Alpena-Montmorency
CONSERVATION DISTRICT

BIODIVERSITY

FOREST STEWARDSHIP MANAGEMENT NOTE #37

"The first rule of intelligent tinkering is to save all the parts."

- Aldo Leopold

WHAT IS BIODIVERSITY?

Biodiversity refers to the variety of life within a given area. It includes all the species present, their genetic make-ups, their interactions with each other and the physical environment, and the spatial patterns they form on the landscape. To appreciate the complexity of biodiversity, three interdependent components of diversity must be considered at a variety of geographic scales.

GEOGRAPHIC SCALES OF BIODIVERSITY

1. MICROHABITAT SCALE - As large, mobile organisms, we tend to view areas of similar vegetation as uniform. However, we are becoming increasingly aware that many organisms depend on smaller-scale habitat features, such as the presence of large fallen logs.

2. COMMUNITY SCALE - An ecological community is a relatively distinct grouping of plants and animals in a setting, such as a wet meadow or a jack pine forest. Communities are roughly equivalent to what foresters call stands, wildlife biologists call habitats, and the Stewardship Incentive Program calls management units. Communities typically occupy from less than an acre up to several hundred acres. This is the scale at which most planned management activities occur.

3. OWNERSHIP SCALE - Private landowners are primarily concerned with the land they own. Most private, non-industrial, forest properties contain more than one community type but are smaller than landscapes. This scale is important in that it represents the largest scale at which management activities are easily coordinated across ecological communities.

4. LANDSCAPE SCALE - A landscape is land area in which ecological communities are intermingled in a characteristic pattern. Landscapes are quite variable in size, but as a rule-of-thumb they range from a few thousand acres to thousands of square miles (FSMN #39). This scale is important due to the mobility of many animals and the flow of surface waters.

5. REGIONAL SCALE - A ecological region is a land area characterized by a unique set of landscape types and broad geological and climatic patterns, such as the Upper Great Lakes Region. This scale is important in terms of wildlife populations trends and factors such as economic development patterns.

6. GLOBAL SCALE - The biodiversity issue must also include consideration of the entire Earth, as species extinction is the most severe form of biodiversity loss.

THE DANGER OF MAXIMIZING DIVERSITY AT THE OWNERSHIP SCALE - The importance of geographic scale is emphasized by the common misconception that maximizing the number of habitat types in a small area leads to greater biodiversity. Such a strategy often does increase the total number of species in the managed area, but the species that inhabit such areas tend to be regionally common. Species that require larger blocks of uniform habitat do not survive well in such areas and these species tend to be regionally rare. Thus, habitat diversification at the ownership scale may reduce species diversity at the regional scale (#15).

COMPONENTS OF BIODIVERSITY:

1. COMPOSITIONAL DIVERSITY - Compositional diversity depends on the identity of the parts in the system. The most commonly studied parts are species and the most commonly studied systems are ecological communities. However, all levels of biological organization (from molecules to the biosphere) are important. For example, to conserve endangered species, it is important to know something about genetic diversity within the species. At the landscape scale, ecological communities constitute the parts of interest, and rare community types need to be conserved.

Quantifying compositional diversity is not easy. The number of species occurring in an area, termed "species richness", is a one measure of biodiversity. But, a simple count of species can be misleading. For example, consider two areas. Area A has ten species, one of which is abundant, the others of which are uncommon. Area B has only eight species, but they are all abundant. Area A is more diverse in terms of species richness, but Area B would certainly appear more diverse and would likely have more types of interactions among the species. Various diversity indices have been devised that take the relative abundances of the species (or other elements) into account (#9).

2. STRUCTURAL DIVERSITY - Structural diversity depends on the physical arrangement, or spatial pattern, of the system's parts. At the community scale, the degree of vertical layering and horizontal patchiness of the vegetation and the distributions of animals are key structural factors (FSMN #41). At the landscape level, structural elements include patches of various community types, corridors linking similar communities, and barriers to animal movements (FSMN #39).

3. FUNCTIONAL DIVERSITY - Functional diversity depends on the patterns of interaction among the system's parts. At the community level, functional patterns relate primarily to feeding and nutrient relationships among species, such as predation, competition, and decomposition. At the landscape level, important functional patterns include water flows, nutrient cycles, animal migrations, and natural disturbances. Functional diversity clearly depends on compositional and structural diversity.

WHY IS BIODIVERSITY IMPORTANT?

Biodiversity is an irreplaceable asset to humanity and to the biosphere. It is the natural biological wealth that undergirds human life and well-being, providing many immediate and long-term benefits (#2,5,12-14,16,).

1. ECONOMIC VALUE - The economic benefit of biodiversity is staggering. Genetic diversity is the basis of all agriculture through plant and animal breeding. Over 40% of all prescriptions written in the U.S. contain one or more drugs that originate from wild species. In terms of timber production, managing for a diversity of tree species provides a hedge against changing timber markets and reduces the risk of losing one's investment to pests or diseases (#5,12).

2. ECOSYSTEM VALUE - Each species in a healthy, natural community contributes to nutrient recycling, energy capture and transfer, gas exchange, water cycle stabilization, soil development and maintenance, breakdown of pollutants, and other ecological processes. Collectively, these processes maintain the ecosystem, and allow it to adjust to disturbances, including climate change. Some species appear to be ecologically more important than others, but our knowledge of ecosystems is so incomplete that it would be unwise to conclude that any species is worthless (#2).

3. GENETIC VALUE - Within a species, the greater the genetic diversity, the greater the ability to resist pests and diseases and to adapt to other environmental stresses and changes. Genetic diversity is the raw material of evolution. Therefore, populations adapted to the differing conditions that occur at the edge of the species range may contain the most valuable genetic material for the species long-term survival.

4. AESTHETIC VALUE - Respect for the wonder of creation is a strong American value and enjoying the beauty of nature is a national pastime (#2).

5. ETHICAL VALUE - Although some species may represent none of the values listed above (as far as we know now), many people believe the very existence of diversity is its own warrant for survival (FSMN #35).

"We should judge every scrap of biodiversity as priceless while we learn to use it and come to understand what it means to humanity." (#18).

HOW CAN PRIVATE LANDOWNERS CONSERVE BIODIVERSITY?

The following list of objectives (adapted from #3) includes a broad spectrum of approaches for enhancing biodiversity. See the References for other practical suggestions, especially #4 and #8). Although there is considerable overlap, the first part of the list focuses on landscape level objectives, whereas the latter part concentrates on objectives that can be implemented at smaller scales.

1. AVOID HABITAT FRAGMENTATION - Maximize continuity of the forest matrix by minimizing fragmentation of large blocks of woodland and other key habitats (#4,7,17, FSMN #25,39).

2. PROVIDE CORRIDORS - Minimize artificial barriers to the movements of native plants and animals. Restore/maintain corridors (narrow strips) of native vegetation between isolated patches of habitat to enhance the movements of plants and animals (#7, FSMN #39). Riparian (streamside) corridors are especially important, as most threatened and endangered species and rare community types are riparian.

3. REPRESENT ALL ECOLOGICAL COMMUNITIES - Restore/maintain the full spectrum of terrestrial, wetland, and aquatic communities that are characteristic of the area, including all ages of these communities (#10,11).

4. RESTORE FOREST STRUCTURE AND COMPOSITION - Restore/maintain a distribution of forest types, stand ages, and size classes characteristic of the region's natural condition. Restoration of old growth forest conditions is especially needed (#7,11, FSMN #38).

5. COORDINATE MANAGEMENT AMONG OWNERSHIPS - Become informed about land-use planning activities in your area and cooperate with such efforts when they are consistent with your objectives (#10,17, FSMN #36,39). Watershed associations offer a good opportunity to work with other landowners toward common goals.

6. MIMIC NATURAL DISTURBANCE REGIMES - Maintain communities and microhabitats that depend on natural disturbances, especially fire, by conducting practices that mimic such disturbances (#11). For example, lowbush blueberries can be maintained by mowing where prescribed burning is not feasible.

7. MAINTAIN GENETIC DIVERSITY - Maintain genetic diversity by using native species, preferably derived from local sources, when conducting plantings (FSMN #7,8,25,27) or releasing animals.

8. AVOID EXOTIC SPECIES - Reduce risks from introduced species that compete with native species by avoiding use of non-native species and by being aware of invasions of exotic diseases, weeds and other pests.

9. FAVOR MIGRATORY BIRDS - Promote high levels of native bird populations, especially Neotropical migrants such as warblers by providing a full range of forest age classes, especially those that are locally scarce, such as old growth (FSMN #38).

10. FAVOR SENSITIVE SPECIES - Provide special protection for species that are area-, edge-, isolation-, or disturbanceÄ sensitive, and ones that are rare, threatened, or endangered (#15).

11. FAVOR LARGE MAMMALS - Provide suitable habitat for large carnivores and other large mammals where restoration efforts are underway.

12. PLAN AND MAINTAIN ROADS CAREFULLY - Recognize the impacts of roads on human land-use patterns and on ecological processes (FSMN #2,4-7).

13. PROVIDE VERTICAL STRUCTURE - Maintain or restore structural diversity of the vegetation in the vertical dimension by creating multi-layered stands, including trees with cavities and snag trees (#8, FSMN #28,41.

14. PROVIDE HORIZONTAL PATCHINESS - Maintain or restore structural diversity of the vegetation in the horizontal dimension by creating canopy gap patterns and other aspects of patchiness that are typical of mature and uneven-aged forests (#8, FSMN #41).

15. DIVERSIFY TREE SPECIES - Encourage tree species diversity, especially hardwood-conifer mixtures, within management units that are heavily dominated by a few species (#17, FSMN #16,17,19,20).

16. PROTECT GROUND FLORA - Mitigate effects of timber harvesting on ground flora diversity by avoiding logging where sensitive species occur and by scheduling logging during winter.

17. PROTECT SOIL - Minimize the impacts of forestry operations on the forest floor and mineral soils (FSMN #4,5,6,7).

18. PROVIDE COARSE WOODY DEBRIS (CWD) - Restore/maintain levels of CWD in managed forests that are typical of mature and old-growth forests (FSMN #28,31,38).

19. PROTECT HYDROLOGY AND AQUATIC ORGANISMS - Minimize the disruption of natural hydrology, including flooding regimes, water tables, and impoundments as fish and other aquatic organisms account for a major proportion of total biodiversity (#1, FSMN #5,30,31).

REFERENCES

FSMN #'s refer to other Forest Stewardship Management Notes in this series.

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