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Managing Wildlife Habitats

in Forested Ecosystems

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W.D. Edge

"Strategies for conserving biodiversity need the participation of private land managers."

Have you ever thought about how your property fits into a larger ecosystem? Regardless of the size or nature of your property, it is connected to the landscape beyond. How you manage your property can affect the health of the larger ecosystem of which it is a part.

To understand these connections, scientists and federal land managers talk about ecosystem management, biodiversity, and landscape ecology. These terms are applicable not just to public lands but to private ownerships as well. But what do they really mean, and what do they have to do with you?

To help you understand and use the concepts of ecosystem management, this publication will:

- Explain the ideas and vocabulary commonly used when talking about ecosystem management
- Describe why private forest lands play an important part in stewardship of forest ecosystems
- Discuss issues concerning wildlife
- Offer suggestions for managing your property for wildlife

Ecosystems — why do they matter?

Many plants and animals have become rare, and some face possible extinction. These species often are listed under the Endangered Species Act (ESA). The purpose is to prevent them from becoming extinct and to allow them to recover so that special protection no longer is needed.

An average of 34 species per year were listed as threatened or endangered in the United States between 1976 and 1986, and listings have increased to more than 50 per year since then. By 1990, more than 3,500 species were listed as candidates for protection (i.e., they have been proposed as threatened or endangered, but there are insufficient data to list them).

The ESA has been criticized for its species-by-species approach because the magnitude of the extinction threat was unanticipated when the act was developed. The feasibility of continuing a species-by-species protection strategy is questionable given the sheer number of threatened, endangered, and candidate species.

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Also, many species are listed not because of any direct attack on their population, but because loss of habitat makes it difficult for them to survive. Therefore, for financial, logistical, and ecological reasons, it makes sense to base conservation strategies not on protecting individual species but on managing the habitats, communities, and ecosystems they call home.

This realization has led to the emergence of ecosystem management as a conservation strategy. The Society of American Foresters defines ecosystem management as "an ecological approach to resource management at the landscape level that blends social, physical, economic, and biological considerations to ensure the sustainability of healthy ecosystems while providing desired values, goods, and services."

In order to understand the ideas behind ecosystem management, you need to be familiar with some of the terms scientists use.

Habitats are vegetation communities that plants and wildlife use to meet their daily and yearround needs.

Ecosystems are biological communities interacting with their physical environment.

Landscape is a large regional unit of land consisting of many forest stands or patches, irrespective of political or other artificial boundaries.

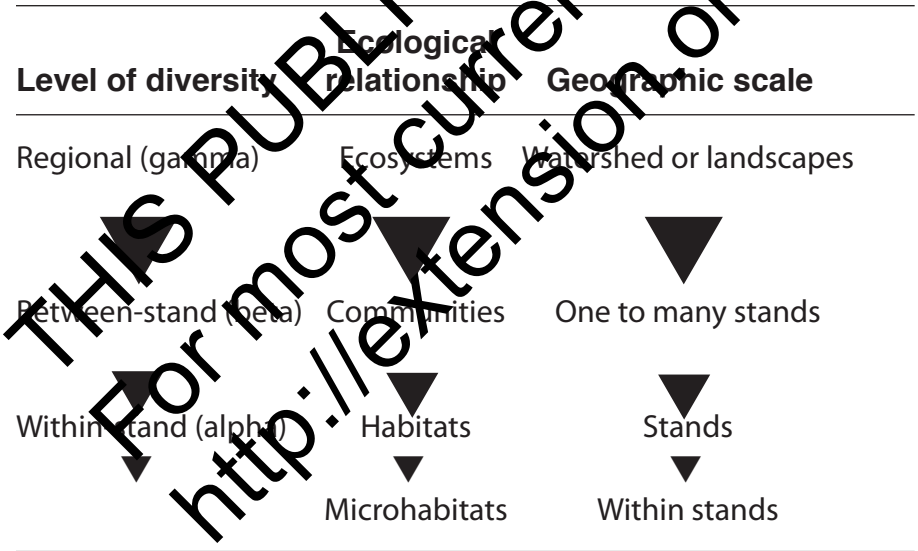

Figure 1.—Ecosystem management considers ecological processes at several scales—ranging from entire watersheds down to small, specialized microhabitats.

Biodiversity—what does it mean?

One of the key concepts of ecosystem management is the importance of maintaining **biodiversity**.*

Biodiversity describes the variety of living organisms. We can look at biodiversity at several levels. For example, we can study genetic differences among individuals; count the number of species, genera, or families in an area; or compare the amount of diversity in different habitats.

Biologists are concerned with three levels of diversity (Figure 1). **Within-stand diversity** (alpha diversity) is the variety of organisms in a particular place or habitat. This also is known as local diversity.

Between-stand diversity (beta diversity) is the difference in variety of organisms among habitats in a particular region. This depends on the number of different habitats and the contrast of adjacent habitats. For example, a clear-cut adjacent to an old-growth stand may have higher between-stand diversity than an old-growth stand adjacent to a sawtimber stand.

Regional diversity (gamma diversity) is the variety of organisms in all habitats within a region.

One way to measure biodiversity

*Key terms are highlighted in bold type and are defined in the glossary on page 11.

Figure 2.—Forest habitats with high structural diversity (left) generally contain more species than habitats with low structural diversity (right).

is **species richness**, a simple count of species in an area. Several basic patterns of species richness exist. They affect how you can manage your property to increase biodiversity and why your property may be an important part of an ecosystem. Three basic patterns of species richness relate directly to management of woodland properties:

- The number of species increases with plant diversity
- The number of species declines as elevation increases
- Different types of ecosystems have different levels of endangerment

These patterns are discussed below.

Pattern #1: The number

Figure 3.—The number of species declines as elevation increases. In the Oregon Cascades, most lower elevation lands, where species richness is greater, are in private ownership (Source: Harris, 1984).

> “Management practices that make sense at local scales may cause undesirable effects at landscape scales if they are overused or uncoordinated.”

of species increases with plant diversity

The term **plant structural diversity** describes the number and complexity of vegetation layers. For example, shrub habitats are more complex than grassland habitats. Old-growth stands or uneven-aged stands are more complex than even-aged saw-timber stands.

As vegetation complexity increases, more organisms can find the food and shelter they need. As a result, the number of species generally increases.

Thus, clear-cuts with remnant logs, snags, or green trees retained have more species than clear-cuts without these components. Uneven-aged forest stands typically have more species than even-aged stands within the same forest type (Figure 2).

Pattern #2: The number of species declines as elevation increases

The more productive forest lands, which have more species, generally are at lower elevations. Thus, the number of species declines as you go up in elevation (Figure 3). As you move from low elevation forests to subalpine forests and alpine areas, habitats become less structurally complex and the environment becomes harsher, reducing species richness. However, these harsh, isolated habitats often are important because they have species that are found nowhere else.

Because most lower elevation areas in the Pacific Northwest are privately owned, the bulk of species richness occurs on private lands in this region. Conversely, most national parks, wilderness areas, research natural areas, and federal forest lands occur at mid elevations and above. Thus, strategies for conserving biodiversity need the participation of private land managers.

Pattern #3: Different types of ecosystems have different levels of endangerment

Within the United States, species listed for protection under the ESA are concentrated in certain areas and ecosystems. Forest ecosystems contain the most threatened and endangered species, probably because these habitats have greater diversity and because they are intensively managed.

The majority of endangered forest species are animals. Listed invertebrates primarily are associated with aquatic ecosystems, particularly those found in forested landscapes.

Conifer forests have more threatened and endangered species than do mixed or deciduous forests. Slightly more listed species are associated with mature and old-growth forests than with earlier successional stages.

Wetland ecosystems cover only 5 percent of the land base in the 48 contiguous states, but they contain nearly 30 percent of listed animal species and 15 percent of listed plant species.

Landscape ecology—looking at the big picture

Landscape ecology is the study of ecological processes at large scales (watershed or larger). This is one of the most important ideas of ecosystem management.

Ecosystem management may require coordinating local-scale management activities in order to have a desired effect at landscape scales. Management practices that make sense at local scales may cause undesirable effects at landscape scales if they are overused or uncoordinated. The following section details landscape-scale issues of concern to wildlife ecologists.

Habitat fragmentation

Habitat fragmentation means that the total amount of a habitat within a landscape is reduced, and the remaining habitat is divided into smaller, more isolated patches (Figure 4). Fragmentation usually results from human land use practices such as agriculture, silviculture, and urban development.

Fragmentation occurs in all vegetation types in the Pacific Northwest, but especially in old-growth forest, westside white oak-savannah and ponderosa pine communities, and sagebrush habitats.

Habitat fragmentation is thought to be one of the most serious causes of the decline in native plant and

❝You can directly influence diversity by the management practices you choose.❞

animal populations. Some of its effects are discussed below.

Edge effects

Habitat edges are zones at the border of two different plant communities or different-aged stands within the same plant community. Examples are the edge between a riparian habitat and an upland site, or the edge between a recent clearcut and a sawtimber stand (Figure 5).

These habitats usually are more diverse than the two communities they bring together.

Many species (perhaps as many as 50–60 percent of all species in the Pacific Northwest) use edges because the contrasting habitats provide choices for food and cover in close proximity to one another.

Because of their contribution to maintaining diversity, for many years the production of edge habitats has been a basic tenet of wildlife management. As habitats become fragmented, however, the amount of edge habitat increases. At first sight, edges resulting from habitat fragmentation seem to increase diversity, but too much edge can have negative effects.

One of the problems with excessive edge habitat is that some species exploit edges, causing them to become a *trap* for other species. For example, many predators, such as raccoons, foxes, opossums, jays, and crows, prefer to hunt in edge habitats. If most of a habitat patch is close to an edge, species that use those habitats for protection may be excessively vulnerable to predators.

For instance, in the deciduous forests of eastern North America, increased predation on songbirds by jays, crows, raccoons, opossums, foxes, squirrels, and skunks extends up to 600 meters from an edge. In the prairie pothole region of the upper Midwest, drainage of wetlands for agricultural use has resulted in isolated islands of ducklings survive to adulthood because of excessive predation by skunks and foxes.

The same thing can happen with plants. For example, because deer often prefer to browse in edge habitats, they severely suppress regeneration of deciduous forest species in small woodlots in the eastern United States.

Brood parasitism is another phenomenon that increases at forest edges. The brown-headed cowbird is an example. The female cowbird does not build a nest, but instead searches for active nests of other species. When she finds one, she removes one or more of the eggs and deposits one of her own.

The cowbird usually chooses the nest of a songbird. The young cowbird typically is larger than the other birds in the nest and pushes them out of the nest or stands on them so that the songbird raises only a single cowbird.

Because cowbirds depend on

Figure 4.—Habitat fragmentation occurs when contiguous habitat (left) becomes subdivided from resource use, development, habitat destruction, etc. As fragmentation proceeds (middle), patches of transformed habitat (white) are created. Eventually, the transformed habitat dominates the landscape; the original habitat occurs only in patches (right).

edge habitats, brood-parasitism is a major reason for the decline of forest birds in heavily fragmented landscapes of the eastern United States. Similar studies have not been conducted in the western United States, but cowbirds do abound here, and population trends for many western songbirds show declines similar to those in the east.

Edge effects also can influence what plants grow in an area. Edge zones usually are drier and less shady than forest interiors. Thus, plants that tolerate shade and limited water have an advantage over typical forest plants, which require more water.

In Douglas-fir forests of the Pacific Northwest, effects such as reduced humidity and increased rates of blowdown may extend two to three tree-heights into a forest. These effects increase growth and mortality rates, reduce stocking density, and affect regeneration of conifer species in old-growth forests up to 137 meters from clearcuts.

Interior species

Just as some species prefer edge habitats, others use only interior habitats. These species require **core habitats**, habitat patches with large interior areas.

For reasons not entirely understood, some species avoid small tracts of seemingly suitable habitat. Many songbirds usually breed only in tracts of forest many times larger than the size of their territories. Studies in grassland prairie fragments in Missouri showed that several species failed to breed in patches smaller than 25 acres, even though this is several times larger than the average territory size.

In highly fragmented landscapes, the average patch size may be too small to exist in such core habitats. Their loss results in a decline in species that need them for reproduction.

United States, where woodlots are isolated among agricultural or urban habitats. One study in the Oregon Coast Range found that winter wrens also are associated with less fragmented landscapes. However, study limitations and the relatively recent nature of landscape fragmentation in the Coast Range limit the conclusions that can be reached for this region.

Metapopulation dynamics

As landscapes become more and more fragmented, plant and animal populations become isolated on "islands" of suitable habitat (Figure 6). Some islands are too

Figure 5.—Edges occur at the borders of two or more habitat types. Ecological processes such as predation or nest parasitism may accelerate along habitat edges.

"Looking at your property as it relates to other ownerships within your drainage or subbasin is the crux of ecosystem management."

individuals. These small groups are known as **subpopulations**.

Subpopulations are vulnerable to environmental change, catastrophes, genetic problems, and random population declines, and some will go extinct. In fact, many population ecologists believe all subpopulations go extinct over a period of hundreds to thousands of generations.

There is a bigger picture, however. The many subpopulations of a species make up its **metapop-ulation**, its entire population within the landscape.

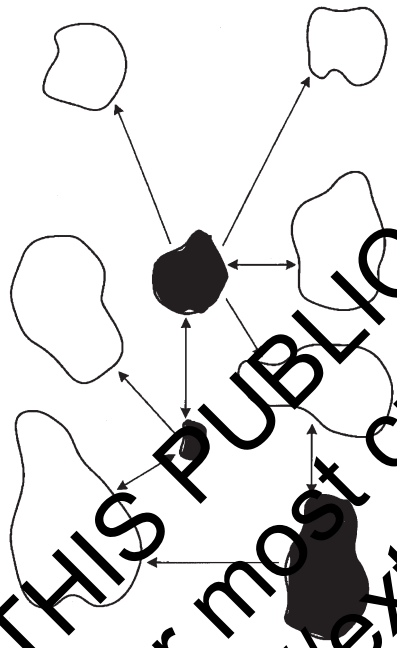

Figure 6.—In a metapopulation, source habitats (shaded) provide excess individuals, which emigrate to sink habitats (nonshaded). The sink habitats might be larger than the source habitats, and may even have more animals, but because of lower habitat quality, subpopulations in sink habitats would go extinct without an influx of animals from the source habitats. Arrows indicate the direction of animal movements among patches (Source: Meffe and Carroll, 1994).

Although individual subpopulations go extinct, the metapopulation may survive because individuals move among habitat islands and repopulate habitat islands where subpopulations have gone extinct.

As habitat fragmentation increases, however, it becomes more difficult for the metapopulation to survive. The overall loss of habitat and habitat isolation reduce the metapopulation, while subpopulations go extinct more rapidly and are less likely to be recolonized.

Corridors

Corridors connect two or more patches of habitat and allow the movement of organisms among patches. Corridors have two main functions: (1) periodic migration of animals among different habitats (for example, seasonal movements to find food), and (2) permanent immigration among habitat patches to replace subpopulations that have gone extinct.

Three types of corridors are needed:

Fencerow scale corridors contain narrow rows of appropriate habitat and connect close habitat patches such as stands. This scale lets small vertebrates move among patches. But because they are narrow, these corridors are composed entirely of edge habitat and do not provide habitat for interior species.

Landscape mosaic scale corridors are broader and longer. They connect major landscape features, such as forests. These corridors allow daily, seasonal, or more permanent movement of both interior and edge species. Examples include large strips of forest connecting forest habitats that are separated by agricultural lands, riparian habitats along rivers, and mountain ridges.

Regional scale corridors connect nature reserves in regional networks. For example, corridors have been designed to connect Glacier National Park in Montana to regional wilderness areas in Idaho, Montana, and Canada.

Most conservation plans recognize the importance of corridors and include maintenance of corridors as part of their management plan.

What can you do?

On your own property

Your property probably supports or could support many plant and animal species. Thus, it may be important for conserving biodiversity on a landscape or regional scale.

You can directly influence diver-

sity by the management practices you choose. This section offers some suggestions for increasing diversity within and between stands on your property.

Increase structural diversity

If you wish to increase biodiversity on a stand level, consider using an uneven-aged silvicultural system. Even-aged silvicultural practices, such as clear-cuts, typically produce stands that are low in structural diversity.

You can increase structural diversity under even-aged management as well, however. For example, if you use a seed-tree regeneration system, leave some or all of the seed trees. Provide structural diversity by retaining snags, logs, and green trees when you harvest. During pre- and commercial thinning operations, consider leaving small patches of unthinned trees, or some subdominant trees that are suppressed.

Promote microhabitats

Microhabitats are small, specialized habitats that meet the specific needs of certain organisms. Snags and logs are examples. Approximately 30 percent of vertebrate species use snags or logs at some time.

Your woodland property most likely contains microhabitats that could be protected or enhanced to increase diversity. If you are interested in increasing biodiver-sity, you will want to provide as many of these structures as you can given your other objectives and management constraints.

Remember that most private woodlands are second-growth forests. Virtually all were harvested prior to forest practice rules or guidelines for maintaining logs and snags.

A recent study indicates that private woodlands in Oregon and Washington provide 6–40 percent of habitat capability for cavity-nesting wildlife, depending on the forest type. Thus, while private woodland owners are providing habitat for cavity-nesters, much more probably can be done.

Depending on the requirements in your state, you may or may not be required to retain some snags and logs when you harvest. At any rate, guidelines or regulations are minimum requirements. Because they do not specify plant community, snag or log type, or size, they usually provide only minimal habitat capability.

Too few studies have been conducted on logs to provide much specific guidance. Snag literature, however, indicates that increasing the number of snags up to or even beyond 10 per acre results in increasing both the number of species as well as the population size of cavity-nesting species.

Remember, the larger the snag the better. Large snags can be used by all species that need them, whereas small snags can be used only by a few species.

Other microhabitats such as

What can you do?

To increase within-stand diversity

- Increase structural diversity
- Increase number and size of logs and snags
- Plant multiple tree species

To increase among-stand diversity

- Protect or culture rare plant communities
- Protect seeps, springs, and wetland sites with ample buffer zones
- Increase riparian zone protection by widening buffer zones and extending protection to smaller and seasonal streams

seeps, springs, ponds, and other wetland communities greatly increase the diversity of your property. Protect them with ample buffer strips.

Increase plant community diversity

Different plant species provide food and shelter to different animal species. Thus, the greater the plant diversity in an area, the greater the overall biodiversity.

The typical clear-cut silvicultural system with only Douglas-fir has lower biodiversity potential than a stand where several species are planted. Thus, consider planting more than one species when you regenerate your stand.

You also can increase plant diversity by controlling competing vegetation less aggressively and allowing some less-desirable species (from a timber-production perspective) to develop.

Riparian zones typically have more plant diversity than the surrounding upland vegetation. Consider widening riparian buffer zones and extending protection to even the smallest streams and those that have water only part of the year.

Rare or uncommon plant communities contribute more than their share to local and regional diversity. Examples include Oregon white oak forests, the Willamette Valley race of ponderosa pine, and peat bogs. Consider protecting or even promoting these plant communities on your property.

Looking beyond your property

Don't stop at your property line though. Consider your property in a landscape context.

Applying concepts of landscape ecology to your property may require more than managing habitats on your own property. You may need to coordinate efforts with your neighbors.

A good place to start is by obtaining vegetation maps or aerial photographs of the drainage or subbasin where your property is located. Use them to evaluate your efforts as they relate to the entire landscape.

Riparian zone management

Riparian zones are important habitats for local and landscape diversity, and may be corridors for species requiring moist habitats. These areas help protect aquatic habitats and your water quality, and are the most obvious connections between your property and your neighbors'.

Again, remember that at least 70 percent of private woodlands in Oregon and Washington were harvested before riparian protection rules or guidelines existed. These habitats need additional protection and attention. Depending on your other objectives, consider widening riparian zones and extending protection to additional sites such as small or seasonal streams.

You, your neighbors, and beyond

Looking at your property as it relates to other ownerships within your drainage or subbasin is the crux of ecosystem management. Depending on your objectives and those of your neighbors, you have a number of alternatives.

You may choose to manage your property independently of your neighbors simply by looking at aerial photographs or vegetation maps of your drainage. Or, in order to be more effective, you may wish to discuss your neighbors' objectives and future plans with them.

You also might consult state fish and wildlife biologists to determine the value of your property in maintaining biodiversity; some areas are more important for biodiversity conservation than others.

Each property differs in respect to its contribution to the ecosystem, so hard and fast rules or guidelines are not possible. Some of the following questions may help you

Glossary

Biodiversity—The variety of living organisms considered at all levels, from genetics through species and higher taxonomic levels, and including the variety of habitats and ecosystems. Key terms associated with biodiversity:

Genetic diversity. The variety of genes within a particular species, variety, or breed.

Species richness. The number of species present in an area. One of the most common measures of biodiversity.

Within-stand or local diversity. The variety of organisms occurring in a particular place, habitat, or stand.

Between-stand diversity. The change in variety of organisms among habitats or stands in a particular region. This depends on the number of different habitats within a region and the contrast of adjacent habitats. For example, a clear-cut adjacent to an old-growth forest would have higher between-stand diversity than an old-growth stand next to a sawtimber stand.

Regional diversity. The variety of organisms summed over all the habitats within a region. This is similar to landscape-level diversity.

Structural diversity. The variation within a habitat that is a function of the structural complexity of the vegetation. Clear-cuts have low structural diversity, while uneven-aged stands have higher structural diversity.

Core habitat—Habitats that occur in the interior of a patch and are not influenced by effects from the edges of the patch.

Corridor—Habitat that links two or more patches of habitat. Corridors function to facilitate movement of animals among patches and may also provide seasonal or year-round habitat.

Fencerow corridor. A narrow corridor linking patches of habitat on a local level that functions only to facilitate movement of animals. Fencerow corridors have no core habitat.

Landscape mosaic corridor. A corridor that links patches of habitat on the scale of a watershed. These corridors not only facilitate movement of animals among habitats, but because they contain core habitats, they also provide year-round habitat for some species.

Regional corridor. A corridor that connects major ecosystems on a regional scale. Regional corridors link large biological or geographical units such as national parks and wilderness areas.

Fragmentation—Breaking up large areas into progressively smaller patches that are increasingly isolated from one another (USDA, 1994). Staggering clear-cuts throughout a watershed covered by mature timber stands is an example. Fragmentation can be harmful to species requiring large contiguous areas of forest, but it also can have neutral or positive effects on diversity.

Habitat edge—The zone of influence adjacent to the border of a habitat patch. Also known as an ecotone.

Landscape—A large regional unit of land consisting of many forest stands or patches, irrespective of political or other artificial boundaries. Landscapes vary in size from a few hundred acres to tens of thousands or more acres. Very large landscapes often are referred to as regions or provinces.

Metapopulation—A group of subpopulations, the sum of which is dependent on the overall persistence and movement of animals within and among subpopulations.

Microhabitat—A specific habitat component used by an animal on a fine scale of resolution. For example, the shade on the north side of a large log might be a microhabitat for salamanders.

Subpopulation—A group of animals confined to a specific area, usually a habitat type, and separated from other members of the same species by habitat or geographic barriers.

think about your property with a landscape perspective.

- Do you have habitats that are uncommon in your watershed or region? Rare plant communities such as Oregon white oak, Willamette Valley ponderosa pine, peat bogs, or old-growth contribute disproportionately to local and regional diversity.
- Can you manage these habitats to maintain or increase their occurrence? In some cases, protection suffices; in others, creative use of silvicultural practices can accelerate occurrence of these habitats.

  For example, thinning practices or uneven-aged silviculture may allow you to enhance diversity and mimic old-growth conditions in younger, second-growth stands.
- Can you reduce habitat fragmentation? For example, if a stand is located in a watershed that is largely in a late successional stage condition, can you defer harvest?

  Or perhaps you have a small stand of late successional stage forest in a watershed that has been largely converted to young plantations. If so, harvesting your stand so that most of the watershed is in early successional stage conditions would reduce habitat fragmentation.
- Does your property contain logical corridors, in addition to riparian management zones, that connect one uncommon habitat to another? Maintaining or planting for the widest strip possible within your objectives may allow movement of animals among patches as well as provide habitat itself.

For further reading

OSU Extension publications

Bennett, M. *Ecosystem Management: Opportunities and Implications for Woodland Owners*, EC 1469 (1996).

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Other publications

Harris, L.D. 1984. *The Fragmented Forest: Island Biogeography Theory and the Preservation of Biotic Diversity* (The University of Chicago Press, Chicago), 211 pages.

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