THE OSPREY

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Federation of Fly Fishers

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Farming Uncertainty in Coastal British Columbia

by John P. Volpe

— University of Alberta —

The presence of free ranging Atlantic salmon in coastal British Columbia has generated considerable debate. Do the promised economic benefits of Atlantic salmon culture outweigh the various associated environmental risks? The recent discovery of multiple year classes of putatively wild reared juvenile Atlantic salmon on Vancouver Island has intensified this debate.

In this article, first published in the Steelhead Society of British Columbia's publication Steelhead Release, *John Volpe, of the Department of Biological Science, University of Alberta, reviews historical introductions of Atlantic salmon to B.C. and compares these events to the present situation. He discusses the value of information brought to bear on the issue of Atlantic salmon colonization of B.C., and demonstrates why it is unwise to rely solely on these data in formulating policy. He also covers the potential ecological effects of Atlantic salmon on native Pacific salmonids, particularly steelhead.*

Since this paper was first published, in fall 2001, Volpe notes, "New data has shown that there are far more Atlantics out there than are reflected in the 'official' tallies. Thus, the potential problem is far greater than generally appreciated."

From 1905 to 1934 significant effort was expended in attempting to introduce Atlantic salmon to coastal British Columbia for the purpose of angling. Estimates of total number stocked (eyed eggs and alevins) are not consistent, reported as 5.5 million, six million and 13.2 million. Primary release sites were the Cowichan River on Vancouver Island and the Fraser River system in the south mainland. Some other systems received plantings but not to the same extent. Eggs and alevins were used almost exclusively for stocking. Very little information exists regarding survivorship to smolt or any other demographic information relating to the success of the stocking efforts. Only a handful of returning adults was reported and there was no indication of natural reproduction.

The failure of these introductions has been presented as evidence that current aquaculture escaped Atlantic salmon will also fail to colonize. Such arguments ignore the dramatic changes to the coastal environment in the intervening years. Indeed the very factors that resisted Atlantic salmon colonization early last century have now been altered to favor colonization. Consider the following points characterizing the historical introductions:

1. Stocking was limited to use of eggs and alevins only; natural mortality was likely very high.

2. Cross country transport of eggs and alevins and rudimentary facilities in B.C. likely affected quality of individuals introduced. Further, the stocking programs were haphazard. These introductions pre-dated modern protocols for maximizing hatchery efficacy. Eggs and alevins were planted when available, often years or decades separating stocking events on particular river sys-

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FROM THE PERCH — EDITOR'S MESSAGE

Salar the Invader

by Jim Yuskavitch

Just over a decade ago, I had the opportunity to travel to Quebec's wild Ungava Peninsula in pursuit of *Salmo salar*, the Atlantic salmon. When I finally hooked my first Atlantic, I discovered immediately why so many anglers the world over are in love with this king of gamefish that the ancient Romans quite appropriately called "the leaper."

Being curious anglers, with a scientific bent, we were interested in knowing a little more about these particular fish. So we scraped scale samples from our catches before releasing them, and upon returning home, sent them off to a researcher we knew at the Woods Hole Oceanographic Institution.

Months passed. Then one day a note from our scientist contact arrived. Much to our surprise, his genetic analysis indicated that some of our fish might have had some "domesticated" influence. How could that be in this wild land on the northern fringe of the Atlantics' range, where wolves stalked woodland caribou along the banks of the same rivers where we stalked *S. salar*? Hatchery strays? Or perhaps the progeny of escapees from the Atlantic salmon farming operations that dot the coastlines of Canada's Maritime Provinces and Maine?

In the Northeast, fish advocates worry about the threat of genetic dilution on wild Atlantic salmon stocks from escaped pen-raised fish. Farmed fish spawning in the wild have been spotted in some streams in eastern Canada.

As the University of Alberta's John Volpe explains in this issue's cover story, the main threat from the Atlantic salmon farming industry off the coasts of British Columbia and Washington State is a bit different — but no less serious.

As in the Northeast, threats include pollution from the salmon's waste and the possibility of interbreeding with wild salmonids. But the real danger for us is the potential for colonization of our wild steelhead streams by escaped Atlantic salmon. That probability is made all the more likely by the depressed condition of most wild steelhead populations.

With many millions of Atlantics finning in pens along our coasts, the odds, I fear, may be in their favor.

Letters to the Editor

Angling 101

Dear Editor:

Your last issue, #43, was a first class piece of work. I think most fly fishers have an affinity with nature and conservation of the fish they so eagerly pursue. Your last issue went one step further in providing some of the ecological interactions affecting fish. The articles should be required reading for "Angling 101." I can think of a few fisheries biologists who would benefit from reading it, too.

Thanks for the continued high quality and keep up the good work. It's much appreciated.

George E. Reid
Lantzville, B. C.

No Pen Raised Salmon!

Dear Editor:

Your ocean lovers special was very informative and brings up more questions than answers.

Not much was said about salmon farming/ranching up on the coast. This is a very serious problem that must be addressed! I have seen the devastating effects this has on East Coast and European fisheries.

Using exotic species (*S. salar*) for sea farming has opened the flood gates of new problems. The dense numbers of fish and pens will attract predators, parasites and many diseases. Does anyone know what infectious salmon anemia will do to West Coast fish? All anadromous fish will be in contact with these pens when entering and exiting their home rivers. What about escapees wandering up and down the coast?

Our problems are complex enough. To compound them with a whole new set of problems is foolish and I hope that we can learn from the other's mistakes.

Enough said!

Lou Duncan
Sisters, Ore.

THE OSPREY

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What Role Should Hatchery Fish Have in ESA Listings?

by Bill Redman
— Steelhead Committee —

Due to the importance of this subject matter, Steelhead Committee Chairman Bill Redman's column is being presented as a full length article.

"In some sections an almost idolatrous faith in the efficacy of artificial culture of fish for replenishing the ravages of man and animals is manifested, and nothing has done more harm than the prevalence of such an idea." John Cobb, Dean of the College of Fisheries at the University of Washington, made this statement in 1930 — remarkable for its time.

Considering the volume and findings of scientific research addressing the effects of hatchery operations on wild salmon and steelhead in the last 20 years, one would think this argument should have been settled once and for all. Even the current on-the-record Policy of the National Marine Fisheries Service (NMFS) has emphasized the harmful effects of hatcheries and the need to avoid them in their recovery plans for fish listed under the Endangered Species Act (ESA).

Sadly, the current situation, which was triggered by federal judge Michael Hogan's decision to strip away ESA protection for Oregon Coastal coho salmon because of the presence of substantial numbers of hatchery fish, argues otherwise.

NMFS New Hatchery Policy

Assuming its schedule holds, NMFS will release for public comment a new draft policy on the role of hatchery fish in ESA listing of Pacific salmon and steelhead at about the time this issue of *The Osprey* is mailed. In its first draft release of the new policy to the states and tribes, NMFS tried to walk a fine line between the following diametrically opposing positions:

1. Wild and hatchery fish of the same species are identical, so the presence of significant numbers of hatchery fish is reason to delist the species, regardless of the status of the wild stocks.

2. Wild and hatchery fish are very different, the future of the runs is dependent on the health of the wild stocks, and ESA protection should be reserved for wild fish only, except when wild stocks are so weak that extinction is highly likely in the near future.

The wild fish need protection, and the science increasingly shows they need protection from hatchery fish.

The first draft of the new Policy allows ESA listing and protection for hatchery fish similar in evolutionary lineage to wild fish in the same Evolutionarily Significant Unit (ESU), but states that wild and hatchery fish in the same ESU will not necessarily receive equal ESA protection. The almost inevitable result, if this hair splitting carries over into the final policy: abundant confusion, conflict, and delay.

A look at supporting statements by proponents of the opposing sides is revealing.

James Johnson, an attorney for a coalition of farmers and ranchers; the building, real estate and other businesses; and local governments, euphemistically named "Common Sense Salmon Recovery," recently argued in favor of delisting four Chinook salmon ESU's by saying: "This listing was wrong from the beginning … They're the identical same fish as the so-called wild fish."

As the principal author of two petitions by fishing and environmental groups — including Trout Unlimited and the Oregon Council of the Federation of Fly Fishers — to list only the wild fish in 15 salmon and steelhead ESUs, Kaitlin Lovell of Trout Unlimited stated: "It's the wild fish that need protection, and the science increasingly shows that one thing they need protection from is hatchery fish." In the cover letter to one of the petitions she wrote: "As the petition highlights, there is ample and significant biological and legal justification for recognizing a distinction between wild stocks and hatchery populations … The petition explores the behavioral, physiological, physical, ecological, reproductive and evolutionary differences between the hatchery and wild stocks."

In an amazing feat of political dexterity, NMFS responded to the opposing sets of petitions by announcing that both "present substantial scientific and commercial information indicating that the petitioned actions may be warranted." This leaves the question of how to deal with the role of hatchery fish in ESA listings entirely up to the final hatchery policy.

The Science

So who's right and what does the science say?

The people, organizations and financial backing behind the petitions to delist view the wild fish as, at least, a sizable inconvenience and, in many cases, an obstacle to profitable operation. So their views of what constitutes good science may be suspect. Their arguments are highly charged emotional appeals and are not supported by broadly based, peer reviewed scientific evidence.

The scientific support for listing of wild fish only is overwhelming, beginning with one of the primary scientific anchors for salmon recovery, the National Academy of Sciences/National Research Council report of 1996: "Upstream, Salmon and Society in the

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Pacific Northwest." The report is the summation of three years of study by 15 authorities in a broad range of salmon related scientific disciplines, who came to unanimous agreement on the report's findings, which stand unchallenged to this day. Most of the rest of this column is made up of direct quotations from "Upstream" and other science, rather than my interpretive words, in order to be certain that there is no misunderstanding of the science and its meaning.

Genetic Diversity

The General Conclusion of "Upstream" includes the following statements. "Management must recognize and protect the genetic diversity of salmon. … A crucial aspect of the recommendations is the overriding need to focus management goals primarily on genetic diversity rather than biomass production." The recommendations on hatcheries include the following: (1) "The intent of hatchery operations should be changed from that of making up for losses of juvenile fish and for increasing catches of adults. They should be viewed instead as part of a bioregional plan for protecting and rebuilding salmon populations and should be used only when they will not cause harm to natural populations." (2) "Hatcheries should be dismantled, revised, or reprogrammed if they interfere with a comprehensive strategy designed to rebuild natural populations of anadromous salmon … ."

Jim Lichatowich, one of the region's most respected and experienced salmon fisheries scientists, quoted from NMFS' own hatchery policy in an October 2001 Declaration in support of continued ESA protection for Oregon coastal coho. "This approach directs attention to fish that spend their entire life cycle in natural habitat and is consistent with the mandate of the ESA to conserve threatened and endangered species in their native ecosystems. Implicit in this approach is the recognition that fish hatcheries are not a substitute for natural ecosystems. … Potential problems associated with hatchery programs include genetic impacts on indigenous naturally reproducing populations." Lichatowich went on to state that, "NMFS' findings (in its original policy) concerning the genetic and ecological risks posed by hatcheries are unassailable." In his book "Salmon Without Rivers," he described in great detail the incredibly complex and varied web of native salmon life histories, much of which has been lost, leading the reader to the inevitable conclusion that hatcheries can not come close to duplicating this complexity.

The conclusion is inescapable. The loss of genetic and life history diversity caused by hatchery operations and the resulting interbreeding of hatchery and wild fish has been and may continue to be the most insidious and most harmful effect of hatchery operations on native salmon stocks. But it is far from the only damage done to wild stocks by hatcheries. The following additional risks, while certainly not a complete list, add up to a very sizable set of hurdles that hatchery operations must clear before they can be assured of avoiding impacts on wild stocks. (Scientific sources noted)

1. Demographic risks: "Large-scale releases of hatchery fish have greatly exacerbated the mixed-population fishery problem. Less productive populations in the mixture, often the naturally reproducing ones, are overfished as a consequence of relatively high exploitation rates, which are set in response to the relatively large contribution of hatchery fish … wild populations in the mixture are eventually driven to extinction as their escapements drop below replacement levels." (Upstream)

2. Domestication: "If fish become domesticated by genetic adaptation to a hatchery, they will have a commensurate decline of fitness in natural environments." (Upstream)

3. Artificial Selection: "The practice of making artificial matings … is a serious concern because it disrupts natural patterns of sexual selection with negative implication for fitness of hatchery fish in natural environments. In hatcheries, the whole process is bypassed. … It is almost certain that one result is loss of general vigor, adaptation to local environments, and evolutionary fitness." (Upstream)

4. Behavior: "The hatchery and stream environments differ in many respects, and the foraging, social, and predator-avoidance behavior patterns of fish raised in the different environments are often different. … hatchery fish … generally experience much higher mortality once released from the hatchery." (Upstream)

5. Disease: "Disease is thought to be directly or indirectly responsible for substantial post release mortality of hatchery fish. Disease outbreaks are relatively common in hatcheries." (Upstream) "When wild salmon mated with the transplanted hatchery fish, local adaptations such as resistance to disease were often diluted or lost." (Lichatowich Declaration)

6. Physiology: "The physiological state of hatchery fish often is suboptimal … The contribution of environmental stress to reducing the immune response of salmon is well documented. Incomplete smoltification of some hatchery fish is also a major cause of concern." (Upstream)

7. Spawning Timing: "hatchery practices often … shift the timing of spawning of hatchery salmon so that it is earlier than their wild counterparts. Earlier spawning produces hatchery juveniles that are larger than naturally spawned fish. … it can lead to displacement of the wild fish. … Early spawning may be a positive trait in the hatchery, but it can prove deadly in the wild." (Lichatowich Declaration)

8. Salmon Carcasses: "In natural situations, the carcasses of the spawning salmon that die provide important nutrients to the river ecosystems … the use of hatcheries leads to a lack of salmon carcasses in the rivers." (Upstream)

9. Carrying Capacity: "there is a major concern about the effect of hatcheries on the carrying capacity of the rivers and oceans. … enormous numbers of fish are released from hatcheries." (Upstream) "Ecological risks result when an influx of hatchery fish pushes the stream to or over its carrying capacity … Because of their larger size (due to earlier spawning), hatchery fish often win the competition and force the wild fish into marginal habitat with low survival potential." (Lichatowich Declaration) "All of these studies are

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cogent evidence for density-dependent growth in the ocean for populations that intermingle in the ocean feeding grounds. Thus salmonids have pushed the upper limits of the ocean carrying capacity ... at least for the growth of salmon. ... The Northwest Fisheries Science Center analyzed the marine survival of wild Snake River Chinook salmon and found a strong negative relationship between their survival and the number of hatchery Chinook salmon released, especially in years of poor ocean conditions." (William Pearcy, How Many Fish Can the Ocean Hold?, *The Osprey*, September 2002)

Table 1. Relative Difference between Wild and Hatchery Reared Salmonids (adapted from Flagg et al., 2000, "Ecological and behavioral impacts of artificial propagation strategies on abundance of wild salmon populations." NOAA Tec. memo NMFS-NWFSC-41.)

Category	Wild	Hatchery
Survival		
egg - smolt survival	lower	higher
smolt - adult survival	higher	lower
Behavior		
foraging ability	efficient	inefficient
aggression	lower	higher
social density	lower	higher
territorial fidelity	higher	lower
migratory behavior	disperse	congregate
habitat preference	bottom	surface
predator response	flee	approach
Morphology		
juvenile shape	more variable	less variable
nuptial coloration	brighter	duller
kype size	larger	smaller
Reproductive Potential		
egg size	smaller	larger
egg number	lower	higher
breeding success	higher	lower

The National Marine Fisheries Service has noted that there are only two similarities between wild and hatchery fish, water and photoperiod, but the fish are markedly different from each other in behavior, morphology, survival and reproductive ability. (Waples 1999; Flagg et al. 2000). This table summarizes these differences.

10. Competition: "Hatchery fish may interfere with natural production by increasing competition for mates." (Lichatowich Declaration)

11. Incomplete Marking: "Potential problems with hatchery programs include ... difficulty in determination of wild run status due to incomplete marking of hatchery releases." (Lichatowich Declaration)

12. Blocking of Migration: "... it is important to prevent blocking of wild fish from migrating upstream of hatcheries because this is likely to compromise recovery and sustainability of wild populations." (Upstream)

13.Fluctuations in Abundance: "Overreliance on hatcheries has also discouraged development of institutional arrangements and behaviors that would accommodate natural large-scale fluctuations in salmon abundance." (Upstream)

14. Monitoring: "Hatchery programs have lacked proper monitoring and evaluation. ... Hatcheries should be rigorously audited for their ability to prevent demographic, genetic, fish-health, behavioral, physiological, and ecological problems." (Upstream)

15. Cost per Returning Hatchery Adult: "The costs per returning hatchery adult varied from $12 for Priest Rapids fall chinook to $1,615 for Winthrop hatchery spring chinook to $3,707 for Nez Perce hatchery chinook." (from the "Report of the Independent Economic Advisory Board to the Northwest Power Planning Council on Hatchery Cost Effectiveness," July 2002.) This report reminds us that hatchery operations and fish are completely dependent on the vicissitudes of political budget processes, with no assurance that their funding will continue indefinitely.

In summary, wild and hatchery salmon and steelhead in the same ESU are very different from each other, in behavior, morphology, survival and reproductive ability. The above table adapted from research by T. A. Flagg et al., 2000 makes that point vividly.

If NMFS concludes in its new hatchery policy that they are the same fish for purposes of ESA listing and protection, a cornerstone of the Endangered Species Act will have been destroyed. The ESA will no longer be about protection and recovery of wild fish. Hatchery fish, which harm wild fish, will suffice.

It's time to speak up.

Farming Uncertainty, Continued from page 1

tems. Where and how each batch of Atlantic salmon was introduced was left up to personnel at each site. Again, in the absence of a standardized protocol, variance is likely in the treatment affecting survivorship from one stocking event to the next.

3. Stocking efforts were spread over 29 years. Even using the high estimate of 13 million, this represents about 448,276 eggs and fry released per year. To put this in perspective, this represents only 0.08 percent of the annual input of the current federal Salmon Enhancement Program (SEP). In fact, currently on any given day there are more Atlantic salmon in B.C. marine net cages than were stocked throughout 1905-1934. The average net cage population of Atlantic salmon in B.C. coastal waters at any one time is about 16.6 million.

4. Atlantic salmon were introduced into habitats that were likely already at or near saturation with native competitors. The amount of available resources and the associated magnitude of competition for those resources can play a significant role in the success or failure of an introduction. Recruitment data from 1905-1934 are not available, but every indication suggests that juvenile rearing habitat was at or near carrying capacity, thus ensuring strong competition for introduced individuals.

Today these conditions have changed significantly — all towards increasing the likelihood of Atlantic salmon colonization.

1. The majority of aquaculture escapes today are adults. A total of 707,635 Atlantic salmon were reported escaped from B.C. and Washington State marine facilities from 1991 to 1998 with an additional 13,500 reported released in B.C. in 2000. An unknown number of escapes, termed "leakage," goes unaccounted or unreported, making an accurate estimate of escapes very difficult. One estimate of unaccounted losses suggests 10 percent to 30 percent of the cage population may be lost in this way. Suffice to say that a significant number of Atlantic salmon slip out of the nets each year and the situation is unlikely to change so long as current net-pen technology is used.

2. Escapees today are healthy, high condition factor adults, reared locally, and immunized against common pathogens.

Atlantic salmon, in their native waters, are fish admired and sought after by anglers the world over and are well worth preserving. But Atlantics swimming wild in the streams of the Pacific Northwest pose dire threats to native salmonids. Photo by Jim Yuskavitch

3. Net-pen operations are clustered on the northeast and mid-west coasts of Vancouver Island. Thus consistent, spatially invariable points of release are established. This has the effect of concentrating the "introduction effort." Experience with the introduction of other exotic species has shown that a consistent point of introduction will increase the likelihood of successful establishment. Not surprisingly, I have found the incidence of occurrence of adult Atlantic salmon in rivers to be inversely proportional to the distance from net-pen clusters.

4. Abundance of native salmonid stocks has declined sharply over the past 70 years resulting in a surplus of underutilized habitat available to a potential transplant such as Atlantic salmon. Vancouver Island stocks of steelhead, the native ecological equivalent to Atlantic salmon, are at an all time low. The 1998 smolt production of Keogh River steelhead, one of the few populations with reliable long term data, was only 16 percent of the long term average since 1977. Any biological system that experiences an 84 percent decline in abundance of a dominant consumer will also be at a diminished capacity to retard the invasion of a niche equivalent species — in this case Atlantic salmon.

CURRENT STATE OF KNOWLEDGE AND ONGOING RESEARCH

In response to public concerns regarding potential environmental effects of the B.C. salmon aquaculture industry, the British Columbia Office of Environmental Assessment (EAO) launched a review in July 1995. Expansion of the industry was halted pending the findings of the review. In August 1997, the final report of Salmon Aquaculture Review (SAR) was released (the full text available at http://www.eao.gov.bc.ca/PROJECT/AQUACULT/SALMON/Report/final/vol1/toc.htm). When it was concluded, the SAR was the largest review of its kind ever conducted in B.C. The report is telling as much for what it does not say as for what it does. Over 100 pages are devoted to potential ecological and genetic impacts of not only Atlantic salmon, which now make up greater than 80 percent of production, but chinook and coho, which make up the balance. In those pages the authors cite 128 reports encompassing all pertinent scientific knowledge available at the time. Of these, 38 deal specifically with Atlantic salmon but only seven deal specifically with Atlantic salmon in B.C (five were non-refereed annual Atlantic Salmon Watch Program reports, one on preda-

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tion inside cages, and a 1997 review paper). The majority of Atlantic salmon materials (82 percent) deal with issues in and around the north Atlantic. Following the release of the EAO's report, the moratorium was lifted. "A cautious yellow light" for expansion was granted in spite of a virtual absence of relevant (i.e. Pacific basin) data. It is not possible to apply these foreign data to the current situation in B.C. without an expectation of errors so great that predictions are rendered meaningless.

To predict the potential impact of Atlantic salmon in B.C. will require local research initiatives in order to assess local sources of variation. Impact (I) of an introduced species has been defined as I=R*A*E where R is the range (m^2), A is the mean abundance and E is the per capita effect of each exotic individual in its new home. The authors of this equation admit that it is likely to be overly simplistic, but even so, at present we lack sufficient data to evaluate even one of the three parameters with regard to free-ranging Atlantic salmon in B.C.

Range is likely the parameter on which we have the most data. Since 1992, the B.C. provincial government and federal Department of Fisheries and Oceans have sponsored the Atlantic Salmon Watch Program (ASWP). The ASWP is a monitoring program where captures and observations of Atlantic salmon are reported via a toll-free telephone number (1-800-811-6010 at the Pacific Biological Station, Nanaimo). Often, carcasses are sent to the Pacific Biological Station for species confirmation and further analysis. These data are compiled and reported annually including summary catch data from Alaska and Washington State. The most northerly capture of an Atlantic salmon was from the Bering Sea. The most northerly possible release site was approximately the north end of Vancouver Island — aquaculture is not permitted in Alaska.

Reports to the ASW Program are predominated by marine captures by commercial fishers. However, various problems exist with the applicability of the ASWP data. Foremost, the data are opportunistic, collected in the absence of an experimental design or controls. For instance, it is unknown how many Atlantic salmon are actually captured annually so predicting what proportion of captures is reported is not quantifiable. Many fishers do not report Atlantic salmon and freeze the carcasses to be used during the halibut season. Further, it is not possible to identify or quantify possible biases in the data if one gear type is more likely to capture/report than another, etc. The ASWP provides qualitative baseline data on Atlantic salmon range for relatively little investment. However, gaps in the data must be remedied before these data can be confidently applied in a quantitative (i.e. predictive) manner.

A "yellow light" for expanding Atlantic salmon farming was given in spite of the absence of relevant Pacific Basin data.

In 1994, a freshwater survey program for Atlantic salmon was initiated by the Provincial Ministry of Environment and funded predominantly through the B.C. Habitat Conservation Trust Fund. The primary objective of the freshwater survey program was to identify evidence of natural reproduction of Atlantic salmon in coastal streams. A secondary objective was to collect distribution and abundance data on ascending adult Atlantic salmon. The survey was conducted by snorkeling pre-selected one- to nine-kilometer (.62 to 5.6 miles) reaches of rivers with histories of Atlantic salmon activity or thought likely to have such activity. The freshwater survey program suffers from similar limitations as the ASWP, most notably data are collected in the absence of controls. There are no controls allowing calibration or error estimates to be generated. For instance, during a survey in a river where juvenile Atlantic salmon are present at some known density, what are the chances of not seeing one? What are the chances of missing half? How much more likely is a surveyor to see a parr than a fry? Juvenile Atlantic salmon exhibit considerably different behavior patterns and micro-habitat preferences compared to native salmonid species. This makes them less likely to be observed by survey crews used to dealing with native species exclusively. To date less than one percent of potential Atlantic salmon rearing habitat has been surveyed and despite the obvious limitations of our technique, three Vancouver Island systems have been identified as supporting putatively wild reared juvenile Atlantic salmon. Without appropriate controls, however, one cannot make the obvious extrapolation to the number of systems likely to be supporting Atlantic salmon if 100 percent survey coverage was applied.

The limitations of the federal Atlantic Salmon Watch and provincial freshwater survey programs become more evident when attention turns to quantifying the abundance (A) term. In the absence of appropriate designs and controls it is not possible to utilize common management tools such as catch per unit effort (CPUE), let alone define confident abundance estimates.

Per capita effect (E) is the most difficult parameter to characterize and not surprisingly the parameter with the least data associated with it. Effects can be partitioned into five classes — each of which must be considered before conclusions can be drawn. Effects could be on individuals, genetic structure, population dynamics, community and ecosystem processes. What little data is available deals almost exclusively with effects on individuals during the freshwater juvenile phase.

Habitat preferences of the eight native coastal salmonid species suggest juvenile Atlantic salmon will share the greatest niche overlap with juvenile steelhead trout. Indeed steelhead (including the non-anadromous form, rainbow trout) until recently were named *Salmo gairdneri*, reflecting the species similarity to *Salmo salar*. Prior to my own research program, juvenile performance of Atlantic salmon and steelhead had been directly compared on only three occasions. Results of these examinations all showed steelhead to be the more aggressive species and, from this, competitive superiority was inferred. These data likely played a sig-

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nificant role in the SAR's conclusion that Atlantic salmon posed a minimal threat of invasion in B.C.

When the experimental designs of these three papers are examined however, a shared flaw is revealed. In all three cases the effect of steelhead - steelhead and Atlantic salmon - Atlantic salmon competition were not separated from steelhead - Atlantic salmon competition. Failing to do this convolutes the results as one cannot discern the extent to which poor (or good) performance of an individual is affected by other individuals of its own species and to what extent it is affected by individuals of the other species. Previous studies assumed that poor performance of one species was due to the competitive effect of the other. Reevaluating the relative performances of Atlantic salmon and steelhead under a more rigorous design shows the relationship between the two species is more complex than previously imagined. Steelhead are more aggressive than Atlantic salmon, as previously concluded, but this does not automatically lead to a competitive advantage. Steelhead show a pronounced bias towards intraspecific (steelhead - steelhead) agonism (Editor's Note: agonism = combativeness or competitiveness). The per capita effect of steelhead on themselves far exceeds the per capita effect of Atlantic salmon. This bias results in Atlantic salmon experiencing relatively little competitive interference from steelhead. Therefore, I conclude — in contrast to conventional opinion — that steelhead at present densities are unlikely to act as a deterrent to Atlantic salmon colonization.

A prior residency effect was also observed which adds complexity to the results. Groups of fish with as little as three days prior residency period dominated subsequently introduced challengers. It made no difference which species were the residents and which where the challengers introduced three days later, residents always dominated — including Atlantic salmon residents dominating steelhead challengers. During the 1905-1934 introductions, little or no opportunity to establish a prior resident advantage would have been possible for introduced Atlantic salmon due to the high abundance of native salmonids. Today in most Vancouver Island rivers, the majority of steelhead/Atlantic salmon habitat remains underutilized. This results in a considerable increase of opportunity for juvenile Atlantic salmon to establish a residency advantage, which in turn should positively affect survivorship.

Potential genetic effects of Atlantic salmon escapees are not as well defined. A small pilot project found Atlantic salmon x *Oncorhynchus spp*. (six species) hybridization attempts were unlikely to produce appreciable numbers of viable offspring. Logistical problems with the experimental design, however, do not completely exclude the possibility of production of viable progeny via hybridization. Devlin's work was a small pilot study only. The narrow breadth of genetic diversity represented by the few individuals of each species used in the crosses was unrepresentative of each species as a whole. What effect this may have had on the results is unknown. More importantly, considerable use of cryopreserved sperm was used. To what degree this may have affected results was not defined. A rigorous examination of this question is long overdue.

Steelhead, at present densities, are unlikely to act as a deterrent to Atlantic salmon colonization.

A further consideration is that the production of viable young is not necessary for hybridization attempts to have a negative effect on native stocks. When hybridization is attempted, regardless if viable progeny are produced or not, there is one less native spawner. The loss of that individual's gametes to the native population reduces the potential reproductive output for that population and thus is considered both an ecological and genetic effect.

Potential population effects such as changes in abundance, distribution, age or size structure of native species and Atlantic salmon have yet to be considered, let alone investigated. Similarly, community effects (species richness, trophic structure) and ecosystem effects (shifts in nutrient availability, primary productivity) also await consideration, both in the juvenile freshwater and adult marine stages of life.

CONCLUSION

One might conclude, based on media reports and government (in)action to date, that there is little we do not know regarding free ranging Atlantic salmon in B.C. waters and that these gaps in knowledge are small enough so as not to be a concern. I would take issue with this position and submit that from an ecological/genetic point of view, we know very little indeed — and we don't even know that.

Correction

An editing error in Robert Hooton's article, "Terminal Gear and Steelhead Sport Fishery Management," in the September 2002 issue of *The Osprey,* resulted in several incorrect mortality figures on page 16.

The correct numbers are 10 percent mortality for bait, three percent for artificial lures and one percent for flies.

The Osprey regrets the error and any confusion it may have caused our readers.

Hatchery/Wild Steelhead Interactions

by Curt Kraemer

— *Washington Department of Fish and Wildlife* —

Over the last several decades there has been increasing concern among anglers and fisheries managers about the potential interactions between hatchery and wild fish and the resource and management consequences of those interactions.

Much of the early interest was, and continues to be, focused on steelhead. The special attention that steelhead have attracted in this arena is likely due to a combination of several factors: 1) the extreme passion that steelhead create in those who angle for them, 2) the readily apparent differences between hatchery and wild fish, and 3) the biological aspect of the hatchery/wild debate has been used as a lever in the social debate of resource allocation.

In the following article, Curt Kraemer, of the Washington Department of Fish and Wildlife, looks at these issues from the perspective of a management biologist and describes how attempts have been made to address them in the North Puget Sound region of Washington State.

Kraemer has worked for the Department for 31 years and is currently district fisheries biologist for the Snohomish and Stillaguamish basins.

Hatchery programs can generally be classified into two broad categories — supplementation and enhancement. In supplementation programs, the primary goal is to assist the local wild fish population, giving it a boost by supplementing the run size and resulting escapement. Enhancement programs are meant to supply more fish for harvest to create additional fishing opportunities. It is not uncommon for a program to be a hybrid of the two types. Steelhead programs are most often fishery enhancement programs. Regardless of the type of program, the hatchery product will interact with both the wild fish and their environments in a variety of ways. The current debate centers on the acknowledgement of the impacts and management agencies' attempts to manage around or mitigate for those impacts.

The various negative hatchery/wild impacts can be put into a number of broad categories. These include: 1) over fishing, 2) masking the status of the wild population, 3) predation, 4) competition, and 5) genetic impacts. How these impacts play out varies depending on the specifics of the river system and its fish community. Let's examine each of these with regard to steelhead.

Even hatchery fish derived from wild broodstock may impart detrimental "domesticated" genes on its progeny, as well as any wild fish with which they may eventually spawn. Photo by Jim Yuskavitch

OVER FISHING

This was one of the first negative hatchery/wild impacts to be recognized. Over fishing is likely to occur when hatchery and wild fish are mixed in the same fishery, as the hatchery fish are often more productive than the wild fish. That is, it takes fewer hatchery fish returning to the hatchery than a wild run spawning in a river to perpetuate the run. This of course means that when mixed stock (both hatchery and wild fish together) fisheries occur, overfishing of the less productive wild stock is likely. A secondary contributor to over fishing occurs when fish abundance is artificially propped up by hatchery production. This occurs when the combined fish abundances of both hatchery and wild fish are high enough to support high angler interest when the abundance of wild fish alone would not.

For recreational fisheries, the marking (typically an adipose fin clip) of hatchery production has allowed for the ability to differentially harvest hatchery and wild fish. The marking of hatchery steelhead has been common since the early 1980s. In many of the recreational fisheries it has been feasible for anglers to release unmarked fish successfully. For winter steelhead the hooking mortality of released fish is typically in the three to 10 percent range. In some fisheries, differences in run timing between hatchery and wild stocks have been used successfully to differentially harvest each stock.

In Washington, the Snohomish

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River system winter steelhead case illustrates how managers have been able to access abundant hatchery stocks while keeping impacts on wild steelhead low. Since 1983, all hatchery production has been fin-clipped (adipose fin removed during rearing). In this case, the winter hatchery stock is an early timed stock with peak returns occurring in late December and early January, while peak returns of the wild fish occur in late February to mid-April. By taking advantage of these two factors (run-timing and the marking of all hatchery fish) a substantial difference in harvest rates has successfully been achieved. In the case when few or no harvestable wild fish are available, the fishery managers have limited the recreational fishery with wild steelhead release regulations (only those fish with missing adipose fin may be retained) and concentrated the tribal commercial net season to the early portion of the run. In such cases, the recreational fishery is sometimes limited to the period when hatchery fish are expected to be abundant (usually through February) and the tribal fishery is concentrated in December and early January. With such seasons, it has been possible to achieve as much as 90 percent exploitation on the hatchery run while holding the total impacts on the wild stocks to less than 10 percent — a combined take that includes commercial fishery and recreational fishing hooking mortality.

MASKING THE TRUE STATUS OF WILD POPULATIONS

The true status of wild steelhead populations has been a little discussed aspect of hatchery/wild impacts. If the manager can't differentiate between hatchery and wild spawners, overestimating the status of wild spawning is likely. This is an especially difficult problem with steelhead. With salmon it is often possible to use carcass recoveries to aid in separating the two. With steelhead, the number of carcasses seen is rarely enough to be of use. Instead the manager needs to rely on other types of information, with differences in spawning time or area being the most useful.

For the North Puget Sound region, this has become less of an issue than in the past. By using the temporal differences in spawning it has been possible to separate the hatchery and wild spawning. The spring/early summer hydrographs of the river systems of the region are dominated by snow run-off. This habitat feature seems to select for a later timed wild steelhead spawning. Mid-March to early June spawning is typically found in the Snohomish basin and late March into July for the Skagit basin. Over the last two decades managers have continued the selection of early spawning hatchery stocks until today the early time Puget Sound hatchery stock spawn from mid-December through February. This has resulted in a nearly complete temporal separation of spawning of the two stocks. This separation is greater for the females than the males. It is not uncommon for the males to linger in the stream for several weeks seeking additional spawning opportunities. Those lingering males would not affect the status determination, since the spawning estimate is normally based on the number of redds constructed, although the males may be of concern because of the potential for genetic exchange.

The true status of wild steelhead populations has been a little-discussed aspect of hatchery/wild impacts.

The use of "native brood stocks" for hatchery enhancement programs may lead to confusion in the status of the naturally spawning fish, as well as confounding harvest management issues. Fish from such programs retain many of the characteristics of the donor stock, including run and spawning timing, while acquiring many of the undesirable traits of cultured fish. There is a growing body of evidence that regardless of the parentage of the hatchery stock, they are not the same as wild fish in terms of producing the next generation of adults. The longer a given stock has been domesticated, the lower their productivity is when spawning in the wild.

PREDATION

There is a concern that hatchery steelhead smolts may be feeding on smaller wild salmonids. As anyone who has spent time around our streams knows, big fish eat small fish. Since steelhead smolts are among the largest juvenile salmonids in our anadromous water, the concern is evident. Some of the first indications of hatchery fish being maladapted to the wild environment were with catchable trout planted in streams. Stream catchable plants were discontinued in this area during the 1970s. Numerous studies established that catchables weren't very successful in holding territories or successfully feeding. While they are in the hatchery, the fish are fed food pellets. Consequently, once they are liberated in the river they aren't very good at recognizing food. When the stomachs of newly released smolts are sampled small twigs and fir needles are as common, or more so, than "real" food items.

Hatchery fish aren't very effective predators during their first few days in the stream — at least until such time as they learn to identify and catch real food items. As the residency time in the stream increases, the fish do become more successful. Thus predation is a larger issue for those smolts that delay or don't migrate than those that leave the system quickly. Steelhead planted as true smolts migrate quickly downstream, often moving dozens of miles a day. The available information indicates that true steelhead smolts spend little time in freshwater or estuarine areas but rather move quickly downstream and on out to the open ocean.

If hatchery steelhead smolts are to be planted, then quality control of the smolts is key to minimizing the potential predation. Numerous studies have documented the characteristics needed to insure optimum out-migration of smolts. This includes timing of release, size at release and body condition at release. When in doubt, mimicking the timing, size and condition of wild steelhead would be prudent. The current

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Washington Department of Fish and Wildlife (WDFW) guidelines call for planting smolts at a size larger than eight to the pound in early to mid-May with a condition factor of slightly less than 1.0. (Editor's Note: Condition factor is a way of measuring the deviation of an individual's weight from the average of an individual of that length for that population. In other words it is a way of quantifying the "fatness" of an individual. A value of less than one would be thinner than average). When these guidelines are successfully met, out-migration of the majority of the smolts can be expected.

COMPETITION

Competition can occur at both inter and intra species level, and it is usually for food and/or rearing space. As with the predation issue, the concern is that the larger hatchery smolts and/or residual fish (smolts that fail to migrate) may be able to out-compete the naturally produced fish. This can be an acute problem with hatchery fish that become residuals. As addressed in the predation section, the smolt planting guideline helps assure that most of the fish planted migrate quickly from the systems.

In the North Puget Sound region, taking advantage of the natural hydrograph may be helpful in reducing the length of time that planted smolts may remain in the systems as well as the number of residuals. Typically, the hydrographs on these systems are dominated by high spring run-offs from snowmelt. Flows often begin increasing in the spring of the year with larger increases in May. For example, the average daily flow on the Skykomish River is 4,440 cubic feet per second (cfs) in April. The average in May is 6,730 cfs (average for the period 1929 to 2000). This increase in flow often occurs in bursts, which flushes out the recently planted steelhead smolts.

A form of competition for space sometimes noted is the "Pied Piper effect." Here, the concern is that large numbers of newly released smolts will encourage or force other fish to migrate early. In this region the smolts from the various salmon (chinook, coho, pink, and chum), sea-run cutthroat, steelhead, and native char populations migrate downstream throughout the spring with May being the approximate peak. Collectively, in the larger systems, literally millions — and sometimes tens of millions — of smolts are produced. Clearly the native fishes have evolved over the millennia with large migrations of smolts occurring in the spring. In the North Puget Sound region, the high spring flows from snow run-off also reduce competition between smolts. In the areas where this type of competition may be of concern, releasing smolts following WDFW's release guidelines, and releasing them during periods of high flows or confining the releases to stream mainstems, would likely reduce impacts.

An angler fishes for summer run steelhead on Oregon's famed Deschutes River, where wild fish, hatchery fish and out-of-basin strays comingle. Photo by Jim Yuskavitch

GENETIC IMPACTS

Much of the concern regarding hatchery/wild interactions has focused on genetics. These can be changes in genetic makeup of the population, differences in behavior of individual fish or changes in diversity of individuals or the population. All of these have, or are thought to have, a genetic component to them. In the Puget Sound region, the hatchery winter steelhead have typically been derived from the "Chambers Creek" stock. The Chambers Creek stock is an early timed composite stock that was reared from much of the latter half of the 20th Century at the state's Chambers Creek hatchery, located near Tacoma, Washington. Today, the progeny are reared at a number of hatcheries throughout the Puget Sound region and elsewhere.

In comparison to the native winter stocks, the Chambers Creek fish have substantially different population characteristics. The hatchery fish return earlier, with a run timing from late November into February and peak returns in late December and early January. Depending on the river of origin, Puget Sound wild winter stocks return from late November into May, with peaks from early March into April. There are substantial differences in spawn timing as well. The hatchery stock spawns from late December until late February and the wild stocks spawn from early March into July with peak activity from late April to mid-May. There are important differences as well in the age structure of the two populations. The hatchery fish tend to be younger, with the fish smoltifying after just one year of freshwater rearing due to the earlier spawning timing and accelerated growth in the hatchery. Typically, about 85 percent of the adults return after two summers of ocean rearing, with most of the rest returning after three summers of rearing. The naturally produced fish typically smolt as two year olds (about 90 percent depending on the population) with most of the rest after one or three years of freshwater rearing. The wild adults typically return after two or three summers of ocean rearing — often more or less equal numbers of each — with some individuals spending even longer periods at sea. Many of these differences, as well as behavioral differences, particularly with the juveniles, are due to selection that occurs during the culture of the hatchery fish.

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The concern, of course, is the potential spawning between the hatchery and wild fish and the resulting passing of hatchery genetic material into the wild population. This can occur in two primary ways. The first is the direct crossing of hatchery and wild fish. The second is subtler. Fish produced from hatchery spawners might survive to interact with wild fish of future generations. In the Puget Sound region, the development of very early spawning of the Chambers Creek stock has limited the spawn timing overlap between the hatchery and the wild winter stocks to nearly zero. Currently the overlap is limited to the lingering hatchery males spawning with the earliest spawning wild females. While there may still be some hatchery produced males on the spawning grounds, their success in spawning with wild females over the larger and better-conditioned wild males would likely limit their spawning to the occasional "sneak" spawning, or to those occasions when no wild males are available. It has been estimated that the spawning overlap between the hatchery and wild steelhead in North Puget Sound region is less than one percent. This is much lower than the overlap from 20 years ago, when it may have been as much as 15 percent. The Washington Department of Fish and Wildlife's Wild Salmonid Policy genetic performance standard calls for a spawner overlap for dissimilar stocks (such as Chambers Creek and Puget Sound wild stocks) to be no more than one percent.

It is common for hatchery steelhead to return to the area where they were released or where they were reared. Thus, their distribution tends to be patchy, with concentration at those release sites. This is contrasted with the distribution of the wild steelhead, which is more reflective of the spawning and rearing potential of the habitat. It is possible to target hatchery fish by concentrating angling at those areas where the hatchery fish "keg up" in hatchery holes. When spawning begins, it will be mostly hatchery fish spawning with hatchery fish in the areas at and near the hatchery holes. However, when calculating the overlap between hatchery and wild spawning I always assume that the hatchery fish are distributed like the wild fish. This assures that the manager is erring on the side of the wild resource.

The second method of interaction is much more difficult to address. If hatchery produced fish are returning to a system, the best method to reduce potential interaction would be to harvest or remove as many of the hatchery produced fish as possible from the system. This can be achieved with high fishing exploitation rates as well as trapping adults at hatchery racks and other locations. For those fish that survive, the best safeguard is to have robust wild populations. The closer the wild population is to filling the carrying capacity of the system, the more selective pressure they would exert against the offspring of the naturally spawning hatchery fish which are less "fit." With the recent poor returns of wild fish in the Puget Sound region, the potential for the survival of offspring from naturally-spawning hatchery fish has likely increased. If these conditions persist, it may be prudent to consider reducing or even eliminating the hatchery programs. In the past, hatchery programs have been terminated, at least in part, for this reason. The steelhead hatchery program on the Cedar River (a tributary of Lake Washington near Seattle), is a recent example.

When returns of wild fish are poor, it may be prudent to reduce or eliminate hatchery programs.

Over the course of my 30-plus year career, there have been substantial changes in our understanding of the pitfalls of hatchery/wild issues. It has become more widely recognized that a greater number of wild spawners are needed, and it is generally acknowledged that hatchery fish are not adequate replacements for naturally-produced fish. Much of the early enhancement efforts in Washington and elsewhere were based on the belief that hatchery fish were equal to wild fish and, therefore, adequate replacements for wild fish. Research over the last three decades has clearly shown that this is not the case. As various negative impacts have been identified, it becomes the responsibility of managers to respond to these issues to improve the situation for the wild resource. For a variety of reasons, managers often respond more slowly than some anglers and other wild fish advocates would wish. In complex issues such as this, it is often best to look at progress over time to evaluate where we were, where we are and where we are going.

In summary, the overriding concern with naturally spawning hatchery fish in wild populations is the potential reduction in the productivity of the wild population. The mechanisms under which the reduced productivity is occurring are increasingly becoming better understood. As a result, managers have been able to take a number of steps to reduce the interactions between the two groups of fish. Whether those steps are adequate depends on one's viewpoint and how risk averse one feels management should be. Those concerned about wild steelhead need to consider such questions as: Are the harvest and recreational benefits of the hatchery fish worth the risk to the wild populations? With increased information and understanding of the issues surrounding hatchery/wild interactions, we should be in a better position to make informed decisions on the adequacies of current management efforts.

THE BIG PICTURE

In the larger arena, my concern remains that we have become so focused on these kinds of issues that we have lost sight of the larger picture. The continued degradation of our rivers and the habitats that support our beloved wild steelhead may soon render moot our debates about hatchery/wild interaction and/or wild fish harvest. Clearly both issues are important, but secondary to having viable rivers.

Cooperative Compliance in the Walla Walla River Basin — An Interview With Mike Bireley

"Cooperative Compliance" is a relatively new approach that some natural resource regulatory agencies are taking. Cooperative compliance works on the premise that you are more likely to get the public to help you protect natural resources if you work with them to solve problems, rather than simply enforcing laws and regulations in a more autocratic way.

Until his retirement from the Washington Department of Fish and Wildlife in April 2002, Mike Bireley managed a successful program in the Walla Walla Basin that assists surface water diverters in obtaining fish screens that keep fish from being sucked into diversion pipes. Originally from Tennessee, Mike worked for the Department for 28 years, and has spent the past 18 years in the Blue Mountains area of Southeast Washington.

This interview, conducted in May, 2002, explores Mike's thoughts about natural resource protection, leadership, and the future of Washington's "water wars." It first appeared in the summer 2002 issue of Washington Waterwatch, *the newsletter of The Center for Environmental Law & Policy. This is a slightly abridged version.*

How did you come up with the idea for a Cooperative Compliance program?

It was an idea born of necessity, really. In November of 1999, I approached WDFW (Washington Department of Fish and Wildlife) Enforcement Chief Bruce Bjork with the idea that we in the Enforcement Program needed to do a better job of fulfilling our habitat protection responsibilities and asked to be assigned to that project on a temporary basis. Chief Bjork agreed and offered his support. Two and a half months later, I participated in the first field tour conducted in the Walla Walla Basin in response to Endangered Species Act listings there for steelhead and bull trout. During that tour I remember thinking that, since the topic was the Endangered Species Act, it probably didn't have much to do with WDFW and that it was primarily a federal NMFS (National Marine Fisheries Service) issue. Boy, was I wrong.

Personnel from NMFS and the U.S. Fish and Wildlife Service (USFWS) conducted the tour. At the end of the day there were probably about 25 people — irrigators, agency personnel, private citizens, and environmentalists — standing around as the day's events were being summarized, and I asked what the top priorities for recovery were in the Walla Walla Basin. One of the NMFS tour guides stated the number one issue for recovery was flow and the number two issue was screens.

Knowing that the Washington Department of Ecology (DOE) has primary responsibility for flow, I realized the second priority, fish screens, belonged to WDFW. It was then that I began to realize that this was going to be as much an issue for me and my agency as it was for NMFS.

When I had originally talked to Chief Bjork, violations of the State hydraulics code were the main thing I was concerned with. Now that I knew screening was considered a major problem in the Walla Walla Basin, it occurred to me that we knew very little about this type of enforcement activity and the current status of compliance levels with these laws. It also dawned on me that it would be my responsibility to find out and do something about it.

WDFW officers hadn't enforced screen laws?

Not very well, apparently. Our level of enforcement activity in this area was very limited, based on my experience.

Were you aware of harm to fish and wildlife as a result of this lack of compliance?

Yes and no. Significant harm to the resource had to be occurring if it warranted being one of the two top priori-

Efforts to save dwindling runs of steelhead and salmon often result in resistance from locals who may perceive them as government "tyranny" and infringements on their property rights. Photo by Jim Yuskavitch

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ties identified by NMFS for recovery, but personally I had very little experience in this field.

Were diversion pipes pulling salmon and steelhead fry up into the pipes?

That's typically what can and often does happen when diversions are improperly screened. Fish that are in close proximity to the entry points, or intakes, can be sucked into pumps or ditches and when they go in, they can't come out. At the time, nobody knew how many diversions there were on the Washington side of the basin. After putting our heads together with DOE's local Watermaster, Bill Neve, we guessed there were between 600 and 800 total surface water diversions that we might have to deal with.

Was the Department of Ecology helpful at all in finding out who had diversions?

Yes, they were, but it was extremely difficult — the water right records in this state are atrocious and you can't just point a finger at DOE and say it's all their fault. In my mind, it has more to do with a failure of political will because I'm a firm believer that where's there's a will, there's a way. My involvement with state water laws amounted to very little direct experience and it became immediately apparent that water laws in this state were politically hot issues.

I can honestly say that learning the "in's and out's" of water law has been the most eye opening experience of my career, without a doubt. Water law, in my opinion, is probably the single most complex and contentious resource protection issue in Washington State, and unfortunately, I don't see that changing anytime in the near future.

What did you do first?

I'd had very little involvement with fish screens, so I knew I had to educate myself fast. We had to find out to what extent screens were problems, and why, and how we were going to get it corrected. With fear and frustration already running high in the Methow because of salmon recovery and ESA, it was pretty clear that a similar approach wouldn't work well in the Walla Walla. I knew if we went that route it would lead to the political arena, which is not the best arena in which to resolve conflict. In all probability, we'd end up with an answer nobody liked. This was in February and March 2000.

I made a trip to the Methow, where WDFW had been engaged in similar issues. I asked our staff in the Ephrata Regional Office what they'd learned through their experiences in the Methow and if they had advice they could share. Fortunately, they were able to put me on the right track. They had developed a four-step compliance plan that relied initially and primarily on voluntary compliance — getting people to comply with these laws because they wanted to and because they recognized that it was important. I thought that was an excellent approach and could work well in the Walla Walla.

The public thought that agencies and environmental groups were out to destroy communities to protect the resource.

Had it been working for them in the Methow?

It was a much harder sell there, partly because the lines had already been drawn and the battle had already begun, which made it that much harder to get people to talk and work together. Many people I talked to said the Methow was too far gone already.

Senator [Valoria] Loveland and Rep. [Dave] Mastin had urged me to go and talk to folks in the Methow and find out what was going on for myself. I did, and was able to spend time in the field with our officers there.

It showed me that the iron fist approach was not the way to get where we needed to be, at least not in this type of situation. It was a real eye-opener. I also had a chance to talk with some very interesting people who were deeply involved in the issues there, including Okanogan County Commissioner Dave Schultz. After hearing so many differing viewpoints and horror stories, I came away with the distinct impression there had to be a better way. The different sides obviously weren't looking at it from each other's point of view. Public sentiment was that the process was way out of balance — that the needs of fish were being placed above the needs of people. The public thought that agencies, and environmental groups, were willing to destroy communities to protect the resource, and they didn't think that was reasonable.

Just as we were beginning to figure out the best approach to use in the Walla Walla, the Klamath Basin debacle started appearing in the press. I was concerned that this real-life example of using pure authority, through the courts, to solve complex resource protection problems involving endangered species, could derail what we were hoping to do in the Walla Walla.

Here's a real life example of environmental groups and the government coming in and appearing to say, "protecting this resource is more important than anything — if it destroys you, your lives or your community, that's just the way it is. That's the law." Obviously, it wasn't as simple as that, but that's certainly the way it appeared to the people who live in the Klamath Basin and based on the media's reports, that's the way it appeared to a lot of people all over the country. People were angry about how the law was being applied there and that anger carried over into a lot of other places, including the Walla Walla. Unfortunately, the net result for us was that very few people were in a mood to trust the government, especially a resource agency, to apply the ESA in a way that would help them rather than just hurt them. It was a huge hurdle to have to overcome.

What role do you think leadership plays in all of this?

I have some good friends in the agricultural community, and I've read a lot of the material about salmon recovery and how the public perceives the process as being out of balance, and I thought a lot of what they said wasn't

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wrong. They've said "Hey, this process is all about meeting the needs of fish and nothing about meeting the needs of people, and that's not right," and I agreed with them. First and foremost, my job IS about people. We protect these resources for people — because they belong to them. The Cooperative Compliance Program in the Walla Walla Basin was and is an effort to prove that you can do both — you can meet the needs of the resource and the needs of people — it is "doable."

According to Peter Block, who wrote a book called "Stewardship," the two greatest cornerstones of stewardship are partnerships and empowerment. He advocates that you have to have both of these in order to do a good job of being a steward in this day and age. What I've seen time and again in the agricultural community is that people see partnerships, particularly with the government, as involving concessions. Mr. Block points out that a partnership is not about concession — it's not at all about giving in to the other person's viewpoint. It just means you're agreeing to work together to find answers, to find a solution.

Imagine your grandkid asking you — "Gee, grandpa, you used to fish here? How come you can't fish here anymore?"

Exactly. You can imagine a point two or three generations from now with people asking what happened to the salmon — what would we tell them? I hope we don't have to tell them that because the public perceived the resource protection laws were so inflexible and the government's approach at enforcing them was so unreasonable that people got mad and overturned those laws. My impression is that the public doesn't necessarily disagree with "what" needs to be done to protect the resource. Their biggest concern is more often than not with "how" we're (government) going to go about doing it.

I knew we were in trouble when I started hearing the word tyranny over and over again as people talked about salmon recovery and the ESA. I heard it at workshops and read it in materials. If that's the public's perception of how government does business, we have a problem. Sometimes it's just the result of a complex set of circumstances made possible by how these laws are written and interpreted, but still, if people perceive resource protection to be "tyrannical," we need to stop and ask ourselves why.

Many irrigation diversions within the Columbia River basin do not have fish screens in place, or have older screens that function poorly. Photo by Jim Yuskavitch

Sometimes people use the word tyranny when they don't like what you're doing, not just the way you're doing it.

You're absolutely right. In a lot of cases it goes back to the "Me" paradigm. People don't like to be told that they can't buy 1,000 acres or 10 acres and do absolutely anything they want with it or to it, no matter what the consequences are for the environment. Unfortunately, if everyone did that it would probably destroy our ecosystem. The public has said natural resources are important and belong to everyone, but a lot of people begin to raise the tyranny issue as a smokescreen — they say resource managers are being heavy-handed and abusive. In some cases that may be true, but in others it's people who are mad because resource laws are interpreted in ways that threaten the balance between resource protection, or public stewardship, and private rights, such as property rights. This is a huge issue and probably the number one cause of conflict in resource protection right now.

So how did you take your philosophies and implement them in the Walla Walla?

I decided we should focus on "finding a fix" rather than "finding fault." My interest as a resource person was to protect the resource, and the property owner's interest was to protect their rights. The challenge, as I mentioned earlier, was trying to find a way to do both.

In the Walla Walla, we developed a program that told people that if they would come forward and agree to work with us, voluntarily and cooperatively, we would provide them with technical assistance and, to the greatest extent possible, financial assistance, to bring their surface water diversions into compliance with state and federal law. We would assist them with obtaining the necessary permits and with clarifying their existing water rights for their diversions. We also told them we wouldn't take them to court, as long as they committed to comply with the law and followed through. That was a controversial step in itself, but it made all the difference in the world to a lot of people who were hesitant about trusting the government to help them, rather than hurt them. And last but not least, we told them that in addition to making their diversions comply with state and federal law, we would also do everything we could to handicap as little as possible their ability to operate as they had in the past.

To our surprise and great pleasure, within the course of a year we had over 350 landowners sign up for the program, which we called the Cooperative Compliance Review and Cost Share Program, or CCRP. They identified over 500 existing surface water diversions throughout the basin that needed to be in compliance. The response couldn't have been better.

We still had to figure out who would look at all those diversions to see what they needed to comply with the law and determine how much it would cost. It

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occurred to me that the Walla Walla Community College had an Irrigation Technology Program. I thought: if we offered to pay the College and the students, using salmon recovery funding grants, would they be willing to go out and assess these diversions and determine how much it would cost to fix them? The students would get paid for their work, and get direct field experience to help them in their studies at the same time. It seemed like a win-win situation. I went to Walla Walla Community College to talk to the head instructor of the irrigation technology program and he thought it sounded like a great idea also. He got the Community College's president interested and this turned out to be one of several key partnerships we were able to develop within the community that ultimately made the program so successful.

Working with the local Walla Walla County Conservation District, we submitted and received grant applications worth over $700,000, which ultimately enabled us to develop a contract with the Community College. The students there have been doing site assessments, as well as helping to design the new screens, for about a year now. They're getting great experience, and it's turned out to be a great partnership.

One particularly revealing and incredible thing occurred during this process that I'm sometimes reluctant to tell people about because it's so illustrative of the good and the bad in this whole situation. State and federal screen criteria say that if a diversion is more than 450 gallons per minute, (one cubic foot per second), it must have a self-cleaning screen to prevent clogging. These types of screens are readily available commercially. On the other hand, if you have a diversion that is less than one cfs (cubic foot per second), you only need a "passive" screen, or one that is not self-cleaning. In the Walla Walla, we discovered that the vast majority of the diversions in this area are small ones that don't require a self-cleaning screen, although one could still be installed and it would work. It's just that these types of screens are usually pretty big and fairly expensive.

We had told people from the beginning that if we could obtain funding, we would use private vendors to make these screens available so that we could put that money back into the community. As the College conducted research to see whether passive screens were commercially available, they discovered that nowhere in the country could they find a passive screen that complied with Washington's screen law. Remarkably, though, by working through a partnership they developed with a screen manufacturer that attended a training seminar we sponsored, the college has been able to obtain a new passive screen that not only complies with state law, but could eventually enable hundreds, if not thousands, of diversions to eliminate harm to fish in Washington's streams and rivers for the first time ever.

What are the new fish screens like?

One of the biggest concerns landowners had was that we were going to come in and put some big contraption on their diversion pipes that would mess things up, wouldn't work nearly as well as what they had, and they would hate it. Frankly, I wasn't so sure they weren't right. When we first started the pilot program installations [fall 2001] of the new passive screens to test how they worked, I made it a point to go out and talk to the landowners involved. To our great pleasure, they consistently said their new screen was better than what they'd had before and that it worked great — "the best thing since sliced bread," according to one landowner. They enthusiastically said they don't have to clean and prime it nearly as often, which results in a lot less work for them. We couldn't possibly have asked for a better outcome. To me, this was one of the best outcomes possible because it proved what could be accomplished through a collaborative process with creative partnerships for resource protection. I'm convinced that what we've seen in the Walla Walla involves empowerment, not concessions.

What do you think it would take to change, to have more enforcement personnel who enforce environmental laws in Washington?

I'm afraid that, based on my observations at least, the only way we'll ever have enough enforcement personnel to adequately enforce environmental laws in Washington is after we have suffered severe, long term losses or extinction of critical species. I'd like to think otherwise, but we're faced with hard financial realities that constantly require us to do more with less. That's just the way it is. Of course, there's always hope that new approaches can be found and implemented to change that, but it's not likely.

What's different about the Walla Walla that made a cooperative approach work?

I'm of the opinion that what makes the Walla Walla different is its approach, process and people. The approach there has been proactive and collaborative in the sense of identifying problems and trying to figure out how we can work together to solve them. There's also been a great deal of effort in distinguishing people's interests and needs from positions and demands. People in the Walla Walla Basin have been willing to give these efforts a chance to succeed, without resorting to groups drawing "lines in the sand." Government agencies have chosen to work together as partners rather than adversaries and when it was prudent, they've even been willing to "think outside the box," if necessary.

The same thing can be said with regards to environmental groups, like CELP (Center for Environmental Law & Policy). CELP has played a major role in supporting the Cooperative Compliance Program in the Walla Walla and in support of taking a collaborative approach to salmon recovery and water resources. These types of things did not happen in the Methow and the Klamath.

That aside, what I think the Walla Walla has illustrated most clearly is that if you take an initial approach that is positive, proactive, collaborative, and cooperative and you follow through to the degree that you're willing to put forth extra effort to do what's right, on everyone's part, instead of just doing what's easy, you can in fact make a difference.

You will run into obstacles, you will run into problems, but you make a commitment to work together to overcome them. That's the key to Cooperative Compliance.

GOVERNOR, DON'T LET IT HAPPEN ON YOUR WATCH

by Stan Young
— Steelhead Committee —

Stan Young, longest serving member of the Steelhead Committee, writes from the heart about his love of steelhead, steelhead angling and his fears for the future of this great and wonderful denizen of our Pacific Northwest rivers.

The river is a tributary to a larger river that flows westward, ending in Puget Sound. I am standing knee deep at the upper end of a pool that is about 60 feet across and 200 feet in length. The pool is paved with a mix of different sized boulders that had been rounded and smoothed as they tumbled down from upriver during past floods. The water is at most five feet deep along the opposite high bank side. A short distance above me, the river cascades down from the next pool upstream. Earlier I had crept along the far bank, searching for steelhead and had spotted eight. They are strung out beginning where the water deepens at the upper end to where it grows shallow near the tailout.

Stately trees, a mix of red cedar, Douglas fir and bigleaf maple, line the river along both banks, towering over a dense understory dominated by vine maple and salmonberry. It being October and there having been no appreciable rain for over a month, the river is low and crystal clear. During floods the river runs as much as ten feet higher, as shown by lines of flotsam that lie tangled in the brush along the banks.

Downstream from me the pool bends gradually right. A strip of bare sun-bleached boulders, exposed when the river drops to its present level, lies behind me and extends the length of the pool. This strip affords casting room, and unless I am careless, my fly won't become entangled in the trees or brush along the edge.

I begin casting my fly 15 yards above where I had spotted the upper most steelhead. This affords a cushion in case it or one of the other fish has changed position and moved further up in the pool. It also permits me to make a few preliminary casts and gauge the proper amount of line needed to reach the far bank. With the water so low and clear, the conditions couldn't be more exacting. A long line must be cast very straight and the fly alight feather light or risk alarming the fish.

Twenty minutes and 15 casts later I have worked down river 50 feet and am casting beyond where half the fish seen earlier were holding, without as much as a nibble. That none have as yet come to the fly indicates either they have been spooked by my actions or are disinterested in the fly I am using. From where I am standing the light is wrong for me to be able to see into the water, so it isn't possible to tell whether the fish are still there.

Unless heroic measures are taken, Washington faces the imminent extinction of virtually all of its wild steelhead and salmon.

My fly is a creation I call The Dancer. Tied with deer and moose hair, it resembles a caddis and is designed to wake erratically across the surface in a way that summer steelhead often find tempting. Normally, the fly is cast across to the far side and quartering down and then let swing until it straightens out below. Fish may grab the fly as soon as it alights, but usually follow it some distance before arching up and taking it. There is nothing quite as exciting as the surface take of a steelhead that may weigh as much as 20 pounds, although most are in the six- to nine-pound range.

Two casts later, the fly is half way through its swing when there is a swirl, the line tightens, I lift up, and am fast to a fish.

The steelhead, sensing that something is amiss, immediately bolts down stream in a run that carries it to the pool's far end. Doubling back and almost opposite me it bursts from the water in a soaring leap. It next streaks upstream fifty feet, leaps again, doubles back, and races again to the far end. There, it pauses, allowing me at last to get slack line back on the reel in readiness for whatever comes next.

But the fish is played out and after a few more short runs and some thrashing about I am able to slide it into the shallows and release it. The fish measures 30 inches and weighs eight or nine pounds. It is a buck. An intact adipose fin reveals that it was stream-bred.

What I just described once was a commonplace occurrence along dozens of Washington rivers. A competent and persistent angler could duplicate the experience many times during the late summer and autumn months. Sadly, that is no longer the case. Now, the same angler is lucky if it happens more than a few times.

Washington State lies mid-range of where steelhead once occurred. Their range extended south all the way to Mexico, and north to the vicinity of Anchorage, Alaska. But Washington was where the species thrived best. Early in the century almost every Washington river or stream that had a decent year round flow and reached the ocean had healthy runs of steelhead. They were never nearly as numerous as salmon but respectable numbers returned each year to where they had been procreated several years earlier.

The steelhead is the Pacific Ocean's counterpart of the fabled Atlantic salmon. Steelhead are similar in almost all respects to Atlantic salmon, in their sleek lines and coloring, their length and size, their life history, in the way they take a lure, including small artifi-

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cial flies, and in their fighting prowess. Anglers who have experienced both rate them about even.

Fly fishing for Atlantic salmon is a tradition in England and Scotland and other European countries that extends back hundreds of years. Atlantic Salmon also occur in Eastern Canada, Iceland, and once were quite common in the rivers of New England.

As with avid Atlantic salmon fishermen, there is almost nothing that those who have taken up the hunt for steelhead let stand in their way when the fish are running. Families are forsaken and jobs deserted. Thousands of dollars are invested in equipment and travel.

The use of flies in angling for steelhead had its beginning only about sixty-five years ago and didn't really catch on until relatively recently. For many years the belief was that steelhead wouldn't take a fly and so everyone cast spoons, bait, or some other weighted lure fished near the bottom. But, beginning about 1930, it was discovered that steelhead would, indeed, come to a fly. And, in late summer and autumn, they would readily rise to flies fished on or near the surface.

Zane Grey was one of the first to discover and write about the effectiveness of flies in taking summer steelhead, based on his experiences in the 1930s along Oregon's Rogue and North Umpqua rivers. In Washington, some years later, Sid Glasso, Walt Johnson, Enos Bradner and a few more had begun experimenting with the use of flies, as had Roderick Haig-Brown and others along the rivers of Vancouver Island in British Columbia.

Today, thousands engage in the sport, so much so that along some rivers, especially during the months of July through November, fly fishers, men and women, outnumber all others. That time of year it has become one of the Northwest's most distinctive and popular outdoor activities.

But there is a huge problem. Just as steelhead fly fishing is coming into its own in the Northwest, the resource upon which it depends is giving out. It's not something that is happening all of a sudden, but something that has been coming on for many years.

The decline in steelhead numbers really began following the end of World War II with the onset of massive dam building programs. Prior to the time a series of huge hydroelectric and irrigation dams was built, the Columbia River and its many tributaries hosted the world's most prolific runs of salmon and steelhead. About then, dams were also constructed across other major Northwest rivers. Some dams were equipped with fish ladders but many such ladders proved ineffective. At other dams nothing was done to get the salmon and steelhead around, and thousands of miles of prime spawning waters were blocked to migrating fish. Dozens of hatcheries were built in an effort to mitigate the effects of the dams, and the claim was made by the dam builders that with hatcheries even greater numbers of fish were possible. The fallacy of hatcheries is shown by the results they achieved. Whereas many millions of salmon and steelhead once swarmed up the Columbia, the count is now in the low thousands.

About the same time the dams were being constructed, lumbermen commenced really large scale logging of the Northwest's extensive old-growth forests. Clear cutting was found to be the most efficient way to get the trees down and to market, and little thought was given to the effects on watersheds and the streams and rivers that sprang from them. Thousands of square miles were logged off and thousands of miles of streams clogged with debris. Formerly these old-growth forests were able to absorb the heavy annual precipitation and rivers seldom overflowed their banks. Once the trees were gone, little remained to stem the runoff and destructive flooding resulted. The floods changed the whole character of the rivers so that they were much less hospitable to fish. Spawning beds were washed away and juvenile and adult fish alike decimated.

Commercial fishing, was becoming more efficient and ever more people were turning to it as a way of making a living. Huge fleets pursued the salmon from when they began returning to the rivers, and gill nets were used in the rivers themselves, some even being strung entirely across rivers. Steelhead weren't targeted by the commercial fishermen, but because they returned to the rivers at the same time as the salmon it was unavoidable that huge numbers were trapped in the nets too.

In 1972, federal judge George Boldt ruled that along many Washington rivers Indians had treaty rights to half the available returning salmon and steelhead. This decision was greeted with outrage by most sport and commercial fishermen. Some of this anger lingers to this day. However, the tribes have proven to be some of the strongest and most vocal supporters of habitat protection and recovery and dam removal and fish passage. And the Boldt decision did force the tribes and the state fish and wildlife agencies to work together on harvest and, to a lesser extent, hatchery issues. But some of the tribes, probably driven largely by the valid concern that habitat restoration and hydro passage improvement might not happen, have opted for hatchery programs that produced a lot of fish but which destroyed genetic diversity and the ability of the fish to reproduce in the wild. That is really the only sure guarantee that the species will survive. Also, the states and tribes have sometimes agreed on harvest levels that have put undue pressure and mortality on depressed wild runs.

Another critical factor has been the ineptitude of the Washington Department of Fish and Wildlife in effectively managing and protecting the salmon and steelhead that are its responsibility. Part of the reason is that the department is chronically understaffed. But the main reason is deficient leadership. Too often the department's administrators have been selected on the basis of their political connections rather than their professional qualifications. This has resulted in decisions being made according to what is politically expedient rather than what is in the best long-term interest of the resource. And enforcement has been almost non-existent.

So, where do we stand today? Washington's salmon and steelhead runs are now in steep decline due to the aforementioned dams, logging, commercial netting, and inept hatchery and harvest management. Of the thousands of different races of salmon and steelhead that had evolved down through the eons of time for the purpose of utilizing all of the different niches and habitats that make up Washington's rivers and streams, most have already been lost, and almost none of those that remain are safe.

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The dams are in place and there is little or no possibility that many will be removed. Measures to improve passage around the dams of downstream migrating smolts and upstream running adults have been proposed, but they are being strongly resisted by potent vested interests dependent on electricity and irrigation. If measures are finally taken, in all likelihood they will be too late to save all but a handful of the few remaining runs of wild fish.

Logging continues apace. The major private and public interests responsible for logging are bowing to public pressure and at long last have begun moderating the extent and kinds of logging. But only after most watersheds and stream habitats have been irreparably damaged.

Commercial netting is being drastically reduced but only because there are so few fish left that it is uneconomical to continue. In spite of the plight of the resource, the commercial harvest continues at levels that only hastens the day when almost no fish remain.

The Boldt Decision has been upheld by the Supreme Court and there is little chance that it will ever be overturned or modified. With time, improved habitat and fewer problems with dams, perhaps the tribes will turn away from their reliance on hatcheries, but continue their defense of habitat and wild salmon and steelhead stocks. Until now, however, the tribes are relying heavily on hatcheries.

Many of Washington's salmon and steelhead runs have been declared "threatened" or "endangered" under the Endangered Species Act. Emergency steps are being taken in accordance with the Act to try and protect and restore the runs. But it is a slow and cumbersome bureaucratic process and these steps may not be in time. One thing that could be of immeasurable help would be for the state's Department of Fish and Wildlife, at long last, to be funded and staffed at levels that enable it to fully carry out it responsibilities. Critically important is that the department's director be a strong, enlightened and professionally competent leader. One previous director, Bern Shanks, was just such a leader, but lack of support from the governor, Fish and Wildlife Commission and budget difficulties he inherited, finally resulted in his being forced to resign. The present director, Jeff Koenings, is professionally competent and making headway but continues to be saddled with crippling deficiencies in funding and manpower.

Only if these deficiencies are fully and promptly addressed is there any assurance that Washington's runs of salmon and steelhead will get the attention they must have if there is to be any chance they will recover. But it's not happening.

The Washington Department of Fish and Wildlife must shoulder the lead and most of the workload in carrying out the measures that must be taken if the salmon and steelhead runs are to be saved. In the past, the Department has lagged behind and actually resisted efforts that have been sought by sportsmen and others alarmed at the rapid decline in salmon and steelhead numbers.

With a forward looking, resolute and strengthened Department, there is hope that fish numbers can be saved and perhaps restored to something near their former abundance. Without such a Department, the chance of success is bleak, indeed.

It is imperative that Governor Gary Locke team up with and strongly support Director Koenings in these efforts. Doing so would be one of the most significant actions he could take and would help define him as a governor committed to restoring salmon and steelhead. One thing is certain: If during Governor Locke's watch the wild stocks are lost, he is the one who will bear the burden of accountability.

The clock is ticking. The eleventh hour is at hand. Unless truly heroic measures are taken, and taken right now, Washington faces the imminent and certain extinction of virtually all of its wild salmon and steelhead stocks and the loss of one of Washington's and the Northwest's unique and important resources.

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We have always skated on thin financial ice, and will continue to do so. But without your support we fold up. The usual donation envelope is provided. Whatever you can afford will be much appreciated (and used wisely).

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