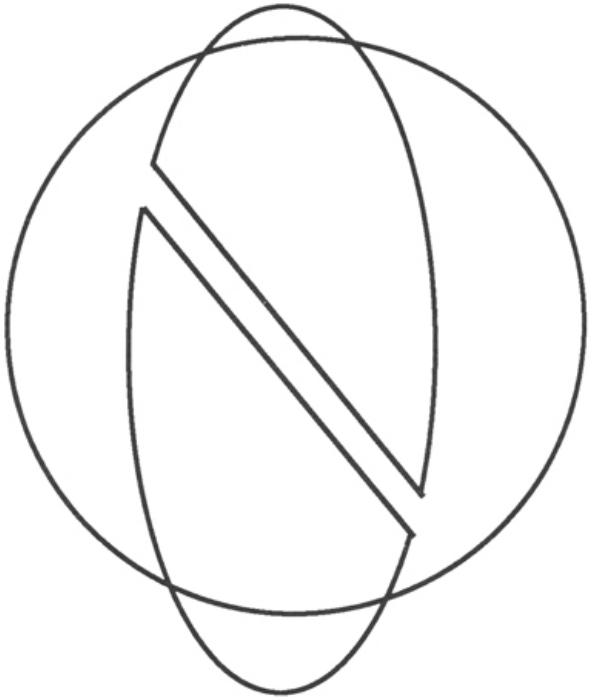
BULLFROG FILMS PRESENTS



BIODIVERSITY: THE VARIETY OF LIFE

STUDY GUIDE

by Mitch Friedman
Executive Director
Greater Ecosystem Alliance

BIODIVERSITY: THE VARIETY OF LIFE
45 minute video
Narrated by Mitch Friedman
Produced by Dal Neitzel

Available from:
Bullfrog Films
PO Box 149
Oley PA 19547

© Copyright Bullfrog Films, Inc. 1992

This Study Guide may be copied for Educational use.

BIODIVERSITY: The Variety of Life

STUDY GUIDE

By Mitch Friedman

BIODIVERSITY. It's a new word, dating only to the early 1980's. But the ideas encompassed by this word have been familiar to people for thousands of years: That all things are connected in a web of life. Biodiversity relates those connections by describing the function of variety, between individuals of a species, between the many species themselves, between the ecosystems which species comprise and reside in.

Inseparable from these levels of variety, or diversity, are the connections between the levels. For instance, genetic variation is the builder of new species, and changes in the mix of species occupying an area changes the nature of the ecosystem there. In this way, biodiversity even encompasses the very processes of life, such as evolution.

Today biodiversity is in dramatic decline. Due to the actions of humans, we are losing variation faster than at any other time in Earth's past. Reversing this trend will require in-depth understanding of the conditions needed to sustain biodiversity. That is the subject of this video tape.

The scientific study of biodiversity and its protection is called conservation biology. This is a very young discipline but is already playing a vitalizing role in science and in politics. Activists and some political leaders are using conservation biology in attempts to better protect nature. This video tape serves as an introduction to some concepts from conservation biology. Many of the ideas related in the video tape were drawn from the references below. These references are listed by category as they appear in the tape.

Glossary

Ancient Forest- A forest which has not experienced a major disturbance for a long enough time that extremely large trees, snags and logs occur. Also called old-growth forest.

Corridor- A connective strip linking two reserves, functions as habitat for native species so as to join the two reserves into one.

Cumulative Effect- The totality of a number of specific negative impacts (e.g., clearcuts, dams) which has a combined effect greater than the sum of the individual impacts.

Disturbance- An event, such as fire or windstorm, which causes a rapid change in an ecosystem.

Edge Effects- Conditions which exist along the interface of two different biological communities (i.e., ancient forest and clearcut) which alter the quality of habitat for some species. For instance, humidity and temperature changes near an edge of a forest.

Ecosystem- The living and nonliving components of an area and their interactions.

Extinction- The loss of a species from an area within its historical range. Extinction may refer to a population disappearing from a local area (often termed extirpation) or to global disappearance.

Fragmentation- The combined effect of disturbances (generally human-caused) on habitat in an area. For instance, clearcuts and roads not only radically change habitat in a specific area, but also cause edge effects and spread of non-native species. All of these effects together are termed fragmentation.

Habitat- The environment in which an organism or species fulfills some aspect of its biological needs, i.e., food, shelter, breeding.

Island Biogeography- The theory that isolated areas of habitat function similar to islands at sea. Small "islands, and those that are farther from other islands, support fewer species than large and/or near islands.

Landscape Ecology- The study of how ecosystems interact within and between one another (at various scales, such as stands or watersheds) across the land.

Minimum Dynamic Area- The smallest size an ecosystem (or reserve) can be while still maintaining internal recolonization sources under natural disturbance patterns.

Native- A species which was historically (before human alteration) present in an area.

Population- The interacting members of a species in an area.

Recolonization- A species may reinhabit an area after being extinct there. Recolonization may occur by individuals moving to the area from adjacent or nearby habitats where the species had survived whatever event(s) caused the extinction elsewhere.

Reserve- An area of land dedicated as habitat for native species and ecosystems.

Riparian- This area along the banks of a stream or river which is influenced (e.g., more moist or sandy soil) by the watercourse. Vegitation may be very different in riparian areas than in upland areas. Riparian areas may extend several hundred feet from the water.

Shifting Mosaic Steady State- As disturbances effect an area from year to year, the location of specific ecosystems will change creating a "shifting mosaic" of ecosystems or habitats. But even though the actual locations change, the amount of each habitat over a large area may remain somewhat constant (steady state).

Snag- Standing dead tree.

Succession- Changes which occur in an ecosytem over time. At different ages, different species and structures (e.g., large trees or logs) occur.

Viable Population- The size of a population (number of interacting individuals) necessary to sustain the long-term health of that population. This number may be quite large since populations are always confronted with genetic, demographic and environmental stresses.

Watershed- The area of land drained by a particular river system. Of course, every inch of land on Earth is in some watershed.

Bibliography

Biodiversity

Norse, E.A. and others. 1986. Conserving biological diversity in our national forests. Washington, D.C.: The Wilderness Society.
(Reviews impacts of forestry practices on biodiversity.)

Noss, R.F. 1991. What can wilderness do for biodiversity? Wild Earth Jrnl., Summer: 51-6.
(A scientific description on why some species require big wilderness.)

U.S. Office of Technological Assessment. 1987. Technologies to maintain biological diversity. OTA-F-331, GPO Stock No. 052-003-01058-5, Government Printing Office, Washington, D.C.
(Describes biodiversity and its benefits to humanity.)

Science 253:717-62.
(This issue of the respected scientific journal offers several articles on the subjects of biodiversity decline and protection.)

Wilson, E.O., editor. 1988. Biodiversity. National Academy Press. 534 pp.
(Comprehensive, includes contributions from many distinguished scientists.)

Conservation biology

Conservation Biology. This superlative quarterly scientific journal may be subscribed to by sending $39.50 to Blackwell Scientific Publications, 3 Cambridge Center, Cambridge Mass, 02142.

Frankel, O.H. and M.E. Soule, editors. 1981. Conservation and evolution. Cambridge: Cambridge University Press.
(This and the following two books provide comprehensive overviews on the development of conservation biology, written by scientists.)

Leopold, Aldo. 1949. A sand county almanac. NY: Oxford Press.
(Predates conservation biology, but belongs on every reading list. The best book ever written.)

Soule, M.E. and B.A. Wilcox, editors. 1980. Conservation biology: An evolutionary-ecological perspective. Sunderland: Sinauer. 385 pp.

Soule, M.E. editor, 1986. Conservation biology: the science of scarcity and diversity. Sunderland: Sinauer Assoc. 584 pp.

Soule, M.E. 1985. What is conservation biology? Bioscience 35(11):727-34.
(Background on this new discipline written by its primary founder.)

Northwest Ancient Forest

Carey, A.B. 1989. Wildlife associated with old-growth forests in the Pacific Northwest. Natural Areas Journal 9(3):151-162.
(Excellent summary of knowledge to-date.)

Maser, C. 1989. The forest primeval. Sierra Club Books. 282 pp.
(This and the next book are excellent lay descriptions of forest ecology by a noted scientist.)

Maser, C. 1988. The redesigned forest. R&E Miles. 234 pp.

Norse, E., editor. 1990. Ancient forests of the Pacific Northwest. The Wilderness Society and Island Press. 327 pp.
(Very comprehensive, written for lay readers.)

Ruggiero, L., and others, coordinators. 1991. Wildlife and vegetation of unmanaged Douglas-fir forests. USDA Forest Service, PNW-GTR-285. 533 pp.
(All the latest science on wildlife habitats in ancient forests.)

Spies, T.A., and J.F. Franklin. 1988. Old growth and forest dynamics in the Douglas-fir region of western Oregon and Washington. Natural Areas Journal 8(3):190-201.
(Excellent summary of the science.)

Extinction

Ehrlich, P.R. 1980. Extinction, reduction, stability and increase: the response of checkerspot butterfly (Euphydryas) populations to the California drought. Oecologia 46(1):101-105.
(Localized extinctions are natural and common, but are offset by subsequent recolonization.)

Ehrlich, P.R. and A. Ehrlich. 1981. Extinction: The causes and consequences of the disappearance of species. Random House.
(General and popular reference.)

Myers, N. 1985. The end of the line. Natural History 94(2).
(A layperson's discussion of the current extinction crisis and implications for evolution: "the death of birth".)

Myers, N. 1987. The extinction spasm: synergisms at work. Conservation Biology 1:14-21.
(Estimates present rates of extinctions.)

Island Biogeography

Harris, L.D. 1984. The fragmented forest: island biogeography theory and the preservation of biotic diversity. Chicago: Univeristy of Chicago Press.
(Northwest ancient forests and island biogeography.)

MacArthur, R.H. and E.O. Wilson. 1967. The Theory of island biogeography. Princeton: Princeton University Press.
(The original reference.)

Newmark, W.D. 1987. A land-bridge perspective on mammalian extinctions in western North American parks. Nature 325:430-2.
(Extinctions occurring in many national parks, relating size of parks to numbers of extinctions.)

Schafer, C.L. 1990. Nature Reserves: Island theory and conservation practice. Washington, D.C.: Smithsonian Institution Press.
(Comprehensive review of ilsand biogeography theory and conservation practice.)

Soule, M.E., B.A. Wilcox and C. Holtby. 1979. Benign neglect: A model of faunal collapse in the game reserves of East Africa. Biological Conservation 15:259-272. (Applications of the theory predict extinctions in even the world's largest nature reserves.)

Weisbrod, A.R. 1976. Insularity and mammals species numbers in two national parks. Pages 83-87 in R.M. Linn, ed., Proceedings of the 1rst Conference on

Scientific Research in the National Parks. USDOI National Park Service Transactions and Proceedings, Series 5. 2 vols.
(Extinctions in Mt. Rainier National Park.)

Population viability

Shaffer, M.L. 1981. Minimum population sizes for species conservation. BioScience 31:131-134.
(The first research paper on this topic.)

Soule, M.E., editor. 1987. Viable Populations for Conservation. Cambridge: Cambridge University Press.
(Comprehensive and detailed book by the master.)

Soule, M.E. and D. Simberloff. 1986. What do genetics and ecology tell us about the design of nature reserves? Biological Conservation 35:19-40. (Thorough review relating population viability to conservation.)

Thomas, C.D. 1990. What do real population dynamics tell us about minimum viable population sizes? Conservation Biology 4(3):324-5.
(Finds that observations of actual populations in nature support findings of computer models: while variation exists between species, in general populations must include sometimes thousands of individuals to be viable.)

Greater Ecosystems

Clark, T.W. and D. Zaunbrecher. 1987. The Greater Yellowstone Ecosystem: The ecosystem concept in natural resource policy and management. Renewable Resource Jrnl. 5(3):8-16.
(Discusses the history of the concept.)

Friedman, M. 1988. Forever wild: Conserving the Greater North Cascades Ecosystem. Bellingham: Mountain Hemlock Press. 96 pp.
(Applies island biogeography theory to a comprehesive wilderness proposal for the North Cascades.)

Grumbine, E.R. 1990. Protecting biological diversity through the greater ecosystem concept. Natural Areas Jrnl 10(3):114-20.
(General scientific description of how the concept applies to biodiversity protection.)

Keiter, R.B. and M.S. Boyce. 1991. The Greater Yellowstone Ecosystem. Hew Haven: Yale University Press. 428 pp.
(Up-to-date science and policy in comprehensive format.)

Landscape Ecology

Bormann, H.F. and G.E. Likens. 1979. Pattern and Process in a Forested Ecosystem. New York: Springer-Verlag.
(From long-term research in a single watershed originated many concepts, including that of "shifting mosaic steady state.")

Christensen, N.J. 1988. Succession and natural disturbance; paradigms, problems, and preservation of natural ecosystems. Pp. 62-86 in J.K. Agee and D.R. Johnson, eds., Ecosystem management for parks and wilderness. Seattle: University of Washington Press.
(Applies landscape concepts to conservation.)

Forman, R.T. and M. Godron. 1981. Patches and structural components for a landscape ecology. BioScience 31(10): 733-740.

Forman, R.T. and M. Godron. 1986. Landscape Ecology. New York: John Wiley and Sons.
(Considered the main source; using as text in many courses.)

Morrison, P. H. and F.J. Swanson. In press. Fire history in two forest areas of the central-western Cascade Range of Oregon. USDA Forest Service, Pacific Northwest Research Station, Portland, OR.
(Source of the figure used in the video tape which showed the pattern of forest stand types related to fire history.)

Pickett, S.T.A., and J.N. Thompson. 1978. Patch dynamics and the design of nature reserves. Biological Conservation 3:27-37.
(Introduced the concept of "minimum dynamic area.")

Shugart, H.H., and D.C. West. 1981. Long-term dynamics of forest ecosystems. American Scientist 69: 647-652.
(Maintaining a shifting mosaic steady state may require a reserve 50-100 times the size of that ecosystem's largest natural disturbance.)

Urban, D.L., R.V. O'Neill, and H.H. Shugart. 1987. Landscape ecology: a hierarchical perspective can help scientists understand spatial patterns. BioScience 37(2):119-127.
(Relates how landscape concepts apply at many scales, using disturbance (from tree-fall gaps to large forest fires) as examples.)

White, P.S. 1987. Natural disturbance, patch dynamics, and landscape patterns in natural areas. Natural Areas Journal 7(1):14-22.
(Excellent summary.)

Connectivity

Defenders of Wildlife. 1989. In defense of wildlife: Preserving communities and corridors. Washington, D.C. 96 pp.
(Describes connectivity in lay language. May also be obtained through Island Press.)

Harris, L. 1988. Landscape linkages: the dispersal corridor approach to wildlife conservation. Transactions: N. Amer. Wildl. and Nat. Res. Conf. 53:595-607.

Harris, L. and J. Eisenberg. 1990. Enhanced linkages: Necessary steps for success in conservation of faunal diversity. In: D. Western and M.C. Pearl, editors, Conservation for the Twenty-first Century. New York: Oxford Univ. Press.
(Reviews develpment of corridor concepts in Florida.)

Hudson, W.E., editor. 1991. Landscape linkages and biodiversity. Defenders of Wildlife and The Island Press. Covelo, Ca.
(Compilation of scientific papers on the values of wildlife habitat corridors.)

McComb, W. In press. Riparian zones as habitat and movement corridors. Proceedings of the workshop: Wildlife diversity and landscape patterns in Northwest coastal forests. Coastal Oregon Productivity Enhancement, Corvallis.

Connectivity and landscape-scale reserve systems

Bader, M. 1991. The Northern Rockies Ecosystem Protection Act: A citizen plan for wildlands management. Missoula: Western Wildlands, Summer: 22-28.
(A plan for a system of connected large reserves across a huge region.)

Noss, R.F. 1983. A regional landscape approach to maintain biodiversity. BioScience 33(11):700-706. (This and the following two papers provide much of the direction for regional reserve design.)

Noss, R.F. 1987. Protecting natural areas in fragmented landscapes. Natural Areas Journal 7(1)2-13.

Noss, R.F. and L.D. Harris. 1986. Nodes, networks, and MUMs: preserving diversity at all scales. Environmental Management 10:299-309.

Pace, F. In press. The Klamath corridors: Preserving biodiversity in the Klamath National Forest. In: D. Western and M.C. Pearl, editors, Conservation for the Twenty-first Century. New York: Oxford Univ. Press. (Application of corridors in a landscape proposal for the Greater Klamath Mountains Ecosystem.)

Perry, D.A., M.P. Amaranthus, J.G. Borchers and S.L. Borchers. 1990. Species migration and ecosystem stability during climate change: the belowground connection. Conservation Biology 4(3):266-74. (One paper incorporating concern for how ecological communities will adjust to changes brought on by global warming.)

Edge effects

Franklin, J.F. and R.T. Forman. 1987. Creating landscape patterns by forest cutting: ecological consequences and principles. Landscape Ecology 1(1):5-18.

Reese, K.P. and J.T. Ratti. 1988. Edge effect: A concept under scrutiny. Trans. North Amer. Wildlife and Nat. Res. Conf. 53:127-36. (Critical review of the edge effect concept.)

Yahner, R.H. Changes in wildlife communities near edges. Conservation Biology 2(4):333-337. (Excellent summary.)

Effects of roads

Adams, L.W. and A.D. Geis. 1983. Effects of roads on small mammals. Journal of Applied Ecology 20:403-415.

Amaranthus, M., R.M. Rice, N.R. Barr and R.R. Ziemer. 1985. Logging and forest roads related to increased debris slides in southwestern Oregon. Journal of Forestry, April:229-33.

Kassworm, W.F. and T.L. Manley. 1990. Road and trail influences on grizzly bears and black bears in northwest Montana. Int. Conf. Bear Res. and Management (8).

Lalo, J. 1987. The problem of road kill. American Forests Sept./Oct.:50-74.
(Estimates that over a million vertebrates die each day on U.S. highways alone.)

Lyon, L.J. 1979. Habitat effectiveness for elk as influenced by roads. Journal of Forestry 77:658-60.

Mech, L.D. 1989. Wolf population survival in an area of high road density. Amer. Midl. Nat. 121:387-9.

Mader, H.J. 1984. Animal habitat isolation by roads and agricultural fields. Biological Conservation 29:81-96.
(Woodland beetles and some mice are shown to seldom cross roads.)

Reh, W. and A. Seitz. 1990. The influence of land use on the genetic structure of populations of the common frog, Rana Temporaria. Biological Conservation 54:239-49.
(A road, which frogs would not cross, seperated one population into two smaller ones.)

Swihart, R.K. and N.A. Slade. 1984. Road crossing in Sigmodon hispidus and Microtus ochrogaster. Jrnl. of Mammalogy 65(2):357-60.
(Some animals won't even cross the rut made by a jeep wheel.)

Thiel, R.P. 1985. The relationship between road densities and wolf habitat suitability in Wisconsin. Am. Midl. Nat. 113:404-7.

Fragmentation

Lehmkuhl, J.F. and L.F. Ruggiero. 1991. Forest fragmentation in the Pacific northwest and its potential effects on wildlife. In: Ruggiero and others, editors, Wildlife and vegetation of unmanaged Douglas-fir forests. Portland, OR, USDA Forest Service PNW-GTR-285.
(Finds that over 80 percent of old-growth dependant species are at high to moderately-high risk of extinction.)

Saunders, D.A. and others. 1991. Biological consequences of ecosystem fragmentation: A review. Conservation biology 5(1):18-33.

Wilcove, D.S. 1987. From fragmentation to extinction. Natural Areas Journal 7(1):23-29.

Wilcove, D., C.H. McLellan, and A.P. Dobson. 1986. Habitat fragmentation in the temperate zone. Pp. in M.E. Soule, ed., Conservation biology: the science of scarcity and diversity. Sunderland: Sinauer Assoc.
(Fragmentation is the primary source of extinctions in temperate areas.)

Alternative forestry

Greater Ecosystem Alliance. 1990. Old forests and new forestry: proceedings of the conference. Bellingham, WA. 36 pp.
(Comprehensive description, contributions from the primary scientists.)

Camp, O. 1984. The forest farmer's handbook: A guide to natural selection forest management. Ashland, OR, Sky River Press. 72 pp.
(Describes the most holistic approach to forestry.)

Fiedler, C. 1992. New forestry: Concepts and applications. Western Wildlands 17(4):2-8.
(Lay article introducing pros and cons of "new forestry.")

Franklin, J.F. 1989. Toward a new forestry. Journal of Forestry. Nov./Dec.:37-43.

Effects of sheep and cattle

Jacobs, L. 1991. Waste of the West: Public lands ranching. Box 5784, Tucson. 602