COLDWATER FISH MANAGEMENT

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For this presentation, "Coldwater fish management", is essentially restricted to trout management.

Because of diverse philosophies and management methods involved in maintaining trout fisheries, three categories will be discussed: (1) Put and take trout fishing using catchable hatchery trout; (2) Wild trout and "quality" fishing; and (3) Unique fisheries, emphasizing the restoration of native species and subspecies and rare fishes.

(1) PUT AND TAKE TROUT FISHERY

The role of the trout hatchery and the use of hatchery trout is one of the major problems inherent in the fishery management program of states with trout waters. On the positive side, modern technology, improved diets, and highly selected strains of trout have enormously increased the efficiency and lowered the cost of producing catchable-sized trout. The other side of the coin reveals the gross inequality of the distribution of costs among the license buyers in states with large scale catchable programs. Detailed studies make clear that, in general, no more than 5% of the license buyers taken home 50% of the catchable trout caught. When 70-80% of a state's license fee monies are used to maintain such a program, it is obvious that the majority of fishermen are being short changed. Perhaps, a more insidious result of attempting to fulfill the insatiable demands of "welfare troutism" or "socialized creel insurance", is the committment of a conservation department's resources and talent to such an extent that their primary task - that of preserving and improving the quality of the environment and of natural fisheries is neglected. This leads to a decline in the quality of the department itself. Better students avoid employment and any competence and enthusiasm originally present is eroded away by the unchallenging task of fish distribution. Such a department may then be staffed with uninspired "time servers."

The complexities of the problem of "cost sharing" a catchable program is directly related to the magnitude of the program. A state with very limited amount of trout water may simply invoke a pay-as-you-go policy where only those fishermen utilizing the catchable trout pay for the program. In states where the catchable program is vast and deeply imbedded in the psyche of the fishermen, the problem can get out of hand. There is a solution, however, to the ever increasing demands for more trout. It is possible to provide, essentially, an unlimited supply of trout while removing the most onerous part of the burden of supplying these trout from the public conservation agency. Particularly in areas of dense population, certain waters can be managed with an admission fee used to purchase trout

from private hatcheries. This type of fishing has been successful in southern California and many municipal and private irrigation reservoirs have been opened to the public when income is available to buy trout, police the area, and even make a profit. A variety of combinations of public and private stocking may be envisioned, but the main aim of a catchable trout program of the future, must be a more equitable distribution of costs among license buyers and a clear statement of the primary goals of the fishery section of a conservation agency; i.e. the protection and improvement of the aquatic environment.

(2) WILD TROUT MANAGEMENT

The term wild trout is used for naturally propagated fish and those stocked as fingerlings and grown in a natural environment. It is understood that in heavily fished waters, wild trout alone cannot supply enough fish to maintain a reasonable catch per hour statistic. In these situations, special regulations on tackle and catch can be used in some areas (quality fishing) and supplementary plantings with catchable trout can be used in others. Thus, there may not be a clear-cut separation of sections 1 and 2 of this discussion.

The emphasis of a wild trout fishery, however, is to preserve and create conditions most favorable for propagation, growth, and survival of natural trout populations. The most economical return to the fisherman in terms of numbers, poundage, and enjoyment, from a hatchery program is the stocking of fingerling trout in lakes having favorable conditions for growth and survival but lacking natural spawning areas. Much research is needed on species and "strains" of trout, on when to stock, and at what size and density to stock, and possibilities of influencing the food chain for optimum production, to more fully utilize the potential of our waters.

Stocking of fingerling trout in waters with adequate natural reproduction is a wasteful practice because the natural mortality rate, as determined by the environment, will allow only a certain number of individuals to survive to the adult stage.

(3) UNIQUE FISHERIES

Remote, isolated waters can be managed to perpetuate rare and endangered forms of fish. For example, several subspecies of cutthroat trout recognized from the western United States are on the verge of extinction due to competition, hybridization, and water use policies. Conservation agencies have a duty to perpetuate these diverse genotypes of our biological heritage. The main problem is to locate and recognize the dwindling remnant populations of our native trouts. Once the true native trout has been found, a watershed can be selected where the unique form may flourish without danger of hybridization or competition. Many waters now containing only stunted brook trout could be reclaimed and a unique fishery established.

No special regulations would be needed in most areas because limited access would control fishing pressure. The esthetic value of each rare trout to the sportsman, understanding the situation, would be many times that of an ordinary fish.

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Butler, R.L. and D.P. Borgeson. 1965. California "catchable" trout fisheries. Calif. Dept. Fish and Game, Fish. Bull. 127: 47 pp.

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[Oct 6, 1998]

Griffith p. 144

- Hatchery costs woven into fish budget.

1/2 deer license money for hatchery

143 hatcheries 2X budget + game mgt

Colo.: 10-18 mil $

DOW (Tracking Wildlife)
Oct 6 98

p. 4 ...

More than 750,000 people buy fishing licenses in state annually.

N.M.
MT
ID

P-5
Wildlife
Bro - cattle

Leopold / Needham 1938 Rep
- too many catch- ... stream ... -

N.M. economic study
- 5 ... water fishermen short changed

ST. 1956
CA - 1,585,000 catchable
1,240,676 lbs. @ 13 ... @ 75/lb.
6/lb.

MT
Mich. - catchable ... fewer hatch. ...

Mich 1956
- use pellet diet
1952-53 - cost $62,000 more
better growth
cheaper

(dry diets)

USFWS hatch
1946 - 1955
trout - 2132 lb. $517... / man-year

A STATUS REPORT OF COLDWATER FISHERY MANAGEMENT IN THE U.S. – AN OVERVIEW OF STATE PROGRAMS

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Bob, p.10
sun-perc
globally extinct
- southern L. ID
- Tinder Pond, NC

Report draft
w/ raw data
tables. Any comments
appreciated.
Joh

ACKNOWLEDGMENTS

We thank the administrators and [illegible] provided the information contained within. W[illegible]ter Rafle, Joe McGurrin, and Steve Moyer[illegible]nally we thank the Weedon Foundation, t[illegible]undation for funding this project.

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Abstract. We queried the fisheries or aquatics administrator from each of the 50 United States, as an expert on his state's resources, about several aspects of coldwater fishery conservation. Each was asked to return a questionnaire and checklist concerning a variety of topics ranging from the composition of the coldwater resource being managed to threats facing resources to expertise employed by the agency. Forty-nine of the fifty states returned completed surveys. The results from this survey provided us a nascent glance into the challenges facing coldwater resource stewards and the conditions under which they manage coldwater fishery resources. The compiled results describe varied suites of challenges, conditions, and approaches used by the 47 states managing for coldwater fisheries. For example, only half (25) of the states manage aquatic resources under the umbrella of a strategic plan, and 10 manage on a more ecosystem or watershed-based approach. Also, habitat-related problems most commonly were reported as obstacles to sustaining wild trout populations (38 states), yet funding for aquatic habitat monitoring, protection, and restoration programs is generally but a fraction of agencies' budgets. Furthermore, the states collectively operate more than 350 coldwater hatcheries with an additional 1200 private facilities nationwide for which 12 of the states have assessed the environmental and 11 states the economic impacts of those facilities. These and other facts point to a gap between some of the real obstacles to the persistence of coldwater resources and the direction taken by some of the state programs. This likely is due to some mix of institutional histories, funding, public opinion, as well as other variables. Desired changes in each of these areas can be facilitated through communication among professionals, administrators, and various stakeholder organizations.

INTRODUCTION

Recreational trout fishing enjoys enormous popularity in the United States (and elsewhere). Recent reports based on 1991 and 1996 user data (Waddington and Laughland 1993, US Department of Interior (USDOI) and Department of Commerce (USDOC) 1997) estimated between 30 - 31% of the nation's approximately 30 million freshwater anglers fished for inland trout (excluding angling on the Great Lakes), while

another 4 - 5% fished for various salmon species and steelhead (Oncorhynchus mykiss) during their inland freshwater phase. Furthermore, trout fishing effort (defined as days of fishing that included fishing for inland trout) was estimated at 19% of total freshwater fishing effort nationwide.

Although trout angling was reported (by Waddington and Laughland 1996) to occur in all 50 states including those beyond the historical native range of the family Salmonidae, participation in trout angling is largely distributed in a pattern that reflects the present pattern and availability of coldwater habitats. In a number of states trout fishing accounts for more than half of the anglers or angling effort. Specifically, within each of 20 states more than half of the freshwater anglers fished for trout, while within 11 states more than half of the freshwater effort included fishing for trout. Cumulatively, more than half of the nation's freshwater trout anglers fished in six states (California, Pennsylvania, Colorado, New York, Washington, and Oregon). Furthermore, seven states (the previous six plus Maine) accounted for more than half of the nation's trout fishing effort.

As a result of trout fishing's general popularity, considerable fishing pressure (and a desire for improved availability and greater access to trout populations of recreational value) continues to be placed on a diminishing base of unaltered or functional coldwater habitats. The magnitude of this pressure has created enormous challenges for the local, state, federal, and tribal resource agencies responsible for managing resources who are asked to offer increasingly more and diverse angling "opportunities" with fewer financial resources per capita than a decade ago. The growth of this pressure on the resource base can also generate considerable controversy and disagreement among stakeholders regarding the most palatable and effective methods for balancing recreational desires and resource protection goals. Resource stakeholders often have differing core interests, desires, and motivations. These constituents often position themselves for greater access to and allocation of the resource with only limited regard for the consequences to the resource. As a result, resource management may be more an exercise in managing users

and the surrounding landscape than in biological management of the targeted resource of interest (i.e., trout or salmon populations).

Waddington and Laughland (1993) summarized data from a national angler-use survey conducted in 1991, which permit a partial view of the patterns of resource use by anglers and other human dimensions of recreational angling. They used the data to model and predict participation in trout fishing and to describe the characteristics of the trout fishing public in terms of income level, age, sex, place of residence, and others. Their general finding was that in comparison to all forms of freshwater angling, trout angling had greater participation by males, by individuals with a higher income, and by individuals who reside in a northeastern or western locale.

The condition and direction of recreational trout fishing are, however, influenced not only by use patterns of anglers and distribution of the biological resource, but also by the goals and activities of the agencies entrusted with managing the resource. Because much of the responsibility for managing recreational living resources lies with the state governments, it is appropriate to examine and compare some of the characteristics of resource management among the states. Generally, the state fish and game agencies have been entrusted with ensuring long-term and equitable availability of the resource. This includes a responsibility for monitoring status and trends and for taking actions to prevent harm and to repair degradation. Each state resource agency operates under a set of challenges largely determined by circumstances and conditions within it borders, although some agencies may also share some common challenges.

Resource managers can bring a diverse suite of tools to bear on resource challenges. In many states newly hired management or research personnel are required to have technical skills equal to that earned with a graduate degree or that would earn American Fisheries Society (AFS) certification as an Associate or Certified Fisheries Scientist. Unfortunately, despite the technical advancements and increased training of personnel who are responsible for managing coldwater fish and their habitats, the list of aquatic and

fishery resources that are declining or are at risk is growing at an accelerating rate (e.g., the hundreds of salmon stocks at risk in the Pacific Northwest; Nehlsen et al. 1991, also by the end of the decade every major inland trout taxa will likely have been petitioned for protection under the Endangered Species Act). Surely, some part of this growing trend is likely due to perceptions from biased or unstandardized reporting as well as to increased sensitivities in the monitoring and measurement methods of the resource; there have been some notable conservation, restoration, and management successes (e.g., east coast striped bass, greenback cutthroat trout). Regardless, the trend is real, and fundamental changes in the direction, methods, and institutions of resource protection and conservation may be required if we are to continue to enjoy recreational use of our coldwater fishery resources. To determine whether such a proposal has merit and the direction it must take, decision-makers need not only accurate inventories and trends of the resource itself, but also an understanding of user behaviors and preferences as well as some gauge of a stewardship program's effectiveness.

The purpose of this status report is to describe some of the characteristics of the agencies responsible for trout (and salmon) management. The report presents a summary of results from an expert survey completed by the fishery administrator (as a local expert) or his/her designee in each state.[1] The survey is part of a larger Trout Unlimited (TU) project to evaluate the status of salmonid resources and trends in coldwater resource conservation.

METHODS

A survey was mailed to the administrator of each state's primary fishery and aquatic resource agency(s) in October 1996 (Appendix 1). A description of the survey's goals was included along with basic instructions for its completion. The survey was developed with input from TU's National Resource Board and program staff, as well as members of the fisheries and resource management profession. Much of the survey was presented in checklist form (that is, the person completing the survey was asked if the variable or condition of interest applied to his or her state), but some questions asked for more detailed information about aspects of coldwater fishery management. As such, the survey

was not designed to be a scientific survey for estimating (or testing correlative hypotheses concerning) the full range or importance of variables. Rather, it was designed as a vehicle to assemble some basic and descriptive information about coldwater fishery management programs across the country.

A follow-up mailing in February 1997 targeted state programs that had failed to respond to the first mailing. Finally, in March 1997 we requested local TU leadership (from remaining delinquent states) to contact the agencies and urge their participation. In April 1997 we tabulated the data from 45 responding agencies and forwarded these to the states for their review and inspection for accuracy. Four more of the delinquent states responded and six states responded with minor corrections. Indiana was the only state not to respond after our repeated inquiries. Therefore, the findings herein reflect the conditions observed in 49 of the 50 states and almost as complete a composite national view as possible.[2]

FINDINGS

Distribution of coldwater resources

Salmonids are widely distributed, managed, and fished across the United States. AFS (1991) taxonomically recognizes 18 nominal coldwater species of the genera Oncorhynchus, Salmo, Salvelinus, and Thymallus occurring in the U. S. At least one coldwater species is native to 35 states (Figure 1). Furthermore, these 35 states plus twelve others (where these genera do not naturally occur) report that non-native coldwater species are managed by the state fishery management agency as well. Only three states (Florida, Mississippi, and Louisiana) reported that they do not actively manage coldwater species (Figure 1). The findings of Waddington and Laughland (1996) support this conclusion except that they estimated trout fishing as having occurred in all 50 states. The reason for this difference is unclear, but fishing on private trout ponds may be responsible. An alternative explanation is that the three states may have ceased former trout management programs between the time data were collected for the 1991 FWS survey and the present survey.

[Insert Figure 1 Here]

In terms of extant distribution among the states (i.e., presence or absence in the state), brook trout (Salvelinus fontinalis) is the most widely distributed of the coldwater species; the species has a broad native range followed by introduction into 22, primarily western, states. Rainbow trout (O. mykiss, including redband and steelhead trout) also has a broad distribution following introduction into 23, primarily mid-western and eastern, states plus Hawaii. Brown trout (Salmo trutta), a non-native species originating from Europe, has been the most widely introduced coldwater species (24 states in all regions of the U. S.). Other popular introductions include Pacific salmon (especially kokanee, O. nerka), grayling (Thymallus arcticus), lake trout (Salvelinus namaycush), and cutthroat trout (O. clarki ssp.). While many of these introductions have resulted in the establishment of self-sustaining populations (also known as wild, feral, or naturalized populations), recruitment where desired often relies on some level of artificial propagation (see Horak 1995 for a state by state accounting of number of introduced fish species that are self-sustaining).

Obstacles to a self-sustaining resource

A common framework employed for fishery management emphasizes managing the so-called 4-H's (Habitat, Hydropower, Harvest, and Hatcheries)[3]. Much of the emphasis in the 4-H management of aquatic resources is directed at confronting and breaching obstacles to maintaining widely distributed, self-sustaining aquatic communities tolerant of fishing pressure. To examine the threats to resource persistence and the range of obstacles to the self-perpetuation of coldwater resources, we asked the states to indicate what obstacles hindered self-sustaining or wild populations. The most commonly reported obstacles were related to habitat conditions (Table 1). The single most common obstacle identified, reported by 38 states with broad geographic coverage, was "Habitat degradation," which encompasses a number of more specific attributes. These attributes included "Erosion or sediments" (34 states), "Agricultural development" (25 states), "Absence of spawning or nursery habitat," (25 states), "Urban development" (22 states),

"Grazing impacts" (19 states), "Barriers to migration" (18 states), "Deforestation" (16 states), and "Mining" (12 states). Hydrological features, such as "Thermal stress" (28 states) and "Over-appropriated water (or low flows)" (20 states), were also important in most regions. To a lesser extent, biotic features were identified as obstacles least frequently including "Competition/predation from non-natives" (17 states), "Unsustainable reproduction" (16 states), "Genetic mixing" (8 states), "Inbreeding" (7 states), "Diseases" (4 states), and "Forage base losses" (3 states). Finally, harvest issues, specifically "Overharvest," was identified as an obstacle by 12 states.

[Insert Table 1 Here]

The states also varied in the breadth of the obstacles they encountered. Fifteen states reported that four or fewer obstacles were important in inhibiting self-sustaining populations. Many states within this group manage only introduced or relatively restricted ranges of coldwater species. A notable exception is Alaska, which has numerous native salmonids, and which indicated that there were not any obstacles to self-sustaining populations. Sixteen states indicated between five and eight of the obstacles were important; seven states with between nine and 12 obstacles; six states with between 13 and 16 obstacles; and two states, New Mexico and Montana, identified more than 16 of the obstacles as important.

We note, however, that the survey did not specifically ask the states to rank or weight the obstacles, so their relative importance is not readily discernible from these results. This information is available from other sources, however. For example, Richter et al. (1997) conducted a survey among experts about imperiled aquatic species (including 60 fish species) to identify major threats to each species' persistence. They reported that the three most commonly cited "stressors" to the imperiled taxa nationwide were agriculture-related non-point sediment and nutrient loading, interactions with non-native species, and impoundment-related hydrologic changes. They also uncovered regional differences in the ranking of stressors especially among eastern versus western species. For example,

eastern species largely suffer from the effects of altered sediment loads, while western species were affected by non-native species, habitat degradation, and altered hydrologic patterns. Although the Richter et al. (1997) investigation cut across a wide range of aquatic and fish taxa, presumably some of the stressors listed will be important for imperiled salmonids as well. Other recent reports (Miller et al. 1989, Nehlsen et al. 1991, Lassuy 1995, Wilcove et al. 1998) have investigated and reported the importance of various factors contributing to the endangerment or demise of numerous fish taxa. It is clear from these reports that generally no single factor is responsible for the decline (or conversely, is an obstacle to persistence) of aquatic species. Therefore, to be effective at long term conservation of the resource, we may need to consider a wider range of obstacles for a given case when deliberating management actions, promulgating rules covering use, and protecting aquatic resources.

Special recognition or status of coldwater resources

Many states recognize the cultural or social value of coldwater species through the designation as state fish or heritage species (Box 1). Specifically, 18 states have designated a coldwater species as their state fish (information from Soucie 1998). Twelve states reported that one or more coldwater species (or population) have been granted a "heritage" designation. In the either case, designation does not necessarily or specifically carry any extra protection or regulation, although, for example, Arizona, Utah, Colorado, Wyoming, and Montana have each imposed management plans and procedures for native cutthroat trout subspecies (Robert Wiley, Wyoming Game and Fish Department – personal communication). Rather, these designations may serve to elevate public awareness and focus the local cultural value of the designated species.

[Insert Box 1 Here]

Ten states reported that one or more native coldwater species (or native gene pools) have been extirpated from their waters (Box 2). In most cases, the extirpations occurred at extremes of the taxon's range (e.g., Coho salmon in Nevada). Other cases represented the

extirpation of an endemic species or species with ranges restricted to a narrow distribution. For example, yellowfin cutthroat trout (O. c. macdonaldi) and Sunapee trout (Salvelinus alpinus aurorealis, a purported, but controversy-ridden designated, subspecies of the Arctic charr; AFS 1991) are likely globally extinct as intact subspecies within their native ranges. Finally, 10 states are presently confronted with managing federal or state listed threatened or endangered coldwater species; the listing of several others is pending or anticipated in the near future.

[Insert Box 2 Here]

Contaminant and consumption advisories for salmonids

Contaminant concerns appear to be limited to a low percentage of the states (but see also Cunningham et al. 1994, Kyle 1998). Twenty eight contaminant or consumption advisories associated with salmonids were reported to us (Table 2). The most expansive were for organochlorides (15 states) and metals (11 states). The advisories were concentrated regionally in the Great Lakes states, New England, and the far west. Only one state each reported salmonid consumption advisories for biological hazards or sediment problems. None reported advisories or contaminant problems for radioisotopes.

Few salmonid species are typically substrate foragers, where the greatest chance of direct accumulation of hazards is likely. Furthermore, salmonids do not tolerate the general degraded conditions often associated with the accumulation of chemical hazards. However, this is not to say that salmonids are immune to contaminant problems; salmonids can accumulate toxins as these move upward through the food chain.

[Insert Table 2 Here]

Fish health

Fish health is a general concern for trout and salmon management. The presence or absence of 11 diseases either in the wild or in state propagation systems is summarized in

Table 3. Furunculosis was the most commonly reported disease in both fish hatchery systems (31 states) and in the wild (19 states). Gill disease was equally common in the states' culture systems (31 states), but has been reported in only a subset of states' wild populations (6 states). This might suggest that fish health is largely a concern limited to propagated fish in the culture environment, however, this conclusion should be tempered by the limited number of state-run programs that monitor diseases in the wild, except as a response to acute outbreaks.

[Insert Table 3 Here]

Ultimately, fish health is a concern for wild fish as well as for cultured fish, especially where propagated fish and wild fish might co-mingle. Although, 76 responses in Table 3 indicated that the occurrence of a particular disease was limited to the culture system, in 49 cases a particular disease was observed *both* in the wild and in the propagation system. Furthermore, 24 responses indicated that a disease was observed solely in the wild.

Because certain kinds of disease outbreaks are often episodic rather than persistent, the presence of a disease in the culture system or the wild may not be necessarily problematic and may be treatable, controllable, or otherwise tolerable. However, those that are problematic as significant threats to the resource base, such as whirling disease (Nehring and Walker 1996, Vincent 1996), are difficult to eradicate or control in the wild in any practical way. The range of responses by the states to the threat of whirling disease outbreaks and spread has been varied ranging from destruction of entire infected production lots at one end of the spectrum (Hulbert 1996) to redirecting release of infected fish into presumably low risk waters (Bennett et al. 1996). The whirling disease case, like a few others such as bacterial kidney disease (BKD) outbreaks out west, is unusual in that it has focused considerable attention on fish health concerns including those in wild populations to a magnitude not seen previously for fishes. The range of responses by the various agencies suggests an area of future focus for developing uniform national or regional standards aimed at monitoring, prevention, and abatement.

Participation in fish propagation

Artificial propagation of coldwater species is an extensively practiced method for coldwater fishery management. The states collectively operate 369 coldwater propagation facilities (Table 4). Washington state operates a large percentage (> 24%) of these with 90 facilities primarily producing one or more Pacific salmon species. All states that manage inland trout release catchable-size trout (generally, TL > 15 cm) as part of their harvestable recreational fisheries. Nationwide, the states release more than of 50 million catchable-sized trout (unpublished data for 1997). Furthermore, 40 states release fish (not restricted to coldwater species) on federal lands (primarily on U.S. Forest Service and Bureau of Land Management land holdings) and 25 avail propagated fish for release on private lands. In addition to the state-operated propagation programs, the states also collectively permit more than 1200 privately-operated coldwater facilities. The true number of operations may be slightly greater because a number of states do not have a permitting process and other states will allow multiple operations under a single "umbrella" permit. The percentage of these that produce trout or salmon solely as an aquacultural product for market versus the percentage that produce fish for stocking public or private waters is not readily discernible, but is likely to change as the production end of management shifts toward private sources. Of the 40 states permitting private propagation operations, 25 either sponsor a certification program or require certification for propagated trout or salmon to be disease-free prior to transport or distribution.

[Insert Table 4 Here]

Program funding and expenditure

Fishery and aquatic resource management operating funds come from a variety of sources, however, user-pay sources (commonly called, fish and game funds) account for the largest share (Table 5a). Sixteen states reported that they received some proportion of their budgets from the state's general revenue fund or citizen tax base (ranging from 0% for 29 states to 44% for Alaska). Fishing licenses and use fees generally account for the

bulk of funding along with federal aid from the Sport Fish Restoration Trust Fund and other sources. Other sources generally are minor with a few exceptions, such as Missouri's dedicated percentage of state sales taxes. Generally unaccounted for in this survey were mitigation funds from federal water development projects (e.g., the Central Utah Project) or private utility construction (e.g., the Luddington, MI Pump Storage settlement), which also provide a basis for additional program funding.

Special user-stamps have been implemented by a number of states to provide additional revenues for operating various programs (Table 5a). For example, inland trout stamps often are ear-marked for recreational trout propagation and stocking in the states. Nineteen states use inland trout stamps as revenue source. In addition, seven states sell anadromous salmon stamps to fund various management activities. Seven states reported they generate revenues through habitat or conservation stamps for special purposes such as habitat improvement, conservation easements, or programs to enhance wild fish programs.

[Insert Table 5a & 5b Here]

Propagation and management activities (management was the most commonly identified "other") generally account for largest proportions of the state's outlays (Table 5b). The responses were not entirely comparable because some states reported percentages for the entire fisheries budget, some states reported percentages for the coldwater program specifically, and one state reported the percentages per budget for all fish and wildlife programs. Regardless, in terms of relative budgetary effort propagation and management generally received considerably greater emphasis than habitat restoration, public resource education, or "other" program elements.

Areas of expertise and specialization of staff

Areas of expertise for trout and salmon management programs included a variety of professional disciplines. Among the biological science professionals, 39 states employ or

contract fish health experts (Table 6). This is not surprising given the prevalence of diseases discussed in the previous section as well as the level of public concern. Thirty-eight states employ trout management biologists and 36 employ salmonid culture specialists. Fewer states employ habitat specialists (27 states) or wild trout biologists (25). Fewer than half of the states (19 total) employ either a population or broodstock (i.e., breeding) geneticist and 14 have available population modeling expertise.

[Insert Table 6 Here]

Among the social science professionals, 35 states employ public education specialists, 13 employ human dimensions experts or sociologists, and 10 employ a resource economist(s). The apparent trend, for both the biological and social sciences, is more states employ a greater number of generalist management biologists than highly specialized personnel such as modelers and economists. Whether the activities in these specialized fields receive a lesser focus because of funding constraints due to program size, because the specific roles are filled through academic or consulting contracts, or because they are not a priority can not be determined from the data. There was also no attempt to weight professional effort by number or experience of personnel fulfilling those roles. The need for these specialized talents may ultimately need to be fulfilled regionally through multi-state cooperatives or through federal-state partnerships.

Programmatic reviews for economic and environmental impact

As part of their regular operations, state agencies periodically review the impacts of their various program elements (Table 7). We asked states whether they had conducted economic or environmental impact studies of 11 management components of their statewide programs. A few program elements accounted for most of the positive responses in either the economic or environmental categories. For example, although every state manages recreational angling, only 29 states have examined the economic impacts of recreational harvest and even fewer (12 states) have examined the environmental effects of such harvests. Across the states 67 economic assessments and

79 environmental assessments have been conducted. Several states, such as Maryland, report that many or most of the categories have been examined, while others, such as North Dakota and Alabama, have not conducted assessments in any of the categories.

[Insert Table 7 Here]

State aquatic resource policies and regulations

State agencies have developed policies and implemented a variety of regulations to address the obstacles to self-sustaining coldwater fishery resources. We asked the states whether or not they had specific policies guiding or regulations governing 23 different activities. Consider first those that concern management direction, agreements, and partnerships (Table 9). Thirty one states have formal agreements with the federal government (e.g., Fish and Wildlife Service, Forest Service, etc.) concerning fishery management. On Forest Service lands, for example, aquatic resources are managed through Memoranda of Understanding with the state fish agencies. Furthermore, many of the states have agreements with other states (21 states), with tribal governments (11 states), or with non-governmental organizations (9 states) to permit inter-jurisdictional management of shared resources. Surprisingly, only half of the states (25 states) operate under long-term or strategic management plans. Sixteen of the states participate in watershed planning (i.e., plans for managing the full range of biological, chemical, and physical attributes of lakes and streams as well as of their surrounding landscape) and 10 states have broader ecosystem management policies (many of which may operate at the watershed level).

[Insert Tables 8 & 9 Here]

Among other policies guiding coldwater resource management (Table 10), 31 states have policies addressing the release of fish by private parties; 25 states have policies for addressing the problem of diseases within the state's culture system; and private aquaculture is a policy concern in 18 of the states. The effects of non-native species or

non-native gene pools (such as subspecies, stocks, or evolutionary significant units (ESUs)) are a concern in 29 states and 16 states, respectively.

Alternately, 25 states have policies governing practices in wild trout waters and 20 states (of the 35 with native coldwater species) address native trout water issues. Furthermore, 14 states have policies or regulations addressing diseases in the wild. Finally, genetic and biological diversity issues, such as brood stock choice, genetically-modified organisms, stock identification, and hybridization are addressed by only a handful of states in each case. Although these data do not permit an analysis of the effectiveness or comprehensiveness of such policies or regulations, they permit some description of the management directions taken by the states. Some of the respondents indicated that for certain subject areas of concern, the issues are addressed on a case by case basis. Again, gauging the effectiveness of this approach is not possible from these data.

CONCLUSION

The purpose of the survey and this status report was to provide an overview of the current status and condition of state coldwater fisheries management programs in the U.S. As such, the primary strength of the information contained within is that it is nearly a complete data set (i.e., 49 of 50 states) for selected elements of the state coldwater programs. We caution that the information requested and reported not be viewed out of context. The data are largely descriptive and limited in specifics due to the "presence and absence" nature of the survey questions. That the survey was designed to be completed by local experts is both a strength and a weakness. The strength is that the information is often reflects experiential or tacit knowledge, not necessarily recorded in the published literature or program reports. The weakness is that information provided can be subjective. Therefore, in viewing the data, it is important to bear in mind three assumptions. First, is that those completing the survey were experts on their state programs and that they completed the survey in an accurate and objective manner. Given that the survey was sent to each state's fisheries administrator, we presume he or she forwarded it to the local experts where appropriate. There was some room for

subjectivity in answering some of the questions (e.g., obstacles to self-sustaining populations). Although we suspect that few states have vigorously and comparatively assessed and weighted the full range and importance of threats to their fisheries resources, the tacit knowledge of the experts provides a valuable perspective on what is important in the state. The second assumption is that the perspectives provided are not subject to rapid change and, therefore, accurately represent the condition of state programs during the response window. If there have been major changes in a program(s) since the survey was completed, some of the description would no longer reflect what is occurring in the states. Finally, we assumed that the survey itself did not change the conditions or outcomes in the states, although ultimately we would hope the information is useful to the agencies by identifying gaps or opportunities in future management directions.

There are also other caveats to prevent misinterpreting the information. First, there was not an effort to scale much of the information by size of angling population, budget, work force, or amount of aquatic resource. This is particularly important when considering departmental expertise and talent-base. States with larger work forces or larger budgets (such as California or Texas) presumably can employ a greater range of specialists than can a state with a much smaller work force or budget (such as Hawaii or Delaware). Even so, this does not obviate the need for acquiring such expertise. Rather it indicates that those states might benefit from regional cooperative alliances to avail such expertise. Furthermore, it flags potential strategic opportunities for federal agencies (e.g., Fish and Wildlife Service, National Biological Service) to provide cooperative services to the states.

In light of these cautionary comments, we highlight a few facts worth further examination:

- 47 of 50 states actively manage for recreational trout fisheries (which underscores the importance of this group to recreational fishery resources);

- except for the three states that do not manage for salmonids, every state manages non-native salmonid species for recreational or commercial catch (Figure 1);

- obstacles related to habitat or water quality and quantity are the most important across the states (Table 1);

- fish health concerns and expression of diseases are not restricted to either captive or wild populations (Table 3):

- private coldwater propagation is an important component to the fish culture equation (there are approximately three private facilities for every state-operated public facility, Table 4);

- the sources and instruments of revenue for state resource programs vary considerably in terms of contribution from resource user (licenses and federal aid) and other sources (such as general revenue funds, GRF, Table 5a). Expenditures also vary among the states in terms of allocation to various components of management to a couple of associations (Table 5b);

- the states employ a broad range of trout (and other aquatic resource professionals, Table 6);

- the states have not overwhelmingly examined the economic or environmental effects of many of the activities under their purview (Table 7), although they have a variety of policies in place covering a broad array of management activities or resource uses (Table 8).

Fishery resource management has the greatest chance for long-term success when strategies and decisions are information-driven. Conversely, for information to be valuable, it must be collected in a manner that is systematic and unbiased. Given the full

range of issues and general characteristics described by the findings from our survey we recommend three primary actions.

1) States should periodically examine their courses of resource management in relation to the primary obstacles confronting persistence of the resource. For example, the primary obstacles to self-sustaining populations were habitat related, yet habitat protection and rehabilitation programs receive less attention across the board in terms of budget or personnel compared with other activities. In some states, this may reflect the compartmentalization of agency functions; that is, other branches of state government may in fact have primary responsibility for habitat protection or restoration while the fishery agency is concerned with angling or commercial use of the fishery resource.
2) The management issues and program characteristics described in the survey be periodically assessed to provide a status of aquatic (in this case coldwater) resource stewardship across the nation. Such a periodic examination would also permit some understanding of the changes in resource challenges and of the trends in management.
3) In future surveys, attention should be paid to acquiring more detailed information for some of the questions asked. Furthermore, future surveys should incorporate more rigorous scientific survey methods to assemble quantitative information. Such designs would also permit tractable hypothesis-testing about the relationships of program elements with conditions of the resource. Such designs would help also to evaluate whether effort and expenditures are being directed in relation to need of the resource as well as need of the end users.

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[1] The survey and questionnaire were entitled "National Assessment of Artificial Propagation." The intent and scope of the assessment, however, extended beyond propagation into a broader management/stewardship context.

[2] The Tables and figures are presented here primarily as totals or averages. Information and responses from the individual states are available through the Internet at www.tu.org/library/conservation. Hard copies are available from Trout Unlimited on request.

[3] In 1997 the National Resource Board of Trout Unlimited adopted a revision of it North American Salmonid Policy. This document addresses TU's perspective on the 4 H's. The document is available through the Internet at www.tu.org/library/conservation. Hard copies are available from Trout Unlimited on request.

Table 1. Summary of obstacles to self-sustaining populations.

Obstacle	Total number of states
Habitat degradation	38
Erosion or sediments	34
Thermal stress	28
Agricultural development	25
Absence of spawning habitat	25
Urban development	22
Over-appropriated water	20
Grazing impacts	20
Barriers to migration	18
Deforestation	16
Unsustainable reproduction	16
Competition with exotics	14
Absence of nursery habitat	13
Overharvest	12
Mining	12
Predation by exotics	11
Genetic mixing	8
Inbreeding	7
Diseases	4
Loss of Forage	3

Table 2. Hazards and consumption advisories for salmonids.

Hazard	Total number of states with advisories
Chlorinated Hydrocarbons	15
Metals	11
Biohazards	1
Sediments	1
Radioisotopes	0

Table 3. Disease occurrences.

Disease	Number of States	
	Wild	Culture
Furunculosis	19	31
Bacterial kidney disease	13	17
Whirling disease	12	9
Gill disease	6	31
Enteric redmouth	7	15
Carcinoma or lymphoma	4	6
Infectious Hematopoeitic Necrosis	4	5
Early mortality syndromes	4	4
Nucleospora salmonis	1	5
Viral Hemorrhagic septicemia	1	2
Swim-up syndrome	1	1

Table 4. State participation in public and private coldwater fish propagation.

Propagation program	Total number
State-operated coldwater facilities	369
Permitted Private Coldwater Facilities	1,280
	Total number of states
Put & take stocking	46
Stocking on federal lands	40
Stocking on private lands	25
State disease certification for private facilities	25

Table 5a. Sources of revenue for fisheries management and the use of special user fees. Fiscal Year (FY) 1997 Budget estimates are license revenues for the entire fisheries program (x $1000). FY 1997 License Sales are for all licenses, stamps, tags, and permits (x 1000).[4] GRF = state general revenue (appropriated) funds.

Revenue Source / State	FY 1996 Budget	GRF revenue (%)	Licenses & fees (%)	Federal aid (%)	Other revenue (%)	FY 1996 License Sales	Inland Trout Stamp	Anadromous Stamp or Permit	Habitat Stamp or Fee
Alabama	6,200	0	35	65	0	503			
Alaska	10,974	44	17	12	27	629		•	
Arizona	6,808	0	25	75	0	634	•		
Arkansas	6,698	0	81	19	0	680	•		
California	44,850	0	41	23	36	2,861		•	
Colorado	11,894[5]	0	68	28	4	951			
Connecticut	2,292	17	37	46	0	175			
Delaware	270	19	16	51	14	34	•		
Florida	19,578	N.A.	N.A.	N.A.	N.A.	1,492	--	--	--
Georgia	7,440	0	59	40	1	798	•		
Hawaii	20	10	15	75	0	6			
Idaho	5,647	N.A.	N.A.	N.A.	N.A.	506		•	
Illinois	9,389	10	69	19	2	839	•	•	
Iowa	4,685	0	61	38	1	428	•		
Kansas	4,558	0	54	46	0	322	•		
Kentucky	7,767	0	30	70	0	627	•		
Louisiana	8,304	N.A.	N.A.	N.A.	N.A.	1,461	--	--	--
Maine	6,978	0	25	75	0	258		•	
Maryland	4,762	0	70	30	0	504	•		
Massachusetts	4,640	0	100	0	0	363			•
Michigan	22,103	1	64	28	7	1,446		•	
Minnesota	20,319	0	61	39	0	1,357	•		
Mississippi	4,877	2	23	75	0	455	--	--	--
Missouri	10,628	0	9	5	86	1,568	•		
Montana	7,678	0	49	45	6	563			•
Nebraska	3,156	0	25	75	0	264			•
Nevada	2,975	5	25	70	0	257	•		
New Hampshire	3,571	0	56	44	0	171		•	
New Jersey	4,705	0	80	20	0	341	•		
New Mexico	3,900	0	39	61	0	255			•
New York	13,568	5	70	25	0	1,041			•
North Carolina	10,989	0	70	30	0	639	•		
North Dakota	1,176	0	25	75	0	137			
Ohio	16,604	4	74	18	4	1,092			
Oklahoma	7,760	0	50	30	20	562			
Oregon	12,369	12	27	4	57	999			
Pennsylvania	19,513	0	54	37	9	1,789	•		
Rhode Island	422	6	19	75	0	54	•		
South Carolina	5,455	32	27	33	8	589			
South Dakota	2,937	0	63	37	0	341			
Tennessee	11,548	0	60	40	0	1,195	•		
Texas	32,817	N.A.	N.A.	N.A.	N.A.	2,098	•		
Utah	7,454	7	43	39	11	755			•
Vermont	2,080	0	56	44	0	132			
Virginia	9,177	0	55	42	3	829			
Washington	13,083	63	0	0	37	969			
West Virginia	4,696	0	80	20	0	312	•		
Wisconsin	21,517	3	72	20	5	1,452	•	•	•
Wyoming	5,999	0	40	41	19	449			•
Total	**486,987**	**--**	--	--	--	**35,794**	**20**	**8**	**8**

Table 5b. Budgetary expenditures (in rounded percentages) for all fisheries management program elements. NA = information not provided. Entries in bold are percentages for entire fisheries program. Italicized entries are for coldwater fisheries programs as a percentage of total expenditure. Single underlined entries are percentages of coldwater expenditures. Double underlined entries are percentages of joint fish and wildlife budgets.

Revenue Source State	Propagation	Research	Habitat	Education	Regulation	Other
Alabama	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Alaska	*4*	*9*	*0*	*1*	*0*	*0*
Arizona	**20**	**10**	**5**	**5**	**1**	**57**
Arkansas	*35*	*10*	*5*	*0*	*0*	*0*
California	**40**	**23**	**26**	**2**	**5**	**4**
Colorado	**57**	**7**	**3**	**1**	**0**	**32**
Connecticut	**25**	**66**	**5**	**3**	**1**	**0**
Delaware	**0**	**36**	**5**	**6**	**1**	**52**
Florida	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Georgia	*25*	*5*	*<1*	*4*	*<1*	*0*
Hawaii	*1*	*0*	*0*	*0*	*0*	*0*
Idaho	*27*	*14*	*0*	*0*	*<1*	*0*
Illinois	**35**	**40**	**0**	**25**	**0**	**0**
Iowa	**19**	**11**	**6**	**8**	**6**	**50**
Kansas	*15*	*5*	*<5*	*5*	*0*	*0*
Kentucky	*0*	*2*	*0*	*0*	*<1*	*0*
Louisiana	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Maine	**60**	**10**	**1**	**2**	**10**	**17**
Maryland	**30**	**40**	**0**	**15**	**10**	**5**
Massachusetts	**58**	**10**	**0**	**0**	**0**	**32**
Michigan	*31*	*21*	*5*	*3*	*0*	*0*
Minnesota	*6*	*1*	*3*	*5*	*<1*	*0*
Mississippi	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Missouri	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Montana	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Nebraska	*25*	*5*	*1*	*2*	*0*	*0*
Nevada	**45**	**45**	**0**	**5**	**5**	**0**
New Hampshire	*78*	*0*	*0*	*0*	*0*	*15*
New Jersey	**50**	**20**	**5**	**0**	**5**	**20**
New Mexico	**62**	**19**	**0**	**0**	**0**	**19**
New York	**40**	**15**	**0**	**5**	**35**	**0**
North Carolina	**39**	**25**	**10**	**1**	**0**	**25**
North Dakota	**25**	**7**	**3**	**10**	**55**	**0**
Ohio	**30**	**20**	**0**	**0**	**0**	**50**
Oklahoma	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Oregon	**45**	**9**	**30**	**10**	**6**	**0**
Pennsylvania	*32*	*5*	*1*	*1*	*18*	*6*
Rhode Island	**40**	**48**	**0**	**12**	**0**	**0**
South Carolina	*5*	*<1*	*<1*	*<1*	*<1*	*0*
South Dakota	**50**	**13**	**1**	**1**	**1**	**34**
Tennessee	**24**	**55**	**20**	**1**	**0**	**0**
Texas	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Utah	**36**	**9**	**4**	**0**	**0**	**51**
Vermont	**40**	**20**	**3**	**3**	**0**	**34**
Virginia	**38**	**41**	**6**	**8**	**1**	**6**
Washington	<u>24</u>	<u>5</u>	<u>1</u>	<u>1</u>	<u>12</u>	<u>57</u>
West Virginia	<u>75</u>	<u>0</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>20</u>
Wisconsin	**36**	**30**	**15**	**3**	**0**	**16**
Wyoming	**45**	**4**	**3**	**0**	**0**	**48**

Table 6. Areas of expertise and specialization available to the states.

Expertise Area	Total number of states
Disease biologist	39
Trout management biologist	38
Salmonid culture specialist	36
Public education specialist	35
Habitat specialist	27
Wild trout biologist	25
Fish population geneticist	18
Population modeler	14
Sociologist	13
Brood-stock geneticist	11
Resource economist	10

Table 7. Summary for the number of states completing economic and environmental assessments for fishery management program elements.

Assessment Area	Economic (no. of states)	Environmental (no. of states)
Recreational harvest	29	12
Fish culture	11	12
Habitat restoration	6	10
Enhancement stocking	4	10
Water quality	3	11
Species introductions	4	8
Chemical thereputants	3	6
Stock transfers	1	6
Disease	1	4
Commercial harvest	5	0

Table 8. Summary of states with policies and regulations addressing planning and agreements.

Policies & Regulations	Total number of states
Federal Agreements	31
Long-term Strategic Plan	25
Multi-state Agreements	21
Watershed Planning	16
Agreements with Tribal Authorities	11
Ecosystem Management	10
Agreements with NGOs	9

Table 9. State policies and regulations addressing biological concerns.

Policies & Regulations	Total number of states
Release by private parties	33
Non-indigenous species	29
Wild trout waters	25
Disease in culture facilities	25
Native trout waters	20
Private aqua-culture	18
Stock transfers	16
Toxic or hazard spills	16
Diseases in the wild	14
Broodstock choice (genetics)	11
T & E critical habitats	7
Triploids & tetraploids	7
Gene pool refuges	7
Stock identification	6
Hybrid crosses	3
Transgenics	2

[4] Data from U.S. Fish and Wildlife Service, Division of Federal Aid, Arlington, Virginia.
[5] Colorado estimates are based on 1996 revenue and license certifications.

X-Sender: carena@mail.tu.org
X-Mailer: Windows Eudora Pro Version 3.0 (32)
Date: Mon, 19 Oct 1998 15:00:55 -0400
To: fwb@picea.cnr.colostate.edu
From: Christine Arena <carena@tu.org>
Subject: hatcheries article

Bob:

Attached is Jim Yuskavitch's hatcheries article. Please call John Epifanio with all comments or corrections (703/284-9415). Thanks.

Christine

Yuskavitch - Hatcheries final.doc

[ca 1998]

****PLEASE DIRECT ALL COMMENTS TO JOHN EPIFANIO: 703/284-9415****

Taking Stock of Stocking
By Jim Yuskavitch

When George Griffith and Art Neuman founded Trout Unlimited in Michigan in 1959, hatcheries were foremost on their radar screen. Trout fishing in Michigan was in a sorry state. Trout habitat degradation and pollution were widespread and the state's fishery was virtually all put-and-take. The 40 anglers who flocked to join TU at its first meeting in Saginaw that summer represented the first of a new group of conservationists in the mold of Aldo Leopold who believed that habitat, not hatcheries, was the key to strong populations of trout—wild trout—and good fishing as well.

So where are we today, on Trout Unlimited's 40th birthday and 130 years after the concept of fish hatcheries was introduced to this continent—a technology that has informed and directed much of our fisheries management over the intervening decades? We know much more now about how hatcheries and stocking have affected trout and salmon throughout the country. And much of the news is not good. But are we putting what we have learned to use in managing our fisheries? Are we emphasizing wild trout and wild trout habitat, or clinging to the same old model? And if hatcheries are not going to go away, are there new ways to use them to benefit wild fish and ultimately anglers?

1813
1864

"The whole idea of an agricultural approach was institutionalized within fish management dating back to the 1800s," said Dan Bottom, monitoring coordinator for Oregon's coho salmon recovery program. "People didn't like to be regulated back then. We thought we could make fish so abundant that we wouldn't have to be. There was tremendous excitement about this new technology."

Artificial propagation of fish in the U.S. goes back to the 1860s and was instituted as a way to repopulate Eastern streams that had experienced significant declines in their wild fish populations from overfishing and human development of the landscape. Hatcheries were based on an agrarian model of raising animals in a controlled environment with a constant food source, combined with the assumption that the limiting factor for fish survivability in the wild was in the early life stages, which could be avoided by artificial propagation. The fish culturists were wildly successful, producing egg survival rates reaching 90 percent, a far cry from the few percent that typically survived in the wild. The evidence was in and the hatchery concept was fully embraced by fishery managers. Hatcheries were embraced, too, by the public, which saw them as the solution to plummeting fish populations, and demanded more hatcheries and increased production. The science of fish propagation merged with the politics of public desire. And politicians and government administrators responded.

By 1883, up to 85 percent of the federal government's fishery program budget was dedicated to fish propagation. By 1900, it was shipping a billion or more eggs and fry of a variety of species,

destined for eventual stocking in waters throughout the country. The federal government began to construct national fish hatcheries around the U.S. and individual states followed suit as they developed their own fisheries programs. Today, there are a total of 66 federal hatcheries in the national fish hatchery system along with as many as 369 state-operated coldwater fish hatcheries.

Fishery managers propagated and planted trout willy-nilly with little or no thought to the effects on native, wild fish populations. The goal was simple and straightforward: Under traditional thinking, more fish planted in rivers and lakes meant more fishing. Rainbow trout from the West Coast were brought east. Eastern brook trout were brought west. Brown trout were introduced from Europe. "Our agency and other agencies pretty much did Johnny Appleseed with fish," said Gary Carmichael, who works with threatened and endangered desert trout at the U.S. Fish and Wildlife Service's Mora Fish Technology Center in New Mexico. "We thought we were doing good for recreational fisheries." Even back in the 1950s, without benefit of the scientific data we have today, Trout Unlimited's founders knew better.

The negative impacts of stocking hatchery trout over wild populations are well-documented. Hatchery-raised trout, domesticated to life in a hatchery, are unschooled in the size-based social order of wild trout, where larger fish take the prime spots in a stream, and often provoke energy-draining fights for position—energy that is better used for finding food.

While competition for food and space between hatchery trout and wild trout of the same species is significant, competition between introduced species and native species can be devastating. Habitat degradation, combined with hybridization with rainbow and other forms of cutthroat trout along with competition from introduced brook trout, nearly wiped out native greenback cutthroats in Colorado. In Tennessee and North Carolina, southern Appalachian brook trout, which already confront the ravages caused by acid precipitation, cling to their last strongholds in headwater streams where waterfalls act as barriers to keep out introduced rainbow trout, which have overwhelmed them wherever the two have co-mingled.

Hybridization between native and non-native species and mixing of genetically divergent populations from formerly isolated drainages are very real threats as well. In the Pacific Northwest, interbreeding of genetically homogenized hatchery salmon and wild salmon may compromise the adaptability of some wild stocks by "swamping" (that is, by overpopulating the reproductive pool of native adults with the offspring from a narrow fraction of a population's genetic diversity). For example, hybridization of Apache trout with introduced rainbows in the Southwest threatens the long-term survival of these natives. Such threats are often expressed in subtle ways. The offspring of hybrid populations may seem normal and healthy, but over the long-term will develop reproductive problems, eventually becoming extinct as a genetically distinct species, subspecies or stock.

The introduction of pathogens from the hatchery to the wild is another serious concern. Montana and Colorado, for example, have recently been hit hard with whirling disease, a parasite that attacks the cartilage of young trout and can virtually wipe out entire populations of some species

in an infected stream (whirling disease does not appear to have an effect on brown trout, since both evolved together in Europe). In Colorado, the practice of using infected river water to supply some hatcheries has allowed whirling disease to infect cultured fish, which is then spread to other streams as those fish are outplanted. And as anglers perceive themselves to be dependent on hatcheries to provide recreational fishing, there is often public pressure to stock diseased fish.

"You have two choices when you have infected fish," said Bruce Rosenlund, project leader for the U.S. Fish and Wildlife Service's Colorado Fish and Wildlife Assistance Office, who works with the greenback cutthroat trout recovery program. "You can bury them or you can get them out to provide some fishing in WD (whirling disease) positive waters where they won't spread the disease. We've buried them in the past and people have been very unhappy."

Ecological problems aside, the hatchery model of recreational fishery management has affected how fishery managers and anglers have thought, and still think, about fish and fishing. "By emphasizing the propagation and stocking strategy," said TU's conservation geneticist John Epifanio, "over the strategy of fixing the real problems related to habitat, overharvest and other factors, we're given a false sense of security that says 'look, we still have lots and lots of fish.' However, number of fish is only one of many features of a viable population."

Although seldom articulated in so many words, the hatchery strategy says that if overgrazing by cows or poor forestry practices render a stream too warm and sediment-filled for native brook trout, we'll just plant brown trout, which are more tolerant of degraded water conditions. If a river is overfished, we'll make up for it by stocking twice as many trout. Or as David Nickum, Colorado TU's Southern Rockies conservation director puts it: "For years and years, fish managers have told people that hatcheries are where fish come from."

If the question is whether fish, and high-quality fishing, can come from good habitat and a policy that emphasizes wild trout over hatchery trout, it was answered in Montana some 25 years ago.

Considered the father of Montana's wild trout program, fish biologist Richard Vincent came to work for the Montana Department of Fish, Wildlife and Parks in the mid-1960s, soon embarking on a 10-year series of studies examining the relationships between hatchery trout and wild trout. At that time, Montana's fish program, like those of most other states, was centered on stocking hatchery fish on top of wild fish to boost recreational fishing. This put-and-take concept simply involves the planting of "catchable" trout—usually in the 10- to 12-inch range—into a stream or other water body with the expectation that they will be quickly caught by anglers. As the stream is depleted of fish, more are stocked to take their place. (A variation on this is the put-grow-and-take concept where fingerlings are stocked and allowed to grow to catchable size. Trout anglers sometimes mistake these for wild fish.)

But Vincent's research, conducted between 1966 and 1976, turned up some astonishing facts. "Because they are very disruptive to the wild population," says Vincent, "we found that stocking hatchery trout on top of wild trout reduced the wild trout population by about 90 percent." And

there was more. Since cultured trout typically lived only two or three months after being released from the hatchery, with less than one percent surviving for one year, hatchery fish were knocking out the wild trout without making up for the difference. "When you stock fish," Vincent continued, "you stock the size you want to catch. The hatchery fish suppress wild fish that would grow larger. But the hatchery fish don't live long enough to grow big." The net result of stocking in Montana's streams was fewer, and smaller, trout. Based on this research, the Montana Department of Fish, Wildlife and Parks instituted a wild fish policy in the mid-70s that ended the stocking of hatchery fish in any stream capable of producing self-sustaining trout populations, which in Montana means almost all of them. The state continues to stock hatchery trout for recreational fisheries purposes, primarily in human-made reservoirs where natural reproduction is not possible.

But Montana's curtailment of stocking in most of its trout streams did not happen without some controversy. "There were concerns that the fishing would get very poor and no one would fish Montana," said Vincent. But as anglers began catching bigger fish, those concerns vanished. The average size of a Montana trout has gone from a 10- to 12-inch hatchery fish to today's 15- to 16-inch wild rainbows and browns. "But there's a catch to a wild trout program," Vincent warned. "You have to have good fish habitat. And you're not going to get habitat improvement unless fishermen ask for it."

Anglers have been asking for it. In response, the sophistication of fish habitat restoration techniques has improved dramatically. Over the past 30 years or so, fisheries managers have gone from dredging streams to produce "fishing holes," installing hard surface rip-rap to stem streambank erosion, and even pulling logs, snags and other woody debris from streams in the mistaken notion that it interfered with fish movement, to a much deeper understanding of what constitutes a functioning stream or river system. Today, we know the importance of woody debris for salmonids and that planting native vegetation is a far better way to stabilize streambanks. Using natural materials and techniques to restore streams (called bioengineering), fishery managers can install structures in such a way that they naturally direct water flow to create meanders and pools, or plant native vegetation over natural fiber matting to create "instant" riparian zones. You can visit virtually any state today with a coldwater fishery and see good salmonid habitat projects that benefit fish. But in spite of this good work, a look at how the states divvy up their budgets shows that hatcheries remain as popular as ever.

For the most part, hatcheries take a hefty share of most states' coldwater fisheries management program budgets. Of the 47 states that have put-and-take trout stocking programs (Florida, Louisiana and Mississippi have no coldwater habitat—but Hawaii has a tailwater fishery and does stock trout), seven devote more than half of their total fisheries program budget to propagation. These include Colorado (57 percent), Maine (60 percent), Massachusetts (58 percent), New Jersey (50 percent), New Mexico (62 percent), South Dakota (50 percent), and West Virginia (75 percent). And these figures only represent direct costs. Such indirect expenditures on hatcheries as administration and health laboratories take an additional budget bite. Eighteen states devote 30 percent or more of their total fisheries budget to hatcheries.

Collectively, state fish stocking programs dumped over 50 million catchable-size trout into the nation's coldwater habitat in 1997. Federal hatcheries added another 8.3 million. And the more than 1,200 private trout and salmon aquaculture ventures in the U.S. are a wildcard. No one knows how many fish are released or escape from these facilities or what their effects are on wild salmonid populations.

Habitat and wild fish are a different story. Only five states report dedicating 10 or more percent of their fisheries budget to habitat work, including California (25 percent), Oregon (30 percent), Tennessee (20 percent), North Carolina (10 percent), and Wisconsin (15 percent). Only 27 states employ habitat specialists. Just 25 have wild trout biologists and some kind of wild trout management policy—programs that typically seek to boost self-sustaining wild populations and minimize their exposure to hatchery fish.

Despite the preponderance of evidence that stocking programs suppress wild trout populations and Montana's long-term experience showing that you don't need catchable trout to have great trout fishing, hatcheries aren't necessarily all bad. Critics will concede that even put-and-take has its value. "The bottom line for our members," said Colorado TU's Nickum, "is that if you have a stream system that produces wild trout, you should rely on what nature provides. But places where you don't have natural production, like reservoirs and urban waters, are candidates for stocking."

In the long term, hatcheries may be best used to reseed or recover threatened and endangered species through careful artificial propagation that retains their genetic purity and "wildness" by using wild broodstock as a source of eggs and sperm. This keeps the gene pool alive while fishery managers find places with suitable habitat to reestablish them. The U.S. Fish and Wildlife Service is currently raising some 50 at-risk fish species in hatcheries as part of its threatened and endangered species recovery programs. In the Pacific Northwest, where many hatcheries have been used to "mitigate" for the loss of salmon from the effects of dams—by releasing large numbers of fish simply to increase the number of returning adults available to commercial and recreational anglers—scientists are experimenting with ways to raise salmon in hatcheries from wild broodstock whose purpose would be to return to spawn and increase depleted runs, not to enhance fishing.

"I think that we're at the beginning of a view that hatcheries can be used to meet the needs of naturally spawning populations," said Don Campton, regional fish geneticist with the U.S. Fish and Wildlife Service's Abernathy Salmon Culture Technology Center in Washington State. "What we're trying to do now is get people at all the agencies to understand that even though hatcheries weren't intended to fill a conservation role, they can."

What keeps traditional put-and-take hatchery programs going on such a wide scale is the belief that we need them if we are going to have recreational fishing. The case for hatcheries as a primary fish management strategy often revolves around the argument that without large numbers of trout to catch, people will stop fishing. Yet Montana's experience is that anglers prefer size and quality over quantity, and a recent TU study in Colorado found that there was no

meaningful relationship between the numbers of fish stocked and license sales.

But there is one last catch. A shift to mostly wild fish would also mean a shift from the idea of maximum harvest made possible by supplementation stocking to the law of "carrying capacity"—that any habitat can only sustain a certain number of animals. Good habitat and wild fish mean better quality, bigger fish. But they also mean fewer of them and the necessity of imposing increased restrictions to protect them from overharvest. And this brings us back full-circle to one of the founding ideas of hatcheries: to produce such an abundance of trout that anglers could fish to their heart's content, without ever worrying about depleting the resource.

"What we need to do," said Epifanio, " is get beyond the myth that we can interminably increase catch rates by top loading our waters, as well as the myth that participation in angling is tied into filling a cooler or mounting trophies on the wall. The recent history of special regulations suggests that anglers can and will change their behaviors to keep within biological realities when the facts are presented plainly." How well a majority of the nation's anglers accept that premise will likely go a long way in determining how we're using fish hatcheries when Trout Unlimited's 80th anniversary rolls around.

Jim Yuskavitch is a writer and photographer who specializes in natural resource and environmental issues. He is a co-author of The Insider's Guide to Bend and Central Oregon, *published last fall by Falcon Publishing, and is currently at work on two books about the Oregon outdoors. Jim was associate editor of* TROUT *from 1987 to 1992, and last wrote for the magazine in Summer 1998 with the piece, "Breaching, Drawdowns, and the Art of Salmon Recovery." He resides in Sisters, Oregon.*

Sidebars

Angling for Dollars

"We found no statistically significant relationship between the number of fish stocked in Colorado and the number of licenses sold," said John Loomis of the Department of Agricultural and Resource Economics at Colorado State University, who, with graduate student Peter Fix, conducted a 1997 study exploring some of the economic assumptions that have driven hatcheries in Colorado for decades. Trout Unlimited's Coldwater Conservation Fund sponsored the study as part of TU's National Fish Hatchery Assessment.

One of the most cherished assumptions is that hatcheries are necessary to provide lots of fish for anglers to catch, or they will stop buying licenses. While the researchers found that not to be true, they did discover a significant relationship between the number of fish that are stocked and interest in fishing; that relationship was not proportional, however. In other words, a 20-percent increase in stocking only resulted in a 10-percent increase in fishing. They also found a fairly consistent trend that catching larger fish and being outdoors in a pleasant, natural setting was valued more highly by anglers than simply catching more fish—a finding that suggests more wild fish management and less stocking might be welcomed by Colorado anglers, as it has been with Montana's wild fish program.

The economics of Colorado's fish hatcheries are equally interesting. The researchers determined that the cash cost to produce a hatchery trout caught by an angler is $1.85 while the benefit to the angler ranges from $0.75 to $1.00, with the benefit based on how much anglers were willing to pay to catch more fish than they were currently catching. "It costs the Colorado Division of Wildlife one-and-one-half to two times what the benefits are to the angler," said Loomis.

The costs of hatcheries are typically calculated on various direct costs, such as labor, fish food, electricity, and maintenance of the facilities. However, there are "opportunity" costs as well. For example, hatcheries are often situated on high-value riverfront property. Would that land be better used to provide a park, campground or angler access? "Just because the state owns the land, doesn't mean it's free," said Loomis. In fact, public ownership of these properties and often the rivers, streams, and lakes into which trout are stocked have economic value that is not reflected on budget sheets.

Another way to look at the economies of hatcheries is to ask whether there might be better ways to spend the money to benefit fish. For example, Colorado has been hard-hit by whirling disease, much of it spread by infected fish stocked from hatcheries that were in turn infected by contaminated river water, which the state uses to supply some of its hatcheries. Colorado plans to spend up to $18 million over the next three years to disinfect affected hatcheries and develop safer water supplies.

Asked Loomis, "Would that money be better spent restoring streams, buying public access or purchasing instream water flows? The more policy relevant question is should they replace the fish that are lost to whirling disease? Our study says that it would be more economically efficient to stock fewer fish." And Colorado anglers just might end up catching bigger trout to boot. —*JY*

Trout Unlimited and Hatcheries [with "What You Can Do" box]

"We need to stop making hatchery managers and their employees the punching bag of the fisheries profession," said Trout Unlimited's conservation geneticist John Epifanio. "They've been given a job to do and they do it well. But I argue it's the wrong job. We've looked at hatcheries as a one-size-fits-all fish operation. Our efforts in propagation need to be focused on how we can use hatcheries for conservation. That's the most appropriate use of a hatchery."

True to its origins, TU's views on hatcheries today, although more sophisticated in their scope, mirror those of its founders four decades ago. Healthy, coldwater habitat is where healthy, sustainable populations of trout and salmon come from, not hatcheries.

TU focuses its concerns on four general areas regarding hatcheries—economics, diseases, ecological interactions, and the loss of genetic heritage. In other words, the stocking of hatchery fish spreads diseases, developed within the close confines of the hatchery environment, to wild fish. Releasing large numbers of hatchery fish on top of a wild fish population may effectively swamp it, exposing the wild fish to excessive competition and a potential decline in their

numbers. And interbreeding between hatchery fish and wild fish may result in hybridization and the eventual loss of a species' genetic distinctiveness or the passing on of genetic material from hatchery fish to wild fish, resulting in fish populations less adapted to life in the wild.

More specifically, TU's prime concern is with stocking trout or salmon in waters containing wild salmonid populations. TU also calls for the elimination of stocking non-native salmonids in waters where it may have detrimental effects on native fish. TU supports put-and-take and other non-reproducing, non-sustainable fisheries when there is relatively little risk to nearby native fish or other species of concern and when it is economically sensible, based on all direct and indirect costs.

"We are not arguing that we need to get rid of all hatcheries or ceasing all releases," continued Epifanio. "Hatcheries are compatible with modern fish management as long as they aren't being used in lieu of dealing with habitat, overharvest and other issues. Given the fact that we already have hatcheries, it doesn't mean that we should go out and raze them. But we probably ought not be building more without examining the need, goals, and effects of programs as objectively and as informed as possible."—*JY*

(*For more information about TU's National Fish Hatchery Assessment, see page ??. Other background information can be found in "Trout Unlimited's North American Salmonid Policy" on www.tu.org. Go to Library/Conservation Documents.—Ed.*)

Cutthroat Comeback: A Success Story in Native Trout Reintroduction

Although hatcheries were developed to raise fish to increase recreational fishing opportunities, a little retooling, with an eye toward genetics, also makes them a valuable vehicle for conservation and species recovery. A case in point is Colorado's greenback cutthroat trout.

In the early 1960s, it was believed that greenback cutthroat trout, native to the headwaters of the South Platte and Arkansas Rivers in Colorado and some small streams in southwestern Wyoming, was gone, a victim primarily of competition with introduced non-native species, and brook trout in particular.

But in 1963, Dr. Robert J. Behnke of Colorado State University discovered a remnant population in Como Creek, a tributary of the South Platte. In 1973, greenbacks were listed as endangered under the Endangered Species Act and later downlisted to threatened in 1978. By 1977, researchers had found three small populations in Colorado totaling about 2,500 fish—far too few to mine for reseeding other streams. So that year, 66 greenbacks taken from Como Creek were delivered to the U.S. Fish and Wildlife Service's Fish Culture Development Center in Bozeman, Mont. as the initial wild broodstock for an artificial propagation program designed to preserve their gene pool and produce enough offspring to reestablish viable, self-sustaining populations throughout their range, as well as a recreational fishery to increase public support for the fish's recovery. It is important to note, however, that a critical part of this recovery program has been to

reclaim former cutthroat trout habitat by poisoning-out their chief competitor—introduced hatchery-reared brook trout.

The Bozeman center produced 160,000 greenback fry between 1981 and 1988. In 1987, the Saratoga National Fish Hatchery in Wyoming began propagating greenbacks from Arkansas River broodstock. Broodstock was kept from becoming inbred and hatchery-adapted by regularly collecting milt from wild greenback males and using it to fertilize eggs at the hatchery. In 1993, all propagation operations were moved to the Colorado Division of Wildlife's Bellevue Experimental Hatchery in Fort Collins. Unfortunately, a couple of years ago the hatchery was infected with whirling disease, necessitating a several-year wait before the greenbacks raised there can be stocked in state streams to ensure that the facility is completely free of the pathogen. But with 17 stable, self-reproducing populations in the South Platte drainage and three in the Arkansas River drainage, fishery managers now have enough wild fish to draw on for broodstock.

"What's interesting about the greenbacks," said Bruce Rosenlund, project leader for the U.S. Fish and Wildlife Service's Colorado Fish and Wildlife Assistance Office, "is how popular they've become. It's now Colorado's state fish. And there has been a lot more interest in native fish and in the sport fishing side of it and a lot more support for recovery." There are currently about 40 sites in Colorado open for hatchery-stocked greenback cutthroat trout fishing under a provision of the Endangered Species Act that allows carefully controlled angling for threatened species. The greenbacks will be eligible for delisting when two more stable, reproducing populations are established in the Arkansas River drainage.

The greenback cutthroat recovery demonstrates that hatcheries, when used intelligently, can both further species conservation goals and produce high-quality recreational angling.—*JY*

FAX COVER SHEET

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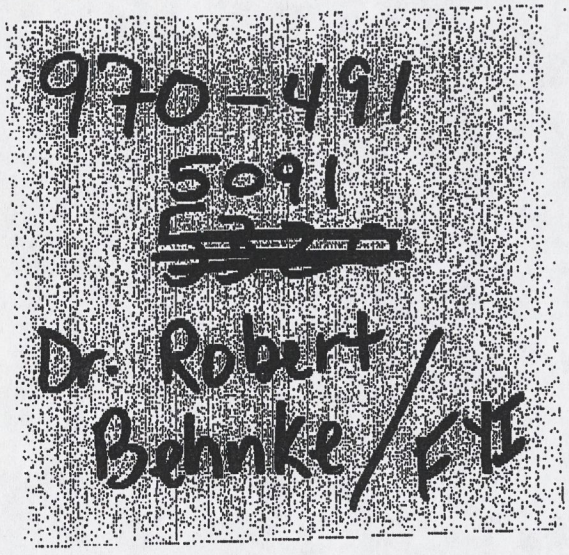

State	1997 license holders	% trout anglers	licenses attributable to trout *	Catchables released	catchables per license associated with trout	biomass in pounds	biomass per license associated with trout	% biomass for catchables	P&T size
Michigan	1306588	13	169856	7,159	0.04	7,779	0.05	4%	8
Ohio	1090031	10	109003	32,104	0.29	18,668	0.17	53%	10
Montana	372096	83	308840	145,116	0.47	48,179	0.16	15%	8
Alaska	408999	51	208589	245,014	1.17	52,952	0.25	78%	7
Alabama	465877	4	18635	27,738	1.49	11,524	0.62	100%	9
Texas	1434447	5	71722	209,862	2.93	69,954	0.98	100%	9
Indiana	600626	3	18019	55,015	3.05	24,393	1.35	100%	7
Wyoming	267342	89	237934	744,246	3.13	203,356	0.85	51%	8
Illinois	762994	5	38150	121,800	3.19	60,500	1.59	76%	10
Maine	246070	76	187013	639,136	3.42	186,423	1.00	77%	6
South Dako	233225	19	44313	174,600	3.94	88,440	2.00	69%	11
California	2216894	77	1707008	7,041,978	4.13	3,722,575	2.18	96%	7
Delaware	26328	27	7109	30,900	4.35	16,200	2.28	100%	11
Maryland	519461	22	114281	500,000	4.38	200,000	1.75	80%	8
Utah	462530	83	383900	1,865,721	4.86	712,948	1.86	76%	8
Washingto	867831	78	676908	3,517,000	5.2	939,900	1.39	80%	7
Colorado	756355	91	688283	3,609,934	5.24	1,432,394	2.08	89%	10
Minnesota	1499317	5	74966	408,117	5.44	72,999	0.97	51%	6
Arizona	452331	48	217119	1,200,000	5.53	428,500	1.97	96%	9
Connectic	174602	69	120475	669,000	5.55	321,000	2.66	96%	6
New Jerse	227689	52	118398	687,205	5.8	254,000	2.15	97%	7
Wisconsin	1401050	8	112084	666,800	5.95	?	#VALUE!	?	7
North Caro	547727	18	98591	612,747	6.22	285,351	2.89	100%	10
Hawaii	6304	25	1576	10,000	6.35	?	#VALUE!	?	10
New York	1040132	52	540869	3,535,007	6.54	?	#VALUE!	?	6
Rhode Isla	34920	58	20254	137,400	6.78	154,100	7.61	99%	12
Massachus	180581	54	97514	664,525	6.81	505,502	5.18	100%	6
Idaho	406506	87	353660	2,492,177	7.05	908,733	2.57	73%	6
Oregon	678377	71	481648	3,428,752	7.12	825,478	1.71	93%	7
Kansas	322350	4	12894	94,203	7.31	?	#VALUE!	?	10
Pennsylvar	1093208	64	699653	5,216,110	7.46	2,543,015	3.63	94%	9
South Carc	510324	7	35723	273,248	7.65	91,028	2.55	69%	9
Tennessee	962760	15	144414	1,129,431	7.82	486,004	3.37	94%	7
Virginia	645957	23	148363	1,267,054	8.54	686,170	4.62	94%	7
New Hamp	166985	64	106870	938,130	8.78	426,701	3.99	97%	6
West Virgil	311830	42	130969	1,186,311	9.06	743,045	5.67	99%	11
Vermont	96793	64	61948	612,859	9.89	173,448	2.80	94%	8
Missouri	966007	18	173881	1,754,500	10.09	1,209,600	6.96	100%	10
Nebraska	222635	13	28943	313,607	10.84	112,000	3.87	97%	9
Oklahoma	646337	5	32317	408,871	12.65	?	#VALUE!	?	9
North Dakc	133589	4	5344	75,431	14.12	41,031	7.68	60%	10
Iowa	395509	5	19775	370,848	18.75	207,178	10.48	99%	9
Nevada	160130	52	83268	1,613,000	19.37	474,194	5.69	97%	8
Georgia	631436	10	63144	1,278,792	20.25	465,810	7.38	99%	6
Kentucky	565801	5	28290	718,800	25.41	239,600	8.47	95%	9
Arkansas	579949	14	81193	2,100,000	25.86	636,000	7.83	81%	9

* licenses attributable to trout participation (based on FWS 91-5 1991 survey).

State	Trout stocked	kg	biomass in pounds	Catchables	kg	biomass	P&T size	Fry	Fingerlings & Subcatchables	Eggs	Adults
Alabama	27,738		11,524	27,738		11,524	9	0	0	0	0
Alaska	1,966,646	*30,956*	*68,103*	245,014	24,069	52,952	6.5/lb	104,278	1,535,354	36,400	3,390
Arizona	2,970,000		446,220	1,200,000		428,500	3/lb	0	1,770,000	0	0
Arkansas	2,600,000		788,000	2,100,000		636,000	9	0	500,000	0	0
California	15,357,977		3,895,234	7,041,978		3,722,575	6/lb	0	8,309,395	0	6,571
Colorado	13,098,073		1,603,085	3,609,934		1,432,394	10	633,056	8,855,083	0	0
Delaware	30,900		16,200	30,900		16,200	11	0	0	0	500
Georgia	1,438,742		472,297	1,278,792		465,810	6	0	159,950	0	0
Idaho	11,575,197		1,244,872	2,492,177		908,733	6	1,093,188	7,985,886	0	0
Iowa	438,598		208,853	370,848		207,178	9	750	67,000	0	1,110
Kansas	94,203		?	94,203		?	10	0	0	0	0
Kentucky	753,950		251,317	718,800		239,600	9	0	31,900	0	0
Maine	1,203,974		243,107	639,136		186,423	6	157,250	374,818	0	893
Maryland	600,000		250,000	500,000		200,000	8	30,000	70,000	0	0
Michigan	7,010,624	######	*672,076*	22,614	*8,558*	18,828	8	0	882,740	0	0
Minnesota	1,596,689		142,907	408,117		72,999	yearling	0	1,184,449		4,123
* Missouri	1,754,500		1,209,600	1,754,500		1,209,600	10	0	0	0	0
Montana	8,780,317		311,193	145,116		48,179	8	1,696,301	6,938,900	0	0
Nebraska	472,586		115,521	313,607		112,000	9	0	158,979	0	0
Nevada	1,971,841		487,784	1,613,000		474,194	8	93,650	180,796	84,395	0
New Jersey	758,310		262,000	687,205		254,000	7	0	71,105	0	0
New York	5,332,865		889,127	3,535,007		?	6	0	1,797,858	0	0
North Carolina	698,826		286,426	612,747		285,351	10	0	86,079	0	0
North Dakota	372,667		68,202	75,431		41,031	10	0	297,236	0	0
Ohio	363,939		34,991	32,104		18,668	10	0	331,835	0	0
Oklahoma	483,936		?	408,871		?	9	0	75,065	0	0
Oregon	7,318,486		887,069	3,428,752		825,478	7/lb	0	3,889,734	0	0
Pennsylvania	7,929,747		2,701,158	5,216,110		2,543,015	9	0	2,713,637	0	0
Rhode Island	188,400		155,880	137,400		154,100	1.33/lb	51,000	0	0	0
Tennessee	1,917,498		516,324	1,129,431		486,004	7	0	788,067	0	0
Texas	348,093		70,036	209,862		69,954	3.5/lb	0	138,231	0	0
Utah	10,137,544		941,788	1,865,721		712,948	8	770,434	7,486,981	0	14,408
Vermont	1,163,938		185,483	612,859		173,448	8	423,500	36,000	0	0
Virginia	1,541,151		731,766	1,267,054		686,170	7	0	268,635	0	5,460
Washington	15,770,000		116,920	3,517,000		939,900	10/lb	12,253,000	0	0	0
Wisconsin	1,310,675		?	666,800		?	7	0	643,875	0	0
Wyoming	6,047,194		402,510	744,246		203,356	8	0	5,303,948	0	0
Florida	0		0	0		0	0	0	0	0	0
Louisiana	0		0	0		0	0	0	0	0	0
Mississippi	0		0	0		0	0	0	0	0	0
New Hampshire				967,000					262,000		
Connecticut											
Hawaii											
Illinois											
Indiana											
Massachusetts											
New Mexico											
South Carolina											
South Dakota											
West Virginia											
USFWS --NFH	78,974,745		2,823,502	8,300,000		1,600,000	~ 5/LB	0	10,934,034	59,740,711	0
Total (rank)	**214,400,569**		**23,511,075**	**58,020,074**		**19,437,111**		**17,306,407**	**74,129,570**	**59,861,506**	**36,455**

TABLE 1: Comparative data on catchable trout programs of selected states. Numbers of catchable trout and costs from Fisheries, Mar.-Apr. 1988 based on 1982 figures for Colorado and Wyoming (1983 figures for other states). License sales and revenue data from S. F. I. Bull., Aug. 1987 (1986 figures).

State	Catchable Trout Stocked	No. Licenses Sold (No. Catchable Per License)	Total Revenue (Catchable per Dollar)
CO	5,419,802	842,367 (6.4)	$ 8,112,431 (.67)
CA	12,350,000	3,425,717 (3.6)	$36,768,883 (.34)
ID	2,221,881	469,667 (4.7)	$ 4,259,384 (.52)
NV	885,335	258,907 (3.4)	$ 2,359,840 (.38)
NM	1,412,840	262,748 (5.4)	$ 3,153,737 (.45)
NY	2,138,541	1,140,926 (1.9)	$ 9,446,449 (.23)
OR	2,351,230	1,115,944 (2.1)	$10,471,777 (.22)
PA	4,911,600	1,110,054 (4.4)	$12,687,629 (.39)
UT	1,569,856	421,746 (3.7)	$ 5,715,367 (.27)
WA	2,528,000	1,156,777 (2.2)	$11,337,798 (.22)
WY	1,209,172	285,000 (4.2)	$ 3,351,403 (.36)

State	Cost of Catchable Production	Cost per Catchable	Cost of Catchables per License	Percent of License Revenue
CO	$3,047,127	$0.56	$3.62	38%
CA	ca. $5,000,000	$0.40	$1.46	14%
ID	$ 925,000	$0.42	$1.97	22%
NV	$ 503,352	$0.57	$1.94	21%
NM	$ 673,000	$0.48	$2.56	21%
NY	$2,500,000	$1.17	$2.19	26%
OR	$1,500,000	$0.64	$1.34	14%
PA	$3,966,800	$0.81	$3.57	31%
UT	$ 784,928	$0.50	$1.86	14%
WA	$1,280,000	$0.51	$1.11	11%
WY	$ 302,000	$0.25	$1.06	9%

rev. 1996 1,850,259 catchables = 549,757 lb. 3.4/lb. | 5lb. 2 17 per license

112,837 licences.
[85,802 resident
27,035 nonresidents

1.5-1.6 million $ 14.8 according to Mgmt

Wallop Breaux allows $ for catchables wt.

1997 - Total: 1,971,841 474,194 catch. lb. (Total?)
catch. ≥ 8" catchs: 1,631,300 @ 487,754
$ ry 93,650
fing.-sub-catch. 180,796

Income sales - 2 mil - 4.8 mil
returns?

~97% biomass >4 lb. 14.4/ac

- fish culture
- overhead

manpower % cost
total fish budget
% culture
% catch. to
(Adm. overhead)
exp. in

raw data

State	Trout stocked	kg	biomass in pounds	Catchables	kg	biomass in pounds	% biomass for catchables	P&T size	Fry	Fingerlings & Subcatchables	Eggs	Adults
Alabama	27,738		11,524	27,738		11,524	100%	9	0	0	0	0
Alaska	1,966,646	#	*68,103*	245,014	#	52,952	78%	>70g	104,278	1,535,354	36,400	3,390
Arizona	2,970,000		446,220	1,200,000		428,500	96%	3/lb	0	1,770,000	0	0
Arkansas	2,600,000		788,000	2,100,000		636,000	81%	9	0	500,000	0	0
California	15,357,977		3,895,234	7,041,978		3,722,575	96%	6/lb	0	8,309,395	0	6,571
Colorado	13,098,073		1,603,085	3,609,934		1,432,394	89%	10	633,056	8,855,083	0	0
Connecticut	857,317		334,000	669,000		321,000	96%	6	163,000	23,200	0	2,117
Delaware	30,900		16,200	30,900		16,200	100%	11	0	0	0	500
Georgia	1,438,742		472,297	1,278,792		465,810	99%	6	0	159,950	0	0
Hawaii	20,000		?	10,000		?	?	10	0	10,000	0	0
Idaho	11,575,197		1,244,872	2,492,177		908,733	73%	6	1,093,188	7,985,886	0	0
Illinois	342,100		80,000	121,800		60,500	76%	10	0	221,000	0	0
Indiana	55,015		24,394	55,015		24,393	100%	7	0	0	0	0
Iowa	438,598		208,853	370,848		207,178	99%	9	750	67,000	0	1,110
Kansas	94,203		?	94,203		?	?	10	0	0	0	0
Kentucky	753,950		251,317	718,800		239,600	95%	9	0	31,900	0	0
Maine	1,203,974		243,107	639,136		186,423	77%	6	157,250	374,818	0	893
Maryland	600,000		250,000	500,000		200,000	80%	8	30,000	70,000	0	0
Massachusetts	664,525		505,502	664,525		505,502	100%	6	0	0	0	0
Michigan	2,175,192	#	*215,789*	7,159	#	7,779	4%	8	0	2,168,033	0	0
Minnesota	1,596,689		142,907	408,117		72,999	51%	yearling	0	1,184,449		4,123
Missouri	1,754,500		1,209,600	1,754,500		1,209,600	100%	10	0	0	0	0
Montana	8,780,317		311,193	145,116		48,179	15%	8	1,696,301	6,938,900	0	0
Nebraska	472,586		115,521	313,607		112,000	97%	9	0	158,979	0	0
Nevada	1,971,841		487,784	1,613,000		474,194	97%	8	93,650	180,796	84,395	0
New Hampshire	1,671,084		438,382	938,130		426,701	97%	6	0	732,954	0	0
New Jersey	758,310		262,000	687,205		254,000	97%	7	0	71,105	0	0
New York	5,332,865		889,127	3,535,007		?	?	6	0	1,797,858	0	0
North Carolina	698,826		286,426	612,747		285,351	100%	10	0	86,079	0	0
North Dakota	372,667		68,202	75,431		41,031	60%	10	0	297,236	0	0
Ohio	363,939		34,991	32,104		18,668	53%	10	0	331,835	0	0
Oklahoma	483,936		?	408,871		?	?	9	0	75,065	0	0
Oregon	7,318,486		887,069	3,428,752		825,478	93%	7/lb	0	3,889,734	0	0
Pennsylvania	7,929,747		2,701,158	5,216,110		2,543,015	94%	9	0	2,713,637	0	0
Rhode Island	188,400		155,880	137,400		154,100	99%	1.33/lb	51,000	0	0	0
South Carolina	418,288		132,518	273,248		91,028	69%	9	0	106,404	0	0
South Dakota	650,000	#	128,700	174,600	#	88,440	69%	11	0	475,400	0	0
Tennessee	1,917,498		516,324	1,129,431		486,004	94%	7	0	788,067	0	0
Texas	348,093		70,036	209,862		69,954	100%	3.5/lb	0	138,231	0	0
Utah	10,137,544		941,788	1,865,721		712,948	76%	8	770,434	7,486,981	0	14,408
Vermont	1,163,938		185,483	612,859		173,448	94%	8	423,500	36,000	0	0
Virginia	1,541,151		731,766	1,267,054		686,170	94%	7	0	268,635	0	5,460
Washington	15,770,000		1,169,200	3,517,000		939,900	80%	10/lb	12,253,000	0	0	0
West Virginia	1,505,667		748,942	1,186,311		743,045	99%	11	0	319,356	0	0
Wisconsin	1,310,675		?	666,800		?	?	7	0	643,875	0	0
Wyoming	6,047,194		402,510	744,246		203,356	51%	8	0	5,303,948	0	0
states that do not stock trout												
Florida	0		0	0		0	0%	0	0	0	0	0
Louisiana	0		0	0		0	0%	0	0	0	0	0
Mississippi	0		0	0		0	0%	0	0	0	0	0
State Totals	**136,774,388**		**23,676,004**	**52,830,248**		**20,086,672**	85%		**17,469,407**	**66,107,143**	**120,795**	**38,572**

not responding
New Mexico

Clueless casting aspersions

If "heavy" is associated with "dense", Charlie's a heavy.

Among the heavy thinkers in trout-fishing circles, the prevailing notion about Colorado is of a great, amorphous fish hatchery spewing anemic rainbow trout out the end of a pipe. The image is of a fish factory churning out "rubber trout," as a recent article in Fly Fishing Rod and Reel magazine described them, to placate the unwashed masses. The clear implication is Colorado stands alone atop a bad-boys list of misappropriated resources.

As it turns out, this characterization isn't even close to true. Whatever you feel about hatchery-produced fish, know this: Colorado isn't the most prolific among western states. Far from it. When it comes to spewing out cold-water fish, the Colorado Division of Wildlife ranks somewhere near the middle of the pack.

A 10-state survey conducted recently by Clete Nolde of the DOW fish production unit provided some rather startling revelations about cold-water hatcheries. Among these: (1)

■ Colorado's average number of state-produced fish per license holder, 15.18, ranks seventh among the surveyed states, 10 in the West, plus Pennsylvania. Idaho led the list with a prodigious 58.36 fish per license, mostly subcatchables. Washington produced 26.92 and Utah 22.42. Now here's the kicker.

Charlie Meyers

Outdoors

Montana, everyone's poster child for wild trout, grew 18.01 fish per license holder; Wyoming, another presumed bastion of the natural method, was close behind with 16.41.

■ Reducing the scope to catchable fish, Colorado still ranks behind the leaders. (2) Nevada is tops at 14.83 per rod, Washington grew 6.78, Idaho grew 6.68, Pennsylvania 5.40, New Mexico 5.68 and Colorado 4.27. *

■ With 748,000 license holders, Colorado ranked fourth behind California (1.8 million), Pennsylvania (972,000) and Oregon (787,000).

These statistics include species other than trout, most notably kokanee salmon.

Colorado's figures for this comparison are from 1997; all others are from 1996. Colorado produced generally fewer fish in 1997 because of problems with disease. The more recent tabulation is considered more applicable, because DOW seems unlikely ever to repeat its earlier volume.

Another factor worthy of consideration is that Colorado, with all its mountain streams and reservoirs, has considerably more water to service than any state save California. (3) In any case, there's often more to these things than first meets the eye.

Spinney lineup

The wildest moment in Colorado fishing will occur at precisely 5:34 a.m. Wednesday. That's when Colorado State Parks personnel fling open the gate for the long-awaited opening of Spinney Mountain Reservoir, the state's most prolific producer of large trout.

Hundreds of anglers line up to be among the first to the lake. Early-birds won't be allowed to queue up before 5 p.m. today. Rangers will be out early Wednesday to sell $4 vehicle passes to those waiting in line. Anglers may not be able to launch large boats because of low water levels.

Let the carping begin

It's billed as the second annual Rocky Mountain Bonefish Invitational, this May 9 affair that will attract some of the area's leading flyfishing enthusiasts. The objects of attention will be the large carp that prowl the shallows of Lagerman Reservoir in much the same manner as bonefish on saltwater flats. The gear, and tactics, are much the same.

Entry fee for the 10 a.m.-3 p.m. affair is $15, kids 15 and under free. Brad Befus, who actually co-authored a book on the subject, will be on hand to help with the finer points. Phone Tom Fulwider for details (303) 989-6009.

Short casts

Poachers who shoot prize game animals face trophy-size fines under a law passed recently by the Colorado Legislature. Inspired by the illegal killing of Sampson, the massive elk who lived near Estes Park, the law imposes hefty fines on top of existing penalties, ranging from $4,000 for antelope to $25,000 for bighorn sheep. Trophy bull elk, deer, moose and mountain goat all carry a $10,000 fine.

Mountainfilm in Telluride will celebrate its 20th anniversary May 22-25 with a rich lineup of featured guests. Among them: David Breashears, Yvon Chouinard, Paul Petzoldt, David Brower, Rick Ridgeway and Bradfort and Barbara Washburn. Phone (800) 525-3455.

Federal resource agencies have established an electronic information system listing recreational opportunities on public lands. It's available on a new website: http://www.recreation.gov.

*In 1980s Colo. led nation with 6.4 per license.

(1) Note catchable trout mixed with fingerlings, subcatchable (put-grow vs. put-take fisheries)

(2) I'll check some of these figures. They seem out of line. For ex. my 1982 figures: Nevada: 3.4 catchables/license (now 14.83!); Wash.: 2.2/license (now 6.78!) ID from 4.7 to 6.68

(3) Not so, Colo. has much less water for salmonid stocking than most western states (ca. 120,000 surface acres of lakes, reservoirs, rivers). - Flathead L., MT (ca. 150,000 acres) more than all Colo. waters -- Also similar with Pend Oreille + Coeur d'Alene, + Priest L. Idaho

X-Sender: carena@mail.tu.org
X-Mailer: Windows Eudora Pro Version 3.0 (32)
Date: Mon, 12 Oct 1998 13:05:11 -0400
To: fwb@picea.cnr.colostate.edu
From: Christine Arena <carena@tu.org>
Subject: catch and release article for TROUT

Bob:

Attached is one of the stories for the Winter issue of TROUT. It's about an education program to promote catch and release and its purpose is to showcase the work of TU members in Wisconsin, not to present the latest science on hooking mortality and catch and release.

I'll send you Jim Yuskavitch's hatcheries article during the next day or so. Will also e-mail you a couple of questions about your Winter column.

Regards,

Christine

SOS - Mayers.doc

Success on the Stream
CPR: Wisconsin Volunteers Put Their Hearts Into Trout-Saving Education Effort
By Jeff Mayers

The one-eyed brown trout swims in a western Wisconsin stream, known to more than a few people. Year after year, the 20-inch trout is there, providing enjoyable sport for those who try to trick the aging fish into their net.

"Several members of our chapter have caught him," said Wisconsin Trout Unlimited Council Chairman John Welter, an Eau Claire attorney. "We compare notes on what he's taking.

"He's not easy to catch. He's in a difficult place to reach. He's picky about what he eats," Welter added. "He's going to be there again because a fair number of people decided not to bring him home. He's fortunate to be in a place where everybody that catches him has turned him back."

This isn't another fish story. It's just one example of how the Wisconsin Council's groundbreaking catch-and-release education program is succeeding in "recycling" trout.

Nobody knows exactly how many trout the four-year-old program has "saved" to be caught by another angler, but enough anecdotes like this circulate to give hope to program organizers who have inspired TU chapters around the country to preach "CPR"—Consider Proper Release. The program doesn't preach a certain fishing method; it tells all anglers—from bait users to fly fishers—how to release a trout properly.

Credit for the catchy slogan goes to Wisconsin trout research biologist Bob Hunt and his wife, Phyllis. Credit for the program goes to a dedicated catch-and-release committee, led by Jim Hlaban of Neenah in Wisconsin's Fox River valley, and all of those chapter members around the state who displayed a CPR video narrated by Joan Wulff, distributed brochures, and tacked up durable, bright streamside signs to remind anglers of all levels that "survival of released trout is in your hands."

Hlaban, a member of TU's Fox Valley Chapter, always thought catch and release was important. But the importance was highlighted during one chapter outing in the early 1990s. Chapter members were at a trout pond introducing trout fishing to children with disabilities. The trout pond owner asked that the pond's small brook trout be released. No problem, thought Hlaban.

"But by the end of the day there were a lot of brook trout floating around," recalled Hlaban, a research scientist for a consumer products company. "If we don't know how to release, how about the general public?"

His committee's work scored a major public relations coup when the Wisconsin Department of Natural Resources (WDNR), endorsed the CPR slogan and its five-step message by placing it on the inside cover of the 1998-99 state trout regulations guide (minus the TU logo, however).

"We certainly encourage the concept of careful and thoughtful release," says Larry Claggett, WDNR's trout coordinator. "[TU has] done a really good job. I wish I could tell you what the response is. I'm sure it's helped. We still hear and see evidence that people don't know how to release."

Claggett said TU's push on catch and release came at a good time—as the state began stressing wild trout reproduction over stocking. In 1990, the state adopted sweeping new regulations that placed Wisconsin's 10,000 miles of trout streams under five categories. The system is based on stream type and biology, potential of the fishery and a desire to provide a diversity of angling experiences. Stream sections designated Category 5 have special regulations that protect blue-ribbon waters, nurture trophy trout or achieve some other management aim. Some of these special regulation waters are designated catch-and-release only, but the category-based system allows trout to be taken on most waters." Later came the adoption of a new statewide catch-and-release early trout season, which in early May 1998 concluded the second year of a three-year trial run. "It's especially appropriate given all of the regulations we have out there," he said.

As many as 2 million trout are caught and released in Wisconsin each year. But according to the TU committee, some 400,000 of them die. Proper handling could recycle an estimated 250,000 trout each year if only anglers practiced five simple steps:

Do not play fish to exhaustion and use a landing net.
Handle fish in a net. Grasp across back and head.
Turn fish belly-up while removing hooks.
Do not remove swallowed hooks...cut the line.
Do not keep fish out of the water for more than 15 seconds.

The easy release steps are nicely illustrated in a six-minute video (see sidebar for availability). The story behind that video brims with TU member innovation, frugality, and problem-solving.

"We formed the committee with the idea of putting together a video. We didn't have the skills, so we began by putting out a brochure," Hlaban said. That was a good start. An estimated 200,000 CPR brochures have been distributed over the past four years to sporting goods stores that sell licenses, WDNR offices, and every Wisconsin chapter.

Enter Todd Hanson, a Fox Valley Chapter member from Appleton who had video experience through his work for a company that produces training and education materials. "Todd had the skill and inclination," said Hlaban. He joined the TU committee.

Hanson put the project out for bid. "We approached it like a real job," he said. That helped contain costs while getting the job done right. WLUK-TV in nearby Green Bay came in as low bidder among four, perhaps because a producer there was a TU member. Shooting was on a top-notch but not widely known brown and brook trout stream near Waupaca.

Meanwhile, others went about finding a way to pay for the approximate $5,000 in production costs. They found a generous benefactor in Nash Williams, a longtime TU member from Madison.

They also found volunteer "actors"—a husband-and-wife spin-fishing team, a bait fisher, and a father-son fly-fishing duo. In the video each successfully catches and releases the same fish at different points in its life. By the end of the video, "Mr. Trout" is a hefty, potential wall-hanger. But the son returns it to the stream, later comparing his act to the recycling of an aluminum can.

Adds narrator Joan Wulff, an image of her late husband Lee Wulff flashing briefly: "The fish you release is your gift to another angler."

In 1996, the Telly Awards, administered by a Cincinnati-based group that recognizes outstanding non-network and cable commercials, films and videos, honored *CPR* for video production excellence.

Durable, lightweight signs were the next public education tool. The blue-white-and-green signs are handsome reminders of the CPR message. TU members around the state posted hundreds of them at popular angler-entry points along streams. Some even made the signs into a sort of streamside information kiosk, containing pamphlets on catch-and-release and other TU activities.

As each new tool emerged, committee members worked with TU chapter officers throughout the state to speed distribution, and enough chapters embraced the program to make an impact. Part of the program's success lies in good research and science, which bolstered the CPR suggestions.

Hunt, a retired WDNR research biologist and another committee member, pioneered some of the research during the late 1960s at central Wisconsin's Westfield trout hatchery. The work, done with hatchery manager Jack Mason, involved about 400 trout—200 in one raceway and 200 in another. Trout were intentionally hooked deeply on baited hooks. Hooks were removed from one set of trout; leaders were cut on the other set.

Hunt recalls that almost all of the trout from which hooks were removed died within a few hours. But about two-thirds of the trout given the leader-cutting treatment survived. At the end of six months, the survivors were cut open to see what happened to the hooks. Some hooks had disappeared; others were in a state of decomposition, having had little effect on the trout. "It was a very dramatic difference," commented Hunt. "We could save two of every three trout if anglers simply sacrificed the cost of a hook."

Hunt believes that anglers, especially bait fishers, should strike quickly to prevent trout from swallowing the hook. "It's not what's on the hook. It's where it ends up," he says, adding that anything close to the gills should be left in place. "If you have a difficult time getting it out, chances are you're going to kill the fish." (*General information on hooking mortality and catch-and-release practices is available from TU at 703/294-9410.—Ed.*)

Hunt said that the catch-and-release ethic, along with better regulations, are helping make better use of a limited resource. Properly releasing a fish means that "there's as many as 2 million fish that don't have to be raised in a hatchery or that nature doesn't have to make for us," he said. "It has both ethical and biological value."

Welter, the state council chairman, has a practical viewpoint: "Our streams get more and more use very year," he said. "The only way that those streams are going to have sufficient trout populations—in the face of increasing fishing pressure—is to encourage people to release most or all of what they catch."

He said that it complements all of the habitat work done by TU members in Wisconsin and across the country. "It's another piece of the puzzle," he said. "We're all better off from a recreational standpoint."

An added attraction is the program's relatively inexpensive cost. The entire bill, according to Hlaban: a little under $10,000 over four years.

Hlaban and his fellow committee members modestly assess their initiative. "I think we did reach a few people," he said. "I think I've seen the needle move in a positive direction. It's something that takes time."

But the work of Hlaban's committee likely will save trout for years to come, as the committee's products gain a national audience. Take this opportunity to improve your CPR skills. Not only will you save a trout, you'll honor the volunteer work of a dedicated band of Wisconsin TUers who found a way to make a difference.

Jeff Mayers, of Monona, Wisconsin, is co-author of Exploring Wisconsin Trout Streams *(1997, The University of Wisconsin Press), and an occasional contributor to* TROUT. *He often writes about the outdoors and travel when he isn't covering politics for the* Wisconsin State Journal *in Madison. He's a native of western Pennsylvania who has lived in the Midwest since 1982.*

Sidebar

To Order

Trout Unlimited's *Consider Proper Release* educational kit includes an instructional video, brochure and sign. The video, titled *CPR: Consider Proper Release*, was produced by TU's Wisconsin Council to promote the proper release of trout and help decrease mortality rates. The six-minute video is narrated by fly-fishing legend Joan Wulff and has helped thousands of people understand and develop catch-and-release techniques. *CPR* follows one fish as it is caught and properly released by spin fishers, bait fishers and fly anglers, at different stages of its life cycle. A coroplastic sign (12" wide by 16 1/2" tall) sports the TU logo and highlights key catch-and-release steps.

The kit costs $18.00. To order, call toll-free at (888-891-2634) and request item #ACC2074.

4/18 mil 4.50/lb.

	no. catch.	wt	% of total haten
		3 895 234 Total	
Calif.	7,041,978	3,722,575 lbs.	96%

3.72 | 1.9 / 70 42 / 372 / 3322 / 3348

1.9/lb. 1 1/19

2861 | 1,3 / 3723 / 2861 / 8620 license no.

$10 mil
Wallop-Breaux
23% fed aid

$ total budget 44,850,000 fish

2,861,000 | 2.$ / 5722

40% propagation 18 mil $ → $4/lb

Research 23% Habitat 20% / 13200 / 14305

2.5 per license
1.3 lb. / 1.9 | 2,5 / 19 / 60

license $ 41%

other 36%

Ed. Rec. other
2 5 4%

Colo.

(5.?) fish

total budget $11,894,000

6.87 mil $

license no. 951,000

$4.30/lb.

3.8/license
1.5 lb.

catchable 3,609,234 | wt 89% 1,432,394 lbs.

9.5 mil | $1,603,085 Tot $
subcon = 170,700 lb.

+10 mil

fed aid 28% oz.

license $, fee (68% (3.1 mil))

other 4% $3,1 mil

% for propagation 57% Research 7% Habitat 3% Ed 1 Rec. 0 Other 32%

3,8 catch./license
$4,30/lb.

% of budget
fed. aid

Nev.

	license no	catch.	wt.	
budget $2,975,000	257,000	1,613,000	474,194	97%
	Tim	1,971,784	487,784	3%

- 1,35 mil $

45% propagation 1,3 mil $

$2,75/lb.

3.41/lb.

Gen. Fund. Rev. 5%
license, fee 25%
fed. aid (70% / $2.1 mil)

45% research
0 Habitat
5 Ed
5 Rec.
0 other

145 / 3 / 135

	License	fed. aid	other
MO ~	9%	5%	86%

prop. Res. etc —
NA NA

NUMBER OF PAID FISHING LICENSE HOLDERS, LICENSE SALES, AND COST TO ANGLERS FISCAL YEAR 1993

State	Paid Fishing License Holders*	Resident Fishing Licenses, Tags Permits & Stamps	Nonresident Fishing Licenses Tags, Permits & Stamps	Total Fishing Licenses, Tags, Permits & Stamps**	Gross Cost To Anglers
ALABAMA	543,460	412,350	104,909	517,259	$5,783,952
ALASKA	374,619	253,969	270,158	524,127	9,178,514
ARIZONA	428,569	423,023	185,430	608,453	6,535,250
ARKANSAS	581,978	485,378	218,566	703,944	7,136,332
CALIFORNIA	2,043,431	3,235,388	51,462	3,286,850	41,351,995
COLORADO	746,959	488,664	420,749	909,413	11,667,656
CONNECTICUT	190,438	178,765	8,503	187,268	2,442,919
DELAWARE	24,725	25,525	5,175	30,700	250,025
FLORIDA	1,004,444	1,014,124	452,752	1,466,876	19,707,145
GEORGIA	669,070	740,594	62,027	802,621	6,798,807
HAWAII	10,634	10,678	342	11,020	35,365
IDAHO	408,312	291,221	175,750	466,971	5,727,322
ILLINOIS	845,536	910,266	43,764	954,030	6,266,890
INDIANA	650,236	606,988	99,448	706,436	6,120,218
IOWA	401,470	384,665	42,001	426,666	4,533,431
KANSAS	286,748	241,342	45,406	286,748	3,505,799
KENTUCKY	633,950	566,121	136,432	702,553	5,612,549
LOUISIANA	606,200	793,158	74,789	867,945	6,563,745
MAINE	285,667	193,676	109,880	303,556	6,138,130
MARYLAND	516,578	456,356	45,460	501,816	4,705,676
MASSACHUSETTS	232,591	427,612	22,831	450,443	3,663,616
MICHIGAN	1,505,862	1,578,844	202,490	1,781,334	18,279,052
MINNESOTA	1,521,085	1,135,821	240,277	1,376,098	20,656,359
MISSISSIPPI	436,076	365,430	70,646	436,076	2,913,594
MISSOURI	1,017,514	1,317,230	264,728	1,581,958	10,472,054
MONTANA	378,960	242,214	291,288	533,502	6,834,803
NEBRASKA	222,873	220,877	30,115	250,992	2,671,114
NEVADA	145,293	104,531	40,762	145,293	1,849,213
NEW HAMPSHIRE	152,704	109,704	53,761	163,465	3,375,016
NEW JERSEY	252,958	373,014	14,069	387,083	4,751,775
NEW MEXICO	225,816	178,999	87,969	266,968	3,208,584
NEW YORK	1,109,161	919,774	194,133	1,113,907	14,146,394
NORTH CAROLINA	535,561	543,544	46,571	590,115	9,399,159
NORTH DAKOTA	114,214	112,468	14,324	126,792	929,424
OHIO	1,212,231	1,084,650	131,796	1,216,446	12,888,048
OKLAHOMA	627,829	473,444	96,796	570,240	6,006,511
OREGON	741,070	915,278	217,026	1,132,304	10,553,226
PENNSYLVANIA	1,193,995	1,850,866	88,698	1,939,564	17,075,729
RHODE ISLAND	39,076	37,149	2,600	39,767	907,203
SOUTH CAROLINA	442,485	402,392	64,493	466,885	4,384,056
SOUTH DAKOTA	187,917	225,190	54,970	280,160	2,304,012
TENNESSEE	860,533	873,201	179,747	1,052,948	9,333,641
TEXAS	1,774,349	2,296,447	124,898	2,421,345	25,120,650
UTAH	449,531	320,573	167,885	488,458	5,955,152
VERMONT	103,416	85,069	54,118	139,187	2,363,194
VIRGINIA	607,877	743,158	82,090	825,248	8,472,342
WASHINGTON	864,482	1,335,933	75,558	1,517,257	15,161,360
WEST VIRGINIA	290,594	542,705	133,923	676,628	4,863,626
WISCONSIN	1,477,797	1,212,072	338,893	1,550,965	21,040,264
WYOMING	207,930	108,808	198,243	307,051	2,966,816
TOTALS***	30,184,801	31,849,246	6,139,710	38,093,721	$412,066,470

* A paid license holder is one individual regardless of the [illegible]
(Data certified by State Fish and Game Departments)
** Period Covered not identified to period covered by cert
*** Persons who fished in more than one State are counte

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NUMBER OF PAID FISHING LICENSE HOLDERS, LICENSE SALES, AND COST TO ANGLERS FISCAL YEAR 1994

State	Paid Fishing License Holders*	Resident Fishing Licenses, Tags Permits & Stamps	Nonresident Fishing Licenses Tags, Permits & Stamps	Total Fishing Licenses, Tags, Permits & Stamps**	Gross Cost To Anglers
ALABAMA	512,743	420,954	85,945	506,899	$5,358,949
ALASKA	392,338	266,595	314,897	581,492	10,266,828
ARIZONA	456,700	444,011	191,929	635,940	6,833,966
ARKANSAS	574,114	491,020	233,255	724,275	7,432,147
CALIFORNIA	2,256,403	3,408,799	60,038	3,468,837	43,080,782
COLORADO	765,251	500,362	440,192	940,574	11,998,156
CONNECTICUT	187,182	177,879	9,303	187,182	1,983,314
DELAWARE	27,328	29,019	5,078	34,097	274,848
FLORIDA	1,039,925	1,056,537	462,154	1,518,691	20,732,154
GEORGIA	661,164	744,690	86,141	810,831	6,769,499
HAWAII	9,282	9,321	259	9,580	30,539
IDAHO	449,590	307,374	191,652	499,226	6,287,464
ILLINOIS	787,924	864,854	28,296	893,150	5,834,742
INDIANA	636,069	598,283	98,447	696,730	6,050,415
IOWA	339,299	332,219	31,670	363,889	3,676,802
KANSAS	316,971	261,082	55,889	316,971	3,753,408
KENTUCKY	573,092	515,123	119,348	634,471	7,572,227
LOUISIANA	813,976	830,711	61,855	892,566	6,446,525
MAINE	273,850	182,085	109,685	291,770	6,472,024
MARYLAND	530,952	446,989	72,055	519,044	4,834,716
MASSACHUSETTS	232,591	427,812	22,631	450,443	3,663,616
MICHIGAN	1,484,622	1,568,982	196,088	1,765,070	18,041,746
MINNESOTA	1,492,988	1,007,980	313,512	1,321,492	19,781,676
MISSISSIPPI	448,368	364,896	83,472	448,368	4,465,696
MISSOURI	937,015	1,248,034	240,262	1,488,296	9,720,186
MONTANA	390,656	246,866	317,266	564,132	7,220,249
NEBRASKA	211,483	204,893	29,203	234,096	2,519,459
NEVADA	155,254	154,213	41,899	195,912	2,301,120
NEW HAMPSHIRE	152,761	109,461	54,595	164,056	3,387,243
NEW JERSEY	241,185	353,788	13,350	367,138	5,000,537
NEW MEXICO	239,284	271,703	104,984	376,687	3,757,040
NEW YORK	1,091,728	916,381	177,778	1,094,159	14,528,755
NORTH CAROLINA	520,015	569,587	52,063	621,650	8,147,622
NORTH DAKOTA	111,612	111,107	13,162	124,269	913,766
OHIO	1,158,726	1,024,745	138,346	1,163,091	11,334,261
OKLAHOMA	693,475	521,142	109,068	630,210	7,114,123
OREGON	698,346	797,382	194,695	992,077	12,189,098
PENNSYLVANIA	1,185,071	1,835,645	81,657	1,917,302	17,258,807
RHODE ISLAND	36,711	54,259	4,002	58,261	448,444
SOUTH CAROLINA	498,597	507,663	74,903	582,566	5,262,329
SOUTH DAKOTA	186,447	222,638	54,032	276,670	2,300,126
TENNESSEE	910,332	935,365	187,089	1,122,454	10,284,027
TEXAS	1,810,293	2,346,843	130,087	2,476,930	25,624,862
UTAH	499,034	346,426	180,914	527,340	6,927,050
VERMONT	112,518	84,880	54,690	139,570	2,355,643
VIRGINIA	632,375	775,940	85,696	861,636	8,877,935
WASHINGTON	729,828	868,862	50,863	919,725	14,468,331
WEST VIRGINIA	290,594	542,705	133,923	676,628	4,863,626
WISCONSIN	1,402,479	1,135,377	335,087	1,470,464	20,784,696
WYOMING	284,857	115,144	229,973	345,117	5,130,069
TOTALS***	30,243,196	31,558,446	6,343,578	37,902,024	$424,663,337

* A paid license holder is one individual regardless of the number of licenses purchased. (Data certified by State Fish and Game Departments)

** Period Covered not identified to period covered by certification for all States.

*** Persons who fished in more than one State are counted in each State where they fished.

NUMBER OF PAID FISHING LICENSE HOLDERS, LICENSE SALES, AND COST TO ANGLERS
FISCAL YEAR 1995

State	Paid Fishing License Holders*	Resident Fishing Licenses, Tags Permits & Stamps	Nonresident Fishing Licenses Tags, Permits & Stamps	Total Fishing Licenses, Tags, Permits & Stamps**	Gross Cost To Anglers
ALABAMA	546,440	482,265	110,868	593,133	$7,195,178
ALASKA	402,405	257,319	334,250	591,569	10,534,741
ARIZONA	468,527	456,003	200,482	656 485	7,067,964
ARKANSAS	590,782	486,705	244,355	731,060	8,026,709
CALIFORNIA	2,300,463	3,239,641	50,173	3,290,014	44,152,456
COLORADO	736,242	484,415	422,651	907,066	11,482,174
CONNECTICUT	189,696	180,364	9,332	189,696	2,522,464
DELAWARE	26,798	29,974	5,193	35,167	278,943
FLORIDA	1,049,704	1,057,832	475,147	1,532,979	20,431,309
GEORGIA	653,189	745,980	72,866	818,846	6,747,390
HAWAII	7,552	7,477	263	7,740	24,756
IDAHO	420,002	276,306	181,490	457,798	5,791,981
ILLINOIS	818,017	852,704	55,792	908,496	10,181,619
INDIANA	550,520	616,782	137,403	754,185	5,486,911
IOWA	414,336	403,169	41,488	444,657	4,698,260
KANSAS	306,943	251,740	55,203	306,943	3,893,402
KENTUCKY	581,858	526,867	123,694	650,561	7,716,101
LOUISIANA	621,283	854,041	60,508	914,549	6,711,509
MAINE	270,024	184,671	100,656	285,329	6,977,395
MARYLAND	554,252	452,392	82,443	534,835	5,010,269
MASSACHUSETTS	227,691	433,641	24,807	458,448	3,673,575
MICHIGAN	1,464,027	1,546,577	194,398	1,740,975	17,222,689
MINNESOTA	1,531,280	1,069,663	330,663	1,400,326	23,655,444
MISSISSIPPI	415,858	369,369	83,617	452,986	4,384,274
MISSOURI	1,011,279	1,340,490	261,626	1,602,116	10,472,421
MONTANA	389,820	254,082	334,577	588,639	7,991,211
NEBRASKA	233,841	221,239	33,894	255,133	2,759,733
NEVADA	156,131	209,658	41,464	251,122	2,480,184
NEW HAMPSHIRE	156,352	112,963	55,251	168,204	3,485,903
NEW JERSEY	241,741	350,891	13,677	364,568	4,990,576
NEW MEXICO	235,714	186,970	77,813	264,783	3,396,661
NEW YORK	1,082,129	908,936	176,183	1,085,119	14,631,646
NORTH CAROLINA	571,273	570,573	51,229	621,802	10,239,047
NORTH DAKOTA	122,863	127,012	14,855	141,867	1,028,556
OHIO	990,387	877,278	116,741	994,019	11,519,959
OKLAHOMA	551,517	403,112	74,209	477,321	10,643,413
OREGON	709,934	839,465	194,971	1,034,436	12,614,297
PENNSYLVANIA	1,164,988	1,649,575	137,585	1,787,160	17,023,467
RHODE ISLAND	35,832	49,023	2,686	51,709	419,917
SOUTH CAROLINA	500,804	507,301	77,652	584,953	5,347,203
SOUTH DAKOTA	206,092	236,535	64,093	300,628	2,544,236
TENNESSEE	964,148	980,438	190,065	1,170,503	10,852,934
TEXAS	1,755,978	2,344,519	110,345	2,454,864	28,592,319
UTAH	514,978	355,023	189,187	544,210	7,112,123
VERMONT	100,397	82,190	53,170	135,360	2,303,492
VIRGINIA	634,115	766,831	87,002	853,833	9,420,457
WASHINGTON	820,940	962,487	46,402	1,008,889	15,276,037
WEST VIRGINIA	310,968	564,909	143,445	708,354	5,200,914
WISCONSIN	1,357,428	1,088,704	331,796	1,420,500	20,161,518
WYOMING	276,989	111,982	224,420	336,402	5,034,766
TOTALS***	30,334,624	31,368,255	6,502,082	37,870,337	$448,592,731

* A paid license holder is one individual regardless of the number of licenses purchased. (Data certified by State Fish and Game Departments)

** Period Covered not identified to period covered by certification for all States.

*** Persons who fished in more than one State are counted in each State where they fished.

As of 08/25/97 01:54 PM

NUMBER OF PAID FISHING LICENSE HOLDERS, LICENSE SALES, AND COST TO ANGLERS
FISCAL YEAR 1996

State	Paid Fishing License Holders*	Resident Fishing Licenses, Tags, Permits & Stamps	Nonresident Fishing Licenses, Tags, Permits & Stamps	Total Fishing Licenses, Tags, Permits & Stamps**	Gross Cost To Anglers
ALABAMA	478,023	415,429	100,062	515,491	$6,348,311
ALASKA	402,913	262,694	345,525	608,219	10,744,773
ARIZONA	444,963	425,384	193,043	618,427	6,625,806
ARKANSAS	576,464	481,074	239,000	720,074	8,234,797
CALIFORNIA	2,320,695	2,972,218	49,362	3,021,580	45,101,905
COLORADO	760,614	513,508	437,932	951,440	11,893,625
CONNECTICUT	177,587	168,146	9,441	177,587	2,314,375
DELAWARE	27,834	29,840	5,204	35,044	282,143
FLORIDA.	1,013,960	1,029,255	451,517	1,480,772	19,821,119
GEORGIA	657,999	756,227	76,265	831,492	6,823,505
HAWAII	6,396	6,297	260	6,557	20,977
IDAHO	508,937	388,825	217,585	606,410	7,159,158
ILLINOIS	789,880	814,553	53,250	867,803	9,749,821
INDIANA	604,399	614,595	133,656	748,251	6,455,133
IOWA	395,532	387,399	39,872	427,271	4,676,035
KANSAS	295,996	234,256	61,739	295,995	4,279,789
KENTUCKY	576,634	490,624	121,851	612,475	7,289,493
LOUISIANA	662,960	604,317	58,643	662,960	7,115,100
MAINE	256,884	179,473	89,481	268,954	7,065,908
MARYLAND	520,738	425,950	80,238	506,188	4,749,191
MASSACHUSETTS	193,299	349,948	18,524	368,472	4,865,026
MICHIGAN	1,348,107	1,580,770	129,437	1,710,207	17,855,100
MINNESOTA	1,535,122	1,261,498	273,684	1,535,122	19,196,571
MISSISSIPPI	401,918	373,338	79,938	453,276	4,705,093
MISSOURI	994,661	1,322,051	256,775	1,578,826	10,341,399
MONTANA	383,074	251,934	325,809	577,743	7,790,102
NEBRASKA	225,114	238,325	30,495	268,820	2,857,764
NEVADA	159,198	211,587	44,243	255,830	2,921,416
NEW HAMPSHIRE	156,985	113,340	55,794	169,134	3,518,340
NEW JERSEY	229,396	333,044	12,958	346,002	4,749,280
NEW MEXICO	265,470	231,215	93,092	324,307	3,819,309
NEW YORK	1,051,781	887,195	165,543	1,052,738	13,847,897
NORTH CAROLINA	558,048	593,768	48,321	642,089	10,866,395
NORTH DAKOTA	126,204	128,083	16,395	144,478	1,062,729
OHIO	1,041,662	922,853	122,876	1,045,729	15,942,865
OKLAHOMA	620,585	454,104	97,021	551,125	7,251,341
OREGON	678,508	804,428	185,655	990,083	12,331,690
PENNSYLVANIA	1,183,432	1,800,604	143,418	1,944,022	17,384,435
RHODE ISLAND	34,774	47,974	4,730	52,704	422,020
SOUTH CAROLINA	502,309	507,926	80,189	588,115	5,381,307
SOUTH DAKOTA	212,132	244,956	68,646	313,602	2,624,485
TENNESSEE	908,807	945,213	186,981	1,132,194	10,650,870
TEXAS	1,699,199	2,266,067	108,936	2,375,003	26,420,733
UTAH	491,014	509,849	285,729	795,578	7,739,547
VERMONT	96,733	80,855	50,719	131,574	2,222,100
VIRGINIA	604,851	728,826	83,512	812,338	9,007,367
WASHINGTON	793,598	900,561	59,808	960,369	14,549,673
WEST VIRGINIA	296,367	260,727	35,640	296,367	4,495,729
WISCONSIN	1,374,809	1,117,540	320,768	1,438,308	19,860,942
WYOMING	267,046	122,660	310,250	432,910	5,355,036
TOTALS***	29,935,533	30,790,243	6,459,812	37,250,055	$446,987,305

* A paid license holder is one individual regardless of the number of licenses purchased. (Data certified by State Fish and Game Departments.)
** Period covered not identified to period covered by certification for all States.
***Persons who fished in more than one State are counted in each State where they fished.

As of 08/26/98 01:55 PM

NUMBER OF PAID FISHING LICENSE HOLDERS, LICENSE SALES, AND COST TO ANGLERS FISCAL YEAR 1997

State	Paid Fishing License Holders*	Resident Fishing Licenses, Tags, Permits & Stamps	Nonresident Fishing Licenses, Tags, Permits & Stamps	Total Fishing Licenses, Tags, Permits & Stamps**	Gross Cost To Anglers
ALABAMA	455,877	400,537	102,784	503,321	$8,199,523
ALASKA	408,999	266,393	362,423	628,816	10,974,077
ARIZONA	452,331	442,110	192,417	634,527	6,808,116
ARKANSAS	579,949	485,194	194,439	679,633	6,697,500
CALIFORNIA	2,216,894	2,813,763	47,588	2,861,331	44,849,678
COLORADO	756,355	505,394	428,475	933,869	11,757,177
CONNECTICUT	174,602	164,213	10,389	174,602	2,292,169
DELAWARE	26,328	29,271	4,857	34,128	269,735
FLORIDA,	1,021,656	1,034,358	457,946	1,492,304	19,557,518
GEORGIA	631,436	722,831	75,132	797,963	7,440,398
HAWAII	6,304	6,202	291	6,493	20,347
IDAHO	406,506	329,936	175,862	505,798	5,647,322
ILLINOIS	762,994	802,390	36,571	838,961	9,388,527
INDIANA	600,626	571,861	90,671	662,532	6,609,511
IOWA	395,509	387,710	40,382	428,092	4,685,360
KANSAS	322,350	248,779	73,571	322,350	4,558,234
KENTUCKY	565,801	509,408	117,280	626,688	7,767,361
LOUISIANA	586,595	1,099,590	362,175	1,461,765	8,304,434
MAINE	248,070	173,325	85,015	258,340	5,977,643
MARYLAND	519,461	421,006	82,652	503,658	4,761,719
MASSACHUSETTS	180,581	344,621	18,196	362,817	4,639,786
MICHIGAN	1,306,588	1,313,695	132,230	1,445,925	22,102,669
MINNESOTA	1,499,317	1,119,717	237,409	1,357,126	20,319,410
MISSISSIPPI	398,032	375,248	79,972	455,221	4,877,434
MISSOURI	966,007	1,267,849	299,693	1,567,542	10,626,110
MONTANA	372,096	244,660	318,050	562,710	7,679,314
NEBRASKA	222,635	235,774	28,519	264,293	3,156,253
NEVADA	160,130	212,154	45,130	257,284	2,975,239
NEW HAMPSHIRE	166,985	114,329	56,704	171,033	3,571,449
NEW JERSEY	227,689	327,679	13,104	340,783	4,705,397
NEW MEXICO	247,608	170,769	84,438	255,207	39,000,000
NEW YORK	1,040,132	882,721	158,332	1,041,053	13,568,950
NORTH CAROLINA	547,727	585,340	53,859	639,199	10,988,756
NORTH DAKOTA	133,589	118,331	18,184	136,515	1,175,887
OHIO	1,090,031	978,648	113,132	1,091,780	16,503,615
OKLAHOMA	646,337	487,663	94,556	582,219	7,760,266
OREGON	878,377	810,949	188,179	999,128	12,369,052
PENNSYLVANIA	1,093,208	1,652,527	136,290	1,788,817	19,513,747
RHODE ISLAND	34,920	50,349	3,807	54,156	421,979
SOUTH CAROLINA	510,324	504,469	84,438	588,907	5,455,158
SOUTH DAKOTA	233,225	259,478	81,124	340,602	2,937,308
TENNESSEE	982,760	1,000,101	194,487	1,194,588	11,546,480
TEXAS	1,434,447	1,992,367	105,286	2,097,653	32,617,539
UTAH	462,530	540,096	214,497	754,593	7,454,805
VERMONT	96,793	81,395	50,978	132,373	2,080,281
VIRGINIA	645,057	742,840	86,153	828,993	9,177,892
WASHINGTON	867,631	811,172	57,788	868,960	13,083,766
WEST VIRGINIA	311,830	273,046	38,784	311,830	4,696,015
WISCONSIN	1,401,050	1,130,982	321,235	1,452,217	21,517,051
WYOMING	267,432	118,856	328,881	448,537	5,999,522
TOTALS***	29,354,111	30,143,097	6,584,335	36,727,432	$498,390,281

* A paid license holder is one individual regardless of the number of licenses purchased. (Data certified by State Fish and Game Departments.)
** Period covered not identified to period covered by certification for all States.
***Persons who fished in more than one State are counted in each State where they fished.

Box 1. State with designated state or heritage trout or salmon.

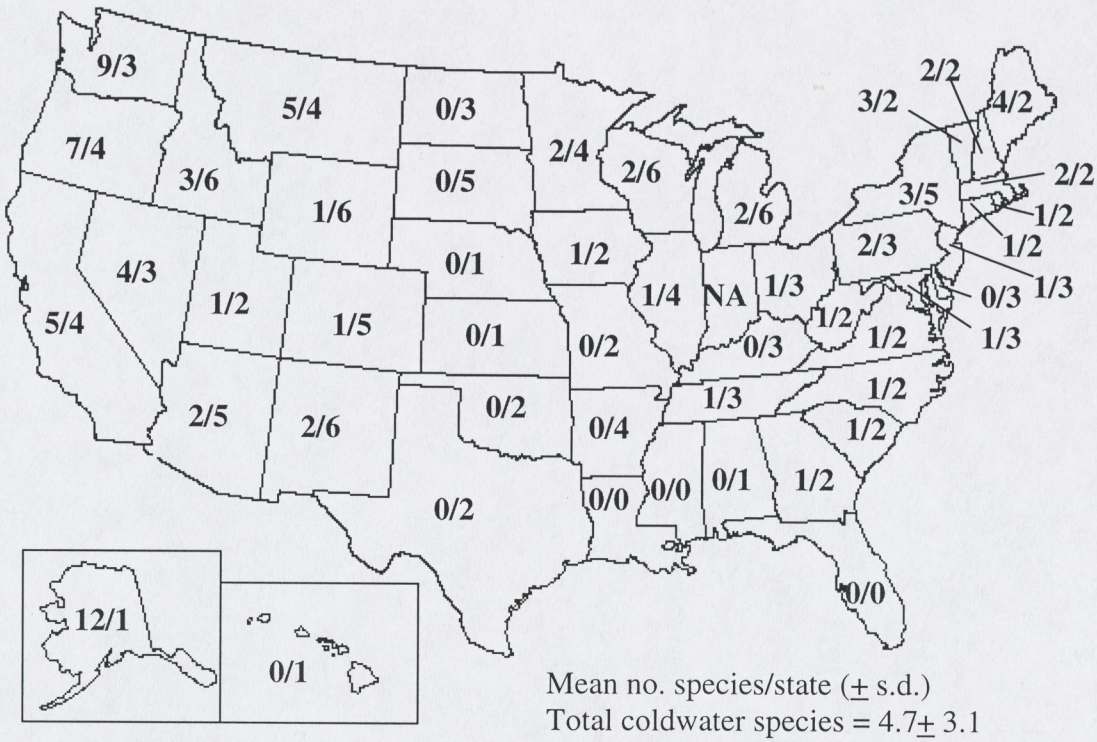
State	State Fish Designation	Heritage Designation
Alaska	chinook salmon	
Arizona	Apache trout	Apache trout, Gila trout
California	golden trout	
Iowa		South Pine Creek brook trout
Maine	landlocked Atlantic salmon	arctic charr, landlocked Atlantic salmon
Michigan	brook trout	
Minnesota		lake trout
Montana	cutthroat trout	Yellowstone cutthroat trout, westslope cutthroat, bull trout, grayling, redband trout
Nevada	Lahontan cutthroat trout	Lahontan cutthroat trout, redband trout, bull trout, Bonneville cutthroat trout
New Hampshire	brook trout	
New Jersey	brook trout	
New Mexico	Rio Grande cutthroat trout	Rio Grande cutthroat trout
New York	brook trout	brook trout
North Carolina		southern Appalachian brook trout
Oregon	chinook salmon	
Pennsylvania	brook trout	brook trout
South Carolina		southern Appalachian brook trout
Utah	Bonneville cutthroat trout	
Virginia	brook trout	
Washington	steelhead	
West Virginia	brook trout	
Wyoming	cutthroat trout	Colorado River cutthroat trout, Bonneville cutthroat, Yellowstone cutthroat, Snake River cutthroat

Box 2. Extinctions and local extirpations.

Colorado –	yellowfin cutthroat trout;
Connecticut –	Atlantic salmon;
Idaho –	coho salmon;
Illinois –	lake trout
Nevada –	coho salmon; chinook salmon;
New Hampshire –	Sunapee trout[9];
New Mexico –	Colorado River cutthroat trout;
Texas –	Rio Grande cutthroat trout;
Vermont –	Atlantic salmon; Arctic charr;
Wyoming –	Greenback cutthroat.

[9] Sunapee trout, as a subspecies (*Salvelinus alpinus aurorealis*) of from Arctic charr, is an unresolved controversy. There is also past record of the extinct of silver trout (*Salvelinus agasizzi*) from the 1930s. The taxonomic status of this species is also unresolved.

Figure 1. Occurrences and distributions of extant coldwater species (accepted species of Oncorhynchus, Salmo, Salvelinus, & Thymallus listed in AFS 1990; does not include subspecies, stocks, races, or hybrids). The numbers in each state represent number of native species/introduced species.



Mean no. species/state (± s.d.)
Total coldwater species = 4.7± 3.1
Native species = 1.8± 2.4
Non-native species = 2.9 + 1.6

Data from Horak 1995

State	proportion of sportfish management effort directed at native species	Ratio of native/non-native sportfish	total # sportfish species
Alabama	0.99	10.5	23
Alaska	0.99	15.0	16
Arizona	0.01	0.4	40
Arkansas	0.94	1.6	45
California	0.49	0.3	37
Colorado	0.01	0.2	36
Connecticut	0.10	0.5	29
Delaware	0.30	0.4	17
Florida	0.96	5.8	27
Georgia	0.96	14.5	31
Hawaii	0.05	0.5	16
Idaho	0.50	0.5	42
Illinois	0.90	3.8	53
Indiana	0.70	4.8	29
Iowa	0.90	3.8	29
Kansas	0.98	0.8	42
Kentucky	0.93	3.0	24
Louisiana	1.00	UD	16
Maine	0.76	2.0	21
Maryland	0.30	0.4	21
Massachusetts	0.20	0.4	26
Michigan	0.65	5.0	42
Minnesota	0.95	3.9	39
Mississippi	0.99	21.0	22
Missouri	0.88	6.3	29
Montana	0.15	1.3	27
Nebraska	0.90	1.5	25
Nevada	0.05	0.1	27
New Hampshire	0.63	1.2	33
New Jersey	0.10	0.5	25
New Mexico	0.05	0.4	39
New York	0.74	3.1	45
North Carolina	0.85	8.5	38
North Dakota	0.80	4.0	20
Ohio	0.99	3.4	35
Oklahoma	0.69	2.3	26
Oregon	0.87	0.4	37
Pennsylvania	0.93	5.5	39
Rhode Island	0.25	0.7	17
South Carolina	0.75	1.7	30
South Dakota	0.80	1.7	35
Tennessee	0.85	7.8	35
Texas	0.96	2.0	18
Utah	0.04	0.2	30
Vermont	0.80	3.7	33
Virginia	0.70	3.8	29
Washington	0.50	0.8	53
West Virginia	0.70	5.0	36
Wisconsin	0.40	6.2	43
Wyoming	0.15	0.4	27
median	0.75	2.00	29.50
mean	0.62	1.6	31

State	**proportion of management effort directed at native species**	Ratio of native/non-native sportfish	total # sportfish species
Arizona	0.01	0.4	40
Colorado	0.01	0.2	36
Utah	0.04	0.2	30
Hawaii	0.05	0.5	16
Nevada	0.05	0.1	27
New Mexico	0.05	0.4	39
Connecticut	0.10	0.5	29
New Jersey	0.10	0.5	25
Montana	0.15	1.3	27
Wyoming	0.15	0.4	27
Massachusetts	0.20	0.4	26
Rhode Island	0.25	0.7	17
Delaware	0.30	0.4	17
Maryland	0.30	0.4	21
Wisconsin	0.40	6.2	43
California	0.49	0.3	37
Idaho	0.50	0.5	42
Washington	0.50	0.8	53
New Hampshire	**0.63**	1.2	33
Michigan	0.65	5.0	42
Oklahoma	0.69	2.3	26
Indiana	0.70	4.8	29
Virginia	0.70	3.8	29
West Virginia	0.70	5.0	36
New York	0.74	3.1	45
South Carolina	***0.75***	1.7	30
Maine	0.76	2.0	21
North Dakota	0.80	4.0	20
South Dakota	0.80	1.7	35
Vermont	0.80	3.7	33
North Carolina	0.85	8.5	38
Tennessee	0.85	7.8	35
Oregon	0.87	0.4	37
Missouri	0.88	6.3	29
Illinois	0.90	3.8	53
Iowa	0.90	3.8	29
Nebraska	0.90	1.5	25
Kentucky	0.93	3.0	24
Pennsylvania	0.93	5.5	39
Arkansas	0.94	1.6	45
Minnesota	0.95	3.9	39
Florida	0.96	5.8	27
Georgia	0.96	14.5	31
Texas	0.96	2.0	18
Kansas	0.98	0.8	42
Alabama	0.99	10.5	23
Alaska	0.99	15.0	16
Mississippi	0.99	21.0	22
Ohio	0.99	3.4	35
Louisiana	1.00	UD	16
mean	**0.62**	1.6	31
median	***0.75***	2.0	29.5

State	**Ratio of native/non-native sportfish**	proportion of sportfish management effort directed at native species	total # sportfish species
Nevada	0.1	0.05	27
Colorado	0.2	0.01	36
Utah	0.2	0.04	30
California	0.3	0.49	37
Arizona	0.4	0.01	40
Delaware	0.4	0.30	17
Maryland	0.4	0.30	21
Massachusetts	0.4	0.20	26
New Mexico	0.4	0.05	39
Oregon	0.4	0.87	37
Wyoming	0.4	0.15	27
Connecticut	0.5	0.10	29
Hawaii	0.5	0.05	16
Idaho	0.5	0.50	42
New Jersey	0.5	0.10	25
Rhode Island	0.7	0.25	17
Kansas	0.8	0.98	42
Washington	0.8	0.50	53
New Hampshire	1.2	0.63	33
Montana	1.3	0.15	27
Nebraska	1.5	0.90	25
Arkansas	**1.6**	0.94	45
South Carolina	1.7	0.75	30
South Dakota	1.7	0.80	35
Maine	***2.0***	0.76	21
Texas	***2.0***	0.96	18
Oklahoma	2.3	0.69	26
Kentucky	3.0	0.93	24
New York	3.1	0.74	45
Ohio	3.4	0.99	35
Vermont	3.7	0.80	33
Illinois	3.8	0.90	53
Iowa	3.8	0.90	29
Virginia	3.8	0.70	29
Minnesota	3.9	0.95	39
North Dakota	4.0	0.80	20
Indiana	4.8	0.70	29
Michigan	5.0	0.65	42
West Virginia	5.0	0.70	36
Pennsylvania	5.5	0.93	39
Florida	5.8	0.96	27
Wisconsin	6.2	0.40	43
Missouri	6.3	0.88	29
Tennessee	7.8	0.85	35
North Carolina	8.5	0.85	38
Alabama	10.5	0.99	23
Georgia	14.5	0.96	31
Alaska	15.0	0.99	16
Mississippi	21.0	0.99	22
Louisiana	UD	1.00	16
mean	**1.6**	0.62	31
median	***2.0***	0.75	29.5

State	total # sportfish species	proportion of sportfish management effort directed at native species	Ratio of native/non-native sportfish
Alaska	16	0.99	15.0
Hawaii	16	0.05	0.5
Louisiana	16	1.00	UD
Delaware	17	0.30	0.4
Rhode Island	17	0.25	0.7
Texas	18	0.96	2.0
North Dakota	20	0.80	4.0
Maine	21	0.76	2.0
Maryland	21	0.30	0.4
Mississippi	22	0.99	21.0
Alabama	23	0.99	10.5
Kentucky	24	0.93	3.0
Nebraska	25	0.90	1.5
New Jersey	25	0.10	0.5
Massachusetts	26	0.20	0.4
Oklahoma	26	0.69	2.3
Florida	27	0.96	5.8
Montana	27	0.15	1.3
Nevada	27	0.05	0.1
Wyoming	27	0.15	0.4
Connecticut	29	0.10	0.5
Indiana	29	0.70	4.8
Iowa	29	0.90	3.8
Missouri	29	0.88	6.3
Virginia	29	0.70	3.8
South Carolina	*30*	0.75	1.7
Utah	*30*	0.04	0.2
Georgia	31	0.96	14.5
New Hampshire	33	0.63	1.2
Vermont	33	0.80	3.7
Ohio	35	0.99	3.4
South Dakota	35	0.80	1.7
Tennessee	35	0.85	7.8
Colorado	36	0.01	0.2
West Virginia	36	0.70	5.0
California	37	0.49	0.3
Oregon	37	0.87	0.4
North Carolina	38	0.85	8.5
Minnesota	39	0.95	3.9
New Mexico	39	0.05	0.4
Pennsylvania	39	0.93	5.5
Arizona	40	0.01	0.4
Idaho	42	0.50	0.5
Kansas	42	0.98	0.8
Michigan	42	0.65	5.0
Wisconsin	43	0.40	6.2
Arkansas	45	0.94	1.6
New York	45	0.74	3.1
Illinois	53	0.90	3.8
Washington	53	0.50	0.8
mean	31	0.62	1.6
median	29.5	0.75	2.0

Table 1a. General information concerning salmonid management in the states. Symbols: Z = Not occurring; N = Native species; I = Non-native species; • = present.

State	Salmonid occurrences	"Heritage" recognition	Extinct taxa	Federal or state "listed" taxa
Alabama	I			
Alaska	N			
Arizona	N, I	•		•
Arkansas	I			
California	N, I			
Colorado	N, I		•	•
Connecticut	N, I		•	
Delaware	I			
Florida	Z			
Georgia	N, I			
Hawaii	I			
Idaho	N, I		•	•
Illinois	N, I			
Indiana	N, I			
Iowa	N, I	•		
Kansas	I			
Kentucky	I			
Louisiana	Z			
Maine	N, I	•		
Maryland	N, I			
Massachusetts	N, I			
Michigan	N, I			
Minnesota	N, I	•		
Mississippi	Z			
Missouri	I			
Montana	N, I	•		•
Nebraska	I			
Nevada	N, I	•	•	•
New Hampshire	N, I		•	•
New Jersey	N, I			•
New Mexico	N, I	•	•	•
New York	N, I	•		
North Carolina	N, I	•		
North Dakota	I			
Ohio	N, I			•
Oklahoma	I			
Oregon	N, I			•
Pennsylvania	N, I	•		
Rhode Island	N, I			
South Carolina	N, I	•		•
South Dakota	I			
Tennessee	N, I			
Texas	I		•	
Utah	N, I			•
Vermont	N, I		•	
Virginia	N, I			
Washington	N, I			•
West Virginia	N, I			
Wisconsin	N, I			
Wyoming	N, I	•	•	
Total		**12**	**9**	**13**

Table 1b. Obstacles to self-sustaining populations. Symbols: • = present; ? = unknown

Obstacle[1] / State	Habitat degradation	Erosion or sediments	Thermal stress	Agricultural development	Absence of spawning habitat	Urban development	Over-appropriated water
Alabama					•		
Alaska							
Arizona	•	•	•	•	•		•
Arkansas	•				•		
California	•	•	•	•	•	•	•
Colorado	•	•	•	•	•	•	•
Connecticut	•	•	•			•	•
Delaware	•	•	•	•	•	•	
Florida							
Georgia	•	•	•		•		
Hawaii							
Idaho	•	•	•	•		•	•
Illinois			•		•		
Iowa	•	•		•	•		
Kansas			•				
Kentucky	•						•
Louisiana							
Maine	•	•	•	•	•	•	•
Maryland	•	•	•	•		•	
Massachusetts	•	•	•		•	•	•
Michigan	•	•		•	•		
Minnesota	•	•		•		•	•
Mississippi							
Missouri	•	•	•	•	•	•	
Montana	•	•		•	•	•	•
Nebraska	•	•	•				
Nevada	•				•		•
New Hampshire	•				•		
New Jersey	•	•	•		•	•	•
New Mexico	•	•		•	•		•
New York	•	•		•		•	
North Carolina	•	•	•	•			
North Dakota							
Ohio	•	•	•			•	
Oklahoma			?			•	
Oregon	•	•	•	•	•	•	•
Pennsylvania	•	•	•	•	•	•	•
Rhode Island	•	•	•			•	
South Carolina	•	•	•		•		
South Dakota	•	•	•	•	•	•	•
Tennessee	•	•					
Texas			•				
Utah	•	•	•	•	•	•	•
Vermont	•	•	•	•			•
Virginia	•	•	•	•			
Washington	•	•		•		•	•
West Virginia	•	•	•	•	•		
Wisconsin	•	•	•	•	•		
Wyoming	•	•		•	•	•	•
Total (rank)	**38(1)**	**34 (2)**	**28 (3)**	**25 (4)**	**25 (4)**	**22 (6)**	**20 (7)**

[1] 9 states reported others; inncludes competition and predation from natives, lack of winter habitat, sterile habitat, acid deposition, road construction, barriers, suburban sprawl, and effects of beavers.

Obstacle State	Grazing impacts	Barriers to migration	De-forestation	Un-sustainable reproduction	Competition from exotics	Absence of nursery habitat	Over-harvest
Alabama				•			
Alaska							
Arizona	•		•		•		
Arkansas				•			
California	•	•	•	•	•	•	
Colorado	•	•			•	•	
Connecticut		•					•
Delaware	•					•	
Florida							
Georgia						•	
Hawaii				•			
Idaho	•	•	•		•		•
Illinois				•			
Iowa	•			•			
Kansas							
Kentucky				•			•
Louisiana							
Maine		•	•	•	•	•	•
Maryland	•		•				•
Massachusetts		•					
Michigan		•		•		•	
Minnesota		•			•		
Mississippi							
Missouri	•		•	•			•
Montana	•	•	•	•	•	•	
Nebraska	•					•	
Nevada				•			
New Hampshire		•		•	•		•
New Jersey			•			•	
New Mexico	•	•	•	•	•	•	•
New York	•			?			•
North Carolina			•				
North Dakota							
Ohio							
Oklahoma				?			
Oregon	•	•	•		•	•	•
Pennsylvania			•	•	•		
Rhode Island		•	•				•
South Carolina							
South Dakota	•					•	
Tennessee					•		
Texas							
Utah	•	•		•	•	•	•
Vermont	•	•	•				
Virginia	•						
Washington	•	•	•		•		
West Virginia			•				
Wisconsin	•	•					
Wyoming	•	•					
Total (rank)	**20 (7)**	**18 (9)**	**16 (10)**	**16 (10)**	**14 (12)**	**13 (13)**	**12 (14)**

Obstacle / State	Mining	Exotic Predation	Genetic mixing	Inbreeding	Diseases	Loss of Forage
Alabama						
Alaska						
Arizona		•	•			
Arkansas						
California	•	•	•			
Colorado	•				•	
Connecticut		•				
Delaware						
Florida						
Georgia						
Hawaii						
Idaho		•	•	•		•
Illinois		•				
Iowa						
Kansas						
Kentucky						
Louisiana						
Maine			•	•		•
Maryland	•					
Massachusetts						
Michigan						
Minnesota						
Mississippi						
Missouri	•	•				
Montana	•	•	•	•	•	•
Nebraska						
Nevada						
New Hampshire			?		?	?
New Jersey						
New Mexico	•	•	•	•		•
New York						
North Carolina						
North Dakota						
Ohio	•					
Oklahoma						
Oregon		•	•	•		
Pennsylvania	•					
Rhode Island						
South Carolina						
South Dakota	•			•		
Tennessee			•			
Texas						
Utah	•	•			•	
Vermont			?	?		
Virginia					•	
Washington		•				
West Virginia	•					
Wisconsin				•		
Wyoming	•					
Total (rank)	**12 (14)**	**11 (16)**	**8 (17)**	**7 (18)**	**4 (19)**	**3 (20)**

Table 2. Hazards and consumption advisories for salmonids. Symbols: • = present.

Hazard	Chlorinated Hydrocarbons	Metals	Biohazards	Sediments	Radioisotopes
State					
Alabama					
Alaska					
Arizona					
Arkansas					
California					
Colorado					
Connecticut	•				
Delaware					
Florida					
Georgia					
Hawaii					
Idaho					
Illinois	•				
Iowa					
Kansas					
Kentucky					
Louisiana					
Maine	•	•			
Maryland					
Massachusetts	•	•			
Michigan	•	•			
Minnesota	•	•			
Mississippi					
Missouri					
Montana	•	•			
Nebraska					
Nevada					
New Hampshire	•	•			
New Jersey	•	•			
New Mexico		•			
New York	•				
North Carolina					
North Dakota					
Ohio	•				
Oklahoma					
Oregon	•	•			
Pennsylvania	•	•			
Rhode Island					
South Carolina					
South Dakota					
Tennessee					
Texas					
Utah					
Vermont	•	•			
Virginia					
Washington				•	
West Virginia					
Wisconsin	•				
Wyoming			•		
Total	**15**	**11**	**1**	**1**	**0**

Table 3. Disease occurrences. Symbols: • = present

Disease / State	*Furunculosis*		BKD		Whirling Disease		Gill Disease		Enteric Redmouth	
	Wild	Culture	Wild	Culture	Wild	Culture	Wild	Culture	Wild	Culture
Alabama										
Alaska	•	•	•	•			?	•	?	•
Arizona								•		•
Arkansas	•	•					•		•	•
California			•	•	•	•	•	•		•
Colorado	•	•	•	•	•	•		•		•
Connecticut		•				•		•		
Delaware										
Florida										
Georgia		•		•						•
Hawaii										
Idaho		•	•	•	•	•		•		•
Illinois	•	•	•	•				•	•	•
Iowa		•						•		
Kansas	•	•		•			•	•		
Kentucky										
Louisiana										
Maine	•			•					•	
Maryland		•				•		•		
Massachusetts	•	•	•	•				•		
Michigan	•	•	•	•	•			•		
Minnesota	•		•					•		•
Mississippi										
Missouri		•		•				•		•
Montana	•		•		•		•	•	•	
Nebraska								•		
Nevada	•	•			•	•				
New Hampshire		•		•				•		
New Jersey								•		
New Mexico		•						•		•
New York	•	•			•					
North Carolina	•	•							•	•
North Dakota										
Ohio		•		•				•		
Oklahoma										
Oregon	•	•	•	•	•			•	•	•
Pennsylvania		•		•	•	•		•		
Rhode Island		•								
South Carolina	•	•								•
South Dakota		•						•		
Tennessee		•						•		
Texas										
Utah			•		•			•[2]		
Vermont	•	•					•	•		
Virginia		•				•		•		
Washington	•	•	•	•	•		•	•	•	•
West Virginia		•				•		•		
Wisconsin	•	•	•					•		
Wyoming	•	•	•		•			•		
Total	**19**	**31**	**13**	**17**	**12[3]**	**9[4]**	**6**	**31**	**7[5]**	**15**

[2] Utah has had incidences of gill disease in the past, but none presently.
[3] Some observed only pathogen - not disease.
[4] Some states with past occurrences are presently Whirling Disease free.
[5] One additional state had an unconfirmed report.

Disease / State	Carcinoma/ Lymphoma		IHN		EMS		*Nucleospora salmonis*		VHS		Swim-up syndrome	
	Wild	Culture	Wild	Culture	Wild	Culture	Wild	Culture	Wild	Culture	Wild	Culture
Alabama												
Alaska	•		•	•								•
Arizona												
Arkansas												
California		•	•	•		•		•				
Colorado								•				
Connecticut												
Delaware												
Florida												
Georgia												
Hawaii												
Idaho		•		•								
Illinois		•[6]			•	•						
Iowa												
Kansas	•									•		
Kentucky												
Louisiana												
Maine												
Maryland												
Massachusetts												
Michigan		•			•	•						
Minnesota												
Mississippi												
Missouri		•										
Montana												
Nebraska								•				
Nevada												
New Hampshire						?						
New Jersey												
New Mexico												
New York					•							
North Carolina												
North Dakota												
Ohio												
Oklahoma												
Oregon	•	•	•	•				•				
Pennsylvania												
Rhode Island												
South Carolina						•						
South Dakota												
Tennessee												
Texas												
Utah												
Vermont												
Virginia												
Washington			•	•			•	•	•	•		
West Virginia												
Wisconsin	•				•						•	
Wyoming												
Total (of 49)	**4**	**6**	**4**	**5**	**4**	**4**	**1**	**5**	**1**	**2**	**1**	**1**

[6] Illinois reports an incidence of an ependymoblastoma in coho similar to its presumed original stock.

Table 4. State participation in public and private coldwater fish propagation. Symbols: • = present.

State	State-Operated Coldwater Facilities	Put & Take Stocking	Stock Federal Lands	Stock Private Lands	Permitted Private Coldwater Facilities	State Disease Certification for Private Facilities
Alabama	0	•			0	
Alaska	3	•	•		32	•
Arizona	5	•	•		2	•
Arkansas	3	•	•	•	2	
California	23	•	•		50	•
Colorado	17	•	•	•	34	•
Connecticut	3	•	•	•	9	•
Delaware	0	•			0	
Florida	0				0	
Georgia	3	•	•	•	57	
Hawaii	1	•			1	
Idaho	21	•	•		162	
Illinois	1	•	•		0	•
Iowa	3	•		•	4	
Kansas	0	•	•	•	0	
Kentucky	0	•	•		15	
Louisiana	0		•		0	
Maine	9	•	•		30	•
Maryland	8	•	•	•	4-6	•
Massachusetts	5	•			23	•
Michigan	6	•	•		100	
Minnesota	5	•	•		25	•
Mississippi	0		•	•	0	
Missouri	5	•	•	•	7	•
Montana	7	•	•	•	15	•
Nebraska	3	•	•	•	15	•
Nevada	4	•	•	•	1	•
New Hampshire	6	•	•		13	•
New Jersey	1	•	•	•	1	•
New Mexico	6	•	•		1	
New York	9	•	•		37	•
North Carolina	4	•	•	•	85	
North Dakota	1	•	•	•	1	•
Ohio	2	•			27	•
Oklahoma	2	•	•	•	?	
Oregon	34	•	•	•	22	•
Pennsylvania	12	•	•	•	63	•
Rhode Island	4	•			0	
South Carolina	1	•	•		1	
South Dakota	4	•	•	•	4	•
Tennessee	5	•	•	•	10	
Texas	1	•	•		0	
Utah	11	•	•	•	15	•
Vermont	5	•	•	•	13	•
Virginia	5	•	•	•	13	
Washington	90	•	•		270	
West Virginia	6	•	•	•	35	
Wisconsin	14	•			72	
Wyoming	11	•	•	•	9	•
Total	**369**	**46**	**40**	**25**	**1,280**	**25**

Symbols: • = present

Table 5a. Sources of revenue for fisheries management and the use of special user fees. Symbols: • = present.

Revenue Source / State	GRF revenue (%)	Licenses & fees revenue (%)	Federal aid revenue (%)	Other revenue (%)	Inland Trout Stamp	Anadromous Stamp or Permit	Habitat Stamp or Fee
Alabama	0	35	65	0			
Alaska	44	17	12	27		•	
Arizona	0	25	75	0	•		
Arkansas	0	81	19	0	•		
California	0	41	23	36		•	
Colorado	0	68	28	4			
Connecticut	17	37	46	0			
Delaware	19	16	51	14	•		
Florida	N.A.	N.A.	N.A.	N.A.	--	--	--
Georgia	0	59	40	1	•		
Hawaii	10	15	75	0			
Idaho	N.A.	N.A.	N.A.	N.A.		•	
Illinois	10	69	19	2	•	•	
Iowa	0	61	38	1	•		
Kansas	0	54	46	0	•		
Kentucky	0	30	70	0	•		
Louisiana	N.A.	N.A.	N.A.	N.A.	--	--	--
Maine	0	25	75	0		•	
Maryland	0	70	30	0	•		
Massachusetts	0	100	0	0			•
Michigan	1	64	28	7		•	
Minnesota	0	61	39	0	•		
Mississippi	2	23	75	0	--	--	--
Missouri	0	9	5	86	•		
Montana	0	49	45	6			•
Nebraska	0	25	75	0			•
Nevada	5	25	70	0	•		
New Hampshire	0	56	44	0		•	
New Jersey	0	80	20	0	•		
New Mexico	0	39	61	0			•
New York	5	70	25	0			•
North Carolina	0	70	30	0	•		
North Dakota	0	25	75	0			
Ohio	4	74	18	4			
Oklahoma	0	50	30	20			
Oregon	12	27	4	57			
Pennsylvania	0	54	37	9	•		
Rhode Island	6	19	75	0	•		
South Carolina	32	27	33	8			
South Dakota	0	63	37	0			
Tennessee	0	60	40	0	•		
Texas	N.A.	N.A.	N.A.	N.A.	•		
Utah	7	43	39	11			•
Vermont	0	56	44	0			
Virginia	0	55	42	3			
Washington	63	0	0	37			
West Virginia	0	80	20	0	•		
Wisconsin	3	72	20	5	•	•	•
Wyoming	0	40	41	19			•
Total	--	--	--	--	**20**	**8**	**8**

Table 5b. Budgetary expenditures (in rounded percentages) for all fisheries management program elements. [7]

Revenue Source State	Propagation	Research	Habitat	Education	Regulation	Other
Alabama	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Alaska	*4*	*9*	*0*	*1*	*0*	*0*
Arizona	**20**	**10**	**5**	**5**	**1**	**57**
Arkansas	*35*	*10*	*5*	*0*	*0*	*0*
California	**40**	**23**	**26**	**2**	**5**	**4**
Colorado	**57**	**7**	**3**	**1**	**0**	**32**
Connecticut	**25**	**66**	**5**	**3**	**1**	**0**
Delaware	**0**	**36**	**5**	**6**	**1**	**52**
Florida	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Georgia	*25*	*5*	*<1*	*4*	*<1*	*0*
Hawaii	*1*	*0*	*0*	*0*	*0*	*0*
Idaho	*27*	*14*	*0*	*0*	*<1*	*0*
Illinois	**35**	**40**	**0**	**25**	**0**	**0**
Iowa	**19**	**11**	**6**	**8**	**6**	**50**
Kansas	*15*	*5*	*<5*	*5*	*0*	*0*
Kentucky	*0*	*2*	*0*	*0*	*<1*	*0*
Louisiana	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Maine	**60**	**10**	**1**	**2**	**10**	**17**
Maryland	**30**	**40**	**0**	**15**	**10**	**5**
Massachusetts	**58**	**10**	**0**	**0**	**0**	**32**
Michigan	*31*	*21*	*5*	*3*	*0*	*0*
Minnesota	*6*	*1*	*3*	*5*	*<1*	*0*
Mississippi	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Missouri	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Montana	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Nebraska	*25*	*5*	*1*	*2*	*0*	*0*
Nevada	**45**	**45**	**0**	**5**	**5**	**0**
New Hampshire	*78*	*0*	*0*	*0*	*0*	*15*
New Jersey	**50**	**20**	**5**	**0**	**5**	**20**
New Mexico	**62**	**19**	**0**	**0**	**0**	**19**
New York	**40**	**15**	**0**	**5**	**35**	**0**
North Carolina	**39**	**25**	**10**	**1**	**0**	**25**
North Dakota	**25**	**7**	**3**	**10**	**55**	**0**
Ohio	**30**	**20**	**0**	**0**	**0**	**50**
Oklahoma	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Oregon	**45**	**9**	**30**	**10**	**6**	**0**
Pennsylvania	*32*	*5*	*1*	*1*	*18*	*6*
Rhode Island	**40**	**48**	**0**	**12**	**0**	**0**
South Carolina	*5*	*<1*	*<1*	*<1*	*<1*	*0*
South Dakota	**50**	**13**	**1**	**1**	**1**	**34**
Tennessee	**24**	**55**	**20**	**1**	**0**	**0**
Texas	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Utah	**36**	**9**	**4**	**0**	**0**	**51**
Vermont	**40**	**20**	**3**	**3**	**0**	**34**
Virginia	**38**	**41**	**6**	**8**	**1**	**6**
Washington	24	5	1	1	12	57
West Virginia	75	0	5	0	0	20
Wisconsin	**36**	**30**	**15**	**3**	**0**	**16**
Wyoming	**45**	**4**	**3**	**0**	**0**	**48**

[7] NA = information not provided. Entries in bold are percentages for entire fisheries program. Italicized entries are for coldwater fisheries programs as a percentage of total expenditure. Single underlined entries are percentages of coldwater expenditures. Double underlined entries are percentages of joint fish and wildlife budgets.

Table 6. Areas of expertise and specialization available to the states. Symbols: • = present.

Expertise Area[8] / State	Disease biologist	Trout management biologist	Salmonid culture specialist	Habitat specialist	Wild trout biologist	Fish population geneticist
Alabama						
Alaska	•	•	•	•	•	•
Arizona	•	•	•	•		
Arkansas	•	•	•			
California	•	•	•	•	•	•
Colorado	•	•	•	•	•	
Connecticut	•	•	•	•		
Delaware		•				
Florida						
Georgia	•	•	•		•	•
Hawaii	•					
Idaho	•	•	•	•	•	
Illinois	•	•	•			•
Iowa	•	•	•	•	•	
Kansas	•					•
Kentucky		•	•			
Louisiana						
Maine	•	•			•	
Maryland	•	•	•		•	•
Massachusetts	•	•	•	•	•	
Michigan	•	•	•	•	•	
Minnesota	•	•	•	•	•	
Mississippi						
Missouri	•	•	•	•	•	•
Montana	•	•	•	•	•	•
Nebraska	•					
Nevada	•	•	•	•		
New Hampshire	•	•	•			
New Jersey	•	•	•			
New Mexico	•	•		•	•	•
New York	•	•	•			
North Carolina		•	•	•	•	
North Dakota						
Ohio	•	•	•			•
Oklahoma						
Oregon	•	•	•	•	•	•
Pennsylvania	•	•	•	•	•	
Rhode Island			•			
South Carolina	•	•	•	•	•	•
South Dakota	•	•	•	•		
Tennessee	•	•	•	•	•	•
Texas	•					•
Utah	•	•	•	•	•	
Vermont	•	•	•	•	•	
Virginia	•	•	•	•	•	•
Washington	•	•	•	•	•	•
West Virginia	•	•	•	•	•	
Wisconsin	•	•	•	•		•
Wyoming	•	•	•	•	•	•
Total	**39**	**38**	**36**	**27**	**25**	**18**

[8] Six states reported others; includes fisheries biologist or fisheries scientist, coldwater ecologist, area manager, entomologist or resource planner.

Expertise Area State	Population modeler	Brood-stock geneticist	Public education specialist	Sociologist	Resource economist
Alabama					
Alaska	•	•	•		•
Arizona			•	•	
Arkansas					
California			•		
Colorado			•	•	
Connecticut	•		•		
Delaware	•		•		
Florida					
Georgia		•	•		
Hawaii					
Idaho	•		•		
Illinois			•		
Iowa			•		
Kansas		•	•	•	
Kentucky					
Louisiana					
Maine					
Maryland			•		•
Massachusetts			•	•	
Michigan	•		•		
Minnesota	•		•		
Mississippi					
Missouri			•	•	•
Montana	•	•	•	•	•
Nebraska					
Nevada					
New Hampshire			•		
New Jersey			•		•
New Mexico		•	•		
New York	•		•	•	
North Carolina			•		
North Dakota					
Ohio			•		
Oklahoma					
Oregon		•	•		•
Pennsylvania			•		
Rhode Island			•		
South Carolina	•	•	•	•	•
South Dakota	•		•	•	
Tennessee	•		•	•	
Texas	•	•		•	
Utah			•		
Vermont		•	•		•
Virginia			•		•
Washington	•	•	•		
West Virginia					
Wisconsin			•	•	
Wyoming	•	•	•	•	•
Total (of 49)	**14**	**11**	**35**	**13**	**10**

Table 7. Economic and environmental assessments of program elements. Symbols: • = present; Ecn. = economic assessment; Env. = environmental assessment.

Assessment Area / State	Recreational Harvest		Fish Culture		Habitat Restoration		Enhancement Stocking		Water Quality	
	Ecn.	Env.	Ecn.	Env.	Ecn.	Env.	Ecn.	Env.	Ecn.	Env.
Alabama										
Alaska	•									
Arizona	•	•						•		
Arkansas	•	•	•			•				•
California	•	•	•			•				
Colorado		•		•						
Connecticut	•	•								•
Delaware		•								
Florida										
Georgia	•		•							
Hawaii										
Idaho	•				•					
Illinois										
Iowa						•		•		
Kansas										
Kentucky	•									
Louisiana										
Maine	•	•								
Maryland	•	•	•	•	•	•		•	•	•
Massachusetts	•		•							
Michigan	•		•	•	•					
Minnesota				•				•		
Mississippi										
Missouri	•		•	•					•	
Montana	•			•	•	•	•	•		
Nebraska	•				•					
Nevada										
New Hampshire	•									
New Jersey	•									•
New Mexico										
New York	•					•		•		
North Carolina	•			•		•				
North Dakota										
Ohio	•	•								
Oklahoma										
Oregon	•		•				•		•	
Pennsylvania		•		•						•
Rhode Island										•
South Carolina	•	•		•		•		•		•
South Dakota	•	•	•			•	•	•		
Tennessee										
Texas	•									
Utah	•			•				•		•
Vermont	•									•
Virginia	•		•	•			•			•
Washington	•			•				•		•
West Virginia	•				•					
Wisconsin			•							
Wyoming						•				
Total	**29**	**12**	**11**	**12**	**6**	**10**	**4**	**10**	**3**	**11**

Assessment Area / State	Species Introductions		Chemical Thereputants		Stock Transfers		Disease		Commercial Harvest	
	Ecn.	Env.	Ecn.	Env.	Ecn.	Env.	Ecn.	Env.	Ecn.	Env.
Alabama										
Alaska									•	
Arizona										
Arkansas										
California		•							•	
Colorado										
Connecticut		•								
Delaware										
Florida										
Georgia										
Hawaii										
Idaho										
Illinois										
Iowa										
Kansas										
Kentucky		•								
Louisiana										
Maine										
Maryland	•		•	•		•	•	•		
Massachusetts										
Michigan				•					•	
Minnesota										
Mississippi										
Missouri	•		•	•						
Montana	•	•								
Nebraska			•							
Nevada										
New Hampshire										
New Jersey										
New Mexico										
New York										
North Carolina										
North Dakota										
Ohio										
Oklahoma										
Oregon		•		•	•	•			•	
Pennsylvania				•						
Rhode Island										
South Carolina		•				•		•		
South Dakota	•							•		
Tennessee									•	
Texas										
Utah		•				•				
Vermont										
Virginia										
Washington				•		•		•		
West Virginia										
Wisconsin										
Wyoming		•				•				
Total	**4**	**8**	**3**	**6**	**1**	**6**	**1**	**4**	**5**	**0**

Table 8. State policies and regulations addressing planning and agreements. Symbols: • = present.

Policies & Regulations / State	Federal Agreements	Long-term Strategic Plan	Multi-state Agreements	Watershed Planning	Agreements with Tribal Authorities	Ecosystem Manage-ment	Agreements with NGOs
Alabama	•						
Alaska	•				•		
Arizona	•	•					•
Arkansas		•					
California	•	•	•	•	•	•	
Colorado	•	•	•			•	
Connecticut		•					
Delaware							
Florida							
Georgia	•						
Hawaii							
Idaho	•	•	•		•		
Illinois	•	•	•			•	
Iowa							
Kansas							
Kentucky							
Louisiana							
Maine	•	•	•		•		
Maryland	•	•	•	•		•	
Massachusetts							
Michigan	•	•	•	•	•		
Minnesota		•	•	•		•	
Mississippi							
Missouri	•	•		•		•	
Montana	•		•		•		
Nebraska							
Nevada	•		•				•
New Hampshire	•	•	•	•			•
New Jersey				•			
New Mexico	•	•	•	•	•		•
New York							
North Carolina	•	•					•
North Dakota	•						
Ohio	•	•	•				•
Oklahoma	•						
Oregon	•	•	•	•	•	•	
Pennsylvania	•	•	•	•			
Rhode Island	•						
South Carolina	•	•	•	•		•	
South Dakota	•	•			•		•
Tennessee	•	•					
Texas							
Utah	•		•	•			
Vermont	•	•	•	•			
Virginia	•		•				
Washington	•	•	•	•	•	•	•
West Virginia							
Wisconsin		•		•	•	•	
Wyoming	•	•	•	•			•
Total	**31**	**25**	**21**	**16**	**11**	**10**	**9**

Table 9. State policies and regulations addressing biological concerns. Symbols: • = present.

Policies & Regulations / State	Release by private parties	Non-indigenous Species	Wild Trout Waters	Disease in Culture Facilities	Native Trout Waters	Private aqua-culture
Alabama						
Alaska	•	•		•		
Arizona	•	•		•	•	
Arkansas	•			•		
California	•	•	•	•	•	•
Colorado	•	•	•	•	•	•
Connecticut	•	•	•	•		•
Delaware						
Florida						
Georgia	•	•	•	•	•	•
Hawaii						
Idaho	•	•	•		•	•
Illinois	•	•		•	•	
Iowa	•					•
Kansas		•				
Kentucky	•		•			•
Louisiana						
Maine			•			
Maryland	•	•	•	•	•	•
Massachusetts						
Michigan	•	•	•	•		
Minnesota	•	•	•	•	•	•
Mississippi						
Missouri	•	•	•	•		
Montana	•	•	•	•		
Nebraska	•			•		•
Nevada		•	•	•	•	
New Hampshire	•	•				•
New Jersey	•	•	•		•	
New Mexico	•	•	•	•	•	•
New York	•	•				
North Carolina	•	•	•		•	
North Dakota	•					•
Ohio		•		•		
Oklahoma						
Oregon	•	•	•	•	•	•
Pennsylvania	•		•	•	•	
Rhode Island	•	•				
South Carolina			•	•	•	
South Dakota	•	•		•	•	•
Tennessee	•		•		•	
Texas						
Utah	•	•				
Vermont	•	•	•	•		•
Virginia	•	•	•	•	•	•
Washington	•	•	•	•	•	
West Virginia						
Wisconsin			•			
Wyoming	•	•	•	•	•	•
Total	**33**	**29**	**25**	**25**	**20**	**18**

Policies & Regulations State	Stock Transfers	Toxic or Hazard Spills	Diseases in the Wild	Broodstock Choice (Genetics)	T & E Critical Habitats
Alabama					
Alaska	•			•	
Arizona	•	•	•		
Arkansas					
California	•	•	•	•	•
Colorado		•	•		
Connecticut		•		•	
Delaware					
Florida					
Georgia	•				
Hawaii					
Idaho			•		
Illinois			•		
Iowa					
Kansas					•
Kentucky		•			
Louisiana					
Maine					
Maryland	•	•			
Massachusetts					
Michigan			•		
Minnesota	•		•	•	
Mississippi					
Missouri	•	•			
Montana	•		•	•	
Nebraska			•		
Nevada	•		•		
New Hampshire		•			•
New Jersey		•			•
New Mexico	•	•	•		•
New York					•
North Carolina	•			•	
North Dakota					
Ohio					
Oklahoma					
Oregon	•	•		•	
Pennsylvania					
Rhode Island					
South Carolina		•		•	
South Dakota	•	•	•		
Tennessee		•		•	
Texas					
Utah	•				
Vermont					
Virginia		•	•		•
Washington	•			•	
West Virginia					
Wisconsin	•			•	
Wyoming		•	•		
Total	**16**	**16**	**14**	**11**	**7**

Policies & Regulations State	Triploids & Tetraploids	Gene Pool Refuges	Stock I.D.	Hybrid Crosses	Transgenics
Alabama					
Alaska	•	•	•		
Arizona	•				
Arkansas					
California					
Colorado	•				
Connecticut					
Delaware					
Florida					
Georgia					
Hawaii					
Idaho	•	•			
Illinois					
Iowa					
Kansas					
Kentucky					
Louisiana					
Maine					
Maryland					
Massachusetts					
Michigan					
Minnesota			•		•
Mississippi					
Missouri		•			
Montana					
Nebraska					
Nevada					
New Hampshire					
New Jersey					
New Mexico	•			•	
New York					
North Carolina		•			
North Dakota					
Ohio	•			•	
Oklahoma					
Oregon			•	•	•
Pennsylvania					
Rhode Island					
South Carolina		•	•		
South Dakota					
Tennessee		•	•		
Texas					
Utah					
Vermont					
Virginia	•				
Washington		•	•		
West Virginia					
Wisconsin		•	•		
Wyoming					
Total	**7**	**7**	**6**	**3**	**2**

STATE OF COLORADO
Roy Romer, Governor
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE
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1996 Size and Numbers of State Raised Coldwater Fish Stocked per License Holder

(Mathematical calculations have not been verified with the states represented)

State	State Raised Catchable Fish Stocked & Avg. Size in Inches (")	State Raised Sub- catchables Stocked & Avg. Size in Inches (")	Avg. Length of State Fish Stocked	Fishing License Holders	Avg. # State Raised Sub-Catch Fish / Lic. Holder	Avg. # State Raised Catchable Fish / Lic. Holder	Avg. Num. of State Fish Per License Buyer	Cat fr
COLORADO 1996	4,532,717@10"	11,800,849@2.5"	4.6"	766,966	15.38	5.90	21.29	3
COLORADO 1997	3,197,846@9.9"	8,155,097@2.5"	4.6"	747,609	10.90	4.27	15.18	figu
Arizona	1,200,000@ 9.7"	20,000@5.5"	9.6"	340,000	0.05	3.50	3.55	4
California	7,497,560@10.8"	8,861798@3.0"	6.7"	1,787,545	4.95	4.19	9.15	
Idaho	2,973,704@9.5"	24,444,077@3.2"	3.9"	469,737	52.03	6.33	58.36	
Montana	162,824@8.6"	6,906,932@5.9"	6.0"	392,392	17.60	0.41	18.01	
Nevada	1,674,237@8.4"	312,795@5.0"	8.0"	112,837	2.77	14.83	17.60	
New Mexico	1,449,604@9.8"	3,206,560@1.9"	4.3"	254,942	12.57	5.68	18.26	2
Oregon	2,476,613@9.2"	5,108,813@3.8"	5.5"	786,972	6.49	3.14	9.63	
Utah	1,833,982@9.7"	9,178,307@3.6"	4.6"	491,094	18.68	3.73	22.42	
Washington	3,324,313@9.45"	9,861,738@3.0"	4.6"	489,678	20.13	6.78	26.92	
Wyoming	684,205@8.7"	6,343,987@2.2"	2.8"	428,212	14.81	1.59	16.41	
Pennsylvania	5,250,000@10.5"	1,250,000@3.0"	8.7	972,053	1.28	5.40	6.68	11

chable Fish m Federal Sources	Sub-catchable Fish from Federal Sources
36,663@9.2"	1,961,480@4.7"
es will be avai	lable in Dec. 1998
53,226@9.0"	710,603@8.6"
4,400@9.1"	30,633@2.9"
0	4,808,219@7.2"
2,950@16.7"	2,083,544@4.1"
7,410@14.9"	545,489@7.4"
54,466@9.9"	517,222@6.6"
970@13.5"	anadromous species
0	1,268,567@5.4"
0	anadromous species
16,182@8.4"	3,345,652@7.2"
5,025@13.5"	361,850@3.3"