Jones & Stokes

Memorandum

Date: January 10, 2008

To: Corrie Veenstra, USACE

From: Chris Earle

cc: Chris Cziesla

Subject: Response to Services comments on NWP 48 BA for Washington

Background

Pursuant to the terms of Contract W912DW-05-D-1001, delivery order DT02, Jones & Stokes prepared a "Draft Biological Assessment and Essential Fish Habitat Analysis: Nationwide Permit 48 in Washington," which was delivered to the Portland District, U.S. Army Corps of Engineers for review on September 27, 2007. Following review, the biological assessment (BA) was modified and a second version delivered on October 12, 2007. This version of the BA was subsequently delivered to the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (FWS) by USACE. Page numbers cited in the FWS comments below refer to this final draft.

The present document, prepared under a modification of the original delivery order (Exercise Optional Letter #01, January 9, 2008), responds to comments on the original BA that were prepared by NMFS and FWS and delivered to USACE on November 21, 2007 (FWS) and December 18, 2007 (NMFS). In addition, a conference call on December 14, 2007 was attended by USACE, NMFS, FWS and Jones & Stokes representatives and served to further inform our understanding of the comment letters.

These responses were prepared using references cited by the Services in their comments, references from the peer-reviewed literature as cited below, and verbal or written comments from persons knowledgeable in shellfish aquaculture methods and their effects, also cited below.

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Response to NMFS Comments

General Comments

Comment 1: We agree with the Corps that there are many uncertainties regarding the effects of aquaculture on protected species, their habitat, and EFH, but we believe that the BA's conclusions can be better supported by examining a larger set of the current literature. We have forwarded to you and the consultants an electronic version of Jeff Fisher's annotated bibliography of the effects of shellfish aquaculture.

Response: The annotated bibliography was used in preparation of the biological assessment, and relevant citations appear throughout the text.

Comment 2: The EFH Assessment can also be strengthened by using information provided in Fishery Management Plans (FMPs). Relevant FMPs can be found at the Pacific Fishery Management Council's website (http://www.pcouncil.org). Care should be taken to adhere to the definition of an "adverse impact to EFH". An adverse impact to EFH is defined as any impact that reduces the quality and/or quantity of EFH and may include direct, indirect, site-specific, or habitat wide impacts.

Response: FMPs reviewed during document preparation are cited in Chapter 8 of the BA. Specific comments relevant to that analysis are addressed below.

Comment 3: We are aware that it is difficult to identify precisely the locations of existing shellfish aquaculture operations in Washington State. However, without accurate descriptions of the action area, our evaluation of the risks posed to listed species, their habitat, and EFH is compromised. We understand that the Corps is working with the consultant to provide more precise and accurate descriptions of the action area, including a clarification of the definition of historic shellfish growing areas.

Response: As required under NWP 48, all reporting forms received from growers will be provided to NMFS and USFWS for their review. Currently USACE does not plan further analyses of information contained in these reporting forms.

Comment 4: The analytical framework for assessing the effects of the issuance of NWP 48 is confusing. We look forward to a final version that clarifies that the analysis will compare the magnitude and extent of the effects of shellfish aquaculture prior to issuance of NWP 48, to the effects of shellfish aquaculture expected after the issuance of NWP.

Response: The final version of the BA has been issued and delivered for your consideration. This memorandum has been prepared to address comments received from the NMFS and the USFWS. Responses presented herein reference sections in the original BA by number and title, as appropriate. The specific issue of effects prior to vs. after issuance of NMP 48 is discussed in BA Section 1.1, Federal Action History, and Section 1.2, Informal Consultation, which states ”that

shellfish aquaculture, having existed in the action area for a long time prior to the development of NWP 48 and in many cases prior to the Endangered Species Act and Clean Water Act, should be included as part of the environmental baseline. This is consistent with the definition of environmental baseline as including "State, tribal, local, and private actions already affecting the species or that will occur contemporaneously with the consultation in progress" (NMFS and USFWS 1998). However, there is limited understanding of the historical effects of shellfish culture, so the potential effects of culture as regulated under NWP 48 should be interpreted conservatively in the evaluation of how culture activities may affect listed species and their habitat."

Specific Comments

Comment 5: We look forward to more detail on the description of culture bed preparation activities; and the effect of those activities on critical habitat and EFH. As you know, effects to eelgrass are an important issue. We look forward to a detailed discussion of shellfish culture and eelgrass interaction.

Response: This comment does not refer to any specific portion of the text. Numerous comments treated below address culture bed preparation and the interaction of shellfish culture and eelgrass.

Comment 6: ATVs are discussed in the effects analysis section. Please describe their usage in the proposed action, and acknowledge their usage as set forth in the SLOPES consultation. Work conducted on the beach should use pre-existing routes so as to minimize impacts to the intertidal environment.

Response: ATV's are sometimes used at grower discretion to access shellfish beds or to move equipment on exposed beds. Such vehicles should be operated in accordance with standard measures intended to minimize impacts, such as the provisions of SLOPES 3 (NMFS 2004) which require:

- Vehicle wash water must be treated before discharge.
- Vehicles will be stored, fueled, and maintained in a vehicle staging area placed 150 feet or more from any stream, waterbody or wetland.
- Inspect all vehicles operated within 150 feet of any stream, waterbody or wetland daily for fluid leaks before leaving the vehicle staging area. Repair any leaks detected in the vehicle staging area before the vehicle resumes operation. Document inspections in a record that is available for review on request by Corps or NOAA Fisheries.
- Vehicles operated within 150 feet of any stream, waterbody or wetland will be inspected daily for fluid leaks before leaving the vehicle staging area.
- Before operations begin and as often as necessary during operation, all equipment used below ordinary high water will be steam-cleaned.

It is not known if all ATV users observe these precautions. We anticipate discussing with NMFS and USFWS the potential adoption of a conservation measure pertaining to ATV use in shellfish aquaculture.

Comment 7: Please include an analysis of the effects of turbidty from unwashed gravel and sand used for intertidal or subtidal aquaculture to the extent that unwashed product is used.

Response: Growers report that graveling is only used to provide a benthic substrate that clams can inhabit. Under NWP 48, graveling would only be a covered activity in areas previously graveled. Graveling is only performed in Willapa Bay, where no NMFS-jurisdictional salmonids occur, but bull trout does occur seasonally. Such use is predominantly between April and October. Therefore, the description of graveling is here amended with the provision that it is only a covered activity when performed in Willapa Bay, between November and March. There is still a small possibility that bull trout could be exposed to turbidity associated with gravel placement during that time period. Willapa Bay has very high background turbidity levels due to constant turbation of benthic silts by tidal currents. Turbidity increases associated with graveling have not been reported by growers to cause observable increases in turbidity, but we are not aware of any actual measurements of turbidity changes associated with graveling. Overall, the exposure of bull trout to turbidity effects associated with graveling is thus both insignificant and discountable.

Comment 8: We look forward to a discussion of the cumulative effects of multiple small impacts, as well as the evidence or lack thereof for long-term effects of shellfish culture on ecosystem services.

Response: There is essentially no evidence for additive effects of multiple small impacts attributable to shellfish culture. Shellfish culture, specifically oyster culture, has been a well established activity in Willapa Bay since the 1850's, and for nearly as long in Humboldt Bay, California. Both estuaries have remained highly functional throughout that time period. In particular, both have retained exceptional value as rearing habitat for juvenile salmonids, and Willapa remains one of the most productive rearing areas in Washington. Shellfish growers attribute this to their zealous defense of water quality; excellent water quality is an absolute prerequisite for successful shellfish culture. Consideration of the historical record reveals that shellfish culture has had some notable adverse impacts on the Willapa Bay ecosystem, primarily the introduction of the aquatic weed Spartina (introduced in the late 19th Century as a packing material for introduced oyster seed) and the replacement of the native Olympia oyster with non-native oyster stocks. However, these are not cumulative effects but major discrete events, and mechanisms have been created (discussed in Chapter 2 of the BA) to prevent recurrence of such events.

There remains the possibility of additive effects of small actions altering habitat in areas subject to other types of shellfish culture, such as clam and mussel culture. Such practices have been performed continuously for a century or more in various waters of eastern North America and northwest Europe that are comparable to the marine environments of western Washington. However, we have not identified any literature addressing the question of cumulative long-term

impacts of shellfish culture in these areas.

Comment 9: Note that EFH identifications are no longer grouped into composites. [8-2, line 331].

Response: Acknowledged. This information does not alter the conclusions of the EFH analysis.

Comment 10: Estuaries and seagrass habitats are designated Habitat Areas of Primary Concern (HAPCs) under the Fishery Management Plans. Please include a discussion of the relevance of this designation and the effects of the project on HAPCs.

Response: Amendment 18/19 of the groundfish FMP (PFMC 2005) identifies Habitat Areas of Particular Concern (HAPC) for the Pacific Coast groundfish fishery. The identified HAPCs in the action area include estuaries, seagrass, and areas of interest. All shellfish culture activities covered by NWP 48 in Washington include the estuary and areas of interest HAPC's (the areas of interest HAPC includes "All waters and sea bottom in state waters shoreward from the three nautical mile boundary of the territorial sea shoreward to MHHW"). The complex relationships between seagrass and shellfish aquaculture, described in the BA, ensure that a substantial fraction of shellfish culture activities covered by NWP 48 include parts of the seagrass HAPC. The effects of the project on estuaries, seagrass and other waters in the action area are described in the BA.

Comment 11: Table 8-1: Cabezon and English sole are not limited to estuaries in Puget Sound. Starry flounder have been observed in seagrass habitat. Please include a footnote to Table 8-1 that states that species in the table may occur in habitats other than those in which they were observed in the surveys used to prepare the Table.

Response: Acknowledged. This information does not alter the conclusions of the EFH analysis.

Narrative Comments from December 14, 2007 NMFS Conference Call

Comment 12: Do growers use treated wood in rafts? If so, discuss potential effects of leaching.

Response: Growers are not prohibited from using treated wood in mussel rafts and it is assumed that some growers covered under NWP 48 do construct their rafts using ammoniacal copper zinc arsenate (AZCA) treated wood, which is generally approved and available for marine use in western Washington. Rafts are constructed on land and towed to their moorage, so contamination effects associated with raft construction do not affect surface waters. Wood impregnated with chemicals such as copper, zinc, and arsenic may directly affect salmon that rear or migrate by those structures, or indirectly when the salmon ingest contaminated prey (Poston 2001). However, mussel rafts are cited in waters with continuous and active current flow in order to ensure a steady supply of phytoplankton for the mussels to feed upon. Therefore dilution effects are continuous and no salmonids in the vicinity of the rafts are likely to be exposed to leachate concentrations sufficient to cause measurable physiological effects.

Comment 13: No need to address Columbia River runs of salmon and steelhead.

Response: The USACE wishes to withdraw the effect determinations for the Columbia River runs of salmon and steelhead, i.e., the Columbia River chum salmon ESU, the lower Columbia River coho salmon ESU, the lower Columbia River steelhead DPS, the middle Columbia River steelhead DPS, the upper Columbia River steelhead DPS, the Snake River steelhead DPS, the upper Willamette River steelhead DPS, the Snake River sockeye salmon ESU, the lower Columbia River Chinook salmon ESU, the upper Columbia River spring-run Chinook salmon ESU, the upper Willamette River Chinook salmon ESU, the Snake River spring/summer run Chinook salmon ESU, and the Snake River fall-run Chinook salmon ESU.

Comment 14: Discuss floatation used be growers; should be encapsulated to prevent styrofoam pollution.

Response: Floatation is made from pressurize plastic floats, reclaimed polyurethane food-grade barrels, or coated or vinyl-wrapped polystyrene foam. Unwrapped polystyrene (Styrofoam®) is not used.

Comment 15: Appropriate to include a conservation measure providing for at least annual cleanup of debris (geoduck tubes, nets, etc.) on grower beaches; relevant to all culture that leaves gear (tubes, nets, longlines, etc.); actions to be only performed on legally accessible properties.

Response: We have received an e-mail from Wayne Palsson, WDFW research scientist, disclosing unpublished data on aquaculture debris in south Puget Sound. A 2005 bottom trawl survey estimated geoduck culture debris in the south Sound amounting to 61,600 pieces of netting and 21,600 culture tubes (Palsson pers. comm..). We anticipate discussing with NMFS and USFWS the appropriate formulation of a conservation measure intended to address this situation.

Comment 16: All pump intakes (for geoduck harvest, and for washing down gear or tubs of harvested fish, etc) that use seawater should be screened in accordance with NMFS and WDFW criteria.

Response: We agree that this is an appropriate precaution and anticipate discussing with NMFS the appropriate formulation of a conservation measure intended to address this situation.

Comment 17: Make clear that frosting is only performed in previously treated areas.

Response: This is correct. Frosting is only performed in previously treated areas.

Comment 18: Shellfish operations using carbaryl are not covered by this consultation and must pursue a separate consultation.

Response: We anticipate discussing with NMFS and USFWS the appropriate formulation of an analysis of carbaryl use in shellfish aquaculture.

Comment 19: Include a summary of shellfish culture effects on plankton productivity.

Response: Shellfish culture effects on plankton productivity are described briefly on page 5-8 of the BA. It is possible to go into considerable detail on this subject. One beneficial effect of shellfish culture appears to be to dampen otherwise extreme natural fluctuations in plankton productivity. Estuaries that have lost a large fraction of their shellfish populations, such as Chesapeake Bay, are vulnerable to short, intense phytoplankton blooms followed by mass mortality of the phytoplankton and the zooplankton that feed upon them. Healthy bivalve populations prevent that outcome by consuming a portion of the phytoplankton and recycling some of the nutrients back into the environment.

Shellfish effects on plankton productivity can be measured. In 2003, the Pacific Shellfish Institute completed a comprehensive two-year study to evaluate phytoplankton abundance and seasonal change within and surrounding a mussel raft farm in southern Puget Sound. This farm has 8 multiple suspended culture units with a total surface area of one acre and a stocking density at harvest size of 240 tons. While phytoplankton abundance was on average 56.3% lower in the center of the raft units, the feeding effects on phytoplankton were localized and contained in the immediate raft system. Despite reductions in phytoplankton abundance within the mussel unit, phytoplankton concentration and community composition outside the raft system did not differ from reference conditions (PSI, 2003).

In a mesocosm study in Rhode Island, Pietros and Rice (2003) specifically investigated the "overgrazing hypothesis" that oyster populations can deplete phytoplankton. They found that "based on rates of ammonia excretion by oysters and observed steady states of ammonia and other forms of inorganic nitrogen in mesocosm tanks, it can be hypothesized that ammonia generated by oysters is taken up by rapidly regenerating phytoplankton in the water column." They concluded that oysters had no net effect in terms of depleting phytoplankton populations, but that oysters can produce changes in the relative abundance of different phytoplankton species.

Comment 20: Clarify definitions of growing area per preamble in FR notice that accompanies issuance of NWP 48.

Response: The referenced FR notice includes the following text (72FR11145):

> For the purposes of this NWP, an existing operation is one that has been granted a permit, license, or lease from a state or local agency specifically authorizing commercial aquaculture activities and which has undertaken such activities prior to the date of issuance of this NWP. For the purposes of this NWP, the project area is defined as the area of waters of the United States occupied by the existing operation. In most cases, the project area will consist of the area covered by the state or local aquaculture permit, license, or lease. The project area may consist of several sites that are not contiguous. The project area may include areas in which there has been no previous aquaculture activity and/or areas that periodically are allowed to lie fallow as part of normal operations. Relocation of existing operations into portions of the project area not previously used for

aquaculture activities may be authorized by this NWP but will require a preconstruction notification. Cultivation in areas that were previously used but allowed to lie fallow does not require a pre-construction notification. Operators should maintain appropriate documentation showing which areas were previously cultivated.

The present consultation addresses shellfish culture within project areas defined per 72FR11145, within an action area defined as stated in Section 2.4 of the BA.

Comment 21: Make it clear that "historic" time included aquaculture.

Response: All references to "historic" or "historical" conditions in the BA refer to times between the onset of written records and the issuance of NWP 48. In much, but not all of the action area, shellfish aquaculture has occurred through the whole of the historic period. In most areas this only applies to oyster culture; mussel and clam (including geoduck) culture are generally more recent phenomena, and geoduck culture in particular has almost all developed during the 21st Century.

Comment 22: Corps needs to provide better information about the acreage of the operations being covered under NWP 48.

Response:

Response to FWS Comments

General Comments

Comment 23: 1) We need a description of the scope of the action. Aside from points on a map we have no information was provided on the amount of acres under shellfish cultivation or what percent of Puget Sound (i.e., nearshore habitat) is being farmed. This information is critical to predict the extent of intertidal habitat used by listed fish, migratory birds and other important aquatic resoures. This information is available from the state resource agencies and the Washington State Health Department. We also need to know the extent of overlap with forage fish spawning areas and eel grass beds.

Response: For the spatial scope of the action, see response to Comment 3. The known extent of overlap with forage fish spawning areas and eelgrass beds is as stated within the environmental baseline and effects analysis chapters in the BA.

Comment 24: 2) It is unclear how a NLAA determination can be made when there is no analysis of the additive effect of how *all* the shellfish farming activities combined affect listed species and their prey. No connection has been made (beneficial or detrimental) between changes in phytoplankton and zooplankton density and ultimately effects to juvenile fish (salmonids, and forage fish). These farmed organisms also compete with native clams and oysters for food. High

densities of shellfish in sheltered bays and coves may be removing significant amounts of phytoplankton, reducing this trophic level, very likely to the detriment of zooplankton and higher tropic level species. There is no discussion on the potential effects to forage fish either from a reduction in prey or reduced spawning habitat.

Response: See the response to comment 19 for discussion of the effects of shellfish culture on plankton productivity. See the response to comment 8 for discussion of the additive effect of all shellfish activities combined. Note also that oyster eggs are used to feed hatchery salmon; about 40% of cultured oyster net productivity is thought to go to support spawning, with all of that spawn discharged to estuarine waters. Oyster, manila clam and geoduck culture in western Washington show net productivity of approximately 12,000 (geoduck) to 72,000 (intensive oyster) pounds per acre per year (Davis pers. comm..), so that represents 4,800 to 28,800 pounds per acre per year of spawn released to nearshore waters (note however that approximately 50% of the oyster harvest is represented by triploid oysters, which do not spawn). No water quality impairment has been noted from these spawn releases, and the net supply of food for juvenile salmon, forage fishes and other small marine fauna is evidently substantial. This is probably one reason why Washington's primary shellfish harvest area, Willapa Bay, is also one of its most productive salmon rearing estuaries.

Comment 25: 3) Too often only one citation is provided which paints a positive picture of the effects of shellfish aquaculture on the environment. We do not deny that there are positive *environmental aspects of this activity on the environment, however, there are negative effects as* well, and these appear to be glossed over in this analysis. We expect the Corp's information to provide an evaluation of the activities under consultation which considers all potential effects.

Under Section 7(a)(2) of the Act "Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency (hereinafter in this *section* referred to as an "agency action") is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with affected States, to be critical, unless such agency has been granted an exemption for such action by the Committee pursuant to subsection (h) of this section. ***In fulfilling the requirements of this paragraph each agency shall use the best scientific and commercial data available*** [emphasis added]**.** Jeff Fisher developed a comprehensive compilation of the current literature; we suggest you review this literature.

Response: The annotated bibliography was used in preparation of the biological assessment, and relevant citations appear throughout the text.

Comment 26: 4) We still need clarity on what is allowed in the NWP #48 regarding expansion of aquaculture facilities? For example, if a grower owns or leases 50 acres but he/she only has 25 acres under cultivation, can he/she expand the operations to the other 25 acres under the NWP #48? In other words does expansion only apply to the acquisition and cultivation on *additional* property not under ownership or lease?

Response: See the response to Comment 20. In the example you cite, the grower would be

eligible to culture “the other 25 acres” under NWP 48, but would require USACE approval of a pre-construction notification in order to do so.

Comment 27: 5) Are shellfish farmers farming their entire lease/ownership? The baseline condition includes those areas under cultivation. If a grower is only using 50% of his/her ownership that is the baseline condition, then any expansion to the other 50% of the tract should be considered in the effects analysis. Currently, we have no way to determine how many acres are under cultivation relative to the areas that *could be* under cultivation in the future.

Response: Currently we do not know how much of each farmer’s lease/ownership is under cultivation. There is no provision in NWP 48 for securing information on the acreage leased/owned that is under cultivation, formerly but not currently cultivated, or never previously cultivated, except in cases where growers are required to submit a pre-construction notification.

Specific Comments

Comment 28: 1) Page 2-9, line 1: What is the size range of the mussel rafts?

Response: Mussel rafts are typically 30 by 34 feet, and a typical mussel farm consists of four to six rafts moored together.

Comment 29: 2) Page 2-9, line 7: Are fish ever trapped in these nets?

Response: The nets initially used are discarded from salmon farms and form a box under the raft, in order to prevent predatory fish from consuming the young shellfish. Later, the nets are removed and replaced with a coarser-mesh perimeter net that is open at the bottom; these nets serve to exclude diving ducks. The growers report that no fish or ducks have been found entangled in these nets.

Comment 30: 3) Page 2-11, line 6: How is the silt manually leveled? What equipment is used?

Response: The ground is dragged with a steel bar and a square of chain mesh. Some oyster growers simply drag a closed dredge. The equipment is dragged behind a boat, during a falling tide.

Comment 31: 4) Page 2-14, line 27: Is this crushed shell and gravel spread over eelgrass beds?

Response: These actions would be performed on a bed recently harvested under NWP 48, and would be performed on a bed previously treated with shell and gravel. This action is intended to facilitate clam culture. Clams can’t be farmed in eelgrass areas; the rhizomes exclude their culture. So, the work would never be done in areas with abundant eelgrass. Also, this work is done in depths above those inhabited by *Zostera marina*. Consequently any eelgrass impacts would only occur to very sparse growth of the invasive seagrass *Zostera japonica*, and even those impacts would rarely occur.

Comment 32: 5) Page 2-15, line 8: Are these growing areas on the same property or are oysters transported off site? If so, where are they taken? These offsite areas (should they exist) should be included in the action area.

Response: This BA covers oysters grown in western Washington. Thus the only "off site" areas would be areas out of state. Currently no oysters are taken out of state for fattening and no such activity is proposed. Normally, oysters are only moved within the confines of an existing shellfish farm. They remain not only within the action area, but within the project area.

Comment 33: 6) Page 2-15, line 16: How often during the grow-out season is the area harrowed. Is this done where eelgrass is growing?

Response: Harrowing occurs only in the Willapa and Grays Harbor area, where it is done to keep the oysters on the bed of the bay. Without harrowing, the oysters would sink into the silty bottom due to bioturbation by burrowing shrimp. Thus the frequency of harrowing depends largely on the intensity of bioturbation by shrimp. In the summer, it may have to be done two or three times. The rest of the year, it generally is not necessary. It is conceivable that harrowing could affect a little eelgrass, but generally eelgrass is incapable of occupying areas populated by burrowing shrimp.

Comment 34: 7) Page 2-17, line 12: How are the stacks de-fouled?

Response: Defouling is rarely done, and is usually only performed at a harvest. The stacks may be pressure-washed, or changed out and left to dry onshore. The pressure washers use screened intakes (see response to comment 16).

Comment 35: 8) Page 2-18, line 13: Does other growth include eelgrass?

Response: See response to comment 31. Clam culture is performed on sites that are too high for *Zostera marina* to grow. *Zostera japonica* is generally controlled as an invasive species.

Comment 36: 9) Page 2-24: Line 17: If shellfish are taken to other areas for "grow-out" this should be considered interdependent and analyzed in this section.

Response: See the response to comment 32.

Comment 37: 10) Page 2-24 line 20: This sentence beginning with "Such facilities…" is unclear.

Response: Because NWP 48 only covers existing shellfish culture operations, it is not necessary for permittees to secure any other federal authorizations in order to perform work under NWP 48. Thus there are not necessarily any interdependent or interrelated actions linked to NWP 48. However, it is foreseeable that some individual NWP 48 permittees shall perform actions, such as dock repair, that are not covered under NWP 48 and that require additional federal authorizations.

Comment 38: 11) Page 2-24, line 28: Have you contacted the Washington State Department of Health? Since they have a database with the location and size of the commercial shellfish companies in Washington it would simply require a download of their database into a GIS. I

suggest you do this and provide us with the information so that we can determine the scale of the action.

Response: We have contacted the Washington Department of Health. They state that they are unable to provide GIS data or any other database information. They will only provide unspecified information regarding shellfish permittees.

Comment 39: 12) Page 2-25, line 16: The double negative makes this sentence very confusing, please clarify.

Response: There are some areas where shellfish culture is allowed by the Washington Department of Health. These are Area 1. There are some areas where shellfish culture, which could be authorized under NWP 48, currently occurs. These are Area 2. Area 2 is entirely within Area 1, but we don't know exactly where it is. There are also areas where shellfish culture is allowed by the Washington Department of Health, but where it does not occur. These areas would not be covered under NWP 48. This is Area 3. Area 1 equals Area 2 plus Area 3. We do not know of any places that are definitely within Area 3.

Comment 40: 13) Page 2-25, Line 20: We expect that the area (total acres) were shellfish growing is allowed to be provided in the BA. At this point we have not seen such information. We need to understand the scope of the action (amount of area under cultivation relative to bull trout critical habitat). The other component of the action area that needs to be considered are any and all grow-out areas.

Response: See the response to comment 3.

Comment 41: 14) Page 3-2, Table 3-1: Please add the Olympic Peninsula DPS for bull trout as shellfish are grown within this DPS and designated critical habitat.

Response: We are not aware of the existence of an Olympic Peninsula DPS for bull trout. Please provide a citation for this listing. There is an Olympic Peninsula Management Unit for the Coastal/Puget Sound bull trout DPS. The BA includes the Coastal/Puget Sound bull trout DPS.

Comment 42: 15) Page 3-37, line 14: Please move the word trout in front of in.

Response: The sentence should read, "Bull trout in Puget Sound undertake rapid directed migrations that may exceed 250 15 kilometers, using nearshore marine shorelines as pathways (Goetz et al. 2003)."

Comment 43: 16) Page 3-37, line 29: Actually, in February 2002 a bull trout was captured by a WDFW technician at river mile 29 in the Willapa River.

Response: The effects analysis has been re-evaluated in recognition that bull trout may occur in Willapa Bay.

Comment 44: 17) Page 3-38, line 4: These are not the correct bull trout critical habitat PCEs that apply to marine near-shore waters. They are 1) water temperatures…2) migratory corridor…. 3) abundant food base…and 4) permanent water quality…(see page 56266 of 70 FR 56212)

Response: The first paragraph on page 3-38 of the BA is here retracted. The proper (marine)

PCEs are as follows (70 FR 56266):

(i) Water temperatures that support bull trout use. Bull trout have been documented in streams with temperatures from 32 to 72 °F (0 to 22 °C) but are found more frequently in temperatures ranging from 36 to 59 °F (2 to 15 °C). These temperature ranges may vary depending on bull trout life history stage and form, geography, elevation, diurnal and seasonal variation, shade, such as that provided by riparian habitat, and local groundwater influence. Stream reaches with temperatures that preclude bull trout use are specifically excluded from designation;

(vi) Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows;

(vii) An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish; and

(viii) Permanent water of sufficient quantity and quality such that normal reproduction, growth, and survival are not inhibited.

Comment 45: 18) Page 4-9, line 3: This sentence beginning with "The organic contaminants…" is incomplete.

Response: The sentence should read, "The organic contaminants polyaromatic hydrocarbons (PAHs), phthalate ester compounds, polychlorinated biphenyls (PCBs), dichloro diphenyl-trichloroethane (DDT) and dibenzofuran were detected in sediments in southern Puget Sound as well."

Comment 46: 19) Page 4-11, Line 3: It doesn't appear that you used WDNRs Shore zone inventory to characterize eel grass. We ask that you use it and create a map with the shellfish farm and an eelgrass layer for the final BA.

Response: We do not have a shellfish farm layer. Thus data do not exist to precisely overlay each farm project area with an existing eelgrass inventory.

Comment 47: 20) Page 5-6, line 21: Are forage fish surveys conducted prior to spreading oyster shell?

Response: No, but shell spreading is not done in areas where surf smelt or sand lance spawn, and activities are deferred if workers observe herring spawn.

Comment 48: 21) Page 5-7, Line 11: What is the source of the contamination?

Response: Chlorine is used to clean equipment and is neutralized prior to discharge. Thus the only contaminants expected to occur are chlorine neutralization residues, present at very low concentrations.

Comment 49: 22) Page 5-8, Lines 14-17: Please provide support (analysis and or citations) for this assertion. How much biomass is consumed by all of the shellfish operations in Washington? What percent relative to the ecosystem productivity is consumed by the shellfish covered under NWP 48? How did you determine that the "…biomass of organisms supported by these operations is too small to represent a measurable fraction of the ecosystem productivity"?

Response: See response to comment 19 for a general discussion of shellfish culture effects on productivity. However, this comment specifically addresses hatchery and nursery operations. The live biomass in a hatchery or nursery is very small; in a hatchery it is a matter of pounds, and in any event hatcheries grow their own food and so place zero demand upon ecosystem productivity. Nurseries have biomass on the order of tens of pounds, two orders of magnitude less than the live biomass loadings on an acre of oyster farm.

Comment 50: 23) Page 5-9, line 8: The Simenstad 1999 paper is not in the literature cited section.

Response: The citation is: Simenstad, C.A., B.J. Nightingale, R.M. Thom and D.K. Schreffler. 1999. Impacts Of Ferry Terminals On Juvenile Salmon Migrating Along Puget Sound Shorlines [sic] Phase I: Synthesis Of State Of Knowledge. Seattle, Washington: Washington State Transportation Center (TRAC). 199pp.

Comment 51: 24) Page 5-9, Line 13: What is your conclusion? Are piscivorous birds going to perch on such structures while foraging for juvenile salmonids or forage fish since "in theory" it could happen?

Response: FLUPSYs are located in water that is too deep for heron foraging, so the principal piscivorous birds in the vicinity of these structures are divers such as diving ducks, alcids and grebes. These predators do not forage from perches, but by actively swimming beneath the water surface. Thus the perching opportunity provided by a FLUPSY is not likely to be utilized by piscivorous birds, and will neither aid nor hinder the foraging behavior of such birds.

Comment 52: 25) Page 5-12, Lines 12-17: There are significant bacteria growing under the mussel rafts cited by APHETI 2006. I assume that mussel rafts are placed in quiescent waters. Correct? Are mussel rafts located in bull trout critical habitat, if so how many? We need to know the amount of nearshore taken up by mussel rafts.

Response: Mussel rafts are not placed in quiescent waters. A steady but slow current is preferable to ensure a steady supply of phytoplankton for the mussels. Mussel rafts in western Washington are sited in waters from 15 feet to 60 feet deep. Bull trout critical habitat includes nearshore waters up to -33 feet MLLW depth (70 FR 56266). The growers estimate that a quarter to a third of western Washington mussel rafts are sited in waters less than 33 feet deep, representing a total of less than 10 rafts covering a total acreage of less than 0.25 acre.

Comment 53: 26) Page 5-12, Line 29 – 30: What is your conclusion?

Response: See response to comment 52.

Comment 54: 27) Page 5-13, Line 2: So your best professional judgment is?

Response: See response to Comment 51 (FWS number 24).

Comment 55: 28) Page 5-15, Line 23: There is no mention of the use of carbaryl to eradicate ghost shrimp from oyster beds. This is an interrelated action which must be evaluated for its direct and indirect effects on listed species.

Response: We anticipate discussing with NMFS and USFWS the appropriate formulation of an analysis of carbaryl use in shellfish aquaculture.

Comment 56: 29) Page 5-16, Line 25: How much is most? Please provide a citation for this phenomenon in Puget Sound. Newell 2005 is cited often yet it isn't in the literature cited section.

Response: The phenomenon has not been studied in Puget Sound. However, one of the BA authors had an opportunity to meet Roger Newell at the shellfish conference and discussed this phenomenon with him. He provided a copy of Newell et al. (2005):

Newell, R.I.E., T.R. Fisher, R.R. Holyoke and J.C. Cornwall. 2005. Influence Of Eastern Oysters On Nitrogen And Phosphorus Regeneration In Chesapeake Bay, USA. Pages 93 - 120. in: The Comparative Roles of Suspension Feeders in Ecosystems. R. Dame and S.Olenin, eds. Vol. 47, NATO Science Series: IV - Earth and Environmental Sciences. Springer, Netherlands.

As for "how much is most," Newell et al. (2005) explain that:

"N and P burial and sediment denitrification … remove N and P from the water column, thereby reducing phytoplankton biomass and primary production. In situations where bivalves are either at very high population densities or living in locations with low water circulation, biodeposition can stimulate microbial metabolism sufficiently to cause the sediments to become anaerobic (Tenore et al. 1982). In such situations, nutrients are regenerated primarily as NH4+ and PO43, with little or no loss due to burial and denitrification."

In the interview described above, when asked how common this situation is, Dr. Newell replied that it has often been seen in experimental situations where the experimental chambers do not contain populations of denitrifying bacteria, and that the situation might be encountered in natural settings with extremely high shellfish biomass loadings.

The shellfish biomass loadings encountered in western Washington are of the same order as the loading created by natural oyster reefs observed in early historical time, so the phenomenon would not be expected in western Washington waters.

Comment 57: 30) Page 5-16, Lines 34 -39: This is perhaps true for the regions where the Olympia oyster was found. However, oyster culture occurs all over the Puget Sound region and so aerobic/anaerobic sediment stratification is likely occurring on a much greater scale. This is one reason why it is critical that we know the scale of the action under consultation.

Response: See response to comment 3 in regard to the spatial scale of the analysis. Nonetheless, the great majority of oyster production in Washington waters is from Willapa Bay, Grays Harbor and south Puget Sound, areas where the Olympia oyster was formerly very abundant.

Comment 58: 31) Page 5-17, line 24: Please see the Puget Sound Nearshore Partnership report on Kelp and Eelgrass in Puget Sound page 3 at the following link: http://pugetsoundnearshore.org/technical_reports.htm

It is highly unlikely that oyster bottom culture provides more species abundance, biomass and diversity than an eelgrass meadow or the same functions.

Response: References supporting the statement are presented in the text, page 5-17. Copies are available upon request. In this connection, a significant new publication has appeared. Wisehart et al. (2007) explore the relationship between shellfish aquaculture and *Zostera marina* seedling establishment. They find high rates of seed production and seedling establishment in dredged oyster beds, with much lower rates for these variables in longline beds. They proposed that eelgrass recovery from oyster harvest disturbance is substantially more rapid in dredged than in longline beds.

Comment 59: 32) Page 5-29, Line 1: Are the growers required to prepare a spill plan? When a spill occurs it must be reported to DOE. Have any spills been reported to DOE; this information will give an indication of the frequency of this event.

Response: The growers are not required to prepare a spill plan. We queried the Southwest Region DOE for spill reports for calendar year 2007. They returned approximately 450 reports, none of which were identified as connected with shellfish. We examined the details in 16 reports for potentially shellfish-related incidents reported in Pacific and Grays Harbor counties, which together produce the majority of Washington's shellfish harvest. One report proved to be shellfish related. It concerned a crane that had fallen off a dock at Nahcotta, Willapa Bay. The incident was immediately reported by Coast Seafoods, who also immediately deployed absorbent booms. The incident is DOE number 530386. The spill included potentially 15-20 gallons of diesel and 20-25 gallons of hydraulic fluid, most of which was successfully pumped off with loss of an estimated 2 gallons. The next day a crane was brought in and the fallen crane recovered.

Comment 60: 33) Page 5-29, Line 12: The growers in Willapa used crushed rock rather than gravel. Is this same substrate that Thom et al., (1994) used in his experiment? Does crushed rock compact differently than gravel forming a relatively impermeable surface?

Response: Thom et al. (1994) performed their study in Puget Sound and did not use the same gravel/rock source. Crushed rock as used at Willapa does not compact; it is used for clam culture and must remain loose so that clams can easily move within it.

Comment 61: 34) Page 5-35, Line 1 on: Is there any grey literature or non-peer reviewed studies available? Since it is plausible that geoducks will compete for prey resources (particularly in sheltered bay and coves and when they are planted in high densities) and dominate as a consumer of the local food web, and then you must assume that juvenile salmonids and forage fish will have less to eat which will lower their growth and survival. This translates into a reduction in prey for bull trout and marbled murrelets and may constitute an adverse effect. I think it would be prudent to alleviate this uncertainty (Line 6) *prior* to the Corp allowing more widespread geoduck culture given the tenuous condition of salmonid and bull trout populations in Puget Sound. It is difficult to see how given the substantial uncertainty how issuance of the NWP#48 would result in

minimal individual adverse environmental effects either separately or cumulatively on the aquatic environment.

Response: The Corps is not proposing to allow more widespread geoduck culture. The proposed action, issuance of NWP 48 , covers only existing aquaculture operations. This action does not entail any increase in geoduck farming beyond the minor changes that may result on a year-to-year basis as areas within an existing lease are cultured or allowed to remain fallow.

Some grey literature does exist, however, addressing the relative differences in carrying capacity likely to exist between different types of aquaculture. All of the following data were provided by Joth Davis (pers. comm..):

Geoducks at harvest represent a biomass loading of 35,000 clams per acre, or 60,000 pounds per acre of living biomass. It takes an average of 5 years for the clams to attain harvest size, so net primary productivity is 60,000/5 = 12,000 pounds per acre per year. In contrast, longline oysters have a net primary productivity of 72,000 pounds per acre per year (six times as much as geoducks), bottom cultured oysters have a net primary productivity of 36,000 pounds per acre per year (three times as much as geoducks), and manila clams have a net primary productivity of 50,000 pounds per acre per year (four times as much as geoducks). With regard to feeding behavior, geoducks filter about 1 million gallons per acre per day, bottom culture oysters filter about 5.3 million gallons per acre per day, and longline oysters filter about 26 million gallons per acre per day. With regard to production of feces and pseudofeces, geoducks produce about 39 pounds per acre per day, bottom culture oysters produce about 95 pounds per acre per day, and longline oysters produce about 473 pounds per acre per day. According to all of these metrics, oyster culture interacts with the surrounding biological environment at a rate at least several times higher than geoducks; yet, as described in previous comment responses, oysters have not been shown to measurably deplete phytoplankton and thus to not impair marine food webs. Therefore it is not plausible that geoducks have these effects, either.

Comment 62: 35) Page 5-36, Line 19: According to the Conservation measure on page 6-1 "Activities in spawning area (e.g., for age fish spawning areas) during spawning seasons must be avoided to the maximum extent possible". So how is it that eggs of herring, sand lance and surf smelt will be trampled during geoduck harvest if this conservation measure is being enforced?

Response: USACE policy directs that conservation measure enforcement is the responsibility of the Services. We look forward to further discussion of this matter with NMFS and USFWS.

Comment 63: 36) Page 5-36, Line 30: Many of the photographs I've seen show lots of activity along the beach therefore these eggs could be trampled as well.

Response: The growers have stated that they do not conduct activities at the elevations used by surf smelt and sand lance for spawning. We have not located any review of this issue in the literature, however.

Comment 64: 37) Page 5-36, Line 26: According to the WDFW Website: http://wdfw.wa.gov/fish/forage/smelt.htm#sbiology

"Spawning occurs in the summer months on beaches along Washington's coast and the Strait of Juan de Fuca. Many additional suspected spawning areas and possible extensions of the documented spawning seasons await investigation, and previously unreported areas continue to found". Thus, surf smelt spawning could occur when tube placement, seeding and net installation are being done (Line 38) if geoducks are grown in these areas.

Response: See response to comment 63.

Comment 65: 38) Page 5-37, Line 12: Therefore, predator exclusion netting is a potential hazard to marbled murrelets as well as bald eagles.

Response: It would be exceedingly unusual behavior for a marbled murrelet to be walking through a geoduck farm. No episodes of injury to marbled murrelets have been reported in association with use of shellfish predator netting. Mortality by this mechanism would appear to be discountable.

Comment 66: 39) Page 5-38, Line 15: The harvest of geoducks does not invasively disturb sediments?

Response: Page 5.38, line 15, is part of Section 5.1.6, Support Activities. The effects of geoduck harvest are discussed in Section 5.1.5, Geoduck Culture.

Comment 67: 40) Page 6-1, Line 8: There is no discussion herein regarding the overlap between forage fish spawning areas and shellfish aquaculture. Where does this overlap exist? At a minimum you should overlay the approved and conditional shellfish growing areas (available from the DOH website) with the location of spawning and holding areas for all forage fish species, this includes eelgrass beds. We expect an analysis of the indirect effects to the prey base of forage fish (epibenthic invertebrates and zooplankton) and bull trout forage fish and juvenile salmonids. If conservation measure number 2 (spawning areas) is to be enforced there should be no shellfish aquaculture allowed in forage fish spawning areas. According to Pentilla (2007) "Standard aquaculture practices may have profound effects of the benthic ecology of Washington State's tidelands and the conservation of forage fish spawning areas, especially for herring. In many areas, herring spawning grounds are coincident with shellfish culture areas, particularly on tideflats occupied by beds of the native eelgrass". I suggest you review Pentilla (2007) and conduct an analysis on the effects of shellfish aquaculture on forage fish. Please see the Puget Sound Nearshore Partnership report on Marine Forage Fishes on Puget Sound. Kelp and Eelgrass in Puget Sound at the following link: http://pugetsoundnearshore.org/technical_reports.htm

Response: Forage fish spawning and shellfish aquaculture are discussed in the BA, pages 2-23, page 5-36, and page 7-13, in addition to the conservation measure proposed on page 6-1, and are also discussed in the responses to comments 47 and 63. Pentilla's (2007) review does not contribute any substantive information on the effects of shellfish culture on forage fishes.

Comment 68: 41) We are not just concerned about herring but also sand lance and surf smelt who's spawning areas and prey species composition may be affected through modification of the beach substrate for clam and oyster bottom culture; we expect to see an analysis of these effects as well.

Response: See the BA, especially pages 5-36 and 7-13, as well as the responses to comments 47

and 63.

Comment: 42) Page 6-1, Line 15: There is no analysis of the overlap between bull trout critical habitat and shellfish aquaculture activities please include this in the BA. How is the reporting of listed species and critical habitat a conservation measure? What is done with this information and how is implemented to benefit or promote the recovery of listed species?

Response: For the analysis of the overlap between bull trout critical habitat and shellfish aquaculture activities see the BA, page 7-14. The requirement that a pre-construction notification include identification of endangered species and critical habitat ensures that the USACE can determine if a given shellfish operation can be covered under NWP 48, or if a biological assessment is required to evaluate the proposed action's effects on listed species and/or critical habitat.

Comment 69: 43) Section 7.2.1: Are brown pelicans and snowy plovers feeding in areas where carbaryl is used to eradicate ghost shrimp? If not, please demonstrate this with literature citations and if so, then please include an analysis of the effects of this insecticide of birds through the ingestion pathway.

Response: We anticipate discussing with NMFS and USFWS the appropriate formulation of an analysis of carbaryl use in shellfish aquaculture.

Comment 70: 44) Page 7-3 Line 29: Please provide an overlay with the Western Snowy plover, brown pelican and marbled murrelet occurrence data.

Response: See the response to comment 3. The requested information is not currently available at the spatial scale of this analysis.

Comment 71: 45) Page 7-4, Line 13: Do aquaculture activities occur where snowy plovers will be feeding at low tide in the inter-tidal areas?

Response: As stated in the BA, page 7-4, line 18, the culture beds are located at elevations low enough that they are rarely if ever used by snowy plover.

Comment 72: 46) Page 7-4, Line 17: Does clam culture occur in snowy plover critical habitat?

Response: As stated in the BA, page 7-4, line 17, no.

Comment 73: 47) Page 7-4, line 24: Marbled murrelets generally forage in shallow waters within 1.25 miles of shore (Strachan et al. 1995). Traditional feeding areas (nurseries) are used consistently on a daily and yearly basis (Carter and Sealy 1990). Foraging locations include physical processes that concentrate prey. In general, small schooling fish and large pelagic crustaceans are the main prey items thus they tend to forage in eel grass beds. Since eelgrass and oyster culture co-occur it is likely that feeding birds may be disturbed by aquaculture activities and reduction in eelgrass would lead to a reduction in forage fish.

Carter, H.R., and S.G. Sealy. 1990. Daily foraging behavior of marbled murrelets. Studies in Avian Biology 14:93-102.

Strachan, G., M. McAllister, and C.J. Ralph. 1995. Marbled Murrelet Food Habits and Prey Ecology. *In*: C.J. Ralph, G.L. Hunt, M.G. Raphael, and J. F. Piatt (tech. eds.). Ecology and conservation of the marbled murrelet. General Technical Report PSW-GTR-152. Pacific Southwest Experiment Station, U.S. Forest Service, Albany, California. U.S. Dept. of Agriculture. 420 pp.

Response: The BA details at length the interaction between shellfish culture and eelgrass, and the interaction between shellfish culture and fish communities. Since these interactions have not been shown to have a net harmful effect on either eelgrass or fish communities, there is no apparent support for the assertion that adverse impacts occur to forage fish or, by extension, to their predators.

Comment 74: 48) Page 7-5 Line 14: Please evaluate the transport of carbaryl to snowy plover habitat as the insecticide will deplete prey resource should concentrations be elevated. Please provide data for the Washington State Department of Ecology and citations for your conclusions.

Response: We anticipate discussing with NMFS and USFWS the appropriate formulation of an analysis of carbaryl use in shellfish aquaculture.

Comment 75: 49) Page 7-13, Line 19: Rather than referring us to the effects section for salmon and steelhead please prepare a separated effects section for bull trout. Additionally, the effects documents in this section address specific action in isolation. This analysis needs to consider the entire action of permitting all shellfish aquaculture throughout the Puget Sound and the additive effects of all activities on the species. Additionally, "take" under the Act occurs on the individual level.

Response: See the response to comment 8 for discussion of additive effects. The following text replaces Section 7.6.1 in the BA:

Effects on the Species

Bull trout have not been recorded in the action area south of Grays Harbor, including Willapa Bay and the Columbia River estuary (WDFW 2004d). Thus the Columbia River bull trout DPS is not known to occur in the action area and the proposed action will have *no effect* on Columbia River bull trout.

Bull trout have been recorded in all parts of the action area from Grays Harbor north, through the Strait of Juan de Fuca, in Hood Canal, and in much of Puget Sound. These fish are all presumed to represent the Puget Sound/Coastal DPS of bull trout. The proposed action *may affect, but is not likely to adversely affect* Puget Sound/Coastal bull trout.

Bull trout in the action area are adults or subadults. They use the action area in migration, an activity which primarily occurs along the marine nearshore, and for foraging, which primarily addresses prey that includes small fishes such as forage fish and juvenile salmon.

The environmental effects of shellfish culture activities are detailed in Chapter 5 and are summarized in Table 5-1, and below.

Habitat-Forming Processes

All shellfish culture activities have some potential to affect habitat-forming processes, which include sediment distribution and currents. However, none of the culture activities were found to have a demonstrable adverse effect on these processes. Although measurable changes in the baseline indicators may occur, those changes are in no case shown to have a measurably beneficial or a measurably adverse effect on habitat suitability for use by bull trout.

Water Quality

Nearly all shellfish culture activities have some potential to affect water quality. The principal effects are as follows:

Changes in turbidity. These include one beneficial chronic effect and several temporary adverse effects. The beneficial chronic effect is removal of phytoplankton from the water column, which improves water clarity and supports growth of eelgrass. Temporary adverse effects occur in response to bed preparation activities sometimes performed for clam and oyster culture, and during oyster, clam, and geoduck harvest. Most of the adverse effects occur in the course of activity performed during low tide, which minimizes delivery of turbidity to surface waters. Effects from spraying bed material (gravel or crushed shell) occur at high tide, and are minimized by only using washed material. In view of the infrequent and temporary nature of these turbidity-causing activities, and the relatively small zone around the activity in which turbidity is actually observable, it is unlikely that the activities are resulting in harm to any fish that may be in the area.

Changes in nutrient status and dissolved oxygen availability. All shellfish have a dynamic relationship with the water column whereby they consume phytoplankton and excrete nitrogenous wastes, some of which is suspended or dissolved in the water column, where it provides a nutrient source that is rapidly converted into phytoplankton biomass, which is again consumed by the shellfish, completing the cycle. The effect is measurable but does not constitute an adverse effect. Besides this, certain activities (harrowing and harvest of bottom culture oysters, oyster bed leveling, and geoduck harvest) have the potential to re-suspend nitrogenous wastes in the water column, causing a short-term increase in water nutrient concentrations and biochemical oxygen demand (BOD). The BOD increase could theoretically support increased algal or bacterial growth that could cause a reduction in dissolved oxygen, but this effect has not been observed. Thus shellfish culture does not have an adverse effect on water quality variables related to nutrient availability, and does not have the potential to adversely affect bull trout via this pathway.

Contamination from human sources. This could occur if a chemical (the only common ones are gasoline and engine oil) were spilled from equipment used on the shellfish beds, or while in transit to the beds, or at the shoreline support facilities (docks, hatcheries, processing facilities). Shellfish growers strive to avoid any form of water quality impairment due to contaminants, which have an immediate and severe adverse impact on the shellfish crop.

Such events are very rare and, when they occur, are immediately addressed using the best available technologies. Thus the effects of such contamination on bull trout are discountable.

Sediment Quality

Nearly all shellfish culture activities have some potential to affect sediment quality. The most common effects are those on sediment nutrient status. Shellfish excrete feces and pseudofeces, either directly to the sediment (in the case of bottom grown oysters or infaunal clams) or to the water column, where they settle to the sediment (in the case of raft, suspended, bagged, racked, or longline culture). Because this process reflects a net transfer of nutrients from the water column to the sediment, it generally represents a beneficial effect that results in measurably improved water quality. In some settings with extremely high shellfish culture densities, the biodeposition of nutrients has been rapid enough to curtail aerobic decay of the biodeposits within the upper sediment stratum, thereby terminating the denitrification process that represents the primary pathway by which shellfish remove nutrients from the estuary. However, this adverse effect has only been observed in warm water shellfish culture in areas having much higher densities of shellfish than are cultured anywhere in the action area. Therefore the risk of impaired sediment denitrification is minimal in the action area, and this does not represent a plausible pathway of effect on bull trout.

Shellfish growers strive to avoid any form of sediment quality impairment due to contaminants, which have an immediate and severe adverse impact on the shellfish crop. Such events are very rare and, when they occur, are immediately addressed using the best available technologies. Thus the effects of such contamination on bull trout are discountable.

Biological Condition

Most effects of shellfish culture are associated with modification of biological condition. Shellfish are environmental engineers that are capable of modifying almost every aspect of their ecosystem. Those modifications are often beneficial, but some adverse effects may occur during certain culture activities.

Hatchery and nursery operations, and mussel raft culture, have not been found to affect the prey base for juvenile salmonids and forage fishes, which are bull trout prey species. These activities primarily alter phytoplankton availability in the water column over subtidal areas, with effects only observable very close to the actual culture facility. However, all types of intertidal culture do alter the prey base, primarily by altering the benthic environment. The benthic environment in most of the action area consists of an open sandy to muddy bottom, and/or a bottom with sparse to dense eelgrass and macroalgae cover. Shellfish culture creates a variety of new substrates. These include shelly bottoms, oyster-covered bottoms, bottoms covered with anti-predator netting that is colonized by macroalgae, and bottoms covered by geoduck tubes, oyster stakes, or oyster racks that provide a hard substrate where previously there was none. Additionally, oyster culture is often associated with new growth of eelgrass, which seems to occur in response to enrichment of benthic nutrients and/or reduction in currents and erosion on the bottom. The new benthic environments are accompanied by a more diverse benthic microfaunal community, which is

actively exploited as a prey resource for juvenile salmon and forage fish. By increasing the complexity and diversity of benthic habitats, shellfish culture has a beneficial effect on prey resources for juvenile salmon and forage fish. However, certain culture activities have a temporary adverse effect on prey resources. Removal of antipredator netting, harvest of clams, and harrowing and harvest of oyster bottom culture all result in a temporary reduction in the biomass and diversity of benthic infauna and epifauna, as well as temporary loss or reduction in submerged vegetation (macroalgae and eelgrass) and temporary loss of the physical structure represented by oysters on the bottom. All of these impacted resources recover within a period of a few weeks to a few months, so that use of a site for shellfish aquaculture represents an enhancement of habitat structure and diversity for most (75 percent to 95 percent) of a culture cycle, alternating with a reduction of habitat structure and diversity for the remainder of the culture cycle. The net effect, however, is beneficial, tending to maintain bull trout prey resources.

Other Effects

Certain aspects of shellfish culture have the potential to cause a direct adverse effect on bull trout:

Rafts, FLUPSYs, and docks (located at support facilities) constitute overwater structures that may have a suite of impacts on fish such as shading benthic habitat, reducing benthic productivity, interrupting longshore migration movements, and providing a perch for avian predators. Rafts and FLUPSYs are not likely to have a substantial adverse effect via these pathways because they are typically sited away from the shore in relatively deep water (at least 20 feet deep, often over 33 feet deep) that receives little use by bull trout. Docks are more likely to result in these impacts, but NWP 48 does not authorize the construction or maintenance of such docks. Construction or maintenance of docks does require a Department of the Army permit and a separate ESA section 7 consultation. Assuming that such a consultation would require various measures intended to minimize the adverse effects of dock construction, and in view of the typically small size of docks used to support shellfish aquaculture activities as well as the small number of such docks within the action area, the interdependent effects attributable to such docks are unlikely to represent a substantial adverse effect on bull trout.

Harvest and harrowing of bottom cultured oysters entails dragging an apparatus across the bed while it is under water. Additionally, accessing the beds entails operation of motor boats in shallow waters near and over the beds. These activities have the potential to disturb bull trout in the vicinity. No instances of injury or mortality of bull trout have been observed in connection with these activities, but it is reasonable to expect that some fish have had to actively avoid such activities, or have altered their behavior in response to the stimuli provided by these activities. Due to the low intensity of the effect, though, it does not amount to an adverse effect.

It is theoretically possible that shellfish culture could introduce new species that could adversely affect the habitat for bull trout. Although some such pests have been introduced in the past (for instance, the introduction of *Spartina* as a packing material for eastern oysters), the shellfish industry has responded by vigorously regulating all such potential introductions,

using precautions summarized in Chapter 5. In view of these precautions, the risk of future introductions of this kind appears discountable. It is also possible that shellfish culture could provide a suitable habitat for organisms not introduced by the shellfish growers, for instance, organisms introduced in ballast water from ocean-going vessels. However, the potential effects of such introductions cannot be anticipated.

Comment 76: 50) Page 7-13, Line 20: See comment Page 3-37, line 29.

Response: See response to comment 43.

Comment 77: 51) Page 7-13, Line 29 on: This section is poorly written and difficult to understand please re-write it. Also, please refer to all of the general comments.

Response: Please refer to all of the general comment responses.

Comment 78: 52) Page 7-14, Line 22: These are not the marine PCEs for bull trout. See CFR 70 part 17 56266 and prepare an analysis of these PCEs. Please prepare a thorough analysis documented with citations as to why or why not a PCE is adversely affected.

Response:

PCE (i), Water temperature. There are no data documenting alteration of water temperature as a result of shellfish culture. Shellfish culture does sometimes create shade, as when mussel rafts are cited or longlines are placed on an oyster bed, but these structures would tend to reduce solar heating of affected waters, which would not constitute an adverse effect on bull trout PCE (i).

PCE (vi) Migratory corridors with minimal physical, biological, or water quality impediments. There are no data asserting that shellfish culture creates a physical impediment to fish movement. Fish have not been observed trapped by shellfish gear. Shellfish culture also does not create an intermittent barrier because it does not alter flow or water temperature, or place structures that impede fish movement.

PCE (vii) An abundant food base. The potential effects of shellfish culture on food base for bull trout primarily include potential effects on juvenile salmonids and forage fish, as well as effects on food and habitat for those organisms. These effects are detailed at length in Chapter 5 of the BA and in the responses to comments presented above. Those analyses establish that there is no evidence that shellfish culture leads to a reduction in these prey resources, and there is some evidence that the net effect of shellfish culture on marine system productivity is a beneficial one, contributing to increased phytoplankton and resulting enhancement of marine food webs.

PCE (viii) Permanent water of sufficient quantity and quality such that normal reproduction, growth, and survival are not inhibited. Shellfish culture has no effect whatsoever on water quantity. Shellfish culture contributes to high water quality both directly, by transporting nitrogen wastes from the water column into the substrate, and indirectly, in that shellfish farmers require the highest water quality and are active in protecting the health of the waters that they use. In areas such as Willapa Bay and Grays Harbor this has produced a record of consistently high

water quality reaching back for over 100 years.

Comment 79: **Comments under other Statutes**: Page 2-18, line 20: Do ducks get caught in these nets? How else are predators "controlled"?

Response: USACE is addressing the effects of NWP 48 implementation as it pertains to interagency consultation responsibilities identified in Section 7 of the ESA. We anticipate discussing with NMFS and USFWS the appropriate mechanism for addressing compliance with other federal statutes.

Comment 80: 2) Page 5-27, Line 7: Please see the report: Washington State Exotics Expedition 2000: A rapid survey of Exotic Species in the Shallow Waters of Elliott Bay, Totten and Eld Inlets and Willapa Bay Link : http://faculty.washington.edu/cemills/WSX2000.pdf

This report highlights the introduction of exotic species associated with ballast water and aquaculture. You will note that a greater number of exotic species have been introduced in shellfish growing areas than Elliott Bay (location of the Port of Seattle). This will likely continue to occur in the future therefore, please provide an evaluation of the effects from introduction of invasive species.

Response: Cohen et al. (2001) accurately state that "aquaculture activities have **historically** been efficient vectors for moving pests and parasites of shellfish. The shipment and planting of oysters for commercial aquaculture is considered to be a possible mechanism responsible for introducing onto the Pacific Coast 35 of the 40 exotic species collected by the Expedition" (emphasis added). However aquaculture as **currently** practiced in Washington does not entail the introduction of any shellfish stocks from other areas. Such introduction can be performed, subject to receipt of a permit from the Washington Department of Fish and Wildlife, which contains numerous provisions intended to prevent any further exotic species introductions. NWP 48 authorizes shellfish culture as currently practiced, thus the risk of exotic species introduction is small, although not negligible. The effects of introduction of an unknown organism cannot be predicted.

Comment: 3) Page 5-31, Line 1: This there any predator control of non-listed species (e.g., migratory birds)? What interactions are you referring to in Line 11?

Response: See response to Comment 79.

Comment: 4) Page 5-39, Line 24: As mentioned previously the use of carbaryl is an interrelated activity with direct and indirect effects to aquatic organisms and birds and will need to be analyzed in the BA.

Response: We anticipate discussing with NMFS and USFWS the appropriate formulation of an analysis of carbaryl use in shellfish aquaculture.

Comment: 5) Page 7-4, Line 31: According to the information presented in the slideshow (see link: http://www.protectourshoreline.org/slideshow/POS_ShellfishAquacultureConcerns.pdf) There have been 3 documented occurrences of bald eagles trapped in predator exclusion netting. Although bald eagles have been de-listed, they are still protected under the Bald and Golden Eagle protection Act. It is very likely that other birds get caught in anti-predator netting even

though it is not reported (I wouldn't expect these incidents to be reported often). Therefore, anti-predator netting is a hazard for avian species and should be considered such in the effects analysis.

Response: See response to Comment 79.

References

Cohen, A.N., H.D. Berry, C.E. Mills, D. Milne, K. Britton-Simmons, M.J. Wonham, D.L. Secord, J.A. Barkas, B. Bingham, B.E. Bookheim, J.E. Byers, J.W. Chapman, J.R. Cordell, B. Dumbauld, A. Fukuyama, L.H. Harris, A.J. Kohn, K. Li, T.F. Mumford Jr., V. Radashevsky, A.T. Sewell, and K. Welch. 2001. Washington State Exotics Expedition 2000: A Rapid Survey of Exotic Species in the Shallow Waters of Elliott Bay, Totten and Eld Inlets, and Willapa Bay. Olympia, WA: The Nearshore Habitat Program, Washington State Department of Natural Resources. http://faculty.washington.edu/cemills/WSX2000.pdf, accessed 2008.02.01.

Davis, Joth. Shellfish scientist. 2007.11.01 email to Jeff Fisher.

National Marine Fisheries Service (NMFS). 2004. Programmatic Biological and Conference Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Revised Standard Local Operating Procedures for Endangered Species (SLOPES III) to Administer Certain Activities Authorized or Carried Out by the Department of the Army in the State of Oregon and on the North Shore of the Columbia River. NOAA Fisheries No.: 2004/01043. Seattle, WA: NMFS Northwest Region.

Pacific Fisheries Management Council (PFMC). 2005. Amendment 18 (Bycatch Mitigation Program) Amendment 19 (Essential Fish Habitat) to the Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery, http://www.pcouncil.org/groundfish/gffmp/gfa19/A18-19Final.pdf, accessed 2008.02.01.

Palsson, Wayne. Research Scientist, Washington Department of Fish and Wildlife. 2007.09.27 e-mail to Jerry Johannes.

Pietros, J.M. and M.A. Rice. 2003. The impacts of aquacultured oysters, *Crassostrea virginica* (Gmelin, 1791) on water column nitrogen and sedimentation: results of a mesocosm study. *Aquaculture* 220: 407-422.

Poston, T. 2001. Treated Wood Issues Associated with Overwater Structures in Marine and Freshwater Environments. White Paper prepared for Washington Department of Fish and Wildlife. April 5, 2001.

Pacific Shellfish Institute (PSI). 2003. Phytoplankton abundance and seasonal change in response to utilization by a high density mussel culture system, south Puget Sound, Washington. Estuarine Research Federation, 2003.

Wisehart, L.M., B.R. Dumbauld, J.L. Ruesink, and S.D. Hacker. 2007. Importance of eelgrass early life history stages in response to oyster aquaculture disturbance. Marine Ecology Progress Series 344: 71-80.