



U.S. Fish & Wildlife Service - Pacific Region
Olympic Peninsula Hatchery Review Team

Olympic Peninsula

Big Quilcene, Quinault, Hoh, Sooes, and Waatch River Watersheds



Quilcene, Quinault, and Makah National Fish Hatcheries Assessments and Recommendations

Final Report, Summary

May 2009

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Summary

Long-term conservation needs of natural salmonid populations and their inherent genetic resources require a reexamination of the role of hatcheries in basin-wide management and conservation strategies. Hatcheries must be viewed as part of the environmental and ecological landscape to help achieve both conservation and harvest goals. These goals need to be part of a holistic and integrated strategy that also combines habitat, hydropower, and harvest needs for conserving and managing fishery resources. These strategies must establish short- and long-term goals for both hatchery-propagated and naturally-spawning populations.

To ensure that its hatchery programs are best meeting conservation and harvest goals, the US Fish and Wildlife Service (Service) began, in October 2005, a multi-year review of 21 salmon and steelhead hatcheries that the Service owns or operates in the Columbia River Basin. This review was expanded in 2007 to include the three National Fish Hatcheries on Washington's Olympic Peninsula. The goal of this review is to ensure that Service hatcheries are operated in accordance with best scientific principles, and contribute to sustainable fisheries and the conservation of naturally-spawning populations of salmon, steelhead and other aquatic species. The Service's review process is modeled after the recent Puget Sound and Coastal Washington Hatchery Reform Project¹. The Service plans to complete its reviews by early 2010.

The report presented here provides benefit/risk assessments and recommendations for salmon and steelhead propagation programs conducted at Quilcene, Makah, and Quinault National Fish Hatcheries. Quilcene National Fish Hatchery (NFH) is located on the Big Quilcene River along the western side of Hood Canal. Quinault NFH is located on Cook Creek within the Quinault River watershed along the southern coast of Washington's Olympic Peninsula, and Makah NFH is located on the Sooes River along the northern coast of the Peninsula.

The Review Team considered, as a foundation for its assessments, four characteristics of each salmonid stock in the Northern Hood Canal, Quinault River and Sooes River watersheds: *biological significance, population viability, habitat conditions, and harvest goals*. The Review Team attempted to use both short- (15 years) and long-term (50–75 years) goals for each salmonid stock, as identified by the fishery comanagers², as a foundation for assessing the benefits and risks of the Service's hatchery programs. Source documents not readily available to the general public, including appendices and background documents for this report, are accessible via the Service's hatchery review website.³

¹ www.ltk.org/HRP.html

² *Comanagers in the Hood Canal/Quilcene River watershed (Quilcene NFH) are the Skokomish Tribe, Washington Department of Fish and Wildlife, Point No Point Treaty Council, Jamestown S'Kallam Tribe, Port Gamble S'Kallam Tribe, Lower Elwha Klallam Tribe, National Marine Fisheries Service (NOAA Fisheries), and the U.S. Fish and Wildlife Service. Comanagers in the Quinault River watershed (Quinault NFH) are the Quinault Indian Nation, Washington Department of Fish and Wildlife, National Marine Fisheries Service (NOAA Fisheries), and the U.S. Fish and Wildlife Service. Comanagers in the Sooes River watershed (Makah NFH) are the Makah Nation, Washington Department of Fish and Wildlife, National Marine Fisheries Service (NOAA Fisheries), and the U.S. Fish and Wildlife Service.*

³ www.fws.gov/Pacific/fisheries/HatcheryReview/

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Quilcene National Fish Hatchery

Facility Overview: The Quilcene NFH began operations in 1911 to support salmon fisheries on adjacent federal lands to mitigate for the reduced abundance of natural-origin fish resulting from degraded habitat. The NFH releases also serve to partially mitigate reduced abundance due to substantial ocean catch of species such as coho. The Quilcene NFH occupies approximately 47.4 acres at RM 2.8 of the Big Quilcene River. Facilities consist of 39 8-foot x 80-foot raceways, three water intake structures (two on the Big Quilcene River and one on Penny Creek), a pre-settling pond; a pollution abatement pond; a hatchery building that contains the office, laboratory, and tank room; an isolation/quarantine building; and a shop/garage. Adult salmon returning to the hatchery are diverted to holding facilities by means of a graduated-field electrical weir and fish ladder at RM 2.8. Quilcene NFH is one of the oldest fish hatcheries in the region.

Funding: The hatchery is funded by Congressional appropriation of hatchery operations funds to the Service and the Service's hatchery cyclical maintenance fund. The operational budget for FY2008 was \$617,343. Costs for monitoring and evaluation (M&E) and fish health in FY2008 were approximately \$100,000 and \$91,000, respectively. Capital Improvements to the Quilcene NFH have totaled \$907,797 during the period 2004- 2008.

Economic Benefit: The estimated total annual economic value of commercial and sport caught coho reared at Quilcene NFH is approximately \$1,500,000.

Coho

Program overview: The coho program operates as a segregated harvest program within Quilcene Bay and the Big Quilcene River. This stock has been artificially propagated since 1911 and currently exhibits a mean adult return date that is approximately three weeks to one month earlier than other hatchery and natural stocks of coho salmon in Hood Canal. Although some historic egg transfers from out-of-basin stocks to Quilcene NFH occurred sporadically prior to 1974, the Quilcene NFH coho stock is believed to largely represent the ancestral lineage of coho salmon native to the Quilcene River. However, the stock has been propagated artificially for nearly 100 years (more than 30 coho generations), largely as a "closed" hatchery population. The hatchery currently releases 400,000 yearling smolts annually on-station. An additional 200,000 smolts are released from a floating net pen in Quilcene Bay (Skokomish Tribal program). Adult collection, egg incubation, hatching, and juvenile rearing occur on-station at the hatchery. The program also transfers 450,000 eyed eggs to George Adams Fish Hatchery for rearing and subsequent release at Port Gamble net pens.

Benefits: Coho from Quilcene NFH support commercial, tribal, and sport fisheries coast wide (Alaska, British Columbia, North Coast, Strait of Juan de Fuca), in the Big Quilcene River, Hood Canal, and Admiralty Inlet of Puget Sound. Tribal fisheries within Hood Canal and hatchery-trapped adult fish distributed to tribal members confer highly significant subsistence and commercial benefits to local tribes. For broods 1993-2002, on average approximately 16,500 coho were recovered annually from releases at Quilcene NFH including 3,100 in treaty tribal fisheries. For the same brood years, on average approximately 4,000 coho were recovered annually from releases at the Quilcene Bay net pen including 900 in treaty tribal fisheries. For these same brood years, on average approximately 5,900 coho were recovered annually from releases at Port Gamble net pens including 2,950 in tribal treaty fisheries.

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Risks: Juvenile coho destined for acclimation and rearing in the Quilcene Bay net pens prior to release are often retained on station after the desired transfer date because of toxic algae blooms in Quilcene Bay. The retention of these latter fish on-station results in rearing densities that exceed fish health guidelines, thus increasing disease risks. Quilcene NFH coho pose some genetic risks to adjacent coho populations in Hood Canal due to limited straying of returning adults to other rivers in the immediate vicinity of the Big Quilcene River. The hatchery weir and adult fishway inhibit upstream migration of winter steelhead and other wild fish native to the Big Quilcene River. Nearshore marine fisheries targeting the earlier returning coho from Quilcene NFH poses an incidental harvest risk to ESA-listed summer chum salmon in Hood Canal.

Recommendations for current program: The Review Team identified 24 specific recommendations to reduce risks and/or improve benefits of the current coho program at Quilcene NFH. These recommendations include; (a) development of natural production and escapement goals for Big Quilcene River coho, (b) assessment of straying risk of coho released from Quilcene NFH and Quilcene Bay to natural populations of coho in northern Hood Canal, (c) assessment of water management practices at the hatchery to determine the maximum number of fish and biomass capacities of the hatchery that would not exceed water-right limitations, and (d) modification of weir and ladder configurations to improve upstream passage conditions for winter steelhead. The Team also recommends improved visitor facilities and outreach programs. This latter recommendation is especially timely because of the location of the hatchery immediately adjacent to a highway heavily travelled by tourists and the pending 100th Anniversary of the Quilcene NFH in 2011.

Alternatives to Current Program: The Review Team considered the pros and cons of four alternatives to the existing coho program ranging from the current program with full implementation of all program specific recommendations (Alternative 1) to termination of all programs at Quilcene NFH and decommissioning of the facility (Alternative 4). The Review Team recommends the implementation of Alternative 2: reduce the size of the current program from 600,000 to 400,000 smolts, or other size equivalent that does not exceed the Service's rearing density guidelines and water right restrictions for the hatchery. The combined effects of water right restrictions, the presence of *harmful algal blooms* (HAB) in Quilcene Bay, and the large numbers of surplus coho returning to the hatchery in recent years warrant reducing the number of smolts released from the hatchery and the Quilcene Bay net pen from a combined total of 600,000 to 400,000 smolts. Adopting this alternative would allow the hatchery to continue to contribute significantly to local tribal, sport and commercial fisheries and still operate within the biological and water-right constraints of the hatchery and the Big Quilcene River, respectively. This recommended alternative also allows more flexible management of the Quilcene Bay net pen. For example, if a HAB occurs, then all 400,000 coho could remain on-station without exceeding the water right restrictions. Conversely when HAB is not an issue, up to 200,000 pre-smolt coho could be transferred to and released from the net pen. This latter approach would reduce feed and workloads at the hatchery and could, under some circumstances, present opportunities for the hatchery to participate in conservation and recovery programs of other aquatic species in the Hood Canal area.

Steelhead

Program overview: The Hood Canal Steelhead Project is a multi-agency, collaborative study and rebuilding effort – led by NOAA Fisheries - that involves supplementing three natural populations (Skokomish River, Dewatto River, and Duckabush River) with hatchery-origin steelhead, and monitoring those three “treatment” populations with three “control” populations that receive no

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hatchery fish. This project will attempt to amplify the abundance of naturally spawning steelhead for approximately eight years, after supplementation will be terminated and returns of natural-origin adults monitored in treatment streams compared to control streams. For this project, eyed eggs are pumped from natural redds in the three treatment streams. Eggs from the Dewatto and Duckabush rivers are transferred to Quilcene NFH for incubation and hatching. The hatchery incubates up to 18,000 natural-origin steelhead embryos annually in a quarantine facility until viral pathogen testing is complete (30 d post-ponding) and the embryos are certified as low risk for viruses. Incoming embryos currently represent five to twenty redds from each of two populations, Duckabush and Dewatto rivers). The fry are transferred to the Long Live the Kings Lilliwaup Hatchery, about 20 miles south of Quilcene NFH along the west side of Hood Canal, for rearing prior to release. Incubation and rearing for the Skokomish River population occurs at McKernan Hatchery.

Benefits: The project is expected to confer significant research benefits by evaluating the potential use of artificial rearing to assist with conservation of imperiled steelhead populations. The effectiveness of hatchery supplementation for increasing the productivity of natural populations while maintaining genetic diversity will be determined by comanager monitoring of the abundance and productivity of the treatment and control populations in subsequent generations after the programs have been terminated. In addition, steelhead incubation and early rearing at the Quilcene NFH is expected to provide a significant conservation benefit to *threatened* steelhead populations in the Dosewallips, Dewatto, and Skokomish rivers by reducing demographic risks to the natural populations. Based on a similar program in the Hamma Hamma River, the expectation is that the program will result in an approximate 10-fold increase in the number of natural redds in the supplemented treatment streams relative to the control streams.

Risks: The project poses some demographic risks to the natural populations in the treatment streams by removing eyed steelhead eggs and disrupting redds. The disruption of redds can lead to increased predation (e.g., by sculpins) and subsequent dislodging of incubating eggs and pre-emerging alevins during freshets following spring rains. However, this project attempts to mitigate those risks by avoiding excess egg collections and precise triangulation of each redd to minimize human impacts. A proportion of the collected embryos do need to be sacrificed for pathology testing to minimize disease risks and comply with disease management policies. Nonetheless, some increased mortality is assumed for eggs remaining in the redds, although the actual mortality associated with redd pumping to non-collected eggs is unknown. Disease risks associated with the program have also been minimized due to utilization of the existing quarantine/isolation building and subsequent testing of representative fry prior to transfer. Although precautions are in place, there is a slight risk of transferring pathogens and disease from the source drainages to Lilliwaup Creek. Genetic risks to the supplemented populations are considered minimal because of (a) the very restricted period under which hatchery-reared fish are under the potential influence of *domestication selection* and (b) the expected number of natural-origin parents contributing to the captively-reared fish relative to the total number of adult steelhead spawning in each treatment stream.

Recommendations for Current Program: The Team recommends that Quilcene NFH continues to support the Hood Canal Steelhead Project through completion of the supplementation phase (2014). The Team concluded that the overall risks of the program are minimal and that the potential benefits of the program far outweigh those risks. This program is considered critically important to the success of the Hood Canal Steelhead Project.

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Alternatives to Current Program: The Review Team considered the pros and cons of five alternatives to the existing steelhead incubation program. These alternatives ranged from maintaining the current level of support to termination of the steelhead incubation and early rearing program. Maintaining the current program requires no major modifications, only small adjustments to current practices and facilities. In the near term, the Team recommends expanding the existing program by developing the capability for Quilcene NFH to rear Hood Canal steelhead beyond the early rearing stage (Alternative 2). This capability would provide for complete implementation of the Hood Canal Steelhead Project by rearing 400 adult steelhead or rearing approximately 8,000 smolts, depending which of four rearing scenarios are chosen. To implement this recommended alternative, the team supports the following upgrades to the Quilcene NFH: 1) prioritizing water use from Penny Creek or adding some type of disinfection unit for Quilcene River water; 2) dedicating rearing containers in a secure area to provide isolation from the rest of the hatchery and adequate biosecurity, including disinfection of effluent; and 3) obtaining an exemption from *The Salmonid Disease Control Policy of the Fisheries Comanagers of Washington State* for a reduced virus testing level because of the ESA-listed status of the stocks and small size of the program. Maintaining the current program (Alternative 1) requires no major modifications, only small adjustments to current practices and facilities. Two longer-term alternatives would expand the capabilities of the Quilcene NFH to contribute to culture-based rebuilding efforts for Quilcene River steelhead (Alternative 3) or other Hood Canal salmon populations (Alternative 4).

Quinault National Fish Hatchery

Facility Overview: The Quinault NFH began operations in 1968 to support salmon and steelhead fisheries on the Quinault Indian Reservation and adjacent federal lands to mitigate for the reduced abundance of natural-origin fish resulting from degraded habitat. The NFH releases also serve to partially mitigate reduced abundance due to substantial ocean catch of species such as coho and fall Chinook. The main facilities of Quinault NFH consist of 36, 16x80-foot raceways, two water re-use pumps, a pollution abatement pond, and three surface water intake structures. The main intake structure is located on Cook Creek, and a smaller one is located on Hatchery Creek. A third intake structure siphons water from a large natural pond and springs (Duck Pond) adjacent to the Moclips Highway, approximately two miles northeast of the facility. The hatchery diverts returning adult salmon to on-station holding facilities by means of an electric fish barrier and ladder. Hatchery operations are coordinated with the Quinault Indian Nation via a Cooperative Agreement.

Funding: The hatchery is funded by Congressional appropriation of hatchery operations funds to the Service and the Service's hatchery cyclical maintenance fund. The operational budget for FY2008 was \$798,251. Costs for monitoring and evaluation (M&E) and fish health in FY2008 were approximately \$235,000 and \$115,000, respectively. Capital Improvements to the Quinault NFH have totaled \$1,586,167 during the period 2004-2008.

Economic benefit: The total economic net benefit of Quinault NFH fall Chinook, coho and steelhead released on station and harvested is estimated to be approximately \$3.3 million annually. The hatchery fish from the Quinault River that are commercially caught in the tribal fishery are being processed and marketed commercially by Quinault Tribal Enterprises under the "Quinault Pride" label.

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Steelhead (Cook Creek, Quinault River program)

Program overview: The current steelhead hatchery stock was founded from natural-origin adults captured in the lower portion of the Quinault River watershed downstream from Lake Quinault. The stock is comprised of early returning adults, a result of hatchery practices that continuously selected for the early portion of the steelhead run while the hatchery stock was being established. The hatchery currently rears 190,000 winter steelhead smolts for release into Cook Creek. The purpose of the program is to mitigate for reduced tribal and sport fishery opportunities in the Quinault River and Cook Creek where abundance of natural-origin adult recruits has declined due to degraded habitat. The program also releases 20,500 steelhead fry into Cook Creek upstream of the hatchery to mitigate for the loss of natural reproduction associated with precluding adult salmon and steelhead from the vicinity of the water intake structure.

Benefits: The location of the hatchery on tribal lands provides significant economic, educational and cultural benefit to the Quinault Indian Nation. In addition, surplus hatchery-origin fish trapped at the hatchery are provided to tribal members for subsistence use. For broods 1993-2002, approximately 3,700 steelhead were recovered annually including 1,300 in treaty tribal fisheries.

Risks: Incidental passage of adult steelhead upstream of the weir on Cook Creek into the hatchery's water source (e.g., due to weir malfunction or high stream flows) poses a disease transmission risk to fish reared on station. Of special concern is the *Infectious Hematopoietic Necrosis* (IHN) virus. The operation of an electric weir in an area where tribal and sport fishing occurs poses a human safety risk because of the tendency of fishers to overlook signage and safety warnings. The segregated steelhead hatchery program poses an unknown genetic risk to natural populations of steelhead in the Quinault River basin due to potential straying and the domestication effects of artificial propagation. Available information indicates high homing fidelity of fish reared and released on-station. Information regarding the incidence of hatchery-origin steelhead in natural spawning areas of the watershed is lacking.

Recommendations for current program: The Review Team identified 31 specific recommendations to reduce risks and/or improve benefits of the current steelhead program at Quinault NFH. These recommendations include: (a) assess distribution and abundance of naturally spawning steelhead in the lower Quinault River Basin and assess the extent of straying of Quinault NFH steelhead that occurs in the lower Quinault River basin; (b) re-implement mass marking of steelhead released on-station at Quinault NFH; (c) reduce disease risks to steelhead reared on station by either disinfecting the water supply (e.g. UV or ozone treatment) and/or reconfiguring the existing water supplies so that Duck Pond and Hatchery Creek can be used for rearing steelhead; and (d) discontinue all steelhead fry outplants.

Alternatives to Current Program: The Review Team considered the pros and cons of four alternatives to the existing steelhead program ranging from the current program with full implementation of program specific recommendations (Alternative 1) to termination of all programs at Quinault NFH and decommissioning of the facility (Alternative 4). The Review Team recommends the implementation of Alternative 1: continuation of the current program with full implementation of all program-specific recommendations.

Steelhead (Hoh River program)

Program overview The Quinault NFH was originally established to restore fisheries to the Quinault Reservation and to adjacent federal lands. As part of this commitment, the Service initiated a program in the mid-1980's to transfer pre-smolt steelhead from Quinault NFH to the

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Hoh Indian Reservation for a smolt release into the Hoh River in support of tribal and recreational fisheries. At the present time, 50,000 steelhead smolts are reared at Quinault NFH for direct release into the Hoh River at *Allen's Bar* (river mile 15). In addition, 50,000 pre-smolts are transferred to the Hoh Tribe for subsequent rearing, imprinting, and release as smolts from Chalaat Creek hatchery (near the mouth of the Hoh River). Hatchery-origin steelhead returning to Quinault NFH provide broodstock for this program. No fish are collected for broodstock in the Hoh River. All steelhead released into the Hoh River receive an adipose fin clip.

Benefits: The program confers significant sport and tribal harvest benefits in the Hoh River. From return years 1990-2007, approximately 2,110 Quinault NFH steelhead were recovered in the Hoh River annually. Of this an average of 1,492 were harvested in tribal fisheries and 618 in sport fisheries. The program provides important economic, social, and cultural benefits to the Hoh Tribe.

Risks: The annual transfer and release of 100,000 Quinault NFH steelhead smolts into the Hoh River poses fish health risks to natural fish populations in the Hoh River. The annual transfer and release of Quinault NFH steelhead into the Hoh River also poses competition and genetic risks to native populations of steelhead in the Hoh River. These genetic and ecological risks are especially acute from hatchery-origin fish that may residualize in the Hoh River. No terminal recovery facilities currently exist for trapping Quinault NFH steelhead returning to the Hoh River. The continued release of out-of-basin steelhead into the Hoh River also poses ecological risks to other native aquatic species.

Recommendations for current program: The Review Team identified 10 specific recommendations to reduce risks and/or improve benefits of the current Hoh River steelhead program. These recommendations include: (a) discontinue the direct outplanting of 50,000 smolts at *Allen's Bar*; (b) assess the feasibility of capturing returning adult hatchery steelhead at Chalaat Creek or at an alternate lower Hoh River site, (c) assist the Hoh Tribe with the purchase and installation of bird netting over the Chalaat Creek pond (d) work with the Hoh Tribe, WDFW, and the National Park Service to conduct spawning ground surveys and smolt trapping studies to estimate the productivity of naturally spawning populations in the Hoh River, and (e) provide or assist with a training internship for a Hoh Tribal staff member at Quinault NFH or other appropriate facility.

Alternatives to Current Program: The Review Team considered the pros and cons of six alternatives to the existing Hoh steelhead program ranging from the current program with full implementation of program specific recommendations (Alternative 1) to termination of the steelhead hatchery program and managing the Hoh River for natural production only (Alternative 6). The Review Team recommends implementation of Alternative 1 for the next five years while the Service works with tribal and state comanagers to develop a long-term steelhead management strategy for the Hoh River. Development of a segregated, locally-adapted steelhead hatchery stock derived annually from adult returns to the Hoh River may be feasible in the lower river area (Alternative 4). An integrated program derived from natural-origin steelhead returning to the Hoh River may also be feasible (Alternative 5). In the long-term, the Team concluded that the Hoh River may present the capability and somewhat rare opportunity to meet tribal fishery needs strictly under a natural populations management strategy as habitats continue to improve and recover from past land-use practices.

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Coho

Program overview: The Quinault NFH coho program is a segregated hatchery program intended to provide fish for harvest. The program is intended to support marine and freshwater fisheries to mitigate for degraded habitat and reduced abundance of natural-origin coho in the Quinault River. The hatchery currently releases 660,000 yearling coho salmon into Cook Creek. An additional 143,000 fry are released upstream of the hatchery into Cook Creek. The original broodstock was founded from natural-origin coho trapped in Cook Creek. Since 1983, all broodstock have been derived from hatchery-origin fish returning to the hatchery.

Benefits: The coho program supports commercial, tribal and sport fisheries in both marine and freshwater areas. In addition, surplus hatchery-origin fish trapped at the hatchery are provided to members of the Quinault Indian Nation for subsistence use. For broods 1993-2002, on average approximately 14,000 coho were recovered annually including 6,800 in treaty tribal fisheries.

Risks: Coho released from Quinault NFH pose some genetic and ecological risks to natural populations of coho in the Quinault River basin. Coho released as fry are known to compete with, and displace, natural-origin young-of-the-year coho in the preferred rearing habitat of juveniles (deep pools in nursery streams). The release of fry thus poses additional ecological risks to natural populations of coho. The use of surface water at the hatchery increases disease risks to fish reared on station. Lack of shade covers over the raceways concentrates fish in shaded areas along pond walls, increasing effective rearing densities, potential stress, and disease risks.

Recommendations for Current Program: The Review Team identified six specific recommendations to reduce risks and/or improve benefits of the current coho program at Quinault NFH. These recommendations include: (a) assess distribution and abundance of naturally spawning coho in the lower Quinault River basin and assess the extent that returning hatchery-origin adults stray in the lower Quinault River basin; (b) discontinue all fry outplants; and (c) continue to investigate and implement methods to maximize green-to-eyed-egg survivals on a consistent basis.

Alternatives to Current Program: The Review Team considered the pros and cons of four alternatives to the existing coho program ranging from the current program with full implementation of program specific recommendations (Alternative 1) to termination of all programs at Quinault NFH and decommissioning of the facility (Alternative 4). The Review Team recommends the implementation of Alternative 1: continuation of the current program with implementation of all recommendations.

Fall Chinook

Program overview: The Quinault NFH fall Chinook program is a segregated hatchery program intended to provide fish for harvest. The program began in 1968 to mitigate for declines in the abundance of natural-origin fish resulting from degraded habitat. Initial broodstock sources included natural-origin Chinook from the Quinault River and eggs or fish from other hatchery stocks of Chinook from the Washington coast and Puget Sound. No imports of eggs or fish from outside the Quinault River basin have occurred since 1985. Stated goals of the program were to enhance and restore coastal fisheries, especially those conducted by the Quinault Indian Nation. The program is currently designed to rear 600,000 fall Chinook smolts for release into Cook Creek. Most of the eggs for this program are currently taken from adults returning to the Lake Quinault Pen Rearing facility (Quinault Indian Nation) because of poor adult returns back to Cook Creek and Quinault NFH.

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Benefits: The program supports marine and freshwater sport and tribal fisheries. In addition, surplus hatchery-origin fish trapped at the hatchery are provided to members of the Quinault Indian Nation for subsistence use. For brood years 1993-2002, an average of 1,150 hatchery origin fall Chinook were recovered annually including 575 in treaty tribal fisheries.

Risks: The apparent lack of cross-breeding between adults trapped at Quinault NFH and adults trapped at the Lake Quinault Pen Rearing facility may be posing a genetic risk to the hatchery stock by reducing the genetic effective size of the population and inhibiting maximization of local adaptations. High stray rates of returning hatchery-origin fall Chinook from Quinault NFH into natural spawning areas of the Quinault River pose a genetic risk to natural populations in the Quinault River. Predator exclusion and control devices at the hatchery are inadequate, increasing the risk of horizontal disease transmission into the hatchery from outside the hatchery and between ponds within the hatchery.

Recommendations for Current Program: The Review Team identified six specific recommendations to reduce risks and/or improve benefits of the current fall Chinook program at Quinault NFH. These recommendations include: (a) develop future fall Chinook broodstock management strategies consistent with genetic guidelines for managing hatchery-origin fall Chinook in the Quinault River as a properly integrated population that is derived from the natural population in the lower Quinault River,; and (b) adjust species composition and program sizes at Quinault NFH to achieve desired survival and return rates for the Quinault NFH fall Chinook program

Alternatives to Current Program: The Review Team considered the pros and cons of five alternatives to the existing fall Chinook program ranging from the current program with full implementation of program specific recommendations (Alternative 1) to termination of all programs at Quinault NFH and decommissioning of the facility (Alternative 5). The Review Team recommends the implementation of Alternative 2, transfer the rearing of all fall Chinook to the Lake Quinault Pen Rearing facility (subject to agreement with tribal comanager).

Chum

Program overview: The Quinault NFH fall Chum program is a segregated hatchery program intended to provide fish for harvest. The program is intended to mitigate for declines in the abundance of natural-origin chum resulting from degraded habitat. Initial broodstock sources for the program included other hatchery stocks in Washington State and returning adults back to Quinault NFH. Imports of eggs from stocks outside the basin ended in approximately 1985. Most of the eggs for this program are currently taken from adults returning to the hatchery. Stated goals were to enhance and restore coastal fisheries, especially those conducted by the Quinault Indian Nation. The hatchery program is currently designed to rear 1.5 million subyearling chum smolts for release into Cook Creek.

Benefits: The average annual harvest of hatchery and naturally produced Quinault River chum from 1996 to 2005 was 1,995 fish. The proportion of the total harvest contributed by hatchery-origin fish is unknown.

Risks: Potential mass spawning of hatchery-origin chum in the Quinault River poses a genetic risk to the natural population. The smoltification and outmigration of chum salmon fry within a few weeks after hatching essentially precludes the marking or tagging of fish prior to release. The

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inability to distinguish hatchery and natural origin adult chum increases demographic risks to the naturally spawning population resulting from potential over-harvest in the Quinault River.

Recommendations for Current Program: The Review Team identified six specific recommendations to reduce risks and/or improve benefits of the current chum salmon program at Quinault NFH. These recommendations include: (a) the application of otolith marks to hatchery-origin chum prior to release to allow assessments of natural spawning stray rates and identification of hatchery and natural-origin chum during or after broodstock selection and spawning, (b) determine an appropriate future broodstock management strategy (e.g., *segregated* vs. *integrated*), and (c) evaluate new methods of trapping and collecting chum adults for broodstock.

Alternatives to Current Program: The Review Team considered the pros and cons of three alternatives to the existing chum program ranging from the current program with full implementation of program specific recommendations (Alternative 1) to termination of all programs at Quinault NFH and decommissioning of the facility (Alternative 4). The Review Team recommends the implementation of Alternative 1 but also concludes that Alternative 2 - increase the size of the program from 1.5 to 3.0 million subyearling smolts - would most likely increase benefits without increasing risks if an alternative broodstock collection site can be developed.

Makah National Fish Hatchery

Facility Overview: The Makah NFH began operations in 1981 to support salmon and steelhead fisheries on the Makah Indian Reservation and adjacent federal lands to mitigate for the reduced abundance of natural-origin fish resulting from degraded habitat. The NFH releases also serve to partially mitigate reduced abundance due to substantial ocean catch of species such as coho and fall Chinook. The Makah NFH is located within the Makah Indian Reservation, approximately 8 miles southwest of the town of Neah Bay, Washington, on the northwest tip of the Olympic Peninsula. The hatchery is located at river mile 3 of the Sooes River. Its main facilities consist of 29, 11 x 80-foot raceways, four 4 x 40-foot raceways, a pump house building, and a two-story hatchery building. A satellite acclimation and release facility is present on Educket Creek and is operated by the Makah Nation for release of hatchery-origin fish into the Waatch River. Service operation of the Makah NFH is coordinated with the Makah Nation.

Funding: The hatchery is funded by Congressional appropriation of hatchery operations funds to the Service and the Service's hatchery cyclical maintenance fund. The operational budget for FY2008 was \$743,859. Costs for monitoring and evaluation (M&E) and fish health in FY2008 were approximately \$340,000 and \$115,000, respectively. Capital Improvements to the Makah NFH have totaled \$2,512,120 during the period 2004-2008.

Economic Benefit: The overall total economic net benefit of Makah NFH fall Chinook, coho and steelhead released on station and harvested is estimated to be approximately \$1.2 million annually.

Fall Chinook

Program overview: The Makah NFH fall Chinook program is an integrated hatchery program intended to provide fish for harvest and to maintain the fall Chinook run in the Sooes River. A variety of fall Chinook stocks were introduced into the Sooes River prior to the construction of the hatchery in 1981. Since the construction of the hatchery, only fall Chinook returning to the Sooes River have been used as broodstock for the Makah NFH fall Chinook program. The hatchery

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currently produces 2.2 million Chinook smolts for release into the Sooes River at the hatchery and produces 100,000 smolts for transfer and subsequent release at the Educket Creek acclimation facility (Waatch River). Fish not otherwise coded-wire tagged are all given adipose-fin clips for release in both the Sooes River and Educket Creek.

Benefits: The hatchery fall Chinook program confers significant sport, tribal, and commercial harvest benefits as well as fish for tribal subsistence and ceremonial use by the Makah Nation. Based on coded-wire tag data, for brood years 1993-2002, on average approximately 4,400 fall Chinook were recovered annually including 250 in treaty tribal fisheries.

Risks: The hatchery program poses a genetic domestication risk to Sooes River fall Chinook – which conflicts with the conservation goal of the program - because neither the proportion of natural spawners composed of hatchery-origin fish (*pHOS*) nor the proportion of the broodstock composed of natural-origin fish (*pNOB*) are controlled or properly managed. Makah NFH is more susceptible to catastrophic loss than most other hatcheries due to the incidence of floods, frequent power outages, and potential tsunamis. Disease risks, low water flows, high water temperatures (during the summer) and dependence on mechanical devices (pumps, generators, sand filters, etc.) are more prevalent at Makah NH than most other hatcheries, further increasing the risk of catastrophic fish losses.

Recommendations for Current Program: The Review Team identified 19 specific recommendations to reduce risks and/or improve benefits of the current fall Chinook program at Makah NFH. These recommendations include: (a) in consultation with the Makah Nation, develop a natural escapement and hatchery broodstock management plan for the Sooes watershed based on the relative numbers of hatchery-origin and natural-origin fall Chinook intercepted at the hatchery, (b) install a tsunami warning system that can be heard throughout the facility and develop a tsunami evacuation plan, (c) develop a consistent and clearly defined M&E program and review on an annual basis, (d) conduct spawning ground surveys and smolt trapping to estimate juvenile production for the Sooes and Waatch Rivers, and (e) work with the Makah Nation to develop a single cooperative agreement regarding program management which addresses fish production levels, marking, responsibilities of the parties, and communications.

Alternatives to Current Program: The Review Team considered the pros and cons of three alternatives to the existing fall Chinook program ranging from the current program with full implementation of program specific recommendations (Alternative 1) to termination of all programs at Makah NFH and decommissioning of the facility (Alternative 5). The Review Team recommends the implementation of Alternative 1.

Coho

Program overview: The Makah NFH coho program is intended to be a segregated hatchery program that provides fish for harvest. The coho program was initiated in 1982 with eggs obtained from the Quinault NFH. In the late 1980's two brood years of fish were replaced with fish from Quinault NFH after an outbreak of *Viral Hemorrhagic Septicemia* (VHS) virus required the euthanization of all fish at Makah NFH. The hatchery currently rears 200,000 coho smolts for release into the Sooes River at the hatchery and 40,000 smolts for transfer and subsequent release at the Educket Creek acclimation facility (Waatch River). Fish not otherwise coded-wire tagged are mass marked with adipose-fin clips for both the Sooes River release and Educket Creek transfer. Broodstock are collected from both hatchery-origin and natural-origin adults. Hatchery and natural origin adults not needed for broodstock are passed upstream to spawn naturally.

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Benefits: The hatchery program confers significant sport, tribal, and commercial harvest benefits. In addition, surplus hatchery-origin fish trapped at the hatchery are provided to the Makah Nation for subsistence and ceremonial use. An estimated mean of 4,700 coho are caught annually in various fisheries based on coded-wire tag data for brood years 1993-2002. Nearshore and in-river fisheries are of particular economic, social, and cultural significance to the Makah Nation.

Risks: Passing an unknown number of hatchery versus natural-origin coho upstream poses genetic and ecological risks for maintaining a self-sustaining natural population in the watershed, although the current status and viability of the natural population is unknown. Amplification of disease within the hatchery poses a disease risk, especially with the occurrence of *Furunculosis*, to fish populations in the Sooes River. Antibiotics used during coho rearing are discharged with hatchery effluent into the Sooes River and may contribute to development of drug-resistant pathogens that could impact fish, wildlife or humans.

Recommendations for Current Program: The Review Team identified seven specific recommendations to reduce risks and/or improve benefits of the current coho program at Makah NFH. These recommendations include: (a) evaluate the ability of the watershed to maintain a self-sustaining natural population of under current habitat and harvest conditions, (b) in consultation with the Makah Nation, develop a natural escapement and hatchery broodstock management plan for coho in the Sooes watershed, (c) discontinue coho fry outplants and (d) evaluate opportunities for chilling and/or disinfecting incoming water for use during summer months

Alternatives to Current Program: The Review Team considered the pros and cons of five alternatives to the existing coho program ranging from the current program with full implementation of program specific recommendations (Alternative 1) to termination of all programs at Makah NFH and decommissioning of the facility (Alternative 5). The Review Team recommends implementation of Alternative 1.

Steelhead

Program overview: The Makah NFH winter steelhead program is a segregated hatchery program intended to provide fish for harvest. The steelhead program was started in 1983 with eggs from the Quinalt NFH. Broodstock are collected from hatchery-origin adults returning to the hatchery. Operation of the weir for steelhead currently directs early-returning hatchery-origin fish into the facility but allows later-returning natural-origin fish to bypass the facility and swim upstream. In the late 1980's, two brood years of fish were replaced with fish from Quinalt NFH after an outbreak of VHS virus required euthanization of all fish at Makah NFH. The hatchery currently rears 158,000 winter steelhead smolts for release into the Sooes River and 22,000 smolts for release at the Educket Creek acclimation facility (Waatch River). Currently no tags or fin clips are applied to either group of smolts.

Benefits: The program confers significant tribal and sport harvest benefits in the Sooes and Waatch Rivers. The mean annual harvest was 2,563 fish (range, 1,163-4,362 fish) based on catch records for the Sooes and Waatch Rivers, 1997– 2007. The average harvest in the Waatch River was 99 fish (range, 23-301 fish), 1997– 2007. The harvest is predominantly tribal. Spawning fish used for broodstock and surplus adults trapped at the hatchery are provided to the Makah Nation for subsistence and ceremonial purposes.

Risks: Steelhead are particularly susceptible to domestication selection. Hatchery-origin steelhead reared at Makah NFH vary greatly in size at the time of release, and fish released below the target

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size are expected to have a significantly lower return rate than larger fish. This differential survival exacerbates domestication effects, and reduces overall smolt-to-adult return rates, thereby affecting the total number fish available for broodstock and harvest. Rearing densities in the start tanks appear to exceed the maximum recommended density index guideline of 0.20 prior to transfer to outdoor raceways. Increased rearing densities increases disease risks, particularly for bacterial cold-water disease. Hatchery-origin steelhead migrating upstream after March 1 can pass upstream unimpeded when the electric weir is turned off, or during extreme flood conditions, thus posing an unquantified genetic risk to the natural population.

Recommendations for current program: The Review Team identified 16 specific recommendations to reduce risks and/or improve benefits of the current steelhead program at Makah NFH. These recommendations include: (a) mass mark all released steelhead annually to allow hatchery and natural-origin fish to be distinguished, in accordance with the Service's best management practices, (b) initiate a study to determine the current upstream migration timing of hatchery and natural-origin steelhead in the Sooes River, (c) reduce initial egg loading densities to the eggs from a maximum of two females per tray, or approximately 8,000 eggs per tray, (d) increase predator control measures in the outdoor raceways to reduce fish losses resulting from bird and mammal predation, (e) conduct genetic analyses of hatchery and natural-origin steelhead in the Sooes River, and (f) work with comanagers to develop a Washington State coast-wide monitoring and evaluation plan for a new emerging strain of the IHN virus.

Alternatives to Current Program: The Review Team considered the pros and cons of five alternatives to the existing steelhead program at Makah NFH ranging from the current program with full implementation of all program specific recommendations (Alternative 1) to termination of all programs at Makah NFH and decommissioning of the facility (Alternative 5). The Review Team recommends the implementation of Alternative 1.

Ozette Sockeye

Program overview: The Lake Ozette sockeye program is an integrated hatchery program intended to assist with the recovery of sockeye salmon in the Lake Ozette system. Lake Ozette sockeye were listed as a threatened species under the U.S. Endangered Species Act in 1999. The current hatchery supplementation program was initiated in 2000. An evaluation of the program is scheduled to occur 12 years (three sockeye generations) after initiation of the program. The evaluation will determine whether the program should be continued or terminated. Beginning in 2000, eggs were collected from adult sockeye trapped in tributaries to Lake Ozette, primarily Umbrella Creek. At the request of the Makah Nation, Makah NFH became involved in the Lake Ozette sockeye program in 2003. The Makah NFH Isolation/Quarantine facility was modified at that time for initial incubation of fertilized eggs to reduce the risk of egg losses that could occur at the Umbrella and Stony Creek remote sites. Unfertilized gametes are taken to Makah NFH, fertilized there, treated with disinfectant, and then incubated to the eyed stage in quarantine. The egg take goal is 305,000 unfertilized "green" eggs. Embryos are otolith-marked during egg incubation at Makah NFH. Eyed eggs are taken subsequently to Umbrella Creek (122,000 eyed eggs) and to Stony Creek Hatchery (183,000 eyed eggs). Release goals are 122,000 subyearling sockeye at 450 fish per pound into Umbrella Creek, and 91,500 subyearling sockeye at 900 fish per pound and 91,500 at 450 fish per pound into Stony Creek.

Benefits: The program provides a conservation benefit by reducing the demographic risk of extinction of Lake Ozette sockeye salmon. This program also provides a research benefit regarding the efficacy of hatchery supplementation to rebuild and/or reintroduce a natural,

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tributary-spawning population of sockeye to an eventual level of self sustainability. The Proposed Recovery Plan (PRP) outlines numerous educational and outreach benefits regarding the recovery of Lake Ozette sockeye salmon.

Risks: The hatchery program poses a genetic risk to the population's spatial structure by potentially preventing distinct shoreline and tributary spawning populations from developing and evolving naturally. An inherent risk of domestication exists also. The program also poses demographic risks to the population by removing adults for broodstock and placing all their eggs in one quarantine facility. The risk of catastrophic loss of an entire brood year exists in the isolation incubation building, the staging facility, remote rearing sites, and during transport. Hatchery-reared sockeye may have greater vulnerability to predation than naturally-produced smolts.

Recommendations for Current Program: The Review Team identified one specific recommendation to reduce risks and/or improve benefits of the current Lake Ozette sockeye program at Makah NFH. This recommendation is to acquire a chilling unit to reduce the incubation water temperature to a safe range for thermal otolith marking

Alternatives to Current Program: The Review Team considered the pros and cons of four alternatives to the existing sockeye program ranging from the current program with full implementation of program specific recommendations (Alternative 1) to termination of all programs at Makah NFH and decommissioning of the facility (Alternative 4). The Review Team recommends the implementation of Alternative 1 and to use the isolation quarantine facility to support conservation programs for other naturally spawning populations of salmonid fishes in the region (Alternative 2) as needed, consistent with the Ozette sockeye program.

Conclusions

The Team concluded that each of the three NFHs on the Olympic Peninsula is effectively performing its original intended function of providing fishing opportunities to partially replace the availability of natural-origin fish that were reduced or lost due to habitat degradation in the Olympic Peninsula region. Each of the three National Fish Hatcheries works closely with Native American Tribes in each region. Hatchery programs at Quilcene, Quinalt, and Makah NFHs provide important economic, social, and cultural benefits to local tribal members. These latter benefits represent a very significant role for these facilities and should remain a Service priority. While the Team identified some ways in which the individual facilities can improve their success in providing fish for harvest, many of the Team's recommendations address conservation needs for naturally spawning populations in the respective watersheds and regions where each hatchery is located. The Team concluded that the current hatchery programs have overlooked some conservation needs for natural populations by focusing primarily on increasing harvest opportunities. In the long run, such an approach may reduce the viability of natural populations and affect future harvest opportunities on all fish.

Each of the three NFHs has isolation and early rearing capability for small conservation programs. The Service should actively seek opportunities to take advantage of those facilities by partnering with comanagers in developing and implementing new conservation/recovery programs where needed.

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