BY CERTIFIED MAIL

January 21, 2004

Office of Protected Resources
National Marine Fisheries Service
United States Department of Commerce

Center for Biological Diversity	)	Petition to list the Cherry Point
370 Grand Avenue, Suite 5	)	population of Pacific herring,
Oakland, CA. 94610	)	***Clupea pallasi***, as “threatened”
510-663-0616	)	or “endangered” under the
	)	Endangered Species Act,
Northwest Ecosystem Alliance	)	16 U.S.C. § 1531 *et seq*.
1421 Cornwall Avenue, Suite 201	)	(1973 as amended).
Bellingham, WA. 98225	)	
360-671-9950	)	
	)	
Ocean Advocates	)	
3004 NW 93rd St.	)	
Seattle, WA. 98117	)	
206-793-6676	)	
	)	
People for Puget Sound	)	
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Seattle, WA. 98104	)	
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	)	
Public Employees for	)	
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Washington, D.C. 20009	)	
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	)	
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EXECUTIVE SUMMARY

Cherry Point herring (*Clupea pallasi*) were once the largest and most prolific herring population in Washington State, spawning in a broad area from Point Roberts to Bellingham Bay. Over the last three decades, the shoreline used by Cherry Point herring for spawning has decreased by 80 percent. In the same period, Washington Department of Fish and Wildlife report that Cherry Point herring spawning biomass plummeted steadily from about 15,000 short tons in 1973 to about 1,600 tons this year – a 90 percent decline – and show no signs of recovery.

Cherry Point herring are a "Distinct Population Segment" under the Endangered Species Act. The best available evidence indicates that Cherry Point herring are distinct and markedly separated from other Pacific herring by physical, physiological, ecological, and behavioral factors. Cherry Point herring persist in a ecological setting that is unique and unusual for Pacific herring, differ from other Pacific herring in genetic characteristics, and are significant to the health and function of Puget Sound.

Petitioners believe that the Cherry Point herring now face a very high risk of extinction in the near future. The best available scientific evidence indicates a dramatic reduction in population size and distribution, significant reduction in spawning area, a small and shrinking effective population, decreased hatching success and viability, population isolation, poor recovery potential, loss and degradation of habitat, and the continued existence of numerous significant threats to Cherry Point herring and its habitat.

Cherry Point herring are classified as "candidate" for state listing, a "critical" stock, and a "species of concern" by the Washington Department of Fish and Wildlife, and "vulnerable" by the World Conservation Union. Its habitat is subject to several management plans and other agency actions, including a State Aquatic Reserve, pollution discharge permits, and aquatic lease reviews. Despite these classifications and agency actions, Cherry Point herring continue to face considerable obstacles to survival. Existing regulatory mechanisms have failed to protect the Cherry Point herring, do not ensure its survival and recovery, and will not protect it from harm.

Because of these and other factors, petitioners recommend that Cherry Point herring be listed by the National Marine Fisheries Service as a "threatened" or "endangered" Distinct Population Segment under the Endangered Species Act. The listing of the Cherry Point herring under the Endangered Species Act will serve to reduce the loss and degradation of habitat, produce new conservation measures, and contribute to the restoration and protection Cherry Point herring and its habitat that is critical to health and function of the Puget Sound ecosystem.

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I. NOTICE OF PETITION

The Center for Biological Diversity, Northwest Ecosystem Alliance, Ocean Advocates, People for Puget Sound, Public Employees for Environmental Responsibility, Sam Wright, and Friends of the San Juans ("Petitioners") hereby petition the United States Department of Commerce to list the Cherry Point Pacific herring (*Clupea pallasi*) Distinct Population Segment ("DPS") as a "threatened" or "endangered" species pursuant to the Endangered Species Act ("ESA"), 16 U.S.C. §§ 1531-1544. Because the Cherry Point herring is endangered or threatened through all or a significant portion of its range, petitioners also request that National Marine Fisheries Service ("NMFS") concurrently designate critical habitat for the DPS pursuant to the timelines specified in the Act.

This petition is filed pursuant to 5 U.S.C. § 553(e), 16 U.S.C. § 1533(b)(3), and 50 C.F.R. § 424.14. This petition sets in motion a specific administrative process as established by the ESA and implementing regulations, placing mandatory response requirements on National Marine Fisheries Service. See 50 C.F.R. § 424.14(b). NMFS has jurisdiction over this petition. See Memorandum of Understanding between the U.S. Fish and Wildlife Service ("FWS") and NMFS regarding jurisdictional responsibilities and listing procedures under the Endangered Species Act of 1973 (August 28, 1974).

In November 2000, responding to a petition from Sam Wright to list 18 species of Puget Sound marine fishes (Wright 1999), NMFS determined that the Cherry Point herring are part of a larger Georgia Basin DPS that does not warrant listing (66 FR 17659). This petition presents evidence that Cherry Point herring are a distinct population, including significant new genetic information that was not available when NMFS made its previous determinations about the classification of Cherry Point herring. For these reasons, NMFS must make a 90 day finding that listing of the Cherry Point DPS "may be warranted" and conduct a status review of this DPS within the timeframes mandated by the Act.

II. PETITIONERS

The Center for Biological Diversity ("CBD") is a nonprofit environmental organization dedicated to protecting endangered species and wild places of North America and the Pacific through science, policy, education, and environmental law. CBD submits this petition on its own behalf and on behalf of its members and staff with an interest in protecting the Cherry Point herring and its habitat.

Northwest Ecosystem Alliance ("NWEA") was established in 1988 and is a non-profit public interest organization incorporated in the State of Washington. NWEA and its 8,500 members are dedicated to the protection and restoration of biological diversity. NWEA conducts research and advocacy to promote the conservation of sensitive and endangered wildlife and their habitat in the northern Pacific region.

Ocean Advocates ("OA") is dedicated to the protection of the oceans for the people and wildlife that depend on them for life, livelihood and enjoyment. Over the past five years, Ocean Advocates has established a strong reputation in the Pacific Northwest for protecting marine and coastal resources along the Olympic Coast National Marine Sanctuary, the San Juan Islands and the Strait of Juan de Fuca from the threat of oil spills.

People For Puget Sound ("PFPS") is a nonprofit citizens' group dedicated to educating and involving people in protecting and restoring the land and waters of Puget Sound and the Northwest Straits. They work to eliminate contamination of our waters, halt the destruction of natural habitats, and sustain the Sound and Straits as a healthy source of peoples' livelihood, enjoyment, and renewal.

Public Employees for Environmental Responsibility ("PEER") is a national nonprofit corporation based in Washington, D.C. with chapters throughout the United States, including Washington State. PEER works to hold federal, state, and local governments accountable to enforce their statutory environmental mandates and to practice scientific integrity in their actions.

Sam Wright is recognized as a Certified Fisheries Professional by the American Fisheries Society. He has 42 years of experience managing fish populations and fish habitat.

Friends of the San Juans is a non-profit membership organization founded in 1979 to protect the San Juan islands. Using science, policy, law, education, and citizen activism, Friends of the San Juans has numerous projects that work to protect, preserve and restore the land, water, and sea of the San Juan archipelago.

III. TAXONOMY

Cuvier and Valenciennes (1847) first described Pacific herring as *Clupea harengus pallasi*. Since that time, taxonomists revised herring taxonomy and identified Pacific herring as a distinct species rather than a sub-species of herring. Based on the findings of Grant (1986), the American Fisheries Society changed their convention and begin referring to them as species. According to Grant's (1986) molecular-clock hypothesis, the ancestors of the Pacific herring entered the Pacific Ocean in the mid-Pliocene, shortly after the Bering Strait opened. The currently recognized nomenclature is *Clupea harengus* Linne (1758) for Atlantic herring and *Clupea pallasi* Valenciennes (Cuvier and Valenciennes 1847) for Pacific herring.

Common name	Pacific herring
Phylum	Chordata
Class	Osteichthyes
Order	Clupeiformes
Family	Clupeidae
Genus	*Clupea*
Species	*pallasi*

IV. SPECIES DESCRIPTION

Pacific herring have a bluish green dorsal side with a silvery ventral surface. Guanine crystals in their skin create the silvery layer that reflects light and provides camouflage. Pacific herring are easily identified by their silvery color, and lack spots, adipose fin, teeth, and head scales or striae (Lassuy 1989; Brown and Carls 1998). The herring's slender, elongate body has large cycloid scales. Adults are generally about 8 inches long but can grow as large as 18 inches. Pacific herring have compressed heads with a mouth directed upward and a lower jaw that extends to a point below the eye.

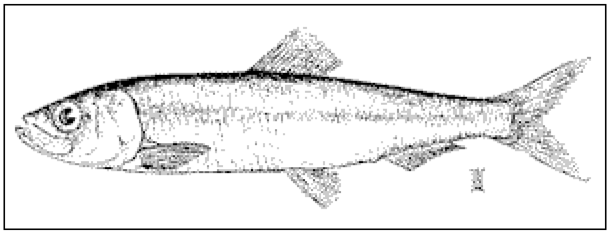

Figure 1. Pacific herring

V. GEOGRAPHIC DISTRIBUTION

In the eastern Pacific, herring occur from Baja, Mexico, north to the Beaufort Sea (Hart 1973). In the western Pacific, herring occur from the Yellow Sea (Tang Qiseng 1980) to the east Siberian Sea (Svetovidov 1952). The stock structure within this broad range is not clearly understood. Grant (1979) distinguished herring in the northwestern Pacific and the Bering Sea from herring in the northeastern Pacific. Many stocks have been identified within the eastern Pacific range (Grosse and Hay 1988). In British Columbia, Canada, herring are currently managed on the basis of five discrete stocks (Schweigert 2000). In Washington State, 18 individual stocks are recognized (Bargmann 1998).

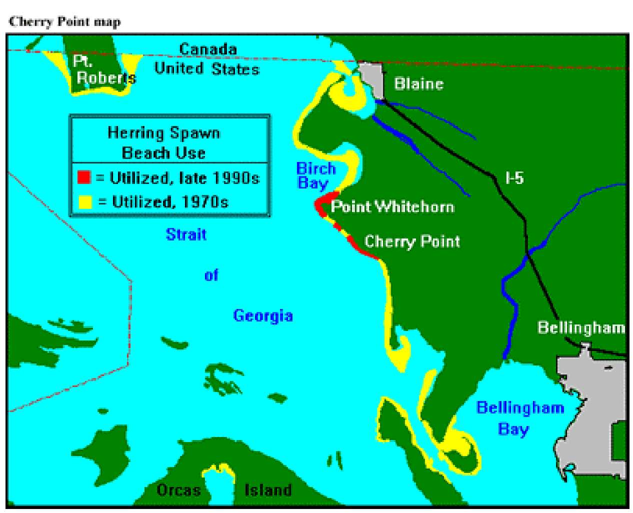

Figure 2. Cherry Point herring spawning area decline (Bargmann 2001).

Cherry Point herring inhabit the coastal waters of the Strait of Georgia. The herring congregate in an area somewhat off shore and move into the subtidal area near Cherry

Point reach to spawn. Although Cherry Point itself is not a large promontory, it affects many physical-chemical parameters in the surrounding waters. Cherry Point may affect herring by influencing water flow, temperature, food supply, and perhaps even the dispersion and retention of larvae and chemicals (Salazar and Salazar 2002).

Historically, Cherry Point herring spawned from Bellingham Bay and much of Lummi Island to the Canadian border around Point Roberts. Since the 1990s, its range has collapsed significantly and now spawning only occurs in a limited area north from Cherry Point to the southern portion of Birch Bay (Figure 2), a distance of only 8.5-km (Markiewicz et al. 2001). From the 1970s to the 1990s, the shoreline used for spawning has decreased by 80 percent (Markiewicz et al. 2001). Cherry Point herring rarely spawn south of the ARCO/BP pier.

VI. HABITAT

The nearshore and inter-tidal zone is crucial habitat for Pacific herring. Cherry Point herring spawn on diverse eelgrass and rocky bottom turf-algae beds (O'Toole et al. 2000). Herring spawn is deposited on eelgrass and more than 25 species of rock-dwelling marine algae that occur between about +3 feet Mean Lower Low Water to the lower limit of algal growth at around -10 feet (Penttila 1994). Spawn is most frequently found on *Zostera marina* (native eelgrass), *Gracilaria*, *Laminaria*, *Sargassum*, and *Botryoglossum* (Penttila, pers. comm.). Stick (1995) found 47 percent of Cherry Point herring spawned on *Desmarestia* although *Desmarestia* was only found in 30.4 percent of areas sampled, showing it to be highly preferred vegetation.

Unlike other Pacific herring populations, the Cherry Point herring spawn in open, high-energy shoreline areas (O'Toole e al. 2000). Two weeks prior to spawning adult herring reside in offshore holding areas between Birch Bay and Sandy Point, such as Alden Bank (EVS 1999).

There are two rivers that significantly influence Cherry Point herring habitat. To the south, the Nooksack River empties into Bellingham Bay and to the north is the Fraser River. Prior to settlement, the Nooksack flowed into Lummi Bay (on the south side of Cherry Point) feeding a large estuary in the Strait of Georgia. The fine sediments from the Fraser and Nooksack Rivers, along with the erosion of coastal sandy bluffs, created the rich subtidal sediments along Cherry Point that were conducive to the growth of the marine plants where herring lay their eggs. With the Nooksack redirected into Bellingham Bay, the Fraser River is now the primary natural source of freshwater influencing Cherry Point herring. It contributes approximately 70 percent of the fresh water to Georgia Strait (Thompson 1994).

At present, the only connection the Nooksack River has with the Gulf of Georgia is via a series of diversions of industrial out fall pipes discharging at depth from a municipal sewer, an aluminum smelter, and two oil refineries.

VII. NATURAL HISTORY

A) Physiology

Herring have a number of special adaptations that increase its ability to colonize different environments, avoid predators and locate food (Blaxter 1985). Herring are very tolerant of salinity far below the osmotic pressure of its body fluids. This tolerance appears to be a sign of efficient osmoregulation thereby allowing it to survive in a wide variety of environments and spawning grounds (Blaxter 1985). Studies of herring otoliths suggest that as young Cherry Point herring occur in freshwater influenced areas where saline levels are lower than those encountered by other Pacific herring (Gao 2002).

The highly reflective nature of the herring's silvery-sides is a subtle adaptation for camouflage. This makes them more inconspicuous to predators, but also makes it more difficult for them to use vision to stay in their schools (Blaxter 1985). Herring have a specialized retina providing additional acuity in the upper-fore direction, that is the orientation in which they approach prey (Blaxter 1985).

A complex nervous system in the herring allows for rapid vertical movements. With a burst swimming speed of 5-7 body lengths per second, herring are extremely fast swimmers (Brown and Carls 1998). It is generally recognized that the herring swim bladder plays a minor role in buoyancy and that its major function is as an acoustic reservoir, which undoubtedly serves in their predator avoidance (Blaxter 1985).

B) Reproduction and Development

Cherry Point herring spawn at a completely different time than other herring populations in Puget Sound. This timing does not correspond to any sort of latitudinal gradient. The peak spawn for all other Washington State herring is from middle to late January until the first week of April. In contrast, Cherry Point herring spawn from mid-March until early June, with peak spawning occurring in mid-May (Figure 3), not following any sort of clinal trend in run timing (O'Toole et al. 2000).

Herring spawn in shallow intertidal areas by depositing eggs on vegetation such as *Zostera* (eel grass), brown and red algae (Haegele and Schweigert 1985) or other substrates such as pebbles, depending on the site. Herring eggs are adhesive and stick to the substrate until they hatch (Bargmann 2001). Despite continuing population declines, spawn deposition intensity and frequency in the Cherry Point area has been maintained, and spawn surveys encounter 'medium' or 'heavy' spawn deposits more commonly in the Cherry Point area than anywhere else in Puget Sound (Penttila 1994).

During spawning season, waves of spawning occur with each lasting a couple of days. According to Stacey and Hourston (1982), the presence of milt in the water column triggers a rapid response in females to spawn. Herring sperm are immotile and are viable for days. The sperm are activated by a protein in the eggs that trigger swimming activity. The eggs generally hatch after 10 to 12 days (Bargmann 2001). Pacific herring larvae usually hatch with a yolk-sac, and then depend on it during the early stages of life (Lassuy 1989). The Cherry Point larvae, born later than all other stocks, have a smaller yolk sac and therefore less time than earlier spawners before they need to find a reliable source of zooplankton (Marshall 2002).

The Cherry Point herring spawn in relatively open areas with high-energy water flows. This open environment makes them more vulnerable to disturbance from storms, large ship wakes, and other events such as oil spills. The spawning season is a vulnerable time for mass spawning species such as herring. The adults expend large amounts of energy in gamete production that needs to be replaced quickly by consuming readily available prey.

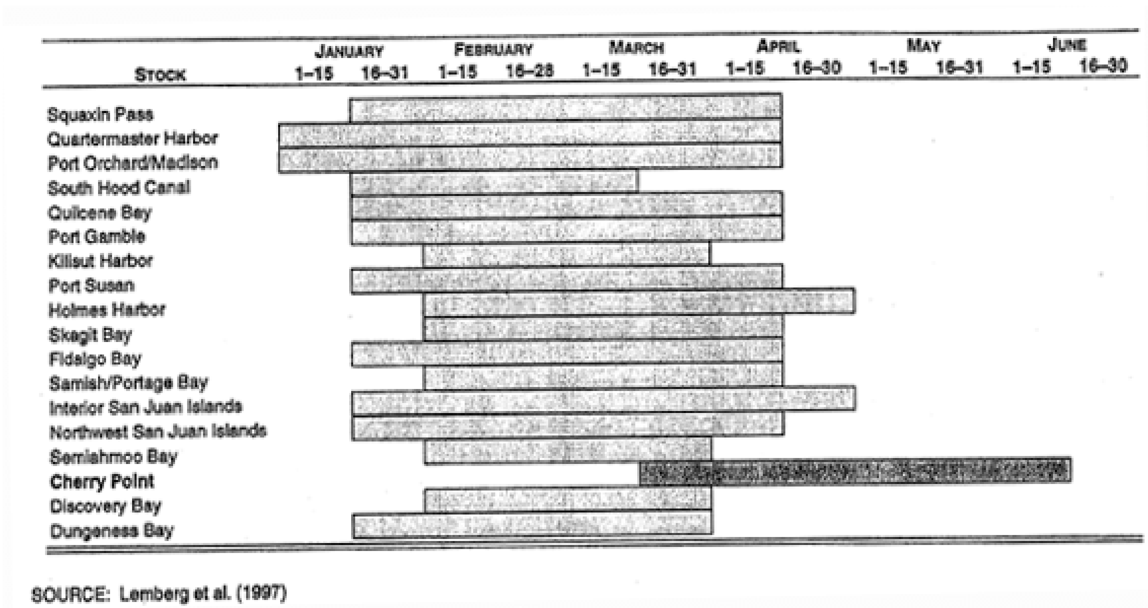

Figure 3. Run timing of Washington State herring stocks (Lemberg et al. 1997).

Herring larvae are planktonic and are subject to local currents. Larvae metamorphose approximately 2 to 3 months after hatching (Lassuy 1989). Juveniles remain inshore and close to the spawning ground during their development.

Movements of maturing herring are not well studied. They may move offshore after several months to complete maturation (Stocker and Kronlund 1998) or remain inshore until their first spawn (Hay 1985). Herring reach sexual maturity in two to four years and return to their natal ground to spawn. Herring may spawn annually for several years (Bargmann 2001) and fecundity increases with body weight (Stout et al. 2001).

There is little information regarding the life history of Cherry Point herring outside of spawning locations. Based on very few tag recoveries from fisheries off Swiftsure Bank, Taylor (1973) suggested that Washington State and British Columbia herring migrate offshore to feed. EVS (1999) speculated that, because of its rapid growth, the Cherry Point herring must migrate. However, the late spawning time makes it less probable that Cherry Point herring migrate offshore when there is ample supply of large and lipid rich copepods (*Neocalanus plumchrus*) available in the Frazier River area from April to June (Marshall 2002).

Some recent studies suggest that the Cherry Point herring population is a year-round resident of this region. Studies of Cherry Point herring otoliths found indications of a greater degree of freshwater exposure than with other Puget Sound herring, suggesting that the Cherry Point herring may live much of their lives in the vicinity of rivers (Gao et al. 2001). Haegle and Schweigert (1985) state that very early and very late spawning in an area is a trait usually attributable to resident populations.

C) Trophic Interactions

Herring larvae and juveniles are plankton feeders. As adults they may eat planktonic organisms, and also small fishes, including euchalon, sand lance, rockfish, and even other herring (Hart 1973).

Each herring life stage is important in the trophic web. Herring eggs and larvae are eaten by plankton feeders, including juvenile salmon, adult herring, invertebrates and birds (Bayer 1980, Hart 1973, Hourston and Haegele 1980). When adult herring are inshore for spawning, they are preyed upon by a variety of predators: salmon, orcas, seals, sea lions, dogfish, and birds (Hourston and Haegele 1980, Nyswander and Evenson 1998, Calambokidis et al. 1997, Walker et al. 1998).

Out-migrating Nooksack chinook smolts appears to have evolved to coincide with the presence of Cherry Point herring larvae (Conrad and MacKay 2000). Similarly, the unique Cherry Point herring spawning period appears to be exploited by seabird populations such as the surf scoter, whose population decline mirrors that of the Cherry Point herring (Nyswander and Evenson 1998).

The tremendous historic biomass of the Cherry Point herring has likely contributed to the year round residency of harbor porpoise in the Southern Strait of Georgia/Boundary Pass region (Hanson et al. 1999). The herring's historic stability is also likely to have contributed to the genetic discreteness observed in the harbor porpoise population (Chivers et al. 2002) that relies heavily on herring for prey (Walker et al. 1998). In addition, there used to be a stable population of Minke whales in the northern reaches of San Juan Channel (Hoelzel et al. 1989) may be coincidental to the decline of the Cherry Point herring (Felleman, pers. obs.).

Herring play a critical role in the life histories of many species in the Puget Sound region as evidenced by the significant portion of herring in the diet of many species, including: Pacific cod (42%), lingcod (71%), halibut (53%), chinook salmon (62%), and harbor seals (32%) (Environment Canada 1998). As a primary food source, Cherry Point herring, historically so abundant, is vital to sustaining a Puget Sound ecosystem.

D) Growth and Age Distribution

While newly hatched Cherry Point herring are smaller than those of other stocks in Washington State, they grow faster. The average length per age class for Cherry Point herring is the largest in the state, especially for the older age classes (Lemberg et al. 1997). For example, in the 5-year age class, the Cherry Point herring average length-at-age was 224 mm. Other herring stocks averaged 199 mm (Port Gamble) and 197 mm (Discovery Bay). Their small size at hatching and large size at adults suggests that Cherry Point herring have historically had access to a rich food source. Warm water years increase growth rates, increasing the demand on food availability (Lemberg et al. 1997).

The older age classes of Cherry Point herring are diminishing (Stout et al. 2001). Historically herring of age class 6 or 7 were quite common, with millions of the herring recorded each year. However, since 1995, herring of age class 7 are not found at all, and age class 6 are rare. Most of the Cherry Point herring are, at most, one or two years old (Stout et al. 2001). The loss of older age classes has been speculatively suggested to be a result of predation (West 1997), but the sublethal impacts of chemical contaminants and disturbance on fitness and survival have not been fully evaluated.

The loss of older age classes could also be the result of changes in food supply for post spawn adults, which feed voraciously to rebuild energy supplies that have been depleted by spawning activities. A lack of prey available to post-spawn herring could help to account for the decline of older adults and the fairly level population of first time 2-year-old spawners (Marshall 2002).

VIII. CURRENT STATUS

A) Classification

The Cherry Point herring is a state candidate and a species of concern in Washington. State candidate species include fish and wildlife species that Washington Department of Fish and Wildlife will review if sufficient evidence suggests that its status may meet the listing criteria for endangered, threatened, or sensitive species. Species of concern include those species Washington State has listed as endangered, threatened, sensitive, or candidate, and species listed or proposed for listing by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service.

The Washington Department of Fish and Wildlife classified the Cherry Point stock as “critical” in 2000. A critical stock is defined as having “abundance low enough that permanent damage to population is likely or has already occurred” (Stout et al. 2001). It is also classified a “vulnerable” by the World Conservation Union (IUCN) (Stout et al. 2001).

B) Current Population Status and Trends

Puget Sound herring stocks are classified according to spawning location, and Cherry Point herring are a geographically distinct spawning stock (Bargmann, pers. comm., 2002a). Cherry Point herring populations have dropped dramatically over the last three decades. In 1973, the spawning biomass was estimated at 14,998 short tons. The spawning biomass dropped as low as about 800 tons in 2000; a 94 percent decline (WDNR 2002).

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Cherry Point	4009	4894	6324	4105	3095	1574	1322	1266	808	1241	1330

Table 1. Spawning biomass estimates (short tons), 1992-2002. (Jagielo, T. ed. 2002)

The escapement goal for the Cherry Point spawners – the number of spawners that are necessary for the population to replace itself and sustain a harvest – is set at 3,200 tons by WDFW. The Cherry Point herring have not reached this goal since 1996 (Table 1).

The population has increased slightly over the past two years, possibly in response to the increased ocean productivity associated with the Pacific Decadal Oscillation (PDO). WDFW estimates that 1611 tons of spawners returned in 2003 (Bargmann, pers. comm., 2003).

In the 1970s Cherry Point spawning biomass was the highest in the state. The herring biomass has decreased significantly since the 1970s (Figure 4) corresponding with the opening of the State's largest oil refinery, ARCO/BP, at Cherry Point in 1972. During the first year of operation the refinery reported spilling at least 20,000 gallons of crude oil during the spawning season (EVS 1999). From the period of 1976-1979, the annual spawning biomass for Cherry Point herring averaged 10,973 tons. From 1996-1999, the average annual biomass was only 1919 tons. In twenty years, Cherry Point herring spawning biomass decreased by 83 percent (Bargmann, pers. comm. 2002b).

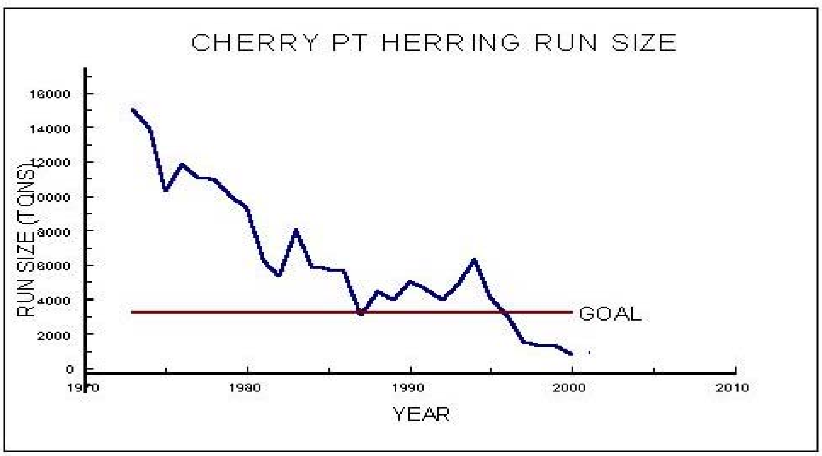

Figure 4. 1973-2000 Cherry Point herring run size (Bargmann 2001).

C) Age Compression

Compression in age intensifies the effects of a declining population, and there is a trend toward compression of the age structure for the Cherry Point herring. The older age classes are disappearing. In the 1970s, it was common to find 2 to 7 year old fish and some as old as 9 to 14 years. Since 1996, it has become extremely rare to find fish older than four. Most of the fish found spawning recently were only one or two years old (Stout et al. 2001, Bargmann 2001, Landis 2002).

More mature spawners are more productive and have the strongest reproduction cycles during years 5 and 6 (Stout et al. 2001). Young spawners are less successful at reproduction, so more individuals in the younger age class means lower reproduction rates than populations with a greater number of older individuals (Stout et al. 2001).

D) Recruitment

Recruitment of Cherry Point herring – the numbers of herring that are joining the spawning population – has been well below average for over four years (Bargmann 2001). Normally recruitment fluctuates, averaging around 2000 tons, but recently it has been hovering around 1000 tons. In 2002, 1330 tons of herring spawned at Cherry Point and WDFW estimates 1611 tons spawned in 2003 (Bargmann, pers. comm., 2003). The 2002 two-year olds came from the smallest run ever (800 tons), so recruitment was quite effective (Table 1). However, if a "recruitment class failure" occurs, the Cherry Point herring will decline precipitously (WDNR 2002).

Population modeling indicates that the current population of young fish cannot be self-sustaining without survivorship of fish age four and older (Landis et al. 2001). Studies that estimated the number of 3-year-old fish in the Cherry Point population over time indicate that recruitment of 3-year-old fish between 1971 and 1976 was much higher than in later years (Landis et al. 2001).

Reduced recruitment and non-fishery related losses of older fish are a key component to the decline of the Cherry Point population (NMFS 2001). The current predominance of two and three year old herring recruiting to the Cherry Point herring is a potential factor affecting fecundity, resulting in offspring that are smaller in number, size, normal development pattern, and fitness. Recent surveys of spawning biomass by WDFW report low egg concentrations.

E) Mortality and Survival

In the 1970s, between 70 to 80 percent of Cherry Point herring would survive from one year to the next. In the 1990s, this dropped significantly to only about 20 to 30 percent survival (Bargmann 2001). University of Washington studies of developing eggs and larvae show that weight at hatching for Cherry Point herring larvae are smaller than at other Puget Sound herring populations and smaller in comparison to past years for Cherry Point (Kocan 1998). In addition, the rate of abnormal development of larvae is higher at Cherry Point and embryos have a lower hatching success (Bargmann 2001).

F) Depensation

Any fish population is limited to some level of abundance by available resources. As abundance increases, the population growth rate will decrease due to reduced individual growth rates, reduced fecundity, or other mechanisms. This phenomenon is a form of density-dependent population growth regulation. There is some evidence of moderate density-dependence growth regulation in Pacific herring (Stocker et al. 1985; Wespestad and Fried 1983). Individual growth rates and age-at-maturity in Strait of Georgia herring can be explained partly by juvenile abundance, indicating at least some density-dependent growth (Haist and Stocker 1985). Still, the lack of strong density-dependence leads to high natural variability in recruitment, because production is also highly dependent on factors other than stock biomass.

In addition to mechanisms of compensation, it should be noted that the opposite phenomenon of depensation (e.g., increasing mortality rates at lower abundance) might also occur in herring populations. Stocker et al. (1985) found depensatory natural mortality in the Strait of Georgia herring, which can be explained by assuming higher predation rates on smaller school sizes, while Haegele and Schweigert (1985) hypothesized that depensatory egg predation by birds is also likely, because the proportion of total egg deposition taken by birds will be higher in years when there are fewer eggs. Fishing mortality is also depensatory because of the schooling behavior of herring. Depensation mechanisms are a concern because they can exacerbate population declines (Hilborn and Walters 1992; Wright 2002).

IX. THREATS AND CAUSES OF DECLINE

The Cherry Point herring population has significantly declined over the last century and their distribution along Washington's northwest coast has contracted to a fraction of its historic range (Bargmann 2001, WDNR 2002). Major sources of organic and inorganic material that maintained and improved spawning habitat have been diverted or altered. Large and polluting industries have been developed and operate upon herring spawning grounds, and other potentially harmful projects are moving forward. Spawning and other life supporting activities are routinely disrupted by extensive vessel traffic and facility operations. Cherry Point herring and their habitat have been altered to the extent that neither species nor habitat can be considered secure.

A multitude of threats currently exist, but the most critical is the continued reduction and degradation of Cherry Point herring habitat by industrial development and pollution (Boettner 2001). Additional threats associated with ballast water, biocides, disease, predation, and ocean conditions exacerbate the ongoing loss and fragmentation of habitat and other direct impacts to Cherry Point herring.

Petitioners request that the Department of Interior list the Cherry Point herring as a "threatened" or "endangered" species pursuant to the Endangered Species Act. Reasons for listing the petitioned species include:

1. Present and threatened destruction, modification, or curtailment of habitat or range;
2. Over-utilization for commercial, recreational, scientific, or educational purposes;
3. Inadequacy of existing regulatory mechanisms;
4. Disease or predation;
5. Other natural or man-made factors affecting its continued existence.

A. Present and Threatened Destruction, Modification, or Curtailment of Habitat or Range

Industrial Activity

There is significant industrial development and operations within a six mile stretch of Cherry Point herring spawning grounds, including the ARCO/BP and Conoco-Philips oil refineries and an Alcoa aluminum smelter (Figure 5). Industrial activities directly, indirectly, and cumulatively harm Cherry Point herring and their habitat through dock construction and operation, outfall discharge, vessel traffic, accidental spills of oil and other poisons, and foreign disease and species from ballast water discharge.

Figure 5. Industrial development in the vicinity of Cherry Point.
Intalco is now Alcoa and Tosco is now Conoco-Philips.

<u>Dock construction and operation</u>

Dock construction alters and diverts long-shore flow, disturbs the sea floor, and shades eelgrass beds. Substantial near shore filling during construction of the Conoco-Philips and Alcoa Piers extended well beyond the extreme low tide mark. This fill disrupts littoral drift of sediment, significantly affecting eelgrass beds along the beach below the drift sector (i.e. extending down to Sandy Point spit). Dredging around the docks disrupts bottom habitat, as does propeller scour from vessel traffic.

One modeling study suggested that the physical presence of the Alcoa and Conoco-Philips Piers could also influence water flow and cause higher concentrations of toxic Polycyclic Aromatic Hydrocarbons ("PAHs") and higher temperatures (ENSR 2001). Herring spawning behavior is adversely affected by changes in temperature.

Dock operations cause noise, light and wave energy disturbances. Shadows cast during the daytime can be a problem to migrating juvenile salmon and forage fish migrating within the near shore areas. Artificial lighting may affect the migration of near shore fish, slowing migration and increasing the potential for mortality. In addition, the high number of pilings in these docks severely restricts the flow of water and sediment, and exacerbates shading problems.

<u>Outfall discharge and other pollutants</u>
Docks also serve as terminus for the industrial outfall pipes. Outfall flows add pollutants and other toxins to the water, and alter water quality, temperature and salinity. The fact that the wastewater effluent coming from the industrial facilities is fresh, means that the associated pollutants will be brought to the surface and prevailing winds will carry it southeastward along the shoreline (ENSR 2001, Figure 6).

The net flow from the ARCO/BP outfall pipe is near shore and southward, thereby exposing Cherry Point herring spawning grounds south of the dock to the combined effluents of all the facilities. In several studies, the percent of Cherry Point herring larvae that failed to hatch, or was found to have abnormalities, was highest in the region in which the plume model predicted the effluents from the ARCO/BP refinery and Alcoa smelter would accumulate (Marshall 2002, Battelle 1974, ENSR 2001).

Date from the most recent studies in the region indicate that between 1996 and 1999 the permitted industrial discharges at Cherry Point were 8 -16.3 million gallons of industrial effluent into Cherry Point herring habitat each day. These daily contributions were from TOSCO (Conoco-Philips): 1.58 million gallons per day ("mgd") (1.0-2.5), ARCO (BP) 4.32 mgd (2.8-6.2), ALUMAX (Alcoa) (1) 4.28mgd (4.0-4.7) ALUMAX (2) 0.98 mgd (0.2-2.9). In addition the outfalls were a significant source of heat (degrees C) TOSCO: 25.5, ARCO: 26.7, Intalco (1) 17, Intalco (2) 21. (See Appendix for specific details)

Along with the effluent itself, the temperature of the effluent impacts the herring's habitat. Salazar and Salazar (2002) suggest that increased temperatures associated with effluent from the outfalls may have significant impacts on developing herring embryos. Temperature can directly and indirectly affect herring in a variety of ways, by decreasing food supplies, and modifying spawning grounds and herring growth rates. Studies in Alaska have shown that elevated temperatures associated with El Nino can accelerate growth rates to the point that the herring do not have sufficient energy to successfully over-winter and spawn, particularly if food is also in short supply due to elevated temperatures (Salazar and Salazar 2002). Temperatures along Cherry Point Reach approached lethal levels during the El Nino year (1998).

Figure 6. Estimated plume from the ARCO/BP refinery (Battelle 1974).

There is also growing concern about ground water impacts on herring spawning beds (Marshall 2002). The Department of Ecology has issued an Agreed Order with ARCO/BP under the Model Toxics Control Act (Chapter 70.105D) requiring ARCO/BP to conduct a groundwater impact study of their unlined wastewater treatment ponds. Concern has also been expressed about atmospheric fallout from the neighboring industries. In addition, historical pollution from the former Superfund site, NW Transformer Inc. in Emerson, Washington, where 24,720 PCB laden transformers were burnt in low heat furnaces and poured in the ground within a half mile of the Nooksack River, may be harming Cherry Point herring. The Alcoa smelter was ranked third highest of 49 sites in Puget Sound with sediment contamination (excluding Superfund sites) and was the highest-ranking site not undergoing cleanup (EVS 1999).

Vessel traffic

Vessels landing and leaving may accidentally discharge oil and other hazardous materials. The ARCO/BP and Conoco-Philips facilities have reported 73 oil spills ranging from sheens to a massive 21,000 gallon spill (EVS 1999). Since the time of that report there have been several vessel incidents, some of which resulted in spills at the Cherry Point refineries during the spawning season. When one spill event occurred after herring spawning, no attempt was made to investigate effects to larval herring that could have inhabited many of the embayments where oil collected.

The Washington State Department of Ecology keeps track of commercial vessels calling on Washington waters. Between 1993 and 2002, an average of 2,815 cargo and passenger vessels entered Washington waters bound for ports in the Puget Sound area (this excludes tankers and any vessel headed to the Columbia River or to Canadian ports). During the same period there was an average of 6,916 cargo and passenger vessels bound for ports in British Columbia and Grays Harbor. The latter only accounts for approximately 50 ships per year. All these numbers from Department of Ecology's database would have to be doubled to account for round trip visits.

The tanker data counts only entries even though there is a considerable amount of oil exported from the State of Washington. Therefore, when doubling the tanker transits some of the vessels would be laden. Between 1993 and 2001, an average of 546 tankers entered the Strait of Juan de Fuca bound for ports in Washington. During the same period an average of 818 tankers passed through Washington waters on their way to British Columbia ports. An additional 3,379 laden tank barges passed through these waters each year.

A couple of trends are worth noting. Cargo and passenger vessels are getting larger, faster and crewed by fewer people over time. In that way, fewer vessels carry more cargo. In addition, there have been significant increases in port capacity both in Canada and the U.S. thereby allowing for the growth in traffic of larger vessels in the future. This trend is continuing as existing ports are expanded and new ones are proposed. There is an expected doubling to tripling of trade volume in the region over the next 10 to 20 years.

As of 1996, approximately 600 annual vessel trips were made to the Conoco-Philips refinery, 30 trips to the Alcoa pier, and 220 vessel trips to the ARCO/BP pier (291 in 1999) (EVS 1999). The Gateway Pacific Terminal ("Gateway"), a bulk commodity pier, is proposed for construction one mile south of the ARCO/BP refinery (EVS 1999). Gateway has already received a construction permit under Washington's Shoreline Management Act and its application for a Rivers and Harbors Act permit is presently pending with the Corps. Once operational, Gateway would further increase vessel traffic at Cherry Point area from two to three large commercial vessel movements per day.

In 1997 there was a total of 11,000 vessel transits in Rosario Strait and 8000 in Haro Strait. Tankers comprised 1000 of the transits in Rosario Strait and 300 of the transits in Haro Strait. Tugs with tank barges comprised 1600 and 1000 of the transits respectively. In addition, the Washington state ferry serving the San Juan Islands and Vancouver Island makes 9,000 transits perpendicular to the shipping lanes annually (Volpe 1997).

Of particular concern is vessel activity in the Cherry Point region during herring spawning months of March through June. During spawning months, traffic was predicted to increase 18 to 36 percent over five years from just the ARCO/BP dock project (EVS 1999).

The projected increase in ship traffic at the existing ARCO/BP pier and the new dock wing increases the probability of minor oil and product spills. Even if ARCO/BP were to maintain the same record of safety compliance, the increased traffic would likely increase risk (ENSR 2001). However, if a spill were to occur, especially during or just before the herring spawning and rearing season, the impact to the Cherry Point herring could be catastrophic. The fact that there is such low survival of adults, one and two year old fish comprise the majority of the spawning population. Therefore, if just one major spill of oil or hazardous material were to occur during or just prior to spawning, not only would that year's recruitment be wiped out, but the entire population would be jeopardized.

The ARCO/BP and Conoco-Philips Cherry Point facilities have spilled oil on multiple occasions, dumping more than 21,000 gallons (EVS 1999). It is important to note that there is a wide range in confidence as to the accuracy of the volume of oil spilled, especially during the earlier accounts. This is especially important in light of the 21,000 gallon spill reported by ARCO/BP on June 4, 1972 when herring larvae were present in large numbers. Since the time of that report there have been eight incidents that resulted in spills at the Cherry Point refineries. Some of the larger ones included: June 27, 1999 – 1,000 gallon crude oil spill at the Conoco-Philips refinery; June 13, 2001 – 1,260 gallon crude oil spill at the Conoco-Philips refinery; August 29, 2001 – approximately 22,400 gallons of oily water from the ARCO/BP refinery. Note the two spills from Conoco-Philips occurred during the time in which herring eggs and larvae were present at Cherry Point.

There has been a demonstrated record of spills at the Cherry Point industrial facilities over time. It is reasonable to expect the risk of spills to increase as the industrial activity and associated vessel traffic in the area increases (ENSR 2001). On December 14, 2003, shortly after the new dock wing was built at Cherry Point, 45 knot winds and poorly maintained mooring lines caused tankers moored at the dock to shift, damaging the facility. If it were not for quick action and some luck, a major spill could have occurred (WDOE 2003).

PAH contamination

Barron et al. (2002) studied the impact of weathered oil and dispersants on herring which are known to be sensitive to Alaskan North Slope crude oil at concentrations of 0.4ug/l (parts per billion) of total PAHs (tPAH). The investigators found that petroleum and weathered oil is photo-toxic, exhibiting a two to greater than 1000-fold increase in toxicity in the presence of sunlight as compared to previous laboratory studies. Herring eggs, embryos and larvae were found to be vulnerable to photo-toxicity if the initial oil exposure occurred as recently as the night before. The use of dispersants increases the ability of herring in early life-history stages to absorb oil into their bodies. The Exxon Valdez spill was likely to have had a dramatic impact on herring in Prince William Sound given the levels of oil detected in the water column (Barron et al. 2002).

The results from caged mussel studies conducted in 1998, 1999, and 2000 suggest that total PAH (tPAH) concentrations measured in mussel tissues and water temperatures measured along the Cherry Point Reach approach that adversely affect herring embryo-larval development (Salazar and Salazar 2002). The detailed analysis of PAHs accumulated in mussel tissues in 1999 show that the highest concentrations were measured at the southernmost ARCO/BP Pier station (400 ppb-dw) and the northernmost Gulf Road station (530 ppb-dw). These were among the highest concentrations measured over the 3-year monitoring period (Salazar and Salazar 2002).

No mussel cages were deployed South of the ARCO/BP pier in 1999 or 2000, and only one site adjacent to the ARCO/BP Pier was monitored in 1998. The area south of the ARCO/BP pier is an area where modeling studies suggest that PAHs would be most concentrated in the event of a spill at the ARCO/BP Pier (Salazar and Salazar 2002; Battelle 1974).

Given the often-unpredictable nature of independent biological systems (effects in herring embryo exposure versus uptake of PAHs in caged mussels), there was a general correlation between tPAH concentrations in caged mussels and effects on herring larvae. In general, when comparing stations to the north of Alcoa, to stations including Alcoa extending south, mussels at the southern stations had the highest concentrations of tPAH in their tissues, and more effects were observed in herring larvae in this area.

Similar trends were observed in both exposed herring larvae deformities and uptake of tPAHs in caged mussels at Cherry Point. These trends are evident even though neither study has found a statistically significant difference between areas. However, these findings warrant further investigation and precautionary action until we know more about the scope of anthropogenic impacts (Salazar and Salazar 2002; Boettner 2001). These observations are consistent with the predictions of the Plume model (ENSR 2001) which is to be expected for the freshwater plume circulation in an estuary (Thomson 1981).

It is important to note that these results were generated by exposing herring for only 4 to 5 days and this may have been too short to get the full dose of potential chemical exposure. In the real world, these embryos would have been exposed to potentially lethal conditions for a total of 14 to 15 days, almost three times longer than those transferred to the laboratory for future development. Furthermore, once transferred to the laboratory, the embryos and larvae were exposed to optimal and constant temperatures compared to rapid fluctuations in temperature and absolute temperatures approaching lethal temperatures along the Cherry Point Reach over the tidal cycle. Embryos would have been exposed to temperatures as high as 16.8°C had they not been transferred to the laboratory as well as to UV radiation, increasing the potential for photo-enhanced toxicity (Salazar and Salazar 2002; Barron et al. 2002).

Ballast water

Discharge of ballast water while loading and unloading ships is a major source of introduced species and disease. Intake of ballast water can result in removal of larval herring from the water column, and treatment of ballast water may introduce biocides into the environment. Approximately 640,000 metric tons of untreated ballast water is released in Puget Sound each year. About 5 million tons are exchanged at sea (WDNR 2002). Ballast water discharge may potentially impact herring through the introduction of disease or non-native predators such as green crabs.

Ballast water uptake by vessels at the ARCO/BP dock will increase with the expected increase in vessel traffic. Herring larvae in the vicinity may be killed when larvae are taken up with ballast water. While mortality rates associated with this activity are not known, it is estimated that a tanker can take up to 10,000,000 gallons or 1,300,000 ft3 of water for ballast.

Biocides

Concerns about the introduction of invasive species, especially from the ballast water of Articulated Tank Barges and Integrated Tank Barges, which cannot conduct mid-ocean exchanges, has lead to proposals to add biocides into the ballast water which could potentially affect the fauna at Cherry Point when discharged. Permission to test one such product, Sea Clean, at Cherry Point is currently being sought (WDNR 2002). This is an issue of concern at Cherry Point because it is the location of the largest amount of unexchanged ballast water entering into Washington waters (Scott Smith, pers. comm.)

Noise pollution

There is also concern about disturbance associated with the increasing vessel traffic calling on Cherry Point industries. Industrial activities typically generate low frequency noise (<1kHz) and this is within the hearing range of fish. In general, salmon are less sensitive to noise than clupeids, which have excellent hearing (Schwartz and Greer 1984) and are known to be sensitive to noise and lights.

Most commercially fished species respond to noise levels exceeding 30db above hearing thresholds (Mitson 1985). In addition, fish with swim bladders tend to have better hearing because the organ acts like an amplifier. As the size of the swim bladder increases with age, hearing capabilities may also increase because amplification is proportional to the cube of the swim bladder's volume (Mitson 1985). Blaxter (1985) recognized the importance of herrings' swim bladder for hearing exceeded that for buoyancy.

Vessel noise dominates the 20 Hz to 500 Hz frequency bandwidth and often reaches 1 kHz. While increased ambient noise may reduce herring's ability to detect predators, it is the abrupt changes in frequency that is expected to have the greatest impact on fish behavior (Schwartz and Greer 1984). Changes in vessel speed associated with docking activities and tugboat assistance of large tankers create abrupt frequency changes.

Schwartz and Greer (1984) found herring were never attracted to any of the playback sounds they presented, but did respond negatively to many. Avoidance behavior involved the cessation of feeding, tightening of the school and slow movement away from the sound source. Alarm behavior was similar to avoidance but occurred with greater speed and intensity. Rapid changes in direction and subdivision of the school sometimes occurred. A startle response was the mildest, involving a single powerful body flexion followed by a 5-10 second period of fast swimming. The schools direction and formation did not alter. Their findings indicated that larger ships could influence the behavior of a school at greater distances than smaller vessels. The fish responded to increases in amplitude and their response increased in intensity and duration as the rate of change of amplitude increased (Schwartz and Greer 1984).

Acoustic surveys indicate that pre-spawn herring hold near the bottom in waters 35–40 m (115–120 ft) deep, potentially limiting the level of impact. However, fish eventually move into shallower waters as they migrate shoreward to spawn and move from this depth during feeding periods. Therefore, noise levels might affect Cherry Point herring spawning and/or feeding behavior.

Pending Industrial Development

Gateway Terminal

Cherry Point was at one time zoned as a "heavy impact industrial" area. However, in response to the precipitous decline of the Cherry Point herring, Whatcom County amended its zoning on November 23, 1999 to impose a moratorium on the development of any additional industrial piers. This local government initiative came in response to a legal action, but still allowed for one more new terminal to be built at Cherry Point.

Whatcom County Planning Department completed a Final Environmental Impact Statement for Pacific International Terminals proposed Gateway Pacific Terminal (Gateway) in February 1997. The 1,092 acre site is located 12 miles northwest of the city of Bellingham and contains 5,460 feet of Cherry Point shoreline. The marine facilities, located one mile south of the ARCO/BP refinery dock, would include construction of a new 105 foot wide and 2,820 foot long pier and a 50 foot wide by 1,100 foot long approach trestle connecting the pier to the terminal storage area (Whatcom County 1997). The pier would be designed to accommodate three vessels ranging in size from 60,000 to 250,000 dwt simultaneously on the outside pier. Up to six barges could be accommodated on the inside of the pier (Whatcom County 1997).

The proposed facility would receive commodities, including liquid natural gas, by train primarily from the Pacific Northwest and Midwestern regions of the United States and Canada. The marine terminal would serve ocean going national and international trade for bulk commodities, break-bulk and other marine cargoes. Most shipments would be on foreign ships destined for Pacific Rim Countries (Whatcom County 1997).

During the initial five years of operation the terminal is expected to handle feed grains, petroleum coke, iron ore, sulfur, potash and wood chips (Whatcom County 1997). Bulk carriers, which handle these goods, are internationally recognized for being the worst maintained class of vessels in the international fleet with some of the highest incident rates. The reason for this is at least twofold. They carry inexpensive products, with low profit margins, so there is little investment put into the ships or crews that carry them. The products are loaded in loose form that puts greater stress on the welds of these ships especially as they transit the North Pacific.

These ships can hold up to 2 million gallons of bunker oil. Bunker oil is separated from the marine environment by a single hull of ships allowed to enter east of Port Angles and will be conducting docking maneuvers within a mile of ARCO/BP – the state's largest oil refinery.

A March 31, 2000, Biological Evaluation ("BE") for the ARCO/BP dock expansion concludes: "[I]t appears likely that another marine terminal will be constructed to the south of ARCO and Cherry Point by Gateway Pacific for the purpose of transshipping bulk commodities. The addition of this facility would probably **significantly increase** vessel traffic in the Southeast Strait of Georgia from an average of two large commercial vessel movement[s] per day to three movement[s] per day." (emphasis added) (EVS 1999).

The BE concludes that "the addition of the Gateway Pacific facility with that of the ARCO pier addition may result in long-term cumulative effects because of the significant increase in vessel traffic." (EVS 1999). EVS (1999) points out that "increasing ship vessel traffic will inevitably increase the risk of an oil spill" and that "if such a spill were to occur, especially during or just before the herring spawning and rearing season, the impact to the Cherry Point herring could be catastrophic."

While the Gateway project is expected to add an additional ship a day to the traffic through Rosario Strait, such annual averages can be misleading, especially when considering seasonal commodities such as grain. There has yet to be a quantitative assessment of oil spill risk associated with increased shipping. The construction and operation of this new terminal, immediately adjacent to the ARCO/BP refinery, has the potential to significantly impact this already critically vulnerable herring population.

<u>GSX Pipeline</u>

On April 24, 2001, Georgia Strait Crossing Pipeline LP (GSX-US) filed an application with the Federal Energy Regulatory Commission ("FERC") to construct, install, own, and maintain a new interstate natural gas pipeline and ancillary facilities in the State of Washington. On September 18, 2002, FERC approved the U.S. portion of the proposed pipeline. Canada's National Energy Board still needs to review the process, but delay in that review have pushed the proposed time to initiate construction from 2002 to 2004.

The GSX-US pipeline would extend 47.3 miles to transport natural gas from the existing pipeline systems in British Columbia to the US/Canadian Boarder at Boundary Pass in Georgia Strait. At Boundary Pass the GSX-US pipeline would interconnect with its Canadian counterpart. GSX-Canada proposes to construct a pipeline that would transport the natural gas from Boundary Pass to two proposed electrical power plants on Vancouver Island. The initial design capacity is for 95,700 decatherms per day (FERC 2002).

During construction 588.7 acres of onshore lands will be affected and 47.4 acres of seabed will be disturbed. The proposed pipeline crosses 10 of the 15 potentially active faults identified along the offshore route, resulting in a 10 percent failure rate over the next 50 years (FERC 2002). The first part of the offshore route through the Cherry Point State Aquatic Reserve is proposed to be constructed using a tunnel under the inter-tidal zone. However, if this procedure proves to be unfeasible for whatever reason, FERC has provided a means by which GSX-US can use the open-cut method through the Cherry

Point herring beds. The offshore right of way also cuts through Alden Bank, a critical herring holding area.

The placement of a structure on the bottom will result in the creation of an artificial reef of immense size. GSX proponents consider the creation of an artificial reef to be an enhancement to the aquatic environment, due to the tendency of rockfish and other species to congregate at these places. However, rockfish and other bottomfish in Puget Sound continue to decline in spite of the presence of numerous reef structures, artificial and natural. In addition, as yet we do not know what the impacts of such a structure would be to migratory juvenile salmon or to migrating Cherry Point herring, since rockfish prey on herring.

Once operational, it is not clear how the noise associated with gas running through the pipeline or the movement of the pipeline along the bottom sediments, will affect the behavior of herring. Nor is it clear from the EIS how routine maintenance or repair operations, in the case of a rupture, may affect herring.

B. Commercial, Recreational, Scientific, or Educational Over-utilization

Studies of the stability and resilience of Pacific herring populations suggest that Cherry Point herring were overexploited in the mid-1970s, and harvested at rates that are equal to or less than sustainable through today. Although the initial decline in Cherry Point herring biomass in the late 1970s and early 1980s may have been partly due to high annual harvests, harvest did not play a role in the declines of the 1980s and 1990s. This is because the time elapsed since the exploitation rate was reduced to sustainable levels is greater than the oldest recorded age class in the population.

The gradual loss of the oldest age classes was caused by increasing mortality of the largest and oldest members of the population over the years 1973 to 1998. While this decline has been speculatively correlated with presumed increases in harbor seal predation since the passage of the Marine Mammal Protection Act of 1972 (West 1997), it also corresponds to the opening and expansion of the ARCO/BP refinery and associated spills and industrial discharges. While it is not possible at this time to make a direct link between the opening and expansion of the ARCO/BP refinery and the decline of this population, industrial development and other factors along Cherry Point has likely contributed significantly to the population's decline.

Loss of the oldest age classes was also observed in the herring stocks of British Columbia in the mid-1960s as a result of over harvesting. In the Cherry Point case, the loss of older spawners, at least over the last 15 years, cannot be due to U.S. harvesters. However, their likely residency throughout the year makes them susceptible to harvests from Canadian waters.

Up until 1995, the decline in Cherry Point herring biomass was not caused by a decline in recruitment biomass. Instead, recruitment of Cherry Point herring has varied substantially among years within a remarkably constant range, and was independent of Cherry Point herring biomass. The causes of the variation in recruitment are unknown—they are not synchronous with recruitment variation for five British Columbia herring stock assessment regions, and they do not appear to be related to the time trend of copepod biomass anomalies measured off southern Vancouver Island between 1985 and 1992 (Marshall 2002). The lack of relationship between recruitment biomass and stock biomass provides additional evidence that the primary cause of the decline in stock biomass has to do with activities peculiar to the southern Georgia Strait ecosystem and less so the waters offshore Vancouver Island.

C. Inadequacy of Existing Regulatory Mechanisms

The catastrophic decline of the Cherry Point herring is ample evidence that existing regulatory mechanisms are inadequate for maintaining a sufficient population size and habitat distribution to ensure survival. Regulatory mechanisms have failed to protect the Cherry Point herring, do not ensure its survival and recovery, and will not protect it from harm from several proposed development projects.

Washington State Department of Fish and Wildlife Candidate Species

The Cherry Point herring is listed as a candidate species in the state of Washington. However, candidate status does not afford the population any mandatory legal protection. For example, despite the Cherry Point herring being listed as a candidate species, neither the State Department of Natural Resources or the Fish and Wildlife even mentioned concern of the Cherry Point herring in their comment letters to FERC on the proposed GSX pipeline.

The Washington Forage Fish Management Plan

The Forage Fish Management Plan, developed by the Washington State Department of Fisheries, plays a valuable role in assessing and managing the fisheries stock but it does not address habitat protection. The Plan is a testimony to the value of forage fish and the Cherry Point herring. Rather than emphasizing yield, or catch, as the primary goal, the Plan emphasizes the role of herring in the ecosystem as a source of food for salmon and other fish, and marine birds and mammals. Secondly, the Plan takes the precautionary approach and calls for reducing fishing or other activities if there is reason to believe that the activities will cause significant harm, even if such a link has not been established by clear scientific evidence. Although the Department of Fish and Wildlife closed the commercial Cherry Point herring fishery in 1996, they do not have the authority to regulate other activities that significantly impact Cherry Point herring and its habitat. Even with the fisheries closures, the stocks have failed to recover.

Washington State Department of Natural Resources – Subtidal leases

The Washington State Department of Natural Resources (DNR) issues leases of state owned aquatic lands for docks, piers, outfalls and associated uses (RCW 79.90.455(3)). None of these leases go through Washington’s State Environmental Policy Act (“SEPA”) review. Instead it is assumed that permits granted in association with the lease will trigger the environmental review. However, the associated permits are typically for a specific construction activity or a point source discharge and do not examine the long-term environmental cumulative impact of the activities that are authorized by the lease. The DNR in July 2003 began work on a Habitat Conservation Plan for its aquatic lands to comply with salmon ESA requirements.

Washington State Department of Natural Resources – Aquatic Reserve
Ensuring environmental protection is a management objective of state owned aquatic lands (RCW 79.90.455(3)). Natural values of state-owned aquatic lands, like wildlife habitat, natural area preserves, representative ecosystems, or spawning areas, are to be considered prior to the DNR issuing any lease or authorizing any changes in use (RCW 79.90.460(3)). The DNR may also designate reserves on state-owned aquatic lands (RCW 79.68.060 and WAC 332-30-151).

Aquatic diversity along this reach is very high with cobble intertidal habitat, large rocks and boulders, and kelp just offshore. Spawning Cherry Point herring and abundant offshore aquatic vegetation attract a wide variety of marine birds and animals (Long 1983). Cherry Point is described by Dyrness et al. (1975) as excellent and a high priority for conservation and research "in spite of several oil refineries in the area." Wahl et al. (1981) identified Cherry Point as one of eighteen "Significantly Important" sites for marine birds in Washington's inland waters. These references are duplicated by Dethier (1989) who recommends it as a site for consideration as a marine preserve.

Whatcom County (1994) identified Cherry Point as a significant wildlife area noting its "valuable habitat and significantly high numbers of diving birds, sea birds, and most notably the harlequin duck" in addition to commercial quantities of fish, crab and herring spawn. Recently, the site has also been highlighted by ecoregional planning efforts led by The Nature Conservancy as a potential conservation area.

In 2000, the outgoing Commissioner of Public Lands ordered and directed that 3,000 acres of state-owned aquatic lands be set aside as the Cherry Point State Aquatic Reserve. This significant effort protects much of the shoreline out to 70 feet from mean low water, or 1/2 mile, whichever is greater, from further development. The order recognizes,

> "…that the property hereafter described possess unique and significant natural values and shall be reserved and withdrawn from conflicting uses for an indefinite term from May 23, 2000, until recovery of Nooksack River salmonid populations and Cherry point herring populations….."

The development moratorium and reserve designation expressly grandfathered all existing leases, including Whatcom County's sewer outfall at Point Whitehorn, ARCO/BP's dock expansion, Alcoa, Conoco-Philips and the construction of the proposed Gateway bulk commodities shipping terminal, one mile to the south of ARCO/BP (see Figure 5). In addition, the proposed natural gas pipeline, Georgia Strait Crossing (GSX), has discussed with the Department the possibility of getting around the designation by tunneling underneath it.

In 2001, the new Commissioner of Public Lands began a SEPA process for establishing a marine reserve designation process and in 2003 began a SEPA process for designating the Cherry Point site as an aquatic reserve. On September 25, 2003, the Commissioner recommended that state-owned aquatic lands next to Cherry Point (from Point Whitehorn south to Neptune Beach) be designated an aquatic reserve. According to the Department of Natural Resources and its Aquatic Reserve Technical Advisory Committee, the Cherry

Point site is recognized as an extraordinary stretch of shoreline with excellent potential to maintain the relatively undeveloped character of the area.

The Washington Department of Natural Resources is developing a management plan and a Supplemental Environmental Impact Statements for the Cherry Point site. Scoping meetings for Cherry Point were held in October 2003 and a final decision on the Cherry Point Reserve's status will be issued in April 2004 based on long-term viability of the proposed management plans, public input and environmental assessments conducted during the SEPA process.

Washington Department of Ecology
The NPDES program administered by the Department of Ecology, as delegated by the Environmental Protection Agency ("EPA"), allow for significant volumes of pollutants to be discharged legally from industrial facilities at Cherry Point. Despite this fact, neither agency has requested consultation with NMFS regarding impacts to ESA listed species, and it cannot be assumed that the allowed discharge levels do not harm chinook salmon or Cherry Point herring. Although, EPA plans to seek consultation on the state's new water quality standards, the consultation will not consider mixing zones, toxics, or other elements of the state NPDES program that are not part of the Department of Ecology's water quality standards update. Studies relied upon by Department of Ecology for NPDES permits for industrial discharges did not examine impacts of pollutants on the surface microlayer.

Senator Magnuson's Amendment to the MMPA
Soon after oil was discovered in the Northern Slope of Alaska, the Valdez Tanker Terminal in Prince William Sound opened to transport crude oil from Alaska to the other states. It quickly became evident that Puget Sound could become a major oil terminal for the United States because it was the closest connection to Valdez.

Predicting immense pressure to use Puget Sound as a major oil terminal, Congress enacted the "Magnuson Amendment" to the Marine Mammal Protection Act (MMPA). The "Magnuson Amendment" forbids federal agencies from approving permits that, among other things, may increase the capability of any pier, located in Puget Sound, east of Port Angeles, to accept crude oil above and beyond that needed for use in Washington State. As Senator Magnuson stated in introducing his amendment: "I and my colleagues from the State have decided to confirm, as a matter of federal law, that increased tanker traffic in Puget Sound is simply bad policy and should not be allowed." 123 Cong. Rec. 16229 (Oct. 4, 1977).

The Amendment's operative language is found in the next part which reads:

> Notwithstanding any other provision of law, on and after the date of enactment of this section, <u>no officer, employee, or other official of the Federal Government shall, or shall have authority to, issue, renew, grant, or otherwise approve any permit</u>, license, or other authority for <u>constructing, renovating, modifying, or otherwise altering a terminal, dock, or other facility</u> in, on, or immediately adjacent to, or affecting the navigable waters of Puget Sound, or any other navigable waters in the

> State of Washington east of Port Angeles, <u>which will or may result in any increase in the volume of crude oil capable of being handled at any such facility</u> (measured as of the date of enactment of this section), other than oil to be refined for consumption in the State of Washington.

33 U.S.C. § 476(b) (emphasis added).

The amendment was motivated by a recognition of Puget Sound's importance to the citizens of Washington State, not only because it contains a wide variety of environments that support a diverse array of fish and marine mammals, but also because it offers such a unique and critical environment to the people of Washington State. The purpose of the provision was to ensure that any modifications to piers associated with refineries in Washington State would not expose Puget Sound to increased risk of an oil spill beyond that associated with Washington State oil needs. This prohibition is even more urgent today as we recognize the significant adverse impact of tanker traffic to the marine environment and as fish and marine mammals in Puget Sound are threatened with extinction.

The catastrophic spill of eleven million gallons of crude oil into Prince William Sound in 1989 escalated public awareness of the dangers of fuel transportation in critical marine environments. Each crude oil tanker that travels into Puget Sound today carries approximately three times the volume spilled by the Exxon Valdez. Meanwhile, chinook salmon and bull trout in Puget Sound are listed as threatened under the Endangered Species Act (ESA), the Southern resident community of orcas has declined by 20 percent over the last five years resulting in NMFS declaring them "Depleted" under the MMPA, and the Cherry Point herring may soon collapse.

The amount of crude oil refined per day at ARCO/BP's refinery has increased consistently over the years, not only to capture the market for refined petroleum in Washington state, but also to sell refined petroleum for use in Oregon, California, and other states. ARCO/BP is also the largest exporter of petroleum coke in the world (EVS 1999). Recently, a third attempt to build a new petroleum pipeline over the Cascade Mountains to feed oil from the refineries to Rocky Mountain markets was stopped by organized citizen opposition because of the tragic fuel spill and explosion of Olympic Pipe Line Company's existing petroleum pipeline in Bellingham, Washington.

ARCO/BP had increased its refinery capacity from 189,000 barrels per day (BPD) in 1996 to as much as 220,000 BPD in 2000. On May 4, 1992, ARCO/BP submitted an application to construct the northern pier wing. ARCO/BP 's application stated that the purpose of the project was to respond to "*increased demand* for terminal usage for non-crude oil tankerage" An "Environmental Report" accompanying ARCO/BP 's application stated:

> "Currently the pier operates at 74 percent, a very high utilization rate that is considered *close to, if not maximum practical utilization*. When the time needed for scheduled and unscheduled preventative maintenance and inspections is taken into account, *the dock is essentially operating at full capacity*."(emphasis added).

The report concluded that "[u]pon project completion, marine traffic, specifically *tanker traffic, is expected to be increased*" (emphasis added). However, the report contained no analysis of whether the increase in vessel traffic would increase the risk of oil spills. Despite the well-documented decline of the Cherry Point herring, and its status as a "Candidate Species" the WDFW and DNR still issued permits for ARCO/BP's dock expansion in the Cherry Point reach.

On June 29, 2000, the U.S. Army Corps of Engineers granted ARCO/BP their permit. An environmental impact statement was not required despite written requests by the U.S. Fish and Wildlife Service. The NMFS issued a finding of non-significance despite the state of the Cherry Point herring. The appeal of the Corps decision to grant this permit is currently before the Ninth Circuit Court of Appeals (Ocean Advocates et al. v U.S. Army Corps of Engineers et al).

The failure of the existing regulatory agencies to exercise their authority when confronted with the political influences of the financially endowed oil industry underscores the need to provide these agencies with greater regulatory authority and the associated political will to protect this population.

Canadian Regulations
Given that the spawning beds occur along the Canadian boarder, it is essential to have bilateral cooperation for the successful management of the Cherry Point herring. The fact that there is an active fishery in Canada, but none in the U.S. in recent years is one example of where the activities of the two countries need to be better coordinated. In addition, pollution knows no borders and the industrialization of the Fraser River is likely to have long term effects on the Cherry Point herring (Georgia Basin Initiative 2002).

D. Disease or Predation

Herring populations around the world are subject to intense predation pressure, which healthy populations have evolved to sustain. While many species prey on herring, it is not possible to attribute the current decline to predation. For example, while pinniped populations have climbed since their protection in 1972, populations of other key herring predators, including seabirds and wild salmon, have been in steep decline (EVS 1999).

The herring's mass spawning behavior is a reproductive strategy to swamp the predator with so much biomass sufficient cohorts survive despite high levels of mortality (Pianka 1978). However, this reproductive strategy is maladaptive when spawning levels are so reduced that predators can consume a large proportion of the population. Furthermore, such concentrations of a population make it inherently vulnerable to anthropogenic impacts such as spills or disturbance during the brief, but intense spawning period.

E. Other Natural and Manmade Factors Affecting Continued Existence

Ocean Conditions
Lasker (1985) argued that it is likely that various factors control populations of herring and other clupeid fishes, and that the major challenge is to determine the relative

influence of these factors. Some authors have suggested that survival during the larval stage is the key determinant of recruitment variability, and that larval survival is highly dependent on the availability of food upon hatching, and perhaps predation and physical conditions as well (Thornton 1995, Wespestad and Fried 1983).

The timing of larval first feeding and food production is also critical to survival (Cushing 1990). Larval drift likely determines whether larvae are in favorable or unfavorable feeding areas, and is controlled by currents and local conditions each year (Zebdi 1990). Larval drift to particular areas will also lead to different rates of predation. Haegele and Schweigert (1995) showed that herring spawn in areas where larvae will be retained. Still, there are inadequate data to confirm whether the larval "critical period" (Lasker 1985) is the major determinant of year class success in herring.

Schweigert (1995) showed that herring recruitment in the Strait of Georgia and on the west coast of Vancouver Island was negatively correlated with sea surface temperature. Hay and Kronlund (1987) found significant negative correlations between spawn deposition and sea surface temperature 2 to 5 years earlier, over the period from the 1930s to the 1980s for stocks in the Strait of Georgia.

One popular explanation for the negative correlation between herring recruitment and sea surface temperature in southern British Columbia and northern Washington is predation by Pacific hake (*Merluccius productus*) (Schweigert 1995). The annual summer migration of hake from California into the coastal waters of northern Washington and southern British Columbia is known to be temperature dependent—the higher the temperature in coastal waters of British Columbia, the farther north hake migrate and the greater the summer biomass of hake (Ware and McFarlane 1995; Zebdi and Collie 1995).

Schweigert (1995) found that recruitment of herring on the west coast of Vancouver Island was significantly inversely related to Pacific hake biomass. Ware (1991) found a significant relationship between herring recruitment and hake biomass for the west coast of Vancouver Island herring stock, although not for the Strait of Georgia stock. Schweigert (1995) reviewed past studies showing that several variables are related to recruitment of one or both stocks, including Ekman transport (high downwelling and favorable wind stress), Tofino sea level, salinity, and El Niño - Southern Oscillation events. He concluded that the mechanism by which temperature is inversely related to recruitment is uncertain, although increased hake predation, changes in sardine abundance, or changes in local food resources due to intensity of upwelling are all possible explanations. Ware (1991) showed that the population of the west coast of Vancouver Island herring is high when temperatures, Ekman transport, and hake abundance are low, and poorer when these three variables are higher.

Alderdice and Hourston (1985) used data from the early 1980s to calculate that surface salinities and food supply were unlikely to be limiting factors on herring in the Strait of Georgia, and hypothesized that the high loss rates of larvae offshore were due to predation. However, Marshall (2002) found correlations between the occurrence of the copepod *Neocalanus plumchrus* and the survival rates of Cherry Point herring to suggest that Cherry Point herring are a resident population. Ware's (1991) lack of correlation between hake biomass on the coast and recruitment of Georgia Basin herring stocks further support notion that Cherry Point herring are a resident population.

While oceanographic factors undoubtedly affect the strength of a given run, there does not appear to be a clear relationship between the decline of the Cherry Point herring and oceanography. Herring stocks in other parts of the Sound appear to have been able to respond more vigorously to recent improvements in oceanographic productivity associated with the PDO, providing further indication that ocean conditions are not the limiting factor in the survival of the Cherry Point herring.

Geography

Although Cherry Point is not a large feature, it is prominent enough to affect many physical and chemical properties in the surrounding waters. Cherry Point could affect herring by influencing water flow, temperature, food supply and perhaps even dispersion of chemicals such as PAHs. It is probably not a coincidence that the southern limit of the current spawning grounds stop at Cherry Point. One modeling study suggests that PAHs would concentrate in the vicinity of Cherry Point in the event of a spill at the ARCO/BP Pier (Battelle 1974, ENSR 2001, Figure 6).

Military Training

The U.S. Navy has been conducting underwater explosive ordinance disposal (EOD) operations in several locations within the Puget Sound region for many years (SAIC 2000). Recently this activity has been shown to have major impacts on forage fish species, including herring. The Navy is currently conducting consultations with NMFS on their impacts to ESA listed species and reviewing the adequacy of their biological assessment.

X. QUALIFICATION OF CHERRY POINT HERRING AS A DISTINCT POPULATION SEGMENT

The ESA provides for the listing of all species that warrant the protections afforded by the Act. The term "species" is defined broadly under the Act to include "any subspecies of fish or wildlife or plants and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." 16 U.S.C. §1532 (16). NMFS and FWS created a policy to define a "distinct population segment" for the purposes of listing, delisting, and reclassifying species under the ESA. 61 Fed. Reg. 4722 (February 7, 1996). Under this policy, a population segment must be found to be both "discrete" and "significant" before it can be considered for listing under the Act.

In 2001, NMFS concluded that there is a single DPS for Pacific herring that encompasses the 18 spawning populations in Puget Sound and the Strait of Georgia, including the Cherry Point herring. This finding was rejected as premature by the Washington Department of Fish and Wildlife scientists who notified NMFS that they did not "necessarily agree" with the finding due, in part, to the Cherry Point herring stock's distinct growth patterns, timing and location of spawn deposition, and other factors (WDFW 2000). This lead WDFW to flatly conclude that NFMS had improperly established the Georgia Basin DPS for Pacific herring (WDFW 2000).

This petition requires NMFS to re-examine this determination because new scientific evidence supporting the designation of the Cherry Point population of Pacific herring as a Distinct Population Segment. The available evidence is conclusive that the Cherry Point herring are genetically and physiologically unique and distinct, reproductively isolated, and therefore "discrete" as that term is used in the distinct population segment policy.

A. DISCRETENESS

Under the joint NMFS/FWS policy, a population segment of a vertebrate species is considered discrete if it satisfies either of the following conditions:

- It is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors. Quantitative measures of genetic or morphological discontinuity may provide evidence of this separation.
- It is delimited by international governmental boundaries within which differences in control, of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4(a)(1)(D) of the Act.

Cherry Point herring are markedly separated and reproductively isolated from other Pacific herring stocks by unique genetic characteristics, physiology, diet and spawning behavior, and other factors.

Genetically Distinct

Geographic fidelity when coupled with physical separation of spawning grounds may result in isolation among populations (O'Toole et al. 2000). Although herring have lower site fidelity when compared with salmonids – resulting in 10-30 times less genetic variation (Beacham 2002) – the distinct timing of the Cherry Point herring spawn has produced a level of genetic separation from the other Georgia Strait and Puget Sound stocks comparable to that found between stocks of coho salmon (*Oncorhynchus kisutch*) (Beacham 2002).

For example, microsatelite DNA testing on Cherry Point herring show them to be the most genetically divergent population in Washington, with a significant difference detected in the 12 loci that were screened (Beacham et al. 2001) (Figure 7). These tests showed that even between different years the Cherry Point herring retain their genetic distinction from other populations (Beacham et al. 2001). Microsatellite DNA testing is very accurate and can uncover genetic distinctions that other genetic tests such at mtDNA studies may not reveal (Shaw et al. 1999).

Canadian studies screening loci with microsatellite DNA testing also found the Cherry Point population to be discrete from other Puget Sound, Strait of Georgia and Canadian herring populations (Beacham 2002).

Beacham et al. (2001) analysis found that the Cherry Point herring stock are discrete when compared to other stocks. The farther a stock originates away from the vertical line on the left of figure 7, the more discrete it is. The length of the horizontal line depicts the genetic distance between stocks within the same unit. The most discrete stocks are Cherry Point and Portage Inlet Georgia. Both stocks are late March spawners and have retained their unique genetic character, suggesting that little straying occurs between populations.

Figure 1. Neighbor-joining dendrogram based on Cavalli-Sforza and Edwards (1967) chord distance for 65 herring samples from southeast Alaska, British Columbia, and Washington.

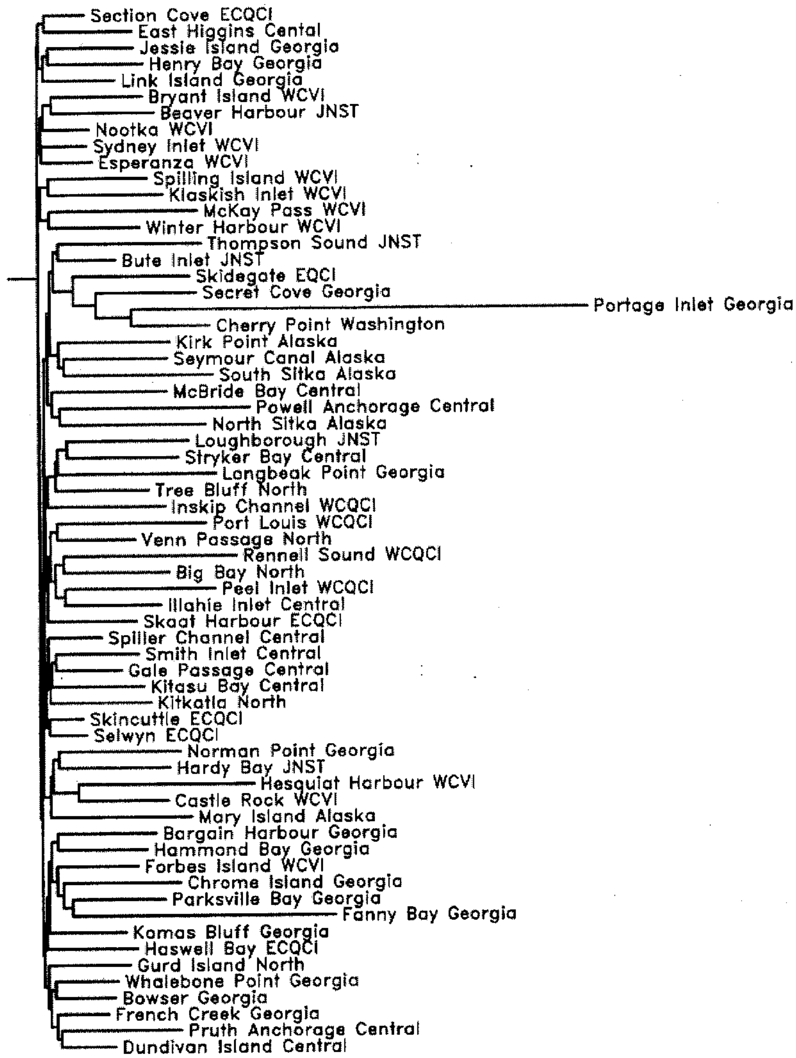

Figure 7. Pacific herring population structure (Beacham et al. 2001)

Concerns about straying have given fuel to the argument to that herring may not be reproductively discrete, mostly predicated upon herring tag results from Canada that indicate 20 percent of herring stray between spawning grounds. However, in Canada, herring populations are relatively large, and the spawning grounds are in close proximity to one another, so the potential to stray is higher than among more geographically isolated spawning grounds. Despite those conditions, the majority of the herring population continue exhibit high spawning site fidelity (Shaklee 2002).

In the Status Review of the Pacific herring (Stout et al. 2001), the Georgia Basin DPS was justified by evidence of straying between spawning populations. Generally, Pacific herring return to the same spawning area year after year. Stout et al. (2001) suggests that while some stocks of Pacific herring may be experiencing decline, straying from other populations can easily repopulate them. There is strong evidence that the Cherry Point herring exhibits strong site fidelity in selecting spawning grounds. Because of their late spawning season, they have become reproductively isolated from other stocks. While intermingling of schools may occur during non-spawning seasons among Cherry Point herring and other stocks, the Cherry Point herring breed during a unique time at a geographically distinct location and therefore straying does not impact genetic discreteness. Winter spawning stocks may show more straying from ground to ground, but the spring spawners show genetic isolation (Bargmann, pers. comm., 2002c).

Other Georgia Basin herring stocks are not likely to repopulate Cherry Point because Cherry Point herring have distinct genetic qualities, physiology, and reproductive behavior that restrict other Pacific herring stocks from spawning in the open exposed conditions or during the spring months. For example, other Georgia Basin herring stocks have not started to spawn along the Cherry Point reach since the decline started in the 1970's.

Physiologically Distinct

Analysis of otoliths, the bones in the herring ears, show that Cherry Point herring inhabit unique environments that isolate them from other Puget Sound herring populations. The otolith is comprised of calcium carbonate ($CaCO_3$) and grows each year. It has a long history of being used to determine age of fish.

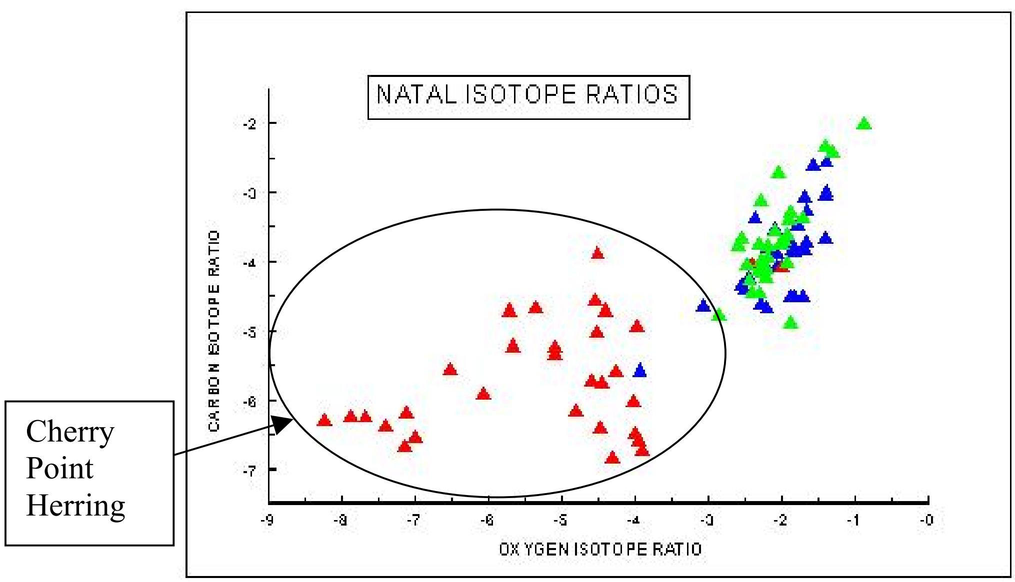

Figure 8. Cherry Point natal isotope ratios, in red (Gao et al. 2001)

Analysis of the carbon and oxygen isotopes can indicate temperature and salinity conditions in herring habitat and provide diet information. Isotope variations determined from otoliths can provide a natural tag to distinguish fish as they move through different waters or remain in natal areas (Gao and Beamish 1999). By looking at the otoliths, scientists can reconstruct environmental exposure to fresh water, and migration patterns.

Gao (2002) examined isotopic signatures from different spawning grounds to determine if there are separate populations of herring. Gao (2002) compared the otoliths of the Cherry Point herring with other populations, such as the Port Orchard and Squaxin Pass herring, and concluded that Cherry Point herring are exposed to different environmental conditions and have different diets than other Pacific herring (Figure 8). These data suggest that Cherry Point herring are born in a different environment than other Puget Sound herring populations and that young herring remain in estuarine environments and do not migrate (Gao et al. 2001).

Distinct Spawning Time and Location

Cherry Point herring are reproductively isolated from other Pacific herring by their spawning location and timing. Cherry Point herring are separated from other Pacific herring by their unique and long-standing ability to spawn in a relatively open, high-energy shoreline habitat (O'Toole et al. 2000). Other Pacific herring stocks spawn in sheltered inlets, bays, and coves.

Cherry Point herring are also separated from other Pacific herring by a spawning period that is unique and distinct from other Pacific herring spawning periods. Pacific herring spawning in Washington state generally takes place from mid-January to mid-April. Cherry Point herring spawning occurs much later, between early April to early June. The spawning season has nearly ended for most other herring populations when the Cherry Point herring begin to spawn. Records dating back to 1927 that report Cherry Point herring spawning between from May 1st and June 10th (Chapman et al. 1941) suggests that reproductive isolation from distinct spawning time is long-standing, and forms a strong behavioral boundary between the Cherry Point herring and other Pacific herring populations.

Distinct Parasites

An examination of parasite infections provides evidence that the Cherry Point herring population is distinct. Cherry Point herring demonstrated a 31 percent rate of infection of *Ichthyophonus hoferi,* a protist that causes lesions and other problems – 15 percent were clinically infected and considered diseased. This is a markedly higher infection rate than any other Pacific herring population that was studied (Hershberger 2002). O'Toole's (2000) review of stock discreteness points out that Trumble (1983) noted that parasitic observations, while not alone a reliable indicator of population separation, add to the evidence that Cherry Point herring are distinct from other populations. Other observations indicated that the Cherry Point herring bodies are normally full of the roundworm *Anasakis*, a parasite that is uncommon in other Puget Sound adult herring.

Distinct Diet
The Cherry Point herring subsist on a different diet than other Puget Sound herring populations. A recent report by the Washington State Department of Ecology suggests that Cherry Point herring feast on a particularly large and lipid rich copepod, *Neocalanus plumchrus,* that dominates the Fraser River area from April through June (Marshall 2002). Adult herring feed on the zooplankton in the Fraser River area where *N. plumchrus* reaches concentrations of 60 animals per Liter.

B. Significance
According to the listing policy, once a population is established as discrete, its biological and ecological significance should then be considered. This consideration may include, but is not limited to, the following:

- Persistence of the discrete population segment in an ecological setting unusual or unique to this taxon.
- Evidence that loss of the discrete population would result in a significant gap in the range of a taxon.
- Evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historical range.
- Evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics.

61 Fed. Reg. 4722.

The Cherry Point herring persist in an ecological setting that is unusual and unique to Pacific herring, it differs markedly from other populations in its genetic characteristics and evolutionary potential, and it is significant to the health and function of the Puget Sound ecosystem.

Unique Ecological Setting
Cherry Point herring live and breed in an ecological setting that is unique and distinct from other Pacific herring populations. As long a data has been collected, Cherry Point herring spawning periods have been distinctly different than spawning periods of other Pacific herring (Chapman et al. 1941, O'Toole et al. 2000). The relatively open, high-energy shoreline spawning habitat used by Cherry Point herring is also unique among Pacific herring (O'Toole et al. 2000). In addition, studies of the otoliths of the Cherry Point herring suggest that young Cherry Point herring occur in freshwater influenced environments, possibly hyposaline estuarine environments, that other herring stocks do not occupy (Gao 2002).

Marked Difference in Genetic Characteristics
The Cherry Point herring differ markedly from other Pacific herring populations in its genetic characteristics. Recent studies on Pacific herring microsatelite DNA found Cherry Point herring to be the most genetically divergent population in Washington. There was a significant difference detected between Cherry Point herring and other Pacific herring at all 12 loci that were screened (Beacham et al. 2001). Canadian studies determined that the Cherry Point population was genetically distinct from other Puget Sound, Strait of Georgia and Canadian herring populations with the degree of genetic

separation from the other Georgia Strait and Puget Sound stocks comparable to that found between ESUs of coho salmon (*Oncorhynchus kisutch*) (Beacham 2002).

Significant to the Puget Sound Ecosystem

Cherry Point herring play a significant role in the Puget Sound ecosystem, and are the most important herring population in Washington State. It was historically the largest population in Washington waters, comprising 32 percent of Washington's herring. Cherry Point herring are the only spring spawning stock in Washington, and the unique run timing may be critical to the survival of local populations of surf scoters (*Melanitta perspiscillata*) (Nyswander and Evenson 1998), federally threatened chinook salmon (*Oncorhynchus tshawytscha*) bound to and from the Nooksack and Fraser Rivers (Conrad and MacKay 2000), and several cetacean species including the harbor porpoise (*Phocoena phocoena*), Dalls porpoise (*Phocoenoides dalli*) (Walker et al. 1998), Minke whale (*Balenoptera acutorostrata*) (Hoelzel et al. 1989), and orca (*Orcinus orca*) (Calambokidis et al. 1997; Felleman et al. 1991). The collapse of the Puget Sound chinook and orca populations are likely to be interrelated, in that herring are eaten by chinook which are in turn eaten by orcas.

When looking at the vital role that Pacific herring play in the ecology of the Puget Sound, it is obvious that their presence as predators and prey, be they spawners, larvae, juveniles, or adults, is invaluable. For example, Cherry Point herring provide food for predators close to shore long after most spawning herring have left for deeper waters. Moreover, the hatch of their young coincides with a springtime bloom of *Neocalanus plumchrus* a copepod and favorite food for the larvae (Marshall 2002), making that production available to larger organisms.

Significant to the Evolutionary Potential of Pacific herring

Cherry Point herring eat, reproduce, breed, and are preyed upon in a different pattern than other herring. These specialized characteristics could be essential for continued evolution and survival of the Pacific herring species. For example, peripheral populations, like Cherry Point herring, are often disproportionately important for protecting genetic diversity (Ehrlich 1988). Distinct traits found in peripheral populations may be crucial to the species, allowing adaptation in the face of environmental change (Hoffman and Blows 1994). Elimination of the Cherry Point herring may be detrimental in the face of predicted widespread changes in climate (Abrahamson 1989, Peters & Lovejoy 1992). For instance, if the climate warms as predicted, releasing freshwater currently stored in artic and alpine environments, the Cherry Point herring's unique adaptation to freshwater influenced environments could be critical to the future of Pacific herring.

XI. Vulnerability to Extinction

Cherry Point herring face a high risk of extinction because of their small population size, certain natural history characteristics, reproductive isolation, threats from industrial facilities and other pending development, and a lack of protective regulatory mechanisms. Populations reduced below a certain number of individuals through disease, habitat loss, habitat degradation, and other factors face a high probability of extinction (Franklin 1980, Gilpin and Soulé 1986, Soulé 1987). Small populations are subject to inbreeding, a loss of genetic variability, random changes in phenotype, loss of heterozygosity, and genetic drift (Primack 1993). Genetic inbreeding ultimately results in decreased fitness and survivorship (Lacy 1987). Small populations can also lose genetic variability through the loss of rare alleles and the percentage of heterozygous genes (Avise 1994).

Low populations size can produce in imbalances in sex and age ratios, low fecundity, and high mortality rates. Collectively these demographics vary at random, but in small populations they have a greater chance of resulting in extinction even when survival and reproductive success are high (Gilpin and Soule 1986). In addition to demographic fluctuations, small populations can experience rapid decline in numbers and local extinction caused by variation in disease, food supply, predation, competition, and other environmental factors (Primack 1993).

Cherry Point herring abundance has dropped significantly from historic levels, corresponding with a significant reduction in the shoreline used for spawning. The small remaining population exhibits many of the specific qualities that suggest a high extinction risk from genetic, demographic and environmental variability. Reduced fitness, possibly from inbreeding, is indicated by lower hatching success and higher rates of abnormal development (Bargmann 2001). Reproduction rates have dropped as the older and most productive Cherry Point herring have disappeared from the population and are not replaced (Stout et al. 2001). Catastrophic events, including massive oil spills during spawning season, have occurred and will very likely occur again.

Certain natural history characteristics of Cherry Point herring increase extinction risk when the population levels are low. Cherry Point larvae are smaller than other Pacific herring and declining in size over time (Kocan 1998). They have smaller yolk sacs (Marshall 2002), and require high prey abundance to sustain high growth rates (Lemberg et al. 1977). Schooling behavior by Cherry Point may result in disproportionately high mortality rates from birds (Haegele and Schweigert 1985) and other herring predators.

Isolated populations are more vulnerable to extinction caused by catastrophic events and a reduced gene flow (Noss and Cooperider 1994). Cherry Point herring are reproductively isolated from other Pacific herring by spawning locating and timing (O'Toole et al. 2000), and have become genetically distinct from other herring (Beacham et al. 2001). Unique diet and salinity tolerances may further isolate Cherry Point herring from other Pacific herring (Gao et al. 2001).

The extinction risk for Cherry Point herring is elevated by direct, indirect and cumulative impacts from industrial activities. Cherry Point herring are killed, harmed, and significantly disrupted by dock construction and operation, outfall discharge, vessel traffic, accidental spills of oil and other poisons, and foreign disease and species from ballast waters. The amount of vessel traffic and the effluent being discharged from the Cherry Point industries and the four effluent discharge pipes has steadily increased over the years as refinery and smelter capacity has expanded, as evidenced by increased limits authorized by the NPDES permits program. Increased vessel traffic and capacity at existing facilities, and plans for new industrial facilities is expected to increase threats to Cherry Point herring and, therefore, its risk of extinction.

Regulatory mechanisms needed for the recovery of the Cherry Point herring do not currently exist. Existing regulatory mechanisms have failed to protect the Cherry Point herring, do not ensure its survival and recovery, and will not protect it from harm from several proposed development projects

Because best available scientific data indicates a dramatic reduction in population size and distribution, significant reduction in spawning area, a small and shrinking effective population size, decreased hatching success and viability, population isolation, poor recovery ability, loss and degradation of habitat, and the continued existence of numerous significant threats to Cherry Point herring and their habitat, petitioners believe that the Cherry Point herring now face a very high risk of extinction in the near future.

XII. REQUESTED DESIGNATION

In light of all of the reasons listed above, petitioners request that the Cherry Point DPS of Pacific herring be listed as “threatened” or “endangered” under the Endangered Species Act. The demise of this distinct population segment is clearly and overwhelmingly related to the loss, degradation and fragmentation of its habitat. Petitioners also request the designation of critical habitat for the Cherry Point DPS coincident with its listing. Critical habitat should be designated in all areas where it is currently located and in key unoccupied areas where restoration is necessary for the conservation of the Cherry Point DPS.

Respectfully submitted,

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XIV. APPENDIX

ENSR

Table 2-1 Effluent Characterization

	Tosco			ARCO			Intalco 001			Intalco 002		
Analyte	(µg/l)	Qualifier	Source	(µg/l)	Qualifier	Source	(µg/l)	Qualifier	Source	(µg/l)	Qualifier	Source
Priority Pollutant Metals												
Antimony	3		1999 Ecology	50	U	1999 Ecology	5		1995 2-C	5	U	1995 2-C
Arsenic	20.8		1999 Ecology	19		1999 Ecology	7	U	1995 2-C	10	U	1995 2-C
Beryllium	10	U	1999 Ecology	5	U	1999 Ecology	0.5	U	1995 2-C	0.5	U	1995 2-C
Cadmium	6		1999 Ecology	58		1999 Ecology	0.5	U	1995 2-C	1.7	U	1995 2-C
Chromium	100		1999 Ecology	420		1999 Ecology	5	U	1995 2-C	5	U	1995 2-C
Copper	29		1999 Ecology	30	U	1999 Ecology	16		Draft Fact Sheet	24		Draft Fact Sheet
Lead	13		1999 Ecology	50	U	1999 Ecology	2		1995 2-C	6		1995 2-C
Mercury	1.97		1999 Ecology	0.7		1999 Ecology	0.5	U	1995 2-C	0.6	U	1995 2-C
Nickel	7		1999 Ecology	208		1999 Ecology	9		1995 2-C	10	U	1995 2-C
Selenium	32.9		1999 Ecology	39		1999 Ecology	7		1995 2-C	5	U	1995 2-C
Silver	10		1999 Ecology	10	U	1999 Ecology	1	U	1995 2-C	1	U	1995 2-C
Thallium	10	U	1999 Ecology	50	U	1999 Ecology	1	U	1995 2-C	1	U	1995 2-C
Zinc	110		1999 Ecology	94		1999 Ecology	50	U	1995 2-C	50	U	1995 2-C
Cyanide	19		1999 Ecology	62		1999 Ecology	32		DMR	5	U	DMR
PAHs												
Acenaphthene	15	U	1999 Ecology	5.38	U	1999 Ecology	0.1881		6/99 Sample	0.0163		6/99 Sample
Acenaphthylene	15	U	1999 Ecology	5.38	U	1999 Ecology	0.0035		6/99 Sample	0.0047		6/99 Sample
Anthracene	15	U	1999 Ecology	5.38	U	1999 Ecology	0.0685		6/99 Sample	0.0216		6/99 Sample
Benzo(a)anthracene	0.02	U	6/99 Sample	0.02	U	2/01 Sample	0.1201		6/99 Sample	0.2412		6/99 Sample
Benzo(a)pyrene	0.02		6/99 Sample	0.02	U	2/01 Sample	0.1518		6/99 Sample	0.3173		6/99 Sample
Benzo(b)fluoranthene	0.02	U	6/99 Sample	0.02	U	2/01 Sample	0.1922		6/99 Sample	0.535		6/99 Sample
Benzo(g,h,i)perylene	15	U	1999 Ecology	5.38	U	1999 Ecology	0.0887		6/99 Sample	0.2596		6/99 Sample
9h-Carbazole	NT	U	1999 Ecology	NT	U	1999 Ecology	0.48	U	4/94 Sample	0.46	U	4/94 Sample
2-Chloronaphthalene	9.6	U	1999 Ecology	5.38	U	1999 Ecology	3	U	7/88 Class II	3	U	7/88 Class II
Chrysene	0.06		6/99 Sample	0.03		2/01 Sample	0.1388		6/99 Sample	0.3944		6/99 Sample
Dibenzo(a,h)anthracene	0.03		7/99 Sample	0.02	U	2/01 Sample	0.0208		6/99 Sample	0.0564		6/99 Sample
Dibenzofuran	15	U	1999 Ecology	100	U	1999 Ecology	3	U	7/88 Class II	3	U	7/88 Class II
Fluoranthene	15	U	1999 Ecology	5.38	U	1999 Ecology	0.3507		6/99 Sample	0.6294		6/99 Sample
Fluorene	15	U	1999 Ecology	26 §		1999 Ecology	0.0975		6/99 Sample	0.0139		6/99 Sample
Indeno(1,2,3-cd)pyrene	0.02	U	6/99 Sample	0.02	U	2/01 Sample	0.0945		6/99 Sample	0.2617		6/99 Sample
1-Methylnaphthalene	15	U	1999 Ecology	NT	U	1999 Ecology	0.0122		6/99 Sample	0		6/99 Sample
2-Methylnaphthalene	15	U	1999 Ecology	2	U	1999 Ecology	3	U	7/88 Class II	3	U	7/88 Class II
Naphthalene	15	U	1999 Ecology	5.38	U	1999 Ecology	0.0378		6/99 Sample	0.0194	U	6/99 Sample
Phenanthrene	15	U	1999 Ecology	56 §		1999 Ecology	0.3272		6/99 Sample	0.1593		6/99 Sample
Pyrene	15	U	1999 Ecology	5.38	U	1999 Ecology	0.2866		6/99 Sample	0.4423		6/99 Sample
Retene	NT	U	1999 Ecology	NT	U	1999 Ecology	0.28	U	3/95 Sample	0.26	U	3/95 Sample
Ave May Temperature, C	25.5			26.7			17			21		

U = Not detected at detection limit, § = value measured below detection limit, NT = not tested

Table 2-4 Cherry Point Industries Compliance Evaluation

Analyte	Maximum Effluent Concentration (µg/L)				Max Receiving Water Concentration (µg/l)	Water Quality Standard		Dilution Required for Compliance			
	Tosco	ARCO	Intalco 001	Intalco 002		Chronic	Human Health	Tosco	ARCO	Intalco 001	Intalco 002
Priority Pollutant Metals											
Antimony	3	50	5	5	0.0522		4300	0.0	0.0	0.0	0.0
Arsenic	20.8	19	7	10	0.577	36		0.6	0.5	0.2	0.3
Beryllium	10	5	0.5	0.5	0.000341						
Cadmium	6	58	0.5	1.7	0.0414	9.3		0.7	6	0.1	0.2
Chromium	100	420	5	5	0.1340	50		2.0	8.4	0.1	0.1
Copper	29	30	16	24	0.591	3.1		9.3	9.7	5.1	7.7
Lead	13	50	2	6	0.02900	8.1		1.6	6.2	0.2	0.7
Mercury	1.97	0.7	0.5	0.6	0.000395	0.025		78	28	20	24
Nickel	7	208	9	10	0.392	8.2		0.8	25	1.1	1.2
Selenium	32.9	39	7	5	0.0308	71		0.5	0.5	0.1	0.1
Silver	10	10	1	1	0.014						
Thallium	10	50	1	1	0.00781		6.3	1.5	7.9	0.2	0.2
Zinc	110	94	50	50	1.080	81		1.4	1.2	0.6	0.6
Cyanide	19	62	32	5		2.8		6.8	22	11	1.8
PAHs											
Acenaphthene	15	5.38	0.1881	0.0163		710		0.0	0.0	0.0	0.0
Acenaphthylene	15	5.38	0.0035	0.0047							
Anthracene	15	5.38	0.0685	0.0216			110000	0.0	0.0	0.0	0.0
Benzo(a)anthracene	0.03	0.5	0.1201	0.2412			0.031	1.03	16	3.9	7.8
Benzo(a)pyrene	0.02	0.5	0.1518	0.3173			0.031	0.6	16	4.9	10.2
Benzo(b)fluoranthene	0.02	0.5	0.1922	0.535			0.031	0.6	16	6.2	17.3
Benzo(g,h,i)perylene	15	5.38	0.0887	0.2596							
9h-Carbazole	NT	NT	0.48	0.46							
2-Chloronaphthalene	9.6	5.38	3	3							
Chrysene	0.06	0.03	0.1388	0.3944			0.031	1.9	0.9	4.5	12.7
Dibenzo(a,h)anthracene	0.03	0.02	0.0208	0.0564			0.031	1.0	0.6	0.7	1.8
Dibenzofuran	15	100	3	3							
Fluoranthene	15	5.38	0.3507	0.6294		16		0.9	0.3	0.0	0.0
Fluorene	15	26	0.0975	0.0139			14000	0.0	0.0	0.0	0.0
Indeno(1,2,3-cd)pyrene	0.02	0.02	0.0945	0.2617			0.031	0.6	16	3.0	8.4
1-Methylnaphthalene	15	NT	0.0122	0							
2-Methylnaphthalene	15	2	3	3							
Naphthalene	15	5.38	0.0378	0.0194							
Phenanthrene	15	56	0.3272	0.1593							
Pyrene	15	5.38	0.2866	0.4423			11000	0.0	0.0	0.0	0.0
Retene	NT	NT	0.28	0.26							
Temperature (C)	25.5	26.7	17	21							

Note:
NT = not tested.
ARCO's PAH values are based on Tosco's PAH values where available, and the second-highest reported detection limit listed by Ecology (1999).
Required dilution for compliance with human health criteria are given when chronic standard for marine water does not exist.
When required dilution is <1, the effluent concentration is less than the WQS.
Current dilution at CMZ: Tosco 1:158, ARCO 1:157, Intalco 001 1:59.5, Intalco 002 1:24.
Maximum receiving water concentrations are based on Table 2-3.
ARCO's reported values for fluorene and phenanthrene are estimates.
Intalco's maximum cyanide values are reported as free cyanide from DMR data.