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Development and Evaluation of Aquatic Conservation Strategies

ALL OPTIONS CONSIDERED IN THE FEMAT report, with the exception of Option 7, used one of three variants of an aquatic conservation strategy first described in Thomas et al. (1993). The conservation strategy was designed to provide a scientific basis for protecting aquatic ecosystems and enable planning for sustainable resource management. It sought to restore and maintain the ecological health of watersheds (Karr et al. 1986, Karr 1991, Naiman et al. 1992) throughout the region by retaining, restoring, and protecting those processes and landforms that contribute habitat elements to streams and promote good habitat conditions for fish and other aquatic and riparian-dependent organisms.

At the heart of this approach is the recognition that fish and other aquatic organisms evolved within a dynamic environment that has been constantly influenced and changed by geomorphic and ecologic disturbances. Stewardship of aquatic resources has the highest likelihood of protecting biological diversity and productivity when land use activities do not substantially alter the natural disturbance regimes to which these organisms have adapted (Swanson et al., in press). Many of the features of the aquatic conservation strategies considered here attempted to maintain or restore these regimes.

Current scientific understanding is inadequate to define fish habitat needs at the watershed scale. Some general fish habitat requirements are well known, such as deep resting pools, cover, certain temperature ranges, food supply, and clean gravels for spawning (Bjornn and Reiser 1991). However, we (the Aquatic/Watershed Group of FEMAT) were unable to specify spatial and temporal distributions of habitat elements necessary for a single species throughout its life cycle, and were even less certain of requirements to support complex, interacting assemblages of different fish species and age classes.

Therefore, we used an aquatic conservation strategy that strove to maintain and restore ecosystem health at watershed and landscape scales. The approach taken in the strategy sought to prevent further degradation and restore habitat over broad landscapes as opposed to individual projects or small areas.

It will require time for this strategy to work. Because the strategy depends largely on natural processes, it may take many decades to accomplish all of its objectives. Some improvements in aquatic ecosystems, however, can be expected in 10–20 years.

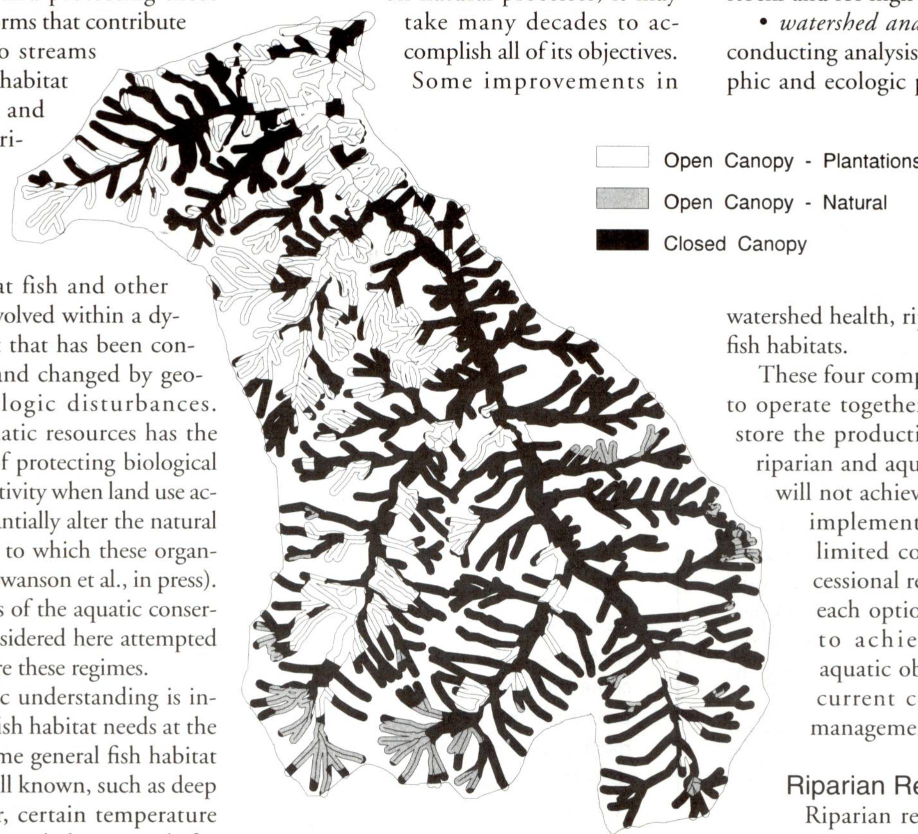

Figure 1. Augusta Creek Watershed on the Willamette National Forest showing riparian reserves designated under riparian reserve scenario 1 and the condition and management history of these riparian reserves.

Components of the Strategy

The basic components of the aquatic conservation strategy considered here are

- *riparian reserves*—lands along streams and unstable areas where special standards and guidelines govern land use;
- *key watersheds*—a system of watersheds distributed through the owl region that are crucial to at-risk fish species and stocks and for high-quality water;
- *watershed analysis*—procedures for conducting analysis that evaluate geomorphic and ecologic processes operating in specific watersheds; and
- *watershed restoration*—a comprehensive, long-term program to restore watershed health, riparian ecosystems, and fish habitats.

These four components were designed to operate together to maintain and restore the productivity and resilience of riparian and aquatic ecosystems. They will not achieve the desired results if implemented singly or in some limited combination. Late-successional reserves associated with each option also will contribute to achieving riparian and aquatic objectives through their current condition and future management.

Riparian Reserves

Riparian reserves are portions of watersheds where riparian-dependent resources receive primary emphasis and where special standards and guidelines apply. They include those portions of a watershed that are directly coupled to streams and rivers, that is, the portions required for maintaining hydrologic, geomorphic, and ecologic processes that directly affect

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streams, stream processes, and fish habitats. Thus they include riparian areas that commonly parallel streams and other primary source areas for wood and sediment, such as landslide-prone slopes in headwater areas.

Thomas et al. (1993) used specified horizontal widths, geomorphic features, or distances based on the height of site-potential trees to delineate interim riparian areas. They defined a site-potential tree as a tree that has attained the maximum height possible given the site conditions where it occurs. A similar approach was used here to establish interim riparian reserves. We defined a site-potential tree as the average maximum height of dominant conifers (200 years or more) on a given site. Using plot data from old-growth stands on federal forests, we estimated that these heights varied from 140 feet to 250 feet, depending on site quality.

Tree heights, measured along a slope distance, were used as ecologically relevant metrics with which to establish interim riparian reserve widths. For example, tree height distance away from the stream is a better indicator of potential wood recruitment or degree of shade than is an arbitrary distance unrelated to ecosystem processes.

Interim widths were developed for three categories of streams and for lakes, ponds, reservoirs, and wetlands. Three scenarios were developed (see Thomas *table 2,* p. 14) that differ with respect to interim riparian reserve widths for streams by category of stream and whether they fall in key or nonkey watersheds.

Figure 1 shows the interim riparian reserve network under scenario 1 (the most extensive network) for a small watershed, Augusta Creek, on the Willamette National Forest. The drainage basin area included within interim riparian reserves for Augusta Creek varied from 18 to 53 percent under the scenarios, with most of the difference due to reserve width along intermittent streams.

Interim widths for riparian reserves apply for all watersheds until a watershed analysis is completed, a site-specific analysis is conducted and described, and the rationale for final riparian reserve boundaries is presented.

Key Watersheds for Species Recovery

A system of key watersheds was designed to serve as refugia for maintaining and recovering habitat for at-risk stocks of

An Alternative View of Riparian Area Management

There is no doubt that riparian areas are critically important features in watersheds. Streamside forests supply essential habitat components supporting ecosystems. There appears to be growing consensus that riparian forests with structural features characteristic of 80- to 200-year-old coniferous forest provide the best mix of values for both aquatic and terrestrial ecosystems.

As in other regions, many riparian forests and streams of the Pacific Northwest do not meet this goal after a century of management practices considered appropriate for the day. Awareness and practices have improved dramatically, especially in the last decade, but watershed assessments reveal that as much as 75 percent of the fish-bearing stream length does not currently meet desired conditions for forest and/or instream habitat conditions. The situation is probably worse for streams flowing through agricultural and urban lands.

The question is not whether riparian areas should be maintained in late-successional forest conditions, but how best to manage them to achieve this state as rapidly as possible appropriate for the terrain. The FEMAT report provides several options for accomplishing these objectives, consistent with federal policy objectives. Most notably, it sets aside very wide buffers serving essentially as preserves. This stipulation has a dramatic effect on the area suitable for forest management. However, alternative options, likely to be equally viable, capitalize on business operating methods and infrastructure and are more compatible with management objectives for private lands. Given the tremendous impact of FEMAT riparian protection on the availability of manageable lands, these options should be fully explored.

Riparian areas can be actively managed to achieve desired conditions as rapidly as possible. To minimize risk associated with active management, a "smarter" system is required than the traditional one-size-fits-all buffer zone prescriptions advocated by FEMAT. Rather than view riparian areas as black boxes, we should get to know them as well as we know the rest of our forestlands. An adaptive management approach requires that decisions within the riparian zone, including how to lay them out and what conditions need to be managed within them, are based on scientific methodologies designed for that purpose and information collected from the site. Actions may include planting different species, stand manipulation to change the forest successional track, and stream enhancement with woody debris where appropriate. Presumably, a "smarter" approach to riparian areas increases the certainty that resource objectives can be met, and thereby eliminates the need for wide prescribed buffers where nothing is known.

Such an adaptive system is possible today, but it clearly requires greater commitment from a number of sectors than has existed in the past. Environmental scientists must build their understanding into workable assessment techniques and reliable decision systems. Foresters must be challenged to bring their knowledge of forest systems to bear. Managers must be committed to a more information intensive process. Organizations must monitor to make sure that methods and practices achieve desired goals for aquatic and terrestrial ecosystems. And government must recognize that the necessary return on this environmental investment is a predictable regulatory system that respects the need for operating flexibility and encourages, rather than discourages, information as a basis for decisions.

Contributed by Kathleen Sullivan, Environmental Forestry Department, Weyerhaeuser Company, Tacoma, Washington.

anadromous salmonids and resident fish species (see Thomas *fig. 2,* p. 15). These watersheds should include areas of good habitat as well as areas of degraded habitat. Areas presently in good condition are anchors for recovery of depressed stocks, while those of lower quality habitat should have a high potential for restoration.

Johnson et al. (1991) identified a network of key watersheds located on national forestlands throughout the range of the northern spotted owl. USDA Forest Service fish biologists deleted some watersheds and added others as new information was incorporated and an overall design further developed. Key watersheds on Bureau of Land Management land have also been included. A total of 162 key watersheds were designated that covered 8.7 million acres, or approximately one-third the federal land within the range of the northern spotted owl. Option 7 was the only option for which key watersheds were not considered.

Because key watersheds maintain the best of what is left and have the highest potential for restoration, they were given special consideration. In most options, key watersheds require watershed analysis prior to further resource management except for minor activities. In addition, some options, such as 9, use ri-

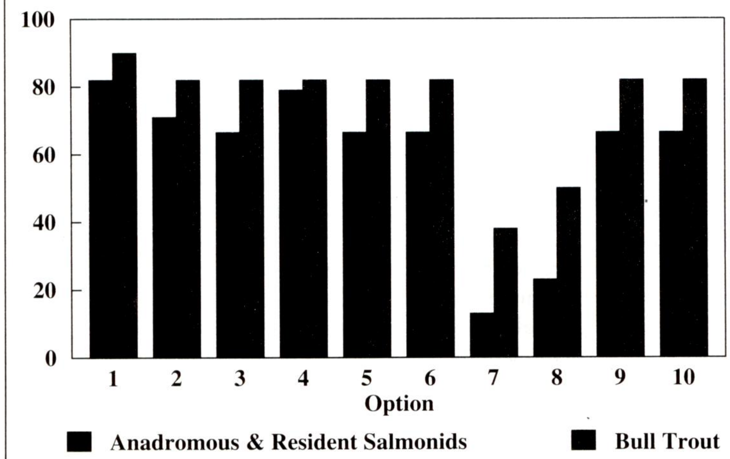

Figure 2. Likelihood of sufficient habitat for bull trout and anadromous and resident salmonids to achieve Outcome A across federal lands over the next 100 years.

Gambling with the Future

This is the question before the nation: are the ancient forests of the Northwest primarily, in President Clinton's words, "a gift of God" held "in trust for future generations" or a cultivated source of commodities and profits? Forests historically have been managed as if we could have it all—ecologically, socially, and economically—now and forever. But we cannot. That is the fundamental truth of the FEMAT report.

The report is a remarkable document, an accessible and comprehensive summary of the state of current knowledge interspersed with unresolved scientific questions, legal queries, and philosophical reflections. It illuminates the complexity of ancient forest ecosystems and candidly acknowledges the sacrifices and limitations inherent in any management choice.

Though ostensibly answering the same call, the FEMAT report and its progeny, Option 9, are divergent and in some respects irreconcilable. The FEMAT report is cautious and acknowledges "our poor understanding of ecosystem function" (IV-72). Conversely, Option 9 brashly advocates an unproven forest management strategy to accelerate the development of certain characteristics deemed, with incomplete scientific knowledge, to be important. The FEMAT report recognizes the potentially critical role played by myriad species of arthropods, fungi, lichens, and mollusks, and warns that it may be prudent to preserve much of the remaining late-successional forest. Conversely, Option 9 provides for liquidation of significant old-growth over the next decade and acquiesces to extirpation of unnumbered species. Option 9 advocates gambling with the future of the ecosystem, while the FEMAT report tells us that we do not know the odds or the stakes.

Somewhere between the Forest Conference and Option 9, the lofty mandate to fashion a "balanced and comprehensive," "scientifically sound, ecologically credible, and legally responsible" management plan was reduced simply to a "struggle to find the tightest possible fit between adherence to requirement of law and our charge to maximize the potential economic and social contribution of the federal lands" (II-105). Option 9 fails to fulfill President Clinton's charge to the team, declines to come to grips with many of the fundamental issues raised in the FEMAT report, and accepts risks that could result in irremediable damage. In providing for management of all the forest and allowing the extirpation of many species, it violates Aldo Leopold's adage that the first rule of intelligent tinkering is to save all the pieces. The FEMAT report tells us how little is known about most of the species that will not survive. What it cannot tell us is what else, including our own survival, may depend on the biological diversity we may elect to sacrifice in the interest of meeting immediate social and economic goals.

When confronted with the starkly limited choices engendered by past forest management, the administration could not muster the courage to dramatically alter course. Its answer to the dilemma is a plan that will provide little protection for species, the ecosystem, and the national trust. Ultimately, Option 9 will be proven scientifically unsound, ecologically perilous, and legally indefensible.

Contributed by Diana Wales, cochair, Umpqua Valley Audubon Society Conservation Committee, Roseburg, OR.

parian reserve scenario 2, which calls for wider riparian buffers for intermittent streams inside key watersheds than on the remainder of the landscape.

Watershed Analysis

Watershed analysis is a stratum of ecosystem analysis applied to watersheds of approximately 20–200 square miles. It plays a key role in any aquatic conservation strategy, ensuring that aquatic system protection is fitted to specific landscapes.

Watershed analysis uses a systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives. This information then may guide management prescriptions, including setting and refining boundaries of riparian and other reserves; developing restoration strategies and priorities; and revealing the most useful indicators for monitoring environmental changes.

Restoration

Watershed restoration should be an integral part of a program to aid recovery of fish habitat, riparian habitat, and water quality and was assumed to occur in most options. The most important elements of a restoration program are to control and prevent road-related runoff and sediment production; improve the condition of riparian vegetation; and improve habitat structure in stream channels.

Of particular concern is that federal lands within the northern spotted owl's range contain approximately 110,000 miles of roads. Without an active program to identify and correct problems associated with roads, habitat damage will continue for decades.

Assessing the Options

In assessing the options relative to protection of aquatic ecosystems, we considered five factors: (1) assessments for the individual races/species/groups made by the "expert" panel (see Meslow et al., p. 24): (2) amount of riparian reserves, and type and level of land management activity allowed within them; (3) extent of other reserves (e.g., congressionally designated withdrawals, late-successional reserves) and type and level of land management activity allowed within them; (4) presence of a watershed restoration program; and (5) prescriptions for management of matrix lands.

The analysis rated the sufficiency, quality, distribution, and abundance of habitat to allow the species populations to stabilize across federal lands. In this assessment, Option 1 and Option 4 had the highest likelihood of attaining sufficient quality, distribution, and abundance of habitat to allow the races/species/groups to stabilize, well distributed across federal lands. Options 7 and 8 had the lowest likelihood (*fig. 2*). Other options fell between the two extremes. Keys to the rating were extent of riparian reserves, standards and guidelines controlling activities within riparian reserves, and extent of late-successional reserves.

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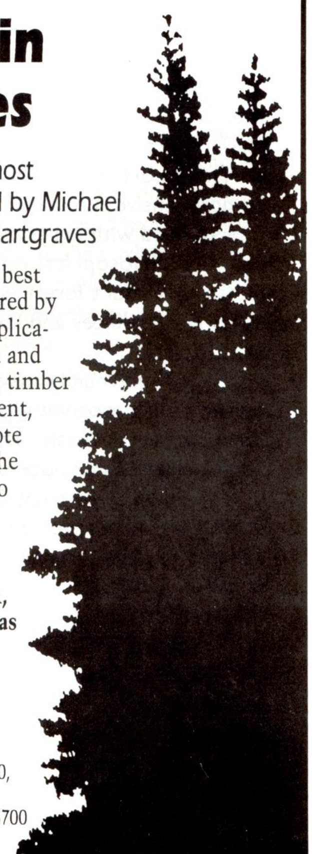

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