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August 25, 2015

Certified U.S. Mail – Return Receipt Requested

Office of the Administrator
United States Environmental Protection Agency
William Jefferson Clinton Building
Mail Code: 1101A
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Administrator Regina A. McCarthy
United States Environmental Protection Agency
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1200 Pennsylvania Avenue, N.W.
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National Marine Fisheries Service (NOAA Fisheries)
1315 East West Highway
Silver Spring, MD 20910

Assistant Administrator for Fisheries Eileen Sobeck
National Marine Fisheries Service (NOAA Fisheries)
1315 East West Highway
Silver Spring, MD 20910

Secretary Penny Pritzker
United States Department of Commerce
1401 Constitution Ave. N.W.
Washington, D.C. 20230

RE: Notice of Intent to Sue U.S. Environmental Protection Agency and National Marine Fisheries Service for Violations of the Endangered Species Act Associated with Consultation on Washington State's Revised Sediment Management Standards for Marine Finfish Facilities

Dear Honorable Civil Servants:

This letter provides notice of Wild Fish Conservancy's intent to sue the United States Environmental Protection Agency, Regina McCarthy in her official capacity as the Administrator of the United States Environmental Protection Agency (collectively, "EPA"), the National Marine Fisheries Service, and Eileen Sobeck in her official capacity as the Assistant Administrator for Fisheries of the National Marine Fisheries Service (collectively, "NMFS") for violations of the Endangered Species Act ("ESA") associated with EPA's approval of revisions to Washington Sediment Management Standards for Marine Finfish Facilities and the ESA section 7 consultation therefor. This letter is provided pursuant to section 11(g) of the ESA, 16 U.S.C. § 1540(g). Also provided herewith is a declaration by Todd Sandell, Ph.D., which Wild Fish Conservancy requests EPA and NMFS consider in determining whether to reinitiate the ESA consultation described herein.

EPA initiated informal consultation with NMFS under section 7 of the ESA in 2008 on the effects of EPA's proposed approval of revisions to Washington sediment management standards intended to enable commercial salmon farms in Puget Sound to be permitted under the Clean Water Act ("CWA").[1] Despite the known harm and significant risks these facilities pose to wild salmonids, NMFS issued a determination that EPA's action is not likely to adversely affect protected species on June 9, 2008.[2] The ESA consultation was thus concluded without fully evaluating the effects of commercial salmon farms through preparation of a biological opinion and without imposing monitoring and other requirements through an incidental take statement designed to protect wild salmonids.

Wild Fish Conservancy challenged the 2008 consultation as insufficient under the ESA. Judge Coughenour of the Western District of Washington found the 2008 consultation inadequate and set aside EPA's approval of the revised Sediment Management Standards. *Wild Fish Conservancy v. U.S. Envtl. Prot. Agency*, No. C08-0156-JCC, 2010 U.S. Dist. LEXIS 41838 (April 28, 2010). The Court further ordered EPA and NMFS to reconsider whether formal consultation is required.

EPA reinitiated ESA consultation with NMFS on the Sediment Management Standards in 2010. Remarkably, NMFS again issued a determination that the Puget Sound commercial salmon farms are not likely to adversely affect threatened and endangered species on April 8, 2011.[3] Consultation was thus again concluded without any detailed analysis of these facilities and without the imposition of monitoring or other requirements.

There was an outbreak of the infectious hematopoietic necrosis virus ("IHNV") in May of 2012, at net pen complexes near Rich Passage at the southern end of Bainbridge Island. This

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[1] The revisions to the Washington sediment management standards at issue include Wash. Admin. Code 173-204-412, which addresses regulation of discharges from net pens and exempts such operations from sediment management standards within an impact zone of 100 feet in all directions from the net pens.

[2] NMFS Tracking No. 2008/02328.

[3] NMFS Tracking No. 2010/06071.

occurred at a time when juvenile salmonids were migrating through the nearshore environment near the commercial salmon facilities. A document prepared by the Washington Department of Fish and Wildlife found that "certainly there is amplification occurring." It can hardly be disputed that this disease outbreak adversely affected threatened salmonids—or, at a minimum, demonstrates that commercial salmon farms in Puget Sound *may* adversely affect ESA-listed species. EPA and NMFS are in violation of the ESA for failing to reinitiate consultation to fully evaluate the adverse effects of the commercial salmon farms in Puget Sound and have also failed to insure that these facilities do not jeopardize protected species.

I. Legal Framework.

Section 7 of the ESA imposes a substantive obligation on federal agencies to "*insure* that any action authorized, funded, or carried out by such agency…is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of" habitat that has been designated as critical for such species. *See* 16 U.S.C. § 1536(a)(2) (emphasis added); *Pyramid Lake Paiute Tribe of Indians v. U.S. Dep't of the Navy*, 898 F.2d 1410, 1415 (9th Cir. 1990). Such jeopardy results where an action reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. 50 C.F.R. § 402.02. Destruction or adverse modification of critical habitat occurs where there is a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. *Id.*

In fulfilling the substantive mandates of section 7 of the ESA, federal agencies planning to fund, authorize, or undertake an action (the "action agency") that "may affect" ESA-listed species or their critical habitat are required to consult with NMFS (the "consulting agency") regarding the effects of the proposed action. 50 C.F.R. § 402.14(a). Formal consultation concludes with NMFS' issuance of a biological opinion determining whether the action is likely to jeopardize ESA-protected species or result in adverse modification of critical habitat. 50 C.F.R. § 402.14(h)(3). If NMFS determines that such jeopardy is not likely, or that reasonable and prudent alternatives to the proposed action will avoid jeopardy, and that any taking of listed species incidental to the proposed action will not violate section 7(a)(2) of the ESA, NMFS must issue an incidental take statement with its biological opinion. 16 U.S.C. § 1536(b)(4). The incidental take statement includes reasonable and prudent measures considered by NMFS as necessary or appropriate to minimize impacts on ESA listed species. 16 U.S.C. § 1536(b)(4)(C)(ii); 50 C.F.R § 402.14(i)(1)(ii).

Informal consultation is an optional process that includes all discussions between NMFS and the action agency prior to formal consultation, if required. 50 C.F.R. § 402.02. If, through this process, the action agency determines that its proposed action is "not likely to adversely affect" protected species and NMFS issues a written concurrence in that determination, the consultation requirements of section 7 of the ESA are fulfilled and formal consultation is not required. 50 C.F.R. § 402.13(a).

Federal agencies have a continuing duty under section 7 of the ESA after consultation is concluded to insure that their actions will not jeopardize the continued existence of listed species

or adversely modify designated critical habitat. The agencies must reinitiate consultation whenever "the amount or extent of taking specified in the incidental take statement is exceeded," "new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered," where the action in question is "subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion," or where "a new species is listed or critical habitat designated that may be affected by the identified action." 50 C.F.R. § 402.16(a)-(d). "The duty to reinitiate consultation lies with both the action agency and the consulting agency." *Salmon Spawning & Recovery Alliance v. Gutierrez*, 545 F.3d 1220, 1229 (9th Cir. 2008).

II. Factual Background.

A. Affected Species and Critical Habitat.

NMFS listed the Puget Sound Chinook salmon evolutionary significant unit ("ESU") as a threatened species in 1999. 64 Fed. Reg. 14,308 (March 24, 1999); 70 Fed. Reg. 37,160 (June 28, 2005); 50 C.F.R. §§ 223.102(c)(8) and 223.203(a). Critical habitat has been designated for this species. 70 Fed. Reg. 52,630 (Sept. 2, 2005).

The Puget Sound distinct population segment ("DPS") of steelhead was listed as a threatened species in 2007. 72 Fed. Reg. 26,722 (May 11, 2007).

The Hood Canal summer-run chum salmon ESU is listed as a threatened species. 64 Fed. Reg. 14508 (March 25, 1999). NMFS has designated critical habitat for this species. 70 Fed. Reg. 52,630 (Sept. 2, 2005); 50 C.F.R. § 226.212(m)(5).

Chinook salmon in Puget Sound are predominately "ocean-type," meaning they migrate to saltwater during their first year after spending little or no time in freshwater. These fish make extensive use of the estuary and nearshore environments, which they enter when they are extremely small (less than 50 mm in length). The nearshore habitat—defined to extend outward from shore (including islands) to a water depth of approximately 30 meters (98.4 feet)—is therefore particularly important to Puget Sound Chinook salmon and has been designated as critical habitat for this species throughout Puget Sound. 50 C.F.R. § 226.212(i)(16); 70 Fed. Reg. 52630, 52637-38 (Sept. 2, 2005) (the significance of the nearshore environment to juvenile salmonids was the primary basis for its designation as critical habitat).

When NMFS listed Puget Sound Chinook salmon under the ESA, it found:

> Overall abundance of Chinook salmon in the Puget Sound ESU has declined substantially from historical levels, and many populations are small enough that genetic and demographic risks are likely to be relatively high.

Several populations within this ESU have already become extinct, and several others—including those within the Nooksack, Lake Washington, mid-Hood Canal, Puyallup, and Dungeness basins—have experienced critically low returns of less than 200 adult fish in recent years.

Summer chum do not rear in freshwater, but rather migrate to natal estuaries almost immediately upon emergence. These fish are the same size when they enter estuaries as emerging fry—less than 40 millimeters. Some summer chum may rear in natal estuaries for a period, while others move directly into shoreline habitats. The "continued survival [of this species] depends substantially on estuarine conditions." NMFS has therefore designated the nearshore environment throughout Puget Sound as critical habitat for this species as well. 50 C.F.R. § 226.212(m)(5); 70 Fed. Reg. 52630, 52637-38 (Sept. 2, 2005) (the significance of the nearshore environment to juvenile salmonids was the primary basis for its designation as critical habitat). Hood Canal summer-run chum experienced a severe drop in abundance in the 1980's, and returns decreased to all time lows in 1989 and 1990 with less than a thousand spawners each year.

Puget Sound wild steelhead numbers are approximately 1 to 4% of their historical abundance. NMFS' 2011 "status review" of this species stated that "[m]ost populations within the [Puget Sound steelhead] DPS are showing continued downward trends in estimated abundance, a few sharply so." The estimated mean population growth rates for all but a few populations within the Puget Sound steelhead DPS are declining—typically by -3 to -10% annually. The Puget Sound Steelhead Technical Recovery Team recently assessed the extirpation risk of twenty of the twenty-three component populations of the Puget Sound steelhead DPS. Twelve of the twenty were rated as a "high" extirpation risk ($\geq$ 70% probability in the next 20-100 years) and one additional one was rated as a "moderately high" extirpation risk (50% probability in the next 100 years). Only seven of the twenty populations, or 35%, were rated as a "low" risk of extirpation.

B. Commercial Salmon Farms in Puget Sound.

There are currently eight Atlantic salmon net pens operated in Puget Sound that produce over 10 million pounds of salmon annually. Four of the facilities are located in or around Deepwater Bay of Cypress Island north of Anacortes, three are south of Bainbridge Island in Rich Passage, and one is northeast of Port Angles Harbor just south of Ediz Hook. Fish are hatched at freshwater hatcheries and the smolts are transferred to the marine net pens in Puget Sound where they are cultivated to a marketable size.

Net pens are floating facilities that contain salmon in permeable enclosures in open marine water. Due to characteristics conducive to commercial success, non-native Atlantic salmon species are raised. The salmon are given feed, antibiotics, and other medications and treatments as necessary.

Atlantic salmon farms have negative environmental and ecological effects. Environmental concerns include biological pollution (escaped famed fish can compete with and prey on native salmonids and farmed fish can transmit disease and parasites to wild fish), organic pollution and eutrophication (fish feces, uneaten fish food, and dead fish contribute to nutrient loading which can lead to low- or no-oxygen "dead-zones"), chemical pollution (a wide range of chemicals are used, including antibiotics and pesticides), and habitat modification.

C. EPA's Approval of Revised Sediment Management Standards and the Associated ESA Consultation.

Washington has adopted sediment management standards as part of its water quality standards required under the CWA, which EPA approved in 1991 under section 303(c) of the Clean Water Act ("CWA"). The Washington State Legislature enacted legislation in 1993 that directed the Washington Department of Ecology ("Ecology") to adopt standards and criteria specifically for salmon net pens. Rev. Code Wash. 90.48.220. The legislation was specifically intended to require revisions to state water quality standards so that salmon net pens could receive permits that would allow these facilities to operate within the mandates of the CWA.

Ecology responded in 1995 with the promulgation of WAC 173-204-412, which specifically addresses regulation of marine finfish rearing facilities under Washington's CWA permitting program. "Marine finfish rearing facilities," commonly referred to as "net pens," are defined as "facilities located within state waters where finfish are fed, nurtured, held, maintained, or reared to reach the size of release or for market sale." WAC 173-204-200(13). This regulation includes various revisions to Washington's sediment management standards, one of which exempts net pens from the sediment management standards within an impact zone of 100 feet in all directions from the net pen facilities. WAC 173-204-412(2).

WAC 173-204-412 was submitted to EPA in 1996 as part of a package of revised water quality standards, but EPA failed to act on the submission for twelve years—until Wild Fish Conservancy provided notice of its intent to commence a CWA citizen suit for EPA's failure to act on the proposed standards within 90 days of Ecology's submission as required under section 303(c) of the CWA.

EPA subsequently notified NMFS of its intent to approve the revisions to WAC 173-204 and requested that NMFS concur in the determination that this action was "not likely to adversely affect" threatened and endangered species. EPA supported its request with a Biological Evaluation. EPA informed NMFS on multiple occasions that it wished to move quickly through the ESA consultation process because EPA was being sued for its failure to act on the revised water quality standards.

NMFS subsequently concurred in EPA's "not likely to adversely affect" determination on June 9, 2008, thereby concluding the ESA section 7 consultation process. EPA then approved the revised water quality standards on September 18, 2008. As noted, the Western District of Washington found this consultation inadequate and set aside EPA's approval. *Wild Fish Conservancy v.U.S. Envtl. Prot. Agency*, No. C08-0156-JCC, 2010 U.S. Dist. LEXIS 41838 (April 28, 2010). The Court further ordered EPA and NMFS to reconsider whether formal consultation is required.

EPA sent NMFS a letter dated December 13, 2010, again announcing its intent to approve the revisions to the sediment management standards and requesting that NMFS concur in EPA's determination that the action is not likely to adversely affect ESA-listed species. EPA supported this request with an update to its previous Biological Evaluation. NMFS issued a letter dated April 8, 2011, concurring in the not likely to adversely affect determination, thereby

concluding the ESA consultation. EPA then approved the revisions to sediment management standards on April 22, 2011, including the exemptions for commercial salmon farms at WAC 173-204-412.

III. EPA and NMFS Violations of the ESA.

EPA and NMFS are in violation of the ESA for not reinitiating their ESA consultation on EPA's approval of the revised sediment management standards applicable to the Puget Sound commercial salmon farms. Further, EPA is in violation of section 7 of the ESA for failing to insure that its approval is not likely to jeopardize ESA-listed species or adversely modify their critical habitat.

A. Failure to Reinitiate Consultation.

EPA and NMFS are in violation of section 7(a)(2) of the ESA, 16 U.S.C. § 136(a)(2), for failing to reinitiate consultation on the effects of EPA's approval of the revised sediment management standards to Puget Sound Chinook salmon and its critical habitat, Puget Sound steelhead, and Hood Canal summer-run chum salmon and its critical habitat.

Events and occurrences that have occurred since NMFS concluded its previous consultation on April 8, 2011, have triggered the requirement to reinitiate that consultation. Most notably, the outbreak of IHNV in May of 2012, at the net pen complexes near Rich Passage reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered. Moreover, this outbreak undermines NMFS' "not likely to affect" determination and warrants formal consultation on EPA's actions.

Submitted herewith is a declaration of Todd Sandell, Ph.D., describing the May 2012 outbreak of IHNV and its likely effects of threatened salmonids. Wild Fish Conservancy requests that EPA and NMFS consider this declaration in determining whether to reinitiate ESA consultation. Dr. Sandell explains that IHNV is among the most virulent pathogens of salmonids. *Sandell Decl.*, ¶ 12. The outbreak occurred at three commercial salmon farms located in Rich Passage south of Bainbridge Island—the Orchard Rocks, Fort Ward, and Clam Bay facilities. While it is likely that the net pen infections arose from wild fish, the high densities in the net pens of Atlantic salmon, which are highly susceptible to IHNV, artificially elevated (bioamplified) the number of viral particles present. *Id.* These three net pens are located within wild salmon habitat. *Id.* at ¶ 14. In fact, juvenile salmonids—the most susceptible to IHNV—must migrate past these commercial salmon farms on their way to sea. *Id.* The outbreak occurred in April and May when juvenile Chinook and coho salmon emigration nears its peak. *Id.* ¶ 21. Reports indicate that the outbreak are in the "U" clade of IHNV, which is pathogenic for Chinook salmon and steelhead. *Id.* at ¶ 23. It is Dr. Sandell's opinion that, "given the magnitude and duration of the IHNV outbreak, the proximity of the infected net pens to nearshore habitat utilized by Pacific salmon..., [that] it is highly likely that ESA-listed Chinook salmon and steelhead trout were harmed." *Id.* at ¶ 24.

B. Failure to Insure No Jeopardy.

In addition to the procedural consultation requirements of section 7 of the ESA, EPA is required to insure that any action it authorizes and/or carries out is not likely to jeopardize the continued existence of any threatened or endangered species or result in the destruction or adverse modification of designated critical habitat. 16 U.S.C. § 1536(a)(2). By approving the revised sediment management standards applicable to Puget Sound commercial salmon farms without formally consulting under section 7 of the ESA and by failing to reinitiate consultation as described herein, EPA has failed to insure that the continued existence of Puget Sound Chinook salmon, Puget Sound steelhead, and Hood Canal summer-run chum salmon is not jeopardized and that the critical habitat for Puget Sound Chinook salmon and for Hood Canal summer-run chum salmon is not destroyed or adversely modified.

IV. Party Giving Notice of Intent to Sue.

The full name, address, and telephone number of the party giving notice is:

Wild Fish Conservancy
15629 Main Street N.E.
Duvall, WA 98019
Tel: (425) 788-1167

V. Attorneys Representing Wild Fish Conservancy.

The attorneys representing Wild Fish Conservancy in this matter are:

Brian A. Knutsen
Kampmeier & Knutsen, PLLC
833 S.E. Main St., Mail Box 318
Portland, Oregon 97214
(503) 841-6515

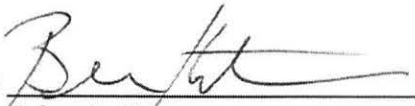
Paul A. Kampmeier
Kampmeier & Knutsen, PLLC
615 Second Avenue, Suite 360
Seattle, Washington 98104
(206) 223-4088 x 4

VI. Conclusion.

This letter provides notice under section 11(g) of the ESA, 16 U.S.C. § 1540(g), of Wild Fish Conservancy's intent to sue EPA and NMFS for violations of the ESA discussed herein. Unless these ongoing and imminent violations described herein are corrected within sixty days, Wild Fish Conservancy intends to file suit to enforce the ESA. Wild Fish Conservancy is available during the sixty-day notice period to discuss effective remedies and actions that will assure future compliance with the ESA.

Very truly yours,

KAMPMEIER & KNUTSEN, PLLC

By: 

Brian A. Knutsen

CERTIFICATE OF SERVICE

I, Brian A. Knutsen, declare under penalty of perjury of the laws of the United States that I am counsel for Wild Fish Conservancy and that on August 25, 2015, I caused copies of the foregoing to be served on the following by depositing it with the U.S. Postal Service, postage prepaid, in the manner specified:

Via U.S. Certified Mail - Return Receipt Requested:

Office of the Administrator
United States Environmental Protection Agency
William Jefferson Clinton Building
Mail Code: 1101A
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Administrator Regina A. McCarthy
United States Environmental Protection Agency
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1315 East West Highway
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National Marine Fisheries Service (NOAA Fisheries)
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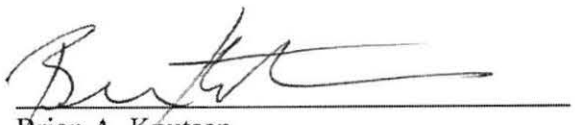
Secretary Penny Pritzker
United States Department of Commerce
1401 Constitution Ave. N.W.
Washington, D.C. 20230



Brian A. Knutsen

DECLARATION OF TODD SANDELL, M.S., Ph.D.
IN SUPPORT OF NOTICE LETTER FOR VIOLATIONS OF THE ENDANGERED SPECIES ACT RELATING TO ESA CONSULTATION ON PUGET SOUND COMMERCIAL SALMON FARMS

I, Todd Sandell, declare the following on the basis of personal knowledge to which I am competent to testify:

1. My current address is 4021 NE 196th St., Lake Forest Park, WA, 98155.

PROFESSIONAL QUALIFICATIONS

2. I am a senior ecologist for the Wild Fish Conservancy, which position I have held since December 2010. I have a BS degree in Biology from Bowdoin College (Brunswick, ME). In 2001, I received a master's degree in Microbiology from Oregon State University in Corvallis, Oregon. I earned a Ph.D. from Oregon State University in 2010 in Pathogenic Microbiology. I have substantial knowledge and experience in parasitology, immunology and the disease ecology of Pacific salmon (how pathogens and parasites influence and regulate populations).

3. My undergraduate work at Bowdoin College (Brunswick, ME) included a focus on immunology. In my senior year I completed an independent study project isolating the cymbidium mosaic virus and generated a rabbit polyclonal antibody to that virus for use in future research. Later I worked at the Barbara Davis Clinic for juvenile (Type I) diabetes at the University of Colorado Health Sciences Center (Denver, CO) where I studied the interactions of the immune system as autoimmunity arose, leading to diabetes in humans and a mouse model. Our work focused on the role of macrophages in triggering the autoimmune cascade and on the development of a synthetic insulin molecule that would not trigger an autoimmune response.

4. After this I attended Oregon State University (OSU; Corvallis, OR) where I initially studied the salmonid immune system response to the pathogen *Renibacterium salmoninarum*; the research focused on macrophages, which harbor the bacterium, and their potential to clear this intracellular pathogen when activated. The lab in which I studied also focused on the human parasite *Schistosoma mansoni*, and as a result I learned much about comparative immunity and the unique aspects of the teleost (bony fishes, which includes salmon) immune system.

5. Later I moved to the Microbiology department and OSU's Salmon Disease Laboratory, where I studied the dynamics of an exotic parasite, *Myxobolus cerebralis* (which causes Whirling Disease in susceptible salmonids), on the salmon and trout populations in the Lostine River, Oregon. This work investigated the role of the environment on parasite transmission with histology, fluorescent antibody techniques and PCR, and identified factors increasing the density of the alternate host and on infection and disease risk.

6. I then spent 7 years at the Hatfield Marine Science Center investigating how pathogens affected the growth and survival of juvenile salmon shortly after marine entry, as well as during their emigration through the Columbia River estuary.

7. Interest in this work led me back to graduate school at OSU, where I studied the disease ecology of juvenile salmon in nearshore marine waters of the northeast Pacific Ocean, utilizing polymerase chain reaction (PCR) and quantitative PCR (qPCR), among other techniques, to detect and quantify bacterial, viral and parasitic organisms and model their effects on growth and survival. I defended my dissertation in

2010 and continue to publish findings from that research. A list of relevant publications is included in with my *curriculum vitae* attached hereto.

SUMMARY OF OPINIONS

8. In summary, it is my opinion that the commercial salmon farms in Puget Sound likely have some adverse effects on native salmonids protected under the Endangered Species Act ("ESA"). It is further my opinion that the outbreak of the infectious hematopoietic necrosis virus ("IHNV") in May of 2012, at net pen complexes near Rich Passage at the southern end of Bainbridge Island, likely led to increased infection levels (and potential mortality) in native stocks of wild, juvenile Pacific salmon within Puget Sound, Washington with IHNV.

ESA-LISTED SALMONIDS IN PUGET SOUND

9. The Puget Sound Chinook salmon evolutionary significant unit ("ESU") was listed as a threatened species in 1999.

10. The Puget Sound distinct population segment ("DPS") of steelhead was listed as a threatened species in 2007.

11. The Hood Canal summer-run chum salmon ESU is listed as a threatened species.

THE MAY 2012 IHNV OUTBREAK

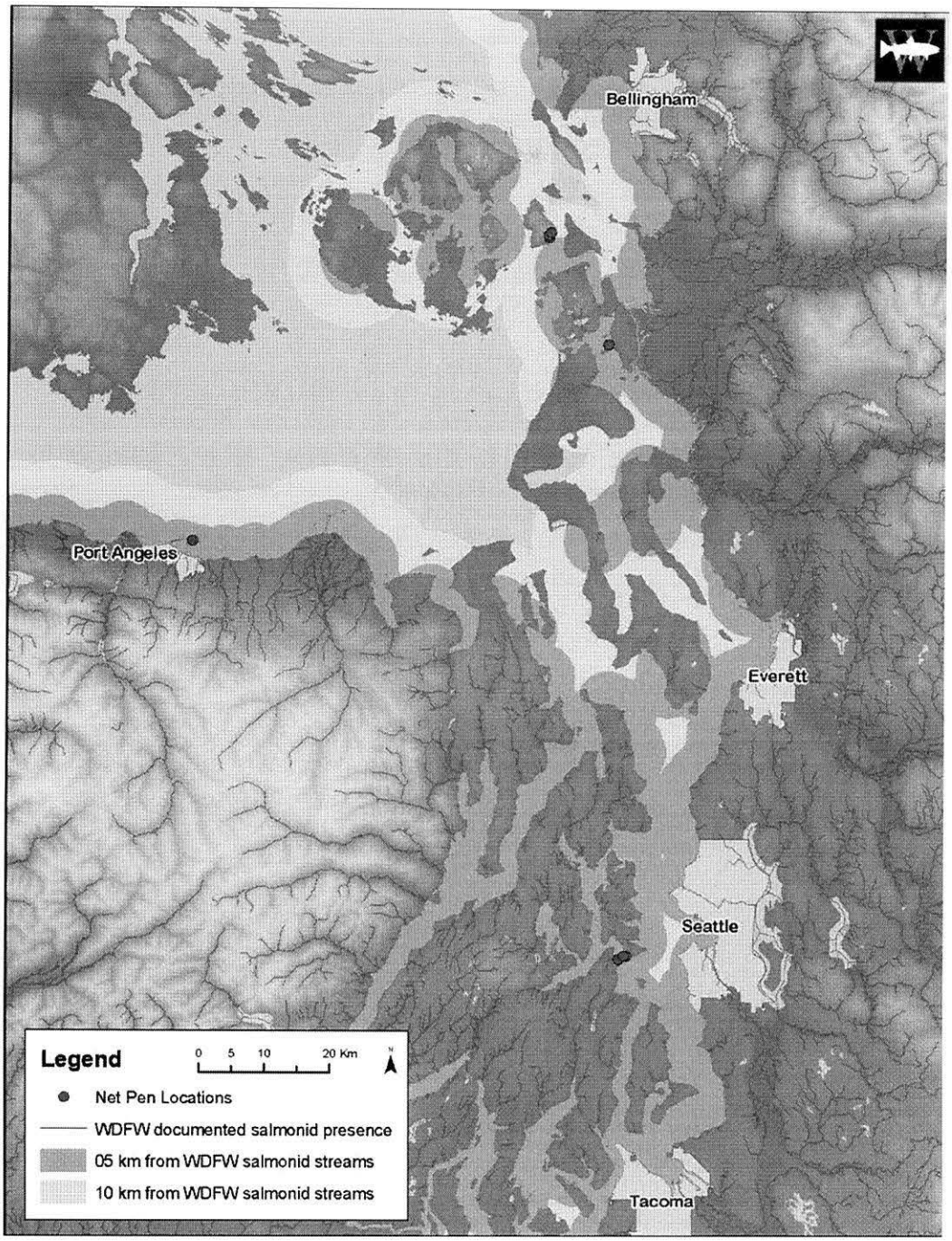
12. IHNV is among the most virulent pathogens of salmonids, and for this reason is listed as a "reportable disease" by the World Organization for Animal Health (OIE), the international body charged with controlling the spread of animal diseases. In 2012, a major outbreak of IHNV occurred at three Atlantic salmon net pen feedlots in Puget Sound, just minutes from downtown Seattle: Fort Ward, Clam Bay, and Orchard

Rock. This outbreak is concerning because of the speed at which the disease spread; the close proximity of the net pens led to a rapid disease progression that exposed native salmonids to elevated levels of the IHN virus and likely caused harm to two threatened species (Puget Sound Chinook salmon and steelhead trout). While it is likely that the net pen infections arose from wild salmon, the high densities of Atlantic salmon, which are highly susceptible to IHNV, artificially elevated ("bioamplified") the number of viral particles present in South Puget Sound, increasing the infection risk for native juvenile salmon.

13. At present the State of Washington and the federal agencies concerned do not stipulate minimum distances between the pens and do not take factors like tidal flow (affecting pathogen plumes emitted from the pens) and proximity to salmon bearing streams into consideration, despite decades of work (and catastrophic disease outbreaks costing billions of dollars in the Norwegian and Chilean Atlantic salmon farming industries) that led to the development of guidelines to reduce disease transmission. While international (OIE) guidelines suggest a minimum of 5km between pens, a study in Chile (Mardones et al. 2011) suggested that 10km between pens might be a safer guideline (note that there are no native salmon in Chile; this guideline was meant only to protect one salmon farm from infection by an adjacent farm). In those countries, the guidelines were put in place to limit the spread of disease between farms or between farms and wild fish, and *were developed to assist the salmon farming industry in protecting their investments*.

14. The placement of these net pens is also a concern; floating between two Washington state parks, the Orchard Rocks marine reserve (two of the net pens are

actually within part of the reserve's boundaries), and the Northwest Fisheries Science Center's Manchester Research Station (NOAA), where several endangered salmon stocks have broodstock rearing to assist in recovery efforts. These net pens are also in the middle of wild salmon habitat (see map, below), including that of ESA listed Puget Sound Chinook salmon and steelhead stocks. Juvenile salmonids, the life stage most susceptible to IHNV (Lapatra 1998), must emigrate past these pens and the pathogen plumes they generate on their way to sea. A map showing the distance from the existing net pens in Puget Sound to the mouths of salmon bearing streams is below (data from WDFW: http://apps.wdfw.wa.gov/salmonscape/); the different shades of orange show proximity to salmon bearing streams at 5 and 10 km distances; the grey shading highlights urban areas. Note that there are few areas within the main basin of Puget Sound that are outside of the 5km buffer (land is shaded green);



15. Despite a declared "quarantine" of the infected pens (which does nothing to prevent the virus being shed from infected Atlantic salmon into the water flushing through the pens), the virus quickly spread to open water facilities at two other locations

in South Puget Sound, including one near the Orchard Parks Marine Reserve and one in Clam Bay. The outbreak may also have affected nearby tribal salmon pens off Squaxin Island. At the time, Bruce Stewart, fish health program manager for the Northwest Indian Fisheries Commission, voiced concern over the delay in removing the infected salmon: "We are concerned about the virus amplification that is occurring from the affected pens, and the length of time the amplifying event is occurring over …American Gold reported increased mortalities starting in April. We now are at end of May and infected fish are still in those pens shedding virus." (http://nwifc.org/2012/05/ihn-virus-detected-in-atlantic-salmon-farm-near-bainbridge-island/).

16. A recent study of IHNV viral shedding and persistence in British Columbia (Garver et al. 2013) reported:

> "Using the laboratory estimates of IHNV shedding capacity of Atlantic salmon as derived herein, it is possible to quantify virus amplification potential from infected sites. For instance if 1% of 500,000 Atlantic salmon contained in an open net-pen site are undergoing acute IHN disease there is a **potential for this outbreak to generate upwards of 1.6 X 10^{11} plaque forming units (PFU) in one hour** during peak virus shedding" (Garver et al. 2013).

That estimate is derived from one pen (500,000 fish) if only 1% (5,000) fish were acutely infected. The number of viral particles released from each infected fish is equal to (1.66 X 10^{11} PFU/5,000 fish) = **32,000,000 PFU released per acutely infected fish per hour**.

17. A May 26, 2012, Associated Press article carried in the Seattle Times reported: "Seattle-based American Gold Seafoods plans to remove more than a million pounds of Atlantic salmon from infected net pens in Rich Passage. In April, the company noticed fish were dying off at a fast rate. Test

results this month confirmed the virus." (http://www.seattletimes.com/seattle-news/wash-fish-farm-kills-stock-after-virus-found/).] If an average Atlantic salmon weighs 7 lbs. at harvest, one million pounds of fish culled equates to 142,857 fish.

18. The net pens in question held infected Atlantic salmon (almost certainly more than 1% infected given the high mortality rate) for an estimated 60 days (1,440 hours). Using the conservative estimate of 142,857 fish culled by American Gold Seafoods, this would have resulted in **65,848,320,000,000** viral PFU being released from the infected Atlantic salmon into South Puget Sound during the course of the outbreak [(= 142,857 *1%= 1,429 fish acutely infected at peak shedding); ((1,429 fish) *(1,440 hours)*(33,200,000 PFU per fish per hour)) = **65,848,320,000,000 (** $6.58483X\ 10^{13}$**, or 65 *Tera*)**].

19. The volume of South Puget Sound is roughly 9% of the 168 cubic kilometer (km^3) total volume for all of Puget Sound (http://www.cev.washington.edu/lc/CLFISH497/Web5.html#PHYS), which equals 15.1 km^3 or 1.51 $x10^{10}$ cubic meters. Applying the calculation from 1,429 infected fish to the estimated volume of 15.1 km^3 means that **3,024,338,624 (3.02 x 10^9) viral PFUs were released per hour per km^3 of water into South Puget Sound**.

20. The IHN virus may remain viable for up to five days in seawater (depending on UV exposure and other factors; (Garver et al. 2013); assuming a 5-day viable lifespan for a viral particle, **3.02 x 10^9** PFU per hour per km^3 equates to **an instantaneous concentration ((5 days)*(24 hours)=120 hours) of 3.62921 $x10^{11}$ total PFU per km^3 (=363 per m^3) during an outbreak**. Given that a dose of 10 plaque

forming units (PFU) may initiate active infection in exposed juvenile Atlantic salmon, the risk of disease transmission to native salmonids – even if they are more resistant to infection – during such an outbreak becomes obvious. While additional experiments and analyses are needed to accurately define the likelihood of transmission, it is my opinion that it is highly likely that at least some ESA-listed salmonids were infected as a result of this outbreak.

21. Note that the IHNV viruses released into Puget Sound in 2012 from the commercial net pens were almost certainly not evenly distributed throughout the water column - it is likely that due to thermal and density layers (e.g. pycnoclines) that inhibit vertical mixing, viral particles would have remained concentrated in the upper water layers near the surface where juvenile salmonids reside. In addition, the viral concentrations near the net pens would have been significantly higher due to proximity to the source (the net pens). This indicates that the concentration of viral particles was almost certainly higher (potentially many times higher) than the conservative estimate given above, although this point should be a topic of further research. In addition, the outbreak occurred in April and May- when juvenile Chinook and coho salmon emigration nears its peak; the location of these net pens in nearshore waters means that juvenile Pacific salmon must migrate past them, and their pathogen plumes, while emigrating to the ocean.

22 IHNV is a highly virulent member of the Rhabdoviridae family, is naturally occurring from the Pacific Northwest to Russia (Kamchatka), Japan and Korea, and infects most salmon species and rainbow trout (and steelhead) to varying degrees. The virus is also found in Europe, presumably as a result of the transfer of infected

rainbow trout from North America (Johansson et al. 2009). Salmon lice (*Lepeophtheirus salmonis*) have been identified as a mechanical vector for the virus (meaning they introduce the virus to new hosts by piercing the skin, but are not internally infected) (Jakob, Barker, and Garver 2011);

23. There are three clades of IHNV, each typically found in a specific geographic area. The "U" clade (most pathogenic for sockeye and kokanee, as well as Chinook salmon and rainbow trout/steelhead) is common in B.C. and Alaska, the "M" clade (most pathogenic for steelhead/rainbow trout, as well as Chinook salmon) is found in the Columbia River basin and the Olympic Peninsula (including the Chehalis River basin), and the "L" clade (most pathogenic for Chinook salmon) is typically found in southern Oregon and California. Preliminary reports are that the recent outbreaks are in the U clade, and thus pose the greatest risk to sockeye and steelhead, but the virus appears to also have infected farmed coho salmon in B.C. *Juvenile salmon are at the highest risk of mortality from IHNV infection* (Lapatra 1998), although survivors may also act as carriers of the virus and may begin shedding viral particles when stressed; in some cases adult fish have been reported to succumb to the infection.

24. In summary, given the magnitude and duration of the IHNV outbreak, the proximity of the infected net pens to nearshore habitats utilized by juvenile Pacific salmon, and the proximity of the pens to salmon bearing streams in South Puget Sound, it is highly likely that ESA-listed Chinook salmon and steelhead trout were harmed.

OTHER POTENTIAL EFFECTS THAT ARE OF CONCERN

25. In addition to several concerns about the effects of net pens widely noted in the literature (e.g. release of chemicals, heavy metals, antibiotics released from fish

farms leading to antibiotic resistance (Goa et al. 2012), the use of baitfish in feed pellets which may deplete food supplies for wild salmon, etc.), the several points discussed below deserve further consideration with regard to the net pens in Puget Sound.

26. It is widely acknowledged that salmon net pen operations have unintentionally released Atlantic salmon into the waters of the Salish Sea since the introduction of marine net pens in the 1980's, though the number of escapees has declined as netting and other practices have improved. However, concern over the introduction of self-sustaining Atlantic salmon populations derived from net pen escapees has been downplayed over the years, due in part to the failed attempts by state fish and wildlife departments to intentionally introduce the species into the Pacific Northwest from 1904 to 1991 (Waknitz et al. 2002). However, a study in the Tsitika River (a moderate-sized (42-km mainstem length) remote river system on the northeast coast of Vancouver Island, Canada) published in 2000 (Volpe et al. 2000) found juvenile *Atlantic* salmon of two size classes present. That they were Atlantics salmon was confirmed by genetic analysis, and scale analysis suggested that they were the naturally produced offspring of adult Atlantic salmon that had spawned in the river. The study also reported that their dietary intake overlapped almost completely with that of native salmonids in the river, implying that they were competing for resources with the native, wild fish.

27. A more recent study (Fisher, Volpe, and Fisher 2014) found that Atlantic salmon offspring were present in 36.6% of the 41 rivers surveyed over a three year period, and occupancy models (models were used because detection frequency of species at low abundance is imperfect) suggested that Atlantic salmon were present in 97% of those rivers and streams occupied by diverse assemblages of native Pacific salmon. The

authors concluded that the continued low-levels of escaped Atlantic salmon in British Columbia (where salmon farms are numerous and of a much larger scale than in Puget Sound) posed a threat for the establishment of this foreign species in waters of the Pacific Northwest, ending "Their [Atlantic salmon] current distribution, and the potential effects on Pacific ecosystems and native Pacific salmon, is a conservation priority that has been neglected in the push for economic return" (Fisher, Volpe, and Fisher 2014, pg. 2145). The authors also pointed out that the habitats encountered in British Columbia are common from the Oregon coast through southeast Alaska.

28. A very recent Scandinavian study detailed the capture of farmed Atlantic salmon infected with two different viruses (salmon alphavirus and piscine reovirus) in a nearby river after they had escaped from their net pen, highlighting the ability of escapees to also transmit pathogens directly to the spawning grounds of wild fish (Madhun et al. 2015).

29. Sea lice, a problematic parasite in British Columbia (little data is available for Puget Sound), have also been a major source of farmed Atlantic salmon loss in Norway. Despite intensive research and the development of therapeutic drugs to address the issue, sea lice control measures are failing in Norway: http://www.worldfishing.net/news101/industry-news/norway-to-slaughter-sea-lice-infected-salmon (10/2013). "The Norwegian authorities have recently ordered that some two million sea-lice infested farmed salmon in the Vikna district of Nord Trondelag be slaughtered with immediate effect after becoming resistant to chemical treatments against the sea-lice parasite. The action has been prompted specifically to protect wild young salmon (smolts) migrating through the fjords to the open sea next May and June from

huge numbers of juvenile sea-lice being produced on and released from particular salmon farms that have been unable to control their lice numbers."

30. Native juvenile salmon (and other fish species) have been shown to congregate around net pen farms due to food availability and shelter from currents, among other reasons (Fernandez-Jover et al. 2008; Dempster et al. 2009). This has the potential to increase their exposure to pathogens, and infected fish may then serve as a disease "vector" (a route of disease transmission) over long distances as juvenile salmon migrate to and from the ocean.

31. In addition to bio-amplifying viruses (and potentially other pathogens), an impact of salmon farming which has only recently gained attention is the potential for salmon raised in net pens to generate more virulent pathogens. The high rearing densities, continuous introduction of native hosts into the net pens, stress, and lack of selection for resistance (all fish are harvested, rather than breeding those that have a higher natural resistance) found in salmon farming operations result in ideal conditions for viral amplification and the evolution of increasingly pathogenic strains. This has been reported both for exotic (foreign to the Pacific Northwest) pathogens like Infectious Salmon Anemia Virus (ISAV; Christiansen et al. 2011; Are Nylund et al. 2003; A Nylund et al. 2007) and native (endemic) pathogens like infectious hematopoietic necrosis virus (IHNV; Troyer and Kurath 2003) and viral hemorrhagic septicemia virus (VHSV; Einer-Jensen 2004).

32. NOAA's stated mandate to expand U.S. aquaculture production may undermine adequate supervision of the finfish aquaculture industry:

> "The US Government advocates a strong policy for national aquaculture development. The Department of Commerce (DOC) has set specific 25-

> year goals to offset the annual $7 billion imbalance in seafood trade, and to double employment and the export value of goods and services. The policy is reflected in strategies proposed by the National Oceanic and Atmospheric Administration (NOAA) and its three line agencies responsible for certification of aquaculture-related activities. With its broad mandate for stewardship of the nation's marine and coastal living resources, NOAA recommends that aquaculture development and environmental protection proceed hand in hand to meet public needs. Thus, in keeping with the Government's firm commitment to the United Nations Food and Agriculture Organization's (FAO) Code of Conduct for Responsible Fisheries, the line agencies of NOAA are encouraging the fisheries and aquaculture sectors to develop national Codes of Conduct, and their sub-sectors to develop and abide by Best Management Practices (BMPs)." (Nash 2001)

33. Promoting aquaculture poses risks to the existing fishery for Pacific salmon, the associated economic impact, and job creation within the fishery, which were estimated in a press release by Senator Maria Cantwell (2011) following reports of detection of Infectious salmon anemia virus (ISAV) in BC:

> "We should not rely on another government – particularly one that may have a motive to misrepresent its findings-- to determine how we assess the risk ISA may pose to American fishery jobs... **One recent study of Pacific salmon estimated the wholesale value of the annual catch at least $2.2 billion dollars, supporting 35,000 harvesting and processing jobs**...With so much at stake, a rapidly spreading virus that causes disease in wild Pacific salmon could be economically and ecologically devastating...While a few scientists may downplay the threat to wild Pacific salmon posed by the ISA infections recently detected in British Columbia, we believe the lessons learned from other recent fish disease outbreaks suggest that ISA should be cause for considerable concern now." [emphasis added]

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct to the best of my knowledge.

Executed this 19th day of August, 2015.

Todd A. Sandell, M.S., Ph.D.

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Todd Anderson Sandell, Ph.D.

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- Ph.D. in Fisheries Ecology (interdisciplinary), Oregon State University (2010); M.S. (2001)
- Data from my dissertation were one component used to develop NOAA's "Ocean Conditions and Salmon Forecasting" ecosystem indicators web page
- Built ecosystem models incorporating qualitative and quantitative environmental factors and pathogen data to forecast annual infection cycles and correlations with adult salmon populations
- 18 years of experience in fish biology, estuarine and marine ecology, and salmon management
- Participated in oceanographic survey cruises in the California Current for 7 years (2001-2008), including sampling of fish, lower trophic levels and abiotic factors to inform ecological models
- Since 2011, have designed, managed and implemented a juvenile salmon research project on the Washington coast, including a 2012 spatial analysis of sea level rise due to climate change
- Awarded $659,000 in research funding from a variety of agencies and foundations since 2011
- Currently have 7 peer-reviewed publications published or in progress
- Dozens of oral presentations of scientific research at regional, national and international meetings

Selected Work Experience

NATIONAL MARINE FISHERIES SERVICE (NOAA contractor) Seattle, WA

• *Fisheries Ecologist*. Conducting research to investigate how juvenile salmon are responding to habitat restoration projects in the Snohomish River estuary. Organize and carry out field sampling efforts, pilot boats for beach seining, enter data via GIS ready tablets, collect fish, scales and finclips for diet, growth and genetic studies. Responsible for logistics and equipment maintenance. 2/2015-present.

WILD FISH CONSERVANCY Duvall, WA

• *Senior Ecologist*. Conducted estuarine research and provided management recommendations on juvenile fish habitat use and restoration priorities in the Grays Harbor estuary, WA. Led a project to investigate the distribution, abundance, migratory timing, and habitat requirements of juvenile fish in the lower Chehalis River and surge plain. Responsible for grant writing, study design and implementation, permitting, habitat assessment, water quality and genetic sampling, building/managing the database, statistical analysis, project reports and publication. Piloted power boats for beach seining and operated fyke traps. Supervised WFC employees and recruited and trained >25 volunteers and college interns in field methodology and fish identification; mentored two students in projects utilizing field data for college credit. Produced the first detailed study (2012) of sea level rise due to climate change in the estuary to predict shifts in habitat availability through 2100 and inform future fisheries management and conservation efforts. 11/2010-present

NATIONAL MARINE FISHERIES SERVICE (NOAA contractor) Seattle, WA

• *Fisheries Ecologist*. Conducted research to investigate the distribution and timing of juvenile salmon habitat residency and the composition of the marine fish community in the Strait of Juan de Fuca, the San Juan Islands, and the Snohomish River estuary. Carried out field sampling efforts with purse seining and tow and lampara netting, piloted small craft for beach seining, built and managed the database, analyzed and presented data at meetings and conferences in fisheries management, and produced summary reports for NOAA and Tribal Nations. Responsible for logistics and equipment maintenance; assisted with federal licensing and a hydroacoustic survey in the Salish Sea via surgical acoustic tag insertion and deployment and retrieval of hydrophones for data upload to the HYDRA online data portal. 6/2008-10/2010

OREGON STATE UNIVERSITY, HATFIELD MARINE SCIENCE CENTER Newport, OR

• *Faculty Research Assistant*. Studied factors affecting the health, condition and survival of juvenile salmonids in the nearshore NE Pacific Ocean. Ocean trawling for fish; sampled zooplankton and nutrients while at sea aboard contracted commercial fishing vessels; crew for monthly purse seining effort in the lower Columbia River estuary. Assisted with quarterly reports to funding agencies, ESA permitting, data entry and analysis, publication of research results, presentation of data at regional and international meetings, and grant applications. Necropsied thousands of juvenile salmon; conducted viral, bacterial and macroparasitic pathogen analysis via microscopy, nested PCR and quantitative PCR. Trained several high school and college interns in field methodology, dissection, microscopy techniques, DNA extraction, nested and quantitative PCR, and protein quantification. 2001-2008

OREGON DEPARTMENT OF FISH AND WILDLIFE Coos Bay, OR

• *Experimental Biology Aide* (seasonal). Performed surveys of spawning Chinook, coho and chum salmon and steelhead trout according to the Ocean Salmon Protocol of ODFW. Identified species, sex, fin marking and reproductive status of adult and jack salmon. Electrofishing for juvenile coho salmon population escapement assessment and monitored weirs and smolt traps. Evaluated and classified potential spawning habitat and hydrology; collected tissue and scale samples from salmonid carcasses. Responsibilities also included communicating with private landowners and stakeholders, navigating over rugged terrain, accurate field notation and maintaining field equipment and state vehicles. 10/2000-3/2001

OREGON DEPARTMENT OF FISH AND WILDLIFE Corvallis, OR

• *Experimental Biology Aide* (seasonal). Performed surveys of pathogens at ODFW hatcheries during spawning. Analyzed samples for *Renibacterium salmoninarum* (bacterial kidney disease), *Myxobolus cerebralis* (whirling disease) and IHNV. Cultured bacteria on agar plates, examined samples microscopically, ran ELISAs, and assisted with data entry and record keeping. Traveled to hatcheries in western Oregon for monthly pathogen surveys. 7/2000-10/2000

UNIVERSITY OF COLORADO HEALTH SCIENCES CENTER Denver, CO

• *Research Assistant*. Studied the onset of autoimmune diabetes in humans and a mouse model. Cultured human and murine T and B cells and dendritic cells; investigated insulin-peptide recognition through cloning, proliferation assays, PCR, ELISA, DNA sequencing, and flow cytometry. 1995-1997

INTERACTIVE KNOWLEDGE, INC. (BOWDOIN COLLEGE) Brunswick, ME

• *Research Assistant*. Designed a closed biofiltering aquarium for microgravity research aboard the NASA space shuttle. Performed experiments on zebrafish and medaka growth rates and inhibition, food/waste analysis by atomic absorption spectroscopy, pheremone extraction, chemical and biological water purification, bacterial culture, and general system design. Produced annual progress reports and supervised two undergraduate lab assistants. 1994-1995

THE NORTHFIELD MOUNT HERMON SCHOOL Northfield, MA

• *Science faculty*. Taught four sections of Introductory Biology and Animal Behavior. Co-authored the school's new biology lab manual, *Investigating Life*. Dorm parent for highly diverse group of students from 9 different countries; science adviser for two independent student projects. Assistant varsity rowing and varsity football coach; head coach of the boy's novice rowing team. 1992-1994

Education

OREGON STATE UNIVERSITY Corvallis, OR

• **Ph.D. Microbiology (Interdisciplinary Ecology).**

Committee: Kym Jacobson (NOAA), Jerri Bartholomew (OSU), Alec Maule (USGS), Carl Schreck (OSU/NBS). Researched the estuarine and marine ecology of juvenile salmonids, focusing on the effects of pathogens and parasites on salmon growth and survival during early marine residency. This work showed that infection by the common pathogen *Renibacterium salmoninarum* (causative agent of Bacterial Kidney Disease), in conjunction with parasitic infections, can impair the growth of Pacific salmon in the wild, and that oceanic and atmospheric conditions act in concert to influence the survival of infected fish. Modeled the effects of environmental factors and predation on juvenile survival, annual infection cycles, and correlations with adult survival. Sample analysis via nPCR and qPCR, microscopy, ELISA, and bacterial culture. Conveyed results via presentations at local and national meetings and through publication in peer-reviewed journals. Trained and supervised college interns and volunteers. 1/2005-6/2010

• **M.S. Microbiology.** Studied the dynamics of *Myxobolus cerebralis*, the introduced parasite causing whirling disease in salmonids. Worked with members of the Nez Perce tribe to perform extensive field collections of sentinel fish and benthic invertebrates in NE Oregon, cultured experimental fish, analyzed samples by PCR, and developed a phagocytic immune response assay utilizing immunofluorescence and flow cytometry. Presented data at numerous scientific meetings. Served as a Teaching Assistant in Introductory Biology; trained 4 undergraduates in molecular techniques in the laboratory. 1/1997-5/2000

BOWDOIN COLLEGE Brunswick, ME

• **Bachelor of Arts, Biology. English minor.** Independent study in virology and immunology. Assistant Editor of the college paper, the *Bowdoin Orient*. Ice hockey, lacrosse. **Dean's list.** 8/1987-5/1992

Publications

Sandell, T., Fletcher, J., McAninch, A., and T. Beuhrens. "Distribution, habitat utilization and emigration timing of juvenile salmonids in the Grays Harbor (WA) estuary." In preparation for submission to *Transactions of the American Fisheries Society*.

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Gerwick, L., Steinhaur, R., LaPatra, S., **Sandell**, T., Ortunez, J., Hajiseyedjavadi N., and C. J. Bayne. 2002. "The acute phase response of rainbow trout (*Oncorhynchus mykiss*) plasma proteins in response to viral, bacterial and fungal inflammatory agents." *Fish and Shellfish Immunology*, Volume 12, 229-242.

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Research Reports

Todd **Sandell** and Andrew McAninch, Wild Fish Conservancy. 2012. "Climate Change in the Chehalis River and Grays Harbor Estuary". Prepared for the Chehalis Basin Habitat Work Group and Grays Harbor County.

Todd **Sandell**, James Fletcher, Andrew McAninch and Micah Wait, Wild Fish Conservancy. 2011-13. "Grays Harbor Juvenile Fish Use Assessment." Annual reports prepared for the Chehalis Basin Habitat Work Group, Grays Harbor County and the Washington State Salmon Recovery Office.

Selected Oral Presentations

Salish Sea Conference 2014, Seattle, WA. "Modeling Sea Level Rise in the Grays Harbor Estuary." Coastal ecology and planning session. Todd Sandell and Andrew McAninch.

Washington State Salmon Recovery Office 2013 Biannual Meeting, Vancouver, WA. "Grays Harbor Juvenile Fish Use Assessment: Applying what we've learned to habitat conservation, planning and fisheries management." Todd Sandell, James Fletcher, Andrew McAninch and Micah Wait.

American Fisheries Society 2011 Annual Meeting, Seattle, WA. "The effect of ocean conditions on bacterial kidney disease infections in early marine phase Chinook and Coho salmon." Todd Sandell, Joe Fisher, Brian Beckman, and Kym Jacobson.

American Fisheries Society National Meeting, Anchorage, Alaska, September 11-15, 2005."A regional comparison of Bacterial Kidney Disease among juvenile Chinook salmon in the Northeast Pacific." T. Sandell, K. Jacobson, J. Orsi and E. Casillas.

North Pacific Marine Science Organization (PICES) 13th annual meeting, Honolulu, Hawaii, October 14-24, 2004. "The distribution and prevalence of Bacterial Kidney Disease (*Renibacterium salmoninarum*) in juvenile Chinook and coho salmon in the Northeast Pacific Ocean." T. Sandell, K. Jacobson, D. Teel and E. Casillas.

American Geophysical Union/Ocean Sciences Meeting, Portland, Oregon, February 6-9, 2004. "Pathogens of juvenile salmonids in the near-shore Northern California Current (NCC) System." T. Sandell, M. House, K. Jacobson and E. Casillas. *Eos Trans. AGU,* 84(52), Ocean Sci. Meet. Suppl., Abstract OS21J-05.

Research Awards and Funding

Grays Harbor Juvenile Fish Use Assessment, 2011- 2013. $200,000 annually (WA RCO).
Grays Harbor Juvenile Fish Use Assessment, 2011- 2013. $40-50,000 annually (USFWS).
Risk Assessment for the Introduction of Viral Pathogens via Farmed Atlantic Salmon, 2012-14. $60,000.
Markham Research Fellowship, Hatfield Marine Science Center, 2005-'07. Award amount: $10,000
John L. Fryer Award in Microbiology, 2007. Award amount: $1,000
James L. Winton Award for Fisheries Pathology, 2006. Award amount: $1,000
Oregon Flyfisher's Scholarship, 2006. Award amount: $4,500

Professional Affiliations

Member of the Coastal and Estuarine Research Federation, the American Fisheries Society, the American Association for the Advancement of Science, and the Wild Steelhead Coalition.

Other Qualifications

Experienced with Microsoft Excel, Word, Access (database creation and management), SigmaStat, StatView, StatGraphics, EndNote, PCOrd, and Tableau software; currently learning R statistics. Proficient in Spanish.

Personal Information

Enjoy white water rafting, jazz, fly fishing, woodworking, cooking, ice hockey, and razor clamming. Colorado Outward Bound School, Alpine Mountaineering, 1991.

Boat and Sampling Experience

2011- 2014: As project leader, trailered and piloted power boats (20' and 14') for beach seining effort in the Grays Harbor estuary and lower Chehalis River during every low tide series from March-September, 2011-13 (~100 days/year); operated fyke traps in tidal sloughs. Trained college interns in small vessel safety; trained WFC employees in small vessel operation and trailering, beach seining, engine repair, and routine maintenance and winterization.

2008-1/2010: Deck boss as part of a large-scale NOAA juvenile fish sampling project in the San Juan Islands (56' purse seiner) and Strait of Juan de Fuca, WA. Also piloted and trailered power boats while assisting with various beach seine, purse seine, and trawl sampling efforts around Puget Sound and the Snohomish River, WA. Sampling of zooplankton assemblage (ring nets), water quality. Assisted with deployment and retrieval of acoustic hydrophones in Puget Sound and general engine maintenance.

2001-2008: Ocean sampling off Oregon and Washington aboard contracted commercial fishing vessels (10-20 day trips in May, June, August, September of each year) as part of the BPA Columbia River Plume study and GLOBEC. Fish trawls, nutrient sampling, zooplankton and phytoplankton sampling (ring, bongo and neuston nets), species identification, data collection and data entry. Concurrent estuary purse and beach seine sampling (every two weeks) in the lower Columbia River estuary. Assisted with various beach seining, electro-shocking projects along the OR coast.

1992-94: Rowing coach at the Northfield Mt. Hermon School, MA. Daily operation of (decrepit) motor boats, lots of experience with outboard engine troubleshooting.

1993: Waterfront director and whitewater canoeing instructor, Camp Moosilauke, NH. Oversaw 5 waterfront staff, taught canoeing, kayaking, sailing; led remote whitewater canoe trips.

1991: Guest of the first class cadets sailing the USCG tall ship ***Eagle*** across the Atlantic as part of a training cruise; set, reefed sails in all weather, learned introductory navigation.

1984-88: East Lyme High School Rowing program; stroke alternate for the 1987 national champion heavyweight sweep 4. Sculled for Blood Street Sculls Rowing Club, Old Lyme, CT in summer.

1987-88: Ran a lobster trap line in Long Island Sound, CT.

1986: Graduated from the USCG small boat sailing training course, New London, CT.

Personal: Avid whitewater rafter and former kayaker. Have run the Green River (Desolation Canyon, UT), Delores River (CO), Colorado (Grand Canyon, AZ), Middle Fork of the Salmon River (ID), Ashuapmushuan River (Quebec), Rogue River (OR), Allagash (ME), Rapid (ME), and Deschutes (OR), among others.

Certifications

Current with First Aid and CPR (Red Cross, Seattle).
Completed 3 Ocean Safety and Survival Courses (U.S. Coast Guard Auxiliary, Newport, Oregon).
Completed the NOAA Small Boat Safety Component Class (NOAA, Seattle), 2008.
NOAA "Drive Safe" training completed 2009.
Washington State Boater's Card (#00015451).
Washington state driver's license (#SANDETA301D3)