



THE OSPREY

A Journal Published by the Steelhead Committee
Federation of Fly Fishers



Dedicated to the Preservation of Wild Steelhead • Issue No. 74

JANUARY 2013

Columbia River Steelhead

An accidental experiment of neighboring rivers

by Bill McMillan

— Wild Fish Conservancy —

Bill McMillan has lived beside Washington and Oregon rivers for 40 years, with many published writings and photography, along with conservation activism. He was a founder of Wild Fish Conservancy in 1989 and its board president for ten years. He is now a retired WFC field biologist.

Bill and his son John have recently published a book, "May the Rivers Never Sleep: Living with North Pacific Rivers as Calendars in the Footsteps of Roderick Haig-Brown" that describes how Haig-Brown inspired their transition from anglers to learning more deeply about rivers through snorkeling, and eventually becoming biologists. It is available from Frank Amato Publications and the Wild Fish Conservancy, where profits go back to the rivers and fish.

My own history with Wind River began vicariously as a nine year old in 1954 with the publication of Clark Van Fleet's Steelhead to a Fly. It was

on display in the book section of Portland's Meier and Frank department store, right next to the sporting goods section where I commonly watched famed fly tier, Audrey Joy, work away at her craft. I would wait

It has been nearly 60 years, often of heart-break, watching wild steelhead diminish in numbers and diversity.

there as my parents shopped for household necessities, going to Portland once per month from our home in Camas, Washington. Over a period of several months, I read Van Fleet's accounts of steelhead fly fishing during the regular visits to Meir and Frank. Of particular interest: he considered Wind River to be one of the challenging equals to the North Fork

Umpqua for steelhead. Lo and behold, Wind River was but 25 miles from my childhood home! I then vowed to be a steelhead fly fisher. As the saying goes, "Be careful of what you wish for." A steelhead fly fisher I became with the freedom of a driver's license at age 16 and a wild steelhead from Wind River that first summer on a #8 Red Ant, fished (unwittingly) perfect greased line.

Little did I know what part Wind River and its steelhead would come to play in the acceptance of responsibility to try to give back to the river and its wild steelhead some small return for all they had given me. It has been nearly 60 years since 1954, often years of heartbreak in watching wild steelhead populations diminish in both numbers and diversity of life histories. Some populations completely vanished in the Columbia basin during my lifetime: the upper Cowlitz, Owyhee, Boise, Payette, Malheur, and North Fork Clearwater rivers to name but some. Each of the above vanished in

Continued on Page 4

**IN THIS
ISSUE:**

**COLUMBIA R
STEELHEAD**
— PAGE 1 —

**PUGET
SOUND C&R**
— PAGE 3 —

**COHEN
COMMISSION**
— PAGE 10

**FRASER
SOCKEYE**
— PAGE 13 —

**OKANAGAN
SOCKEYE**
— PAGE 16 —



FROM THE PERCH — EDITOR'S MESSAGE

There is Good News, Too.

by Jim Yuskavitch

While *The Osprey* regularly brings to its readers reports on declining populations of wild steelhead and salmon, and the many difficult challenges and barriers they face if these remarkable fish are to survive into the future, not all is doom and gloom. There are successes and many reasons for optimism, and this issue of *The Osprey* highlights some of those bright spots.

Our cover story by respected wild fish advocate and biologist Bill McMillan outlines how wild steelhead have made a comeback in Washington's Wind River when state fish managers abandoned the emphasis on hatchery supplementation, contrasting with wild steelhead in the Hood River that struggled as hatchery supplementation continued. May the lessons of the Wind be applied to other streams needing wild steelhead recovery.

Or consider Craig Orr and Stan Proboaszcz's story on the Cohen Commission and the political pressure that eventually resulted in an investi-



Sockeye salmon on spawning bed. Photo by Mike Gauvin/ODFW

gation into the steep declines of sockeye salmon in British Columbia's Fraser River, along with the accompanying article by scientists Douglas Braun and Brendan Connors whose research on Fraser River sockeye aims to help determine the causes for populations swings. And Tom Kahler describes how a water management model to improve habitat on the Okanagan River has increased the sockeye population far above what can be achieved by traditional hatchery supplementation methods.

These kinds of successes are testimony that, while the future of wild salmon and steelhead is not guaranteed, neither is it inevitably doomed.



THE OSPREY



Chair
Will Atlas

Editor
Jim Yuskavitch

Contributing Editors

Pete Soverel • Bill Redman
Stan Young • Norm Ploss
William Atlas • Schuyler Dunphy
Scott Hagen

Contributors

Bill McMillan • Will Atlas
Craig Orr • Stan Proboaszcz
Douglas Braun • Brendan Connors •
Tom Kahler

Layout

Jim Yuskavitch

Letters To The Editor

The Osprey welcomes submissions and letters to the editor.

Submissions may be made electronically or by mail.

The Osprey
P.O. Box 1228
Sisters, OR 97759-1228
jyusk@bendcable.com
(541) 549-8914

The Osprey is a publication of The Federation of Fly Fishers and is published three times a year. All materials are copy protected and require permission prior to reprinting or other use.

The Osprey © 2013

The Federation of Fly Fishers is a unique non-profit organization concerned with sport fishing and fisheries

The Federation of Fly Fishers (FFF) supports conservation of all fish in all waters. FFF has a long standing commitment to solving fisheries problems at the grass roots. By charter and inclination, FFF is organized from the bottom up; each of its 360+ clubs, all over North America and the world, is a unique and self-directed group. The grass roots focus reflects the reality that most fisheries solutions must come at that local level.



THE OSPREY IS PRINTED ON RECYCLED PAPER USING SOY INK

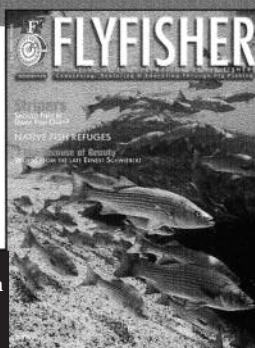
Join the Federation of Fly Fishers

Conserving, Restoring, Educating Through Fly Fishing

Invest in the future of "all fish, all waters," with a membership in the FFF — a nonprofit organization. Your membership helps make us a stronger advocate for the sport you love!

Federation of Fly Fishers
5237 US Hwy 89 South, Suite 11
Livingston, MT 59047-9176

Your membership includes a subscription to *Flyfisher*, the magazine of FFF.



Yes, I want to join the FFF:

- \$35 Individual
- \$15 Youth (under 18)
- \$25 Senior (65 and older)
- \$45 family

- Payment enclosed
- Bill me later

Name _____

Address _____

City _____ State _____

ZIP _____ Phone _____

Join by phone 406-222-9369
or at www.fedflyfishers.org

You'll also receive **FLYFISHER**, our quarterly magazine!



ESA Listings, Catch and Release and the Future of Puget Sound Steelhead

by Will Atlas

— Chair, Steelhead Committee —

This year for the fourth consecutive winter, the Skagit River, one of Washington's most storied steelhead rivers, will be closed to angling at the end of January. To the south the Stillaguamish, and Skykomish, both equally steeped in angling tradition, have been closed during the peak months of the wild winter steelhead run since 2001. These closures are the Washington Department of Fish and Wildlife's understandable reaction to two decades of depressed steelhead abundance in Puget Sound, the product of more than a century of destructive overharvest, habitat destruction, hatchery supplementation and a turn for the worse in marine survival for steelhead entering the Georgia Basin. Like so many advocates for wild fish, my passion for their conservation began with angling. This evolution, from catch and release angler to tireless advocate was accelerated dramatically by many days spent fishing for, and occasionally catching, wild steelhead on my home rivers in Puget Sound. And while I recognize the need to do everything in our power to recover steelhead in Puget Sound, I question the efficacy of closing catch and release fisheries, particularly when viewed in isolation as means of recovering wild steelhead stocks.

In their effort to reduce the risk of extinction within the Puget Sound ESU, NOAA and WDFW have opted to close the steelhead rivers of Puget Sound 3-4 months before the historic end of these fisheries. While their intentions are admirable, these closures are inconsistent with and far more severe than regulations in other areas where steelhead have been listed under the ESA. Take for instance the lower Columbia and Willamette, where the vast majority of streams remain

open to catch and release fishing until the end of March. On the many tributaries of the Snake, steelhead angling remains open for most of the year and anglers may catch ESA listed steelhead anytime from August to March, and on the upper Columbia, an ESU where steelhead were only recently down-listed from Endangered to Threatened, we have seen seasons lasting anywhere from 2 to 7 months during the last 4 years.

While we need to do everything to recover wild steelhead, I question the efficacy of closing catch and release fisheries for that purpose.

Given this disparity you might expect the situation in Puget Sound to be much more dire than in those areas currently open to sport fishing, however this is far from the case. While for the most part wild steelhead abundance remains depressed below escapement goals in Puget Sound, the Skagit was at or near its escapement goal of 6,000 fish each of the last two seasons. Meanwhile, all of the aforementioned ESUs where fisheries impacting wild steelhead currently occur annually remain depressed below their ESA targeted recovery goals as well. Even more baffling is the inconsistency within Puget Sound. While steelhead fisheries remain closed from February through April, anglers are allowed to harvest ESA

listed wild Chinook in parts of Puget Sound, and marine fisheries with much higher catch and release mortality are kept open nine months of the year. The management of these Chinook fisheries is the result of harvest rates that have been agreed upon by both NOAA and WDFW. Meanwhile we have lost our fisheries for wild winter steelhead almost entirely, depriving residents of Puget Sound of the opportunity to enjoy these iconic fish and starving economically depressed riverside communities of three months of economic activity generated by these once popular fisheries.

The agencies have always fallen back on the argument that these populations may not meet their escapement goal, and thus allowing any fish to be killed, even incidentally by catch and release anglers, is not biologically defensible. This argument holds some water, and their concern with maintaining abundance of ESA listed steelhead is warranted. However, as we have learned from steelhead monitoring projects in watersheds without angling such as Snow Creek in Puget Sound and the Keogh River on Vancouver Island, marine survival is above all else responsible for year to year fluctuations in adult population sizes. Indeed the "carrying capacity" of a watershed, the level of adult abundance often used as an escapement goal, actually varies with changes in marine survival. In a large river such as the Skagit, Skykomish, Nooksack or Stillaguamish, catch and release angling would have a negligible impact on the trajectory of steelhead populations. Throw in the fact that the available data and run forecasts of steelhead abundance in Puget Sound range from poor and unreliable to non-existent, and it is as though managers have



Columbia River Steelhead Continued from page 1

the belief that hatcheries could mitigate the loss of wild populations through dams. I early learned the lie of mitigation as the secret weapon to ravage land and waters.

Through adult years, I increasingly shifted river time from that of fishing to volunteer spawning and snorkel surveys to create databases from which wild steelhead populations might be better understood and subsequently managed for recovery rather than continued diminishment. One of these volunteer efforts was the initiation of snorkel counts at Wind River as a means of monitoring its wild summer-run steelhead in 1983. The history, both before and after, has been complex – often discouraging – but with much recent hope. Wind River now provides a management template for wild steelhead recovery rather than continued trends toward extinctions directly related to investments dominated by past billions of dollars spent on West Coast hatchery programs.

Wind River is 155 miles above the mouth of the Columbia. Its steelhead story is more complete due to its proximity to Hood River on the Oregon side of the Columbia about 14 miles upstream. Detailed genetic studies of wild and hatchery summer-run steelhead have occurred at Hood River combined with annual adult returns provided by counts at Powerdale Dam (until removal in 2010). Although similarly detailed genetic study has not occurred at Wind River, snorkel counts and comparative ladder/trap counts provide annual summer-steelhead return numbers. The ultimate comparative value is provided by hatchery summer-run steelhead smolt plants having been eliminated on Wind River since 1998 whereas hatchery summer-run steelhead smolt plants continued at Hood River until 2010 and hatchery winter-run plants remain ongoing.

Wind River's Early History

A 1949 U.S. Fish and Wildlife Service (USFWS) report included 1936-1940 spawning gravel measures at Wind River that found it could support 5,950 pairs of "salmon" above Shepard Falls (spelling at time) then limited to steel-

Table 1. Estimates of pairs of steelhead Wind River spawning gravel could support

Wind River spawning gravel area	Number of steelhead pairs it could support
Shepard Falls to Carson Lumber Mill Dam	2,500 pair
Carson Lumber Mill Dam to source	1,500 pair
Panther Creek	over 1,500 pair
Cedar Creek (Panther Creek tributary)	150 pair (indicated several hundred fish)
Trapper Creek	300 pair
Total	5,950 pair
Total if Trout Creek added as equal to Panther	7,450 pair

head prior to laddering. This was after splash dam operations had occurred dating to at least 1899 and other logging effects on stream channel degradation. It also excluded Trout Creek, since found to be a major spawning tributary likely at least as productive as Panther Creek. Passage improvements at Trout Creek were made in 2009 with removal of Hemlock Dam, its poorly designed fish ladder, and draining of the sediment filled reservoir behind. This was done to increase wild steelhead productivity. Wild steelhead production by Wind River location based on spawning gravel available in 1936 to 1940 is shown in Table 1.

Females typically outnumber male steelhead, but the proportions are regionally variable. In an 1896 examination of over 4,000 summer-run steelhead destined for the Columbia basin above Celilo Falls, 37% were males and 63% females. Historic wild winter-run steelhead at Puget Sound's Green River and Waddell Creek of the California Coast were found to be 48%-49% male in the 1930s and 1940s. If males were 37% of total numbers the historic Wind River spawning habitat could have supported 11,825 summer steelhead; if males were 48% of the total it could have supported 14,327 summer steelhead.

In 1951, Wind River was reported to have an estimated escapement of 2,500 summer steelhead after a harvest of 7,500 pounds (750-1,100 steelhead depending on a 7 or 10 pound average per fish as a likely range) – a return to river run-size of 3,250-3,600 wild steelhead. Until 1947, the Carson Lumber Company dam blocked access to spawning gravel in upper Wind River basin that could support 1,800 of the total basin spawning pairs (2,700-3,500 steelhead adjusting for fewer males). The 1951 steelhead were from parentage limited to spawning and rearing waters downstream of that dam – long excluded from some of the best spawn-

ing habitat in the basin.

In 1957 it was reported by Enos Bradner, outdoor columnist for the Seattle Times, that 257 Wind River steelhead had been counted past the ladder at Shepard Falls by September 15th, with another 300 steelhead estimated to have leapt the falls: total 557 wild summer steelhead. In 1956, 183 had leapt the falls. Although natural passage was not reported for 1956, presumably it was a similar percentage to 1957. Bradner indicated that the once famed steelhead fishing had been in decline as determined by his 20 years previous experience, especially since about 1952. What the steelhead harvest was in 1956 and 1957 is unknown, but it was apparent that summer steelhead escapement had greatly declined since 1951. And even the 1951 data indicate Wind River was far below the spawning gravel carrying capacity determined in the 1930s.

Wind River Since

The first release of summer steelhead hatchery smolts was made at Wind River in 1957 (origin unknown). In 1962, an estimated 838 wild summer steelhead were sport caught at Wind River. Sustained releases of Skamania Hatchery smolts from the Washougal River did not begin until 1961, with first adult returns in the summer of 1963. Between 1961 and 1980 an average of 78,000 Skamania Hatchery summer-run smolts were planted annually at Wind River. The average total sport catch (hatchery and wild) from 1963 to 1982 was 1,100 steelhead. Considering the wild summer steelhead catch of 750-1,100 fish in 1951, and 838 wild summer steelhead in 1962, it is apparent that the combined wild and hatchery catch of 1963-1982 added little or nothing to angling success despite the large annual investment in hatchery smolt plants. Apparently, hatchery

Continued on next page

Continued from previous page

steelhead were merely replacing wild steelhead at the added public cost of the hatchery program.

With this background, in 1981 Washington Department of Game (WDG) recommended that Wind River be managed for wild steelhead with elimination of hatchery steelhead plants. After public meetings and written comments were assessed, the Game Commission in January of 1982 endorsed that recommendation. Wind River became the first steelhead stream in Washington to be managed for wild steelhead with hatchery summer-steelhead smolt plants discontinued that same year.

However, in 1983, a very low return of steelhead occurred at Wind River and throughout much of the Northwest. Although the decline in steelhead returns that summer was due to reduced ocean productivity related to the 1982-1983 El Niño event, and had nothing to do with the wild management decision, WDG suddenly reversed course at Wind River and resumed hatchery summer steelhead plants in 1984.

Even though hatchery steelhead releases resumed, it remained that Wind River had been designated a Wild Steelhead Management River in 1982 as outlined in 1981. That designation held despite the 1983 decision to resume hatchery plants in 1984. The decision included: reducing hatchery plants to half or less; implementing wild steelhead catch and release; and then waiting for wild steelhead to respond with some anticipated increase in returns before again halting hatchery plants to fulfill the original decision. The question was, would wild steelhead respond by reducing hatchery plants from an average of 78,000/year to 33,000/year as occurred? And what monitoring method(s) would be implemented to effectively determine that? No monitoring by WDG had been done on Wind River at the time and none had been outlined in any management plan.

In 1980 volunteers from the Clark-Skamania Flyfishers (CSF) initiated samplings of several Wind River tributaries to determine juvenile steelhead/rainbow distribution. In 1982 the volunteers did a 1.25 mile spawning survey of upper Wind River. Then

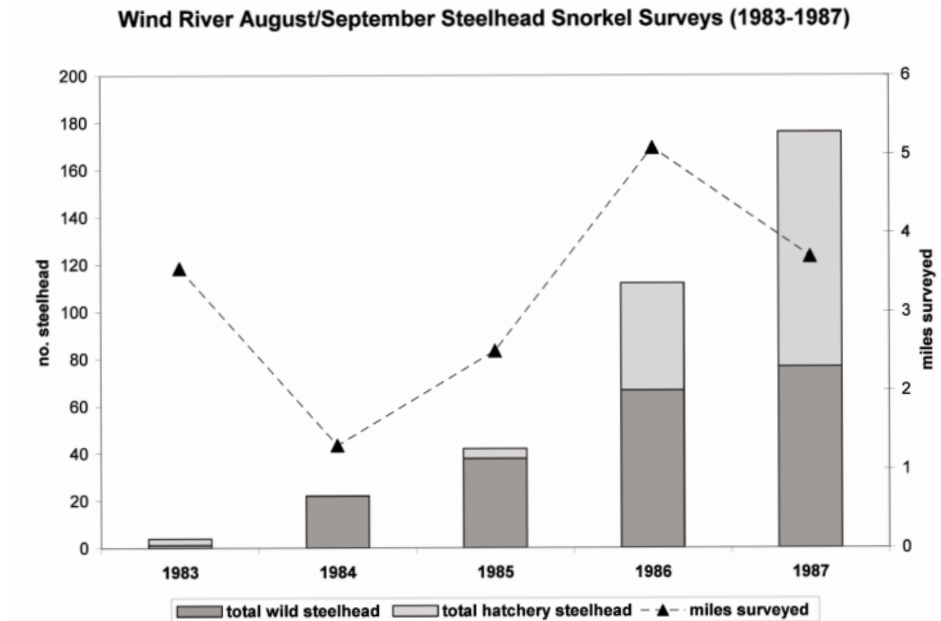


Figure 1.

after consulting with volunteers who had helped the British Columbia Fish and Wildlife Branch monitor Vancouver Island wild steelhead populations, in early September of 1983 three volunteers from the CSF initiated Wind River snorkel surveys as a means to stimulate effective data collection from which to monitor wild steelhead population responses to management changes. The results from that initial 3.55 mile snorkel survey were startling. Only four total steelhead were counted, of which only one was wild, two were hatchery, and one was unknown origin. The survey included two miles in the heart of the steelhead over-summering canyon area. However, in each of the subsequent four years steelhead numbers increased during these volunteer snorkel surveys. Figure 1 (above) provides the findings.

Although these limited surveys provided a relatively accurate indicator of increasing numbers of steelhead after 1983, it did not provide sufficient data to know complete basin numbers, nor the eventual spawning distribution by basin area. From a volunteer standpoint of limited manpower and time, full basin snorkel surveys were not possible. In 1985, WDG initiated basin-wide spawning surveys. However, these too had limitations due to hatchery steelhead again returning to the basin. How differentiate wild from hatchery redds?

In the report made by the CSF to Washington Department of Wildlife (WDW after name change in 1987) about the 1987 snorkel survey results, it was suggested that the CSF volunteers collaborate with WDW, Washington Department of Fisheries, and Gifford Pinchot National Forest personnel to snorkel survey the entire length of mainstem Wind River used by summer-run steelhead in late August or early September of 1988. This subsequently occurred. Since then there have been continuous 16 mile surveys led by what is now Washington Department of Fish and Wildlife (WDFW). These snorkel surveys provided a baseline from which to determine how wild steelhead numbers would respond if hatchery steelhead plants were eventually eliminated to fulfill the original wild steelhead plan. However, snorkeling alone does not count every steelhead. WDFW developed methods to fine tune the snorkel counts to provide better escapement estimates. As explained by Dan Rawding and Patrick Cochran in a 2005 report to BPA:

Adult summer steelhead escapement was estimated using four different mark-recapture methodologies. Our "Jumper" method is based on summer and fall snorkel surveys to determine the ratio of fish jumping Shipherd Falls to those trapped in the fish ladder.

Continued on next page

Continued from previous page

Wind River Wild Summer-Run Steelhead Escapement Estimates for Years Available & Hatchery Summer Smolt Plants 3-Years Prior to Align with 2-Salt Spawn Year Returns (1950-2011)

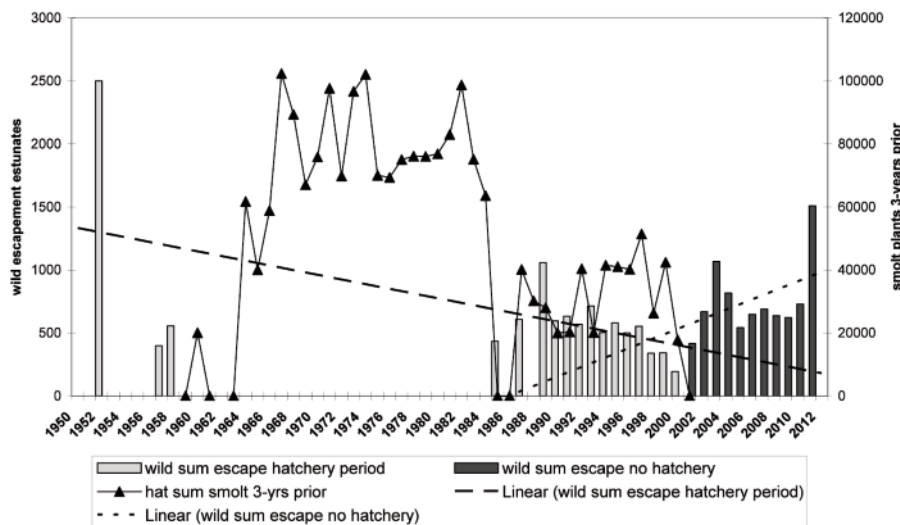


Figure 2.

Expansion of the ladder count by this rate for the remainder of the jumping period and a direct count of adults for the remainder of the run year were used to estimate summer steelhead abundance. (Note: Trapped fish have colored tags and “jumpers” do not as sighted in snorkel counts. The “jumper” method has been the primary method used.)

With wild steelhead numbers subsequently found declining after 1988 and on through the 1990s, the decision was made to once again eliminate further hatchery steelhead releases after 1997 at Wind River. The resulting history of Wind River counts, spawning surveys, and hatchery plants are provided in Figure 2 (no escapement estimates were made from 1960-1984; more recent data were provided in 2012 by Dan Rawding, of WDFW, and from a BPA report he co-authored in 2011):

What is apparent from the two trend lines shown in Figure 2 is that after hatchery plants were discontinued in 1998, the wild summer steelhead responded with increased escapement (black bars and dotted line), while the period from 1952 to 2000 indicates wild summer steelhead escapement declined during the period dominated by hatchery steelhead plants from 1957 to 1997 (gray bars and dashed line). However, the question remains, was this actually a result of eliminat-

ing hatchery smolt plants or was it due to improved freshwater and/or ocean conditions on steelhead survival during the more recent period?

Hood River Early History

On April 14, 1806 Captain William Clark indicated that Labiech's (Hood) River came off Mt. Hood and was filled by a bed of sand much like the Quicksand (Sandy) River he had explored thirteen days earlier. The latter was nowhere deeper than 4-6 feet. It had a wide bed, but it was composed of quicksand with shallow channels dispersed across its 350 yard breadth. No native people occupied the Sandy River in Clark's exploration up it. A recent eruption of Mt. Hood had apparently occurred. If similar to the 1980 eruption of Mt. St. Helens, where boiling mudflows temporarily eradicated mainstem fishlife in the Toutle River, it would explain the 1806 absence of the native people who depended on salmon. Apparently Hood River was similarly impacted. By the time of first record keeping (late 1800s to early 1900s) anadromous fish recovery had naturally occurred at both rivers since the Lewis and Clark Expedition.

Hood River was surveyed in 1944 and included in the USFWS Columbia basin reports. Former large runs of salmon and steelhead were said to have been

depleted. Rather than having a waterfall near the mouth as at Wind River, the primary falls of selective importance for steelhead is a half mile up the West Fork, 14 miles from the main river mouth. Although the West Fork was found to have the best spawning gravel in the basin, sufficient for an estimated “several thousand salmon and steelhead,” irrigation diversions had reduced flows at the falls. Some steelhead were said to remain, while Chinook were near extinction (soon to go extinct). Furthermore, the 3.5 miles of mainstem Hood River between the powerhouse a half mile above the mouth and Powerdale Dam, was commonly left dry or nearly dry. Due to this passage problem, there was little optimism for Hood River anadromous fish at that time when combined with the other dams and/or diversions further upstream on the East, Middle, and West forks.

Hood River Since

By 1955, apparently better passage had been provided at Powerdale Dam and counts and trapping of steelhead began. A 1966 Oregon Fish Commission report indicates that of 882 total wild steelhead counted that year, 189 were summer-run and the rest winters. However, winter and summer steelhead run-timing overlapped, and in most of the early years many steelhead could not be differentiated for summer and winter distinctions. One of the exceptions was in 1962 when 217 hatchery summer-runs along with 363 wild summer-runs were counted as listed in a 1985 Bonneville Power Administration (BPA) report.

However, until 1965 the counts may not have been complete. In a consultant's report for the Nez Perce tribe in 1991, it indicates that Powerdale Dam counts only occurred at one ladder (of two) from 1955 through 1962, and from 1955 through 1964 some fish may have been able to go over the dam in high flows without using the ladders. The 1985 BPA report indicates the first year when counts were effectively broken out and complete was 1971 with 572 wild summer-runs and 303 hatchery. Hood River wild summer-run numbers in 1962 and 1971 were similar to those estimated passing Shepard

Continued on next page



Continued from previous page

Falls in 1956 and 1957 at Wind River.

Unlike Wind River, which has only a token wild winter-run of steelhead primarily limited to the mile of river basin below Shepard Falls, Hood River has a winter-run steelhead population that is larger than that of the summer run. They spawn in the mainstem, East Fork, and Middle Fork of Hood River, while the summer-runs spawn primarily in the West Fork above Punchbowl Falls.

The 1991 consultant's report indicates that the first hatchery reared summer-run steelhead smolts were released at Hood River in 1958 from wild broodstock and continued through 1966. Beginning in 1967, out-of-basin Skamania hatchery origin summer-run smolts were released. A 2011 report by Robert Reagan to BPA indicates that Skamania smolts continued to be released at Hood River through 2007. Hood River wild broodstock hatchery summer-run smolt releases were added in 1999 and continued through 2009 (except 2007). Out-of-basin winter-run smolt releases from Big Creek Hatchery began in 1988 and ended in 1991 at Hood River. Hood River wild broodstock hatchery winter-run smolt releases began in 1993. In 1992, the hatchery winter-run smolt releases were of mixed Big Creek Hatchery and wild broodstock heritage.

Between 1991 and 1993 the Hood River Production Plan (HRPP) was developed from which to: "protect, enhance and restore wild and natural populations of anadromous and resident fish within the Hood River Subbasin". The plan, described in the 2011 report to BPA, included three main categories: 1) hatchery supplementation, 2) habitat restoration, and 3) monitor and evaluation. The latter included the Hood River Steelhead Genetics Study.

Hood River DNA and scale samples from all steelhead passing Powerdale Dam began in 1991 as a means to address certain concerns. As explained in a 2003 report to BPA, Relative Reproductive Success of Hatchery and Wild Steelhead in the Hood River, by Dr. Michael Blouin of Oregon State University (OSU):

There is a considerable interest in using hatcheries to speed the recovery of wild

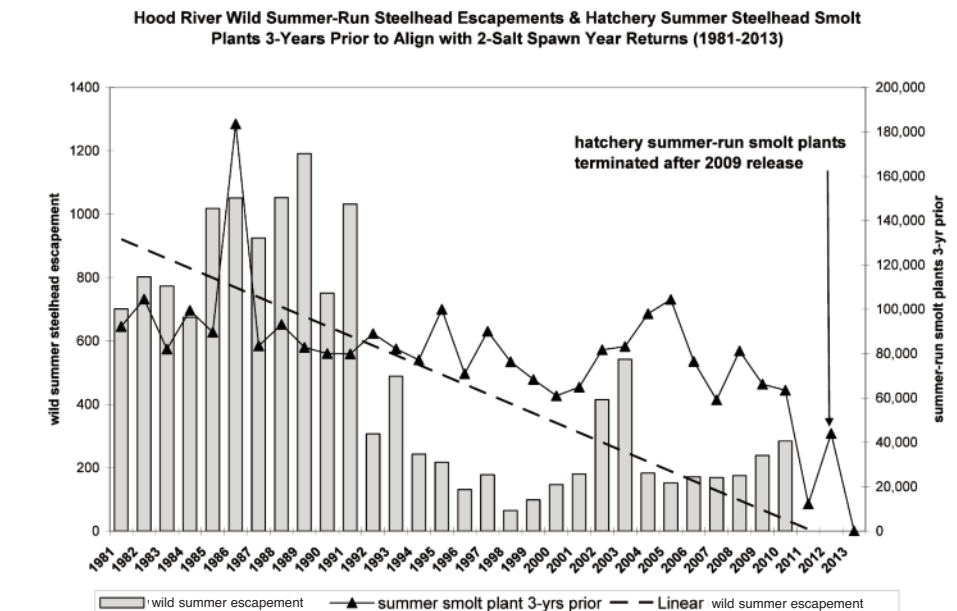


Figure 3.

Populations ... These hatchery programs cost the region millions of dollars. However, whether such programs actually improve the status of wild fish remains untested. The goal of this project was to evaluate the effectiveness of the Hood River hatchery program ... During the 1990's "old" domesticated hatchery stocks of each run (multiple generations in the hatchery, out-of-basin origin; hereafter Hold) were phased out, and conservation hatchery programs were started for the purpose of supplementing the two wild populations (hereafter "new" hatchery stocks, Hnew)"

Numerous Hood River studies and reports have followed. A 2009 report to BPA from the Confederated Tribes of Warm Springs by Ryan Gerstenberger, Hood River Production Program Monitoring and Evaluation (M&E), Annual Report for Fiscal Year October 2007 – September 2008, indicates the progressive findings:

During the initial period of the HRPP wild summer steelhead appeared to be in severe decline in the Hood River. A supplementation strategy using hatchery reared fish from wild broodstock was employed in order to boost the number of returning spawners while maintaining the genetic characteristics of the native stock. There were significant improvement to returns in 2000 and 2001 (years when virtually every anadromous fish stock in the Columbia Basin flourished) but there

was little if any positive wild adult return response from the hatchery supplementation. Another assumption of the wild broodstock supplementation strategy was that smolts reared from wild origin parents should be better adapted to the basin and experience better survival than the "domesticated" out-of-basin origin fish stocked to provide angling opportunities. In fact the opposite was the case and ODFW reported that the Hood stock hatchery steelhead consistently had lower smolt to adult ratios than Skamania stock steelhead of the same brood year (1999-2005) (Olsen 2007). Thus it appears that summer steelhead supplementation was ineffective at rebuilding the wild run. As a result Hood River managers decided to end the Hood River wild broodstock hatchery supplementation. The last release of Hood River stock summer steelhead is to occur in spring 2009.

The line that I have put in bold above is an understatement. The portrayal of the Hood River wild summer steelhead adult escapement trend from 1981 to 2010 (end of Powerdale Dam counts with its removal) compared to all summer steelhead smolt plants made three years before to align with the dominant adult spawning year returns is provided in Figure 3 above.

Regarding domesticated broodstock resulting from hatchery rearing over multiple generations, the Hood River

Continued on next page

Continued from previous page

studies found that compared to wild fish their relative reproductive success in the wild was only 8% for winter-run and 33% for summer-run steelhead (from a paper in Fisheries for Global Welfare and Environment, 5th World Fisheries Congress 2008, by Hitoshi Araki of OSU). Araki and colleagues further found in a 2009 paper in Biology Letters published by the Royal Society, that wild-born steelhead from two captive-bred parents (of wild broodstock) had overall only 37% of the relative reproductive fitness of steelhead from two wild parents and only 87% if from one captive-bred parent and one wild parent. Furthermore, a significant carry-over effect was found that continued to drag the wild population down in the generation after hatchery supplementation. The wild population would have been 8% higher without the carry-over effect.

Hood River's wild winter-run steelhead declining response to domesticated broodstock hatchery steelhead smolt releases (from Big Creek) resulted in termination of those plants after 1991 and initiation of Hood River wild broodstock hatchery winter-run smolt plants in 1993 (mixed Big Creek and wild broodstock heritage smolts released in 1992). The wild winter-run returns during the period of using wild broodstock hatchery smolts have been considered to be more successful than with summer steelhead at Hood River with continuation of the program as indicated in the 2009 Confederated Tribes of Warm Springs report to BPA. However, as shown in Figure 4, the trend is similar to that of Hood River summer steelhead and would appear to be headed toward the same eventual end. Furthermore, genetic studies of hatchery winter-run steelhead from wild broodstock and wild Hood River winter-run steelhead that spawned naturally together resulted in a reduced total returning population size. As indicated in a 2012 article in Heredity, Effective Size of a Wild Salmonid Population Is Greatly Reduced by Hatchery Supplementation, by Mark Christie of OSU and colleagues:

... the additional hatchery fish doubled the total number of adult fish on the spawning grounds each year, but cut the effective population size of the

Hood River Wild Winter-Run Steelhead Escapements & Hatchery Winter-Run Smolt Plants 2-Years Prior to Align with 2-Salt Spawn Year Returns (1981-2013)

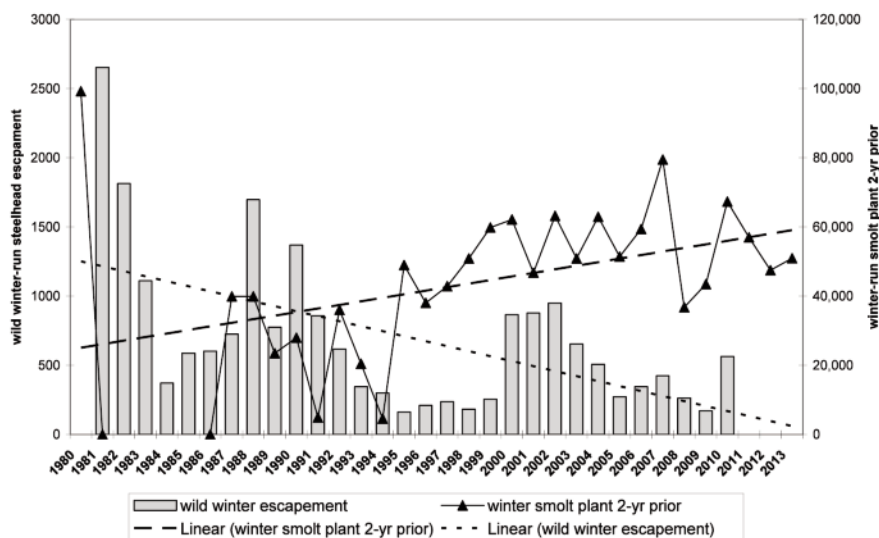


Figure 4.

total population (wild and hatchery fish combined) by nearly two-thirds. (bold my emphasis not authors)

Finally in order to better compare the Wind River example of ceasing hatchery summer-run steelhead plants over a ten year period to that of continued hatchery summer-run steelhead plants at Hood River, a statistical analysis comparison was made by William Atlas (Chair of the Steelhead Committee of Federation of Flyfishers) in 2011. This was included as part of the coordinated comments by several conservation organizations and individuals related to a recent WDFW Wind River planning process that may, or may not, result in backtracking once again to some sort of resumed hatchery steelhead plants. Among the conclusions from the Atlas statistical analysis comparisons:

Prior to the elimination of hatchery supplementation in the Wind, the two populations showed strong temporal coherence in abundance ($R^2=0.409$) and the mean standardized abundance for the Wind and Hood River were not significantly different for that period ($p=0.108$). However following the elimination of hatchery supplementation in the Wind River in 1998, the two populations diverged significantly ($p=0.0018$) with the Wind showing a positive trend relative to its long term mean and the Hood showing a negative trend... These results suggest that the elimination of hatchery releases in the Wind River

has benefitted wild summer steelhead significantly. During the period from 2000-2010 when hatchery releases were eliminated, the Wind River consistently showed a positive trend relative to its long term mean. This trend contrasts sharply with the trend observed in the nearby Hood River where hatchery supplementation continued throughout that period. To our knowledge the only difference between the two systems that could explain this trend is the discontinuation of hatchery supplementation in the Wind.

It was further explained that the Wind River data excluded the modern record run of 1,500 wild steelhead in 2011 because there were no comparative data from Hood River yet available. It would likely have resulted in even greater differences in their diverging wild steelhead trends. Figure 5 provides a depiction of these findings (Atlas 2011):

Conclusion

With their mouths separated by only 14 miles in what is now the Bonneville Dam pool, Wind River and Hood River were at similar levels of wild summer-run steelhead depletion when their hatchery steelhead histories began in the latter 1950s. Beginning with settlement in the late 19th century, Wind River had been altered by logging activities and the Hood by agricultural

Continued on next page

Continued from previous page

irrigation. Both rivers included steelhead management histories that could not seem to make up their minds, the Hood alternating back and forth between eliminating hatchery steelhead and the other alternating between wild broodstock, traditional domesticated broodstock, and back to wild broodstock again. The two rivers combined provide important comparative results for the differing hatchery options taken over the past 50 years. By accident, rather than by planning, their proximity has resulted in a fish management experiment of great learning consequence. The results provide a template for a Columbia River wild steelhead recovery future if appropriately applied, and more broadly for the Northwest Region riddled by ever increasing steelhead ESA listings.

Hood River management has tenaciously clung to alternating choices of steelhead used for hatchery broodstock, both summer and winter runs. The summer-run hatchery history has been the longest and the first to be ter-

minated as of 2010. This was after well documented genetic studies provided unavoidably clear findings: for either broodstock choice the relative reproductive success in the wild was only about one-third of that for wild steelhead. The hatchery broodstock choice results were no better, or even worse, for winter-run steelhead. The domesticated winter broodstock had a relative reproductive success in the wild that was less than one-tenth that of wild winter steelhead and that of wild winter broodstock was again about one-third of that for wild steelhead. Furthermore, the hatchery effect on the overall natural spawning population of steelhead does not go away. This is due to a carry-over effect that remains in the generation after hatchery supplementation as a lingering drag on the wild population that would have been 8% higher otherwise. This diminishment apparently continues to occur throughout the supplementation years, and may even remain for some time after supplementation ceases.

The Hood River studies indicate it is not only impossible to recover a wild steelhead population through hatchery supplementation, no matter which broodstock alternative is used, but that it will unavoidably continue to decline throughout time. In other words, the result is progression toward hatchery induced extinction of the wild population.

Alternatively, 14 miles away at Wind River, smolt plant termination in 1998

had been one of continuous decline. The subsequent ten years from 2000 to 2010 provided a significantly positive increase in the wild adult Wind River summer steelhead population without direct hatchery smolt plant influence. This compared to the Hood River wild summer steelhead population response that did not similarly increase under the continued influence of hatchery smolt releases. Furthermore, the statistical analysis did not include the 2010 return of an estimated 1,500 wild summer steelhead at Wind River, which is the largest known wild escapement since the 1951 estimate. Only the coming years will tell what the Wind River wild steelhead population response will be to the 2009 removal of Hemlock Dam at Trout Creek, a former major spawning tributary. At minimum it was a deterrent to both juvenile and adult migrations.

How long the cleansing of the drag on wild Wind River steelhead productivity may take as a result of prior hatchery/wild spawning interactions is unknown. But a wild recovery has begun in the long delayed fulfillment of Wind River's designation as a Wild Steelhead Management river in 1982.

The question remains: will state, tribal, and federal fish and habitat managers and scientists broadly apply the lessons learned ... not only in the Columbia basin, but in the Northwest Region? Or will the belief in hatcheries and the flow of money they provide continue to seduce scientists and managers to ignore whatever the findings may otherwise indicate? Faith in hatchery belief has dominated West Coast fishery history: 135 years of steady wild salmon and steelhead decline, much of it apparently caused through billions of dollars spent on the wrong choice of options for a sustainable future. Meantime, the American East Coast Atlantic salmon example of decimation continues on track to be replicated for West Coast steelhead. The Wind and Hood River examples clearly indicate we have choices. In fact, hatchery/wild steelhead research dating to the 1970s found similar results as at Hood River. But there was no comparative Wind River to document results from hatchery plant cessations. There is no longer that excuse.

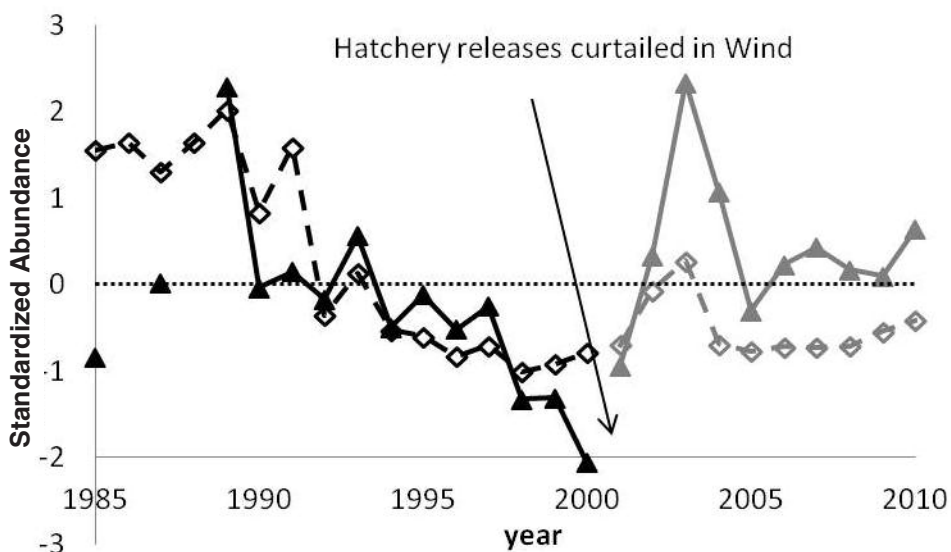


Figure 5. Triangles = Wild Wind R. Steelhead, Diamonds = Wild Hood R. Steelhead

minated as of 2010. This was after well documented genetic studies provided unavoidably clear findings: for either broodstock choice the relative reproductive success in the wild was only about one-third of that for wild steelhead. The hatchery broodstock choice results were no better, or even worse, for winter-run steelhead. The domesti-

cated winter broodstock had a relative reproductive success in the wild that was less than one-tenth that of wild winter steelhead and that of wild winter broodstock was again about one-third of that for wild steelhead. Furthermore, the hatchery effect on the overall natural spawning population of steelhead does not go away. This is due to a carry-over effect that remains in the generation after hatchery supplementation as a lingering drag on the wild population that would have been 8% higher otherwise. This diminishment apparently continues to occur throughout the supplementation years, and may even remain for some time after supplementation ceases.



The \$26 Million Question:

Will Canada act now to protect Fraser River sockeye?

By Craig Orr and Stan Proboszcz

— Watershed Watch Salmon Society —

Craig Orr is Executive Director of the Watershed Watch Salmon Society. Stan Proboszcz is a fisheries biologist with the organization. Based in Coquitlam, British Columbia, the Watershed Watch Salmon Society works to protect B.C.'s wild salmon. Find out more about the Watershed Watch Salmon Society at:

www.watershed-watch.org.

The Miriam-Webster Dictionary describes an Inquiry as 1) an examination into facts or principles, 2) a request for information, and 3) a systematic investigation of a matter of public interest.

Seasoned readers of *The Osprey* might be excused, however, from wondering just who's protecting their interests when it comes to the plight of wild Pacific salmon. They might also be forgiven for doubting governments' resolve when it comes to "systematically investigating" any natural resource crisis that might reveal government not acting in the best interests of the public. After all, why pay to officially advertise what many have long known: that Pacific salmon have been methodically plundered, ignored, traded-off to competing interests, devalued, and otherwise abused for at least as long as we've had government and government resource managers?

No federal inquiry had been called to examine the facts behind the collapse of Canada's once-teeming Atlantic cod. Instead government tried hard to prevent academic scientists from publishing their views on cod mismanagement. But in 2009, government and Canadians faced a new crisis with iconic Pacific salmon. Fraser River sockeye had been in free fall for 20 years, and when barely a million and a half sockeye limped back to the once-mighty Fraser in 2009, the lowest-ever return from dozens of once productive stocks, the crisis—in sockeye and in

public confidence—finally tipped the scales. Canada would have its inquiry.

So when Justice Bruce Cohen stepped up to the podium on October 31, 2012 to deliver his much-anticipated final report on the Inquiry into the Decline of Fraser River Sockeye, even the jaded took notice. Especially when the reserved, former provincial Justice delivered a blockbuster tome of nearly 1200 pages and 75 recommendations that, if enacted, could do more to bolster sockeye fortunes—and the public interest—than has ever been seen in Canada.

*Fraser River sockeye
had been in free fall
for 20 years, and just
1.5 million fish limped
back to the once-
mighty river in 2009.*

The report, a culmination of 3 years of effort, 3 extensions, and \$26 million in funding was a massive undertaking, to say the least. Nearly 50 groups petitioned for participant status. Justice Cohen and an army of 95 lawyers and representatives examined 179 witnesses, including scores of government managers and senior bureaucrats. Some 573,381 documents, 98% from the Government of Canada, were disclosed to the Inquiry and made available to the eventual 21 official participants who represented several aboriginal and fishing groups, conservationists, salmon farmers, industry, and government. Cohen also commissioned 33 expert and policy and practice reports, and, judging by the breadth of issues examined, he seemingly meant to leave no stone unturned in his

search for potential factors in the decline of Fraser sockeye.

It's particularly telling that, when the hearings opened on October 25th, 2010, Justice Cohen was safely ensconced on the 8th floor of the federal court in downtown Vancouver listening intently to experts describe the sockeye life cycle, while outside, a couple hundred soggy wild salmon advocates raised banners and voices demanding he protect wild salmon from industrial aquaculture operations.

The elephant in the room—aquaculture—clearly wouldn't be ignored this time around, even though it wasn't scheduled to be discussed until after other issues of possible relevance. But outside on the streets it was literally stopping traffic. Concerns about salmon farming impacts were also identified in nearly 70% of the 800 plus public submissions received by the Inquiry.

The spotlight on salmon aquaculture was hardly surprising, given the acrimonious and highly public debate that had been raging in BC for 10 years, ever since sea lice outbreaks on wild juvenile fish had become an annual spectator sport. Over that decade, Watershed Watch promoted awareness around sea lice impacts and urged reform of government and industry: counting lice on farms in the Broughton Archipelago, helping implement lice monitoring on wild fish, meeting continuously with industry and government, co-organizing half a dozen international workshops, and publishing more than a few journal articles on the interactions between wild and farmed fish—including one showing salmon farms significantly amplify lice on migrating wild juvenile Fraser sockeye.

But like demonstrators outside the courtroom, we were extremely frustrated by how readily such a huge weight of evidence was repeatedly dis-

Continued on next page

Continued from previous page

missed by both federal and provincial governments. Perhaps grasping for elusive conservation straws, we hoped the Inquiry and its ability to compel and examine witnesses and their evidence held promise as a means of revealing impacts and reforming management.

For years, those concerned about the link between farm derived sea lice and wild salmon declines banged their heads against the provincial government's iron door, trying mostly in vain to gain access to farm fish health data. When conservation participants asked Cohen to obtain these data back to the time when sockeye began declining, industry and government argued it was too onerous. But hey, we're with you in spirit they claimed, and to prove it we can spare 5 years or so. In a defining moment—but only after several rounds of affidavits—Justice Cohen overturned his own interim ruling and expanded the examination of fish health information to 10 years of data and 120 farms. It was a hopeful sign.

From day one, our and other lawyers also methodically introduced evidence of a serious conflict of interest within Canada's Department of Fisheries and Oceans (DFO). Exhibits were tabled revealing senior federal scientists were asked to contribute tranquilizing language to speeches for Members of Parliament in anticipation of a debate about farming impacts. Budgets and other documents flashed across courtroom monitors proving that government vigorously promoted Canadian farmed fish as sustainable commodities at the Boston Seafood Show and in private meetings in California with Safeway staff. A line-by-line, hour-long examination of the job description and travel itinerary of DFO's Aquaculture Director General became the type of almost daily "drama" that eventually helped shape one of Justice Cohen's seminal recommendations: that "The Government of Canada should remove from the Department of Fisheries and Oceans' mandate the promotion of salmon farming as an industry and farmed salmon as a product." As Cohen stated in a volume of his report dedicated to his 75 recommendations, "Because of its mandate to promote the salmon farming indus-

try, there is a risk that DFO will act in a way that favours the industry to the detriment of wild fish."

With each new piece of evidence it became increasingly clear that DFO was failing at its primary mandate: to protect salmon and salmon habitat. Senior officials reluctantly admitted more habitat was being lost than protected, before adding carefully that the policy was more of a "guideline." Federal habitat biologists bravely conceded their relationship with the province was dysfunctional, and their capacity to protect habitat had been gutted. Canada's official Wild Salmon Policy, a forward-looking blueprint for preserving the diversity and adaptive capacity of sockeye and other salmon, was treated like some backwoods-to-be-shunned cousin. Pollutants that were poorly monitored and barely regulated likely also contributed to sockeye woes. Cohen also heard concerns about and made recommendations to improve catch monitoring, enforcement, enhancement, fisheries certification, aboriginal co-management, decision-making transparency, test fishing, stock assessment, habitat protection, contaminants monitoring, and science capacity, to name some. He expressed acute concern over climate change—both its impacts on sockeye and lack of government action. In a seminal document commissioned for the Inquiry, academic scientist Scott Hinch showed that sockeye were increasingly subjected to dangerous levels of thermal stress. The Fraser River had warmed significantly in just 4 decades and in recent years thousands of salmon from the least temperature tolerant stocks perished annually in river before they spawned, never to pass along their genetic legacy.

But something else was also going on, something big that had only started surfacing in the work of DFO geneticist, Dr. Kristi Miller. A pathogen, possibly related to aquaculture, had rocketed to the top of the suspect list in the decline of Fraser River sockeye. Miller published a paper in the journal *Science* a few months before the two-and-half-week aquaculture-specific hearings were to begin. She found compelling evidence suggesting an unidentified virus—now known as a parvo virus—was linked to large scale behavioural changes and excessive

pre-spawn mortality in Fraser sockeye. But she was not allowed to talk about it, so her compelled testimony drew media in droves.

But while she didn't produce a smoking gun—good science is more about disproving than proving—she did point a spotlight on the issue of pathogens and the muzzling of scientific messengers bearing bad news. Still, the aquaculture and evidentiary hearings ended—for a brief time at least—with the public appetite barely whetted.

Then researcher Alex Morton and Professor Richard Routledge of Simon Fraser University announced in October 2011 they had positive test results for infectious salmon anemia virus (ISAV) of apparently European origin for the first time in wild Pacific sockeye. Their findings created a media frenzy, made even more intense when a previously unseen 2004 report surfaced suggesting DFO too had found, and then dismissed positive tests for ISAV years earlier. American senators even took heed and initiated testing of U.S. stocks. And as participants, we prompted Cohen to re-open the Inquiry, and in December 2011 he did, for a special session on pathogens.

Once again, DFO's Dr. Miller emerged as a star witness. She reported that her DFO lab had recently produced positive test results for ISAV in both wild sockeye and B.C. farm salmon. More alarming, she told Cohen that "the virus is causing enough damage to elicit a strong response in the [sockeye] salmon." As if this wasn't enough, Miller also found signals of piscine reovirus (PRV) in farm and wild fish—a pathogen found in the Norwegian industry linked to heart and skeletal muscle inflammation in farm fish (a virus we also found in subsequent testing with Dr. Routledge in Cultus Lake cutthroat trout).

Sadly, Dr. Miller was on her way to becoming an international poster-child for a Canadian smack-down on scientific transparency in its ranks. And the issue was trade, not conservation. Wild and farmed salmon are both huge trade commodities. Farmed salmon is British Columbia's largest agricultural export, the vast majority ending up on the plates of U.S. consumers. Enter the Canadian Food Inspection Agency (CFIA). Evidence tabled in the last

Continued on next page



Continued from previous page

days of hearings strongly suggested the CFIA and senior ranks in DFO were trying to derail growing concerns around “reportable” pathogens like ISAV that would trigger international trade barriers.

Dr. Frederick Kibenge, an accredited expert in detecting ISAV for the World Organization for Animal Health (known as the OIE), similarly testified he felt “attacked” by government audits of his independent lab, which rained down after he reported positive results for viruses. E-mails from high-ranking CFIA officials emerged likening this situation to a “war” and congratulating colleagues for “turning the PR tide” to their favour. Evidence mounted suggesting objective and science-based investigations by government into positive reports of viruses were lacking. And a year later, Dr. Kibenge’s struggles continue to appear in national media reports after the CFIA requested the OIE strip his lab’s certification. If not for the powers of a federal judicial inquiry, and Miller’s and Kibenge’s testimony, it might all sound like some whacky government conspiracy theory.

Despite the intense focus and new information on disease revealed through the Inquiry, Cohen reported that he could not isolate a “smoking gun” in the decline of Fraser River sockeye. Expert testimony and reports commissioned by Cohen suggested climate change and competition for food from (greatly enhanced) pink salmon also played a factor in sockeye woes. But he had heard enough facts to conclude that farmed salmon represent a “serious or irreversible threat” to Fraser sockeye. And in an unprecedented ruling on the burden of proof, he called for a freeze on salmon farming production and directed government to prove the industry isn’t harming wild fish. Otherwise, said Cohen, government should remove the farmed fish from the migration path of wild juvenile sockeye.


Cohen also had much more to say, couched in three volumes of text and his 75 recommendations. Particularly heartening to those of us who had fought in these trenches was his championing of Canada’s long-neglected Wild Salmon Policy. He recognized the value of this seminal conservation pol-

icy and that it was being given short shrift compared to the promotion of farmed fish. Cohen called on government to appoint a wild salmon champion and gave timelines for its full implementation. And he also called on Canada to fully enforce its habitat protection policy.

In his quiet and sobering way he also chastised the Federal government for weakening fish habitat protection and environmental assessment legislation—at the same time he had been deliberating on the evidence. Perhaps it’s fitting that Cohen’s three volumes are titled, *The Uncertain Future of Fraser River Sockeye*.

In the end, most were pleased by what Cohen delivered. We now had an unprecedented blueprint for sustaining Fraser sockeye, and a report that placed an even broader focus on wild salmon and natural resource management. Massive amounts of information had been revealed on the causes of the declines and on what ecological guru Buzz Holling terms “resource management pathology.” And public expectations for change had never been higher. Fearing evidence revealed throughout the hearings might fade in the minds of citizens, we compiled a highlights report with links to hundreds of key exhibits and testimony (see our Cohen highlights report at www.water-shed-watch.org/).

As of this writing, however, we’re still awaiting government’s response to the Cohen Inquiry and final report. Will government allow DFO to finally do its job of protecting wild salmon? Or will we continue to see conflicted mandates and inadequate attention to science, and thus insufficient change and priority given to conservation? No one currently knows the answer to this \$26 million dollar question. Many remain skeptical, especially of a government that seemingly favors resource extraction over long-term sustainability and broad public interest.

But the die has been cast, and it’s hard not to feel just a bit more hopeful that the odds have shifted, at least a bit. Also remember a public uproar initiated this whole investigation and it may take one more round of noise to prompt meaningful government action. Justice Cohen showed us that it is possible. After all, don’t anglers deserve a bit of hope? 

NMFS to Investigate Searsville Dam

The National Marine Fisheries Service has launched an investigation into whether Stanford University’s operation of Searsville Dam has violated the Endangered Species Act by harming steelhead trout and other species threatened with extinction. The dam blocks steelhead from migrating to almost 20 miles of historically accessible habitat upstream, it dewateres Corte Madera Creek below the dam, degrades water quality and habitat downstream and causes other negative impacts that harm threatened species.

For over a decade, American Rivers, members of the Beyond Searsville Dam coalition, and other stakeholders have tried to work collaboratively with Stanford University to address the problems caused by their dam. The CA Dept of Water Resources even offered funding to investigate options to deal with the dam’s environmental liabilities. But Stanford ultimately rebuffed these efforts.

Stanford believes its dam is not subject to state or federal laws that protect fish and wildlife, as currently operated. Conservation groups disagree, and welcome NMFS’s investigation.

“While we’re disappointed that Stanford chose to take a path of resistance, avoidance, and lack of collaboration for so many years, we are happy to see that NMFS has decided that enough is enough and has opened an investigation into Stanford’s environmentally destructive dam.” said BSD director Matt Stoecker.

The NMFS investigation comes after years of requests from local groups that Stanford comply with state and federal laws, challenges to their controversial Habitat Conservation Plan and a State review of dam safety. Recently, Stanford began its Searsville Dam Alternatives Study, an internal process evaluating options for the dam’s future. The threat of an enforcement action against the university for ESA violations, which could include penalties, should motivate Stanford to complete its study process by the end of 2013.



The Highs and Lows of Fraser River Sockeye Salmon

By Douglas Braun and Brendan Connors

— Simon Fraser University —

Douglas Braun is a post doctoral researcher at Simon Fraser University in British Columbia. His research focuses on understanding the influences of life history and the environment on population dynamics of Pacific salmon

Brendan Connors is also a post doctoral researcher at Simon Fraser University in the School of Resource and Environmental Management. His work seeks to understand how natural and human mediated processes interact to shape ecological dynamics.

Two cups of coffee in, I head to Yard Creek in a Simon Fraser University pick-up with my two field assistants early one August morning in 2006. I was nearing the end of my first field season; my PhD full of promise. The sun was beating down on the Fraser Watershed just outside of Salmon Arm, and I was eager to complete a full summer of surveying sockeye spawning streams. As we hauled our gear down to the creek's edge, I immediately noticed that the creek was dotted with red – sockeye salmon returning to spawn. This is the first time I saw sockeye salmon spawning, and I felt like a kid on Christmas morning, brimming with excitement. We had other surveys to complete that day, but we decided to spend the day at Yard Creek, exploring and bearing witness to this iconic event in nature. The perseverance and power that these sockeye exerted was palpable in the air. I felt a sense of honor and privilege watching these magnificent animals mate and prepare for death all in the same moment. I sat on the bank of the creek and watched them inch closer towards their fate as I contemplated the future of these animals.

Historically, the Fraser River has been one of the most productive sockeye salmon watersheds in the world. The vast Fraser River basin, occupy-

ing nearly two-thirds of British Columbia, is home to 200-plus populations of sockeye salmon. Commercial, First Nations, and more recently, recreational fishermen, have reaped the benefits of these fish over the years, catching collectively, on average, an astounding 4.5 million fish per year, and in some years upwards of 15 million (1946-1989). But by 2009, this time of plenty had passed, and many Fraser River sockeye populations had experienced an enigmatic decline in productivity, a disturbing trend that had actually begun in the early 1990s.

Historically, the Fraser River has been one of the most productive sockeye salmon fisheries in the world.

During this recent period of low productivity, we have seen dramatic restrictions to both commercial and First Nations fisheries catches. A particularly troubling year was 2009, when it was predicted that 10.5 million sockeye would return to the Fraser River, but only 1.5 million fish reached it to spawn in the more than 200 spawning locations throughout the Fraser Basin, the lowest number of sockeye to return since 1947 when modern records began. This decline in abundance put immense pressure on aboriginal and commercial fishing communities that depended on sockeye for food, social, and ceremonial purposes, as well as their livelihoods. This was the last straw; one of the greatest salmon producing watersheds in the world was in trouble and people want-

ed to know what was happening to their fish. The problem was that no one really knew why these populations were declining and the various possible explanations quickly became overwhelming. Reports of seal predation, over-spawning, climate change, adverse ocean conditions, algal blooms, pathogens, competition, illegal fishing, salmon farms, freshwater conditions, sewage, and even volcanoes as possible culprits flooded the media.

The alarming returns of sockeye in 2009 prompted the establishment of a federal judicial inquiry by Canada's Prime Minister Stephen Harper, to "identify the reasons for the decline of the Fraser River sockeye salmon populations," kicking off a \$26.4 million two- and a half-year process to get to the bottom of the issue. The Cohen Commission, as it came to be known (Bruce Cohen, a justice of the Supreme Court of British Columbia, was appointed Commissioner of the proceedings), was tasked with reviewing what was already known about Fraser sockeye, and calling witnesses and commissioning reports to enable the commissioner to make "independent findings of fact" about the causes of the decline and the role management played in conserving Fraser River sockeye salmon.

Other groups also sat up and took notice. Simon Fraser University hosted workshops in late 2009 to gain an understanding of why we saw such drastically low returns that year, as well as the reasons behind the two-decade decline. Experts from across North America attended to present ideas on topics ranging from seal predation to volcanoes, and qualitatively considered the likelihood that "their" factor contributed to either the devastating returns in 2009 and/or the two-decade decline in Fraser sockeye survival. Along with Brendan Connors, I was fortunate enough to attend these

Continued on next page

Continued from previous page

workshops, furiously taking notes for the organizers in an effort to record the wealth of information that came out during the workshop. Those workshops provided us with the idea that would ultimately result in a study linking pink salmon abundance and exposure to farmed salmon to the declines in Fraser sockeye. However, our first challenge was to decide which of the many hypotheses to include in our analyses, with some being more plausible than others.

Fortuitously, the Pacific Salmon Commission organized an Expert Panel in June 2010 to evaluate possible causes of declining Fraser River sockeye. The panel synthesized the evidence for and against the long list of possible agents and narrowed the list down to four that were deemed the most likely: 1) Over-spawning – the negative effect that a large abundance of spawners might have on their juveniles and the juveniles of subsequent spawners. This might arise when juvenile sockeye from a large brood year consume all the food in a nursery lake leaving very little for juvenile sockeye that enter the lake in following years. In recent years due to shifts in management approaches (e.g., reduced fishing pressure), a greater number of fish have made it to their spawning grounds, potentially increasing this delayed negative effect. 2) Ocean conditions – it is well established that survival is influenced by conditions experienced by salmon soon after they enter the ocean. Sea surface temperature (SST) is an index of the biological conditions salmon experience early in life with cool waters typically being rich in high quality food and warmer waters composed of poor quality food resources. Increasing SST over the past couple of decades has therefore led to concerns that the ocean has become increasingly less hospitable for juvenile sockeye. 3) Pathogens – disease outbreaks can occur naturally in wild Pacific salmon, and work by DFO highlighted the potential role pathogens may play in influencing mortality of adult sockeye returning to spawn. Research elsewhere has suggested pathogens (viruses, bacteria, and parasites) from salmon farms may contribute to declining wild salmon

productivity, and the increase in potential hosts for pathogens as a result of intensive salmon aquaculture along Fraser sockeye migration routes could lead to increased exposure to disease for wild sockeye. Though little is known about pathogens in wild salmon, these tantalizing bits of evidence led to concerns that salmon aquaculture may play a role in pathogen transmission from farmed to wild salmon. 4) Competition with pink salmon – despite concerns about salmon at the southern end of the range, the abundance of Pacific salmon across the North Pacific is actually at an all time high. This has led to concerns that increasing numbers of salmon, including ocean ranches and hatchery pro-

*Our data suggested
that increasing
competition with pink
salmon in the ocean
coincided with Fraser
sockeye declines.*

duced fish, may be reaching or exceeding the biological carrying capacity of the North Pacific Ocean. The most abundant species of salmon are pink salmon (or pinks), which are considered “super” competitors. Pinks grow fast, boast high feeding rates, mature early, and are often one step ahead of other Pacific salmon species with respect to their migration habits. Their high feeding rates can alter the distribution and abundance of prey leaving little food for other species of salmon to consume. In fact, pink salmon abundance has been linked to shifts in diet, delayed maturation, reduced growth and survival of other Pacific salmon species, including sockeye. Pink salmon are the most abundant Pacific salmon species, and since the 1970s their abundance in the North Pacific has been on the rise, peaking in 2005 at more than 600 million across the North Pacific and leading to speculation that pinks were outcompeting Fraser sockeye.

We diligently set about the task of compiling data on each of the factors

identified by the Pacific Salmon Commission to quantify the weight of evidence for each of the four hypotheses put forward to explain the observed declines in Fraser sockeye. Early on we recognized that it was unlikely that any single factor would be operating in isolation; it was more plausible that multiple factors may act in concert, with their effects possibly offsetting or compounding each other. In addition to Fraser sockeye we considered sockeye populations from other parts of British Columbia and Washington State to give us more power to test each hypothesis, because sockeye populations from other regions varied in their relationship with things like ocean conditions and exposure to farmed salmon.

When we had finished crunching the numbers we were surprised by what we found. Our analyses suggested that increasing ocean-basin-scale competition with pink salmon in the North Pacific Ocean (which have more than doubled in abundance since the 1960s) has occurred along with reduced productivity of Fraser sockeye. This suggested that increasing competition with pink salmon for a finite amount of food in the open ocean was leading to lower survival of Fraser River sockeye.

We also confirmed what had been previously known: increasing ocean temperature early in life reduces survival, but the effect of warming oceans is weaker than increasing numbers of pink salmon. However the real surprise of our analyses was that the negative effect of pink salmon on sockeye productivity was made worse by higher numbers of farmed salmon that wild Fraser sockeye migrate past early in marine life. What this suggested is that juvenile sockeye that are exposed to salmon farms early in marine life may pick up pathogens that make them less able to compete for resources with pink salmon later on in the ocean. Alternatively less food as a result of competition with pink salmon in the open ocean may lead to the “expression” of disease in sockeye that are infected but not in a diseased state. It appeared as though the impact of exposure to salmon farms was mediated by the abundance of pink salmon competitors such that an effect of salmon

Continued on next page



Continued from previous page

farms was not readily distinguishable on its own.

You might ask, "If pink salmon are affecting Fraser sockeye out in the ocean, why aren't other populations declining as well?" It turns out the decline in sockeye productivity is more widespread than just the Fraser Basin. Another recent study by one of our co-authors, Randall Peterman, looked at 64 sockeye populations from Washington State through Alaska and found that many of the sockeye populations across the North Pacific are experiencing declines in productivity, but not as steeply as some Fraser populations, lending further support for the pink salmon hypothesis.

At the time when we began this study, Fraser River sockeye had captivated a national audience and had never garnered so much attention, time, expertise, and money being directed toward their plight. Then the unthinkable happened. On the back of the lowest returns on record and apparent verge of collapse, sockeye returned to the Fraser River in record numbers (29 million!). Though their abundance in 2010 was impressive, the productivity (returning adults per spawner) of the 2006 brood year that produced the record returns was only slightly above the long-term average. In other words, a large number of spawners in 2006 gave rise to the large returns in 2010, but this was not an extraordinary event. This point eluded the media and was not communicated well to the public. This unexpected event provided us with an opportunity to see how well our analyses stood up to the amazing spectacle of almost 30 million salmon returning to spawn. In other words, could our analyses predict the productivity of the generation of Fraser sockeye that return in record numbers in 2010? Indeed the relationships we quantified did a surprisingly decent job of predicting the productivity of the generation of sockeye that returned in 2012. While the 2010 return was an amazing event to bear witness to, with the 20-year decline and low returns of 2009 being the backdrop for 2010, it seemed as though this high abundance was an anomaly. In reality the fantastic return was the result of cautionary fisheries management,

allowing lots of fish to return to their spawning grounds four years earlier, and the low abundance of pink salmon competitors in the North Pacific, which was about half the number of pinks that competed with sockeye that returned in record low numbers in 2009.

Though our research is the most comprehensive examination of the drivers of declines in Fraser sockeye conducted to date, it is important to remember that our results are correlative and are not necessarily evidence of causal mechanisms. Our findings are a critical first step towards understanding what may have caused the reductions in Fraser sockeye productivity and returns. As a result we are hopeful that managers, scientists, the Cohen Commission, and the public will see value in using our study as the foundation upon which further research into underlying mechanisms driving year-over-year declines in Fraser sockeye can be based. Specifically, future research should more closely examine the mechanisms and evidence for and against the hypotheses of competition, interaction with farmed salmon, and sea-surface temperature.

Fast forward to the present. The Cohen Commission released their final report on October 29, 2012. This report considered all 160 witnesses' testimonies, 900 public submissions, 2100 exhibits, and 14,000 pages of transcripts. This massive amount of information has been summarized into recommendations that include "...changes to the policies, practices and procedures of the Department of Fisheries and Oceans in relation to the management of the Fraser River sockeye salmon fishery." It is our hope that the recommendations made by the Commission will help rethink the way salmon are managed so as to reflect the fact that salmon do not respect international boundaries. We need to move towards international cooperation in the management of salmon, which would recognize that there is a finite amount of food in the ocean. In addition, because our research suggests that passing close to salmon farms early in life may weaken the ability of sockeye to compete for food with pink salmon in the open ocean, we need to also move towards management that appreciates the real world complexity

of life in the ocean, where the conditions salmon experience early in life can influence the outcome of experiences later in life. Perhaps most importantly our research argues for large-scale experimental manipulation of farmed-salmon production coupled with an increased understanding of where and when pathogens occur in wild and farmed salmon to more definitively assess the effects of salmon aquaculture on sockeye salmon.



Glossary

Adult returns – Number of mature adult salmon that return to the coast prior to the onset of fishing.

Recruits – For a given sockeye salmon population (i.e., "stock"), abundance of adults (also referred to as "recruits") as calculated by summing the estimated number of spawners with abundances of fish that were caught in various fisheries (where the population of origin is identified by methods such as fish scales and genetic identification).

Productivity – The ratio of adult returns (recruits) to the number of spawners that produced them. This ratio reflects the combination of survival rates across the entire life span, i.e., both the freshwater and post-juvenile stages.

Spawners – The fish that are not caught in fisheries and make it to their natal streams to reproduce. When referring to Fraser River sockeye, this abundance is in units of Effective Female Spawners (EFS), which are the number of females that successfully spawned.

Brood year – The year that sockeye spawned. For example, Fraser sockeye from the 2005 brood year primarily returned to spawn in 2009.

Additional information on the Cohen Commission:

Cohen Commission official website - <http://www.cohencommission.ca/>

Watershed Watch Salmon Society - <http://www.watershed-watch.org/resources/cohen-inquiry-highlights/>

Success of a Non-Traditional Mitigation Project for Okanagan Sockeye Salmon

By Tom Kahler

— Public Utility District No. 1, Douglas County, Washington —

Author Tom Kahler is a Fisheries Biologist with Douglas County PUD in East Wenatchee, WA, where he implements the fish-passage and habitat components of the Wells Hydroelectric Project Habitat Conservation Plan. Tom is also a member of the Upper Columbia Salmon Recovery Board's Regional Technical Team that sets priorities for and reviews and scores proposals for habitat actions in the Wenatchee, Entiat, Methow, and Okanagan river basins

The Okanagan population of sockeye salmon (*Oncorhynchus nerka*) is one of only three remaining populations of the eight (Fulton 1970) or ten (Gustafson et al. 2007) that once occupied the Columbia River Basin. Of the remaining three, only the Okanagan and Wenatchee populations remain viable, with the third, the Redfish Lake population, substantially bolstered by hatchery production and representing less than one percent of the annual sockeye returns to the Columbia.

Though a viable population, Okanagan sockeye occupy only a fraction of their former habitat. Since 1921, Okanagan sockeye have reared in Osoyoos Lake, the smallest of three major lakes in the Okanagan River Basin and the adults have spawned in the Okanagan River between Vaseux and Osoyoos lakes. Prior to the construction of dams at the outlet of Okanagan Lake in 1915 and Skaha and Vaseux lakes in 1921, Okanagan sockeye also reared in Okanagan and Skaha lakes (Fulton 1970; Bull 1999) and utilized spawning habitat both in the Okanagan River and several tributaries to Okanagan Lake. Channelization of all but 6 km of the Okanagan River between Osoyoos Lake and McIntyre Dam in 1954 for flood-control purposes further reduced spawning habitat. Nevertheless,

researchers (Hyatt and Rankin 1999) estimated that even the limited spawning habitat remaining could support a minimum capacity of 135,471 spawners (calibrated to adults counted at Wells Dam) and the rearing habitat in Osoyoos Lake could support the progeny from an estimated minimum escapement (Wells counts) of 117,453 spawners. Hyatt and Rankin (1999) noted that despite the estimated capacity of the habitat, neither of these escapement objectives had been achieved since counts commenced at Wells Dam in 1967.

Implementing a water management model has eliminated many mortality factors that limited sockeye smolt production in the past.

Annual counts of adult Okanagan sockeye at Wells Dam have fluctuated somewhat regularly over time, reaching a low of 1,662 in 1994 (Figure 1). In 1997 the National Marine Fisheries Service considered an Endangered Species Act listing, but concluded that despite three consecutive years of low returns, the population remained viable, not warranting a listing at the time (Gustafson et al. 1997). Adult counts of Okanagan sockeye averaged 30,202 from 1977 to 2007, representing approximately 56 percent of the total annual run to the Columbia River Basin during that period. For comparison, escapement of Wenatchee River sockeye averaged 23,271 during that same period, representing approximately 43 percent of the total annual run to the Columbia River Basin. During this 31 year period the two pop-

ulations generally tracked one another (see Figure 1). However, beginning in return-year 2008, the Okanagan sockeye run-counts diverged dramatically from the Wenatchee sockeye counts, posting two record returns at Wells Dam (2010 and 2012) and setting a five-year average count of over 200,000. During this period Okanagan sockeye have comprised approximately 90 percent of the total return to the Columbia River Basin, while the annual counts of the Wenatchee stock remain consistent with historic inter-annual variation, and Snake River returns continue to represent less than one percent of the Columbia Basin total.

The obvious question posed by these data is, what has changed since the mid-2000s that would affect only the Okanagan sockeye population to result in such a sizable increase in adult returns? The short answer: the implementation of a water-management model in the Canadian Okanagan has eliminated or at least minimized density-independent mortality factors that routinely and often profoundly limited past smolt production from the Okanagan Basin. The long answer is a story of the collaborative development and success of a non-traditional mitigation measure, and of the resilience of wild salmon.

Public Utility District No. 1 of Douglas County, Washington, (Douglas PUD) owns and operates the Wells Hydroelectric Project, the upstream-most dam on the Columbia River that provides fish passage. In 1990 Douglas PUD signed a long-term settlement agreement with fish management agencies and tribes specifying Douglas PUD's measures to mitigate for losses to fisheries resources associated with passage of Wells Dam. For Okanagan sockeye, the Wells Settlement Agreement specified annual hatchery production of 200,000 smolts. After only a few years of

Continued on next page

Continued from previous page

attempting to achieve those hatchery-production goals, Douglas PUD realized that they needed to seek other measures for meeting their mitigation commitments for Okanagan sockeye, and they began working with Canadian collaborators to identify viable options.

In the 1990s Douglas PUD funded numerous studies in the U.S. and

ing the 1990s, Douglas PUD funded Glenfir Resources to develop a list of options for protecting and restoring salmon habitat as a means to enhance the production of Okanagan sockeye in Canada. The resultant Phase I report (Bull 1999) presented 18 enhancement and protection options for consideration by the COBTWG from which the COBTWG identified a “short list” of options that received more detailed

resources, including kokanee in Okanagan Lake, and sockeye; 2) control flooding of both lake shores and river/tributary floodplains; 3) provide water for domestic and irrigation use; and 4) maintain flows for navigation and tourism/recreation uses. The 1974 Okanagan Basin Implementation Agreement (OBIA) delineates the management terms for the OLRs, defining instream-flow requirements and lake-elevation levels for the four management objectives listed above, and specifically for spawning and incubation of both sockeye in the river and kokanee on lake shores.

The Phase II “short-list” report for the COBTWG described the frequency of OLRs deviations from the OBIA flow objectives, indicating that potentially substantial increases in sockeye and kokanee production could result from avoiding those frequent deviations or by providing sockeye with a predictable spawning and incubation environment such as a spawning channel. Density-independent mortality events resulted from those deviations from flow targets, including redd desiccation/freezing and scour during incubation, and reduced suitability or availability of spawning habitat. The severity of the consequences for sockeye production from flow-management decisions became apparent one October day when Douglas PUD biologists encountered dewatered sockeye redds and dead and stranded spawners in the primary spawning area immediately below McIntyre Dam. Water managers had closed the dam gates to facilitate maintenance activities and the flow below the dam comprised only seepage through the dam, groundwater input, and inflows from a small tributary.

The COBTWG recognized that better flow management could reduce the frequency and magnitude of those density-independent mortality events, but the sometimes-competing management objectives and the lack of readily available data impeded the achievement of improved flow management. For water managers, OBIA flood-control objectives necessitated anticipating the spring freshet to avoid flooding lakeshore and riverside communities; yet, releasing too much water before sockeye fry emergence resulted in

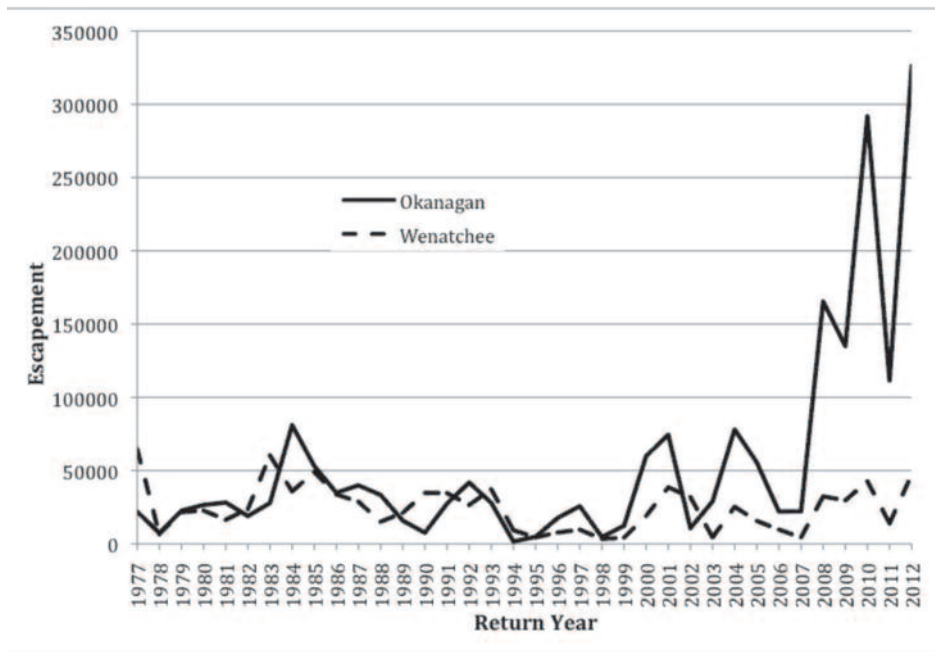


Figure 1. Escapement of Okanagan River (Canada; solid line) and Wenatchee River (dashed line) sockeye, return years 1977 through 2012.

Canada with the intent of defining the life-history attributes of Okanagan sockeye and of identifying factors that limit sockeye survival during the phases of their life cycle that they experience at and upstream of Wells Dam. In 1996, three of Douglas PUD’s Canadian collaborators (Canada Department of Fisheries and Oceans [DFO]; British Columbia Ministry of Water, Land and Air Protection [Ministry]; and Okanagan Nation Fisheries Commission [now represented by the Okanagan Nation Alliance—ONA]) organized into the Canadian Okanagan Basin Technical Working Group (COBTWG) to more effectively address salmon stock and habitat restoration issues in the Canadian Okanagan River Basin. As a culmination of the sockeye limiting-factors and life-history studies completed dur-

investigation in a Phase II report. For that short-list the COBTWG narrowed down the options to eight that addressed three primary factors: pre-spawn mortality, mortality from redd scouring, and habitat improvement. To understand the reason why redd scour made the short list, one must understand the basics of water management in the Canadian Okanagan River Basin.

The Canadian Okanagan River originates at the outlet of Okanagan Lake, with river discharge controlled by Okanagan Lake Dam as the “spigot” for the Okanagan Lake Regulation System (OLRS). The OLRs is managed by the Ministry, and comprises several sediment basins, multiple grade-control structures, and four dams (on Kalamalka, Okanagan, Skaha, and Vaseux lakes). The Ministry manages the OLRs to, 1) protect fisheries



Continued from previous page

redd scouring. Even the fisheries-resource objectives competed. For example, achieving the lake levels to minimize desiccation of kokanee redds in Okanagan Lake required water releases in the fall that interfered with sockeye staging or spawning. Even with defined targets for each water-management objective, water managers lacked the real-time data and an analysis platform that would allow them to respond to rapidly changing hydraulic conditions and consistently attain flow objectives.

In 2000 the COBTWG recommended to Douglas PUD their preferred option for meeting sockeye ecosystem-restoration objectives in the Canadian Okanagan: the development of a water-management model that would facilitate the routine achievement of flow objectives for sockeye and kokanee without compromising other OBIA objectives. Later that year, Dr. Kim Hyatt of DFO, leading a steering committee of the COBTWG, presented Douglas PUD with a proposal to develop an internet-based, multi-user decision-support model for use by the steering committee and operators of the OLRs to manage water in the Okanagan River Basin. The model, called the Fish-Water Management Tool (FWMT) would comprise a set of five linked biophysical sub-models: 1) Climate and Hydrology, 2) Okanagan Water Management Rules, 3) Climate and Water Temperature, 4) Kokanee Egg-to-fry Emergence, and 5) Sockeye. Each sub-model would require substantial data to develop and implement, and the FWMT proposal included both the initial data collection to support sub-model development and the creation of the necessary infrastructure and research programs to provide real-time and near real-time physical and biological data for long-term implementation of the FWMT. Fisheries professionals on the COBTWG FWMT Steering Committee and Ministry water managers would access the FWMT via the internet and, using that supporting data, would run, share, and discuss water-forecasting model-scenarios to inform water-management decisions in a collaborative environment. The FWMT would provide users with both the data and the computational tools to forecast the

probable outcomes of water-management actions and the consequences of those outcomes for all OLRs resource responsibilities.

FWMT proponents estimated an average gain of 10-15 percent in sockeye smolt production would result from FWMT implementation. Using that estimate of anticipated gain, Douglas PUD sought and received approval from the parties to the 1990 Settlement Agreement (replaced in 2004 by the Wells Habitat Conservation Plan [HCP]) for the development of the FWMT as a mitigation alternative. With Douglas PUD funding, the FWMT Steering Committee commenced data collection

*The Fish-Water
Management Tool
as an alternative to
traditional hatchery-
centered mitigation
has proven to be a
spectacular success.*

and model development in 2001. That same year, Douglas PUD released the last of their hatchery sockeye into Osoyoos Lake. By 2004, the FWMT was ready for real-time testing, and the FWMT Steering Committee completed a retrospective analysis with the FWMT using data from the previous 25 water years (Hyatt and Alexander 2005). The retrospective analysis estimated the relative change in smolt production that would have resulted from each historic sockeye brood year had OLRs operators used the FWMT to manage water in the Okanagan Basin during that year. The results of the retrospective analysis found an average annual increase in smolt production of 55 percent over the 25-year period. Full implementation of the FWMT as the decision-making tool for operators of the OLRs commenced in water year 2005 (October 2004-September 2005), and has continued each year since.

Brood-year 2004 Okanagan sockeye spawned in October 2004. One hun-

dred forty-five thousand of their progeny returned over Wells Dam in 2008, the first year of divergence of the Okanagan sockeye returns from the Wenatchee sockeye returns as depicted in Figure 1. Canadian fish and water managers have continued the annual implementation of the FWMT in each water year since 2005, and returns from each respective brood year have in most cases dramatically exceeded 100,000 at Wells Dam. Annual COBTWG hydroacoustic-survey estimates of sockeye smolt production from Osoyoos Lake have increased from pre-FWMT values of approximately 300,000 smolts to post-FWMT-implementation values of 3,000,000 to over 8,000,000 smolts (smolt-migration year 2010). Estimates of FWMT performance in the retrospective analysis (Hyatt and Alexander 2005) had estimated changes for each of the 25 years of historical data in isolation, not accounting for the cumulative improvement in smolt production over time resulting from increases in adult escapement, such as began in 2008.

The substantial reduction in density-independent mortality of sockeye from redd desiccation and scour events resulting from FWMT implementation has fueled the remarkable recovery of the Okanagan sockeye population. With the FWMT, OLRs managers have also prevented devastating fry- and adult-mortality events that occurred annually in the North Basin of Osoyoos Lake in late summer when expansion of the anoxic hypolimnion encroaches upon the thermocline squeezing the habitable zone for sockeye. [*Editor's Note: Anoxic hypolimnion refers to low dissolved oxygen levels in the water column from the bottom of the lake upward. If this low oxygen region expands upward toward the thermocline in the summer months, it limits the suitable area for juvenile coldwater fish; bottom water is too oxygen poor for them to survive and surface water is too hot and they are squeezed into a narrow band of suitable habitat resulting in low survival.*] Using FWMT forecasting, OLRs managers can retain water in Okanagan Lake until late summer and release it in a pulse that mitigates the "squeeze," increasing the volume of the habitable zone. Canadian users now consider the FWMT an indispensable component of

Continued on next page

Continued from previous page

the OLRs, appreciating the benefits of substantially increased sockeye abundance, a resurgence of lakeshore-spawning kokanee, and the avoidance of lakeshore and riverine flooding. The Okanagan Basin escaped damage from devastating floods that ravaged neighboring basins in Interior British Columbia in 2006 because of the forecasting power of the FWMT. Canadian researchers are now using the prospective capabilities of the FWMT to model climate-change scenarios to facilitate resource planning.

The FWMT as an alternative to traditional hatchery-centered mitigation has proven a spectacular success by removing the human-induced impediments that suppressed the inherent productivity of the natural-origin Okanagan sockeye, allowing them to rebound to at or above their historic abundance. Because the benefits of the FWMT accrue during the freshwater phases of the sockeye life-cycle, improvements in smolt production resulting from FWMT implementation should allow for much larger returns of Okanagan sockeye relative to pre-FWMT levels even when ocean conditions cycle through less favorable states in the future. The COBTWG parties who collect input data and maintain and operate the FWMT with funding from Douglas PUD, and make the day-to-day water-management decisions, are committed to long-term implementation of the FWMT. This commitment ensures continued benefits to sockeye and other OLRs stakeholders. The COBTWG's success with the FWMT is evident in the resurgence of Okanagan sockeye and kokanee, and they deserve and have received recognition in the form of a 2008 British Columbia Premier's Award, and a 2011 Murray A. Newman Award for Excellence in Aquatic Research and Conservation for significant achievement in aquatic conservation.

Douglas PUD will soon post on their webpage (<http://www.dcpud.org/>) a number of videos documenting the development and operation of the FWMT.




Chair's Corner
Continued from page 3

been left to manage steelhead populations with a blindfold on.

As anglers and advocates in the 21st century, it is incumbent upon us to put stewardship and conservation at the forefront, and if catch and release sport fisheries do indeed jeopardize the persistence of a population, they should be closed. But the reality is, on some of the larger populations of steelhead in Puget Sound, catch and release managed under selective regulations would have a negligible impact on wild populations of steelhead, while still allowing three months of angling opportunity — a core part of WDFW's mission. This lost opportunity deprives depressed communities of economic opportunities and alienates one of the department's core constituencies,

steelhead anglers. State agencies are understandably under duress and in many instances managers are doing the best they can with limit data and resources. However, we need to ask more of WDFW. As our state fisheries management agency, they must be advocates for the recovery of wild fish but also for sport fisheries. In a changing and evermore crowded world, WDFW needs to recognize the importance and utility of catch and release fisheries as a means of providing angling opportunity while minimizing impacts on fragile populations of steelhead. We won't see a steelhead fishery on the Skagit this winter, but in starting this conversation now with WDFW we can work together with the state to ensure that we are providing opportunities while simultaneously working towards recovery of listed stocks.





To receive *The Osprey*, please return this coupon with your check made out to The Osprey - FFF

THE OSPREY

NAME _____

ADDRESS _____

CITY/STATE/ZIP _____

PHONE _____

E-Mail

<p><input type="checkbox"/> I Am a New Subscriber</p> <p><input type="checkbox"/> I Am an Existing Subscriber</p> <p>Yes, I will help protect wild steelhead</p> <p><input type="checkbox"/> \$15 Basic Subscription</p> <p><input type="checkbox"/> \$25 Dedicated Angler Level</p> <p><input type="checkbox"/> \$50 For Future Generations of Anglers</p> <p><input type="checkbox"/> \$100 If I Put Off Donating, My Fish Might Not Return Home</p> <p><input type="checkbox"/> \$ _____ Other, Because _____</p>	<p><input type="checkbox"/> Send My Copies By E-Mail (PDF Electronic Version)</p> <p><input type="checkbox"/> Send My Copies by Standard Mail (Hardcopy)</p> <p>If you are a new subscriber, how did you hear about The Osprey?</p> <p><input type="checkbox"/> Friend or fellow angler</p> <p><input type="checkbox"/> Fishing show</p> <p><input type="checkbox"/> Fly shop, lodge or guide</p> <p><input type="checkbox"/> Another publication. Which? _____</p> <p><input type="checkbox"/> Club or conservation group meeting</p> <p><input type="checkbox"/> Other _____</p>
---	---

I am a . . .

Citizen Conservationist

Commercial Outfitter/Guide

Professional Natural Resources Mgr.

Other _____

The Osprey — Steelhead Committee
Federation of Fly Fishers
5237 US Hwy 89 South, Suite 11
Livingston, MT 59047-9176

Thanks For Your Support



THE OSPREY

*Federation of Fly Fishers
5237 US Hwy 89 South, Suite 11
Livingston, MT 59047-9176*

Address Service Requested

Non-Profit Org.
U.S. Postage Paid
PAID
Bozeman, MT
Permit No. 99

2012 HONORS LIST

The Osprey wishes to thank the dedicated people and organizations who gave their financial support in 2012. Our readers are our primary source of funding. It's pretty remarkable that our home-grown journal, which only comes out three times a year, has developed such a generous following. Don't think we're not grateful, and a bit humbled.

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

\$1000 and greater

Nicholas H. Anderson

\$200 to \$499

Howard A. Johnson
Peter Broomhall
Washington Steelhead Flyfishers

\$100 to \$199

Craig Erdman
Doug Schaad
Jay H. Beckstead
Dale Greenley

Scott Hagen
Charles Keller
Jon B. Lund
Jerry E. Reeves
Paul J. Utz
Tom White
Washington-British Columbia Chapter,
American Fisheries Society

\$50 to \$99

Harold Boswell
David Christian
Ronald Dyslin
Stephen M. Egge
Michael Gabrion
Lawrence C. Hill
Dacid Johnson
Art Lingren
David W. Narver
Ron E. Schwarz
Lory Watkins
Richard N. Williams

\$15 to \$49

John O.G. Jenkins
Yancy Lind
Kevin D. Baker
Richard A. Bennett
Robert L. Bettzig
Jeff Bright

Greg Connolly
Michael Crissy
Raymond Evans
Jim Hoschouer
Richard E. Johnson
Vance J. Luff
Gerald B. Mahony
Nathan Mantua
Robert J. Masonis
R.J. Petrillo
Robert Sheeley
Donald J. Starkin
Jon Williams
Dale Timberlake
Greg Connolly
Larry Brown
Pat Ford
Richard Watts
Keith Beverly
Fred Carter
Ed Heidel
Teresa Kasza
William Lenheim
Pat Hoglund
Margaret Filardo
David Borokowski
Marty Degregorio
Dale Watkins
Kevin Eastman
Todd Brown