

Fish Stocking in Protected Areas: Summary of a Workshop

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Abstract—Native and nonnative sport fish have been introduced into the majority of historically fishless lakes in wilderness, generating conflicts between managing wilderness as natural ecosystems and providing opportunities for recreation. Managers faced with controversial and difficult decisions about how to manage wilderness lakes may not always have ready access to research relevant to these decisions. To address this problem, and to expose scientists to the concerns and constraints of managers and wilderness users, a workshop was held in October 1998 at the Flathead Lake Biological Station in Polson, Montana. Participants included 43 scientists, state and federal managers, wilderness users and advocates and students. Four subject areas were addressed: federal, state, tribal and user perspectives, community and ecosystem effects, species effects and management recommendations. Papers from the workshop are being developed for an issue of the journal *Ecosystems*.

The conflicts between managing wilderness as “natural” ecosystems and providing opportunities for recreation are especially acute in fisheries management. Native and nonnative sport fish have been introduced into the majority of historically fishless lakes in wilderness (Bahls 1992), usually to the detriment of the native biota (Bradford and others 1993; Chess and others 1993; Tyler and others 1998). Alpine lakes are the primary target for recreation in wilderness (Hendee and Schoenfeld 1990), and fishing opportunities may further concentrate use in these areas, resulting in resource damage and compromising solitude in the wilderness experience. Fish stocking, especially using aircraft, is also considered to conflict with wilderness values (Duff 1995).

However, fish stocking in mountain lakes long predates the Wilderness Act of 1964, and fishing is the objective of a sizable proportion of wilderness visitors (Fraley 1996; Hendee and Schoenfeld 1990). Language in the Wilderness Act, reserving the rights of the States with respect to management of fish and wildlife, is often cited as justification for continued active management of fisheries in wilderness (Duff 1995; Fraley 1996). Conversely, other language in the Wilderness Act promoting the preservation of natural systems, and increasing emphasis on wilderness as a reference point for the study and management of ecosystems

(Hendee and others 1990; Kaufmann and others 1994) are difficult to reconcile with many of the current practices of fisheries management.

Consequently, managers are faced with controversial and difficult decisions about how to manage wilderness lakes, and they do not always have ready access to research relevant to these decisions. Considerable research has been conducted recently on the biological effects of fish stocking on resident biota. Many managers tend to minimize these effects, however, instead promoting untested alternative hypotheses (Fraley 1996). Thus, we organized a workshop, held for three days in October 1998 at The University of Montana Flathead Lake Biological Station.

The objectives were to present wilderness managers with the latest research results and management recommendations on the effects of fish introductions on wilderness lakes; to encourage discussion of issues, areas of agreement, conflicts and recommendations for future management and research among managers, scientists and wilderness and recreation users; and to publish a compilation of research results and management recommendations that will be useful for scientists and managers, alike.

The workshop was organized into four sessions, which included formal presentations and a block of time for group discussion. The workshop began with an overview of fish stocking in wilderness from federal, state, tribal and user perspectives, including summaries of key legislation, policy and description of current management practices. A session on community and ecosystem effects included effects of fish stocking on lake nutrient cycling, algal dynamics and invertebrates and interactions between predators, hydroperiod and amphibians. The third session focused on effects on vertebrate species and included discussions on effects of stocking on native fish and amphibians. The final session described restoration and management. This paper briefly describes the presentations and summarizes the findings and comments from the discussions. The complete agenda and abstracts can be found at the Aldo Leopold Wilderness Research Institute's web site (www.wilderness.net/leopold/bulletin.htm).

Participants

Participation in the workshop was by invitation to try to achieve representation by scientists, managers and interested wilderness users and advocates and to keep the size of the meeting small enough for productive discussions. Organizations represented by the 43 participants included the National Park Service (2 participants), U. S. Fish and Wildlife Service (2), U. S. Forest Service (9), U. S. Geological Survey (4), California Department of Fish and Game (1),

In: Cole, David N.; McCool, Stephen F.; Borrie, William T.; O'Loughlin, Jennifer, comps. 2000. Wilderness science in a time of change conference—Volume 5: Wilderness ecosystems, threats, and management; 1999 May 23–27; Missoula, MT. Proceedings RMRS-P-15-VOL-5. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

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Montana Fish Wildlife and Parks (3), Oregon Department of Fish and Wildlife (1), Washington Department of Fish and Wildlife (1), Confederated Salish and Kootenai Tribes (1), University of California (1), Colorado State University (1), Idaho State University (2), The University of Montana (4), Salish Kootenai College (2), Savannah River Ecology Laboratory (1), Utah State University (2), University of Washington (1), Alliance for the Wild Rockies (1), Trail Blazers (1), Trout Unlimited (1), Wilderness Watch (1) and a private consultant (1).

Overview of Fish Stocking Policies and Attitudes

The workshop emphasized the biological effects of fish stocking, mostly, but not exclusively, in western North America. First we reviewed the history of the issue, current policies of the various management agencies and the views of wilderness users and advocates. We began with an introduction to the issue by Bruce Bury (U. S. Geological Survey) and continued with an overview of federal viewpoints. Sue Matthews (U. S. Fish and Wildlife Service and Arthur Carhart National Wilderness Training Center) reviewed the Wilderness Act and the issue of federal versus state control of fisheries management in wilderness. Linda Ulmer (U. S. Forest Service) summarized Forest Service policy guidance on fish stocking in wilderness and Bruce Freet (National Park Service) described the history and controversy of fish stocking in the creation and management of North Cascades National Park.

Next, there were talks on the policies of states and tribes, including Montana (James Satterfield, Jr., Montana Fish, Wildlife and Parks), Washington (James Johnston, Washington Department of Fish and Wildlife), Oregon (Terry Farrell, Oregon Department of Fish and Wildlife), California (Betsy Bolster, California Department of Fish and Game) and the Flathead Indian Reservation (Joe Dos Santos, Confederated Salish and Kootenai Tribes).

Lastly, we heard from several conservation organizations. Michael Swayne (Trail Blazers, Seattle) described his group's efforts during the past 65 years to assist the State of Washington with stocking wilderness lakes, conducting fish surveys and maintaining a database of high-elevation lakes. Bruce Farling (Trout Unlimited) described his organization's desire to emphasize science and wild fish management in wilderness. George Nickas (Wilderness Watch) stated that nonnative species should not be introduced into wilderness and that fish stocking is generally at odds with wilderness values.

Considerable information was presented in this session and lively discussion followed. One major point was that there is no single definition of what constitutes an indigenous species of fish, with differences between state and federal policies and even internally among Forest Service documents. This is clearly contributes to the greater problem that there is no clear or consistent set of policies for how federal and state agencies cooperate, an issue also discussed by Duff (1995) and Fraley (1996). However, participants generally agreed that cooperation and objective research, rather than conflict and litigation, was necessary to effectively manage fisheries in wilderness. The point was well

made that the public doesn't care about the squabbles among agencies.

Community and Ecosystem Effects

The second session began with Daniel Schindler (University of Washington) describing changes to nutrient cycling and algal dynamics resulting from fish introductions. Brook trout introduced into a fishless lake in Banff, Alberta, altered grazing on phytoplankton by eliminating large zooplankton, resulting in an increase in primary productivity. Food webs were altered, with nutrients, particularly phosphorus, transported from storage in the benthos into the pelagic zone. Charles Hawkins (Utah State University) reported results from a study of zooplankton and macroinvertebrates in 48 lakes in the Uintah Mountains in Utah (Carlisle and Hawkins 1998). The study included three predator regimes—no fish, brook trout and cutthroat trout; and three habitat types—sand, cobble and macrophyte-dominated substrates. Differences among lakes were not due to differences in structural complexity. Lakes with fish had smaller zooplankton and few macroinvertebrates compared with fishless lakes. Joel Snodgrass (Savannah River Ecology Laboratory) described interactions between fish and amphibians in Carolina bays, which are small depression ponds on the Atlantic Coastal Plain. These ponds are typically temporary, but ditches now connect many to creeks and rivers, and fish have colonized some of them. A diverse amphibian fauna occurs in this area, but presence at a pond depends on amphibian body size, presence of fish and hydroperiod. For example, small-bodied salamanders are restricted to temporary ponds without fish, while large-bodied species may occur in more permanent ponds containing fish.

Effects on Vertebrates

Ted Koch (U.S. Fish and Wildlife Service) began this session with an overview of the Endangered Species Act, including factors leading to listing and procedures to be followed in interactions with other federal and state agencies. He pointed out that the states have the primary legal responsibility for managing fish and wildlife, but the federal role has been growing since the Lacey Act of 1906 and the Migratory Bird Act of 1918. Effective use of the Endangered Species Act for conservation is often hampered by poor understanding of taxonomic relationships (including ability to define distinct population segments), poor understanding of species' status and difficulty in monitoring trends of most species.

Christopher Frissell and Susan Adams (The University of Montana) described the effects of stocking on native fish. Several widely-distributed species, including bull trout, west slope cutthroat trout and Yellowstone cutthroat trout are threatened by habitat destruction and the stocking of nonnative trout. Interactions between native and nonnative trout include predation, competition, disease, hybridization and effects on food webs. Native trout have been largely extirpated from lower elevation waters and secure habitats are predominately in nonwilderness roadless areas. Stocking nonnative trout into headwater lakes can have severe

consequences, because there are few barriers to downstream migration.

Michael Adams (U. S. Geological Survey) observed that fish are often overlooked as a cause of amphibian declines in low-elevation, nonwilderness habitats. Largemouth bass, nonnative to the western U. S., have a negative effect on native frogs, particularly if bullfrogs (another nonnative species) are present. At a landscape scale, habitat gradients like those studied by J. Snodgrass in South Carolina may allow native amphibians to persist. Kathleen Matthews (U. S. Forest Service) described comparisons of amphibian and fish distributions between the John Muir Wilderness and Kings Canyon National Park in the Sierra Nevada in California. Surveys of 2162 lakes from 1995 to 1997 found fewer lakes with fish in the Park (where stocking was terminated in 1977). Mountain yellow-legged frogs were more common in the Park and rare in the adjacent John Muir Wilderness, where stocking continues. David Pilliod (Idaho State University) has studied Columbia spotted frogs in 73 lakes in the Frank Church-River of No Return Wilderness in Idaho. Adult frogs were found in equal numbers at lakes with and without fish, but reproduction was successful only in a small number of small ponds without fish. He suggested that the removal of fish populations to restore frogs should be done only at sites that would derive the greatest benefit.

Restoration and Management

The session on restoration and management included descriptions of current management practices and a proposal for a watershed-based reserve for native species in the Sierra Nevada. Amy Harig (Colorado State University) described attempts to restore lakes in the Adirondack Mountains in New York, where acid rain and introduced fish (perch and planktivorous cyprinids) have negatively affected native fish communities. Several measures of zooplankton, phytoplankton and native fish were combined for an index of biological integrity to judge success of restoration efforts. James Johnston (Washington Department of Fish and Wildlife) and James Darling (Montana Fish, Wildlife and Parks) described current fish management in the northern Cascades in Washington and the Beartooth Plateau in Montana, respectively. Finally, Roland Knapp (University of California) presented a proposal to restore populations of mountain yellow-legged frogs and macroinvertebrates in four watersheds in the John Muir Wilderness. Of 130 lakes, 117 currently have trout and small populations of frogs occur at the other 13. Selective removal of trout from 16 lakes would result in improved breeding habitat for frogs and greater connectivity among frog populations. Implementation of this restoration project is currently underway.

Products

Several papers, based on presentations at the workshop, are currently being developed. These will be submitted as a group to the journal *Ecosystems*, intended as a special feature. Our goal is for papers to be submitted by the end of 1999, with publication by mid-2000. Participants in the workshop were enthusiastic about the information presented and the discussions that followed. We hope that the published papers will bring this information to the larger scientific and management communities.

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