AFS Policy Statement #9:
Effects of Altered Stream Flows on Fishery Resources (Revised)
(Full Text)

A. Issue Definition

Alteration of the quantity and timing of river or stream flow can significantly affect fisheries resources. The American Fisheries Society (AFS) is alarmed at the loss of natural streams in North America, and greatly concerned with management of fisheries in streams that have been altered. The AFS believes that public trust rights need more recognition and stronger consideration of the management of stream resources.

Severe, long-term adverse impacts and irreplaceable loss of stream fishes have occurred throughout North America. Some river basins, particularly in the more arid American Southwest, have been so radically altered by dams and diversions that an almost total replacement of native fish faunas has occurred. Many of our historic and valuable riverine fishes are declining in distribution and abundance, and some are threatened with extinction. In addition, adverse affects of water development have resulted in international problems in water supplies, and loss in estuarine productivity. Degradation of stream water quality has, in some instances, made the remaining water questionable for further use.

There are few river basins in North America where natural flow regimens have not been altered. Dams built by public and private agencies regulate impounded water supplies by storing and releasing water for power, flood control, irrigation, navigation, municipal and industrial uses, and others. Water diversions further reduce the amount of water available to stream resources, and also return the remainder to a point distant to the intake. Diversions may degrade water quality parameters such as sediment load, temperature, pesticides, herbicides, and others. Regardless of environmental impacts of water diversions or impoundments, these developments are considered "beneficial" by state and provincial law. Conversely, instream flow use of water for fishes is not universally recognized.

Most agencies accept fishery protection as conditional to awarding water rights. However, quantification of stream flow needs of fishes, and operational and legal protection are not presently adequate. The importance of protecting stream fishery resources from a water rights perspective is little understood by the public at large, and fishing as a recreational use of larger streams and rivers has been increasingly de-emphasized by agencies in deference to reservoirs.

The AFS believes that governmental and private sectors do not place sufficient emphasis on protection of instream water for management of stream fisheries resources. In this statement, we stress a need for more careful consideration in planning future stream alterations, discuss potential impacts of alterations, and provide guidelines for future management of stream fisheries.

B. Impacts of Altered Stream Flows

Changes in stream flow can affect fishes directly and indirectly. Direct effects of flow alterations are certainly important if migrations are blocked, fish are trapped in dewatered sections, or reproduction is disrupted. However, insidious effects may be far more detrimental, and include alteration and loss of stream habitat, introduction of competing non-native fishes, degradation of water quality, and other effects. As an example, it is difficult to assess fishery impacts associated with a reduction in stream flooding; however, changed nutrient cycles and disruption of food webs may have serious ecosystem consequences.

Decreased stream flow can contribute to direct mortality if fish eggs are exposed, covered with silt, or left without sufficient, oxygenated water. Reduction in usable habitat can result in decreased abundance, size, and condition of fishes. Water velocities and the amount of appropriate substrate can be so changed that spawning sites become limited, and in some species, an increase in interspecific hybridization may occur. Anadromous or resident species may not move to appropriate spawning sites if attractant flows are lost or stream passage is inadequate.

Reduction in spawning or nursery habitats by stream regulation or diversions can concentrate eggs and young, encouraging increased predation by resident or introduced fishes. Production of essential food organisms, or their availability in occupied habitats, may be reduced for all life stages of fishes. Productivity of riverine systems may be reduced by storage projects that trap nutrients or release water at unfavorable temperatures.

Water resource developments and operations may affect stream resources both beneficially and adversely. Return flows from irrigation projects may be warmer, sediment laden, and contaminated with chemicals, including biocides and fertilizers. Conversely, return flows into river channels during droughts can provide some beneficial effects. Flows from hydroelectric plants may fluctuate greatly and create unstable environments. Water degraded in temperature or chemical composition can displace, or limit growth in fish populations. However, projects providing planned flows can mitigate and potentially enhance fish populations in some environments.

Estuaries are also sensitive to alteration and reduction of stream flow. Eggs and larvae of some estuarine fishes cannot tolerate high salinity of the marine environment that may result from reduced freshwater flows. In this case, the quantity and seasonal timing of freshwater inputs are particularly critical to these sensitive stages. Productivity of estuarine food organisms partially depends on the alochthonous material transported by rivers. Reservoirs may act as nutrient traps thereby reducing estuarine productivity.

Instream flows are a public trust, and stream ecosystems must be protected as irreplaceable resources. Natural stream systems, if properly managed, can provide sport, subsistence, and commercial fisheries at little cost. However, unless stream flows are

established, implemented, and protected, the following impacts can be expected to accelerate:

1. Replacement of unique regional fauna by fishes adapted to the more regulated stream environment. This extirpation will result in more listings of endangered species. Stream fishes currently considered as endangered will continue to disappear in nature.

2. Reductions in localized stream flooding will continue to degrade bottomlands and reduce stream productivity, adversely affecting stream fishes.

3. Riparian habitat will continue to be degraded, and degradation will adversely affect stream quality.

4. Reductions of stream flows will reduce and degrade stream habitat, increase summer water temperatures, reduce oxygen, and concentrate pollutants.

5. Fluctuating flows associated with power generation will reduce stream resources by promoting unstable channels. Such flows will alternately scour, and then promote downstream siltation of stream habitats.

6. Loss of spring peak flows below dams will result in perennial armoring of stream bottoms, with downstream effects of wider, shallower channels due to loss of stream power to move sediments. Alteration of natural hydrographs will result in changed species composition.

C. Needed Actions

1. AFS encourages state and provincial governments to legally identify stream resources, water needs, and to give formal recognition of instream fishery needs as a beneficial use in their water resource programs.

Different legal doctrines-riparian and appropriation- govern allocation of water and water rights in North America. Riparian rights insure land-owners whose properties are bounded or traversed by streams, the right to certain uses of water, usually including fishing and recreation. However, the appropriation doctrine gives exclusive right to the senior water user in a stream, permitting (and in some instances demanding) complete diversion of water to obtain a water right. Under both the riparian and appropriation doctrines, fisheries resources are often not included as beneficial use. In many locations, it may be difficult to obtain recognition of the needs of instream fishery resources without further legislative action.

AFS therefore encourages its membership at all levels to become involved in the process of obtaining legal protection of instream flows, and to provide decision makers with compelling reasons why stream fish habitats should receive more consideration. It is up to AFS members and other interested groups to convince legislators that legal recognition is necessary for instream fisheries habitats.

2. AFS Members should promote the identification of fishery opportunities at new and existing water storage projects, and promote an equal consideration of fishery resources. Opportunities for use of a portion of the unallocated stored water in existing projects for enhanced instream fishery flows should be vigorously pursued. New water projects should be planned and operated with instream flow needs for fisheries as one of the project purposes. Past conflicts over water development can be reduced if the fishery profession demands and is included as a full partner in project planning and operation.

3. AFS will promote development of better habitat evaluation procedures, and support research efforts to obtain more comprehensive information about stream habitat requirements of fishes.

Professional fishery workers must continue to provide technically sound and feasible options and alternatives for protection and management of the resource. To date, verification or validation of stream flow recommendations has been inadequate. Without follow-up evaluation of stream flow recommendations, fisheries management with respect to instream flows is only a guessing game. AFS members must become involved with determination of instream flows that work to meet an intended purpose, i.e., result in sustaining or increasing the stream resources.

The concept of "minimum flows" and other low flow standards based on statistical records instead of biology (whereby it is assumed that needs of stream fishes can be met as long as some water remains) are seriously outdated. Seasonal life history needs of stream fishes must be understood if we are to provide sufficient water at the correct location and at the proper time to provide for reproduction, recruitment, growth, and other life needs. Long-term monitoring of fish populations may be the only viable approach to understanding stochastic and density-dependent factors that influence carrying capacity in dynamic stream environments. Ways of empirically relating instream flows to fish populations must be developed.

4. AFS will promote the formation of national and international programs to evaluate streams ecosystems, with emphasis on conservation of fisheries resources.

Stream ecosystems, particularly riverine and warmwater systems, are complex in biological/physical/chemical interactions, and may traverse many political boundaries. Such systems are difficult to study. Financial support is generally available only for studies of economically important species in restricted areas. Information received from such studies is usually site specific and extremely limited in scope. More emphasis is needed to evaluate present baseline conditions, and to determine future effects of stream alteration. Research and management for conservation of stream resources must occur at the regional river basin level.

5. AFS will encourage governments to adopt a "no net loss" policy for conserving remaining stream ecosystems in North America. It is time to recognize the importance of stream and riverine ecosystems as national assets,

bringing these systems in perspective as links between wetlands, estuaries, and other environments. Replacement of stream channels with aqueducts, ditches, and pipes, should be discouraged. The concept of "no net loss" or "net gain" has merit, but further discussions are needed to reach a workable definition. One approach would be to place the burden of proof on those proposing development to show that alterations would not be detrimental in the extreme, and to provide for follow-up evaluations and means for mitigation. Better understanding of functional relationships between stream habitats and fish life histories would provide for further refinement of management alternatives.

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