A Brief Guide to Conservation Biology Resources.

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January, 2000 for Joel Pagel of Region 5, USDA Forest Service.

There has been a veritable explosion of resources over the past 10 years for conservation biologists. What follows is not meant to be a comprehensive list. Instead, this constitutes what we think are highlights in a very large literature. In particular, the journal articles cited are a combination of classic or benchmark papers in the field and a somewhat more eclectic suite of recent papers that represent examples of the application of various conservation strategies.

1. Journals

General Conservation Journals:

http://www.wkap.nl/jrnltoc.htm/0960-3115


http://www.consecol.org/Journal/

http://www.jstor.org/journals/10510761.html

Journal of the British Ecological Society


Journal of the Society for Ecological Restoration.

In addition, many taxon specific journals publish lots of conservation. For example:

http://www.interscience.wiley.com/jpages/1052-7613/

http://www.wkap.nl/jrnltoc.htm/1386-2588


There are also numerous region specific journals that publish conservation research. For example:

- **Great Basin Naturalist.** Irregular. Brigham Young University. Provo, UT.

- **Northwest Science.** Quarterly. Washington State University Press. Pullman, WA.

There are also journals targeted toward conservation managers, such as:

- **Natural Areas Journal.** Quarterly. Natural Areas Association, Rockford, IL.

- **Restoration and Management Notes.** Semi-annual. University of Wisconsin Press Madison, WI

Many useful statistics packages exist. Here are a couple that are easy to use and cheap:

  This software lets you use an extraordinary graphical interface to display and analyze data. JMP is software for interactive statistical graphics and includes: a spreadsheet; a broad range of graphical and statistical methods; options to highlight and display subsets of data; data management tools; a calculator for each column; a facility for grouping data and computing summary statistics; special plots, charts and communication capability; tools for moving analysis results between applications and printing; and a scripting language for saving frequently used routines.

- **Statistix for Windows.** Tallahassee, Florida: Analytical Software.
  Statistix is a very fast, easy-to-use data analysis program designed to encourage you to “play” with your data. Manipulating data becomes simple and straightforward, allowing you to focus on your research and not your software.

Simulations are often used to project scenarios or predict future population. While these can be dangerous when used inappropriately, several packages are available to help. Here are a couple examples.

- **Ecobeaker 2.0.** Ithaca, NY: (Eli Meier, 1998.) (Uses Quicktime software from Apple)
  This is the premier program for teaching ecology, conservation biology, and evolutionary biology at the university level. It lets students see population and community level dynamics on screen while performing the kinds of experiments done by practicing ecologists.

  RAMAS is a microcomputer implementation that simulates discrete-time age- or stage-structured population dynamics. It predicts the behavior of population trajectories driven by stochastic
environmental variables and estimates demographic risks associated with these trajectories such as the probability of extinction or population explosion.
2. Books

In recent years many, many books have emerged on Conservation. In particular, Island Press publishes many books in this area. Other academic presses (e.g., Oxford Univ. Press, Cambridge Univ. Press, Univ. of Chicago Press, Academic Press, Blackwell Scientific, Prentice & Hall) also have books series on conservation. Here is a list of some recent books that you may find useful. I group them into (A) General Conservation; (B) General Ecology; (C) Monitoring; (D) Policy and Law; (E) Restoration; and (F) Other.

(A) General Conservation

This text addresses some introductory concepts in conservation biology and biodiversity, then addresses population- and system-level concerns, and lastly goes over practical applications and human concerns, including management, restoration, and economics.


Provides explicit guidelines on inventorying biodiversity, selecting areas for protection, designing regional and continental reserve networks, managing forest, rangeland and aquatic ecosystems, establishing monitoring programs, and setting priorities.


Conservation policy is shifting away from the preservation of single endangered species toward conservation and management of the interactive networks and large-scale ecosystems on which species depend. This book offers a scientific framework for this new approach, providing a solid basis for future research and development of stronger links between ecology and public policy.

(B) General Ecology

This work includes mathematical models in population biology and ecology including exponential, logistic and age-structured population growth, along with models on metapopulation dynamics, competition, predation, and island biogeography.

(C) Monitoring

Experts summarize the monitoring of a wide range of different plants and animals. This book identifies the need for long-term surveying in a standardized way, reviews work in progress, and recommends procedures for recording various taxa.


Herpetologists recommend ten standard sampling procedures for measuring and monitoring amphibian and many other populations. They provide a detailed protocol for each procedure’s implementation, a list of necessary equipment and personnel, and suggestions for analyzing the data.


This is a practical introduction to the subject of monitoring ecological and biological change. It discusses the role of different organizations which implement monitoring programs using a wide range of examples, and ends with a focus on the application of ecological monitoring.


This text outlines clearly, with worked examples, the main techniques used by field ecologists to enumerate plants and animals. Each taxonomic group is treated separately, with detailed descriptions of appropriate census methods; their advantages, disadvantages, and biases.

Manual for designing and implementing inventories of mammalian biodiversity, emphasizing formal estimation approaches. It begins with brief natural histories of mammals, then details field techniques for different species. It provides guidelines for study design, discusses survey planning, describes statistical techniques, and outlines methods of translating field data into electronic formats. Includes extensive appendices.

(D) Policy and Law


Case studies of prominent species recovery programs are presented in an attempt to explore and analyze their successes, failures, and problems, and to begin to find new ways of improving the process.


This is an agenda addressing, first, the biological aspects of conservation, including biological surveys, inventory, and monitoring, conservation research, information needs, and human resources. Secondly, it describes the socioeconomic context, including project- or community-level research, international economic research, and global macroeconomic research. Finally, it describes the cultural context, including local management systems, adapting and promoting local knowledge, and priority groups. It ends with a series of recommendations.


Topics covered include: Scientific and policy foundations of biodiversity protection; domestic efforts to establish an effective endangered species protection regime; international biodiversity protection; biodiversity as a genuinely public entity; and the future of biodiversity law.

(E) Restoration


Ecologists discuss the ideas of a synthetic approach to ecological research and discuss its implications both for ecology and for the practice of habitat restoration providing a basis for a stronger and more productive relationship between ecological theory and practice.


Ecologists explore the idea of a synthetic approach, empirical and theoretical, to ecological research, and discuss its implications both for ecology and for the practice of habitat restoration.

(F) Other


Leading experts in the field clarify key elements of sound ecosystem management and offer concrete prescriptions for implementing them.


This book brings together leading ecologists, philosophers, and economists to analyze the issues surrounding the concept of health as it relates to ecosystems. Both theoretical and practical aspects of what constitutes a healthy ecosystem are examined—philosophical and ethical underpinnings as well as implications for public policy and ecosystems management.


This book describes how nature’s benefits, like timber, pest control and soil fertility, are delivered, how important they are to society, and how their value can be incorporated into decision making.

This book begins with a focus of the biology and genetics of rare plant species, and then describes the broad biological principles that are fundamental to the design of any conservation program for rare plants. It then addresses the management and assessment of off-site collections. The final section describes conservation strategies of genetic diversity.


A collection of essays combining theory, lessons learned from the past, and current measures underway to further our understanding of the planet’s resources. It addresses this shift in attitude, why it has occurred, and what is to be done about conserving biological resources.


This collection of essays reflects the wide range of views that are held about what constitutes biodiversity; from its perception in terms of species numbers, categorization of landforms, or different ecological levels, to the view that biodiversity is a dynamic and socio-political necessity for our own survival.


This book gives an evolutionary perspective stressing the need to explore current and long-term issues, highlighting different conservation strategies. It addresses several controversial issues facing conservation biology and their underlying scientific principles.


A user-friendly primer to the essential survey methodologies of quantitative field ecology, or paleoecology, integrating the intuitive approach of the field researcher with the rational analytical tools of the statistician. It is a step by step guide to estimating population densities, determining adequate sample sizes, estimating the relative abundance of species, and measuring and modeling diversity.


This book provides an accessible introduction to ecological concepts for planning professionals and students. It synthesizes and explains important ecological concepts and represents a guide for planners that clearly details how to incorporate conservation plans into their work.


This edited volume focuses on setting the stage for a case study of conservation in the highly agricultural Midwest. The first several chapters describe the primary ecosystems, the second section describes how common conservation issues, such as fire management and genetics of small populations. The final section focuses on describing conservation programs that address these issues.


This is a synthesis of the scientific foundation for the protection and management of biological diversity. Its six sections include: Fitness and Viability of Populations; Patterns of Diversity and Rarity; Their Implications for Conservation; The Effects of Fragmentation; Community Processes; Threats and Management of Sensitive Habitats and Systems; and Dealing With the Real World.
Annotated bibliography to Conservation Biology Literature
Grouped by subject

1.0 Species as Targets of Conservation

Suggests that too much emphasis has been placed on the attributes of species declining toward extinction and not enough emphasis on the processes that cause populations decline and their cures.

Provides quantitative criteria for assessing endangerment based on the probability of extinction within 100 years. This and more recent modifications are becoming the standard for assessing extinction threat and defining threat categories both nationally and internationally.

Reviews recent legal actions associated with the USFWS and implementation of the ESA through listing. In particular, the USFWS is under intense political pressure to save species through other means than the ESA. Several recent decisions not to list have countered consistent recommendations by all biologists involved, leaving the courts to feel that the USFWS may be acting capriciously in listing.

A must read for conservation biologists reviewing island biogeographic theory, simple IUCN reserve design rules, minimum population sizes, the 50/500 rule, fragmentation, corridors, and metapopulations.

1.1 50/500 rule

Abenspurg-Traun, M., and G. T. Smith. 1999. How small is too small for small animals? Four terrestrial arthropod species in different-sized remnant woodlands in agricultural Western Australia. Biodiversity and Conservations 8(5):709-726. Sometimes small remnant habitats are useful, both as stepping-stones or as adequate habitat for small animal populations, despite what the 50/500 rule predicts.


Templeton, A. R. 1994. Biodiversity at the molecular genetic level: experiences from disparate macroorganisms. Philosophical Transactions of the Royal Society of London Biological Sciences 345(1311):59-64. This reviews how genetic diversity, the basis of adaptive flexibility, is measured molecularly. The measures are then linked to the 50/500 rule, emphasizing that ‘universal’ rules like the 50/500 rule are misleading and should not be applied.

1.2 Metapopulations

Hanski, I. 1994. Patch-occupancy dynamics in fragmented landscapes. TREE 9: 131-135 Reviews math and empirical results of studies assessing the behavior of patchy populations and whether or not they function as metapopulations.

1.3 Minimum viable populations / Population viability analysis


Botsford, L. W., and J. G. Brittischer. 1998. Viability of Sacramento River winter-run Chinook salmon. Conservation Biology 12(1):65-79. Several Pacific salmon population characteristics are described and used in viability analysis to create a model that is specific for salmon in the Sacramento River


Kynard, B. 1997. Life history, latitudinal patterns, and status of the shortnose sturgeon, Acipenser brevirostrum. Environmental Biology of Fishes 48(1-4):319-334. Anthropogenic impacts, like dams, fish harvest, dredging, flow regulation, and pollution, have caused shortnose sturgeon populations to fall well below the MVP of 1000 adults for five out of 11 populations. The release of stock cultured fish into the wild populations is not recommended.

Johnson, K. H., and C. E. Braun. 1998. Viability and Conservation of an Exploited Sage Grouse Population. Conservation Biology 13(1):77-84. With 23 years of populations survey data, the viability of this population is analyzed and the current pressures of hunting and habitat degradation are considered in the recommendations.


Morris, W., Doak, D., Groom, M., Kareiva, P., Fieberg, J., Gerber, L., Murphy, P. and D. Thomson. 1999. A Practical Handbook for Population Viability Analysis. The nature Conservancy. Reviews population viability analysis techniques as well as assesses when a formal PVA is called for, versus situations where simple time-series modeling would be preferable.

Shaffer, M. L. 1981. Minimum population sizes for species conservation. BioScience 31:131-134. The paper that started the whole thing by conceptualizing the idea that viable populations ought to be the management objective for conservation.

poor success in reintroduction, displacement of ecosystem protection programs, etc. Despite the seriousness of these limitations, captive breeding programs are on the rise, and for good reason.

Books that address the topic of population viability analysis


1.3 Genetics of conservation


Hamrick, J.L. and M.J.W. Godt. 1990. Allozyme diversity in plant species. In Plant Population Genetics, Breeding, and Genetic Resources (Brown, Clegg,Kahler and Weir, eds). Sinauer, Sunderland, MA. The first in a series of papers where this set of authors analyze the distribution of genetic variation in plants. In particular, they show that certain life history attributes (e.g., dispersal syndrome) are related to genetic diversity. With respect to conservation, this paper shows that there is a pattern whereby rare species tend to have lower overall genetic variation than common ones.


Books that address the topics of genetics and endangered species protection

1.4 Population fragmentation

Bolger DT, Scott TA, Rotenberry JT. 1997. Breeding bird abundance in an urbanizing landscape in coastal Southern California. Cons. Biol. 11:406-21. Bolger et al have used the scrub fragments in San Diego to examine how fragment size and age relates to the ability of these fragments to protect native species diversity. In this paper they look at this issue with respect to breeding birds.

Bolger DT, Alberts AC, Sauvajot RM, Potenza P, McCalvin C, et al. 1997. Response of rodents to habitat fragmentation in coastal southern California. Ecol. Appl. 7:552-63. Bolger et al have used the scrub fragments in San Diego to examine how fragment size and age relates to the ability of these fragments to protect native species diversity. In this paper they look at this issue with respect to small rodents.

Fahrig, L. and Merriam, G. 1994. Conserving fragmented populations. Conservation Biology 8:50-59. Argues that general models of fragmentation are not sufficient because they do not include the spatial structure of the patches and that this is of critical importance. Also argues for
a direct empirical link in modeling efforts so as to focus models on critical attributes such as the dispersal capabilities of the target organism.


### 1.6 Complex Interspecific Interactions


### 1.7 Demographic Studies

Schemske DW, Husband BC, Ruckelshaus MH, Goodwillie C, Parker IM, et al. 1994. Evaluating approaches to the conservation of rare and endangered plants. *Ecology* 75:584-606. *By surveying recovery plans for vascular plants, the authors argue that there is not nearly enough attention devoted toward collecting basic demographic information on endangered species. The authors propose some simple models to remedy these shortcomings.*


### 1.8 Recovery Planning and Habitat Conservation Plans

Clark, T.W. 1996. Appraising threatened species recovery efforts: practical recommendations. Pages 1-22 in *Back from the Brink: Refining the Threatened Species Recovery Process* (S. Stephens and S. Maxwell, eds.). Surrey Beary and Sons. *Suggests an alternative conceptual model for developing plans for recovering endangered species. These include a formal problem orientation and a mechanism for appraising success or failure. By doing this, one can formalize the process of learning from actions taken and offer concrete recommendations for future management.*


Smallwood, K. S., B. Wilcox, R.Leidy, K. Yarris. 1998. Indicator assessment for habitat conservation plan of Yolo County, California, USA *Environmental Management* 22(6):947-958. *With the goal of maintaining the integrity of a given HCP, these authors have created a method for planners to rank land parcels based on their ecological integrity, collateral value, and conservation potential. Examples of how this technique can be applied to a HCP are given.*

Tear, T.H., J.M. Scott, P.H. Hayward and B. Griffith. 1995. Recovery plans and the endangered species act: are criticisms supported by data? Conservation Biology 9:182-195. *Evaluated a set of recovery plans to show that recovery plans are typically data deficient. The authors suggest reasons for patterns in attributes of recovery plans and recommend changes in how recovery plans are written.*
1.9 Translocation of species

Gordon, D.R. 1994. Translocation of species into conservation areas: A key for natural resource managers. Natural Areas Journal 14:31-37. Presents a dichotomous key to aid land managers to make decisions regarding potential translocation projects to augment species conservation efforts. This is particularly useful for plants, but applies to any species.


1.9.1 Management units


Parker, K. M., R. J. Scheffer, and P. W. Hedrick. 1999. Molecular variation and evolutionarily significant units in the endangered gila topminnow. Conservation Biology 13(1):108-116. Genetic data from four populations of the Gila topminnow are compared and evaluated in conjunction with the historical and physical differences between their separate watersheds. Management recommendations are made.

2.0 Communities as Targets of Conservation


Schwartz MW. 1994. Conflicting goals for conserving biodiversity: issues of scale and value. Nat. Areas J. 14: 213-16. Describes how conservation objectives at the community level may conflict with species or ecosystem goals. As a result, this paper suggests explicit delineation of conservation goals in order to develop plans.

Shugart H, West D. 1981. Long-term dynamics of forest ecosystems. Am. Sci. 69:647-52. Not really a conservation paper at all, but it briefly describes the way plant ecologists view forest communities and sets the stage for how conservation strategies for communities would be different than those for species.

Books describing communities as targets for conservation and how to prioritize them


2.1 Community integrity
Moyle, P. B. and P. J. Randall. Evaluating the biotic integrity of watersheds in the Sierra Nevada. Conservation Biology 12(6):1318-1326. 100 watersheds in the Sierra Nevada were evaluated for health using an index of biotic integrity developed by the authors. Low scores were attributed to a combination of the presence of dams, exotic fish species, high road density, and high land use intensity.
Smallwood, S. K. 1994. Site invasibility by exotic birds and mammals. Biological Conservation 69(3):251-259. The eradication of exotics may not actually improve the integrity of reserve systems; instead, it may just be an expensive and useless attack on the symptom of low integrity rather than actual integrity.
Taft, J.B., G.S. Wilhelm, D. Ladd, and L.A. Masters. 1998. Floristic quality assessment for vegetation in Illinois: A proposed method for assessing vegetation integrity. Erigenia. You won’t find this paper in any libraries, but it is very important. Basically, the authors develop a method first proposed in The Flora of the Chicago Region by Swenk and Wilhelm that suggested that one can assess the biological integrity (or quality) of a site by looking at the constituent plant community. If plant species vary in their sensitivity to degradative forces (bad disturbances), then the lack of these species from otherwise intact sites implies habitat degradation. The authors propose a systematic metric for quantifying this through rating all plant species.

2.2 Disturbance / fire in natural systems
Hobson, K. A., and J. Schieck. 1999. Changes in bird communities in boreal mixedwood forest: harvest and wildfire effects over 30 years. Ecological Applications 9(3):849-863. Even after 28 years following disturbance, there was a lack of bird community convergence, meaning that the maintenance of biodiversity by foresters is an extremely long-term task.
Schwartz MW, Hermann SM. 1997. Midwestern fire management: prescribing a natural process in an unnatural landscape. In Conservation in Highly Fragmented Landscapes, ed. MW Schwartz, pp. 213-33 New York: Chapman & Hall. 436 pp. Generally reviews the ways by which applying a managed fire regime may act as a surrogate for natural disturbance, but also cautions against thinking that managed fire is a full surrogate for natural fire as managed burning programs are constrained by safety and practicality such that they are not likely to reach the full spectrum of variation in natural fire regimes.

2.3 Edge Effects
Suarez AV, Bolger DT, Case TJ. 1998. Effects of fragmentation and invasion on native ant communities on coastal southern California. Ecology 79:2041-56. More of the work from Bolger’s group working on the fragments in San Diego. This group has used a group of different sized and aged scrub fragments to assess the effects of edge and fragment size on a variety of groups of organisms.
Suarez AV, Pfennig KS, Robinson SK.1997. Nesting success of a disturbance-dependent songbird on different kinds of edges. Cons. Biol. 11:928-35 More of the work from Bolger’s group working on the fragments in San Diego. This group has used a group of different sized and aged scrub fragments to assess the effects of edge and fragment size on a variety of groups of organisms.
3.0 Ecosystem Targets of Conservation


**Books that focus on ecosystem conservation**


3.1 Ecosystem Health

Armitage, M. H. 1999. The euryhaline gobiid fish, Gillichthys mirabilis Cooper 1864, second intermediate trematode, Pygiospoides spindalis Martin 1951. Bulletin Southern California Academy of Sciences 98(2):75-79. *In this example, trematodes are used as indicators of Mugu lagoon ecosystem health.*

Costanza, R. 1992. Toward an Operational Definition of Ecosystem Health. Pp. 239-256, in *Ecosystem Health*. R. Costanza, B. G. Norton, and B. D. Haskell, eds. Island Press; Covelo, CA, 269 pp. *Summarizes concept definitions of Ecosystem Health, then attempts to develop a practical definition encompassing vigor, organization, and resilience within the system (Table 2).*


Wolfe, M., D. Norman. 1998. Effects of waterborne mercury on terrestrial wildlife at Clear Lake: Evaluation and testing of a predictive model. Environmental Toxicology and Chemistry 17(2):214-227. *Mercury (Hg) contamination is assessed through the analysis of mammalian and avian tissues. The results confirmed the accuracy of a predictive model that could be used for other aquatic systems containing mercury.*

**Books on Ecosystem Health as the Criteria for Conservation Management**


3.2 Range of Variability

general summary of how to apply historic range of variability as a concept for ecosystem management.

Fule, P. Z., W. W. Covington, M. M. Moore. 1997. Determining reference conditions for ecosystem management of southwestern ponderosa pine forests. Ecological Applications 7(3):895-908. Because of fire exclusion, tree density has gone from 148 tree/ha in 1883 to 1265 trees/ha and a very different species composition. “The comparison shows that the contemporary forest is well above the range of presettlement variability in forest density”.


3.3 Core-buffer area concepts


Key papers not included in the binder


3.4 Ecosystem Function as a target


Schwartz MW, Brigham CA, Hoeksema JD, Lyons KG, Mills MH et al. Linking biodiversity to ecosystem function: implications for conservation ecology. Oecologia In press. Evaluates data and theory to assert that there is not sufficiently strong evidence for us to make the argument that in order to preserve ecosystem function that we need to conserve natural levels of diversity. Despite the appealing nature of this argument, most ecosystems appear to function at near pristine levels with a small fraction of their natural diversity.
4.0 Surrogates for Conservation Evaluation


Simberloff, D. 1998. Flagships, umbrellas, and keystones: is single-species management passé in the landscape era. *Biological Conservation* 83:247-257. *Examines problems with the indicator, umbrella and flagship species concepts. Suggests that keystone species may be a more appropriate focus for applying single-species concepts to saving habitats and landscapes. This paper also examines the potential problems with adaptive management and ecosystem management concepts.*

**Books on the topic**

4.1 Flagships


White, P. C., K. W. Gregory, P. J. Lindley, and G. Richards. 1997. Economic values of threatened mammals in Britain: a case study of the otter *Lutra lutra* and the water vole *Arvicola terrestris*. The perceived economic value of conserving these two species is evaluated through a telephone survey. *The results suggest that public opinion may be just as important as rarity and endangerment in the allocation of funding.*

4.2 Umbrella Species

Berger J. 1997. Population constraints associated with the use of black rhinos as an umbrella species for desert herbivores. *Cons. Biol.* 11:69-78. *An empirical study of rhinos and associated African ungulates to assess the utility of rhinos as umbrella species. The results were mixed. Rhinos were good umbrellas in some senses and poor ones in others.*

Fleury, S. A., P. G. Mock, and J. F. O’Leary. 1998. Is the California Gnatcatcher a good umbrella species. *Western Birds* 29(4):453. This project, designed in a 52,414 ha study area, suggests that the California Gnatcatcher is only a good umbrella species for species with similar habitat requirements.

Launer, A. E., and D. D. Murphy. 1994. Umbrella species and the conservation of habitat fragments: a case of a threatened butterfly and a vanishing grassland ecosystem. *Biological Conservation* 69(2):145-153. *Because of a tenuous linkage between the butterfly’s population scale and the scale of its associated plants, the authors conclude that all of the fragments containing these butterflies must be conserved if the butterfly is to be effectively used as an umbrella species.*
4.3 **Keystone Species**

4.4 **Indicator species**
Chase, M. K., J. T. Rotenbury, and M. D. Misenhelter. 1998. Is the California Gnatcatcher an indicator of bird-species richness in coastal sage scrub? Western Birds 29(4):468-474. *Two years of point count data covering 17 sites in three counties show that the California Gnatcatcher is not a good indicator species.*
Taggart, J.B. 1994. Ordination as an aid in determining priorities for plant community protection. *Biological Conservation* 68:135-141. *Ordination has frequently been used to delineate covariation in plant species in order to define communities. Here these researchers use data from savannas of the southeastern US to examine the utility of these data in order to set conservation priorities by identifying sites that ordinate the furthest from already protected sites.*

**Key papers not included in the binder**
Prendergast JR, Eversham BC. 1997. Species richness covariance in higher taxa: Empirical tests of the biodiversity indicator concept. *Ecography* 20:210-16. *Prendergast has had a series of papers on indicators, most of which show that they don’t work very well.*

4.5 **Hotspots and the biogeography of diversity**
Balmford A. 1998. On hotspots and the use of indicators for reserve selection. *TREE* 13:409. *Reviews work on testing hotspots (covariation in diversity), and suggests that this may not be the right question to ask when prioritizing sites for protection.*
Dobson AP, Rodriguez JP, Roberts WM, Wilcove DS. 1997. Geographic distribution of endangered species in the United States. Science 275:750-52. Shows that most endangered species are found in areas of high human population density. Thus the protection of large tracts of land may miss the species.


Quinn, R.M., Lawton, J.H., Eversham, B.C. and Wood, S.N. 1994. The biogeography of scarce vascular plants in Britain with respect to habitat preference dispersal ability and reproductive biology. Biological Conservation 70:149-157. Using the British Ordnance Survey National Grid 10km² data set of rare vascular plants to query where centers of loci are for different species and relating these to habitat, species dispersal ability and reproductive biology. Species with poor dispersal ability tend to have more locally clustered distributions than species with good dispersal ability. The authors suggest that reintroduction and translocation should be used to supplement natural dispersal in fragmented landscapes.


Williams P, Gibbons D, Margules C, Rebele A, Humphries C, et al. 1996. A comparison of richness hotspots, rarity hotspots, and complementary areas conserving diversity of British birds. Cons. Biol. 10:155-74. Williams has developed a global diversity mapping algorithm that has been used to find hotspots and minimum sets to capture diversity. Here is an empirical example.

4.6 Taxonomic patterns in rarity


Kunin, W.E. and Gaston, K.J. 1993. The biology of rarity: patterns, causes and consequences. Trends in Ecology and Evolution 8:298-301. Reviews literature on life history attributes associated with species that are rare because of being geographically limited, habitat specialists, or having small population sizes. Refocuses research effort on delineating these patterns and suggests a distinction between attributes that increase the propensity of a species becoming rare versus attributes that facilitate a species survival despite being rare.


Milligan, B. G., J. Leebens-Mack, and A. E. Strand. Conservation genetics: beyond the maintenance of marker diversity. Molecular Ecology 3(4):423-435. DNA sequence variation associated specifically with genealogical analytical techniques may be the most valuable way to use molecular data in conservation biology. This would provide the means for interpreting otherwise unavailable, long-term demographic information for predicting species viability.


The authors show that rarity is not randomly distributed among taxa. In fact it is highly skewed. Taxonomic groups of mammals and birds with few species tend to be over-represented by rare taxa.


### 4.7 Extinction Risk

Lande, R. 1999. Extinction risks from anthropogenic, ecological, and genetic factors. Pp. 1-22 in Landweber, L.F., and A.P. Dobson (Eds.). *Genetics and the extinction of species; DNA and the conservation of biodiversity.* Princeton Univ. Press. Reviews types of stochastic behavior in populations and the population sizes over which they are likely to be an important factor in predicting extinction likelihood. Important because it gives good tangible examples of these factors.


### 5.0 Designing Protection Programs


Books on the topic.


### 5.1 Reserve Size / SLOSS

Andersen, M. C., D. Mahato. 1995. Demographic models and reserve designs for the California spotted owl. *Ecological Applications* 5(3):639-647. The SOHA plan uses a large number of small reserves, while the HCA plan uses a smaller number of relatively large reserves. The two plans are compared and the HCA plan seems to lead to a more viable population.


Noss and Cooperrider. 1994. Island Biogeography and SLOSS. Pp. 138-142. Single Large or Several Small, a controversy resolved by changing the “or” to “and” and getting: large and several.


Schultz, C. B. 1998. Dispersal behavior and its implications for reserve design in a rare Oregon butterfly. Conservation Biology 12(2):284-292. The dispersal patterns of these butterflies indicates that many small patches of habitat would be a more effective reserve design than would a single corridor.

Schwartz, M.W. 1999. Choosing the appropriate scale of reserves for conservation. Annual Review of Ecology and Systematics 30:83-108. Counters a recent trend to an increasing emphasis on large sites and conservation at higher levels organization to suggest when conservation on small sites is the appropriate strategy, and when species level programs may reasonably take precedence over community or ecosystem approaches.


5.3 GAP analysis


Prendergast, J. R., R. M. Quinn, and J. H. Lawton. 1999. The gaps between theory and practice in selecting nature reserves. Conservation Biology 13(3):484-492. Convenient new tools for designing reserves (like gap analysis) have been largely ignored by planners simply because they are unaware of them. This problem is discussed along with advantages of several of these tools.

Scott, J. M., and B. Csuti. 1997. Noah worked two jobs. Conservation Biology 11(5):1255-1257. “[Most] natural areas have been set aside because they have little economic value, because of their scenic appeal, and because the opportunity to designate them presented itself.”

representation of biological diversity, enabling managers to fill the gaps by improving management plans.

**Book on topic (empirical example)**


### 5.4 Minimum sets

Ando, A., Camm, J., Polasky, S. and Solow, A. 1998. Species distributions, land values, and efficient conservation. Science 279: 2126-2128. Several researchers have developed algorithms to maximize efficiency in the capture of rare and endangered species by selecting reserves that contain the largest numbers of unprotected species. In this paper, Ando et al. expand on these methods by altering reserve selection regimes based on cost of land. For example, it may be more efficient to protect two cheaper parcels of land that contain fewer species individually, than it would be to purchase the one parcel with the most species.


### 5.5 Do Corridors Work?


6.0 Management Strategies

6.1 Adaptive management


6.2 Ecosystem Management


Frissell, C. A. 1993. Topology of extinction and endangerment of native fishes in the Pacific Northwest and California (USA). Conservation Biology 7(2):342-354. The historic range and present status of the Coho Salmon and Chum Salmon is mapped from previously available data. The usefulness of such a map to managers is discussed.


7.0 Restoration Ecology


Kupferberg, S. J. 1996. Hydrologic and geomorphic factors affecting conservation of a river-breeding frog (Rana boylii). Ecological Applications 6(4):1332-1344. Evidence shows that this CA species of special concern relies on very specific channel conditions for successful reproduction. Plans for the restoration of river channels should take these data into consideration.

Packard has been at the forefront of mobilizing volunteers to restore prairies and savannas in Illinois. Here is his take on restoration.

Warren, R. D. A. Waters, J. D. Altringham, and D. J. Bullock. 2000. The distribution of Daubenton’s bats (Myotis daubentonii) and pipistrelle bats (Pipistrellus pipistrellus) (Vespertilionidae) in relation to small-scale variation in riverine habitat. Biological Conservation 92(1):85-91. The enhancement of vegetation and channel structure will be a valuable approach for promoting the sustainability of these bat populations.


8.0 Protection and the Law


Zedler, J. B. 1996. Coastal mitigation in southern California: the need for a regional restoration strategy. Ecological Applications 6(1):84-93. Four mitigation case studies are discussed and alternative approaches are presented. The intention here is to help other regions avoid the same problems encountered in southern California.


Sierra Club v. Marita, 46 F.3d 606 (7th Cir, 1995).

Books on topic

9.0 Books on the policy environment of the environment