THE OSPREY

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The Wild Steelhead of Russia's Kamchatka Peninsula

ALSO IN THIS ISSUE:

SNAKE RIVER BASIN WILD STEELHEAD FACE EXTINCTION

LESSONS FROM THE ELWHA • RESTORING EEL RIVER STEELHEAD • BRITISH COLUMBIA FISH FOLLIES

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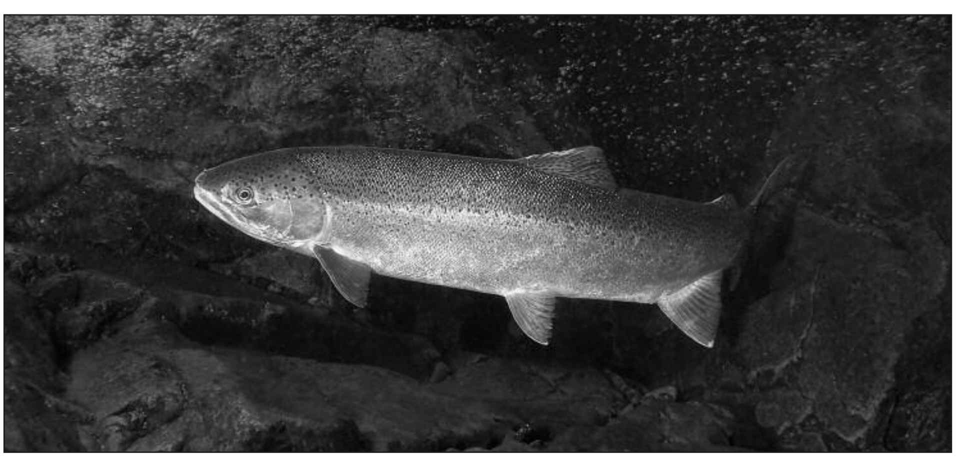

THE OSPREY

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A word from Chair Pete Soverel

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Warm regards,

Pete Soverel
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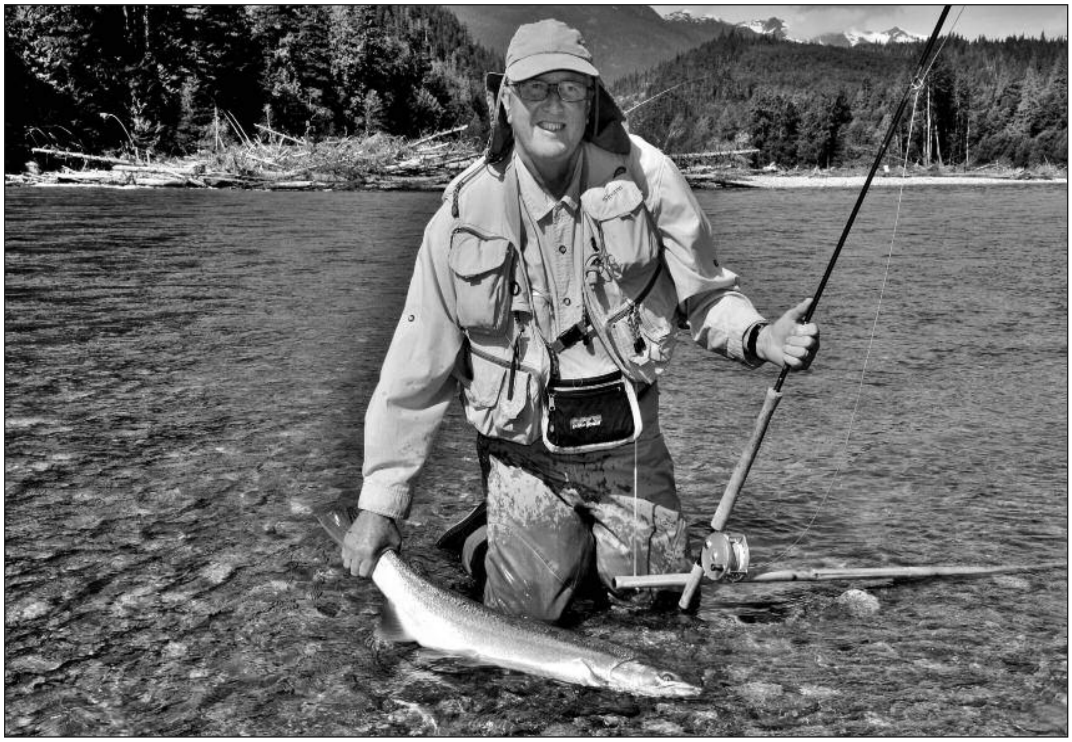

Your donations to *The Osprey* help us continue our work to influence wild steelhead and salmon management so that these magnificent fish will always be with us. Photo by Greg McDonald

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Jim Yuskavitch
Editor, The Osprey

BC Misses Big Time

By Pete Soverel

As is usual, the misses in this issue's column greatly outnumber hits, particularly involving some outrageous events in British Columbia.

HITS

Skagit River

Last year the National Oceanic and Aeronautic Administration approved a five-year Skagit tribal/recreational fishery plan opening the Skagit River February 1-April 30 for both recreational catch and release and tribal harvest fisheries for ESA listed wild winter steelhead. The plan sets target mortalities in relationship to projected total wild winter. The Washington Department of Fish and Wildlife has assigned a team to monitor carefully the fishery and produce weekly reports including number of anglers, wild steelhead landed, and other data. These weekly reports are public documents. Tribal co-managers are to report the results of their fisheries at the conclusion of the season.

MISSES

Canada Department of Fisheries & Oceans (DFO)

Canada presents itself as an open, civil society. The conduct of DFO makes a mockery of that projection. Here are a few examples:

2018 – 2019 Ecstall River, British Columbia Fiasco

Last summer a group of Americans associated with top leadership/owners of Bass ProShops, Ducks Unlimited and others were apprehended fishing for Chinook salmon on the Ecstall River, a lower Skeena River tributary, which was closed to angling as a Chinook conservation measure. The Americans were fishing under a very curious program in which Lax Kw'alaams First Nation in cooperation with Komoham Lodge owned by John Morris (Bass ProShop) using angling permits owned by Marcus Kossler — former owner of Komoham Lodge who had sought, and apparently received, DFO authorization to survey Ecstall Chinook under the fig leaf that these fish were part of Kw'alaams' traditional food resources — itself a ridiculous proposition since the Kw'alaam's traditional home area is almost a 100 miles distant from the Ecstall in an area where it is virtually certain that Kw'alaam's never exercised any traditional fishing. Someone in the local, Terrace, BC DFO office evidently approved this charade.

In the aftermath of the Ecstall River incident, many people had questions about this ridiculous affair, which has DFO refused answer.

When the American bigwigs arrived in their squadron of private jets, they were whisked off to the Ecstall by helicopter to be met by Komoham Lodge personnel and taken fishing in pre-positioned jetboats. These boats had been launched in the Skeena for the run up the Ecstall channel — a very challenging 50-60 mile trip up a shallow, tidally influenced inlet with dangerous mudflats, deadheads and poor water clarity. As soon as the jetboats had been launched, the rigs and trailers were quickly driven away removing visible evidence of the operation. The Ecstall staff did not include any trained biologists or data collection protocols to support the purported scientific purpose of the operation.

A few days later, locals began asking DFO what was going on over on the Ecstall with this boondoggle fishery by a bunch of rich Americans while everybody else was prohibited from fishing of any kind in the Skeena and tributaries. Public scrutiny and rapidly growing public outrage were exactly what DFO didn't want. To head off this public disaster, DFO suddenly reversed course and mounted a helicopter raid to the Ecstall rounding up the illegal fishers, Komoham guides and closing down the operation.

In the aftermath of this incident, many organizations and individuals have queried DFO for an explanation of this ridiculous affair: how did this happened; who approved it; who rescinded the approval; what happened to the illegal fishers and Komoham guides (fines, citations, etc.); what happened to Komoham Lodge; why was there not qualified/trained scientist present to conduct the purported scientific program; which DFO official signed off on the Kw'alaams band proposal, which was so far removed from their traditional fishery sites; and so on. These are all simple, easily answered questions, which DFO has refused to do. Over the intervening 8 or 9 months and repeated queries, DFO has said the incident is closed; the incident investigation is not closed; they are continuing their investigation; can't or won't answer who signed off on the authorization; what happened to the rich gringos; and so on. Tellingly, not a single question has yet to be answered. Perhaps best illustrative of the DFO's institutional opacity and on-going stonewalling, we know that staff in DFO minister Jonathan Wilkinson's office withheld direct communications to the minister on this sensitive issue. After learning of these communications as a result of direct contact with the minister, Wilkinson appear to have ordered the investigation re-opened although DFO still won't provide any information about the incident and we are still waiting for an official response to our simple queries. DFO's refusal to provide clear, even ANY, answers displays a shocking indifference to public accountability and trans-

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parency on a matter of great interest to the public with important implications for Chinook salmon conservation as well as DFO-First Nations shared management responsibilities.

As if this were not bad enough, some months ago, 38 hereditary Gitxsan First Nations chiefs proclaimed the entire Skeena closed to non-tribal commercial and recreational fisheries for all of 2019. Not surprisingly, this announcement resulted in a blizzard of queries to DFO, including *The Osprey*. Had the Gitxsan's coordinated this closure with DFO; what did the proclamation mean; where did the authority that the Gitxsan's asserted come from? As in the Ecstall case, so far, not a peep out of DFO. Think about it: DFO simply ignores public queries in response to an assertion of complete tribal authority over the entire Skeena watershed for which DFO is the responsible federal agency.

Thompson River Steelhead

Thompson River steelhead are known to be on the brink of extinction principally attributable to DFO approved commercial/tribal chum salmon roe fisheries. Thompson steelhead have declined from 4,000 to 5,000 to less than 150 fish over the past 10 to 15 years. Not only has DFO stonewalled all efforts to implement effective steelhead conservation measures within the Fraser River watershed or marine approaches, they have taken no action to remove blockage to steelhead migration into the Bonaparte River caused by debris clogging the river near its junction with the Thompson. The Bonaparte is an important spawning tributary for endangered Thompson steelhead. Although informed of the migration barrier months ago, neither DFO or provincial authorities have responded to the notices or done anything to allow steelhead to access spawning areas trapping the fish downstream of the blockage, nor has the ministry deigned to respond to public demands for action.

Atlantic Cod

It is worth recalling that DFO is the agency that oversaw the collapse of Atlantic salmon and Atlantic cod fisheries in eastern Canada. Cod had provided a vibrant, lucrative commercial fishery for 1,200 years only to be managed into

Southern resident orcas need an increased population of Chinook now if they are to survive. Photo by John McMillan

oblivion over a decade or so by DFO bureaucrats.

Starving Southern Resident Orcas

ESA threatened Southern Resident Orcas are slowly starving to death in the absence of abundant Chinook salmon — their favored prey. Washington governor Jay Inslee convened a task force to consider options to help prevent extinction. After much hand wringing, the governor's task force came up with a list of panacea steps: improved habitat, keeping whale watching boats further away from orcas, further "studies" about removing lower Snake River dams; tripling hatchery Chinook production; canceling hatchery policy guidelines are a few of most worthless recommendations, none of which addresses the pressing need for an IMMEDIATE increase in the prey base for orcas. Even if increased hatchery production worked (unlikely since hatchery productivity has been declining steadily; a condition not likely to be reversed with increased releases), the program would not produce any increase in Chinook numbers for 4 to 6 years. Similarly, Snake River dam removal can't possibly increase Chinook abundance in less than 15 to 20 years. One can only wonder what the orcas are to eat in the intervening decades? Conspicuously absent in the recommendations were any steps to curtail marine harvest: *THE ONLY* step which could increase Chinook marine abundance immediately. Nothing about modifications to the salmon treaty with Canada; nothing about constraining Alaskan interception fisheries. In other words, not a word about anything that might actually help orcas avoid extinction in the near term.

While it is true that in different forums (North of Cape Falcon; Pacific Salmon Treaty; Washington, Oregon and California fish & wildlife commissions season settings) have imposed much more stringent harvest regimes. The point here is that the governor's task force did not suggest any efforts to curtail marine harvest and Governor Inslee received their recommendations without any public rebuke for their failure to address the obvious.

Pete Soverel is Chair of The Osprey *Management Committee, and President and founder of The Conservation Angler.*

LETTERS TO THE EDITOR

Bulkley River Study Should Be Required Reading

Dear Editor:

I think the review of the Bulkley River Steelhead Catch and Release Study (*The Osprey*, January 2019) should be in every issue of *The Osprey*. I have long wondered about catching steelhead anywhere a run is in a critical situation. We all know that fly fishing is a blood sport and under the most ideal of situations for catch and release there is some fish mortality. While I understand from my own fly fishing for steelhead that we are not talking a lot of fish, at least I don't catch a lot of steelhead, it is still killing some steelhead when there are so few. I wonder if it is not a little disingenuous to criticize so many when we are part of the problem and are apparently unwilling to refrain from our sport in certain situation on certain rivers.

Eric Pettine
Windsor, CO

The Kamchatka Steelhead Project:

A multi-year international science and conservation project

By Peter W. Soverel and Kirill V. Kuzishchin

The Kamchatka Steelhead Project was initiated in the spring of 1994 — the brainchild of Pete Soverel (then President of The Wild Salmon Center) and Professor Ksenya Savvaitova (Ichthyology Department, Moscow State University). The object of their work was to conduct a long-term study of the completely natural population of *Oncorhynchus mykiss* — anadromous and resident forms — on the Kamchatka Peninsula in the Russian far East. These populations, although unaffected by any interactions with artificially propagated fish, had been severely depressed by intense commercial poaching during the early 1990s. The Russian Federation had listed the anadromous form (steelhead) under their Red Book (loosely analogous to our Endangered Species Act) as a rare and disappearing species. As a consequence, this provided paper protection against taking, exploitation by either commercial or recreational fisheries. Nonetheless, local populations had been reduced dramatically.

Soverel and Savvaitova saw that the combination of fish protections and pristine wilderness habitat provided an unmatched opportunity to understand and document recovery mechanisms, re-expression of life history (LHS) variations, evolutionary legacy and genetic diversity. Of course, the very nature of the wilderness locations, far from human settlements without any road access meant detailed monitoring of wilderness rivers and their fish would be extremely expensive. Soverel and Savvaitova devised a unique, revolutionary solution combining US and Russian scientific resources with sponsoring anglers. These sponsors would fund the field expeditions and associated scientific analysis. They would also participate in the expeditions to assist in collection of biological data (scale/tissue samples, morphometric measurements, sex, tagging) by catch-and-release fly fishing as volunteer field workers authorized under the terms of the Red Book by the Russian Ministry of Environment. The first expedition to test the concept was conducted in the fall of 1994 to the Kvachina and Snotalvayam rivers in western Kamchatka. The resulting Kamchatka Steelhead Project (KSP) continues to this day.

BACKGROUND

O. mykiss were first described by famous Russian naturalists S. Krasheninnikov, G. Steller and P. Pallas in the 1740s and 1750s. Although non-anadromous forms of *O. mykiss* were widely distributed throughout Kamchatka, for reasons not understood to this day, anadromous populations were confined to several dozen rivers along 600 km of the peninsula's west coast leaving a gap of thousands of miles between Asian and North American populations — a very unusual circumstance among world species.

> ***Steelhead on the Kamchatka Peninsula were so little studied or understood they came to be regarded as a mythical, rather than real fish.***

Because steelhead abundance in Western Kamchatkan rivers is much lower than the robust stocks of Pacific salmon in Kamchatka rivers, steelhead were never an important commercial species for the past 250 years. Lacking commercial interest and in the absence of a significant recreational fishery, steelhead never generated much serious interest from scientific institutions. Indeed, steelhead were so little studied or understood, they came to be regarded as a mythical, rather than a real, fish. Only in late 1960s, did a young Russian scientist, Ksenya Savvaitova and her colleague, Valery Maximov, initiated studies that clearly established that Kamchatka steelhead were real, not imaginary, fish. Asked what sparked her interest, Savvaitova replied, "Kamchatka was a mythical place in Russian culture inhabited by this mysterious, perhaps imaginary, fish. I thought it would be a wonderful and beautiful place populated by a wonderous and beautiful fish. I was right."

Under her leadership, she and Maximov embarked on arduous expeditions, walking scores of miles through tundra wilderness, to collect modern data on *O. mykiss*. At that time, most in the scientific community assumed steelhead and "rainbow" trout were separate species or, at a minimum, separate life forms of the same species that were reproductively isolated. Savvaitova and Maximov established conclusively that steelhead and rainbow trout were, in fact, one and the same the same species that exhibited different LHS forms. They further concluded that there was only one species of *O. mykiss* around the Pacific Rim from Kamchatka to Mexico. Remarkably, at the same time, noted American ichthyologist, Dr. Robert Behnke arrived at the same conclusion which was eventually accepted by the majority of the world's scientists.

Unfortunately, Savvaitova's/Maximov's early work in the 1970s was interrupted for rather long period arising from domestic Soviet/Russian social developments. The long list of unstudied issues they developed was not explored, from a stock description to the problem of steelhead-rainbow diversity and relationships throughout the Peninsula. There was not even a clear understanding of the boundaries of the specie's range. Due to the very remote location of steelhead rivers and draconian punishments under the Soviet period for poaching, steelhead were largely free

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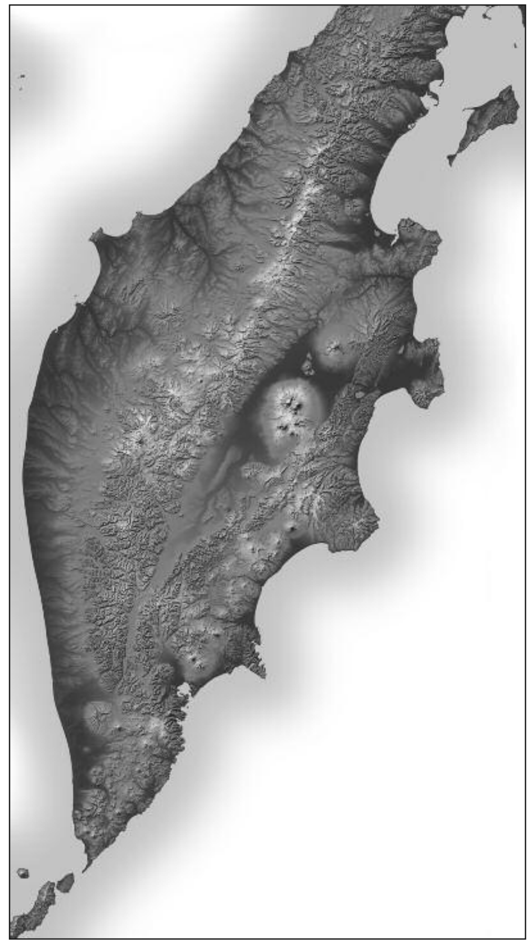
from anthropogenic influences, including habitat alternations, fish farming and oil/gas extraction so steelhead populations remained robust.

However, technical progress (ATVs and snowmobiles) facilitated human access to these remote steelhead rivers for poachers. At the initiative of Moscow State University scientists, the Russian Federation listed the anadromous form of *O. mykiss* in the “Red Data Book” of rare and disappearing species in 1983. It was a unique case of providing legal protections for a species while it was still healthy before vital dangers for its existence appeared.

With the collapse of the central Soviet government, funding for scientific study/analysis, monitoring and enforcement evaporated making assessment of stock size, abundance trends, and LHS structure impossible. Funding for the scientific community also diminished greatly, throwing fisheries biologists into the same desperate economic circumstances as the rest of the Russian population. Steelhead poaching by local inhabitants, bereft of a social safety net, became increasingly common with greater and greater effort and resulting impact on steelhead stocks, especially in the rivers near villages and towns. The increased poaching presented a severe risk of local extirpations. And because of the absence of scientific funding, there was lack of good scientific data establishing the actual status of various steelhead stocks, a situation well known in the western conservation community: “ No data; no problem!” even in the face of a serious problem.

It was in these desperate, chaotic circumstances that Soverel and Savvaitova conceived the Kamchatka Steelhead Project in 1994 to resume Savvaitova/Maximov’s earlier work to include a current estimate of the status of the wild steelhead stocks throughout Kamchatka. Soverel and Savvaitova (S&S) proposed their new model linking sponsoring anglers/volunteer data collectors with Russian scientists — a unique model of collaboration never tried before. Anglers collect biological samples through catch-and-release fly-fishing while, at the same time, funding the actual expeditions and scientific analysis. The KSP demonstrated the efficacy of a new strategy for the study, conservation and sustainable management of unique aquatic natural resource. It is supported by the Russian Federal Ministry of Natural Resources, which championed inclusion of the KSP as an authorized project under the Russian-USA Governmental Agreement on the Environment.

For the past 25 years, the KSP has provided invaluable data that have led to groundbreaking scientific discoveries furthering our understanding of steelhead, models for the conservation and recovery of steelhead-rainbow on the Kamchatka Peninsula and North America. A long list of various biological issues was covered by the strong efforts of international team, new data appeared and was published in the scientific magazines detailing major scientific achievements.



Kamchatka is a remote and wild 104,248-square-mile peninsula in the Russian Far East. Image courtesy NASA/JPL/NIMA

SCIENTIFIC ACHIEVEMENTS

Kamchatkan steelhead display a spectacular array of LHS unmatched by any other population groups. As noted above, prior to the KSP, *O. mykiss* were thought to consist of two related but separate population groups: anadromous and resident LHS *forms* that were more or less separated even when co-existing in the same drainage. In our study rivers, we discovered a much more complicated picture within-species and within-stock diversity. Virtually all Kamchatkan *O. mykiss* populations contain a bewildering combination of resident, semi-resident, semi-anadromous and anadromous specimens of O. mykiss. We call them “the life history strategy types” and distinguish 5 of them: 1. Typically Anadromous; 2. Resident; 3. Riverine-Estuarine; 4. Estuarine; 5. Anadromous B.

Typically Anadromous

These fish spend several years in the freshwater, then migrate to the high seas where they live for several years before returning to their native river as mature spawners.

Resident

These fish stay in the freshwater environment all their life span and reach maturity here. This fish can do within-river movements from one tributary to another but do not leave the riverine biotopes. In between those extremes there are a number of fish with partial migratory behavior.

Riverine-Estuarine

These fish live most of their lives in freshwater, but leave the river for brackish estuaries for short periods (perhaps from a few weeks to 3 months, typically during the summer). The sea migration is short duration to feed on the pink and chum juveniles in the rivers and near shore in the vicinity of the river mouth. They come back to the river after pink/chum juveniles go offshore.

Estuarine

This LHS type spend 2-3 years in the river as a juvenile parr, leave the river, but do not go to the high seas preferring to stay in big lagoons with the brackish water at the mouth of some rivers along the west coast.

Anadromous B

The fifth LHS type lives in the river for 2-3 years then outmigrates. In con-

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trast to "Typically anadromous" fish, the smolts of "Anadromous-B" fish stay in the coastal waters for the whole summer and go back to the river for wintering. Such immature fish, migrating during fall in the Kamchatkan rivers, we call the "Half-pounders", as they are called in North America. The Half-pounders after wintering in the river make a second outmigration the next spring to the high seas and stay there until they mature.

When returning from the sea, "Typically anadromous" and "Anadromous-B" are identical in appear and can be distinguished only by scale analysis.

Differentiation of the LHS forms are derived from thorough analysis of the scale structure of fish, and a clear understanding of complicated stock structure derived from the expanded data set provided by angling operations. The hook-and-line technique is characterized by low or even absence of selectivity and very high catch rates. So, each expedition provided scientists with data quality and quantity that was not previously available.

After identifying these LHS groupings, we then sought to understand the relationships between all those "groups" within and between populations. To address this question, we turned to microchemistry analysis of the ear bone called the otolith. This is a very informative recording structure that can provide a precise record of events in the lifespan of individual fish. We examine each layer of the otolith bone to determine the ratio of isotopes within elements and between elements of strontium (Sr) and calcium (Ca). These ratios reveal the environment the fish inhabited at the time the bone was laid down — sea or freshwater, and even the specific stream. By examining the layers of otolith bone from the outer layer to the center, we can confirm scale aging and LHS data. Additionally, by examining the ratios of elements and Sr/Ca at the very center of the otolith, which was inherited as an egg from the fish's mother, we can determine whether the mother was a resident rainbow or anadromous steelhead.

The data from different rivers revealed spectacular results of combinations of LHS variations in parents and their progeny: anadromous mothers produced anadromous, semi-anadromous and resident progeny. Equally amazing, resident rainbow mothers produced typically anadromous and anadromous-B progeny as well as resident offspring. This means, of course, that steelhead and rainbows in Kamchatkan rivers are not separated at all but, rather, are all components of the complicated system that form the entire gene pool or one homogenous population.

We have also documented that different LHS types spawn together. On the spawning grounds on the Kol River we observed how resident male spawned one-by-one with typically anadromous, estuarine and resident females. The data from genetic analysis, done for microsatellite loci and D-loop of the mitochondrial genome, proved our 0-hypotheses that fish of different LHS type belong to the united population. This means LHS is a *choice* each individual *O. mykiss* makes in response to environmental factors and these choices take place every generation in response to altering environmental conditions. Thanks to our pioneering studies we can be sure that LHS variation in *O. mykiss* is the individual attribute of the particular specimen and we have a continuum over a broad range of individual variation. From the point of the biological logic, we cannot conclude that groupings are actually separate since typically anadromous and resident fish could easily be brother and sister.

This phenomenon needs further explanation, specifically why do Kamchatkan *O. mykiss* display such stunning variability even among siblings? We surmise it arises as a response to highly variable short-term environmental conditions, which require LHS flexibility to insure sustainability in the harsh Kamchatkan environment. The winter is lengthy and very cold and rivers as well as the sea freeze. Each year, juvenile *O. mykiss* must locate and take refuge in the streams that freeze and they have to persist under hard winter conditions. Flexible systems of interacting fish of different LHS types provide population fitness in the changing severe environment at outer limits of the species' range. Thus, we suggest that Kamchatkan *O. mykiss* are one of the most sustainable geographical groups throughout the whole species natural range given their extreme short-term adaptability.

Bonnie Ellis, a participating scientist, with a 25- to 28-pound steelhead hen from the Utkholok River. Photo courtesy The Conservation Angler

One of the strong benefits of the KSP Project is the expanded works throughout the whole Peninsula. We conducted extensive biological surveys on several dozen rivers on both coasts from the Opalla in the south to Palana on the northwest coast, and Uka on the northeast coast. Our surveys have included small rivers, such as Kvachina, Snotalvayam and Kekhta as well as larger rivers such as Sopochnaya, Krutogorova, Ozernaya, Zhupanova and Oblukovina. These surveys reveal that the ratio of LHS types vary greatly from river to river. In some, typically

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anadromous and anadromous-B steelhead predominate while in the other systems we find few migratory fish and remarkable predominance of the resident rainbow, especially in east coast rivers where anadromous fish are only rarely encountered. The third grouping of rivers, much less common, contain similar ratios of all 5 LHS types.

With this background, we undertook analyses of the relationships between the biological attributes of the fish and a precise description of their riverine geomorphology. We concluded that the ratio of different LHS choices was a biological expression of the complexity of their riverine environment. Complex piedmont rivers with extended floodplains, numerous channels and off-channel habitats encourage the expression of a specific biotope, resident rainbows. At the same time, the number of available spawning grounds that *O. mykiss* can use is very limited due to the hard pressure put on the fish by low springtime temperatures. As a result, in the rivers of such type, like the Kol, Pympta, Zhupanova and others, we see that the ratio of resident fish is considerably higher than any of anadromous and semi-anadromous ones. The Piedmont River can be defined as a typical "rainbow" system. In comparison, the constrained, tundra-type rivers with few or no back channels contain mostly anadromous steelhead with a few residents. The number and ratio of semi-anadromous *O. mykiss* is high in those rivers, which has a large lagoon with brackish water, like the Sopochnaya, Krutogorova, Voyampolka rivers along with some others.

We have very long-term data sets covering half a century that illustrates that the ratio of different LHS types is not stable over time and, in fact, varies from year to year in response to changing environmental conditions — a demonstration of the critical importance of LHS variability as a survival hedge. It means that the array of environmental factors is changing and the ratio of fish that we have each year is a result of non-linear, complicated system of linkages between population of steelhead and river conditions. And any of the strong environmental influences could be a factor in shifts in the LHS adoption in various generations of juveniles. We see that the number of Riverine-Estuarine *O. mykiss* increases in the years when big numbers of pink salmon fry make their seaward migration. Having such a foraging resource, *O. mykiss* have more incentive to follow it both in the river and in the coastal waters. Global warming also provides more suitable conditions for resident fish in freshwater thus increasing the ratio of resident, non-migratory steelhead. Thereafter, the ratio of LHS types is a flexible equilibrium that provides population fitness and a most effective system of local adaptations at the mesoscale in each separate watershed.

Kirill Kuzishchin, of Moscow State University, and co-director of the Kamchatka Steelhead Project, collects biological data samples from a wild steelhead. Photo courtesy The Conservation Angler

Another important characteristic of Kamchatkan *O. mykiss* is the demographic attributes of the local stocks. KSP expeditions established that Kamchatkan steelhead stocks are comprised of very long-lived fish. For example, the majority of the juveniles spent 3, 4, 5 even more years in the rivers before smolting. This freshwater residency is much longer than in the rivers of North America, where juveniles leave rivers at age 1-2 or less commonly 3-5 years. Also, the ocean phase in Kamchatkan steelhead life span is long, fish stay in the high seas from 1 to 6 years before first spawning, and most of fish spend 3 years in the ocean before spawning. It means that the average age at maturation in all studied Kamchatkan steelhead stocks is typically 6 or 7 years old. It is much higher than in North America, where most of fish mature at age 4-5 years. But the most remarkable and amazing differences between Kamchatkan and North American steelhead is the ratio of repeat spawners in the stocks. Beginning from our first year, 1994, it was discovered that more than 75% of typically anadromous and anadromous-B fish are repeat spawners, and the number of spawning events ranged from 2 to 6. We sampled one fish that already spawned 7 times and we caught it when it was on the way to its eighth (!) spawning. It was a female, 99 cm in length and 58 cm in girth (calculated weight is 12.9 kg), and about 11 years old, which spent 3 years in the river, 2 years in the high seas before first spawning and then every year thereafter returned to spawn again, increasing in size and fecundity each year. This famous fish was caught in the Snotalvayam River in 1995. In the other years there were fish in each river with 4-6 spawning marks on their scales. The number of such fish is not high, but the fact that they occur in all studied rivers has importance for the understanding of whole life history traits of steelhead in Asian part of their range.

It is possible, that high number of repeat spawners in Kamchatkan steelhead stocks is a result of the absence of a commercial fishery during the steelhead migration. The Kamchatkan steelhead run from the sea takes place in the late fall, after the main run of pinks, chum and coho salmon. But the more

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likely explanation is that until very recently, steelhead stocks on Kamchatka were untouched for centuries, which provided an opportunity to express the innate pristine genetic structure of the local stocks and retain the potential to persist under the severe and unpredictable Kamchatka environmental conditions, where it is possible that when adverse conditions strike, the offspring from a given year's breeding cycle may largely fail to survive. However, because of potential for multiple spawning and complex adult spawning distribution, the species is very resilient and can recovery in the better years. Thus, Kamchatkan steelhead have a strong background to provide a successful brood of surviving offspring. Therefore, populations on Kamchatka have an enhanced capacity to weather adverse fluctuating environmental conditions.

Virtually all North America coastal rivers from Mexico to the Aleutians host both winter (ocean maturing) and summer (river maturing) steelhead. They are different in the run time, body shape, sexual maturity, coloration, and distribution. Frequently these different LHS occur in the same watershed with one form or the other predominating and typically utilizing different spawning areas and spawn timing. In other systems, especially one with severe obstacles to migration (long distances of hundreds of kilometers, waterfalls that can only be negotiated at certain flows/temperature regime and so on) summer runs typically are the only LHS represented in the population.

On Kamchatka for years, we tried to determine whether there were seasonal races of steelhead similar to North America. At the beginning of the KSP, based on the data from 1970-71, we thought that Kamchatka populations were only river maturing steelhead. The fish enter the rivers sexually immature. They over-winter, develop sexual maturity and the spawn the next spring, 7 to 8 months later. In 2004, when we still able to conduct spring operations, we collected spring run (ocean maturing) steelhead in several west coast rivers, the Utkholok, Kol and Kekhta. It is a remarkable discovery. Expeditions in 1970 and 1971 did not discover spring-run steelhead, while scientists worked from snow to snow. We think, that the appearance of the spring-run fish could be due to the warming of the surface water in the whole North Pacific. For Asian, steelhead it means the improvement of the ocean conditions for foraging and migrations. While the spring-run fish are rare, it shows that even in the severe conditions the steelhead tend to be as variable as possible to elaborate a series of adaptations for survival at the frontier.

The KSP has passed through several stages, evolving along with actual tasks. During the early stage of our work, inventorying steelhead populations was the primary task. That's why there were many expeditions to the rivers from Palana River to Opalla River, and a number of float trips on the big rivers of peninsula.

During this stage we payed serious attention to the diversity of the resident rainbow trout. It is well known that there are many natural different lineages along the Pacific drainage of North America including rainbow trout, redband trout, Kamloops trout, golden trout, Apache trout and many more that are all various forms of *O. mykiss* and distantly related to many subspecies of cutthroat trout. Kamchatkan trout, before KSP begun, were thought to be more uniform and defined as similar to the lineage of the "coastal rainbow trout" of Western North America. But the first expeditions discovered that diversity within Kamchatkan trout populations is higher than previously supposed. In a number of rivers, the form has similarities with the North American redband trout, and there are individual trout that appeared to be similar to North American coastal cutthroat trout and west slope cutthroat trout. Again, such unique data was collected as a result of efforts of KSP anglers, when thousands of fish went through their hands and scientists had a chance to see the real picture of trout diversity. Findings of trout with some ancestral features of morphology gave a basis for new hypotheses of before- and postglacial colonization of the trout in the North Pacific. It is possible, that diversity of trouts on Kamchatka is "a glimpse into the past of North America", and now we can see the ghost of past interactions between different trouts and, possibly, the traces of between-species hybridization in postglacial waterbodies.

The present-day stage of the KSP is focused on the monitoring of the population health of the model populations. Keystone steelhead stocks in several Northwestern Kamchatka rivers including the Utkholok, Kvachina, and Snotalvayam are of special importance and need careful annual monitoring. The steelhead stocks from those rivers are characterized by very high intraspecific and populational ecological and genetic diversity. Those steelhead ecosystems are recognized by the local Nature-Protecting Agencies as watersheds with one the world-highest steelhead densities and could be used as a natural example for the restoration of the depleted stocks in the exhausted ecosystems of Kamchatka and other regions. Steelhead stocks from Kvachina,

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Angler-scientists with the Kamchatka Steelhead Project travel the trail across Kvachina Plain to the Snotalvayam River. Photo courtesy The Conservation Angler

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Snotalvayam and Utkholok rivers are the best studied throughout the whole Kamchatka, and, indeed, the world. They have been the subject of regular investigations since 1970 that continues to the present. It was discovered that the biological attributes in the steelhead that vary most over time are age composition, longevity of the freshwater and ocean periods of life, iteroparity rate [the rate of multiple reproductive cycles over the steelheads' lifetime], all of which could be a universal cumulative indicator of the stock status in the particular year. An important part of the complex research was done in 2010-2011 when direct fish counts by a sonar system were executed to get precise data for the steelhead run attributes and abundance.

We have long sequences of data on basic attributes of the intrapopulation structure dating from 1970 to 2018. Based on this half-century data set, we can plot the long-term and short-term variations within and between LHS types and distribution in the Utkholok, Kvachina and Snotalvayam populations. In 1970-1971, typically anadromous LHS predominated with very few resident type, all of which were male fish. From 1995 to 2006 there was a measurable decrease in the percentage of anadromous LHS types (Typically-anadromous and Anadromous-B); semi-anadromous (Estuarine and Riverine-estuarine) fish appeared; and Resident fish males and females were equally present. Most recently (2016-2018), anadromous types increased as a percentage of the populations coupled with a decrease in semi-anadromous ones in the Utkholok River, but males and females were still equally present the resident fish population. The current population appears to be trending towards the LHS structure similar to that documented in 1970-1971.

We have observed other attributes in flux. For instance, the longevity of the freshwater period in anadromous fish increased slowly from 1970-2016 to 3.88 years with a maximum of 5 years. But starting in 2017/2018 the trend was reversed with freshwater residency declining to 3.01. Similarly, ocean longevity for most fish in 1970/71 was 2 years; 1994-2010, 3-4 years (3.65 average); 2017/18; 2-3 (2.93 average). It is a remarkable example of the dynamic level of iteroparity in Kamchatka steelhead populations.

In 1970-1971 more than 85% of anadromous fish were maiden spawners, in 1994-2011: more than 83% were repeat spawners, and a majority had spawned three times. This trend reversed in 2015-2018 when maiden fish again dominated the populations consisting of 60-75% of spawners. In general, in the last years we can see the LHS structure resembles that of the early 1970s.

The data illustrates that intrapopulation structure returned to what was the norm 50 years ago, before anthropogenic disasters of the early 1990s. The good news is that our field activity and presence has virtually eliminated large-scale poaching with the immediate consequence of dramatically increased spawning escapement each subsequent year with current populations 4-5 times greater than 1994. The current populations are very robust and are trending towards restoration of historic abundance and LHS structure. Contributing to Kamchatkan steelhead populations and alteration of LHS structures may also be the result of climate change with significant warming of the North Pacific region — both terrestrial and marine. Kamchatkan steelhead inhabit the coldest region of the species range. The increasing temperatures now prevalent in the Kamchatkan/North Pacific region provide better living conditions in the freshwater habitats and in the coastal areas. It is known that steelhead smolts survive better during their passage from freshwater to saltwater at higher water temperatures. In any case there is strong evidence for both hypotheses and they probably combine to enhance Kamchatkan steelhead recovery, and argue for continued monitoring efforts with our regular field expeditions in the rivers of the northwest Kamchatka.

So, thorough analysis of inter- and intrapopulation structure of Kamchatkan *O. mykiss* provided a number of conclusions:

1. Present-days features of biology result from evolutional processes.

2. Steelhead manage to survive in an unfriendly environment utilizing a number of solutions including the option of multiple lifetime opportunities to reach maturity and produce surviving offspring and avoid risk of death or even extinction.

In Kamchatka, we have unique steelhead populations that demonstrate a broad range of adaptations and capacity to fit into different environments and stay in time and space over a long timeline. As a result, we have natural stocks that could be a gauge for restoring ruined steelhead populations over their natural range and better understanding of how to create a strategy of sustainable use of the resource.

Peter Soverel is President of The Conservation Angler. Kirill Kuzishchin is a fisheries scientist at Moscow State University. They Co-directors of the Kamchatka Steelhead Project.

To learn more about the Kamchatka Steelhead Project go to:
www.theconservationangler.com/ksp.html

The Conservation Angler and Moscow State University wish to thank:the more 800 sponsoring anglers who have provided the financial support to make the KSP possible and who were responsible for the collection of thousands biological samples;institutional supporters (National Oceanic and Aeronautic Administration, US Department of State, National Fish & Wildlife Foundation) who have provide import financial assistance at critical junctures; our scientific partners at the Washington Department of Fish and Wildlife, Oregon Department of Fish and Wildlife, National Marine Fisheries Service, U.S. Fish and Wildlife Service, Washington State University, University of Montana Flathead Lake Biological Station, University of California (Davis), Russian Ministry of Environment, Wild Salmon Center; Sergey Lamzov (deceased), the Russian fisheries inspector who helped eradicate steelhead poaching;Serge Karpovich and John Sager without who this program would never have seen the light of day.

Without the support from all of you, we would know less about steelhead and the fish would face a more uncertain future. Instead, steelhead have shown us their remarkable adaptivity, resiliency in the face of adversity, will to survive and, most importantly, that they know how to do all these things if will be give them the space to be steelhead. Maybe the agencies in North American will listen to help restore the varied LHS structures essential to abundant, resilient, sustainable populations – large and small.

Wild Snake River Basin Steelhead Runs on Path to Extinction

By Brett Haverstick and Gary Macfarlane

The Snake River is a major river of the Pacific Northwest. It is just over 1,000 miles long and is the largest tributary of the Columbia River. The Snake originates in Yellowstone National Park before carving its way through eastern and southern Idaho and the chasms of Hells Canyon. Downstream from the deepest gorge in North America, the Snake is met by the Grande Ronde River in Oregon, the Salmon River in Central Idaho and the Clearwater River in North Central Idaho. Following its confluence with the Clearwater, the Snake turns left and embarks westward on its journey to the Columbia and Pacific Ocean. All told, the mighty Snake River Basin encompasses parts of six states (Wyoming, Idaho, Utah, Nevada, Oregon, and Washington) and covers almost 110,000 square miles.

The Snake River Basin was historically one of the greatest producers of anadromous fish in the United States. Prominent runs of Chinook, coho, and sockeye salmon, and steelhead filled its rivers and tributaries on an annual basis for millions of years. This bountiful and life-giving abundance came to a crashing end in the 20th Century, however, due to overharvesting by commercial fisheries and the dam building frenzy that captured our nation. Along with the four hydroelectric dams built on the lower Columbia, an additional fifteen dams were built along different segments of the Snake. This, tragically, resulted in Chinook salmon and steelhead no longer spawning above such places as Hells Canyon, and beyond, as thousands of miles of historically accessible fish habitat was damned, degraded and destroyed.

In 1997, the National Marine Fisheries Service (NMFS) listed Snake River Basin steelhead as “threatened” under the Endangered Species Act (ESA). Both A-run and B-run wild steelhead are federally protected. A-run steelhead spend one to two years in the ocean before attempting to return to their spawning grounds, while the B-run fish spend two to three years in the ocean. Unfortunately, listing these iconic fish under the ESA has not prevented them from being at high risk of going extinct. The past two years have witnessed the lowest return of wild steelhead to Idaho since the 1970s, and the 2019 return is expected to be as bad or worse.

This background underscores the fact that the Snake River not only contains some of the best steelhead habitat but some of the toughest inland migrations of steelhead anywhere. While not the longest migration of the *Oncorhynchus* genus—for example, Chinook salmon travel 2,000 miles to spawn in the Yukon—the spawning runs of steelhead and other anadromous members of the salmonid family spawn far inland and probably spawn at higher elevations in the Snake River system in Idaho than anywhere else. Steelhead are famed as the greatest swimmers of this genus. Unlike their Pacific salmon cousins, also in the *Oncorhynchus* genus, steelhead are iteroparous, meaning that they do not automatically die after spawning. Nonetheless, the rigors of the long distance and elevation gains that anadromous fish in the Snake River Basin meant that few steelhead actually returned to spawn again. Sadly, the series of dams on the lower Snake and Columbia rivers have virtually ended any return spawners.

Between 2010 and 2018 the state of Idaho did not have a “take” permit for ESA listed wild steelhead or a NOAA approved management plan.

In October 2018, Friends of the Clearwater joined five other groups, led by The Conservation Angler, in filing a 60-Day Notice of Intent to Sue (NOI) the state of Idaho and the Idaho Department of Fish & Game (IDFG) for authorizing a steelhead fishing season, despite these dangerously low numbers, and despite not having an approved fish management plan and Endangered Species Act “incidental take permit” from the National Oceanic & Atmospheric Administration (NOAA). This permit is required under the Endangered Species Act (ESA) whenever a listed species may be “harmed, harassed or killed…” during a proposed agency action – in this case, the steelhead fishing season.

Idaho did not have a take permit between 2010 and 2018. The federal government did not approve Idaho’s Fisheries Management & Evaluation Plan (FMEP) in those eight years. As a result of public accountability, IDFG Commissioners announced the closure of the steelhead season effective December 7, 2018. The closure would prevent steelhead fishing on the Clearwater, Salmon and Little Salmon rivers, as well as the Idaho bank of the Snake River.

Soon after IDFG’s announcement in November, the Idaho River Community Alliance was formed by local fishermen, outfitters, businesses and citizens “with the goal of inserting themselves into any negotiations or maneuverings that could fend off the pending closure of Idaho’s steelhead season or lead to an earlier reopening.” Two chapters were specifically formed – a Riggins Chapter and a Clearwater Chapter. The town of Riggins is located along the Salmon River. Lewiston, Idaho is located near the Snake – Clearwater River confluence.

The community alliance soon approached the conservation groups about a resolution to keep the steelhead season open beyond December 7, 2018

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in exchange for certain voluntary conservation measures aimed at preventing wild steelhead from being harmed or killed. This included keeping wild (intact adipose fin) steelhead in the water until they are released, use of barbless hooks, and the mandatory retention of adipose-fin-clipped hatchery steelhead. The state of Idaho would also agree to close portions of the Salmon River and the South Fork Clearwater to protect wild steelhead winter sheltering areas. In return conservation groups would agree not to pursue litigation against Idaho for violating the ESA until an expiration date in early 2019.

While the agreement was being reached, NOAA Fisheries finally started analyzing Idaho's FMEP. Weeks following the 35-day federal government shutdown, NOAA announced that it had approved Idaho's application. The approval came the same day the negotiated agreement between conservation groups, the community alliance and the state of Idaho was set to expire. For the first time since 2010, the state of Idaho's steelhead fishing season was now in full compliance with federal law.

Fish Creek in the Clearwater National Forest is the best wild steelhead producing tributary stream in Idaho. Photo by Chuck Pezeshki

The filing of the Notice of Intent to Sue was, indeed, effective in moving the agencies to act, though the very recent decision made by NOAA Fisheries needs to be carefully scrutinized as a quick review of the decision by us suggests important conservation measures do not kick in until wild steelhead numbers are far too low. Keep tuned in to *The Osprey* for more information as this and other issues affecting wild steelhead progress.

While federal and state governments continue to manage for hatchery production, wild salmon and steelhead returns to the Snake River Basin continue to plummet. Wild steelhead numbers have been less than 50% of the 10-year average in each of the last two years. The 2019 forecast for wild fish returns are even worse. Wild steelhead passage in the fall of 2018 at lower Granite Dam — fish headed mainly for Idaho — was only 18% of average.

The Clearwater River Basin in Idaho plays an important role in wild steelhead recovery in the Snake River Basin. Though not the largest subbasin in the Snake, in terms of acreage, the Clearwater is the largest tributary — on average slightly larger than the Salmon River — in terms of water production. Even more notable, the larger fish of the fabled B-runs are mainly found in the Clearwater. Prior to the construction of Dworshak Dam on the North Fork Clearwater in the 1960s, that stream produced an inordinate share of the large B-run steelhead. Indeed, Pony Flats on Cayuse Creek was perhaps the best spawning habitat in the world for steelhead.

Nonetheless, important spawning habitat remains in the main Clearwater River and its tributaries. Several smaller tributaries to the main stem Clearwater provide wild steelhead habitat, including the Potlatch River and Lolo Creek. Of course, the Middle Fork Clearwater and its main tributaries — the Lochsa and Selway Rivers — have crucial steelhead habitat. Fish Creek on the Lochsa is touted as the best wild steelhead stream in Idaho. Meadow, Gedney, and O'hara Creeks are important steelhead tributaries to the Selway. Further, the Selway River is one of only three larger river subbasins that have not been influenced by hatchery steelhead production in the Snake River Basin. The other two are in the Salmon River drainage in Idaho. Even the South Fork Clearwater, which has compromised fish habitat due mainly to past development, still contains crucial steelhead spawning habitat.

Aside from the main threat to steelhead survival — the lower Snake River dams — other threats include an attitude that blames everyone else. For example, IDFG point fingers and asks why Oregon and Washington get away with their programs and vice versa. All who take or fish for steelhead must recognize the cumulative impacts of actions on wild steelhead. Groups like the sponsoring organizations behind *The Osprey* have been at the forefront in urging that we must make changes and sacrifices to protect wild steelhead, and in leading by example. There are also principled individual anglers who have fished for steelhead for decades but stopped in 2018 because of the low numbers of returning wild fish. A comprehensive plan, rather than the current piecemeal approach of various governmental/Tribal entities, needs to be implemented as well.

Climate change also plays a role by making the journey to and from the ocean more difficult. While Idaho has much excellent spawning habitat, some crucial spawning grounds are under increasing pressure from development like logging and suction dredge mining. For example, the Forest Service has more than doubled timber sale levels on the Nez Perce and Clearwater national forests in North Central Idaho over the average harvest since 2000. The agency has proposed to radically increase logging levels several fold more. Most of that logging is slated for watersheds that support steelhead. And more people recreating or traveling in steelhead spawning watersheds can have impacts as well.

Wild steelhead don't have much time left under status quo management. There may be light at the end of the tunnel, however. Congressman Mike Simpson (R-ID), at a recent fish summit in Boise, expressed in very emotional terms, the need to recover runs of salmon and steelhead in Idaho. He asked the audience what mitigation efforts would need to occur if the four dams on the Lower Snake were removed? This may be the needed turning point for wild steelhead in Idaho, Washington, Oregon, and elsewhere. Let's all work to save wild steelhead. And we must hurry before it is too little, too late.

Gary Macfarlane is Ecosystem Defense Director for Friends of the Clearwater. Brett Haverstick is its Education and Outreach Director. Learn more about their work at:

www.friendsoftheclearwater.org

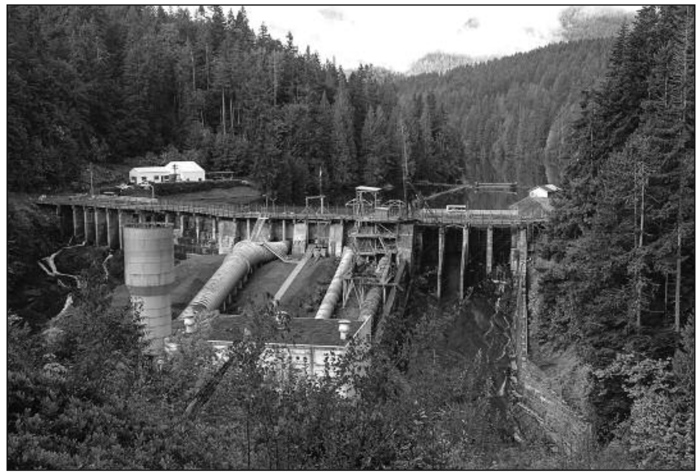
The Elwha River: What Have We Learned Since Dam Removal?

By John McMillan, Roger Peters, Mike McHenry, Sam Brenkman, Sarah Morley, George Pess, Joseph Anderson, Thomas Quinn, Melissa Foley, Keith Denton, Mary Moser, Rebecca Paradis, Pat Crain, Heidi Hugunin, Josh Geffre, and Anna Geffre

The Elwha River, on Washington State's Olympic Peninsula, was home to the largest dam removal project in the world. For over 100 years, the Elwha Dam (River kilometer (Rkm) 8.0) blocked the upstream passage of anadromous fish in the Elwha River. Glines Canyon Dam (Rkm 24.1), built 14 years later, further impounded the system. After decades in the making, the Elwha River Ecosystem and Fisheries Restoration Act was enacted in 1992 and dam removal began in 2011. Over six years have passed since the Elwha Dam was fully removed in 2012, and four years since Glines Canyon Dam was deconstructed in 2014. The Elwha River is free flowing and for the first time in generations, its headwaters in Olympic National Park are accessible to anadromous fish.

Outwardly, removal might seem like the hard part. It was, but it was also a relatively short process. The more enduring challenge is rebuilding runs of salmon, steelhead, trout, char, and lamprey. It is difficult to monitor a watershed where the vast majority of habitat is in remote wilderness areas lacking road access but such research efforts are critically needed. What we learn in the Elwha River will drive adaptive management of this watershed and help inform future dam removal projects elsewhere.

As with any scientific field, there are many interesting dam removal issues ranging from sediment transport to fish recovery. To date, many studies on these topics have been published in peer-reviewed journals and more are in preparation. In this article, we review our findings on coho and Chinook salmon, steelhead, bull trout and Pacific lamprey, among which Chinook salmon, steelhead and bull trout are listed for protection under the Endangered Species Act. We also summarize how macroinvertebrates (food for the fish) were affected by the high sediment loads during dam removal.



The Elwha Dam, which blocked upstream movement of fish in the Elwha River, was removed in 2012 . Photo by John McMillan

This review is based on data collected by scientists working for the Lower Elwha Klallam Tribe (LEKT), federal and state agencies, NGO's, universities, and the Olympic National Park (ONP). Research done in the basin is by no means limited to this group, and others (such as Anne Shaffer with Coastal Watershed Institute) have also contributed valuable information on the complex physical and biological aspects of the system's recovery from dam removal. Here we draw both from studies that have already been published and those that are still in progress. While the distinction may seem small, readers should regard unpublished data as considered preliminary. Some of the studies will take several more years to complete.

> *With the dams gone, the Elwha is free flowing for the first time in generations and fish can reach habitat in Olympic National Park.*

Chinook Salmon

The historic Elwha River Chinook salmon population, with fish reported in excess of 100 pounds, was legendary on the Olympic Peninsula. The spring run was heavily impacted by the dams and the run was nearly lost from the Elwha. The summer/fall run was successfully maintained until dam removal by a Washington Department of Fish and Wildlife (WDFW) hatchery program initiated in the 1930s, but spawner distribution was limited to the lower river. The current population is directly descended from native Elwha Chinook and represents an important evolutionary legacy of the species in the Puget Sound region.

The population of Chinook prior to dam removal averaged 2,900 returning adults (1991-2011), the vast majority of which were of hatchery origin. Since dam removal began in 2012, we have estimated the number of returning adults to range from a low of 2,628 in 2016 to a high of 4,360 in 2014. The estimate for 2018 is not yet available but is anticipated to be in the range of 5,000-7,000 adults. Based on otolith analysis, the origin of the returning Chinook has remained overwhelmingly from the

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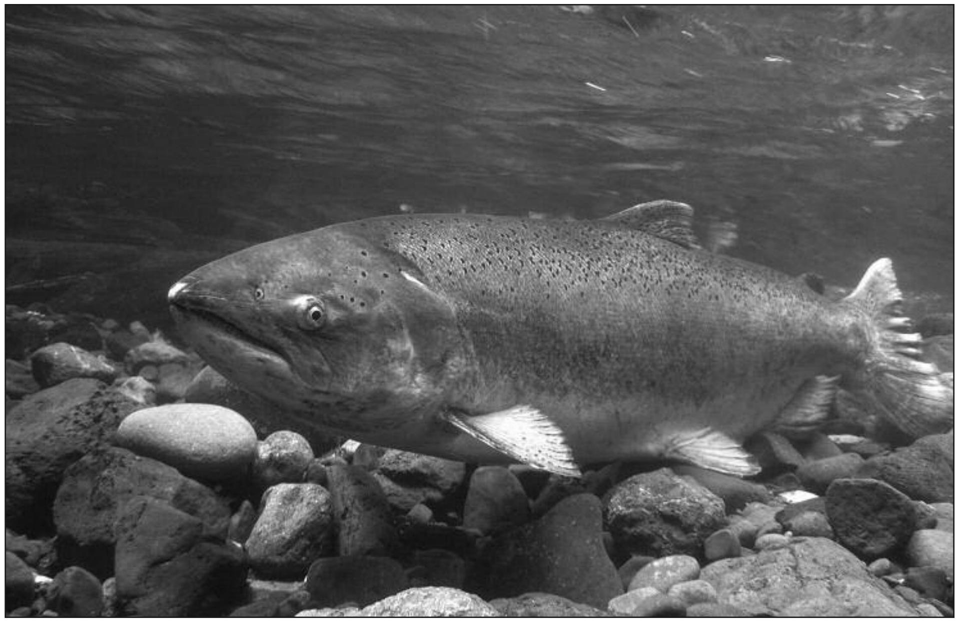
hatchery (>90%). This is not surprising, as conditions in the river during and immediately following dam removal were not conducive to successful natural reproduction. Dam removal resulted in the release of approximately 20 million metric tons of sediment, adversely affecting conditions for incubating embryos and rearing juveniles. Project managers hope to see the first signals of increased natural origin Chinook production in the coming years as channel conditions stabilize and incubation and rearing conditions improve.

The spatial expansion of Chinook salmon spawning has been impressive. Chinook quickly colonized the area above Elwha Dam and below Glines Canyon Dam following the removal of Elwha Dam in 2012. When Glines Canyon Dam was removed in 2014, Chinook ascended areas upstream of that site. In 2018, during peak spawning ground surveys of the majority of the Elwha River, a total of 1,601 redds were located, including the furthest upstream redd just above the confluence of the Hayes River at Rkm 45.5. The number and wide distribution of redds in main-stem, side-channel and tributaries bodes well for the future of this iconic species.

Coho Salmon

Elwha River coho salmon have been extremely successful at recolonization as a result of hatchery operations and natural processes. An adult coho salmon relocation program was initiated by the LEKT prior to dam removal in the fall of 2011 and continued through 2018. From 2011 to 2018, over 3,000 adult coho salmon that returned to the LEKT hatchery downstream of the dams were moved into five tributaries upstream of the Elwha dam and into the main-stem Elwha just downstream of the former Glines Canyon Dam. The goal was to accelerate recolonization because most coho salmon returning to the river were of hatchery origin and thus predisposed to return to the hatchery, potentially slowing upriver colonization.

Initial relocations in 2011-2012 focused on Little River and Indian Creek, which were not directly affected by dam removal. During and initially after dam removal, the vast majority of adult coho salmon observed on the spawning grounds were relocated hatchery origin fish (~94 to 96%) (Liermann et al. 2017).



Chinook salmon have quickly recolonized former spawning habitat since the Elwha and Glines Canyon dams were removed between 2011 and 2014. Photo by John McMillan

This was not surprising because published studies suggest the stray rate for adult coho salmon to be less than 3% (Westley et al. 2013), and most of the Elwha coho were of hatchery origin at the beginning of the project.

The proportion of adults, presumably both hatchery and natural-origin, that are naturally colonizing appears to have increased since 2016. Further evidence for the success of this adult relocation program is provided by juvenile coho salmon observed upstream of the former Glines Canyon Dam, within the former Mills Reservoir and its tributaries. In addition, the number of estimated coho salmon smolts has increased since 2014 from a little over 9,000 to over 17,000 in 2017.

One of the highlights of coho recolonization in the Elwha River has been the establishment of different life histories in different tributary environments. While comparable in location and size, Indian Creek is considerably less steep than Little River and is warmer due to its source at Lake Sutherland. During the first two years of adult coho relocation, redd densities were similar, but Indian Creek produced four to five times more age-1 smolts per km than Little River, which produced a greater proportion of smaller, age-0 fry outmigrants relocating to other rearing areas.

Steelhead

Prior to dam removal, the Elwha River supported both winter and summer steelhead runs. After dam construction, hatchery Chambers Creek winter steelhead were planted from 1965-2012 and Skamania summer runs from 1968-2000. Since the start of dam removal there have only been releases of hatchery steelhead that were derived from Elwha winter runs. We don't have rigorous estimates of wild steelhead abundance prior to dam removal, but limited redd counts in the years before deconstruction suggested a population of about 150-300 adults. We presume that nearly all, if not all, of those redds were constructed by winter steelhead because so few adult summer steelhead were observed below the Elwha Dam in the three years prior to dam removal whereas winter steelhead were present and frequently caught by anglers.

The naturally spawning winter steelhead numbered fewer than 400 fish in 2013, shortly after Elwha Dam was removed. It then increased sharply to roughly 1,200 fish in 2014, and since has averaged a similar number – with the largest run occurring this past season in 2017/2018. Most of those adults were from hatchery releases of native broodstock, with natural-origin fish comprising roughly one-third of the run each year, although pinpointing the exact proportion of natural-origin fish has been difficult.

Estimates of steelhead smolts have also increased following dam removal, from 423 in 2014 during the times of

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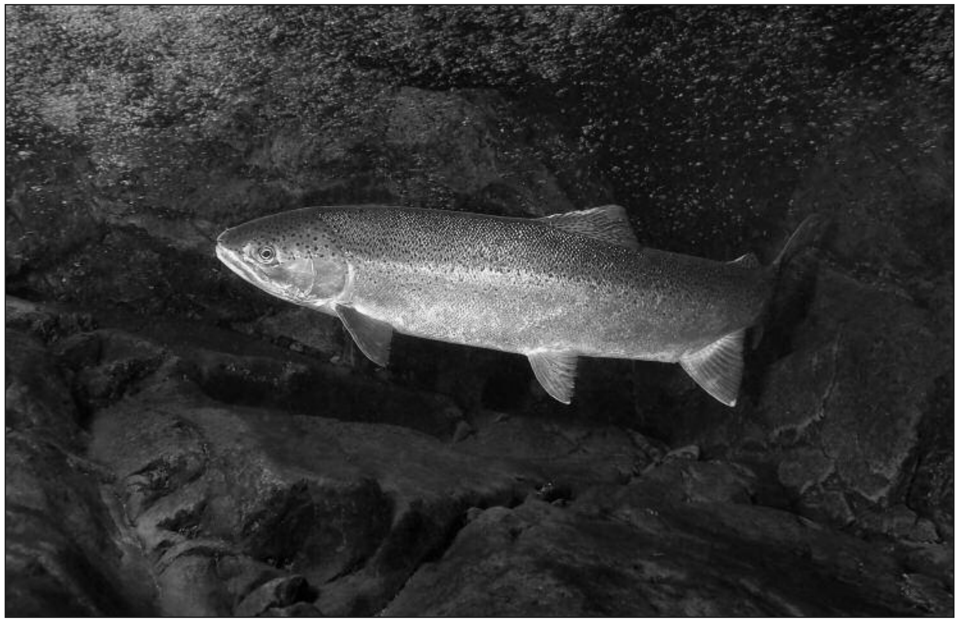
highest sediment discharge to 11,722 in 2017. This suggests that the Elwha River and its associated tributaries are becoming more favorable for juvenile rearing post dam removal.

Perhaps most encouraging is the return of wild summer steelhead. Unlike winter runs, there have not been any recent releases of hatchery summer steelhead in the Elwha. Prior to dam removal snorkel surveys of the lower Elwha (2009-2011) never revealed more than one or two summer steelhead, some of which were clipped. Post dam removal, we first observed unclipped/unmarked (presumably wild) adult steelhead upstream of the Elwha and Glines Canyon dam sites in October 2013 and August 2016, respectively, but it was not until the summer of 2017 that we began to appreciate what was happening. Extensive snorkel surveys of the upper Elwha River in September 2017 recorded 75 adult summer run fish (74 unmarked; 1 marked). Preliminary data from a riverscape survey from the headwaters (~Rkm 60) to the mouth in 2018 revealed 229 adult summer run fish (192 unmarked, 2 marked, 35 unknown). SONAR estimated the 2018 summer run population to be at least 300 fish. Like the phoenix, summer runs have arisen from the ashes. The origin of these fish remains a question and will be investigated in the coming years.



Particularly encouraging is the return of summer steelhead to the Elwha River system. Photo by John McMillan

Bull trout

Bull trout exhibit diverse life history patterns that often require extensive movements, and thus are especially susceptible to the effects of fragmentation caused by dams. The Elwha River dams restricted bull trout movements to areas either upstream, in-between, and downstream of the dams (Corbett and Brenkman 2012). All evidence indicates that bull trout were very scarce (1-6 fish per km), generally small-bodied, and had lower levels of genetic variation and gene flow compared to populations in free-flowing rivers of coastal Washington (DeHaan et al. 2011; Brenkman et al. 2012).

Bull trout rapidly responded to dam removal with increased migration distances, expanded spatial extent, repeat spawning migrations, resumption of anadromy, and increased length and weight indicative of growth benefits associated with restored connectivity. Radio-tagged adults were the first salmonids to ascend the two former dam sites and moved 64 km upstream to reach newly accessible headwater habitats, thereby reconnecting with an isolated segment of the population. Bull trout resumed anadromy, as indicated by adult movements to and from the Elwha estuary and the presence of bright, silvery colored adults typical of marine phase salmonids. Additionally, isotopic signatures demonstrated extensive reliance upon marine prey-similar to those of adult Pacific salmon that had spent several years at sea (Quinn et al. 2017). Also, year-round sampling in the estuary of the Elwha River indicated that juveniles move back and forth between the lower river and the estuary, though these individuals did not seem to stay long in marine waters (Lincoln et al. 2019).

Renewed access to marine waters and food items (i.e., eggs, juveniles, flesh) derived from salmon migrating upriver are important for the bull trout for several reasons. First, bull trout are growing larger and faster, allowing them to produce more eggs laid in deeper redds (less prone to scour), likely producing more offspring, thereby making the population more productive. In addition, the reestablishment of life history diversity and broader spatial distribution should make the population more resilient in the future. Understanding movement patterns and life history diversity is central to managing fish populations and restoration of connectivity may be key to recovery of this threatened species.

Lamprey

Both anadromous Pacific lamprey and river lamprey likely inhabited the upper reaches of the Elwha River prior to dam construction. Pacific lamprey is a Federal Species of Concern and is also a Washington State monitored species; river lamprey is a Washington State candidate for listing. After dam construction, lampreys were extirpated above the dams and records of anadromous lamprey downstream were scarce (Moser and Paradis 2017). However, in the year following Elwha dam removal (2012), larval Pacific lamprey were detected in Indian Creek and other streams upstream from the former Elwha dam site. Larval abundance rapidly increased in these streams, and metamorphosed juveniles were captured by summer 2016.

Since that time, Pacific lamprey spawning has been documented in tributaries upstream of both Elwha and Glines Canyon dam sites during redd mapping surveys (i.e., Hughes, Madison, Sanders and Boulder creeks). In addition, a radio-telemetry study in 2017-18 confirmed that adult Pacific lamprey rapidly moved upstream into areas well above both dam sites. The study confirms that, given access to historically-important habitats, Pacific

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lamprey can immediately colonize these areas and soon thereafter are able to contribute to the restoration of healthy ecosystems.

Macroinvertebrates

Dam removal significantly affected the number and composition of macroinvertebrates in river and estuary habitats of the Elwha River. The effects of dam removal were most pronounced in the lower river and estuary, likely due to high levels of sedimentation. Downstream of Elwha Dam, macroinvertebrate drift density declined by 85% in 2012 and by 95% in 2013 compared to pre-removal years. Macroinvertebrate taxonomic composition also changed below and between the dams: nearly all mayflies, stoneflies, and caddisflies populations decreased sharply during dam removal, with many disappearing completely. In the lower river, this translated to an 83% decrease in the amount of energy available to drift-feeding salmonids.

In the estuary, macroinvertebrate abundance declined by approximately 55% during dam removal and the taxonomic composition of the estuary macroinvertebrate community was significantly altered from pre-removal years. Macroinvertebrates associated with brackish waters disappeared completely from the estuary and oligochaete worms became more abundant. The abundance of terrestrial macroinvertebrates with an aquatic life stage also declined 85% during dam removal. Unlike the lower river, the energy density of macroinvertebrates in the estuary did not change during dam removal as a result of changes in abundance. This was due to the replacement of numerous, smaller-bodied organisms with larger-bodied ones.

As a result of the changes in prey availability in the river and estuary, the number and type of prey items found inside salmonid stomachs was also altered by dam removal. This shift was particularly pronounced in the lower river, where the energetic contribution of terrestrial prey rose from 20% pre-removal to 70% during removal. The proportion of terrestrial prey eaten by juvenile salmonids in the estuary increased 85% during dam removal, as did the frequency of piscivory. While the number of fish with empty stomachs increased four-fold during dam removal in the estuary and the number of prey items per fish stomach decreased, the total amount of energy from those items remained nearly the same as before dam removal.

Habitat on the Elwha River system is slowly improving since the dams were removed. Photo by John McMillan

The Future of a River Set Free

As expected, dam removal had some initial adverse effects on the Elwha River's environment. These negative impacts seem to have been largely transient, and we have since documented many positive responses, including Chinook salmon migrating into the headwaters, coho recolonizing tributaries, the re-awakening of summer steelhead, increased size and abundance of bull trout, and the arrival of lamprey. The river's sediment loads are stabilizing and conditions are much more favorable for macroinvertebrates and fish spawning and rearing in the mainstem Elwha.

It is also important to remember that we are in the very early stages of recovery and the initial effects of dam removal still linger. For example, Chinook spend three to five years at sea and steelhead spend one to four years in freshwater followed by one to four years at sea. Hence, fish returning in 2018 could be the progeny of fish that spawned in 2013 or 2014, during the height of impacts from dam removal. Consequently, it will take several more years for fish to realize the true potential of the main-stem habitats. All of us are excited to watch that process unfold and learn more about how fish and macroinvertebrates recolonize habitat after dams are removed.

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Restoring Wild Summer Steelhead to California's Upper Eel River

By Scott Greacen

Whether they used weirs, dipnets, or fly rods, people who catch fish in the rivers of the Pacific slope have always recognized summer-run steelhead as clearly distinct from their winter-run kin. Like spring-run Chinook, summer steelhead don't just return to freshwater in the opposite season from their cousins in the same river system; they aren't even ready to spawn when they do. Their gonads mature while the fish over-summer in coldwater refugia, often as high as they can get in a given watershed. Thus, researchers describe both summer steelhead and spring Chinook as "premature migrants," distinguishing those runs from the more familiar winter steelhead and fall chinook forms, or "mature migrants."

Summer steelhead are extraordinary fish in many ways. Because summer steelhead don't really eat during their time in freshwater, they have to carry a lot of body fat — stored energy — to survive to spawn. But summer steelhead also include the strongest swimmers and highest jumpers of all salmonids. Some of the obstacles that separate winter and summer steelhead spawning reaches are simply astonishing, including huge boulder 'roughs' that appear to present total barriers to fish passage. Only repeated observations of adult fish above these barriers — and collection of otoliths from juveniles showing they had an ocean-going parent — have convinced fisheries biologists that summer steelhead do manage to surmount them.

When fall rains come, summer steelhead go even higher to spawn. These behaviors allow summer steelhead to exploit ecological opportunities their winter-run relatives usually can't reach. But they also make both adult and juvenile summer-run fish more vulnerable to human impacts because they spend more time in the freshwater habitats subject to our impacts. (By contrast, an adult winter-run steelhead might make its entire spawning run, and return to the Pacific, in less than two weeks.)

Now, new science suggests not only that summer steelhead are truly different from their winter-run relatives in important ways, but that the key genetic variation that makes them so extraordinary is at risk unless we can protect already-dwindling populations of summer run fish. Recent investigations of the salmonid genome with powerful new techniques have revealed a single region in the salmonid genome responsible for the dramatic differences in physiology and behavior observed in summer steelhead and spring chinook. Researchers at the University of California Davis were the first to suggest that variation at this site determines the complex behavioral and physiological differences associated with 'premature migration' in both summer steelhead and spring-run Chinook [See "On the Evolution and Conservation of Summer Steelhead and Spring Chinook," *The Osprey*, January 2018].

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When Scott Dam was built a century ago without any fish passage, the summer steelhead run in the upper mainstem Eel River vanished. This population was the southernmost summer steelhead run. Its loss reduced the diversity and viability of the larger population of Northern California summer steelhead. Photo by Rob Badger, Friends of the Eel River

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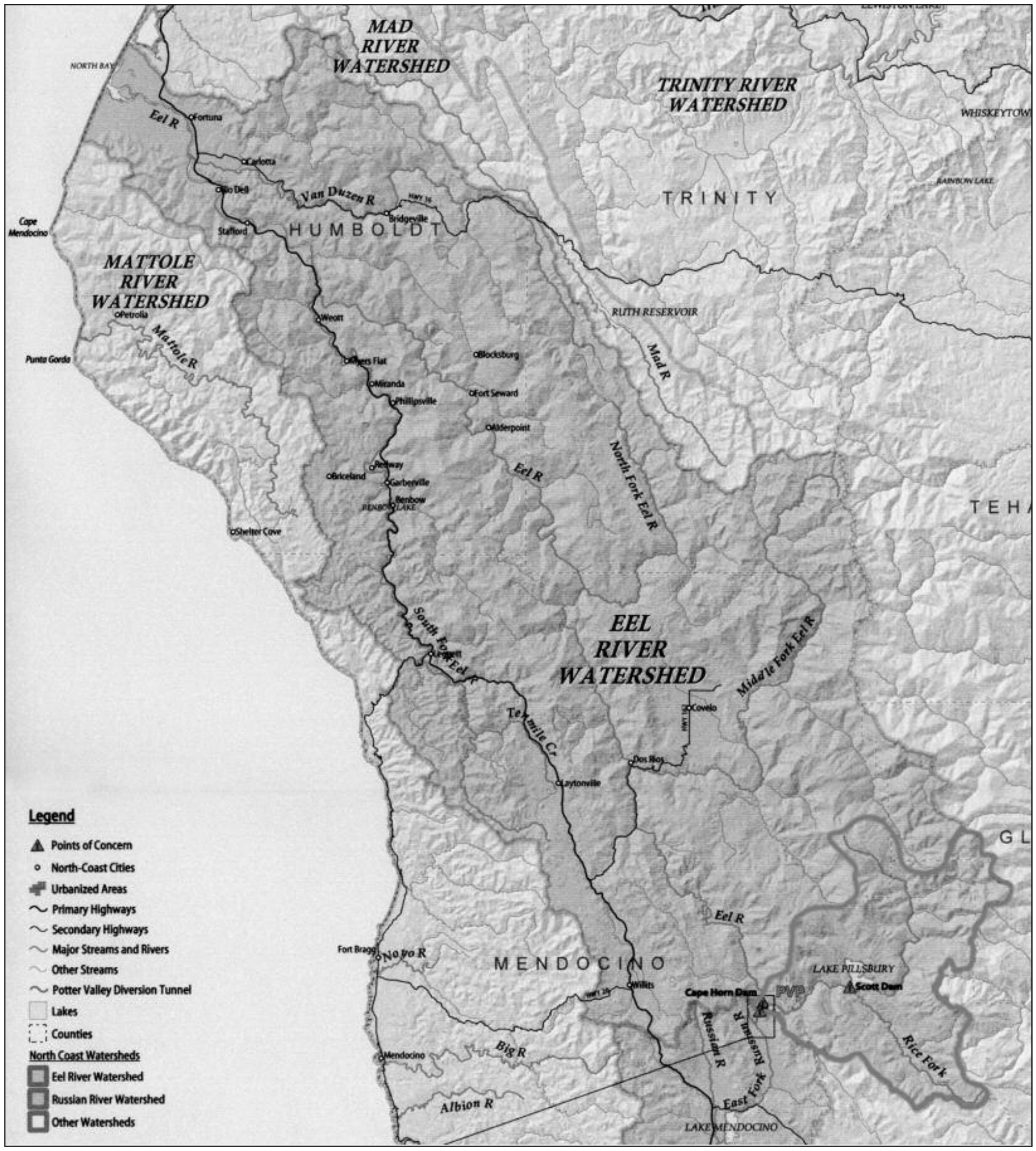

What's more, that team has found the steelhead premature migration variant (allele) in rainbow trout in streams above Scott Dam on the upper mainstem Eel River.

Coastal rainbow 'trout' are, of course, the freshwater form of steelhead, *Oncorhynchus mykiss*. (Steelhead, long known as 'steelhead trout," were recognized in the 1990s as part of the *Oncorhynchus* genus that includes all other Pacific salmonids. Thus, we might as well think of rainbows as 'freshwater salmon.') Rainbows and steelhead are the same fish: the difference is that some go to the ocean, get big, and, if they get really lucky, return to spawn, while others stay in freshwater their entire lives. A 'rainbow' can have 'steelhead' parents, and vice versa. In general, whether a given rainbow runs to the Pacific appears influenced by both genetic and environmental factors.

Summer steelhead have been unable to reach the headwaters of the upper mainstem Eel River since Scott Dam was built between 1920 and 1922 without any fish passage. The discovery of the premature migration variant in rainbow trout above the dam and the Lake Pillsbury reservoir strongly suggests that, if passage to the Pacific were restored, the summer steelhead population that vanished in the upper mainstem Eel after Scott Dam's construction could be restored. Recovery of the lost Upper Eel River population of summer steelhead would significantly bolster the larger regional population's odds of survival.

There is more good news. With some prompting from conservationists, fisheries agencies may be moving to recognize these new insights and increase protections for surviving populations of Northern California summer steelhead. In September 2018, Friends of the Eel River filed petitions with both the state of California and the federal National Marine Fisheries Service (NMFS) seeking additional protections for Northern California summer steelhead. We asked NMFS to consider designating Northern California summer steelhead as a separate Distinct Population Segment (DPS) with an Endangered status.

Recall for a moment that steelhead are ocean-going rainbow trout. NMFS, an agency of the Department of Commerce, is responsible for steelhead because they are anadromous — they spend part of their life cycle in the ocean. On the other hand, the US Fish and Wildlife Service, part of the Department of the Interior, is responsible for freshwater fish, including rainbow trout. The services' joint "Distinct Population Segment," or DPS, policy, which applies only to steelhead, is an awkward agreement about their overlapping jurisdictions for *O. mykiss* populations that attempts to bridge the gaps between steelhead's almost infinitely plastic biology and inflexible federal regulations.)

Summer steelhead have been unable to reach the headwaters of the mainstem Eel River since the Scott Dam was built.

California doesn't use the DPS construct in its listing process under the state's Endangered Species Act, so we left the question whether to evaluate all summer steelhead populations in the state, or just the Northern California populations, up to the California Fish and Game Commission and the Department of Fish and Wildlife. The Fish and Game Commission is now scheduled to consider our petition at their June 12-13

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meeting in Redding. Given the Commission's decision earlier this year to move toward a state listing for spring Chinook (in response to a petition filed by the Karuk Tribe and the Salmon River Restoration Council citing the same research), we are cautiously optimistic we'll see a positive determination from the state of California.

Meanwhile, NMFS has also taken what could be the first steps toward an uplisting for Northern California summer steelhead. In an April 22 Federal Register filing, NMFS announced the agency has determined that FOER's petition to list Northern California Summer Steelhead as a DPS with Endangered status "presented substantial scientific information indicating the petitioned action may be warranted." Under the federal Endangered Species Act (ESA), NMFS will next conduct a status review to determine whether the uplisting FOER proposed is warranted. (The status review process is supposed to take 12 months, but petitioners have often had to sue years after blown deadlines to force federal agencies to decide in listing cases.)

A summer steelhead holed up on the Middle Fork Eel River. Photo courtesy Shaun Thompson, California Department of Fish and Wildlife

While NMFS employs some of the most expert biologists in the field, listing decisions have become highly politicized over the last few decades. Federal agencies including NMFS have generally been unwilling to take decisions opposed by economically and/or politically powerful interests.

When steelhead were listed under the Endangered Species Act (ESA), federal fisheries scientists were divided whether to lump winter and summer steelhead together, or to split them as separate entities. Based on early genetic evidence that summer steelhead in a given watershed are generally more closely related to winter-run fish in their watershed than to summer-run fish in other watersheds, the lumping view prevailed. So the steelhead populations protected under the federal ESA today include winter and summer runs across a given region.

For example, summer steelhead on the Northern California coast are listed together with winter-run fish from Redwood Creek in the north to the Mattole River and coastal streams on the Mendocino County coast in the south. The National Marine Fisheries Service (NMFS) assesses the current status of this Northern California steelhead population as "threatened."

The new science suggests that lumping summer and winter steelhead together will result in the loss of summer steelhead and their unique genetics.

The new science strongly suggests that lumping premature migrants with delayed migrants for conservation purposes, as current policy does, is likely to lead to the loss not only of premature migrant populations, but of the premature migrant gene itself. In this view, losing the populations of summer steelhead that survive today would be a final and serious loss, a local extinction, rather than the mere disappearance of a life history likely to re-emerge from the larger winter-run populations that remain.

This is basically because fish that get two copies of the premature migrant gene are fully summer steelhead (or spring chinook) — they are *homozygous* for that trait. But fish that have one premature migrant variant and one mature migrant — that is, *heterozygotes* — return to freshwater *in between* the premature migrants and fall/ winter runs, which is to say, in California's Mediterranean climate, the worst conditions of late summer and early fall, before fall rains restore flows. Heterozygotes are likely to be selected out of the population very quickly under most natural conditions. Thus, the continued existence of heterozygous fish depends on the persistence of the homozygous populations. Without those sources, UC Davis researchers contend, the premature migrant gene is likely to be lost completely.

This brings us to the second problem with listing Northern California summer steelhead together with winter-run fish in the same watersheds: summer steelhead populations are in much

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worse shape.

In a definitive 2017 review of the status of California salmonids [Moyle, Peter, Lusardi, Robert A, Samuel, Patrick J, Katz, Jacob V. E. August 2017. *State of the Salmonids: Status of California's Emblematic Fishes 2017*, UC Davis Watershed Sciences Center. A report commissioned by California Trout. 579 pp.], Dr. Peter Moyle (arguably the pre-eminent authority on California fishes) and his coauthors found the conservation status of Northern California summer steelhead to be 'critical,' a further decline from a 2008 assessment that had summer fish already facing a 'high' risk of extinction. (Both would appear to reflect a higher degree of threat than the ESA's 'endangered,' which means, essentially, likely to become extinct over the next century.) Across the region, Moyle et. al. note there are now far fewer adult summer steelhead than winter fish, estimating fewer than 1,000 adults returning to spawn across the region in any given year, and remnant populations numbering only in the hundreds of individuals in any given spawning stream.

As we've noted, summer-run fish are more vulnerable to human-created impacts than winter fish. Moyle et. al. summarized 15 major anthropogenic threats to summer steelhead, including three they assessed as having the potential to push the species to extinction in the next 50 years: major dams, agriculture (both conventional and cannabis), and disrupted estuaries.

However, Moyle et. al. also highlight the overarching threat to Northern California summer steelhead as the combination of existing impacts and anthropogenic climate change: "Northern California (NC) summer steelhead are in long-term decline and this trend will continue without substantial human intervention on a broad scale. Due to their reliance on cold water to over summer during the warmest months in freshwater and critical susceptibility to climate change, NC summer steelhead are vulnerable to extinction by 2050."

While many of the threats that have driven Northern California summer steelhead to their present peril are long-term problems not susceptible to any easy resolution — none greater than the regional warming and drying driven by anthropogenic climate change — there are some straightforward things we can do to help Northern California summer steelhead survive the coming decades. Most obvious is to remove Scott Dam, the 130-foot high structure on the upper mainstem Eel River that blocks all fish passage into about 10% of the river's headwaters.

A bald eagle feeding on spawned-out winter steelhead along the Eel River. Photo by Allan Campbell

Scott Dam is one of two dams on the upper mainstem Eel River that are part of the Potter Valley Project (PVP). Pacific Gas and Electric (PG&E), owner of the PVP and its dams, has now abandoned its 2017 effort to relicense the project, which appears to cost many times more dollars to operate than it generates in hydroelectric power. Proponents of keeping the Eel River dams face a June 28, 2019 deadline to submit proposals to FERC to take over the PVP and relicense it. If FERC does not receive a bid the agency can accept, it will likely require PG&E to prepare a dam decommissioning and removal plan.

According to a 2017 study by Humboldt State University grad student Emily Cooper, there are an estimated 288 stream miles of potential steelhead habitat above Scott Dam. This estimate of the utility of this habitat is substantially reinforced by the fact that those streams still have native rainbow trout in them, fish who have survived since Scott Dam blocked passage to the sea almost a century ago. The fact that many of the rainbows above what were thought to be possible steelhead migration barriers above the dam turn out to still be carrying two copies of the premature migration gene only reinforces the extraordinary nature of these fish.

The opportunity to restore steelhead runs in the upper Eel is one of the key reasons conservation, fishing, and tribal interests have been working toward removing Scott Dam on the upper mainstem Eel River. But until now, we didn't know that we might actually be able to reverse the local extinction of a vanished run. This could add another absolutely critical self-supporting population to the summer steelhead populations still hanging on in the Middle Fork Eel and Van Duzen River tributaries of the Eel River watershed.

Scott Greacen is Conservation Director for Friends of the Eel River. To learn more about their work visit their website at: eelriver.org

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FISH WATCH — WILD FISH NEWS, ISSUES AND INITIATIVES

World Salmon Forum Scheduled for August

The World Salmon Forum (WSF) is taking place in Seattle, Washington on August 21st to 23rd, 2019. Due to the continuing decline of wild salmonids globally, the timing of this event is imperative and long overdue. The WSF event will call for a paradigm shift in wild salmon management based on a place-based approach, with the goal of reestablishing wild Atlantic and Pacific salmon, wild sea-trout, and steelhead to levels of historic abundance.

Oregon Fishing and Conservation Groups Petition State for New Logging Rules

In late April, twenty conservation and fishing organizations delivered a rulemaking petition to the Oregon Board of Forestry requesting new rules to prevent logging-related harm to "resource sites" for coho salmon listed under the state and federal Endangered Species Act. Coho salmon, which are split into three evolutionarily significant units in Oregon, were first listed in Southern Oregon in 1997, and soon thereafter along the rest of the Oregon Coast in 1998. The Lower Columbia coho population was listed almost over a decade ago, in 2005.

While coho salmon have been threatened with extinction for years, the Board of Forestry has never initiated a state-mandated review of its rules to protect the fish even though

The Oregon Forest Practices Act affords fish and fish habitat the least protection of all the West Coast states. Photo by Jim Yuskavitch

the Oregon Forest Practices Act clearly requires the Board of Forestry to address conflicts between logging and habitat for species at risk of extinction. The conservation groups point out that there are major ongoing conflicts between logging practices and coho salmon habitat that need to be resolved.

Oregon has relied heavily on voluntary measures by timber companies to protect coho. Between 1995 and 2017, taxpayers invested $65 million dollars of public funds on instream habitat restoration efforts. However, Oregon's weak forest practices rules still allow logging to degrade aquatic habitat critical to the recovery of coho salmon.

Oregon's rules for state and private timberlands are the weakest in the Pacific Northwest. Oregon has dragged its feet in addressing problems that have long been identified by state and federal expert agencies such as intensive logging too close to streams and on landslide-prone areas, sediment from forest roads, and large areas dominated by clear-cuts and young plantations are perpetuating poor freshwater habitat conditions.

The Board has been taking a very slow and piecemeal approach to updating its policies. The last rule change took 15 years but still didn't address some of the biggest problems for salmon and water quality – and left the Rogue Basin and its salmon out of the picture entirely.

Frank and Jeanne Moore Steelhead Special Management Area Created on North Umpqua

On March 12, President Donald Trump signed S. 82, sponsored by Oregon Democratic Senator Ron Wyden that established the Frank and Jeanne Moore Wild Steelhead Special Management Area in the Steamboat Creek watershed on the North Umpqua River. The special management area specifies that managing for wild steelhead is a priority on about 100,000 acres in what is probably the most important steelhead and salmon habitat in the North Umpqua watershed,

Frank and Jeanne Moore talk steelhead conservation at their home along the North Umpqua River in 2016. Photo by Jim Yuskavitch

however other natural resources uses, such as logging, will still be allowed.

The designation honors Frank and Jeanne Moore, who live along the North Umpqua River. Frank Moore, now into his 90s, is a World War II veteran of the D-Day invasion who returned home to become, along with his wife Jeanne, among the river's — and its wild fish — most vocal and effective advocates, including a founder of the Steamboaters in 1966, a group of local angler-conservationists who still zealously guard the welfare of the river's wild steelhead population.

The establishment of the Frank and Jeanne Moore Wild Steelhead Special Management Area is an important legacy for the Moores' lifelong mission to conserve North Umpqua wild steelhead.

Columbia Basin Barbless Hooks Rollback

The Washington Department of Fish and Wildlife is considering ending requirements that anglers must use barbless hooks when fishing for salmon and steelhead in all areas of the Columbia River basin within Washington state. The rollback is based on some studies that say the mortality rate for fish caught and released on barbless hooks is not much better than fish caught with barbed hooks, and many anglers don't like to use barbed hooks as it increases the odds that a "fish on" will unhook itself.

The Washington Fish and Wildlife Commission has told WDFW to move forward with making barbless hooks voluntary rather than required by June 1 at the latest. Before that change can be implemented, WDFW must make sure that it does not violate any federal rules or policies governing Columbia River basin fisheries. The voluntary barbless rule would apply to all fisheries in the Washington portion of the Columbia River basin.

The Oregon Fish and Wildlife Commission is not considering a similar rule change for the Oregon portion of the Columbia River basin.

A new rule would makebarbless hooks voluntary when fishing in the Washington State portion of the Columbia River basin. Photo by Jim Yuskavitch

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