species' historic ranges.
- Extant listed species, widely distributed in North Central region, whose range overlaps commercially harvested species' ranges, and for which another region maintains national lead.
- Listed species undergoing reclassification, delisting, or post-delisting monitoring activities, for which another region maintains national lead.

U.S. Fish and Wildlife Service. **Making the ESA work better.** *Endangered Species Bulletin* 20(3):1-4 (1995). The U.S. Department of the Interior announced a ten-point philosophy to "improve implementation of the Endangered Species Act." This includes reducing impacts on landowners; minimizing social and economic impacts; creating conservation incentives; providing prompt information; using sound and objective science; acting to conserve species to avoid their qualifying for listing; increasing recovery and delisting; building partnerships; focusing on species groups; and promoting efficiency and consistency. This brief document stresses taking an ecosystem approach to species conservation.

U.S. Fish and Wildlife Service. **Non-game birds of management concern - the 1995 list.** USDI - FWS, Office of Migratory Bird Management. The FWS used a five-step process to identify species of concern. This project is aimed at "reducing the likelihood of having to propose any migratory bird species for Federal listing s Endangered or Threatened." These criteria are: (1) a modified group decision-making exercise (Delphi), (2) a review of Breeding Bird Survey data, (3) a review of Audubon Christmas Bird Count data, (4) a review of Partners in Flight prioritized regional lists of neotropical migrant land birds, and (5) a review of the U.S. Fish and Wildlife Service's "candidate" species list.

To qualify for national listing, a species had to meet at least one of the following ***selection criteria***: (1) A Delphi [panel of experts] score of Moderate or High concern by more than 50% of all respondents, (2) a long-term (1966-1993) population decline documented by the Breeding Bird Survey that equals or exceeds 2.5%/year, (3) a long-term (1959-1988) population decline documented by the Audubon Christmas Bird Count that equals or exceeds 2.5%/year, (4) a composite Partners in Flight rank score of at least 24 in (a) 2 or more USFWS regions or (b) the USFWS region that contains at least 50% of the U.S. breeding range or population, or (5) a Category 1 or Category 2 "candidate" species in a geographical area covering at least 10% of the U.S. breeding range. The full document

explains these criteria in more detail:
http://migratorybirds.fws.gov/reports/speccon/tblconts.html

U.S. Fish and Wildlife Service. **Department of the Interior 50 CFR Part 17 endangered and threatened wildlife and plants; notice of final decision on identification of candidates for listing as endangered or threatened** [Federal Register: December 5, 1996 (Volume 61, Number 235)] [Rules and Regulations] [Page 64481-64485] From the Federal Register Online via GPO Access [wais.access.gpo.gov] [DOCID:fr05de96-10] In its Notice of Final Decision, the Service discontinued the maintenance of a list of category-2 species. The Service's Endangered Species Program will identify candidates for addition to the list of endangered or threatened species through a collaborative process between the public and private sectors. The Service, through all its appropriate programs, will take an active role with its partners and other knowledgeable individuals to identify and conserve species of concern, identify research needs, set priorities for developing the information and determine how to accomplish the work needed to resolve the status of species.

Tools available to the Service and its partners for use as a foundation for identifying potential candidates include: the Natural Heritage Central Database of TNC and the International Network of Natural Heritage Programs and Conservation Data Centres, the Service's list of Migratory Nongame Birds of Management Concern in the United States, species protected by State endangered species laws or identified by State agencies as rare or vulnerable, species identified by other Federal agencies as vulnerable or of management concern (e.g., the USFS's and BLM's "sensitive species"), and [[Page 64485]] species identified by professional scientific societies as rare or vulnerable (e.g., the American Fisheries Society and National Audubon Society/Partners in Flight).

The most comprehensive single source of information on rare or imperiled species is the Natural Heritage Central Database, developed by TNC and the network of State Natural Heritage programs, which ranks the conservation status of species at the global, national, and state levels. This information is available from TNC and the State Heritage programs. When all available information has been evaluated, the Service will determine if a particular species meets the information standards and status criteria for recognition as a candidate species, and if so, the

Regional Director will recommend to the Service's Director that the species be added to the candidate list.

Other species may warrant further review or monitoring or not warrant further consideration for candidate status at that time. Non-candidate species petitioned for listing will require initiation of a status review when the Service makes a 90-day finding of "substantial information." If the Service makes a 12-month finding of "warranted" or "warranted but precluded," the species would then become a candidate. The annual update of the candidate notice of review will serve as recycled petition findings until such time as a final determination can be made on whether a proposed listing rule should be published.

Usher, M.B**. An assessment of conservation values within a large site of special scientific interest in North Yorkshire, England.** *Field Studies* 5(2):323-348 (1980). Criteria useful in assessing the conservation value of land are considered. Discussion concentrates on area, diversity of species and habitats, relationships between area and number of species especially in relation to limestone pavements, naturalness and typicalness of the site, presence of rare species, and the interpretation of expressions such as fragility and stability. The environment of an important conservation area, the Malham -Arncliffe S.S.S.I. (site of special scientific interest) is described. The criteria used in assessment are considered in relation to this S.S.S.I., and only i.e., size, diversity of species and habitats, and rarity are useful in assessing the importance of parts of a large area of overall importance. Conceptual

differences between some criteria, which can be measured or estimated by scientific means, and other criteria, that are dependent upon value judgments of the assessor, are stressed.

Van Helsdingen, P.J. **Criteria for selection of species for the Bern Convention: the example of Macrothele calpeiana.** Council of Europe Environmental Encounters Series No. 10: 39-41 (1990).

Van Putten, Mark and S.D. Miller. **Prairie dogs - the case for listing.** *Wildlife Society Bulletin* 27(4):113-1120 (Winter, 1999). In 1902, biologist C. Hart Merriam, lacking any valid data, proclaimed that the black-tailed prairie dog caused a 50%-70% reduction cattle productivity on the open range. Thus began decades of relentless persecution of this species, which continues in various forms today. In 1998, the National Wildlife Federation (NWF) filed its first-ever petition (see www.nwf.org/grasslands) to list the black-tailed prairie dog as a threatened species under the ESA. NWF evaluated the following factors in agreeing this once prolific species is "spiraling toward extinction:" spatial distribution status and trend (less than 1% of more than 40 million ha of historic range), including colony fragmentation; official state persecution status as a "pest;" unregulated "recreational" shooting; landowner misperceptions regarding competition with livestock, most of which are contrary to science fact; ravages by an exotic disease (sylvatic plague); and population ecology (relatively low reproduction and survival rates of young). In addition, this species is a keystone in maintaining remnant shortgrass prairie communities, "whose activities have a disproportionately large effect on community or ecosystem structure or function." Federal listing consideration has prompted states to propose a draft conservation strategy as an alternative to listing.

Walters, Jeffrey R. **The AOU Conservation Committee review of the biology, status, and management of Cape Sable Seaside Sparrows: Final report**. *Auk* [print] 117(4): 1093-1115 (October, 2000).

Washburn, Lowell. **Protected status granted to Iowa timber rattlesnakes.** *Iowa Conservationist* Sept./Oct. 2000:25-26. Iowa recently joined 18 other states in listing the timber rattler as either endangered or threatened. Although Washburn does not have a lot of background data on Iowa rattlesnakes, he thinks "everyone agrees they have declined." The law 's intent is to "keep common species common" by preventing the removal of snakes by collectors. Rattlers have "an extremely low reproductive rate," and most snakes taken are pregnant females, which remain in the vicinity of den sites after spring dispersal.

Webb-Grahame, J.W. and E. Carrillo**. Risk of extinction and categories of endangerment: perspectives from long-lived reptiles.** *Population Ecology*, 42 (1): 11-17 (April, 2000). The IUCN Red List of Threatened Animals is an important conservation tool, but "the accuracy of predictions about risks of global extinction within 10 years is difficult to test objectively." Grahame and Carrillo compared IUCN predictions with the results of attempts to derive realistic scenarios that could lead to the global extinction of six species of long-lived reptiles. For three species, the IUCN predictions matched real events reasonably well but still overestimated risks of global extinction. For the other species, the predictions did not match real events.
Occasionally, some species that are not at risk of extinction but that do have "other conservation problems" appear on the list as being globally threatened when in fact they are not. Grahame analyzed data from species experts for six long-lived crocodilians and turtles, determined their conservation status independently, and compared the results to current IUCN threat categories for those species.

He identifies *eight flaws with IUCN criteria or their application to long-lived reptiles*: 1) time scales do not fit, in that 3 generations (~100 years) is "far too long for assessing status reliably…;" 2) using scientific precaution by not over-interpreting data conflicts with using conservation precaution by exaggerating risks to attain enhanced conservation action; 3) the criteria do not factor in ongoing conservation actions, thereby overestimating risk of extinction; 4) the criteria do not offer a clear means to factor in the existence of secure populations that effectively prevent extinction; 5) the criteria need to provide clear direction on how to account for the fact that some national populations of a species contribute more to global population security for one species than for other species; 6) extent of historical decline over three generations may be unrelated to future risk of global extinction; 7) verification procedures and use of expert panels for assessing conservation status are not required, so the highest level of accuracy is not assured; 8) Using only the IUCN criteria exaggerates extinction risk relative to real risk, and the wrong criteria are sometimes deliberately selected in order to maximize conservation action.

Weller, Derek. **Limiting the scope of the Endangered Species Act: Discretionary federal involvement or control under Section 402.03.** *Hastings West-Northwest Journal of Environmental Law and Policy*. 5(3): 309-334 (1999). Section 7(a)(2) of the Endangered Species Act requires federal agencies to ensure that their actions are "not likely to jeopardize the continued existence of any endangered" or threatened species. However, section 402.03 of the joint regulations developed by USFWS and NMFS to implement the ESA contains an exemption for "non-discretionary" actions, which are thereby not restricted by the ESA. Weller asserts that it "is absolutely clear that this regulation (s. 402.03) was promulgated in direct violation of the (federal) Administrative Policy Act (APA). At no time was the public or any other interested person given an opportunity to comment on the possibility of exempting non-discretionary actions. It is also clear from the legislative history that the Congress did to intend to exclude non-discretionary actions from" the Section 7(a)(2) mandate. By excluding certain actions, section 402.03 "runs contrary to the underlying purposes of the ESA to conserve threatened and endangered species."

Western Governors' Association. **Policy resolution 97-116: reauthorization and amendment of the endangered species act of 1973**. June 24, 1997. This organization recommends a number of changes in the ESA, including the following changes pertaining to listing or de-listing:

- Abandon the "single-species approach" and rely upon habitat conservation plans to address "the recovery and protection of species in clusters or related groups." Give priority to conserving species through habitat-based planning in a way that will also negate the need to list other species dependent upon the same habitat.
- Hold public hearings as part of the listing process, and address "significant comments."
- Instead of judicial review, use "alternative dispute resolution mechanisms" to resolve disputes involving the application of scientific data.
- Require peer review in ensure the use of science-based decisions regarding listing.
- Do not apply the same regulatory restrictions to the conservation of endangered species as are required for threatened species. Give landowners and others more discretion.
- Provide incentives to landowners to protect habitat for at-risk species in order to maintain their status above that which would prompt listing.

Wiig, O. **Evaluation of the polar bear in relation to the 1996 IUCN red list of threatened animals.** *Occasional Papers of the IUCN Species Survival Commission* (SSC) 19: 45-46 (1998).

Wilcove. David S, et al. **What exactly is an endangered species? - an analysis of the U.S. endangered species list: 1985 - 1991.** *Conservation Biology* 7(1):87-93 (Mar. 1993). Wilcove looked into the facts behind criticisms that the ESA protects an inordinate number of sub-species and populations (in addition to full species), and that the scientific rationale behind listing decisions is weak. The answer is that 80% were full species, 18% sub-species, and 2% distinct populations. At the time of listing, median population sizes were 1075 for vertebrates, 999 for invertebrates, and less than 120 for plants. These population sizes are barely above the lowest generally believed to be viable in the wild. Access to reliable population estimates was a major problem for those who evaluated candidate species. Generally, more complete estimates population data was gathered only after a species was listed. One population viability modeler suggests minimum conservation targets of from 1,000 to 10,000 individuals, depending upon the magnitude of a specie's natural population fluctuations. The authors conclude that earlier listing of declining species "could significantly improve the likelihood of successful recovery," with more options available at less social and economic cost.

Wilkinson, Todd. **Species protection hits budgetary wall.** *Christian Science Monitor*, February 16, 2001. The Fish and Wildlife Service, citing a budget crisis, said it would not consider adding more animals or plants to the federal endangered species list until at least the end of this year. The decision also points, some say, to the need to revise the Endangered Species Act. In order to minimize bitter battles between environmental and property-rights forces. The Act, and species sheltered by it, in order for both to survive, must provide some compensation for property owners for safeguarding imperiled creatures on their land. The F&WS faces court orders, stemming from environmental lawsuits, to declare "critical habitat" areas for 350 species already listed as endangered or threatened. The cost of those lawsuits has paralyzed the agency's ability to move other imperiled species onto the list, says agency spokesman Hugh Vickery.

Williams, J.D. and R.J. Neves. **Freshwater mussels: a neglected and declining aquatic resource.** IN: Laroe, E.T. et al. Our living resources: a report to Congress on the national distribution, abundance and health of U.S. plants, animals, and ecosystems. USDI - National Biological Service, Washington, D.C. 1995, 530 pp.

Yu, Jinping and Stephen Dobson. **Seven forms of rarity in mammals.** Journal of Biogeography, 27(1):131-139 (January, 2000). Conservation biologists have identified threats to the survival of about a quarter of the mammalian species; to identify patterns of rarity and commonness of mammals, Yu studied a global sample of 1212 species (about 28% of the mammals) using the '7 forms of rarity' model (in which species are roughly divided into above and below the median for local population density, species' range area, and number of habitat types). From a niche-based hypothesis of abundance and distribution, Yu predicted that mammals would exhibit a bimodal pattern of rarity and commonness, with an overabundance of species in the relatively rarest and most common categories; and just such a significant bimodal pattern emerged, with over a quarter of the species classified as exceedingly rare and a further quarter very common, supporting the niche-based hypothesis. Orders that include large mammals, including perissodactyls, primates, diprotodonts, and carnivores, exhibited significantly high proportions of relatively rare species; and tropical zoogeographic regions, especially Indomalaya, had relatively high proportions of species in

the rarest category. Significant biases in the available data on mammals included under-sampling of small species like rodents and bats, and a relative paucity of data on zoogeographic regions outside of North America and Australia. Mammalian species listed as of conservation concern by the IUCN occurred in all cells of the model, indicating that even relatively common species can be listed as threatened under some conditions; but Yu also found that sixty-three species were relatively rare in all three criteria of the 7-forms model but were not listed as threatened, indicating potential candidates for further study. *Mammals may be a group of animals where rarity or commonness is a natural aspect of species biology*, both confirming and perhaps partly explaining the large proportion of mammals assigned threatened status.

Zelewsky, Meredith. **The Morton Arboretum advances protection of endangered species.** Press release, April 28, 2000. Two employees of the Morton Arboretum have proposed guidelines for reclassifying or de-listing endangered native **plants** once it appears their populations have recovered or actions have stabilized their habitats. These guidelines assess a plant population's viability by factoring in population size, growth trends, habitat size, protection status, and land management conditions. These criteria are applied to populations around the entire state. The guidelines are intended to incorporate future advances in knowledge about plant species and their management. The guidelines are intended for use by the Illinois Endangered Species Protection Board. (Meredith: 630-719-5768; Marlon Bowles: 630-719-2422.) [Full - Guidelines requested 6/01]

Zink, Robert M. et al. **Genetics, taxonomy, and conservation of the threatened California Gnatcatcher.** *Conservation Biology* [print] 14(5): 1394-1405 (October, 2000. The California Gnatcatcher (Polioptila californica) has become a flagship species in the dispute over development of southern California's unique coastal sage scrub habitat, a fragile, geographically restricted ecosystem with high endemism. One aspect of the controversy concerns the status of the subspecies of this bird in southern California coastal sage scrub that is currently listed as threatened under the U.S. Endangered Species Act.

To investigate the recent population history of this species and the genetic distinctiveness of subspecies and to inform conservation planning, Zink used direct sequencing of mitochondrial DNA (mtDNA) for 64 individuals from 13 samples taken throughout the species' range. Zink found that coastal sage scrub populations of California Gnatcatchers are not genetically distinct from populations in Baja California, which are dense and continuously distributed throughout the peninsula. Rather, mtDNA sequences from this species contain the signatures of population growth and support a hypothesis of recent expansion of populations from a southern Baja California refugium northward into the southern coastal regions of California. During this expansion, stochastic events led to a reduction in genetic variation in the newly occupied range.

Thus, preservation of coastal sage scrub cannot be linked to maintaining the genetic diversity of northern gnatcatcher populations, despite previous recognition of subspecies. Our study suggests that not all currently recognized subspecies are equivalent to evolutionarily significant units and illustrates the danger of focusing conservation efforts for threatened habitats on a single species.

Part 2 - References Consulted, Sorted by Topic

References in this section are sorted by the following topics:

- Listing Criteria Discussion - States of the U.S.
- Listing Criteria Discussion - U.S. Endangered Species Act
- Listing Criteria Discussion - Other Nations
- Non-Governmental Organization (NGO) Species' Status or Priority Ranking Criteria
- Conservation Biology Not Directly Related to Listing
- Endangered Species Laws – Critiques

See Part 1 for abstracts and summaries.

Listing Criteria Discussion - States of the United States

Bowles, Martin and T. Bell. **Establishing recovery targets for Illinois plants - a report to the Illinois endangered species protection board.** Unpub. manuscript, 20 pp. (with five individual "Recovery Target" reports) (1999).

Brauning, Daniel, M. Brittingham, et al. **Pennsylvania breeding birds of special concern: a listing rationale and status update.** *Journal of the Pennsylvania Academy of Science* 68(1): 3-28 (1995).

Britten, Hugh B., et al. **The impending extinction of the Uncompahgre fritillary butterfly.** population estimates and trends data to use in listing decisions.)

Brown Loren E. **The trend toward extinction in the unusual forward burrowing Illinois chorus frog.** *Reptile & Amphibian Magazine* 43:70-73 (1996).

Defenders of Wildlife. **State endangered species acts: past, present, and future.** WWW presentation at www.defenders.org/pubs/sesa09.html Feb. 2001.

Defenders of Wildlife. **State endangered species acts: past, present, and future.** WWW presentation at http://www.defenders.org/pb-bstes.html. July, 1996.

Edwards, R.J. et al. **A classification of Texas aquatic communities with special consideration toward the conservation of endangered and threatened taxa.** *Texas Journal of Science* 41(3): 231-240 (1989).

Hensley, Harriet. **The role of state conservation plans in the listing of endangered and threatened species.** *The Advocate* 42(10): 8-12 (1999).

Herkert, J.R. (Ed.) **Endangered and threatened species of Illinois: status and distribution, volume 2 - animals.** Illinois Endangered Species Protection Board, Springfield, IL. 142 pp. (1992).

Johnson, Terry B. **State fish and game agency wildlife diversity program contacts.** Arizona Department of Wildlife (2000).

Kirkland, Gordon L., et al. **Survey of the statuses of the mammals of Pennsylvania.** *Journal of the Pennsylvania Academy of Science* 64(1):33-45 (1990).

Landry, Judith L. **A rating system for threatened and endangered species of wildlife.** *New York Fish and Game Journal* 26:11-21 (1979).

Mahan, Carolyn G., et al. **The status of the northern flying squirrel (Glaucomys sabrinus) in Pennsylvania.** *Journal of the Pennsylvania Academy of Science* 73(1):15-21 (1999).

Menhinick, E. F. **A numerical method for ranking of endangered species and its application to North Carolina freshwater fishes**. *Journal of the Elisha Mitchell Scientific Society* 102(2): 54-86 (1986 [1987]).

Metcalfe-Smith, Janice, et al**. Selection of candidate species of freshwater mussels (Bivalvia: Unionidae) to the considered for national status designation by COSEWIC**. *Canadian Field Naturalist*, 112 (3):425-440 (July-Sept., 1998).

Milsap. Brian A., et al. **Setting priorities for the conservation of fish and wildlife species in Florida.** *Wildlife Monographs*, 111, 1-57, July, 1990. in Florida, trend of Florida's population of that taxa, period of occurrence in Florida, and harvest data for Florida.

National Endangered Species Act Reform Coalition. **How has the ESA impacted people?** Undated Web presentation (www.nesarc.org/esamain.htm), (after July, 1997).

National Endangered Species Act Reform Coalition. **NESARC's principles for ESA reform in the 106th Congress.** Undated Web presentation (www.nesarc.org/ esamain.htm

Nebraska Game and Parks Commission - Natural Heritage Program. **Recommendations for revisions to the state list of threatened and endangered species - appendix A - criteria for evaluating species.** Unpublished Web manuscript: http://bighorn.ngpc.state.ne.us/TandE/Appendix_A.htm (October, 1999).

Ripa, Dean. **Degenerated science: a critique of proposed new laws protecting venomous snakes in North Carolina, and a request for science and factuality in the evaluation of animals for the endangered species act.** *Bull Chicago Herp. Soc.* 35(5):93-134, 2000.

Rolley, Robert E. et al. **Wisconsin's bobcat harvest management program.** Wisconsin Department of Natural Resources, Monona, WI. Unpublished report, August, 2000.

Sample, David and M Mossman. **Identifying bird species of management concern and priority habitats for Wisconsin.** *In* Managing Habitat for Grassland Birds, D. Sample and M. Mossman, Wisconsin DNR, 1997, pp. 20-44.

Shepard, Bradley B. et al. **Status and risk of extinction for Westslope cutthroat trout in the upper Missouri River basin, Montana.** *North American Journal of Fisheries Management* 17(4):1158-1172 (1997).

Sorrie, B.A . **Notes on the rare flora of Massachusetts.** *Rhodora* 89(858): 113-196 (1987).

Washburn, Lowell. **Protected status granted to Iowa timber rattlesnakes.** *Iowa Conservationist* Sept./Oct. 2000:25-26.

Listing Criteria Discussion - U.S. Endangered Species Act

Anon. **Canada Lynx listed as threatened in USA.** *Cat News* 32:13-14 (Spring, 2000).

Federal Register. **Endangered and threatened wildlife and plants: designation of the freshwater mussel, the fanshell, as an endangered species.** 55:25591-25595 (1990).

Gerber, Leah. **Seeking a rational approach to setting conservation priorities for marine mammals.** *Integrative Biology* 1(3):90-98 (1998).

Hensley, Harriet. **The role of state conservation plans in the listing of endangered and threatened species.** *The Advocate* 42(10): 8-12 (1999).

Kirsch, Eileen and John G. Sidle. **Status of the interior population of least tern.** *Journal of Wildlife Management* 63(2):470-483 (1999).

Nicholopoulos, Joy. **The endangered species listing program.** *Endangered Species Bulletin* xxiv(6):6-16 (Nov./Dec. 1999).

Noss, Reed F. et al. **Endangered ecosystems in the United States: a preliminary assessment of loss and degradation.** USGS Biological Resources Division - website document (www.biology.usgs.gov/pubs/ecosys.htm), 83 pp.. (1995 or later.)

Ralls, Katerine, et al. **Developing a criterion for delisting the southern sea otter under the U.S. Endangered Species Act.** *Conservation Biology* 10(6):1528-1537.

Scott, J. Michael, et al. **Gap analysis: A geographic approach to protection of biological diversity.** *Wildlife Monographs* 0 (123):1-41 (1993).

Smallwood, K. Shawn. **On the evidence needed for listing northern goshawks (Accipiter gentilis) under the Endangered Species Act. - a reply to Kennedy.** *Journal of Raptor Research* 32(4):323-329 (Dec. 1999).

Suckling, Kieran, N. Greenwald, et al. **Petition to list the yellow-billed cuckoo *Coccyzus americanus* as a federally endangered species.** The Center for Biological Diversity, *Endangered Species Report* No. 36, Feb. 2 1998.

Thompson, Frank R., et al. **Status of neotropical migrant landbirds in the Midwest: identifying species of management concern.** IN: Finch, Debra M. and Peter Stangel, eds. Status and Management of Neotropical Migratory Birds; 1992 September 21-25; Estes Park, CO. Gen.Tech. Rep. RM-229, Fort Collins, CO:USDA - Forest Service, Rocky Mountain Forest and Range Experiment Station. 422 p.

USDA - Forest Service. **Chapter 2670 - threatened, endangered and sensitive plants and animals.** Forest Service Manual 2600 - Wildlife, Fish and Rare Plant Habitat Management R9 Supplement 2600-2000-1, Eastern Region, Milwaukee, WI (Jan. 28, 2000).

U.S. Fish and Wildlife Service. **Non-game birds of management concern - the 1995 list.** USDI - FWS, Office of Migratory Bird Management.

U.S. Fish and Wildlife Service. **Department of the Interior 50 CFR Part 17 endangered and threatened wildlife and plants; notice of final decision on identification of candidates for listing as endangered or threatened** [Federal Register: December 5, 1996 (Volume 61, Number 235)] [Rules and Regulations] [Page 64481-64485] From the Federal Register Online via GPO Access [wais.access.gpo.gov] [DOCID:fr05de96-10]

Van Putten, Mark and S.D. Miller. **Prairie dogs - the case for listing.** *Wildlife Society Bulletin* 27(4):113-1120 (Winter, 1999).

Weller, Derek. **Limiting the scope of the Endangered Species Act: Discretionary federal involvement or control under Section 402.03.** *Hastings West-Northwest Journal of Environmental Law and Policy*. 5(3): 309-334 (1999).

Zink, Robert M. et al. **Genetics, taxonomy, and conservation of the threatened California Gnatcatcher.** *Conservation Biology* [print] 14(5): 1394-1405. October, 2000.

Listing Criteria Discussion - Other Nations

Australian Capitol Territory Parks and Conservation Service. **Threatened species & communities in the ACT - criteria for assessment.** Unpubl. 29 pp.

Avery, Mark, et al. **Revising the British Red Data list for birds: the biological basis of U.K. conservation priorities.** *Ibis* 137 (SUPPL. 1):S232-S239 (1995).

Canadian Wildlife Service. **Committee adopting new criteria.** COSEWIC Update, Environment Canada Website [www.cws-scf.ec.gc.ca/es/recovery/july00/eng/cosewic.htm (July, 2000).

Crins, William J. **Rare and endangered plants and their habitats in Canada**. *Canadian Field Naturalist* 111(3):506-519 (1997).

Environment Australia. **About the environmental protection and biodiversity conservation act - Part 7 - Division 7.1 Listing.** Environment Australia Web presentation, last updated Mar. 26, 2001 (http://www.environment.gov.au/ epbc/about/index.html).

Environment Canada. **Assessing the status of species that may be at risk in Canada.** Environment Canada Web presentation, last updated Nov. 3, 1999 (www.cws-scf.ec.gc/es/legis/uassess.thm).

Environment Canada. **COSEWIC update - committee adopting new criteria**. Environment Canada Web presentation - July, 2000. [http://www.cws-scf.ec.gc.ca/es/ recovery/july00/eng/cosewic.html]

Greenslade, Penelope. **Heritage listing of invertebrate sites in southeastern Australia.** *Memoirs of the Queensland Museum* 36(1):67-76 (1994).

Lim, Leong. **The 10 lords of the universe - the New South Wales TSC Act's scientific committee.** *Pacific Conservation Biology* 3(1):4-12 (Feb. 1997).
Maes, Dirk and C. Van Swaay. **A new methodology for compiling national Red Lists applied to butterflies (Lepidoptera, Rhopalocera) in Flanders (N-Belgium) and the Netherlands.** *Journal of Insect Conservation* 1(2):113-124 (June, 1997).
McIntyre, S. **Risks associated with setting of conservation priorities from rare plant species lists.** *Biological Conservation* 60:31-37 (1991).
Meier, A.J.et al. **Criteria for the introduction of the St. Croix ground lizard.** *New York State Museum Bulletin* No. 471: 154-156 (1990).
Melzer, Alistair, et al. **Overview, critical assessment, and conservation implications of koala distribution and abundance**. *Conservation Biology* 14 (3):619-628 (June, 2000). *(See Environment Australia.)* [Full @ DNR GEF2 LB]
Menon, A.G.K. **Criteria for determining the status of threatened categories of Indian freshwater fishes.** IN: Dehadrai, P.V., et al. [Eds], Threatened fishes of India: proceedings of the National Seminar on Endangered Fishes of India held at National Bureau of Fish Genetic Resources, Allahabad, 25 and 26 April, 1992. Nature Conservators, Muzaffarnagar (1994).
Munro, W.T. **COSEWIC, and B.C. bird species designated by COSEWIC.** *British Columbia Birds* 1(1): 2-8 (December 1991):1993
Sanderson, William G. **The rarity of marine benthic species in Great Britain: development and application of assessment criteria.** *Aquatic Conservation* 6(4):245-256 (1996).
Shank, Christopher. **The Committee on the Status of Endangered Wildlife in Canada (COSEWIC): A 21-year retrospective.** *Canadian Field Naturalist* 113 (2): 318-341 (April-June, 1999).
Sharratt, Norma J., et al. **The invertebrate fauna of the sandstone caves of the Cape Peninsula (South Africa): Patterns of endemism and conservation priorities**. *Biodiversity and Conservation* 9(1): 107-143 (Jan., 2000).
Sklyarenko, Sergei. **Rare raptors of Kazakhstan and their status.** *Newsletter on the World Working Group on Birds of Prey and Owls* No. 23/24:30-31 (1996).
Thomas, C.D. **Rarity, species richness and conservation: Butterflies of the Atlas mountains in Morocco**. *Biological Conservation* 33(2):95-118 (1985).
Usher, M.B**. An assessment of conservation values within a large site of special scientific interest in North Yorkshire, England.** *Field Studies* 5(2):323-348 (1980).
Williams, J.D. and R.J. Neves. **Freshwater mussels: a neglected and declining aquatic resource.** IN: Laroe, E.T. et al. Our living resources: a report to Congress on the national distribution, abundance and health of U.S. plants, animals, and ecosystems. USDI - National Biological Service, Washington, D.C. 1995, 530 pp.

Non-Governmental Organization (NGO) Species Conservation Status or Priority Ranking Criteria

Anon. **Criteria for determination of Red Data Book and notable species status***.* *Heteroptera Study Group Newsletter* No. 8: 4-7 (1988).
Baker, Richard J. **Process for evaluating a species' vulnerability to extinction.** *Unpub*. (1993).
Beissinger, Steven et al. **Report of the AOU Conservation Committee on the Partners in Flight species prioritization plan.** *The Auk* 117(2):549-61 (2000).
Bigalke, R.C. **Criteria and their application in the reintroduction of large mammals.** *Acta Zoologica Fennica* No. 172: 165-168 (1984).

Borges, P.A. **Ranking the Azorean Natural Forest Reserves for conservation using their endemic arthropods**. *Journal of Insect-Conservation* [print] 4(2): 129-147 (June, 2000).

Cameron, R. A. **Dilemmas of rarity: Biogeographic insights and conservation priorities for land mollusca.** *Journal of Conchology*, SPECIAL PUBL. (2):51-60 (June, 1998).

Carter. Michael F. et al. **Setting conservation priorities for landbirds on the United Sates: the Partners in Flight approach.** *The Auk*, 117(2):541-548, 2000.

Collar, N.J. **Globally threatened parrots: Criteria, characteristics and cures.** *International Zoo Yearbook*, 37: 21-35 (2000).

Defler, T.R. **An IUCN classification for the primates of Colombia.** *Neotropical Primates* 4(3):77-78 (September 1996).

Ellis, Willem N. et al. **Changes in rank abundance of Microlepidoptera in the Netherlands.** *Entomologische*, Berichten, Amsterdam (9): 129-137 (1999).

English, V. and J. Blyth. **Development and application of procedures to identify and conserve threatened ecological communities in the South-west Botanical Province of Western Australia.** *Pacific Conservation Biology* 5 (2):124-138 (Sept. 1999).

Eyre, M.D. and S.P. Rushton. **Quantification of conservation criteria using invertebrates**. *Journal of Applied Ecology* 26(1): 159-172, 1989.

Favre, David S**. The risk of extinction: a risk analysis of the Endangered Species Act as compared to CITES.** *New York University Environmental Law Journal* 6(2): 341-366 (1998).

Fekete, G., et al. **Application of three approaches to evaluate abundance and rarity in a sand grassland community.** *Coenoses* 10:(1) 29-38 (1995).

Fleishman, Erica , et al. **A new method for selection of umbrella species for conservation planning.** *Ecological Applications*. [print] 10(2): 569-579 (April, 2000).

Freitag, Stefanie and A.S. Van Jaarsveld. **Relative occupancy, endemism, taxonomic distinctiveness and vulnerability: Prioritizing regional conservation actions.** *Biodiversity and Conservation* 6 (2):211-232 (1997).

Gardenfors, U. **A closer look at the IUCN Red List categories: the regional perspective.** *Species* (25):34-36 (1995).

Gigon, Andreas, et al**. Blue lists of threatened species with stabilized or increasing abundance: A new instrument for conservation.** *Conservation Biology* 14 (2):402-413 (April, 2000).

Gotmark, F., et al. **Are indices reliable for assessing conservation value of natural areas?: An avian case study.** *Biological Conservation* 38(1):55-74 (1986).

Grigera, Dora and Garmen Ubeda. **Vertebrate fauna as a criterion for ranking natural environments by their conservation value: A study case.** *Medio Ambiente* [print] 13(2):50-61 (2000.

Gulliver, R.L**. The rare plants of the Howardian Hills, North Yorkshire (England, UK) 1794-1988.** *Watsonia* 18(1): 69-79 (1990).

Hallingback, Tomas. **The new IUCN threat categories tested on Swedish bryophytes.** *Lindbergia* 23(1): 13-27 (1998).

IUCN. **2000 IUCN Red List - Background.** International Union for the Conservation of Nature (IUCN), Gland, Switzerland. http://iucn.org/themes/scc/redlists/criteria, and http://iucn.org/redlist/2000/background. Feb., 2001.

IUCN. **Threatened fish? Initial Guidelines for applying the IUCN Red List criteria to marine fishes.** http://iucn.org/themes/ssc/redlists/fish.htm . May, 1996.

IUCN Species Survival Commission. **IUCN Red List categories.** International Union for the Conservation of Nature (IUCN), Gland, Switzerland (Nov. 30, 1994).

Jungius, H . **Criteria for the reintroduction of threatened species into parts of their former range. Threatened deer. Proceedings of a working meeting of the Deer Specialist Group of the Survival Services Commission.** International Union for Conservation of

Nature and Natural Resources, Morges, Switzerland [434pp]: 342-352 (1978). [Available via UW Steenbock Library]

Koch, S. O., S. L. Chown, et al. **Conservation strategies for poorly surveyed taxa: A dung beetle (Coleoptera, Scarabaeidae) case study from southern Africa.** *Journal of Insect Conservation*. [print] 4(1): 45-56 (March, 2000).

Linder, H.P. **Setting conservation priorities: the importance of endemism and phylogeny in the southern African orchid genus Herschelia**. *Conservation Biology* 9 (3):585-595 (1995). [Full @ DNR GEF2 LB]

Mace, Georgina M. and R. Lande. **Assessing extinction threats: toward a reevaluation of IUCN threatened species categories.** *Conservation Biology* 5(2):148-157 (1991).

Master, et al. **Rivers of Life.** The Nature Conservancy (1998). http://consci.tnc.org/library/pubs/rivers/rivers.pdf]

Meylan, Anne B. **Status justification for listing the hawksbill turtle (Eretmochelys imbricata) as critically endangered on the 1996 IUCN Red List of threatened animals.** Chelonian *Conservation and Biology* 3(2):200-224 (April, 1999).

Morris, William, et al. **A practical handbook for population viability analysis.** The Nature Conservancy, April, 1999, 80 pp.

New. T.R. **Limits to species focusing in insect conservation.** *Annals of the Entomological Society of America* 92(6):853-860 (Nov. 1999).

Partners in Flight. **Partners in Flight species prioritization process.** Unpub. report. (Oct, 2000).

Poulsen-Bent,Otto and N. Krabbe. **Avian rarity in ten cloud-forest communities in the Andes of Ecuador: Implications for conservation.** *Biodiversity and Conservation* 6 (10):1365-1375 (1997).

Powles, Howard, et al. **Assessing and protecting endangered marine species**. *ICES-Journal of Marine Science*, 57(3):669-676 (June, 2000). "endangerment".

RAMAS Software. **RAMAS RedList: Threatened species classification under uncertainty.** Ramas Software, 2000.

Rylands, A.B., et al. **A species list for the New World primates (Platyrrhini): distribution by country, endemism, and conservation status according to the Mace-Lande system.** *Neotropical Primates* 3(suppl.):113-160 (1995).

Sakamoto, M. **The present trend of CITES and new listing criteria.** Biological Sciences (Tokyo) 47(3):141-154 (Oct. 1995).

Seddon, M.B. **Red listing for mollusks: A tool for conservation?** *Journal of Conchology*, special publ. (2):27-44 (1998).

Stattersfield, A.J. **Identifying threatened species in the "south" using new criteria.** *Pacific Conservation Biology* 4(1):33-38 (1998).

Stein, Bruce A., et al., eds. **Precious heritage - the status of biodiversity in the United States.** The Nature Conservancy and Association for Biodiversity Information. Oxford University Press, New York. 2000. 399 pp.

Van Helsdingen, P.J. **Criteria for selection of species for the Bern Convention: the example of Macrothele calpeiana.** Council of Europe Environmental Encounters Series No. 10: 39-41 (1990).

Walters, Jeffrey R. **The AOU Conservation Committee review of the biology, status, and management of Cape Sable Seaside Sparrows: Final report**. *Auk* [print] 117(4): 1093-1115 (October, 2000).

Webb-Grahame, J.W. and E. Carrillo**. Risk of extinction and categories of endangerment: perspectives from long-lived reptiles.** *Population Ecology*, 42 (1): 11-17 (April, 2000).

Wiig, O. **Evaluation of the polar bear in relation to the 1996 IUCN red list of threatened animals.** *Occasional Papers of the IUCN Species Survival Commission* (SSC) 19: 45-46 (1998)

Zelewsky, Meredith. **The Morton Arboretum advances protection of endangered species.** Press release, April 28, 2000.

Conservation Biology Concepts Not Linked to Specific Listing Criteria

Anders, P.J. **Conservation aquaculture and endangered species: can objective science prevail over risk anxiety?** *Fisheries: Bulletin of the American Fisheries Society* 23(11):28-31 (1998).

Arita, H.T. et al. **Rarity in neotropical forest mammals and its ecological correlates**. *Conservation Biology* 4(2):181-192 (1990).

Bibby, Colin J. **Recent past and future extinctions in birds**. IN *Philosophical Transactions of the Royal Society of London, Biological Sciences* 344 (1307):35-40 (1994

Bock, C.E. **Geographical correlates of abundance vs. rarity in some North American winter landbirds.** *Auk* 101(2): 266-273 (1984).

Cone, Marla. **A Disturbing Whale Watch in Northwest.** *Seattle Times*, Feb. 22, 2001.

Demauro, Marcella M. **Relationship of breeding system to rarity in the lakeside daisy (Hymenoxys acaulis var. glabra).** *Conservation-Biology* 7(3): 542-550 (1993).

Dennis, Roger L.H . **An inflated conservation load for European butterflies: Increases in rarity and endemism accompany increases in species richness.** *Journal of Insect Conservation* 1(1): 43-62 (1997).

Dunham, J.B. et al. **Habitat fragmentation and extinction risk in Lahontan cutthroat trout.** *North American Journal of Fisheries Management* 17(4):1126-1133 (1997).

Ellis, Willem N. et al. **Changes in rank abundance of Microlepidoptera in the Netherlands.** *Entomologische*, Berichten, Amsterdam (9): 129-137 (1999).

Gibbs, James P. and John Faaborg. **Estimating the viability of ovenbird and Kentucky warbler population in forest fragments.** *Conservation Biology* 4(2):193-196 (1990).

Hodgson, J.G. **Commonness and rarity in plants with special reference to the Sheffield Flora (UK): Part II: The relative importance of climate, soils and land use.** *Biological Conservation* 36(3):253-274 (1986).

Kattan, G.H. **Rarity and vulnerability: The birds of the Cordillera Central of Colombia**. *Conservation Biology* 6(1):64-70 (1992).

Kushlan, J.A. **Conservation and management of the American crocodile.** *Environmental Management* 12(6):777-790 (1988).

Leon-Cortes, Jorge L, et al. **The distribution and decline of a widespread butterfly Lycaena phlaeas in a pastoral landscape.** *Ecological Entomology* [print] 25(3): 285-294 (August, 2000).

Lovett, Jon C et al. **Patterns of plant diversity in Africa south of the Sahara and their implications for conservation management.** *Biodiversity and Conservation* 9(1):37-46 (Jan., 2000)

Menges, E.S. **Evaluating extinction risks in plant populations.** Pp. 49-65 in: P.L. Fiedler, and P.M. Kareiva, eds. *Conservation Biology: For the Coming Decade*. Second edition. Chapman & Hall/ITP. New York, NY (1998).

Menges, E.S. **The application of minimum viable population theory to plants.** Pp. 45-61 in: D.A. Falk and K.E. Holsinger, eds. *Genetics and Conservation of Rare Plants*, Oxford University Press. New York, NY (1991).

Michaels, Karyl and Louise Mendel. **Carabid beetle and vegetation associations in the Tasmanian Eastern Tiers: Implications for conservation.** *Pacific Conservation Biology* 4(3): 240-249 (1998).

Navarrete-Heredia, Jose L. **Is the apparent rarity of Liatongus monstrosus (Bates) (Coleoptera: Scarabaeidae) real or an artifact of collecting?** *Coleopterists Bulletin* 50(3): 216-220 (1996).

Reed, J.M. **The dynamics of red-cockaded woodpecker rarity and conservation.** Sveriges Lantbruksuniversitet Institutionen for Viltekologi Rapport No. 17: 37-56 (1990).

Taylor, B.L. **The reliability of using population viability estimates for risk classification of species.** *Conservation Biology* 9(3): 551-558 (1995).

Yu, Jinping and Stephen Dobson. **Seven forms of rarity in mammals.** Journal of Biogeography, 27(1):131-139 (January, 2000).

Endangered Species Laws - Critiques

Bogert, Laurence M. **That's my story and I'm stickin' to it: Is the "best available" science *any* available science under the Endangered Species Act?** *Idaho Law Review* 13(1): 85-150.

Bringsoe, Henrik. **Quo Vadis? Three American CITES proposals for American reptiles.** *Herptological Review* 29(2):70-71, 1998.

Carroll, R. et al. **Strengthening the use of science in achieving the goals of the Endangered Species Act: an assessment by the Ecological Society of America.** *Ecological Applications* 6(1):1-11 (1996).

Corn, M. Lynn. **The listing of a species: legal definitions and biological realities.** Congressional Research Service, Dec. 15, 1992**.**

Dansky, Shawn M. **The CITES "objective" listing criteria: are they "objective" enough to protect the African elephant?** *Tulane Law Review* 73(3):961-979 (1999).

Doremus, Holly. **Delisting endangered species: an aspirational goal, not a realistic expectation.** *Environmental Law Review* 30(6): 10434-10454 (2000).

Doremus, Holly. **Listing decisions under the Endangered Species Act: why better science isn't always better policy**. *Washington University Law Quarterly* 75(3): 1029-1153 (1997).

Hill, Kevin D. **The Endangered Species Act: what do we mean by species?** *Boston College Environmental Affairs Law Review*, 20(2): 239-264, Winter 1993.

Sidle, John G. **Arbitrary and capricious species conservation.** *Conservation Biology* 12(1): 248-249 (1998).

Sullins, Tony A. **Endangered species act - judicial review of an emergency listing - A wasteful allocation of resources? *City of Las Vegas v. Lujan*, 891 F.2d 927 (D.C. Cir. 1989).** *Land and Water Law Review* 26:619-632 (1991).

Tear, T.H., et al. **Recovery plans and the endangered species act: are criticisms supported by data?** *Conservation Biology* 9(1):182-192.

U.S. Fish and Wildlife Service. **Making the ESA work better.** *Endangered Species Bulletin* 20(3):1-4 (1995).

Western Governors' Association. **Policy resolution 97-116: reauthorization and amendment of the endangered species act of 1973**. June 24, 1997.

Wilcove. David S, et al. **What exactly is an endangered species? - an analysis of the U.S. endangered species list: 1985 - 1991.** *Conservation Biology* 7(1):87-93 (Mar. 1993).

Wilkinson, Todd. **Species protection hits budgetary wall.** *Christian Science Monitor*, February 16, 2001.

Appendix B. DNR Staff Comments on Listing Criteria and Survey Questions used with DNR and Federal Agency Staff

DNR Staff Comments on Listing Criteria

General Criteria and Listing Comments

- Criteria is useful for delisting as well as listing
- Definitely need delisting criteria but it should not necessarily be the same as the listing criteria
- Also need to develop some broad guidelines for the Special Concern species list
- A more developed broad criteria set will definitely help as a guiding tool in the listing process
- Criteria should also have some way of recognizing and dealing with those species of plants that are disturbance-loving
- Criteria need a mechanism for dealing with newly found species and reintroduced species
- Criteria even within plants needs to be different. (lichens need different criteria than trees which need different criteria from sedges)
- If using one set of criteria for both plants and animals it will have to be very general and therefore it might make sense to have separate criteria for the two
- If using the same set of criteria for both an extremely mobile animal and a butterwort, must use very broad criteria
- Heritage methodology/criteria works best for plants and less so for animals
- Need to look at the Heritage data we have in order to develop criteria. The available data may not support certain types of criteria
- Element teams should be convened to look at criteria. This will help with credibility of criteria before putting it in code
- If a species meets all the criteria, it should be listed unless it is already under intensive specific management
- Economic factors should not play a role in listing endangered or threatened species

Data Issues and Needs

- For some species, the data available is mostly in the form of anecdotal information and criteria needs to be able to accommodate this
- Certain types of data and information are difficult to obtain, despite vigorous attempts, for certain species
- Criteria must look at historic known range versus last decade range.
- Look at research and past monitoring to document trends. Trend data does not necessarily have to be from Wisconsin.
- Look more closely at the life history and habitat needs.
- Use new tools to analyze the landscape and the populations before listing is also important.
- Before listing, assess what level of survey has been done and determine if this is sufficient to gauge the population in the state.
- Factors looked at should include: trends and risk, things a species needs and things it can't tolerate, level of specialization of the species, viability reality, changes that this species goes through or may go through.
- Need to know how good the data is and how viable the population is.
- For many species, the necessary population trend data is often lacking.
- Criteria must recognize the uncertainty of the rarity of some species.
- The use of criteria elucidates the need to obtain more data for some species.
- Numbers should only be used as guidelines.
- Population numbers are important data to look at but the science behind them must also be analyzed.
- Population trend is also an important factor to include in listing criteria.
- Look at the quality and viability of the populations.
- With respect to species habitat, it is ideal to have trends in habitat loss available.

- Habitat measures should not be numerical because many factors play into habitat issues.
- Aquatics must be measured in terms of populations and we must look for breaks between populations (things such as dams) to determine which are separate EO's.
- Migratory species are another unique group of species that must be accounted for. Some species may be showing declining populations but we need to recognize whether the problem is here or where they winter.
- Some species are particularly vulnerable to certain threats including invasives and this needs to be recognized.
- Factors to include in criteria are: population numbers and trends over time, habitat (potential, trends, association with a unique habitat, quality), threats (present and potential, during all life stages) and unique life history qualities (mussels-fish hosts are critical, leps-need plant host)

Survey Questions used with Wisconsin DNR and Federal Agency Staff

Contact Information

Contact Name: _____

Contact Affiliation (Bureau): _____

Contact Telephone No.: _____

Contact E-mail (for non-DNR individuals): _____

Involvement in Listing Criteria Discussions

Have you previously been involved in discussions about criteria for listing species as endangered/threatened? ___ Yes ___ No

If yes,

What was the context of the discussions about listing criteria?

(e.g., Were the discussions academic exercises? Were they state agency efforts with a specific purpose? Were they multi-agency strategy sessions? Did the discussions involve the public? etc.)

How recent were these discussions about listing criteria?

Were criteria developed as a result of the discussions? ___ Yes ___ No

If yes, are the criteria used only for listing species as endangered/threatened or are they used for delisting/recovery purposes as well?

If yes, do the criteria cover only endangered/threatened species or do they cover a continuum from common to rare?

What were the three most important things you learned from/took away from discussions about criteria for listing endangered and threatened species?

Who else was involved in the discussions?

Would it be worth my time to contact that person (those persons)? ___ Yes ___ No

Opinions/Thoughts about Listing Criteria

In general, what kinds of factors do you think should be considered/included in criteria for listing species as endangered or threatened?

What do you think are the most significant factors that should be considered when deciding whether a species should be listed as endangered or threatened?

With respect to species populations and distributions:

What types of quantitative measures might be worth looking at?

What types of qualitative measures might be worth looking at?

With respect to species habitats:

What types of quantitative measures might be worth looking at?

What types of qualitative measures might be worth looking at?

Are there any factors/considerations that you think are unique to or should be considered for specific species or groups of species?

(e.g., when it comes to listing criteria, should we treat invertebrates differently than vertebrates or should we treat all animal species the same? Should we treat plants the same as animals? Should we treat forest-dwelling species the same as aquatic species?)

What are appropriate sources of data to be used in listing decisions? How can/should these data sources be incorporated into criteria?

What role should economic factors play in listing species as endangered or threatened?

How should land use or other socio-economic factors be handled in listing species as endangered or threatened?

Are you familiar with any specific published or unpublished literature, reports, or documents that should be reviewed as a part of this study?

Are there any other thoughts you have about criteria for listing species as endangered or threatened?

Appendix C. State Agency Contacts and Survey Questions used with Other States

State Agency Contacts

Alabama
Bob McCollum
Nongame Coordinator
Alabama Department of Conservation and Natural Resources

Alaska
John Wright
Alaska Department of Fish and Game

Arizona
Jim McGinnis
Arizona Department of Agriculture

Sabra Schwartz
Nongame Branch
Arizona Game and Fish Department

Arkansas
Karen Rowe
Chief, Nongame & End. Wildl. Program
Arkansas Game and Fish Commission

California
Sandra Morey
Chief, Habitat Conservation Planning Branch
California Department of Fish and Game

Colorado
Gary Skiba
Division of Wildlife
Colorado Department of Natural Resources

Delaware
Kit Heckfcher
Zoologist, Natural Heritage Program
Division of Fish and Wildlife
Dept. Natural Resources & Enviro. Control

Florida
Tom Logan
Endangered Species Coordinator
Bureau of Wildlife Diversity Conservation
Florida Division of Wildlife

Georgia
Mike Harris
Chief, Nongame Wildl. & Nat. Heritage Section
Georgia Department of Natural Resources

Hawaii
Carol Terry
Wildlife Biologist
Hawaii Division of Forestry and Wildlife

Idaho
Chuck Harris
Zoologist
Non-Game Wildlife Program
Idaho Department of Fish and Game

Illinois
Sue Lauzon
Executive Director
Illinois Endangered Species Protection Board

Indiana
Katie Smith
Division of Fish and Wildlife
Indiana Department of Natural Resources

Iowa
Daryl Howell
Zoologist
Parks, Recreation and Preserves Division
Iowa Department of Natural Resources

Kansas
Ed Miller
Endangered Species Specialist
Kansas Department of Wildlife and Parks

Kentucky
Brainard Palmer-Ball
Terrestrial Zoologist
Kentucky State Nature Preserves Comm.

Louisiana
Steve Shively
Zoologist
Louisiana Natural Heritage Program
Department of Wildlife and Fisheries

Maine
Don Cameron
Botanist
Maine Natural Areas Program

Mark McCollough
Endangered Species Group
Department of Inland Fisheries and Wildlife

Maryland
Glenn Therres
Biodiversity Program Manager
Wildlife and Heritage Division
Maryland Department of Natural Resources

Massachusetts
Tom French
Assistant Director
Natural Heritage and Endangered Species
Division of Fisheries and Wildlife

Michigan
Mike Penskar
Botanist
Michigan Natural Features Inventory

Pat Lederle
Endangered Species Coordinator

Minnesota
Rich Baker
Nat. Heritage & Nongame Research Program
Section of Wildlife
Minnesota Department of Natural Resources

Mississippi
Tom Mann
Cynthia Rickis-Gordon
Mississippi Natural Heritage Program
Mississippi Museum of Natural Science
Department of Wildlife, Fisheries and Parks

Missouri
Peggy Horner
Endangered Species Coordinator
Missouri Department of Conservation

Montana
Dennis Flath
Montana Dept. of Fish, Wildlife and Parks

Nebraska
Rick Schneider
Coordinator/Ecologist
Nebraska Natural Heritage Program
Nebraska Game and Parks Commission

Nevada
Larry Neel
Nevada Division of Wildlife

New Jersey
Larry Niles
Chief, End. & Nongame Species Program
New Jersey Department of Fish and Wildlife

New York
Peter Nye
Endangered Species Unit Leader
New York Dept. Environmental Conservation

North Carolina
Randall C. Wilson
Nongame Section Manager
North Carolina Wildlife Resources Comm.

Ohio
Kendra Wecker
Division of Wildlife
Ohio Department of Natural Resources

Patricia Jones
Division of Natural Areas and Preserves
Ohio Department of Natural Resources

Carolyn Caldwell
Division of Wildlife
Ohio Department of Natural Resources

Oklahoma
Mark Howery
Oklahoma Department of Wildlife
Conservation

Oregon
Martin Nugent
Oregon Department of Fish and Wildlife

Pennsylvania
Jerry Hassinger
Pennsylvania Game Commission

Rhode Island
Christopher Raithel
Wildlife Biology, Heritage Program
Rhode Island Division of Fish and Wildlife

South Carolina
Tom Kohlsaat
Chief, Wildlife Diversity
Wildlife and Freshwater Fisheries Division
South Carolina Dept. Natural Resources

South Dakota
Eileen Dowd Stukel
Wildlife Diversity Coordinator
South Dakota Dept. Fish, Game and Parks

Tennessee
Richard Cart is new contact (actually
responder was Robert Hatcher who is no
longer with the agency)
Tennessee Wildlife Resources Agency

Texas
Dorinda Scott
Department of Wildlife and Parks

Utah
Randy Radant
Division of Wildlife Resources
Utah Dept. Natural Resources

Vermont
Steve Parren
Coord., Nongame & Nat. Heritage Program
Vermont Fish and Wildlife Department

Virginia
Tom Smith
Virginia Natural Heritage

Ray Fernald
Virginia Dept. of Game and Inland Fisheries

Washington
John Gammon
Program Manager/Lead Scientist
Washington Natural Heritage
Washington Dept. of Natural Resources

Harriet Allen

West Virginia
Kathy Leo
Wildlife Resources Section
West Virginia Dept. of Natural Resources

Wyoming
Bob Oakley
Wyoming Game and Fish Department

Survey Questions used with Other States

State: _____

Contact Information

Contact Name: _____ Contact Telephone No.: _____

Contact Affiliation: _____ Contact E-mail: _____

Listing Criteria Status

Does your state have criteria for listing species as endangered/threatened? ___ Yes ___ No

If yes,

Are the criteria contained in…___ statute? ___ admin. rule/code? ___ agency policy?

When were the criteria adopted/approved? _____

Who develop and adopted the criteria? Developed: _____

Adopted: _____

Have the criteria been updated/revised? ___ Yes ___ No If yes, when? _____

Do you currently have plans to update or modify the criteria you use? If so, what are these plans?

Are the criteria used only for listing species as endangered/threatened or are they used for delisting/recovery purposes as well?

Do the criteria cover only endangered/threatened species or do they cover a continuum from common to rare?

Do you feel that the development and use of criteria has been effective for determining if a species should be listed? Why or why not?

Have you had much support and/or opposition to the development/use of criteria in listing species? Please explain from whom and why? (Was it opposition to the concept of criteria, specific criteria or certain species?)

How have you dealt with opposition to the use of criteria?

Are there any opponents of criteria that you would recommend we speak with?

Is there any advice you would want to give to states considering developing and using listing criteria?

How can we get a copy of the criteria?

If no, why not?

Appendix D. Example Listing Criteria/Guidelines from Other States

Criteria in Statute or Administrative Rule –

- **Maryland**

Qualitative Criteria/Guidelines from Other States –

- **Ohio**
- **New York**
- **Maine**
- **Michigan**

Quantitative Criteria/Guidelines from Other States –

- **Colorado**
- **Missouri**
- **Nebraska**