THE OSPREY

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An In-Depth Look at the Thompson River Wild Steelhead Crisis

ALSO IN THIS ISSUE:

WILD FISH CONSERVATION HITS AND MISSES • HATCHERY STEELHEAD REPLACING DESCHUTES REDBANDS • CLIMATE CHANGE AND SKAGIT SPAWNING TRIBUTARIES

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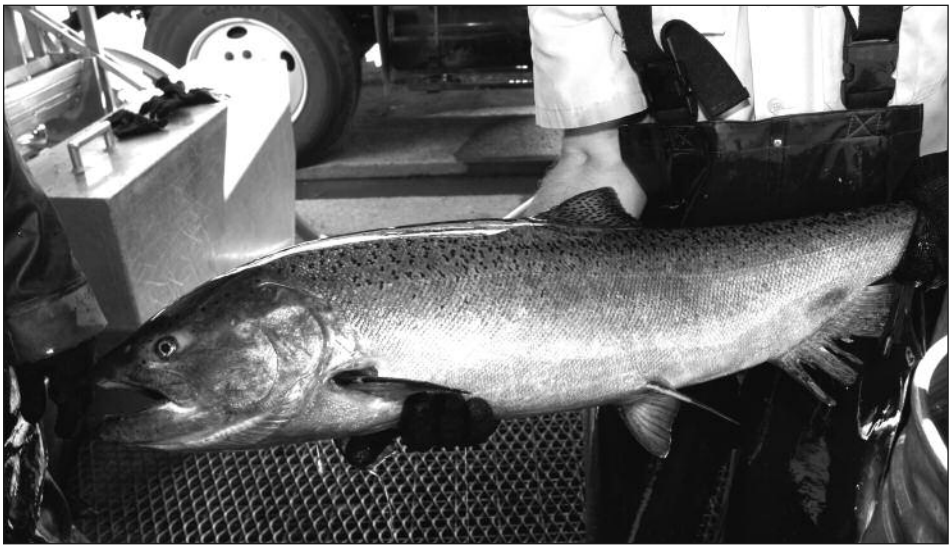

THE OSPREY

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Steelhead Society of British Columbia

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Singing the Shutdown Blues

by Jim Yuskavitch

As I write this column, it's the 31st day of the partial government shutdown, set off, as we all know by now, by a political dispute over whether or not to build a wall along the US-Mexico border.

And believe it or not, the shutdown has even affected *The Osprey*, causing a delay in some articles being turned in because authors affiliated with shuttered federal agencies were among the approximately 800,000 furloughed workers or the peer-review process held up.

While *The Osprey* is often critical of government management of our wild Pacific salmon and steelhead, many of our authors are government scientists, and many of the ideas for stories originate in federally-funded research.

And even though conservationists and wild fish advocates have many concerns and disagreements with government oversight of natural resources, nevertheless, the shutdown has also highlighted how important agencies such as the National Oceanic and Atmospheric Administration, US Fish and Wildlife Service, US Forest Service, Bureau of Land Management, National Park Service and Environmental Protection Agency are to the nation's publicly-owned fish, wildlife, water and land.

Perhaps the most disturbing stories of the negative impacts of the shutdown come from our national parks. Campgrounds are littered with garbage, overflowing restrooms and at least some people ignoring park rules that help protect their fragile environments. Visitors have been spotted (and sometimes photographed) walking off boardwalks onto sensitive meadows in Yosemite National Park and letting their dogs run free with wildlife at Yellowstone. Perhaps the most disturbing reports come from Joshua Tree National Park where people have driven their off-road vehicles across the desert, churning up the fragile soil, and at least one incident of someone knocking down an ancient Joshua Tree. In some cases, environmental damage perpetrated during the shutdown may take decades or longer to recover — if ever.

Even The Osprey wasn't spared the negative impact of the government shutdown.

Here in central Oregon where I live, who knows what kinds of damage is being done in the forest with a reduced presence of Forest Service staff where firewood theft and poaching ESA-listed bull trout are ongoing problems.

In addition, the shutdown has postponed wildfire-related work such as firefighter training and planning for prescribed burns to reduce fire danger in western national forests. That could translate into bigger, harder-to-extinguish fires this summer with potentially severe consequences for wild fish and fish habitat.

At least for now, I've not heard of any direct damage being done to wild Pacific salmon and steelhead fisheries because of the shutdown, but when agencies such as NOAA and the US Fish and Wildlife Service are closed or severly cut back, it doesn't help any. Neither does it help when agencies like the US Forest Service and Bureau of Land Management that play important roles in managing and restoring wild fish habitat are in the same boat. But if the shutdown is reinstated, we will surely see more repercussions for our wild fish resources.

There wasn't much wild fish advocates could do to change the situation. But as we work to move the natural resource agencies to better and more effective wild fish conservation and recovery policies, we also need to recognize the key role they play to eventually reach those goals.

How The Osprey Helps Wild Fish

T*he Osprey* has been bringing the latest science, policy, opinion and news stories to its readers supporting wild Pacific salmon and steelhead conservation and management for 31 years. But we are much more than a publication that you subscribe to because of your own interest in wild fish conservation. The funds we receive from our subscribers allows us send *The Osprey* to wild fish conservation decision-makers and influencers including scientists, fisheries managers, politicians and wild fish advocates.

Sending The Osprey to decision makers is key to our wild fish conservation advocacy. Your support makes that possible.

So when you subscribe/donate to *The Osprey*, you not only receive a subscription yourself, but you also help us put *The Osprey* into the hands of the people we need bring to our side to save our wild fish.

Please go to the subscription/donation form on page 23 or on-line at http://www.theconservationangler.com and donate whatever you are able. Thank you.

Jim Yuskavitch
Editor, The Osprey

Net Pens Out, Salmon Wasted

By Pete Soverel

In this and future issues of *The Osprey*, I will briefly touch on concurrent successes and failures regarding wild steelhead and salmon management. Sadly, setbacks typically outweigh progress, in large part because management agencies remain wedded to policies and practices that not only haven't worked, but have been demonstrably counter-productive. This general observation is particularly true regarding hatchery and harvest practices over which management agencies have direct control yet persist with actions that, based upon observable results, are positively counter-productive and harmful.

HITS

Atlantic Salmon Net Pen Phase Out

Washington State decides to phase out all open water Atlantic salmon net pens by 2025 as current aquaculture company leases expire and will not be renewed. This is huge and leaves British Columbia as the only remaining misguided authority permitting these environmental disasters to continue. Even in BC, under pressure from First Nations and local advocates, Broughton Archipelago net pens will be closed over the next five years.

Columbia and Snake Rivers Wild Steelhead Conservation

Faced with the lowest projected wild steelhead returns, especially Snake River B-runs, Washington and Oregon fish and wildlife commissions established a set of coldwater refugia on the lower Columbia River, where there are in-flows of cold water, to protect migrating fish that congregate in those locations. Idaho declined to enact any conservation measure to protect historically meager wild steelhead runs, which prompted a coalition of conservation organizations to sue because the Idaho Department of Fish and Game did not have Endangered Species Act permits to conduct any steelhead fishery. Indeed, Idaho had authorized illegal fisheries each year since 2010. Under this threat, ID F&G came to their senses and agreed to a series of conservation measures and submitted a fishing plan to the National Oceanic and Atmospheric Administration. But the plan they submitted is more or less identical to the last one it submitted in 2010. In our view, this plan is deeply flawed and should not be approved by NOAA without a full-scale federal environment review. After all the proof is in the pudding — wild Idaho steelhead are heading for extinction. In any case, the conservation coalition has changed the terms of debate in Idaho. It will no longer be business as usual.

Selective Harvest

Washington has approved a commercial demonstration project of a pound net in the lower Columbia (see page 21 for more information on this exciting, innovative harvest methodology).

MISSES

Failure to Protect Wild Salmon and Steelhead

The biggest miss is the on-going and complete failure of responsible management agencies to protect wild salmon and steelhead stocks throughout their American and Canadian ranges. Especially shocking are the status of stocks in the most productive systems — Sacramento, Columbia/Snake, Fraser, Dean and Skeena. For example, Columbia basin wild salmon and steelhead are in grave trouble, with many stocks facing high risk of near-term extirpation and hundreds of locally adapted stocks already extinct because their migration corridors are blocked by high, impassable dams. In aggregate, current wild Columbia salmon and steelhead populations are no more than about 1% and more likely about .25 of 1% of historic abundance. All surviving stocks have been listed as threatened or endangered under the federal Endangered Species Act for two decades. Over that period, stocks have continued to decline towards extinction in spite of legal, ESA requirements that management agencies must adopt programs and practices to promote their recovery. Declines in some stocks such as Snake River wild B-run summer steelhead and Willamette winter run steelhead have been dramatic. For example, wild Willamette winter steelhead returns have plummeted from about 11,000 to 800-900 in the past ten years or so.

Similarly, dire conditions apply to interior Fraser River steelhead stocks with current runs to the Thompson and Chilcoltin rivers totaling less than 200 fish. Response of the Canadian Department of Fisheries and Oceans, Provincial authorities and tribal managers is nothing, just business as usual. Even more shocking, the reported First Nation landings of steelhead is one. Let me repeat that — one. This doesn't even begin to pass the laugh test.

Many FN fisheries are completely unmonitored by federal, provincial or tribal enforcement personnel. Check out these photos of a typical fish waste incident. Contrary to official Department of Fisheries and Oceans and First Nations statements that the fish are collected, they are not. No DFO or FN enforcement folks show up, but FN folks try to minimize the impact by throwing

Here's one the First Nations monitors missed. Photo courtesy Symon Kirchner

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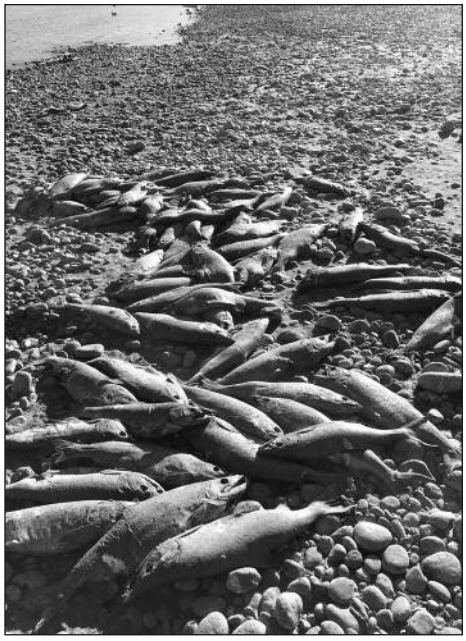
the wasted fish into the river.

These fish are all males. The females have been stripped for their roe while males are simply discarded. Want more?

Male salmon left to rot along the Fraser River, British Columbia. Photo courtesy Symon Kirchner

Over the next several issues, *The Osprey* will feature issues related to US/Canadian tribal/First Nations fisheries: how they are authorized; allocations fixed; monitored; enforced and; conservation issues related to double dipping — tribal fishers who fish in commercial openers, tribal openers, subsistence openers and so on. The first of that series is by Bob Hooton addressing Thompson River steelhead beginning on page 6.

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



Male salmon discarded along the Fraser River, British Columbia. Photo courtesy Symon Kirchner

LETTERS TO THE EDITOR

My Heart Leaped

Dear Editor:

My heart leaped up when I beheld the lovely new magazine named *The Osprey* in beautiful black and white with the fine fish-hunting hawk in what looked to me as an osprey in dive, not on a salmonid but on fish opinion of the world.

Each article, especially Jack Stanford and Rick Williams' *The Efficacy and Role of Hatcheries in Securing the Future of Pacific Rim Wild Salmon*, expressed *The Osprey's* long, long effort to bring facts, bring science to the many stubbornly ignorant who still have control of managing salmonids in this part of the world. It has been a long, hard slog on the part of *The Osprey* managers and editors. A slog that has to continue so long as salmonids swim and struggle to replicate their kinds.

I say bravo to editor Jim Yuskavitch for his excellent work and bravo to Chair Pete Soverel for foresight, efforts and skills in uplifting and maintaining *The Osprey*. If I may I also give kudos to John Sager, who eons ago struggled with the then primitive computers and my rush-rush editorial efforts to get the newsletter known as *The Osprey* out to hands waiting for science about the destinies of the fish who honor us with their presences.

Jack de Yonge
New Jersey

Editor's Note: Jack de Yonge was a long-time member of the Steelhead Committee and editor of The Osprey *from 1990 to 1993.*

Making a Difference

Dear Editor:

I wish to thank you on your article by Jack Stanford and Rick Williams (*The Efficacy and Role of Hatcheries in Securing the Future of Pacific Rim Wild Salmon, September 2018*). It clarified my thoughts on hatcheries. I was very pleased as it answered my many questions I have had over the years concerning hatcheries. When one has an animal that is so predictable as salmon, why screw it up? Watching those minnows swim round and round in a tank, it is amazing to me that they find their way home at all. I have said to myself while watching them, good bye to biodiversity. I certainly hope that your international journal will help make a difference.

Mike Harris
Comox, British Columbia

Managing Thompson River Steelhead to Zero

An in-depth look at a legendary river's wild steelhead crisis

By Robert Hooton

Readers of *The Osprey* are no doubt aware there has been a steadily developing conservation crisis with respect to British Columbia's revered Thompson River steelhead (TRS). The evolution of issues and processes surrounding those fish and their status is difficult to stay abreast of but it's worth a snapshot circa late 2018 nonetheless.

I suspect an early question that will surface among readers of these comments is why would a little-known, freelance, long retired government fisheries biologist sound off in an American based conservation oriented publication on a Canadian issue? Two answers – first, there is no similar publication north of the 49th parallel with anywhere near the reach of *The Osprey*. Second, Thompson River steelhead are an international treasure. They know no borders. The anglers who have experienced them are brothers and sisters of a common mother. To a one they are deeply concerned this one of a kind steelhead population is on the brink of extirpation. Canadian politicians seem oblivious to that fact. They need to be educated and held accountable for their negligence and dereliction of duty. The more I can do to educate the broadest possible constituency in the hope that enough pressure can be brought to bear to actually do something to arrest the demise of those fish, the better I will sleep.

I should clarify right at the outset that TRS are one of a group of steelhead, including Thompson, Chilcotin, Nahatlatch, Bridge, Seton and Stein, originating from tributaries of the middle reaches of the Fraser River upstream from Boston Bar (about 150 miles upstream from Vancouver). This group is identified as Interior Fraser Steelhead (IFS) on the basis of common genetics. The focus on the Thompson here and now is because the other IFS stocks have been so depressed for so long they have disappeared from the steelhead landscape. The Chilcotin River stock, for example, is now smaller than the southern resident orca population but how many people have ever heard of those steelhead? The only fish left to fight for are the Thompson's. For perspective, consider a comment by a retired professional colleague upon receiving the most recent status report on TRS. "J---- C-----, there are more people on the distribution list than there are steelhead!"

Some Background

TRS are not just a unique stock among the 450 or more separately identifiable stocks in British Columbia. That habitually applied word falls well short of recognizing the stature of these fish. They are big, they have a long known genetic make-up that imparts superior swimming performance (i.e. they commonly fight like hell) and they arrive in a river with enough volume and gradient during the season when water temperature optimizes aggressiveness. Together these are the attributes that underlie those frequent numerous accounts of epic angling encounters. Road access, accommodation and services immediately at hand and all within a day trip of Vancouver — where else has such a combination of features been so readily available in modern times? It helps that the river is classified, guiding is forbidden and boats have been a relatively minor feature of the fishery for most of its history. The most preferred stretch of the river around the confluence of its major tributary, the Nicola River, was ruled out of bounds for fishing from a boat decades ago.

Thompson River steelhead are an international treasure. Anglers who have experienced them are deeply concerned they will soon be extirpated.

The TRS fishery does not have anywhere near the longevity of other legendary fisheries such as those of several California streams, Oregon's Umpqua and Deschutes rivers , Washington's Skagit or Idaho's Clearwater. It only emerged on the angling scene after the Second World War and the improvements in road access through the Fraser Canyon and beyond. By then the Thompson's steelhead had already been subjected to 75 years of commercial fishing by fleet sizes that dwarf those of the present. Seasons bracketed the entire spawner immigration timing as well as the kelt emigration period. The only things that ever constrained commercial gill netting of the mainstem Fraser all through its tidal reaches in those years was winter ice and the debris that accompanied headwaters snowmelt in spring.

It wasn't until the late 1970s that the first attempts to establish steelhead abundance commenced. The estimates from that point forward are best illustrated by material developed by the provincial steelhead management biologists.

The low point in Figure 1 represents the final number of steelhead (150) estimated to have made it to spawning in the spring of 2018. Clearly that is the all time low. The prediction for 2019 is only marginally higher.

The three zones identifying spawner populations theoretically required to meet abundance levels that would accommodate different sport fishing management regulations. Those zones and the theory behind them are described in a 2016 document titled "Provincial Framework for Steelhead Management in BC". For those who are interested in reviewing that framework, it can be found at:
http://www.env.gov.bc.ca/fw/fish/docs/Provincial-Framework-for-Steelhead-Management-in-BC-April-2016.pdf

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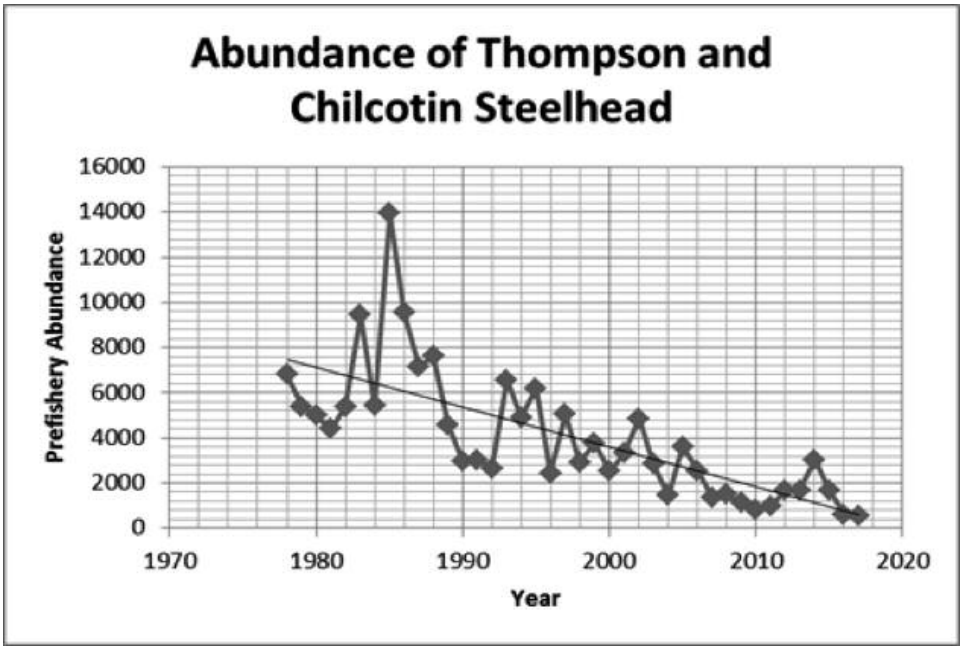

Figure 1. The estimated pre-fishery abundance of Thompson and Chilcotin steelhead from the time provincial government biologists first began concerted efforts to make those estimates to the present. Thompson steelhead contribute roughly 75% of these numbers. Source: Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

recover when less than half of such a pathetically low escapement goal is being realized. Such a number obviously fails to accommodate any sport fishery. It also implies that if by some stoke of luck the stock ever did recover to that level or anything beyond, it would be entirely acceptable to fish the stock right back down to that level.

As we will see below, the people who prepared and signed off on the steelhead management framework have virtually no ability to move Thompson River steelhead out of the extreme conservation concern zone. That is not a reflection on their commitment or dedication but merely a statement on the political realities of the times.

Jurisdictions

Multiple jurisdictions with competing mandates and objectives are never a recipe for effective resource management. Any British Columbia steelhead that approaches fresh water in times and places where commercial and First Nation (FN) fisheries are prevalent face major obstacles in that respect.

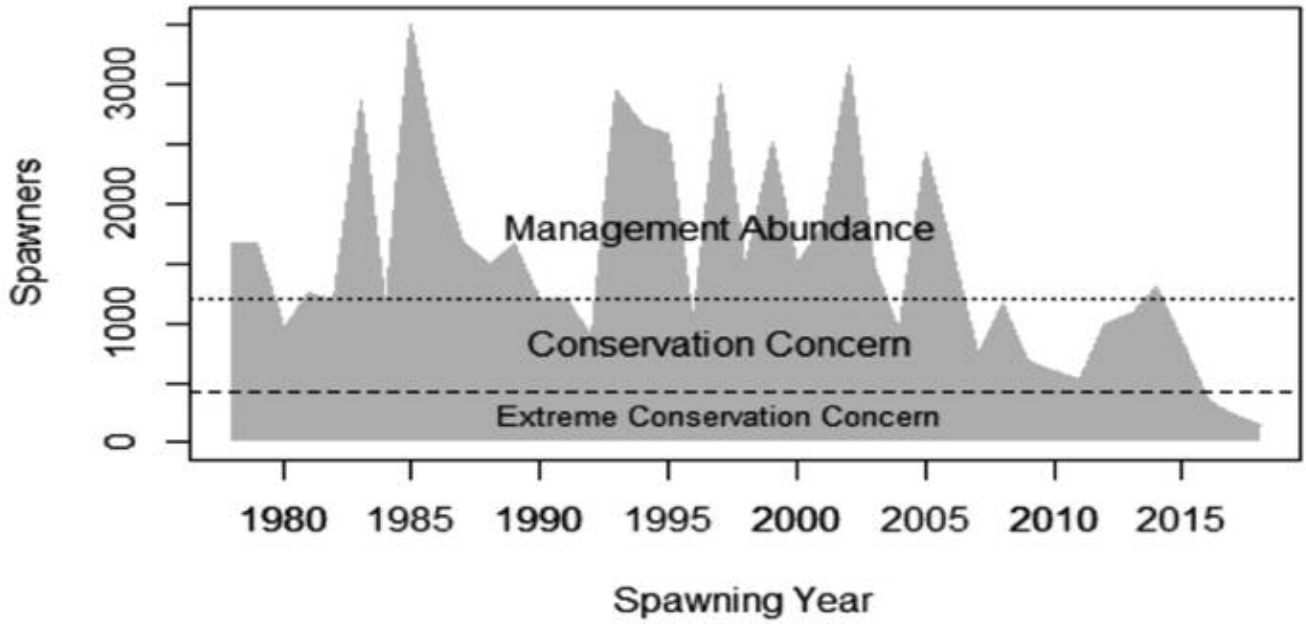

Figure 2. Thompson River steelhead spawner abundance. Source: Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

Stated simply and in the context of the status of Thompson River steelhead, all a person needs to know is the threshold for falling into that "extreme conservation concern zone" is the stock is at less than 10% of the abundance needed to seed the steelhead producing habitat of its river of origin. Moreover, that is only in a perfect world where the ratio of males to females is optimal and the spawners are distributed perfectly over the total available steelhead-producing habitat. What are those odds? If you're like me, you'll probably wonder why a river system whose stock specific Chinook and sockeye salmon escapement targets number in the thousands and tens of thousands (even hundreds of thousands in the case of Adams River sockeye), respectively, is expected to

The federal government's Department of Fisheries and Oceans (DFO) has domain over all recreational, commercial and FN fisheries in both marine and freshwater environments. However, administration of the freshwater recreational fishery has been delegated to the Province of British Columbia. On

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surface that would appear manageable. It isn't and it is getting worse in that respect.

Within the provincial government hierarchy there are now multiple ministries (the provincial analogue of US federal departments) with a stake in the future of TRS. The ministry most people assume is in charge is Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD). (How's that title for emasculating fisheries management?) In fact, it is another Ministry (Agriculture) that assumes the lead role. That relates to the Agriculture people being the licensing and marketing agency for the commercial fish processing industry and its products, including farmed Atlantic salmon. When steelhead run timing overlaps that of commercially targeted species like sockeye and chum salmon, and pressure is brought to bear on DFO for announcing commercial and First Nations net fishery openings that obviously impact Thompson fish, the only provincial voice ever heard by DFO comes from the Agriculture people. Complicating the picture is the presence of two other provincial ministries — Aboriginal Affairs and Reconciliation and Environment. The former's title speaks to its mandate. The latter is supposed to address environmental issues but also compliance and enforcement. Conservation Officers who at one time dealt almost exclusively with fishing and hunting now spend very little time on these traditional activities.

Both federal and provincial governments espouse the gospel of the United Nations Declaration of the Rights of Indigenous People and trumpet the word reconciliation at every opportunity. Underlying all of that is the Canadian Constitution Act (1982) that affirmed and recognized the rights of aboriginal people and laid the foundation for the existing order of priority in terms of fisheries management, namely, 1) conservation, 2) food, social and ceremonial use by First Nations and 3) commercial and recreational fisheries. The net effect is steelhead simply do not warrant anything other than lip service from either federal or provincial governments.

The emergence of a third and equal level of government, First Nations, has become an integral component of life in Canada. Between our constitutional obligations and multiple court decisions pursuant to them we find ourselves in an era where we are compelled to have "free and informed prior consent" for any resource management decisions perceived to impact First Nations. In the context of managing fisheries that influence the status of Thompson River steelhead, this manifests itself in DFO being compelled to consult and negotiate any fishery that might have bearing on those fish. Between DFO's chronic negligence and denial with respect to the influence of fisheries under its jurisdiction on steelhead and the large number of individual FNs spread along the TRS migration corridor, such a system cannot possibly reduce pressure on those fish.

DFO's denial of the influence of commercial and First Nations fisheries cannot reduce pressure on Thompson River steelhead.

Management

No one can influence the number of Thompson bound steelhead departing central North Pacific pastures. Our intervention begins when they enter the south coast waters of BC and must pass through seine and gill net fleets. The fish have two possible migration corridors to Mother Fraser. One is down the outside of Vancouver Island and around its southern tip, through Juan de Fuca Strait and into the river. The other is inside down through Johnstone Strait (see map). In earlier years the split between inside and outside routes was important because mixed stock net fisheries off Nitinat (near the entrance to Juan de Fuca Strait) intercepted Thompson bound fish. More recently those nets have been moved inshore and presently do not appear to impact TRS. The other fisheries, the Johnstone Strait gill net and seine fisheries are much more problematic. When unleashed by DFO to harvest late returning sockeye salmon and, immediately thereafter, chum salmon, TRS are exposed.

Genetics work and salmon focused test fisheries conducted by DFO and the Pacific Salmon Commission (PSC) have provided all the necessary background to understand when and where TRS steelhead are encountered. The PSC test fishing sites are located on the following maps. The DFO sites are fewer but also cover Johnstone Strait and the lower Fraser River. The standard method of estimating the in-season abundance of TRS for at least the last 30 years is the chum test fishery that DFO runs at Albion, at essentially the same location as Whonnock on the maps on the following page.

Management of the fisheries that impact TRS most has nothing to do with their abundance. Despite their status as endangered and recommended for listing under Canada's Species At Risk Act, not a single fishery under the jurisdiction of DFO and known to impact those steelhead has ever been adjusted accordingly. Talk yes, adjustments no. The only fisheries that are ever managed according to anticipated abundance of target species are those focused on chum and sockeye salmon. International treaties force that approach for sockeye while the price of chum roe is the primary driver of the latter. These remarks speak only to the commercial fishery interception of steelhead. The other fishery of greater significance today is the First Nations fishery that occurs everywhere from the mouth of the Fraser and all along the migration corridor of TRS, all the way to Kamloops Lake. Keep in mind there are also FNs fishing with either owned or contracted vessels that partake of regular commercial fisheries in tidal waters, both near shore and through the tidal areas of the lower Fraser itself. There is also a documented fishery by FN anglers targeting TRS in the Thompson River itself in the winter months.

Whereas the textbook description of fisheries management implies knowledge of target species abundance, harvest safely available, a system of administering and quantifying harvest and adequate monitoring of compliance to ensure harvest is not exceeded, that is clearly not the case for steelhead. Last year was a prime example. There were exactly two steelhead encountered by DFO's Albion test fishery between October 1 and its termination on November 23. Alarm bells were ringing loudly for three weeks before that. Yet, DFO called multiple seine and gill net openings in Johnstone Strait and further south before and since. Worse still,

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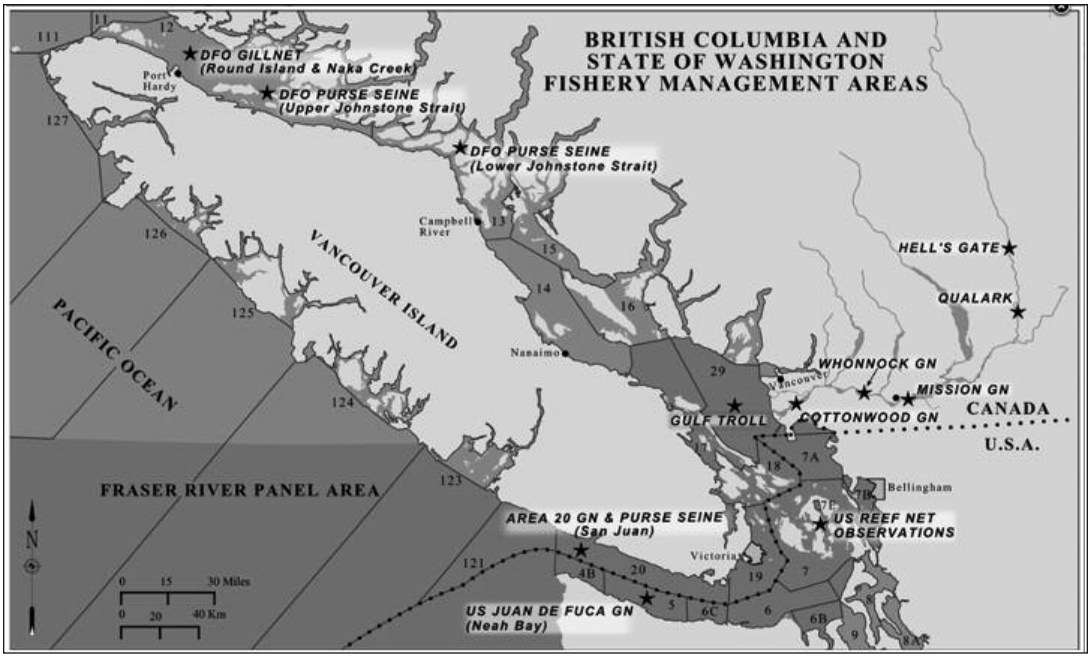

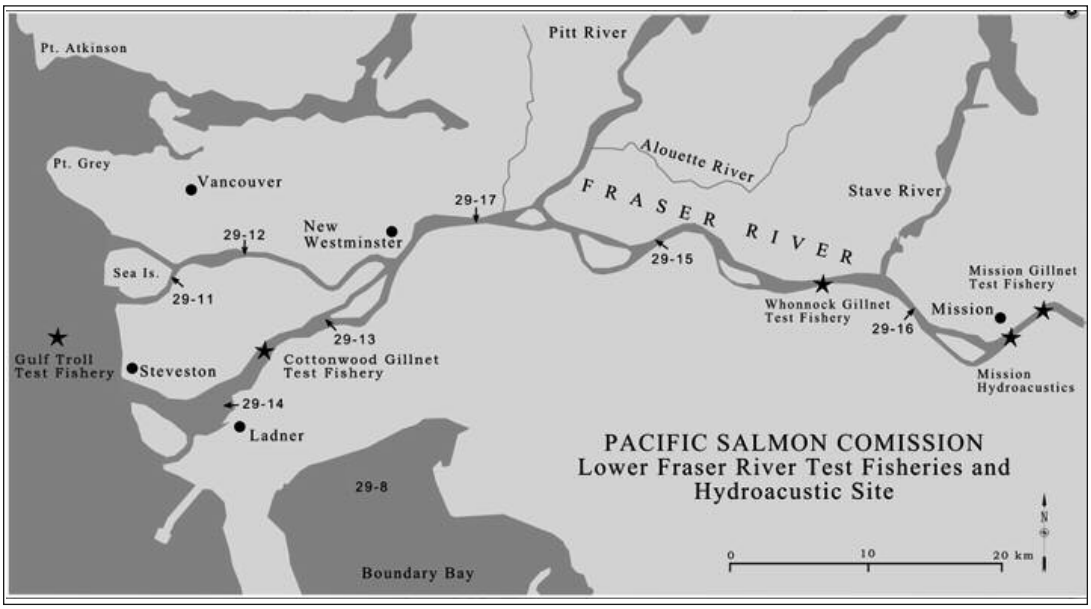

Source: Pacific Salmon Commission

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the legally sanctioned FN fisheries which were mandated as beach seines only (because they are deemed to be "selective") all through the late returning Adams River sockeye run timing were promptly replaced by gill net fisheries targeting chum salmon as soon as the sockeye were thought to be past. The fact that the chum and steelhead run timing overlap never enters the consciousness of the people who control those fisheries.

The legal FN fisheries are only part of the story of the impact of their fisheries on TRS. Beyond DFO authorized fisheries there is a very obvious unsanctioned fishery that no one has ever dealt with successfully. There are multiple eye witness descriptions and an abundance of photographic and video evidence of FN net fisheries accounting for large numbers of salmon, oftentimes with nothing more taken than the roe from chums. These accounts typically elicit expressions of righteous indignation from FN leaders and commitments to deal with transgressors. No one seems able to provide evidence that ever happens or that the frequency of incidents has diminished. The politics involved preclude the intervention of DFO enforcement officers as anything more than messengers.

In terms of quantifying the impact of any of the net fisheries on TRS (or any others in British Columbia) the formal records are embarrassing. For example, the published DFO tally of FN territory by territory, week by week harvest of steelhead between the mouth of the Fraser and the lower Fraser Canyon (~115 miles) over the entire period when interior bound steelhead would be expected to be present (September 1 through early November) over the past four years is two fish (one in 2018 and one in 2016). There are no records whatsoever for the substantial FN fisheries that occur anywhere upstream, nor is there any acknowledgement of that previously mentioned harvest of TRS by FN anglers who fish the Thompson in winter. Square that with DFO's records of steelhead caught by its Albion chum test fishery. In making two sets per day (one hour each), often only on alternate days the single test fishery net caught 28 steelhead in that same period.

The reported commercial catch of steelhead is no better. Commercial fishers learned long ago that acknowledgement of actual steelhead catch could never be to their benefit. DFO is fully aware of the deficiencies of their published catch data but has never footnoted or qualified its own numbers. Over time, they are interpreted and applied as ironclad evidence of no problem by those whose interest is not served by disclosure or conservation. Alaska figured it out many years ago when the interception of Skeena origin steelhead by its net fleets in Districts 104 and 106 (Southeast Alaska) was brought to light. They made that issue disappear quickly with the simple measure of forbidding the landing and retention of steelhead. No data equals no problem.

In terms of summarizing fisheries management and how it is prosecuted in relation to TRS (and, in fact, steelhead in general), the description is quite simple: The recreational fishery in times and places where TRS are likely to be encountered has been closed since 2017. For many years before that the Thompson itself was reg-

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Level of control exercised by managers and fishery that influences abundance of Thompson River steelhead

Variable	Commercial	First Nations	Recreational
Harvest Management	Low	Nil	High
Catch Accounting	Low	Nil	Moderate
Enforcement	Nil	Nil	High

Source: Robert Hooton

ulated on a single barbless hook, artificial lure only, catch and release basis. No credible case can be made that fishery has had any impact on TRS returns over that period and more. The recreational fishers swallowed the bitter pill of closure because DFO contended they could not restrict the FN fisheries if any recreational fishery remained open. Given the extent of the sanctioned and unsanctioned fisheries the FN community has been conducting on the Fraser River this year, one can only ask how DFO passes the red face test for conservation after the recreational fishers, the least impactful by far, have voluntarily stopped fishing.

Anecdotal Observations

Thompson River steelhead are renowned for their size, as indicated previously. They are also on the high end of the fecundity spectrum. That has been a large part of the rationale for such low thresholds for the aforementioned zones of conservation concern and extreme conservation concern. There is a very important pattern evident, however. The maximum size of TRS has been on a downward trend for the past 40 years. From those trophy winning weights in the high 20-pound class and frequently breaking 30 pounds up until 1978, the maximum size has dropped steadily to range between the high teens and low 20s since about 1990. In fact the weight of the largest steelhead sampled by the provincial biologists since 1990 was about 25 pounds and there have been only four other years since then where the largest fish recorded reached 22 pounds. None of the fish sampled in the last four years exceeded 20 pounds. Predictably, there has been a corresponding decline in the number of recruits per spawner, from between 9 and 13 in the mid-1980s to less than 1 in the past 2 years.

The age composition of TRS has not changed, so the decline in maximum size can only be related to growth at sea. This is a mirror image of wild Chinook stocks along the Pacific coast. In Southeast Alaska there is a long-term data set on wild fish originating from a large number of streams whose habitat is unaltered over the period of record. The pattern of declining size at age is also common there. Commensurate with that there has been a major reduction in the age composition of female spawners. Formerly dominant 4 to 6 year olds have been replaced by 3 year olds whose fecundity and average egg size translates to escapement requirements far in excess of what they were given the original age composition of the stock. These stocks are subject to fishing mortality at sea, however, and that has much to do with declines in the number of fish that reach age 4 to 6. Whereas TRS do not display declining age at spawning because they don't get harvested by commercial fisheries to the same extent as Alaska Chinook they do exhibit declining size at age.

The other steadily accumulating evidence of problems at sea concerns the potential overloading of the entire north Pacific and Gulf of Alaska ecosystem with hatchery origin chum and pink salmon. Alaska's ocean ranching proponents are no small part of that problem but Japan's chum hatcheries are an even bigger issue. A ten-fold increase in hatchery chum output over the period of record has been shown to influence the primary food items available to both Chinook and steelhead. The ultimate link to TRS occurs when the returns of enhanced Japanese chum fail, as they did in 2018, driving the demand for chum roe from this side of the Pacific upward. The commensurate rise in price of that luxury product encourages ever more targeting of mature chums for nothing more than their eggs. The most concentrated fishery for those chums occurs in the estuaries and rivers of southwestern BC. When there are 150 TRS migrating through

A close up of the annual Thompson River steelhead trophy derby winners of yesteryear and the weights of their winning fish. Those are the kinds of steelhead the Thompson once produced. Photo by Robert Hooton.

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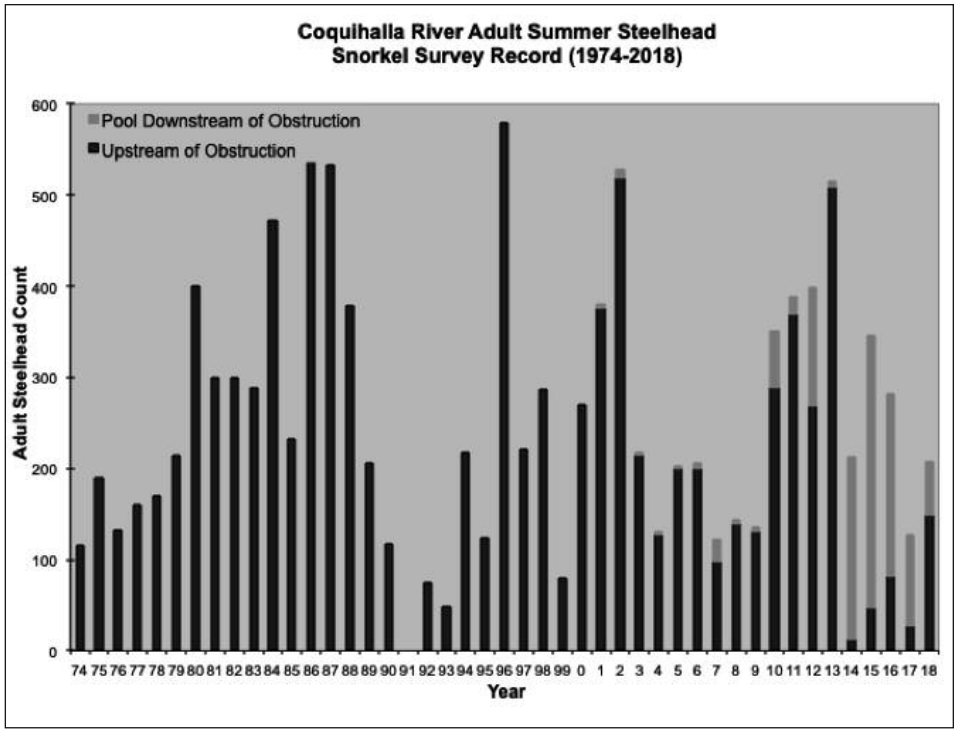
the same waters as a million chum salmon (the DFO forecast for south coast chum salmon in 2018) the addiction to the lucrative chum roe fishery trumps conservation.

The point in raising declining size at age of TRS is to emphasize the importance of increasing escapement, not just to previously calculated thresholds, but to levels well beyond to offset the negative influence smaller and fewer eggs on recruitment of smolts and, eventually, adults. Given the point on the stock recruitment curve TRS are at, the only logical method of improving their status is reducing harvest to ensure the fish that do begin a homeward journey from their ocean feeding grounds arrive on redds.

The other instructive piece of data that I see no evidence has ever been considered in debates around manageable factors influencing the number of TRS making it home is the annual counts of summer steelhead in the Coquihalla River, a coastal summer steelhead tributary of the Fraser about 100 miles east of Vancouver. To those who contend seals are responsible for population declines because they eat all the smolts and/or that ocean productivity, not nets is the limiting factor, I say please explain the figure on this page.

Coquihalla smolts exit the Fraser at the same time and via the same route as TRS smolts. Logically, they occupy the same ocean at the same time and travel the same migration routes on their return. The argument that the TRS habitat has been seriously compromised doesn't hold up either. The Coquihalla has suffered far more habitat abuse than any part of the Thompson. Furthermore, the steelhead producing area of the Coquihalla is a tiny fraction of the Thompson's. The only difference between the two stocks is the Coquihalla fish travel through BC coastal waters and the lower Fraser before the net fisheries for salmon are underway. They enter the Fraser during runoff when high water and debris limit FN fisheries even if there was enough early returning Chinook salmon left to invite netting effort at that time. Whereas we have no hope of influencing ocean rearing conditions and little prospect of harvesting enough pinnipeds to make any difference (even if they were proven to be a problem for TRS) we can exercise full control over nets if we are serious about conservation.



Source: Coquihalla River snorkel survey, Ministry of Forests, Lands, Natural Resource Operations and Rural Development

Processes

The one big lesson we should have learned by now it is that process is never an answer. It would take no small book to list the number of government and non-government sponsored groups, organizations, societies, associations, councils, alliances, secretariats, etc. that have engaged in many dozens at least of meetings, symposiums, summits, conferences, or whatever, all with the intent of conserving Thompson River steelhead. I challenge anyone involved in any of those processes to produce evidence a single TRS has been saved as a result. Even a submission by the University of Victoria's Environmental Law Center on behalf of BC's largest fish and wildlife advocacy organization, the BC Wildlife Federation, to Canada's Auditor General requesting an examination of Canada's failure to protect endangered Pacific salmon and steelhead under its own Species at Risk Act (SARA) has gone unanswered for more than seven months.

The future of TRS rests with the ultimate process now unfolding. That is the DFO facilitated public consultation on the recommendation of Canada's designated science community experts (COSEWIC) to proceed with the SARA listing of the stock group, Interior Fraser Steelhead, which Thompson River steelhead dominate — all 150 of them — as endangered.

The ultimate decision will not rest on the worth of Thompson River steelhead as an angling treasure or on their symbol as the canary in the coal mine. Instead, it will almost certainly center on the sheer economics of conservation. If one wades through the plethora of material DFO has put in circulation, the only conclusion likely is the cost-benefit of conserving TRS is daunting. Significantly constraining, much less ending, lucrative commercial and First Nations fisheries for the sake of 150 steelhead whose only supporters are a bunch of anglers who can't get on the same page and have taken themselves out of the equation by agreeing to cease fishing, is a pretty unlikely outcome.

Robert Hooton retired as supervisor of the Fish and Wildlife Section for the British Columbia Ministry of Environment's Vancouver Island Regional Office in 2008.

A Changing Climate and Steelhead

The race for survival in Washington's mid-Skagit tributaries

By Bill McMillan

After ten years of conducting independent spawning surveys at five mid-Skagit River Basin tributary creeks in Washington State, several salmon and steelhead spawning year proved particularly revealing for steelhead. The findings suggest that while a warming climate may increase steelhead spawning mortality in Washington State's Skagit River tributaries, natural selection may also increase overall survival by selecting for earlier spawning fish, especially as the Washington Department of Fish and Wildlife phases out planting of hatchery fish.

From the first fall rains with salmon entry, until the end of steelhead spawning in latter May or early June, I have conducted independent spawning surveys since 2009/10 at five primary Mid Skagit River tributary streams (O'Toole, Mill, Savage, Finney, and Dry creeks). 2018/19 is the 10th year of doing so. In three of the most recent four survey years, the probable effects of progressing climate change have been particularly evident. Particularly dry periods in April/May have resulted in those tributary creeks that are intermittent going dry earlier than occurred in the past 20 years of living near these streams. Two of these go dry every year (Savage and Dry creeks), and one some years but not others (Mill Creek). Furthermore, one of the perennial tributaries has numerous side channels that are intermittent and are going dry earlier than in the past (Finney Creek). Only one of the five streams regularly surveyed has been relatively unaffected in recent years from its past history of being perennial throughout and cool of flow (O'Toole Creek). The first year of particularly dramatic change occurred in the flow patterns in the spring of 2015 that happened to also coincide with a significant increase in returning wild steelhead spawning at two of the five tributaries (O'Toole and Finney creeks). The report that follows was written at the end of the 2015 spawning season. It was distributed to a relatively long list of people responsible for Skagit Basin fisheries management, and to those known to otherwise have interests in Skagit Basin steelhead and what recovery progress may, or may not, be occurring. The report provides a discussion of what was found in the spring of 2015 and what the implications for the steelhead future may be for similar steelhead spawning streams in the Skagit Basin.

Since 2015 the wild steelhead spawning returns to Finney and O'Toole creeks have continued to greatly increase, more modestly increased at Mill Creek, slightly increased at Savage Creek, and have significantly declined at Dry Creek. Savage and Dry creeks are the most severely affected by intermittency duration, where past hatchery steelhead spawning was most frequently observed, and with the least evidence of wild recovery progress to date. A great contrast in wild steelhead recovery progress is evident in the five mid-Skagit tributaries regularly surveyed. The evidence suggests that recovery progress can differ by specific tributary hydrological characteristics, and by past hatchery steelhead interaction history.

Findings suggest that a warming climate may increase spawning mortality, but natural selection may also increase overall survival.

The spawning return at Finney Creek was greater than any in the recent past to comparatively draw from (past high 20 redds found in 2014 compared to 101 redds in 2015). This increase in spawning evidence provided the opportunity to draw more conclusions from the observations made. It also coincided with weather and stream flow conditions that may provide a glimpse of what the increasing effects of climate change will result in the coming 10 to 50 years and the challenges that will confront fisheries managers for effective wild steelhead recovery.

As one example, I recorded precipitation with a rain gage near the mouth of Savage Creek's entry to the mid-Skagit River beginning in the fall of 2001. The average rainfall in that time for the April/May period was 10.456" but in 2015 was 6.885", only 66% of the average. May's rainfall was only 1.4" in 2015 compared to an average of 4.216", 33% of average and the lowest rainfall in 15 recorded Mays. This coincided with a winter of little snow accumulation, particularly at the lower elevation hills that surround the mid-Skagit Valley. Yet, winter rainfall was at least normal. High and low temperatures throughout Puget Sound's fall and winter were well above normal, causing this anomaly and divergence from past winter trends of normal-to-better snow accumulation during normal-to-better rainfall years (see Cliff Mass, University of Washington meteorologist, May 18, 2015 weather blog http://cliffmass.blogspot.com/).

Intermittency of stream flows during the previous five years of surveys has been identified as a probable primary driver of steelhead spawning time in mid-Skagit tributaries that begin to go dry by late June (Figure 1, from McMillan 2015). It was also thought that more general patterns of streamflow variations during the spawning season and water temperatures also likely contributed to steelhead spawning time that may otherwise vary to some degree by these environmental factors — as much as 30 to 40 day differences in spawning time peaks. However, there were not specific enough streamflow and temperature data taken from which to find very significant correlations to steelhead spawning time. Recognizing this, during each spawning survey at

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each creek during the full extent of the October 2014 through May 2015 salmon/steelhead spawning season, water and air temperatures were methodically taken. Although it remains that tools to determine daily streamflows were not available, the temperature data taken compared to whether steelhead spawned earlier (prior to March 15th) or later (after March 15th) helps to further explain some of the variations in steelhead spawning time associated with intermittent streams (Figure 2).

Although Finney Creek appears to be an outlier in an otherwise greater percentage of early steelhead spawning coinciding with ascendance of warmer average water temperatures, the high stream temperatures in May of 2015 may be particularly anomalous to those of the past at Finney Creek. Finney's source is considerably higher elevation than the other four creeks surveyed with more commonly lingering effects of snowmelt to its flow than at the others. But this year there was little such contribution to Finney Creek's flow after April. Also, in January and much of February, Finney Creek posed difficulties for me to do spawning surveys, which was often high with turbid flows. This may have resulted in lack of finding better evidence of early spawning that may have actually occurred. This was not similarly a constraint on the smaller creeks.

Particularly revealing from the water temperature data taken in 2014/2015 are those of Savage Creek just below a large pond as compared to those measured just above it, and to those of Finney Creek (Figure 3). During most of the fall and winter, Savage Creek below the pond was about one degree Fahrenheit (F) warmer than just above the pond. However, after cold spells during which Savage Pond had iced over and the ice remained for several days even after the weather warmed, it resulted in lingering colder temperatures by a degree or two (F) below the pond than above it. By mid-March the temperatures below the pond began to increasingly diverge with greater warmth from those above the pond. As much as intermittency, these rapidly warming temperatures may result in discontinuation of most steelhead entry for spawning purposes into Savage Creek as evidenced by nearly all steelhead spawning there being prior to March 15th (94% overall in the period of 2010-2014, and 100% in both 2014 and 2015).

At Finney Creek, water temperatures were often colder in winter than either location at Savage Creek. However, beginning in early May it began to quickly diverge from Savage Creek above the pond and by the end of May was nearly as warm as Savage Creek below the pond where heat accumulates in the pond from mid-March onward. This is likely explained to a large extent by the extremely dry May with resulting rapid diminishment of Finney Creek stream flow due to lack of snow accumulation in its headwaters. Finney Creek in late May of 2015 exhibited flows more characteristic of late July in previous years. Due to past logging that has resulted in a very wide stream channel that is fully exposed to sunlight, without snowmelt contribution, its water temperatures rapidly reached the mid-60 F range by late May. There has been little, if any, prior climate history to which Finney Creek steelhead have adapted from which to adjust to this rapid shift in stream flow conditions of May 2015. The streamflow height remained sufficient for steelhead to enter from the Skagit River until late May, but spawning

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Figure 1

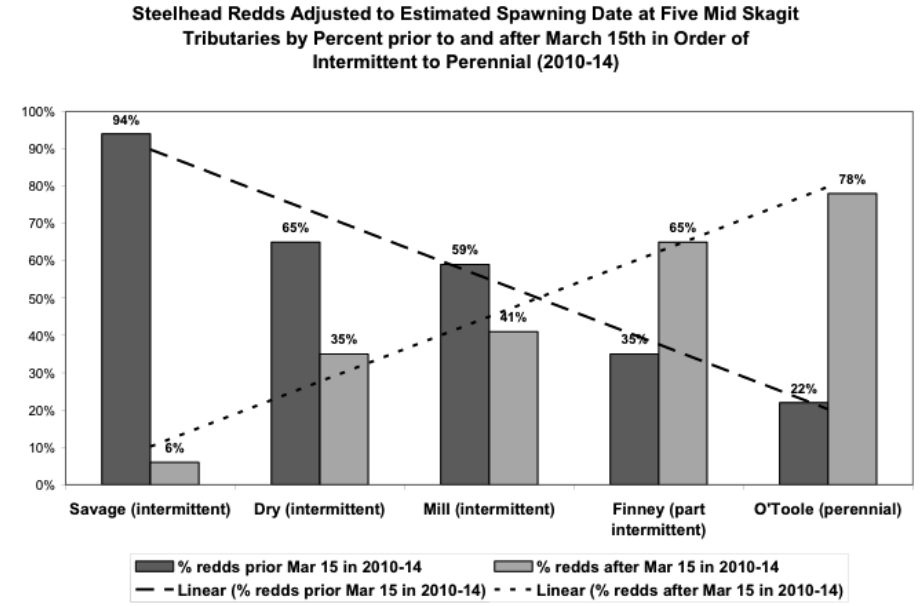


Figure 2

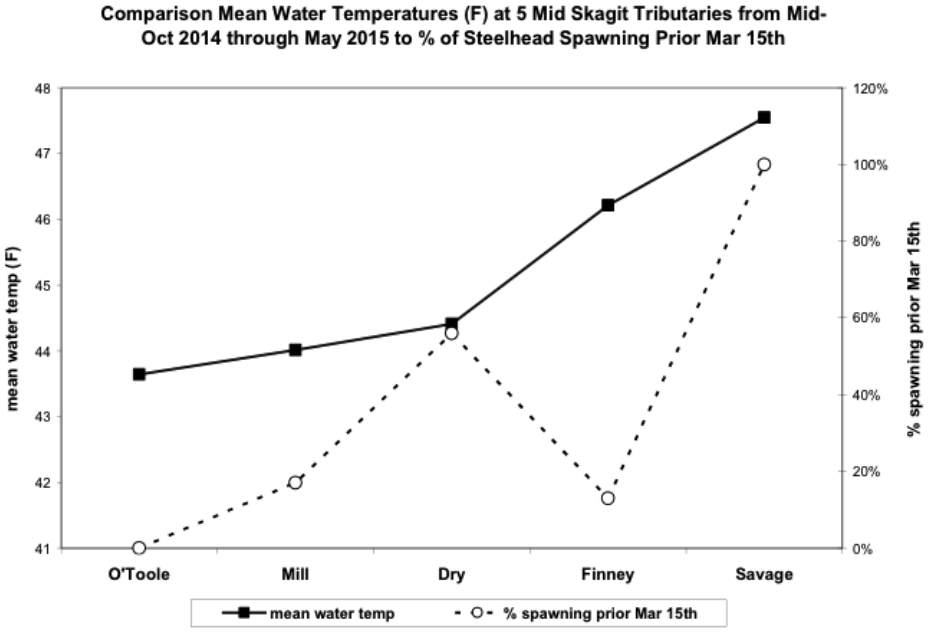
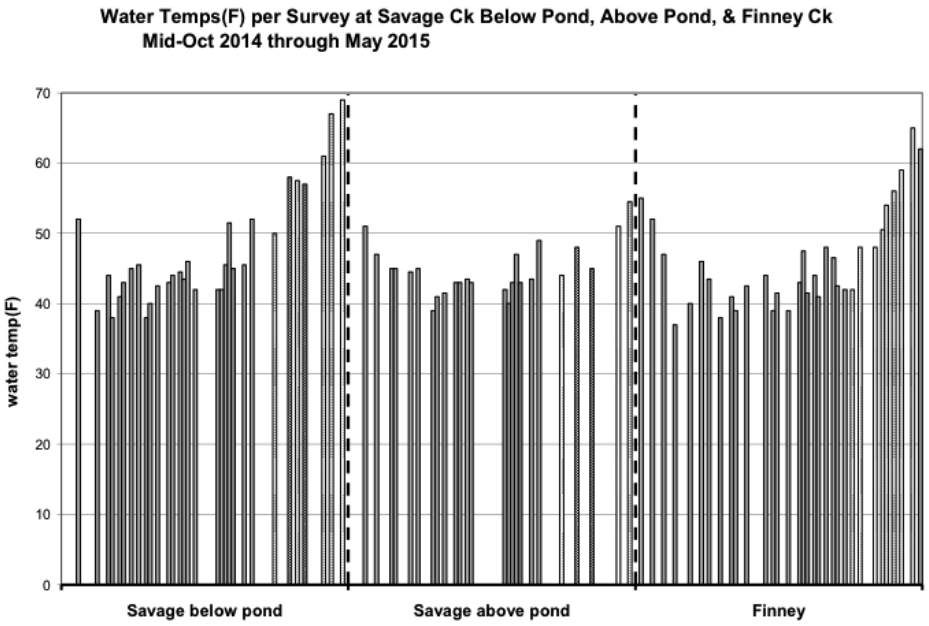


Figure 3



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rapidly dropped off in the final week. May 2015 had a greater proportion of all spawning than prior years.

Finney Creek and O'Toole Creek are the only streams of the five regularly surveyed that had a continued prospect for steelhead entry and spawning after the first week in May 2015. Unlike Finney, O'Toole Creek retains a relatively cold and sustained flow throughout the summer — at least in the past. It has always been perennial. Finney Creek, however, diminishes to very low flows by August combined with late afternoon water temperatures that can be 70 F or more on days when high air temperatures are greater than 80 F. Given the present diminishment in Finney Creek flow by late May, it is conceivable that parts of lower Finney Creek's main channel could go dry by late summer if drought conditions continue to escalate. Its numerous side channels have commonly done so in the past, sometimes by early June, although not the mainstem.

Finney Creek steelhead often have concentrated spawning at side channels, particularly at their inlet and outlet areas, but sometimes throughout the channel. Side channels are likely somewhat less affected by higher flow events in winter and early spring with diminished effects from potential scour. Downwelling or upwelling through redds at the upper and lower ends of side channels may also be conducive to higher egg-to-fry survival. However, 2015 proved to be a race of egg-to-fry emergence early enough to be unaffected by side channels dewatering. To some degree this has occurred before, as had been documented in late May of 2014 at a Finney side channel beginning to go dry where young-of-the-year steelhead fry were photographed along with other species. Although no steelhead redds were observed in that side channel, steelhead fry apparently dispersed into it from other hatch locations for rearing. Due to the greater spawning escapement, steelhead utilized a greater extent of Finney Creek's available spawning gravel in 2015 than in the past. This included greater use of the side channels.

Lower Finney Creek, in a half-mile section below the entry of Dry Creek, had particularly greater spawning use by later returning steelhead than in the past. This is despite a main channel shift that left a quarter mile of the former mainstem channel vacated. All the spawning was concentrated into the remaining final quarter mile of the half-mile total survey length. One side channel in that latter quarter mile had particularly high steelhead spawning use. Photos 1 and 2 portray part of this spawning use as on May 6, and again on May 28, 2015 showing dramatic changes in streamflow and the redds going dry. Yet, as shown in Photo 3 the steelhead fry had already emerged and were schooled in the bottoms of these redds. They were still capable of moving downstream to the main channel of Finney Creek if they outmigrated before this side channel went completely dry. These steelhead fry emerged within 21-42 days after the estimated spawning dates based on how old the redds looked from algal growth on them. However, based on the size of some of the fry that were larger than others, their emergence must have been 7 days or more earlier with some redds older than estimated.

Table 1 shows estimated lengths of time for steelhead to hatch and to

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Table 1

Temperature	Days to Hatch	Days to Emerge	Total Days to Emerge	Reference
2 C (35.6 F)	115	---	---	Quinn 2005
5 C (41 F)	68	---	---	Quinn 2005
8 C (46.4 F)	42	---	---	Quinn 2005
11 C (51.8)	28	---	---	Quinn 2005
14 C (57.2)	22	---	---	Quinn 2005
5.5 C (41.9)	80	---	---	Hardy 2002
10 C (50 F)	31	20	51	Hardy 2002
15 C (59 F)	19	10	29	Shumway et al. 1964
10 C (50 F)	35*	---	---	Shumway et al. 1964
5 C (41 F)	80	2-3 weeks	94-101	Wales 1941
15 C (59 F)	19	2-3 weeks	33-40	Wales 1941
10 C (50 F)	50	---	somewhat later	Wydoski & Whitney 1979

*** Dissolved oxygen considerations from Quinn 2005: decreased O2 delayed hatching at 10 C (50 F) from about 35 days to 40 days in steelhead as cited from Shumway et al. 1964.**

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emerge from time of egg fertilization as previously compiled from available literature (McMillan 2015). Given that Finney Creek had water temperatures at afternoon to evening of 55-65 degrees F throughout the month of May, it apparently accelerated the emergence times enough to potentially allow fry of even relatively later spawning steelhead after mid-March to get out of the gravel and be free-swimming within the 21-42 day period since spawning was estimated to have occurred. This is despite the fact that in latter March and through much of April the Finney Creek water temperatures were 41-48 degrees at afternoon and evening and would have slowed development. The other alternative is that the actual ages of the spawning redds were older than estimated, which is entirely possible as well. Nevertheless, it does seem possible that the recently accelerated warmth of Finney Creek has resulted in a race between late spawning and diminishing streamflows that at least some of these fry may ultimately win. However, even if the majority, or even all, lose this race, it will eventually result in a selection for earlier spawning as was found in other side channel areas (Photo 4) and a population that will increasingly evolve toward earlier spawning as climate and environment will dictate. But this can only occur if management allows substantial numbers of steelhead that enter the Skagit River early (November to February) to effectively increase in numbers to fill the many tributary creeks of the Skagit basin where intermittent flows will increasingly become the norm. Intermittency is also becoming earlier. Dry Creek (of lower Finney Creek) went dry in its lower 200 feet by May 31, 2015 as compared to just prior to June 28, 2014.

The proportion of overall steelhead fry in Finney Creek basin that include one or more parents of hatchery origin likely emerge earliest. It is known from observations of participants on an active redd at Dry Creek by WDFW surveyors (pers. comm. Andrew Fowler of WDFW) that at least one hatchery origin male was spawning there with a wild female on January 28, 2015. It was present on another redd the next day with a group of 3 other steelhead of unknown sex and origin. At mid Savage Creek (130 m above a large pond) a possible coho redd of very fresh construction was located on February 10, 2015 although its large size suggested possible steelhead as well. At least 9 steelhead fry associated with it were photographically documented on May 5th and again on May 19th (Photo 5). It was subsequently determined to be a steelhead redd with fry emergence likely in April based on their size of about 2 inches in length. This confirms the need to make collections for steelhead genetic determinations in May at the early fry life history level if hatchery parentage is to be found before their numbers are culled out. Chambers Creek origin hatchery steelhead are known to have low survival in the wild and rapid loss would particularly occur at the fry stage in intermittent creeks with no inherent guide to quickly migrate downstream.

The observations of what may drive steelhead spawning at the mid-Skagit tributaries and how it may vary by stream, by temperature, and by presence of a pond or lake are nothing particularly new. Much of this has been found to be a general rule of thumb for fall spawning salmon as described by Quinn (2005):

"*... there is surprisingly little research on the variation in adult reproductive success as a function of spawning date, and the relationship between fry emergence and survival has only recently received attention. Many researchers have pointed out that populations spawning in cold rivers do so earlier in the year than those using rivers with milder temperatures ... Salmon also tend to spawn earlier at higher latitudes, and this seems to be an adaptation of populations to their local environment ... For example, the outlets of lakes typically have milder winter temperatures than their inlets, and sockeye tend to spawn later in the outlets (Brannon 1987). This presumably results in synchrony of emergence because all populations need to strike the same balance between food availability, temperature, and predator avoidance in the lake, though this hypothesis is seldom really tested.*"

However, with winter/spring spawning steelhead, the effects differ somewhat as found in mid-Skagit tributaries. There is a reverse effect in that warmer streams seem to promote earlier spawning, not later, and the pond/lake effect is part of this although, perhaps more importantly, there is a re-

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Photo 1

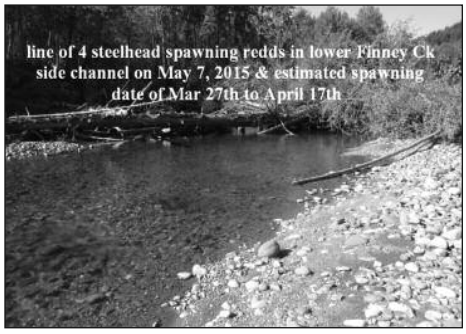


Photo 2

Photo 3

Photo 4

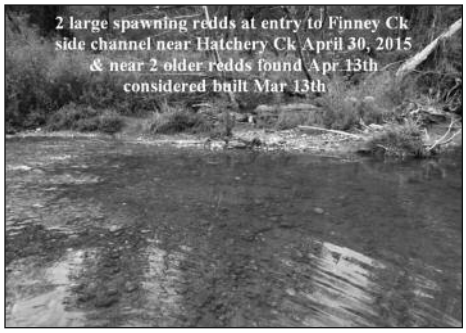
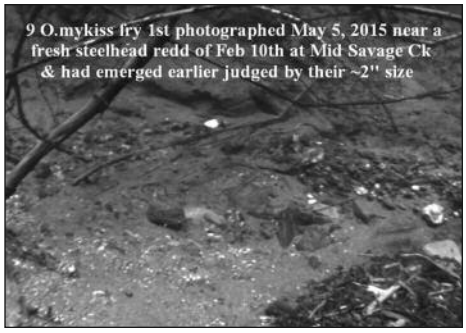


Photo 5



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lationship of warmer temperatures also further enforced by intermittency of flows.

But it gets more complex as there are apparent genetic differences within populations of a species for more or less rapid rates of embryo development to emergence (again from Quinn):

"*... In addition to variation in developmental rates among species and among rivers as a function of different thermal regimes, there is also variation among populations exposed to the same temperatures (e.g., Beacham and Murray 1989). For example, Brush Creek, on Vancouver Island, has distinct populations of early- and late-spawning chum salmon. Despite the separation of spawning dates, all the fry migrate to sea synchronously because the early population develops slower, for a given thermal regime, than the later one (Tallman 1986; Tallman and Healey 1991).*"

In the case of the Skagit basin, genetic sampling in 1980 of juvenile steelhead at over 50 areas of the basin found most of the genetic variation occurred in the smaller tributaries, not the larger mainstems (Phillips et al. 1981). In fact, each of the tributary populations appeared genetically distinct from the others. In the case of Finney Creek, and perhaps others, is it even more complex? Are there genetically different populations within Finney basin as well with differing spawning timings that have different egg-to-fry emergence rates? It has been found that Dry Creek of lower Finney basin has a greater percentage of early steelhead spawning than mainstem Finney, but there is also now evidence of late spawning steelhead in mainstem Finney Creek that may have very rapid egg-to-fry development.

The recent Finney Creek findings of rapidly rising water temperatures in May coinciding with late steelhead spawning the same month raises yet another question regarding predicted continuation of climate change with warming. At what upper temperature limit does steelhead embryo mortality occur which may render steelhead spawning unproductive? Yet again from Quinn:

"*In addition to the rate of development and hatching, survival (or mortality if you are more pessimistic) is the other key issue during the intragravel period. Very low and high temperatures can be lethal but are probably not a major cause of embryo mortality in most situations. Murray and McPhail (1988) incubated embryos of the five salmon species at 14°, 11°, 8°, 5°, 2°C. Each species had a slightly different pattern (and there is also variation among populations), but survival was generally poor at 2°and 14° and good from 5-11°. Salmon generally do not spawn in water near the upper lethal temperatures, and lethal low temperatures are not reached in most coastal systems ...*"

Shifting climate conditions may move steelhead toward earlier spawning but will require restoring early returning wild runs.

What is the actual lethal high temperature threshold for Skagit basin steelhead? Does it differ between the mainstem and the tributaries, and further vary by tributary and even within tributaries?

At Savage Creek, very few steelhead were found to spawn after March 15th in 6 years of spawning surveys conducted there between 2010 to 2015. There may have long been a selective factor for this, although colder water temperatures do occur at Savage Creek above the upper large pond it flows through than below it. For instance, on May 19 the Savage Creek flow just above entry to the pond was 51 F, but just below the outlet it was 67 F, a 16-degree difference. In the case of Finney Creek, there has been no recent history, at least in the past 17 years of my residing near it, of this rapid increase in water temperatures from late April to the end of May as occurred in 2015 (Table 2). Potentially low survival, or lethal conditions may have occurred for embryo development from May 17 onward. This may minimize or even negate steelhead spawning success that occurred throughout May of 2015 in Finney Creek. The only estimates of embryo survival to water temperature relationships were found for salmon, not steelhead. It could be that steelhead embryo development may continue to successfully occur at warmer water temperatures, or otherwise vary by differing hydrology characteristics of specific tributaries. Nevertheless, it is a particularly important consideration given the predicted future of climate change and Pacific Northwest conditions that may come to resemble those of California in the 20th century.

Table 2. Finney Creek afternoon/evening water temperatures (April 30-May 28, 2015)

Date	Water Temp (F)	Water Temp (C)
4-30-2015	48	8.9
5-6-2015	50.5	10.3
5-7-2015	54	12.2
5-15-2015	56	13.3
5-17-2015	59	15
5-28-2015	65	18.3
5-31-2015	62	16.7

Figure 4 portrays the steelhead spawning at Finney Creek in 2015. The redds observed were adjusted to reflect their estimated spawning dates from varied degrees of algal growth on them or other criteria such as filling of redd pits with sediment, or otherwise decreased definition of the redd. Of the early spawning that occurred (13% prior to March 15th), it can be anticipated that 50-67% of the spawning included hatchery steelhead participants as found in mid-Skagit tributaries in the five year period of 2010-2014 from observations of active spawning that then occurred (McMillan 2015). Of the late spawning that occurred, the period of potential lethal water temperatures for embryo development is depicted. However, the lethality of the dotted line on the far right might well extend to early May due to high temperatures those embryos would eventually endure unless emergence is rapid enough to counteract it as a result of the same temperatures.

Over the next 11-12 years with elimination of hatchery plants in the Skagit basin, natural selection toward more early spawning may occur without the cumulative effects of Chambers Creek hatchery steelhead presence (from the

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Figure 4

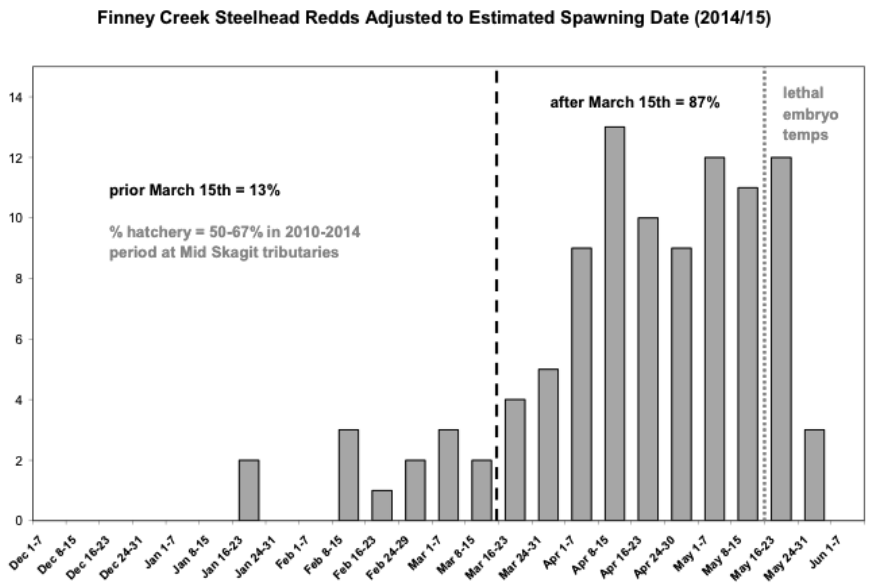
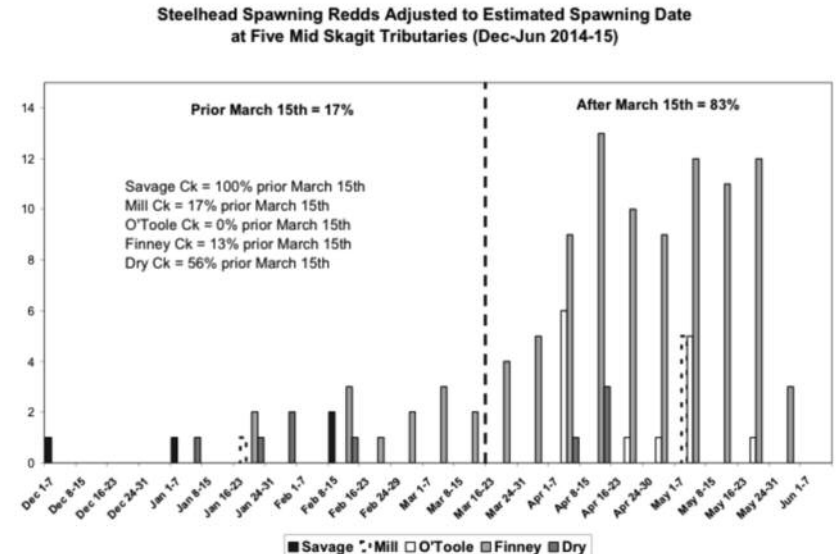


Figure 5



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standpoint of focus of early harvest fishing effort on the early steelhead, decreased predator attraction during smolt outmigrations, and spawning ground interactions that can limit wild productivity). Also, given the shifting climate conditions, natural selection may now progressively move steelhead toward earlier entry and earlier spawning as warming temperatures may well require. However, management of steelhead would have to allow this to occur with focused efforts to recover the earlier return component of wild steelhead life history options.

Finney Creek in 2015 has received what may be the largest wild steelhead spawning escapement to occur in the past 15 years or more. During the January through May 2015 spawning season, 101 steelhead redds were counted (Figure 5) in the 4.5 miles (7.24 km) of mainstem Finney surveyed of which winter steelhead most commonly use a total of 6 to 7 miles (9.66-11.27 km) for spawning. This would result in a mainstem total of 135 to 157 steelhead spawning redds, given the fact that the length that was not surveyed is at least as good spawning habitat as the surveyed reach. (This excludes 9 steelhead redds found at Dry Creek and 1 steelhead redd found at Quartz Creek, both tributaries of Finney.) This increased escapement will likely provide a stronger base for natural selection to draw from in 2015 at Finney Creek with greater ability to adapt to climate change by this steelhead spawning population. Although wild steelhead returns have generally been increasing in the Skagit basin since 2010, this trend can level or reverse at any time if ocean and/or freshwater environmental conditions take a downward turn from those of the past 7-8 years. For instance, the coming summer conditions may greatly limit juvenile steelhead survival and similarly limit this year's seeming escapement benefits.

The Skagit wild steelhead future remains at a critical edge that holds great biological interest for the outcome, but a scientific opportunity may be missed if the quality of the monitoring is insufficient to effectively guide the concept of adaptive management.

Fish biologist Bill McMillan is a longtime wild fish advocate who has published many papers on the subject. He is currently Archivist for The Wild Fish Conservancy.

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Hatchery Steelhead Replacing Native Redbands on Deschutes Tribs (Among Other Problems)

By Jim Yuskavitch

Two recent studies have confirmed that hatchery steelhead raised at the Round Butte Hatchery are genetically replacing wild redband trout in Whychus and McKay creeks, two important wild fish tributaries of the Deschutes River in central Oregon.

The most recent study, *Genetic determination of stock origin for* Oncorhynchus mykiss *collected in the Upper Deschutes River Basin*, conducted by the US Fish and Wildlife Service and Portland General Electric was released on July 24, 2018.

The study's objective was to "evaluate the genetic relationship between Round Butte hatchery origin steelhead and *O. mykiss* [wild, native redband trout] collected from Whychus, McKay and Ochoco creeks in 2016." Whychus Creek is a tributary of the Deschutes River while McKay and Ochoco creeks are tributaries of the Crooked River, which, along with the Metolius River, is one of the two main Deschutes tributary streams.

Juvenile hatchery steelhead, raised at the Round Butte Hatchery located on the Deschutes River at Round Butte Dam, have been released into Whychus Creek since 2007, and in McKay and Ochoco creeks beginning in 2008. Since that time, almost seven million hatchery steelhead have been released in the upper Deschutes basin above the three-dam Pelton-Round Butte Hydroelectric Project.

The releases of hatchery steelhead juveniles in the upper Deschutes basin is part of a major effort to restore steelhead runs, along with spring Chinook and sockeye salmon, which were blocked by the construction of the dams. The two lower dams, Pelton and Pelton Reregulating dams were completed in 1958, with the third, uppermost dam, Round Butte Dam, was finished in 1964. Pelton Dam created Lake Simtustus, while Round Butte Dam created Lake Billy Chinook where the Crooked and Metolius rivers flow into the Deschutes.

Historically, spring Chinook salmon migrated into the upper basin in the Deschutes, Crooked and Metolius rivers. The upper Deschutes and Crooked rivers had a summer steelhead run, while the sockeye run was restricted to the Metolius River and up into Suttle Lake. In fact, this was only one of two native sockeye runs in Oregon, with the other at Wallowa Lake in the northeastern part of the state, also extirpated.

Researchers found that wild redband trout in Whychus Creek were genetically indistinguishable from Round Butte Hatchery steelhead.

While fish passage was provided at the dams, they never worked very well and it wasn't long before the salmon and steelhead runs in the upper basin vanished.

In 1994, Portland General Electric, which owned the dam complex, began the application process to relicense the project for another 50 years. It was granted the license by the Federal Energy Regulatory Commission in 2005. As part of the agreement, the Confederated Tribes of Warm Springs, on which much of the hydro project is located, became co-owners of the project, and PGE and the Tribes agreed to help fund a massive effort to return the extirpated salmon and steelhead runs to the upper river basin.

PGE researchers during the course of trying to determine the most effective ways of passing fish over the dams made a surprising discovery. The cold water from the Metolius River and the warmer water from the Crooked River mixing with Deschutes River water in Lake Billy Chinook, created currents that confused downstream migrating

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Completed in 1964, Round Butte Dam created Lake Billy Chinook. The collection and selective water withdrawal facility is at left. Photo by Jim Yuskavitch

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juvenile fish, and offered at least a partial explanation for the ineffectiveness of the original fish passage facilities. Salmon and steelhead that may have successfully reared in the upper rivers became lost in the reservoir's currents as they migrated downstream and were not able to find the fish passage at Round Butte Dam, essentially becoming stranded above the dams.

To solve the water current problem, PGE constructed a "selective water withdrawal tower" in the reservoir that mixes the different water temperature layers in the reservoir to create a current that leads downstream migrating smolts to a collection facility from where they are trucked below the project and released into the Deschutes River. Similarly, upstream migrating adults are captured at a fish trap at the Pelton Reregulating Dam at river mile 100 and trucked above the hydro project and released.

The decision to use hatchery steelhead (and hatchery spring Chinook salmon) to repopulate the upper basin was made simply because the original wild stocks are gone. But now some serious unintended consequence are arising as a result of that decision.

The genetic samples taken in 2016 of wild, native redband trout in Whychus, McKay and Ochoco creeks yielded some disturbing data. The researchers found that "O. mykiss from Whychus Creek are genetically indistinguishable from Round Butte hatchery" steelhead where 90 percent of the sampled fish had genes traceable to the hatchery steelhead. That number was 26 percent for McKay Creek redbands and 25 percent for Ochoco Creek redbands.

And the influence of hatchery steelhead genes has increased over the years. Genetic data collected from Whychus Creek redbands in 2013 found that 75 percent were associated with hatchery genetics. That same study also found that only 3 percent of McKay Creek fish were genetically identical to the hatchery steelhead. There was no earlier genetic data for Ochoco Creek redbands.

The reintroduction has encountered other unanticipated problems as well. First and foremost, poor returns of upper basin adult fish. Although the first adult spring Chinook salmon came back to the upper basin for the first time in 40 years in 2012, returns have been far below expectations.

In 2018, only five upper Deschutes basin origin spring Chinook salmon were captured at the Pelton fish trap. Photo by Jim Yuskavitch

A volunteer releases steelhead fry into Whychus Creek in 2007. Photo by Jim Yuskavitch

For spring Chinook, the Oregon Department of Fish and Wildlife identified 1,000 fish returning to spawn in the upper basin each year as its "vision of success," based on the estimated amount of upriver habitat available for producing juveniles. But since 2012, fewer than 60 upper basin origin spring Chinook have shown up annually. In 2018, only five spring Chinook salmon returned, and just 20 in 2017. The highest return year was 2016 with 54 fish.

The picture for summer steelhead is even worse. Although 128 upper basin origin adults returned in 2012-13 it has been a downward trend since then with 96 for 2013-14, 93 in 2014-15, 75 in 2015-16 and 39 for 2016-17. Only 25 upper basin origin summer steelhead returned for 2017-18. In addition, most of the adult steelhead trucked and released above Round Butte Dam have tended to go into the Crooked River, the most water quality and habitat limited of the three rivers due to extensive agriculture and ranching activities in that watershed.

The situation is just as bad for the sockeye. While there was a relatively high return in 2016 of 529 fish, that dropped to 56 in 2017 and just 39 in 2018.

The restoration strategy is a little different for sockeye. Since Lake Billy Chinook had been stocked with kokanee for many years that included broodstock from the orignal sockeye population, fisheries biologists thought that if the kokanee had downstream fish passage a portion of them would migrate out to sea and come back as sockeye. Unfortunately, that has not been the case, probably because the old Suttle Lake/Metolius River genes have been completely eliminated from Lake Billy Chinook kokanee from decades of hatchery plants.

Another unintended consequences involves the approximately $150 million

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selective water withdrawal tower in Lake Billy Chinook at Round Butte Dam. By mixing the different temperature layers in the reservoir, it is sending warmer water downriver from the dams than previously, which is causing some significant ecological changes in the lower Deschutes, covered in the January 2017 issue of *The Osprey*. Some of these impacts include high pH levels along with excessive algae growth, a change in the makeup of macroinvertebrates that includes more non-insect species such as snails and worms that are more tolerant of degraded stream environments, and an increase in black spot disease in lower Deschutes bull trout caused by flatworm parasites. The declines in river and angling conditions are also affecting the small lower Deschutes community of Maupin whose economy is highly dependent on fishing, rafting and other river-related businesses.

In 2016, the Deschutes River Alliance filed a lawsuit against Portland General Electric to enforce temperature, pH and dissolved oxygen requirements as required by the Clean Water Act certification that the company was given to operate the hydroelectric complex. But after some initial victories, the courts ruled that PGE was not violating its clean water certification. The Alliance is currently appealing its case to the federal 9th Circuit Court.

However, there is some positive news in all this. The anticipation of restoring the upper Deschutes basin anadromous fish runs has brought millions of dollars in federal and other grant money to central Oregon that federal, state and local government agencies along with land trusts, watershed councils and other conservation groups have been using to purchase important riparian areas, restore degraded habitat and offer aquatic related environmental education programs.

The selective water withdrawal and collection facility cost an estimated $150 million to research and build. Photo by Jim Yuskavitch

The only thing missing is the fish.

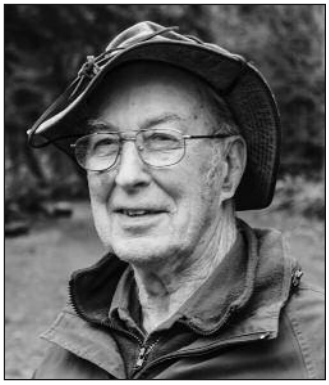
Jim Yuskavitch is editor of The Osprey. *Some of the information for this story was provided by the Deschutes River Alliance. You can find out more about its work on the Deschutes River at: www.deschutesriveralliance.org*

IN MEMOIRIUM

Howard Johnson (1925-2019)

By Sean Gallagher

In early January, my close friend, long-time wilderness fishing partner, and conservationist, Howard Johnson died. Howard and his wife Doreen, who pre-deceased him, left a stellar record of conservation achievements: leadership roles with the Washington Steelhead Trout Club, and Steelhead Committee of the Federation of Fly Fishers; The Doreen Johnson Conservation Area along the Green River (58 acres); and Mother Earth Farm. It is difficult to separate their accomplishments because they worked as a team. For example, several years ago they inherited Doreen's parent's farm in the upper Puyallup Valley. It was prime real estate; the developers were salivating; there was real money in the offing. But the property was also prime farmland bordering a salmon producing river. They gave it to the Emergency Food Network to farm. Mother Earth Farm as it is called produces nearly 100,000 pounds of fresh organically grown produce for our local food banks. Howard threw in his tractor.



Howard was my life-long friend and mentor. It started when I was a 16 year old kid with my hair on fire about steelhead. I wanted to know all of Howard's secrets. He was just what a kid needed — steady, knowledgeable, patient, generous. He took me under his wing schooling me on the Skagit and Green rivers. Over time, we began making frequent trips together. You get to know someone really well when you shared Howard's tiny 1966 Alaskan eight foot pop-up camper ("The Howard Johnson Motel") for weeks at a time on some remote river bar on Vancouver Island with a warm crackling fire on a starry winter night, miles from pavement, steelhead finning in the riffles. To us it was a little slice of heaven.

There were many tents, campers, and cabins shared over the years, and not just with me. Every year for decades Howard would journey deep into the Skeena and Stikine River watersheds with his good friend and fellow steelhead slicker Ed Conroy. Pete Soverel and John Sager spent weeks, even months together exploring the wilds of British Columbia and the Russian Far East—to mention a few.

Knowledgeable, reliable, and witty are all words that describe Howard. He also had a great sense of humor and laughed at his own quirks such as his special order, stripped down Chevy Suburban (AM only radio) for which he paid a substantial premium over loaded vehicles available on local lots! Then came that mischievous smile.

Everyone who fished with Howard has a story. Howard believed no one is perfect, he wasn't. He was simply the perfect buddy. His family suggest remembrances in support of steelhead conservation to: The Conservation Angler, 16430 72nd Ave W, Edmonds, WA 98026 or at www.theconservationangler.org

Sean Gallagher is author of Wild Steelhead, The Lure and Lore of a Pacific Northwest Legend, *published by Wild River Press.*

FISH WATCH — WILD FISH NEWS, ISSUES AND INITIATIVES

Washington Tests Pound Net on Lower Columbia

From August 25 to October 31 of last year, The Washington Department of Fish and Wildlife conducted a pound net trap test fishery in Cathalamet Channel on the lower Columbia River. The purpose was to test the effectiveness of pound nets for catching hatchery salmon for harvest while safely releasing wild fish unharmed.

Pound nets are a kind of fish trap where a net fence attached to pilings in the water blocks fish movement, diverting them into the trap, or pound, where the fish can be removed with a dip net and sorted, with adipose fin clipped fish kept and wild fish released.

WDFW biologists attending the net collected biological information then released all wild salmon and all steelhead. Hatchery salmon were kept and sold by WDFW to help offset the costs of the test fishery. Any wild fish that died during capture were donated to a local food bank.

Over the course of the test fishery, 1,508 Chinook salmon were captured and 907 released, 954 coho captured and 469 released, and 322 steelhead, including A and B runs and from unknown stock, were captured and released. The pound net also caught four sturgeon, which were released.

Data collected from the test fishery included stock composition, migration patterns and genetic samples. The data will help WDFW determine if pound nets are effective fishing method for ensuring that mortality limits on ESA-listed fish are not exceeded by the river's commercial fisheries.

Pound net fishing techniques may offer an effective way to harvest hatchery salmon for the lower Columbia River commercial fishery while protecting wild salmon and steelhead. Photo by Aaron Jorgenson, Wild Fish Conservancy.

$83,000 Hatchery Atlantic Salmon

Hatchery-reared Atlantic salmon stocked in Scotland's Spey River last year clocked in at a cost of 60,000 Pounds each, or a little more than $83,000 in US dollars, according to a November 2018 news report in the *Sunday Times of London*. These ultra-expensive fish were part of a release of 500,000 into the Spey to help rebuild the river's Atlantic salmon numbers.

Hatcheries continue to be less cost-effective ways to produce fish than nature. Photo by Jim Yuskavitch

But a follow-up DNA study found that of the 800 salmon caught by anglers, only two came from the hatchery. In spite of opposition from conservationists, the Spey Board plans to double hatchery production.

The paper also reports that wild Atlantic salmon populations have decreased in the UK and surrounding ocean by 45% since 1971.

While perhaps not quite so expensive, the actual costs of raising Pacific salmon and steelhead in hatcheries to when they return to their natal rivers and become available to anglers (or for ESA recovery purposes) can range anywhere from less than $100 to approaching $10,000, and in some cases, exemplified by the Spey River example, much more.

Saving Chinook Salmon to Save Orcas

Last March, Washington State governor Jay Inslee signed Executive Order 18-02 that directs the Washington Department of Fish and Wildlife and other state agencies to begin working to restore the Southern Resident orca population and provides $1.1 billion to get the job done.

The Southern Resident orca population, which ranges from Washington to Alaska, has been declining since 1995. Since then their numbers have dropped from 98 to 74. Of particular concern was that the J-pod that frequents Puget Sound and the Salish Sea had not successfully raised any young in some time until last year when one calf was born that has apparently survived.

What makes the Southern Resident orcas different from other orca populations is that they feed exclusively on fish, mainly salmon, with Chinook salmon being the dominant prey species. The decline in Columbia and Snake river Chinook salmon is a primary factor in the orcas' slipping pop-

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ulation numbers.

While the new recovery plan also addresses the whales' exposure to toxic chemicals and disturbance from vessels, increasing the Chinook salmon population remains the key factor for their recovery, and the plan budget incudes $750,000 to review breaching the four lower Snake River dams to boost salmon runs.

The survival of the southern resident orcas is directly tied to the health of Columbia and Snake river Chinook salmon runs. Photo by Holly Fearnbach/NOAA

Other actions the state intends to take to increase salmon numbers include protecting and restoring habitat, increasing hatchery production, managing harvest, removing fish barriers and managing predation on Chinook salmon by sea lions and sea birds.

Columbia River Gill Net Policy Discussed

Fisheries managers from Oregon and Washington met in early January to discuss commercial gill net fishing on the mainstem, lower Columbia River.

Since 2013, both states have been following a plan developed by former Oregon Governor John Kitzhaber that restricts the commercial gill net fishery to side channel areas.

A major point of contention is that Washington does not allow any mainstem commercial fishing for Chinook salmon while Oregon does under certain conditions. No decisions were made at the meeting.

Bulkley River Steelhead Catch and Release Study

A recent study of the effects of catch and release on the summer run recreational steelhead fishery on the Bulkley River in British Columbia and published in the journal *Fisheries Research* has produced some good tips for steelhead anglers wanting to minimize potential harm to the fish they catch.

The researchers took blood samples (without killing the fish), tracked the steelhead using radio telemetry to determine stress levels of caught and released fish, their movements after being released and their response to varying times exposed to air and at various water temperatures.

Some of the things the researchers found was that steelhead experienced higher stress levels when caught by hook and line as opposed to other methods such as dip nets. Also, fish that were exposed to the air after being landed also experienced higher levels of stress and moved further downstream after they were released than fish that were kept in the water through release.

Survival over the following three days after a fish was released was 95.5% while overwinter mortality of caught and released fish was about 10.5%. Deep hooking, especially on the tongue, was a major cause of mortality.

Overall, the study found that catch and release regulations on the Bulkley are an effective conservation tool for maintaining the steelhead fishery.

For anglers, the researchers suggest that hooking mortality can be reduced by ensuring that they limit the fish's exposure to air to less than 10 seconds and to be aware of water temperatures as warmer temperatures increased mortality.

The study was conducted by researchers from Carleton University in Ottawa, the University of Massachusetts Amherst and British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Fisheries Branch.

Increase in Lethal Sea Lion Removals Okayed

Last December, President Donald Trump signed legislation allowing a significant increase in the number of sea lions that may be killed on the Columbia River system to protect ESA-listed runs of salmon and steelhead.

The bill amends the Marine Mammal Protection Act of 1972 to allow the states of Washington and Oregon, and

A recent catch-and-release mortality study on British Columbia's Bulkley River found it to be an effective method for managing the recreational steelhead fishery. Photo by Christof46. Converted to B&W, Creative Commons Attribution-Share Alike 4.0 International License.

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Columbia River treaty tribes to lethally remove both California and Steller's sea lions that prey on listed salmon and steelhead, along with white sturgeon.

The sea lion population in the Columbia River has doubled each year between 2012 and 2016. According to the US Army Corps of Engineers, sea lions ate 5,384 salmon or steelhead at Bonneville Dam in 2017, representing 4.7% of the year's runs of summer and winter steelhead and spring Chinook salmon.

The two states and tribes will be allowed to kill up to 930 sea lions annually for five years. The Oregon Department of Fish and Wildlife also received a permit to remove as many as 99 California sea lions per year for up to five years that are preying on runs of Chinook and steelhead at Willamette Falls on the Willamette River.

But sea lions can only be killed from just downstream of Bonneville Dam, at river mile 112, to McNary Dam, and on Columbia River tributaries in Oregon and Washington.

While predation on ESA-listed salmon and steelhead is a factor, most wild fish advocates point out that the real culprits causing declining wild fish runs are dams that directly kill fish or block access to habitat, overharvest by commercial fishers, habitat loss and competition and genetic dilution from hatchery fish.

The number of sea lions that may be killed in the Columbia River basin to protect ESA fish has been increased. Photo by Sharon Melin/Alaska Fisheries Science Center/NOAA Fisheries

Poor Idaho Spring Chinook Run Predicted for 2019

Fisheries managers are predicting a poor 2019 run for Idaho spring Chinook salmon. Run strength is based on the number of returning one-year-old, or jack salmon, with larger runs often indicating a strong run the following year.

However, last spring's run of Clearwater River jacks was only about 11,000 fish, the third lowest since 2009.

The predicted spring Chinook run for 2019 is 8,200 wild fish and 40,000 hatchery fish. Only about 9,800 hatchery fish are predicted to return to the Clearwater River, and since more than half of those fish will be needed for hatchery spawning only about 2,000 may be available sport anglers and tribes.

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