Final Assessment of Threatened and Endangered Marine and Anadromous Fish Presence Adjacent to the NAVBASE Kitsap Bangor: 2015-16 Beach Seine Survey Results

Prepared for:

Naval Facilities Engineering Command Northwest (NAVFAC NW)

Submitted by:

The WDFW Marine Fish Science Unit

Taylor Frierson, William Dezan, Dayv Lowry, Larry LeClair, Lisa Hillier, Robert Pacunski, Jennifer Blaine, Andrea Hennings, Amanda Phillips, Philip Campbell

FINAL REPORT

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Executive Summary

Puget Sound is home to a variety of marine and anadromous fish species that are afforded legal protection under the Endangered Species Act (ESA). The ESA-listed fish species within Puget Sound most relevant to this study include three species of rockfish (Yelloweye, Canary, and Bocaccio), four species of salmonid (Chinook, Hood Canal summer-run Chum, steelhead, and Bull Trout), and one species of forage fish (Eulachon). In an effort to determine whether occurrence of these ESA-listed species has the potential to affect operations in the waters adjacent to the Naval Base Kitsap (NBK) at Bangor, the Naval Facilities Engineering Command Northwest (NAVFAC NW) and the Washington Department of Fish and Wildlife (WDFW) entered into a cooperative agreement whereby the WDFW agreed to survey these waters to evaluate both the seasonal and resident presence of ESA-listed fish.

The NAVBASE Kitsap Bangor, specifically the Bangor Naval Restricted Area (BNRA), was surveyed by the WDFW in 2014, 2015, and 2016 using various techniques and technologies. After reviewing the geographic scope, depth profile, water quality, and security restrictions associated with the survey area, it was determined that a combination of sampling methods including a remotely operated vehicle (ROV), split-beam echosounder (hydroacoustics), scuba diving, lighted fish traps, and beach seining would be used to survey the BNRA. Beach seine surveys targeted forage fish and juvenile salmonids in the nearshore, while all other sampling techniques were appropriate to surveying rockfish and critical habitat for all species. Surveys for rockfish were conducted at six month intervals in 2014 and 2015, while surveys for forage fish and juvenile salmonids occurred monthly in 2015 and 2016, in order to detect temporal changes in fish abundance or distribution. This report is only intended to outline the 2016 beach seine results and follow up one full year of sampling that began in 2015. See Appendix A for a comprehensive list of fish species recorded for beach seining in 2015-16. For results on rockfish, their critical habitat, and a description of sampling methods other than beach seine see the 2014-15 final report. Surveys focused on juvenile rockfish and their rearing habitat (i.e., nearshore vegetation) are planned to begin in early 2017.

There were two confirmed ESA-listed species captured with the beach seine at the NAVBASE Kitsap Bangor, Hood Canal summer-run Chum and Chinook Salmon. Summer-run Chum Salmon cannot be visually distinguished from fall-run Chum Salmon juveniles; therefore, tissue samples collected in 2016 facilitated run assignment through genetic analysis in a separate report. Sampling in 2016 began in January with the intention to capture Hood Canal summer-run Chum Salmon that were detected in nearshore areas earlier (January-February) than fall-run Chum Salmon (March-April). The peak catch rate for Chinook Salmon occurred in June for both survey years, primarily at the site south of the FSB. However, based on results from the 2015-16 surveys we preliminarily conclude that in order to reduce impact on juvenile salmon, the work window (July 15 to January 15) for the NAVBASE Kitsap Bangor facilities' in-water maintenance, military construction (MILCON), mitigation projects, future Fleet training and testing should not include February through July, as is consistent with the measures outlined in WAC 220-660-330.

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Background

The inland marine waters of Washington State, which include all waters east of Cape Flattery and south of the Canadian border (i.e., Puget Sound), are inhabited by a variety of species that have been afforded legal protection under the Endangered Species Act (ESA) due to a reduction in their range, average biomass, a combination of these population-level parameters, and/or their inherent "value" to humankind. This value may stem from fisheries or other exploitative uses, ecotourism, other non-exploitative uses, or recognition of the integral ecological role a species plays in the local or regional food web (NMFS online). Several fishes protected under the ESA within Puget Sound include Eulachon (*Thaleichthys pacificus*) (NMFS 2010a), Chinook Salmon (*Oncorhynchus tshawytscha*) (NMFS 1999a), Hood Canal summer-run Chum Salmon (*O. keta*) (NMFS 1999b), steelhead (*O. mykiss*) (NMFS 2007), and Bull Trout (*Salvelinus confluentus*) (USFWS 1999). Each of these species is listed as Threatened, being significantly reduced in abundance and experiencing ongoing pressure from several threats, but not under imminent threat of extirpation or extinction. In 2010, ESA protection was extended to three species of rockfish within a geographic area that includes the vast majority of Puget Sound (NMFS 2010b); Yelloweye Rockfish (*Sebastes ruberrimus*) and Canary Rockfish (*S. pinniger*) were afforded Threatened status, while Bocaccio (*S. paucispinis*) received an Endangered designation.

These ESA-listings have the capacity to influence nearshore construction activities and at-sea operations of private and government sector vessels. As a result, the United States Department of the Navy (DON) desired to understand the species composition, timing, and migration of ESA-listed Threatened and Endangered (T&E) fish, and additionally ensure compliance with the Fish and Wildlife Conservation Act, Magnuson-Stevens Fishery Conservation and Management Act, and the Sikes Act Improvement Act at the following nine Naval installations: Naval Air Station (NAS) Whidbey Island Crescent Harbor, NAS Whidbey Island Lake Hancock, Naval Magazine (NAVMAG) Indian Island, Naval Base (NAVBASE) Kitsap Keyport, NAVBASE Kitsap Bremerton, NAVBASE Kitsap Bangor, Naval Station (NAVSTA) Everett, Manchester Fuel Department (MFD), and Zelatched Point. A Cooperative Agreement (CA) was established between the DON and the Washington Department of Fish and Wildlife (WDFW) to design and implement studies to assess shoreline and adjacent marine water use by ESA-listed fish species. It was further agreed that the WDFW, based on known ESA-listed fish habitat preferences and trophic relationships, would also assess the suitability of the habitat and prey for supporting ESA-listed fish at each of the nine installations.

The four primary project tasks identified in the CA are: 1) a kick-off meeting to formalize the monitoring project planning and management; 2) develop survey protocols and a study plan; 3) conduct field surveys and collect field data; and 4) provide a final report documenting results of surveys at Navy installations. In accordance with Tasks 1 and 3, a kick-off meeting between principle participants from the WDFW and NAVFAC NW personnel was held in November 2015. The meeting included discussions on security, access, survey methods, scheduling, logistics, and installation-specific survey priorities. Monthly progress reports were prepared by the WDFW, and meetings were held periodically to discuss headway and to identify and resolve any impediments to the project. The WDFW coordinated and communicated extensively with installation security and other personnel to arrange for access at prescribed times and locations. Task 2 is detailed under headings below, and this report meets the deliverables requirement for the final task by detailing all research conducted as part of this cooperative agreement at the NAVBASE Kitsap Bangor installation.

Methods

Study Area

The NAVBASE Kitsap Bangor is located along the eastern shore in the northern reaches of Hood Canal (Figure 1a), and includes a marine facility within the Bangor Naval Restricted Area (BNRA) which encompasses an area of approximately 4.2km^2 (Figure 1b). Due to security restrictions, the study area was limited to the area shoreward of the BNRA boundary to the floating security barriers (FSB); as well as a specified exclusion zone near the southernmost pier structures. The areas restricted to these surveys are known as the Waterfront Restricted Area (WRA), port operations area, and Carderock exclusion zone (Figure 2). The study area covers approximately 2.4km^2, which is 57% of the overall marine area within the BNRA. The majority of bottom habitat is considered featureless mud and sand (NOAA nautical chart 18458), with vegetative habitat features including nearshore eelgrass (*Zostera* spp.) and macroalgal beds (e.g., Ulvales, Laminariales) occurring on pebble and cobble substrates (WA DOE Coastal Atlas Map).

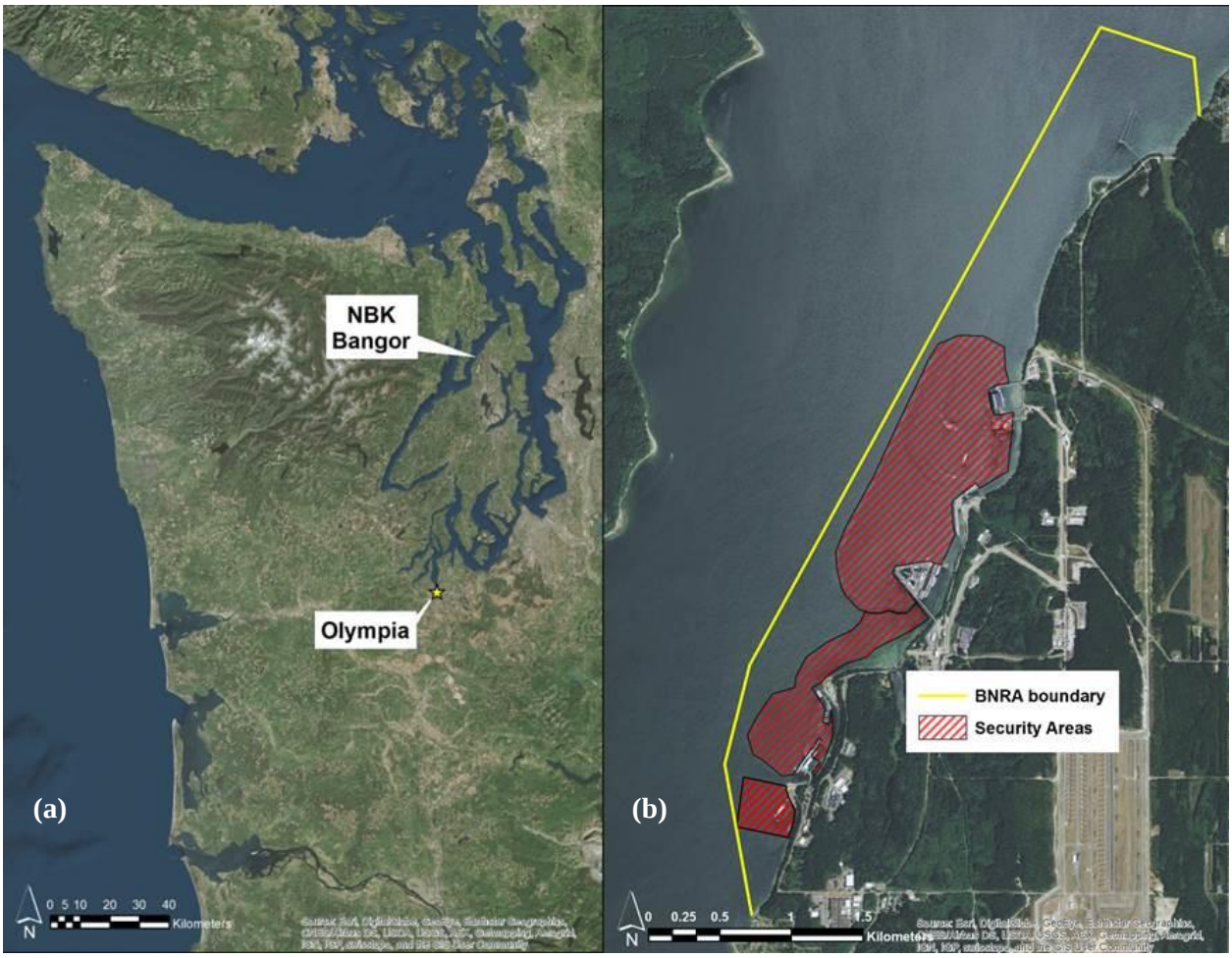

Figure 1. Orthophoto of the NAVBASE Kitsap Bangor location in Puget Sound (a) and the Bangor Naval Restricted Area (BNRA) boundary line in yellow and security areas in red stripes (within the floating security barrier) (b). Image from Esri DigitalGlobe.

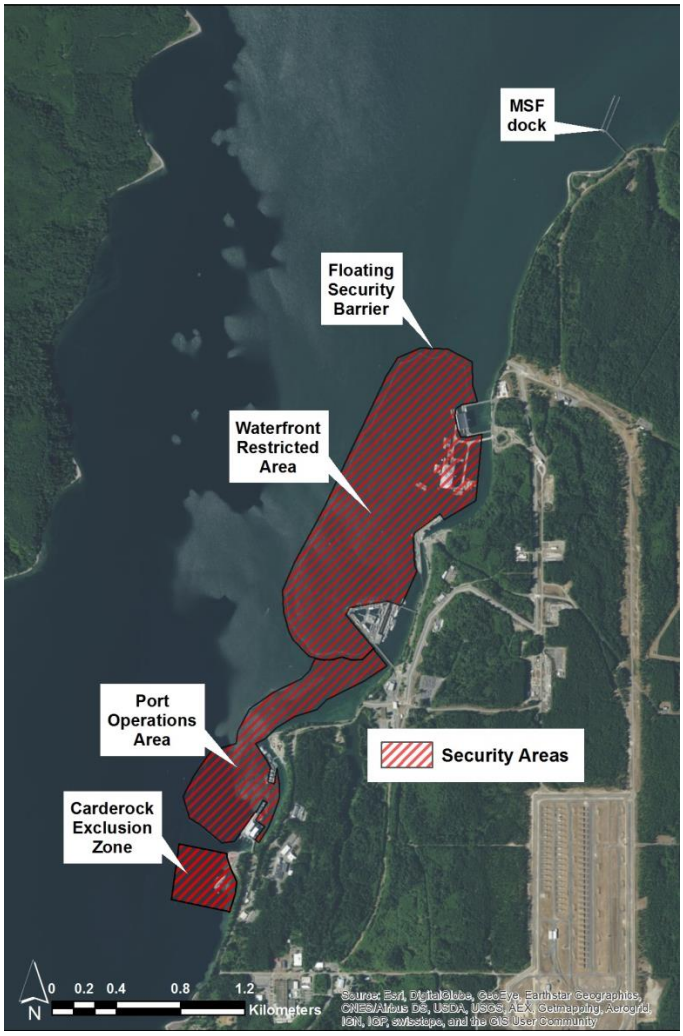

Figure 2. Orthophoto of the NAVBASE Kitsap Bangor identifying the security areas prohibited to the WDFW surveys: Carderock exclusion zone, port operations area, Waterfront Restricted Area (WRA). The floating security barrier (FSB) and Magnetic Silencing Facility (MSF) dock are also labeled. Image from Esri DigitalGlobe.

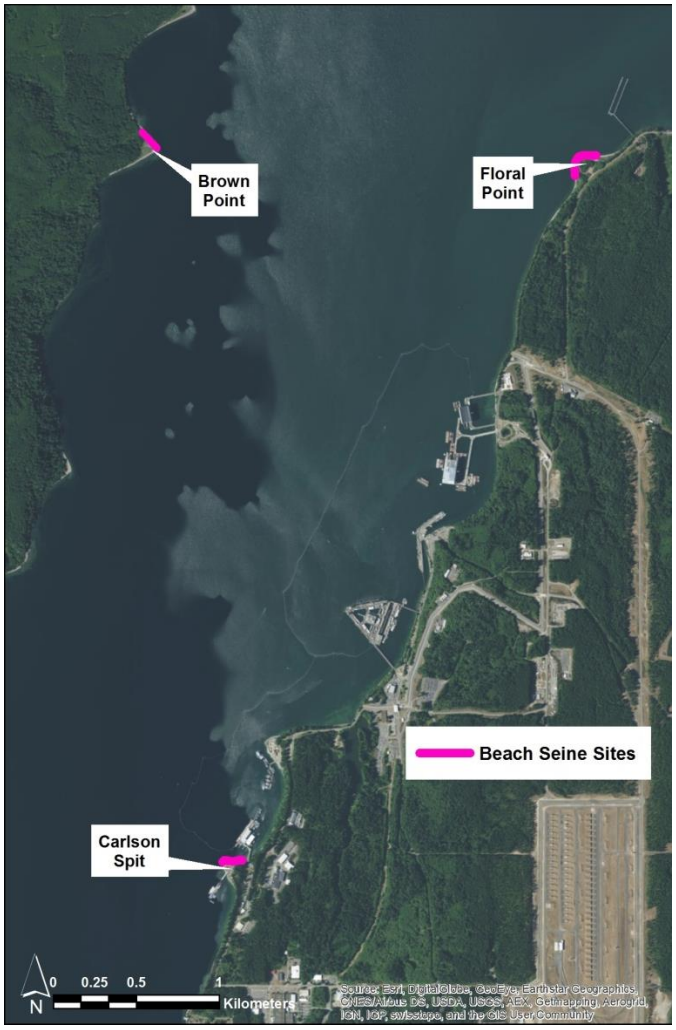

Figure 3. Orthophoto of the NAVBASE Kitsap Bangor identifying the beach seining survey sites: north site (Floral Point), south site (Carlson Spit), and west site (Brown Point). Image from Esri DigitalGlobe.

Within the study area, survey sites were sampled with a beach seine at Floral Point, Carlson Spit, and Brown Point (Figure 3). Floral Point is 1.5km north of the WRA boundary and is relatively undeveloped and unexploited in comparison to Carlson Spit, which is directly adjacent to the southern boundary of the port operations FSB and large service pier. Both of these sites were sampled in 2015 and 2016. Brown Point is an undeveloped shoreline outside the BNRA but occupies Navy property along the Toandos Peninsula, and was only sampled in 2016. Bangor's shoreline is classified as a mixture of feeder bluffs, transport zones, and accretion shoreforms; broken up by relatively small sections of modified shoreline (WA DOE Coastal Atlas Map). Each of the sampling sites is classified as accretion shoreforms, with mixed pebble and gravel substrate. Currents along the coast predominantly travel south to north, and eddy around numerous natural points and artificial structures during peak tidal exchanges. All three sites are historically documented spawning beaches for Pacific Sand Lance (*Ammodytes personatus*) (WDFW online).

Survey Design

Beach seining allows fish to be collected in the intertidal and shallow subtidal zone (<5m deep) where few other techniques are capable of sampling. This is critically important for assessing forage fish and juvenile salmonids because they rely heavily on this nearshore zone for spawning, feeding, refuge, and/or migration. From the possible array of shorelines controlled by the DoN in need of assessment, sampling sites were selected based on accessibility due to security restrictions, as well as the presence of suitable shorelines that would not severely snag the net (e.g., boulders, trees). These sites were sampled monthly from May to September in 2015 and January to September in 2016 at high-slack tides, which are known to be preferred by beach-spawning forage fish and migrating juvenile salmonids. A minimum of two to four beach seine "sets" were performed at each of the sites on a single date each month. Sampling typically began closest to the point on Carlson Spit, with subsequent sets deployed along the beach to the northeast. Sampling at Floral Point typically began at the point with subsequent sets deployed along the beach to the northeast. Sampling at Brown Point typically began along the northwest shoreline with the second set deployed closer to the point. All fish captured during sampling were identified, counted, and released.

Beach Seining Survey Protocols

Beach seine surveys were conducted during daylight hours, within two hours of high-slack tide using a 5.5m WDFW research vessel (aluminum hull, 115hp outboard motor) equipped with a bowpicker. The beach seine was 36.6m long x 3.7m deep with 3.2mm knotless nylon mesh (Cristensen Net Works - Everson, WA). The net was cut to taper from 1.8m to 3.7m deep in the leading 18.3m of net, followed by 18.3m of netting 3.7m deep (Figure 4). This "Skagit" net design is widely used by the WDFW, Wild Fish Conservancy (WFC), Skagit River System Cooperative (SRSC), and many other organizations to assess nearshore fish assemblages throughout the Puget Sound region.

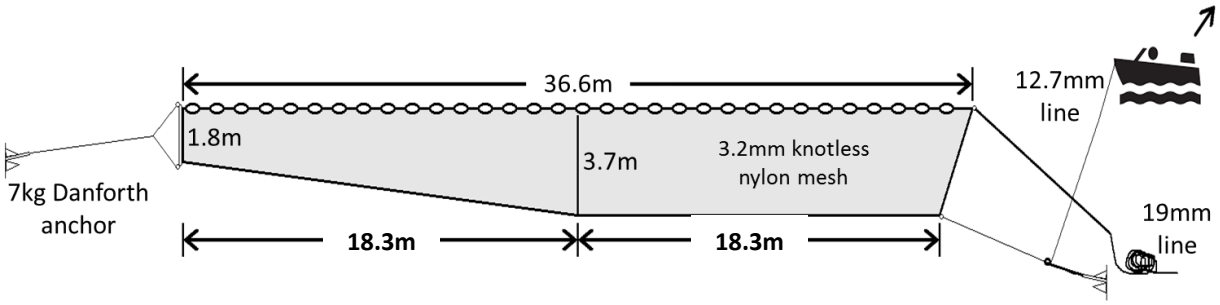

Figure 4. Diagram of the beach seine with dimensions used for sampling.

During sampling, the shallow end of the net was anchored to the beach with a 7kg Danforth anchor and deployed perpendicular to the beach. A haul line of 19mm braided nylon attached to the deep end of the net was secured to the bow with approximately 10m of line between the boat and end of the net. The net was towed by the boat in reverse against the current in a "round haul" fashion and returned towards shore at a point approximately 75% of the net's length (Figure 5). As the boat approached shore, a second line of 12.7mm, three-strand nylon attached at the net's lead line was tossed to a crew member on shore, passed through a stainless steel snatch block attached to a second anchor, and returned to the boat where it was secured to a post on the bow. The boat then carefully reversed away from shore pulling the line through the anchored snatch block, and landing the net on the beach (Figure 6a). Set durations ranged from three to five minutes from net deployment to landing on the beach, and each sampling trip typically included six to ten total sets on a given date.

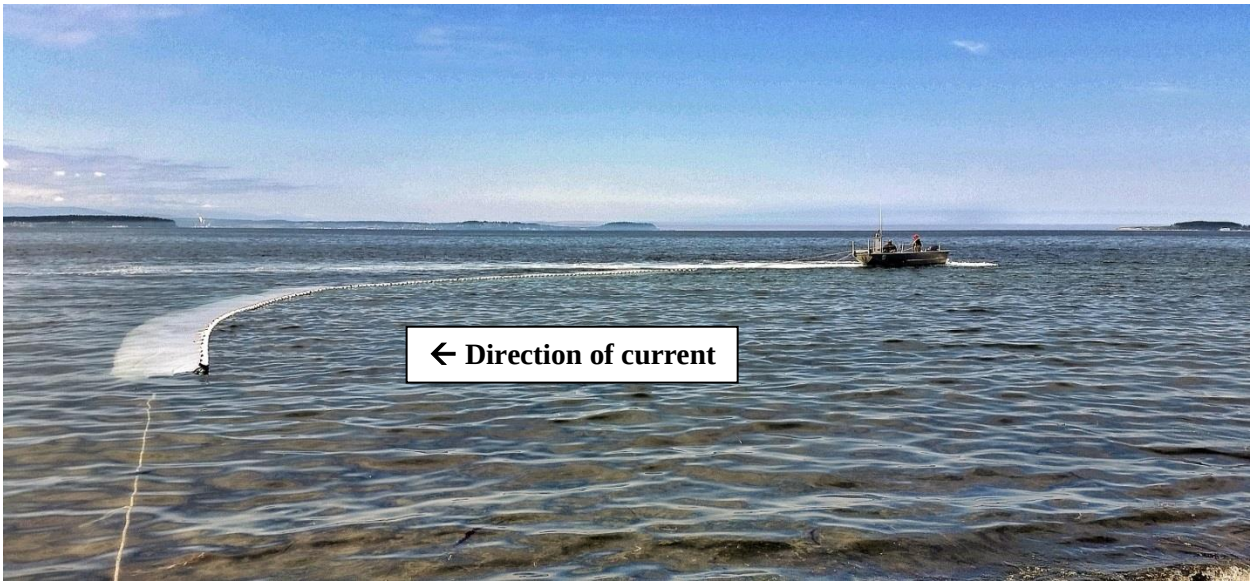

Figure 5. Photo taken while beach seining showing the "round haul" net deployment method into the current.

Figure 6. Photo taken during a beach seine set showing the use of a snatch block anchored to shore and research vessel to land the net (a). The WDFW beach seine staff sorting fish species in the landed net enclosure (b).

Upon landing the net, smaller catches were transferred to 113L containers that were aerated by bubblers and regularly irrigated with fresh seawater. Larger catches were retained in the net enclosure to minimize heat and oxygen stress during handling. Each set's catch was sorted and identified to the lowest possible taxonomic level and enumerated before release (Figure 6b). Holding time was often less than 5 minutes and not longer than 15 minutes. A subsample of each species of forage fish (n=40) and juvenile salmonid (n=20) was measured (fork length) to the nearest millimeter for each sampling trip. Salmonids were checked for adipose fin presence/absence to determine hatchery or natural-origin, if applicable to the species. In addition to collecting biological data specific to catch, information describing weather, water surface conditions, depth, tide stage and elevation, primary and secondary substrate characteristics, and amount of algae in each set was recorded.

Results

Beach Seine Surveys in 2015

Beach seine sampling occurred at Floral Point and Carlson Spit once a month from May to September 2015 (see Figure 3). A total of 33 sets were completed in 2015, with two to four sets occurring at each site on each date. The maximum nearshore water depths during beach seining averaged 6.6m at Floral Point and 7.1m at Carlson Spit.

A total of 37 fish species (including unidentified taxa) were captured over the five months of sampling from both sites consisting primarily of Shiner Perch (*Cymatogaster aggregata*) and Pacific Herring (*Clupea pallasii*) (Table 1). Species richness ranged from 9 to 27 species captured during each sampling trip, with peak species richness observed in June (Figure 7). Fork lengths were recorded for a total of 163 forage fish and 172 salmonids during all five months of sampling at both sites (Table 2).

Table 1. Total number of beach seine sets completed and counts of all marine fish captured by sampling month in 2015.

Species	12-May	9-Jun	10-Jul	5-Aug	4-Sep	Total	% of Total
# of Sets Completed	**4**	**6**	**7**	**8**	**8**	**33**	-
Bay Pipefish	1	7	13	9		30	0.51%
Buffalo Sculpin		2			4	6	0.10%
Chinook Salmon		18	7	4	2	31	0.53%
Chum Salmon	3	20				23	0.39%
C-O Sole			2	3		5	0.09%
Coho Salmon	32	16	4	1		53	0.91%
Copper Rockfish (juvenile)			2			2	0.03%
Crescent Gunnel		3			3	6	0.10%
Cutthroat Trout	19	27	9	7	1	63	1.08%
English Sole			33	16	5	54	0.92%
Flatfish (unidentified)		1	7			8	0.14%
Fluffy Sculpin		2	1			3	0.05%
Great Sculpin			1			1	0.02%
Greenling (unidentified)		2				2	0.03%
Gunnel (unidentified)			29	51		80	1.37%
Pacific Herring			714	2	6	722	12.35%
Pacific Mackerel		1				1	0.02%
Pacific Sand Lance	1	47	11	63	1	123	2.10%
Pacific Staghorn Sculpin	4	27	99	37	16	183	3.13%
Padded Sculpin			7	20	20	47	0.80%
Penpoint Gunnel		2				2	0.03%
Pile Perch		17		14	1	32	0.55%
Pink Salmon		2		1	1	4	0.07%
Rock Sole		1		2	3	6	0.10%
Rockweed Gunnel			1			1	0.02%
Saddleback Gunnel		6	25	14	5	50	0.86%
Sculpin (unidentified)	1	2			1	4	0.07%
Shiner Perch	1147	284	1835	408	405	4079	69.77%
Slender Cockscomb				1		1	0.02%
Snake Prickleback				10		10	0.17%
Splitnose Rockfish (juvenile)		1				1	0.02%
Starry Flounder	1	1	4	3	2	11	0.19%
Surf Smelt		21	3	18	1	43	0.74%
Threespine Stickleback		3	88	42	3	136	2.33%
Tidepool Sculpin		5	10	1	2	18	0.31%
Tubesnout		2				2	0.03%
Whitespotted Greenling		1	1	1		3	0.05%

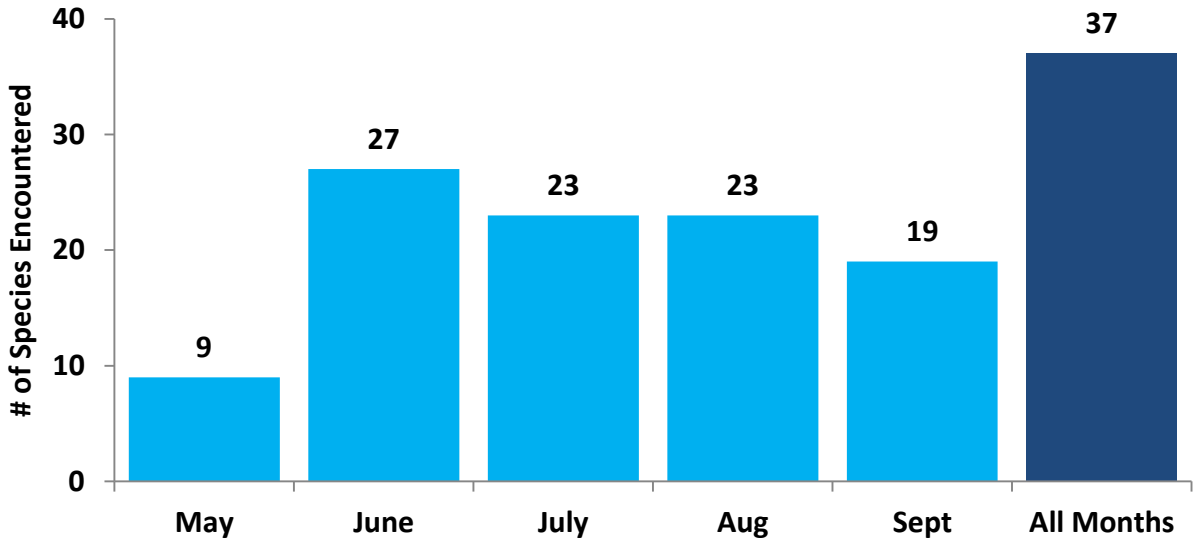

Figure 7. Species richness (including unidentified taxa) of all fish captured during beach seining surveys, by month and all months combined in 2015.

Table 2. Fork length (mm) data summaries for juvenile salmonid (left) and all forage fish (right) species sampled in 2015. *Indicates adult salmonids (>300mm). Cutthroat Trout includes juveniles and adults.

Species	Mean ±SD	CV	n
Chinook natural	87 ±15.00	0.17	8
Chinook hatchery	119.18 ±47.19	0.40	22
Chinook natural*	555	-	1
Coho natural	109.42 ±13.28	0.12	45
Coho hatchery	128.13 ±61.46	0.48	8
Chum Salmon	112.96 ±26.41	0.23	23
Pink Salmon	112 ±46.67	0.42	2
Pink Salmon*	460 ±12.73	0.03	2
Cutthroat Trout	211.64 ±55.69	0.26	61

Species	Mean ± SD	CV	n
Pacific Herring	69.94 ± 12.67	0.18	33
Pacific Sand Lance	86.24 ± 14.75	0.17	87
Surf Smelt	91.16 ± 24.19	0.27	43

Forage fish species captured in 2015 included Pacific Sand Lance, Surf Smelt (*Hypomesus pretiosus*), and Pacific Herring with peak catch rates occurring in June through August (Figure 8). The most commonly captured forage fish species during all five months of sampling was Pacific Sand Lance, encountered at both sites with peak catch rates in June and August (7.8 fish/set). Pacific Sand Lance fork length data for all months combined fit the age-length estimates for mixed broods up to age-2 (Emmett et al. 1991, Greene et al. 2011) (Figure 9). Surf Smelt were captured at both sites with a peak catch rate in June (3.5 fish/set) and declined in August (2.3 fish/set). Surf Smelt mean fork length data for all months combined resulted in high variation (CV=0.27), and a bimodal distribution of mixed age classes (Figure 10) as well as variation in length between sexes of the same age class (Penttila 1978). Pacific Herring were captured at both sites, but predominantly from the Floral Point site, with a peak catch rate in July (102 fish/set) that then declined in August and September (<1 fish/set). Pacific Herring captured in July through September fit the age-length estimates for age-0 and age-1 fish (Buchanan 1985) (Figure 11). No ESA-listed Eulachon were captured during any beach seine sampling.

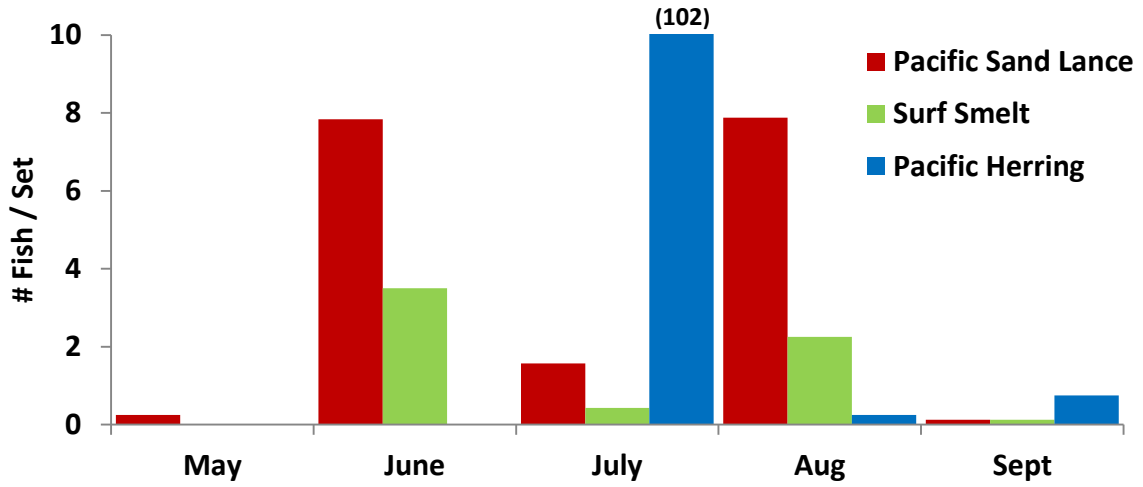

Figure 8. Catch rates for forage fish species captured during beach seining, by month for both sites combined in 2015. Values are labeled for catch rates exceeding the vertical axis.

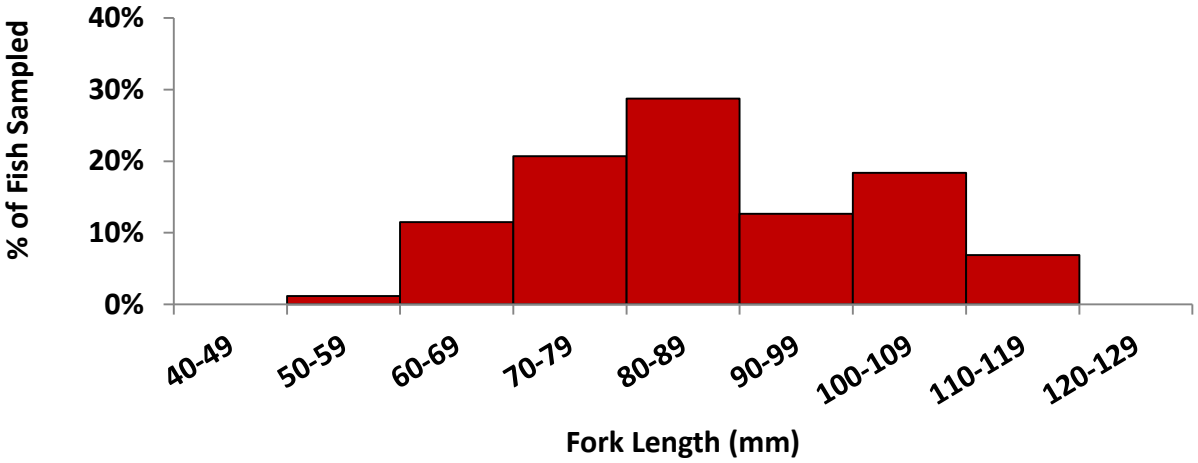

Figure 9. Pacific Sand Lance fork length histogram for all months and sites combined in 2015.

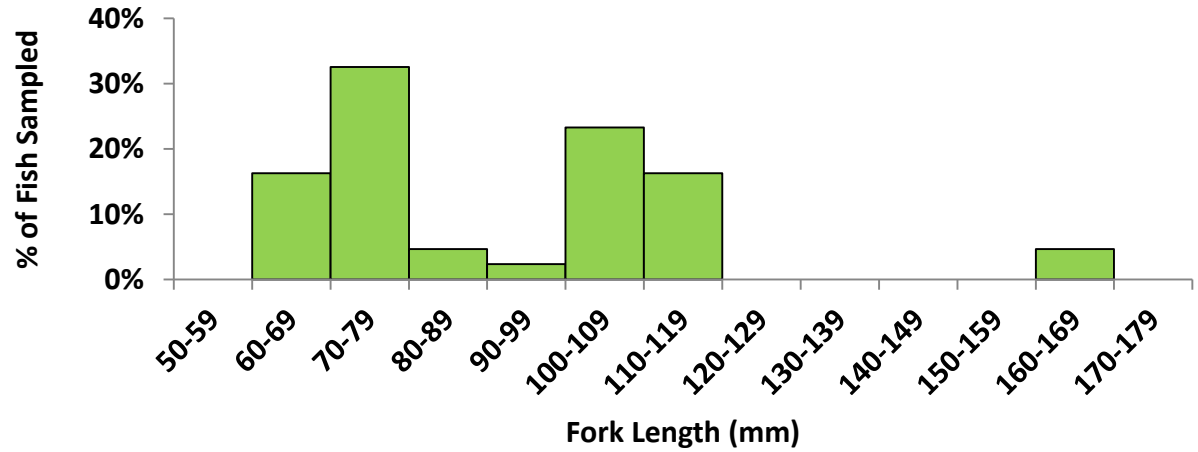

Figure 10. Surf Smelt fork length histogram for all months and sites combined in 2015.

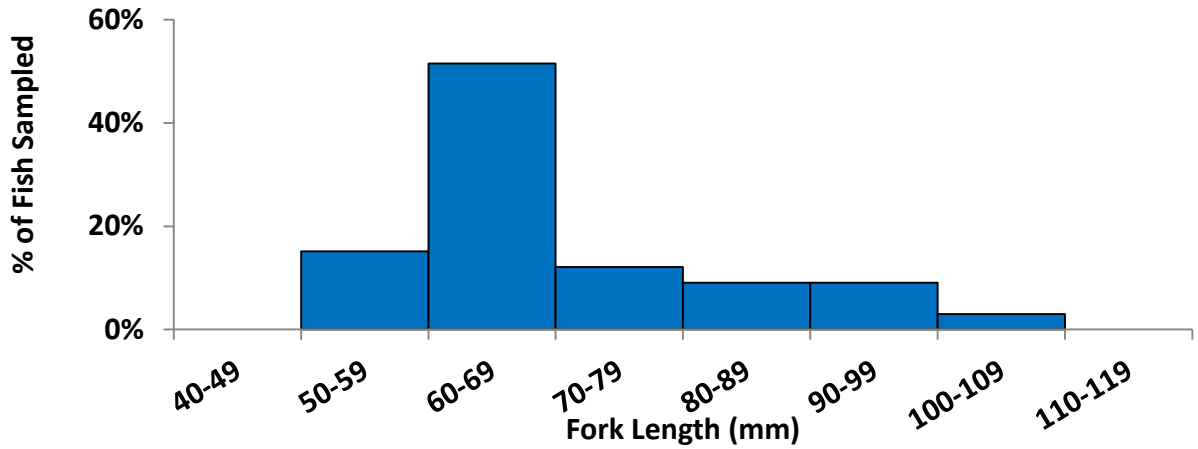

Figure 11. Pacific Herring fork length histogram for all months and sites combined in 2015.

Salmonid species captured in 2015 included Chinook Salmon, Chum Salmon, Coho Salmon (*O. kisutch*), Pink Salmon (*O. gorbuscha*), and Cutthroat Trout (*O. clarkii*) with variable peak catch rates occurring in May and June (Figure 12). Salmonid fork lengths generally increased for each species' cohort, as a consequence of seasonal growth after outmigration from local watersheds, from May through September (Figure 13). Chinook Salmon was the only confirmed ESA-listed species captured at the NAVBASE Kitsap Bangor in 2015, predominantly recorded from Carlson Spit but present at both sites. The peak catch rate occurred during June (3 fish/set), consisting of 11 hatchery and 7 natural-origin fish, and steadily decreased through September. A single adult Chinook Salmon was captured in July. Chum Salmon were mostly captured at the Carlson Spit site with the peak catch rate occurring in June (3.3 fish/set). Chum Salmon were entirely absent from catches during July through September sampling. Coho Salmon catch rates reflected an even distribution from both sites, with the peak rate observed in May (8 fish/set), before declining steadily from June through August. Only 8 of the 53 total Coho Salmon were hatchery-origin. A total of four Pink Salmon were captured from both sampling sites; two juveniles in June, and one adult in both August and September. Cutthroat Trout were captured at both sites but primarily from Carlson Spit with peak catch rates in May (4.8 fish/set) and June (4.5 fish/set). Cutthroat Trout fork length data for all months combined showed high variation (CV=0.26), and multiple age classes from juvenile to adult (Emmett et al 1991).

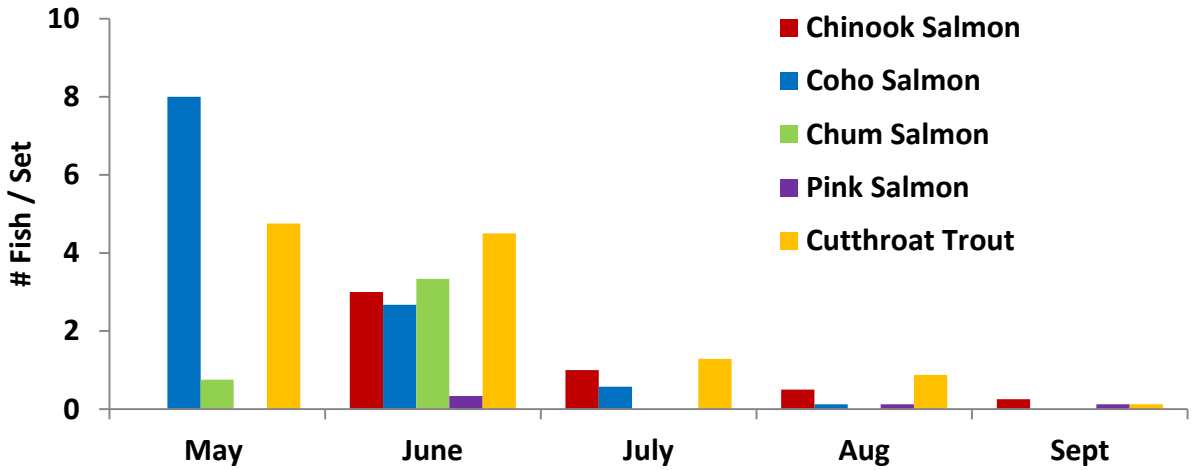

Figure 12. Catch rates for salmon species and Cutthroat Trout captured during beach seining, by month for both sites combined in 2015.

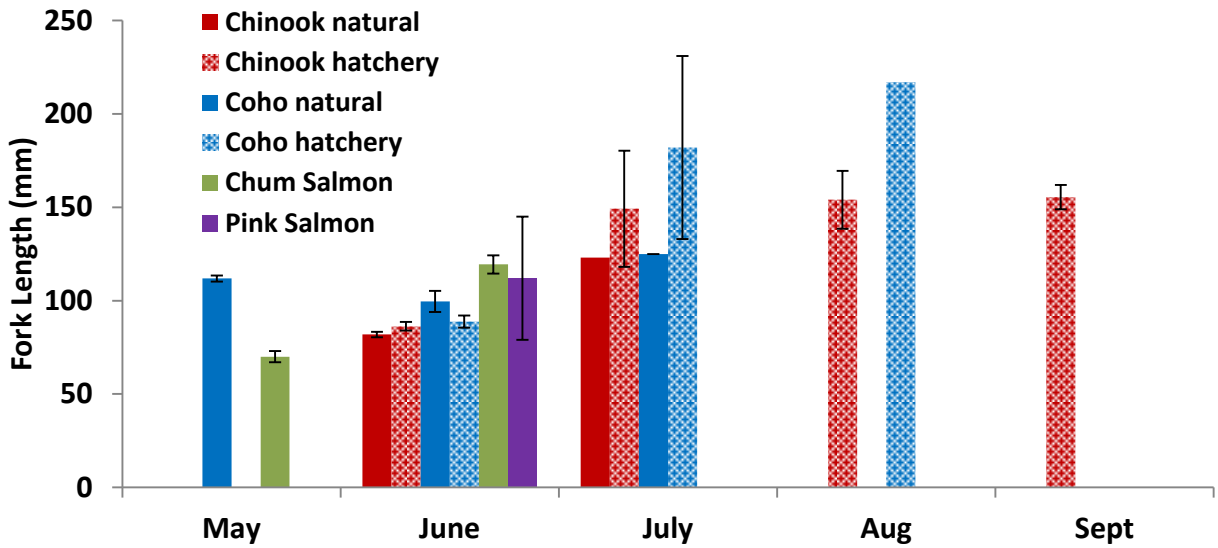

Figure 13. Mean fork length (± 1SE) for juvenile salmonid species, by month for both sites in 2015.

Three age-0 rockfish were captured with the beach seine in June and July. Many age-0 rockfish can be difficult to identify to species without genetic analysis, but these were presumably identified as one Splitnose Rockfish (*S. diploproa*) at Floral Point, and two Copper Rockfish (*S. caurinus*) from Carlson Spit (Figure 14). None of these age-0 rockfish matched the physical characteristics of any of the three ESA-listed rockfish species. All of these rockfish were determined to be age-0 due to their small lengths (31mm to 46mm), and were likely rearing in the nearshore vegetation.

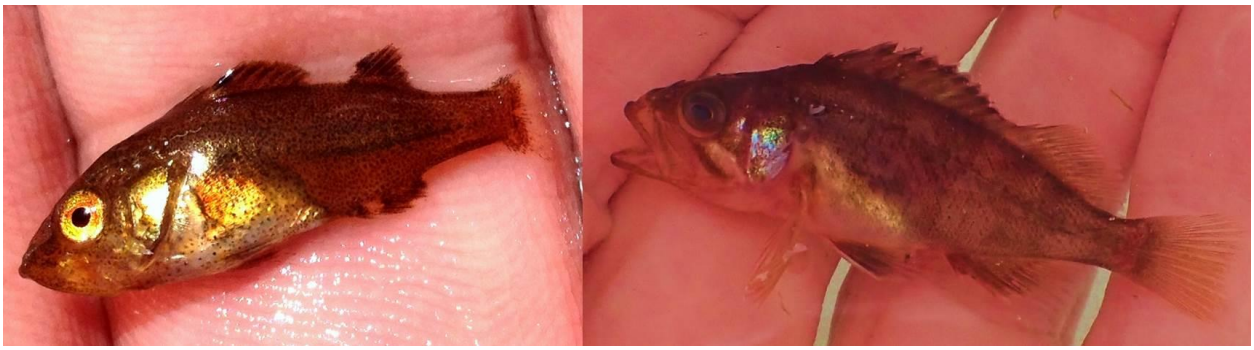

Figure 14. Photos of age-0 Splitnose Rockfish (left), and age-0 Copper Rockfish (right) captured in the beach seine.

Beach Seine Surveys in 2016

Beach seine sampling occurred at Floral Point, Carlson Spit, and Brown Point once a month from January to September 2016. A total of 79 sets were completed in 2016, with two to four sets occurring at each site on each date. The Brown Point site was not sampled in April due to extremely high Chum Salmon densities (509 fish/set) encountered at the other sites that potentially exceeded the expected take of ESA-listed Chum requested on the project's collection permit. The maximum nearshore water depths during beach seining averaged 5.4m at Floral Point, 6.0m at Carlson Spit, 4.4m at Brown Point.

A total of 38 fish species (including unidentified taxa) were captured over the nine months of sampling from all three sites consisting primarily of Shiner Perch, Pacific Herring, and Chum Salmon (Table 3). Species richness ranged from 6 to 22 species captured during each sampling trip, with peak species richness observed from June through September (Figure 15). Fork lengths were recorded for a total of 174 forage fish and 401 salmonids during all nine months of sampling at the three sites combined (Table 4).

Table 3. Total number of beach seine sets completed and counts of all marine fish captured by sampling month in 2016.

Species	5-Jan	2-Feb	7-Mar	1-Apr	13-May	14-Jun	12-Jul	11-Aug	7-Sep	Total	% Total
# of Sets Completed	9	8	10	2	10	10	10	10	10	79	-
Artedius Spp. (Sculpins)				1	2	3			1	7	0.05%
Bay Pipefish	5	3	2		1	3	1	4		19	0.13%
Buffalo Sculpin	7	9	21		1	5	3	2	1	49	0.34%
Chinook Salmon			2		4	5	1	3	4	19	0.13%
Chum Salmon	48	125	594	1019	14	3	1			1804	12.64%
C-O Sole									1	1	0.01%
Coho Salmon	1				36	6	2	9	6	60	0.42%
Crescent Gunnel							1			1	0.01%
Cutthroat Trout		1			27	15	17	9	18	87	0.61%
English Sole		6	2		9	60	53	38	17	185	1.30%
Flatfish (unidentified)	1			4		11		1		17	0.12%
Gadidae (unidentified)						1				1	0.01%
Goby (unidentified)			1							1	0.01%
Great Sculpin		2	2							4	0.03%
Greenling (unidentified)		3								3	0.02%
Gunnel (unidentified)					1					1	0.01%
Kelp Perch									1	1	0.01%
Northern Anchovy								3	12	15	0.11%
Pacific Herring						4	1	102710	8	*2723	*19.1%
Pacific Sand Lance	1					143	16	6		166	1.16%
Pacific Staghorn Sculpin	2		1		18	107	161	45	67	401	2.81%
Padded Sculpin	3	3	3			3	2	6	12	32	0.22%
Pile Perch							31	3	26	60	0.42%
Pink Salmon	1	8	36	102	3					150	1.05%
Rock Sole	1	2						1	3	7	0.05%
Saddleback Gunnel			1		94	118	27	42	22	304	2.13%
Salmonid (unidentified)								1		1	0.01%
Sculpin (unidentified)	1			5		1	1			8	0.06%
Sharpnose Sculpin	1				11		1	1	1	15	0.11%
Shiner Perch					1143	2432	2626	503	1279	7983	55.92%
Slender Cockscomb	1									1	0.01%
Snake Prickleback						4		1	1	6	0.04%
Starry Flounder	2	2	3		3	28	6	14	7	65	0.46%
Striped Seaperch									2	2	0.01%
Surf Smelt			1	1	2	4	3	3	17	31	0.22%
Threespine Stickleback	1					14	10	14	3	42	0.29%
Tidepool Sculpin						1				1	0.01%
Tubesnout			2							2	0.01%

***** Total excludes an estimated 100,000 Pacific Herring captured in a single set in August.

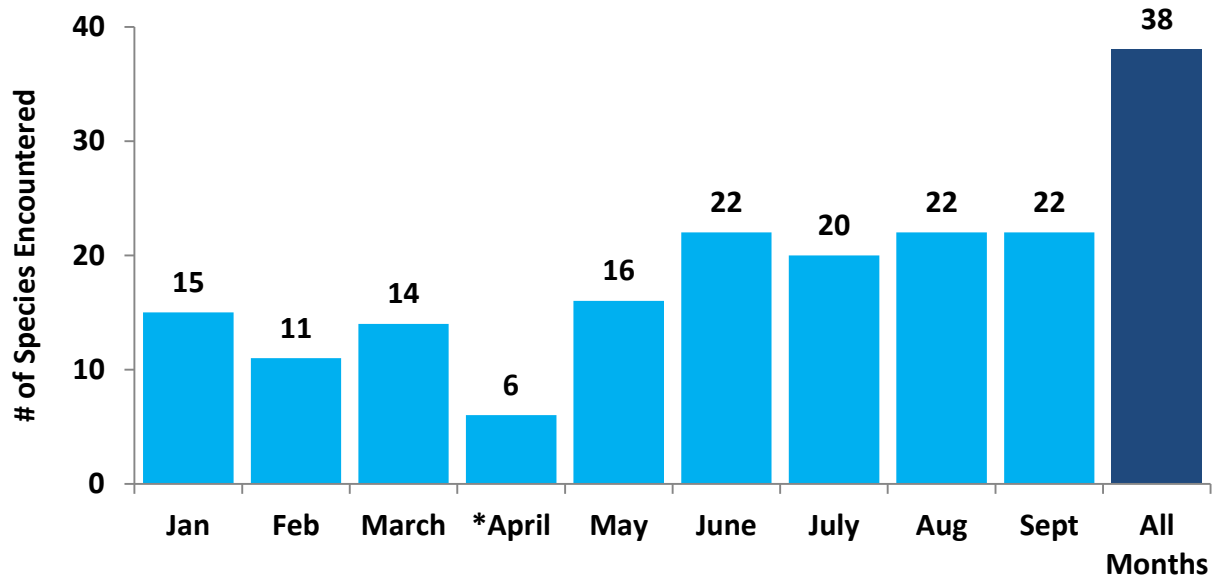

Figure 15. Species richness (including unidentified taxa) of all fish captured during beach seining surveys, by month and all months combined in 2016. *Only two sets were completed in April due to high densities of Chum Salmon.

Table 4. Fork length (mm) data summaries for juvenile salmonid (left) and all forage fish (right) species sampled in 2015. *Indicates adult salmonids (>300mm). Cutthroat Trout includes juveniles and adults.

Species	Mean ±SD	CV	n
Chinook natural	150.50 ±48.79	0.32	2
Chinook hatchery	140.13 ±63.33	0.45	16
Chinook hatchery*	650	-	1
Coho natural	106.34 ±32.11	0.30	44
Coho hatchery	208.53 ±84.16	0.40	15
Coho hatchery*	349	-	1
Chum Salmon	43.73 ±11.50	0.26	183
Pink Salmon	38.56 ±10.78	0.28	52
Cutthroat Trout	207.45 ±75.15	0.36	87

Species	Mean ±SD	CV	n
Pacific Herring	78.11 ±15.62	0.20	53
Pacific Sand Lance	108.08 ±22.71	0.21	77
Surf Smelt	112.38 ±26.25	0.23	29
Northern Anchovy	35.93 ±12.00	0.33	15

Forage fish species captured in 2016 included Pacific Herring, Pacific Sand Lance, Surf Smelt, and Northern Anchovy (*Engraulis mordax*) with peak catch rates occurring from June through September (Figure 16). Forage fish catch rates varied widely by location each month, with Pacific Herring dominating the catch at the Carlson Spit site in August with an estimated 100,000 fish from a single set. Pacific Herring were also captured at the Floral and Brown Point sites, but only at minimal catch rates (<1 fish/set). Pacific Herring fork length data fit the age-length estimates for age-0 and age-1 fish (Buchanan 1985) (Figure 17). Pacific Sand Lance were encountered at all sites with a peak catch rate in June (14.3 fish/set). Pacific Sand Lance fork length data for all months combined resulted in high variation (CV=0.21), and a multimodal distribution for mixed broods up to age-3 (Emmett et al. 1991, Greene et al. 2011) (Figure 18). Surf Smelt catch rates were very low (<1 fish/set) throughout 2016 with a peak catch rate in September (1.7 fish/set). Surf Smelt fork length data for all months combined resulted in high variation (CV=0.23), and a multimodal distribution of mixed age classes (Figure 19) as well as variation in length between sexes of the same age class (Penttila 1978). Northern Anchovy were only encountered in August and September at low rates (<2 fish/set), primarily at the Carlson Spit site. Nearly all of the Anchovy captured fit the age-length estimates for post-larval fish (Emmet et al. 1991) (Figure 20). No ESA-listed Eulachon were captured during any beach seine sampling.

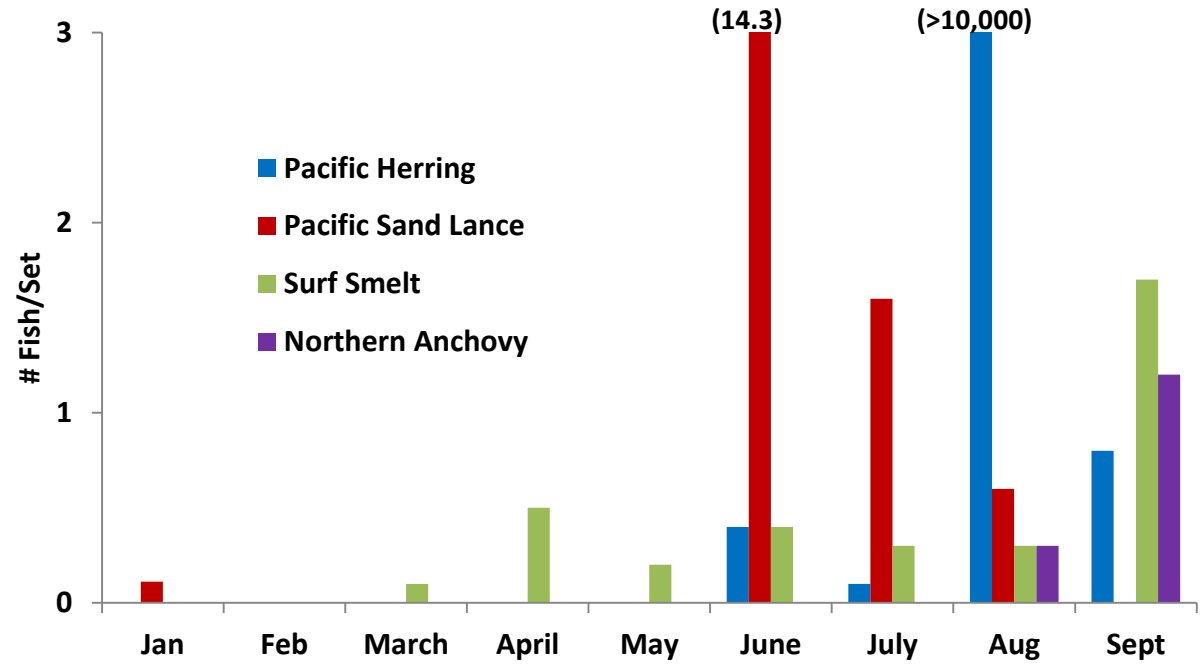

Figure 16. Catch rates for forage fish species captured during beach seining, by month for both sites combined in 2016. Values are labeled for catch rates exceeding the vertical axis.

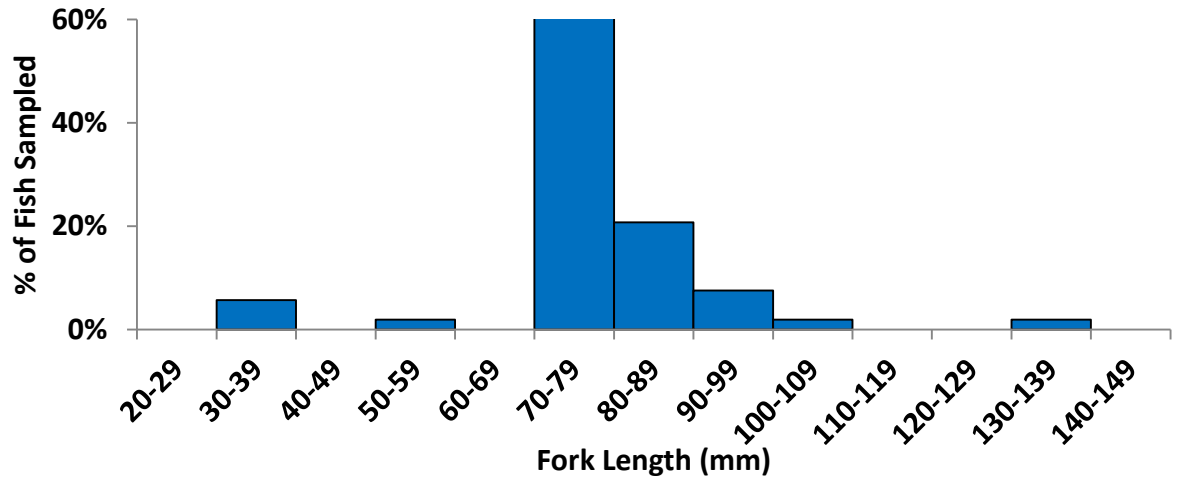

Figure 17. Pacific Herring fork length histogram for all months and sites combined in 2016.

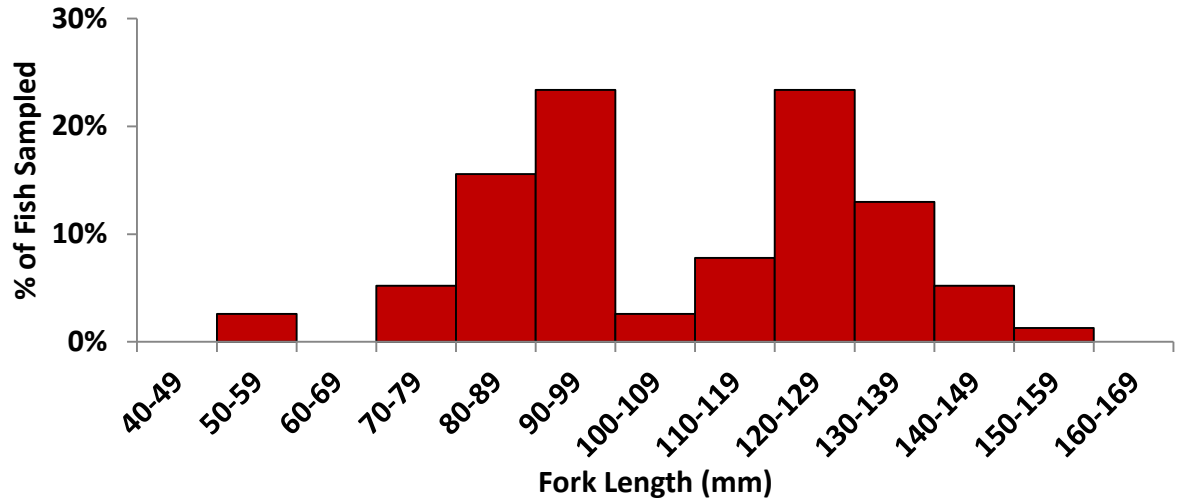

Figure 18. Pacific Sand Lance fork length histogram for all months and sites combined in 2016.

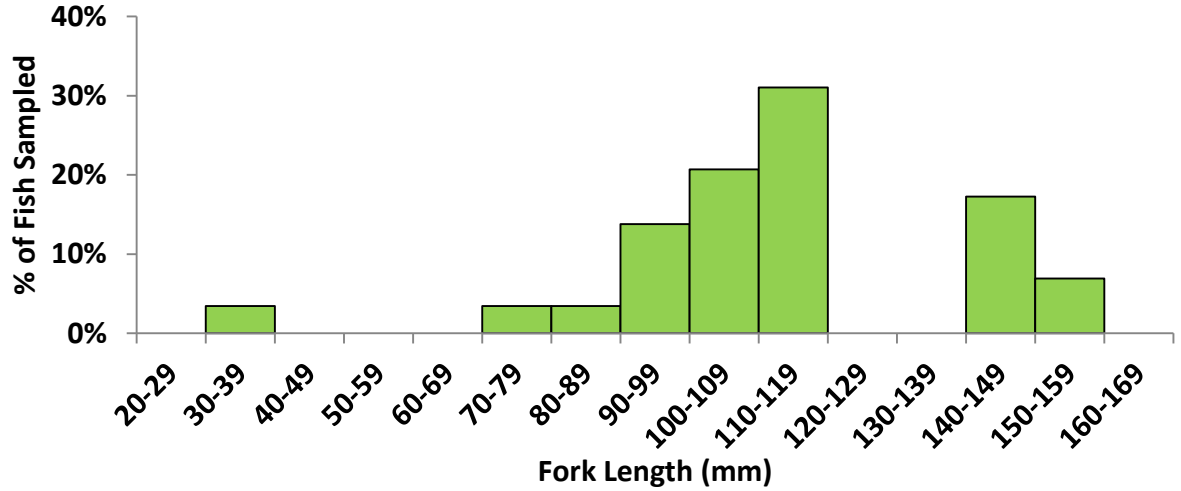

Figure 19. Surf Smelt fork length histogram for all months and sites combined in 2016.

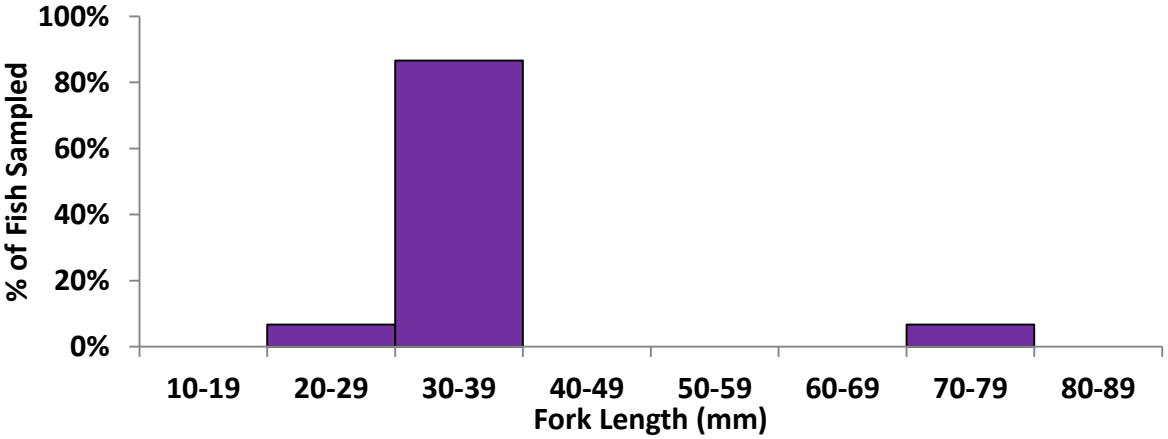

Figure 20. Northern Anchovy fork length histogram for all months and sites combined in 2016.

Salmonid species captured in 2016 included Chinook Salmon, Chum Salmon, Coho Salmon, Pink Salmon, and Cutthroat Trout with variable peak catch rates occurring from March through June (Figure 21). Salmonid fork lengths generally increased for each species' cohort, as a consequence of seasonal growth after outmigration from local watersheds, from January through September (Figure 22). Chinook Salmon was one of the confirmed ESA-listed species captured at the NAVBASE Kitsap Bangor, predominantly recorded from the Carlson Spit and Floral Point sites. The peak catch rate occurred during May and June (0.5 fish/set), and catches remained very low through September. One adult hatchery Chinook Salmon was captured in September. Coho Salmon were captured at all sites with the peak catch rate observed in May (3.6 fish/set), that then declined during June through September (<1 fish/set). Only 16 of the 60 total Coho Salmon were hatchery-origin. Chum Salmon were encountered in large densities from January to April at all sites with the peak catch rate occurring in April (509 fish/set) and quickly declining in May (<2 fish/set). Genetic analysis of Chum tissue samples revealed that ESA-listed Hood Canal summer-run fish comprised 97% of all Chum captured in both January and February, while 84% of all Chum captured from March through May were fall-run fish (Figure 23). Pink Salmon were captured at all sites with the peak catch rate occurring in April (51 fish/set) and quickly declining in May (<1 fish/set). Cutthroat Trout were captured at all sites with the peak catch rate in May (2.7 fish/set), which then declined through September (<2 fish/set). Cutthroat Trout mean fork length data for all months combined showed high variation (CV=0.36), and multiple age classes from juvenile to adult (Emmett et al 1991).

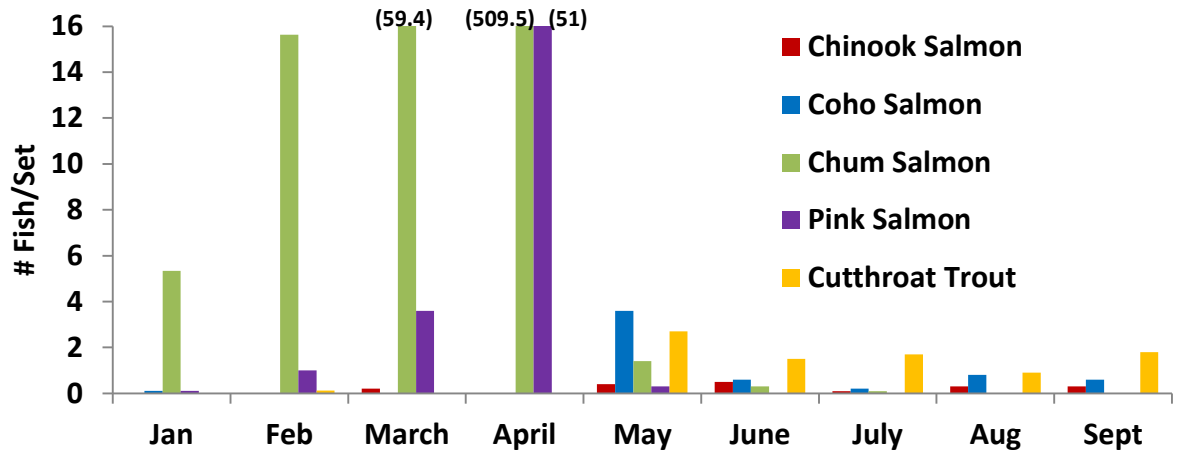

Figure 21. Catch rates for salmonid species captured during beach seining, by month for all sites combined in 2016. Values are labeled for catch rates exceeding the vertical axis.

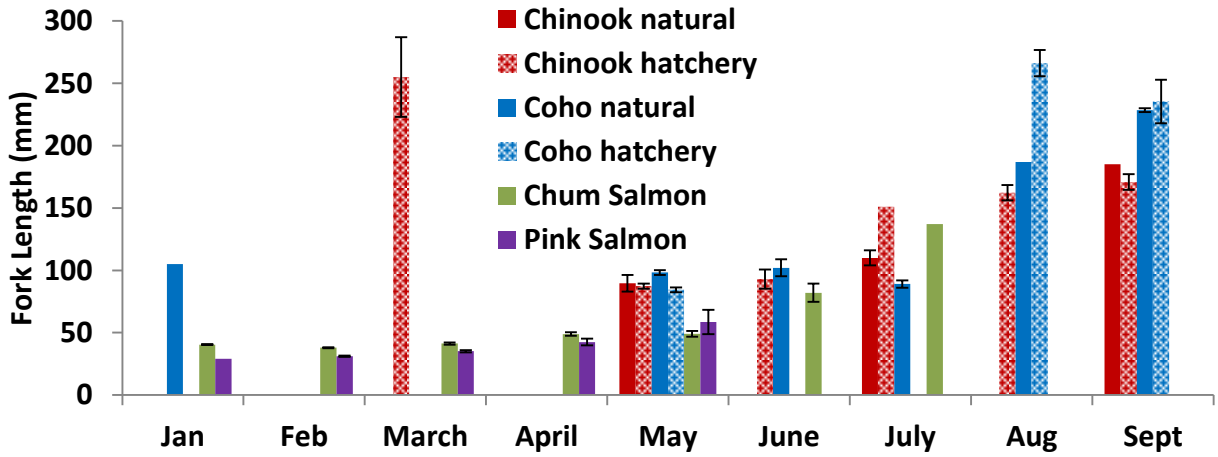

Figure 22. Mean fork length (± 1SE) for juvenile salmonid species, by month for all sites in 2016.

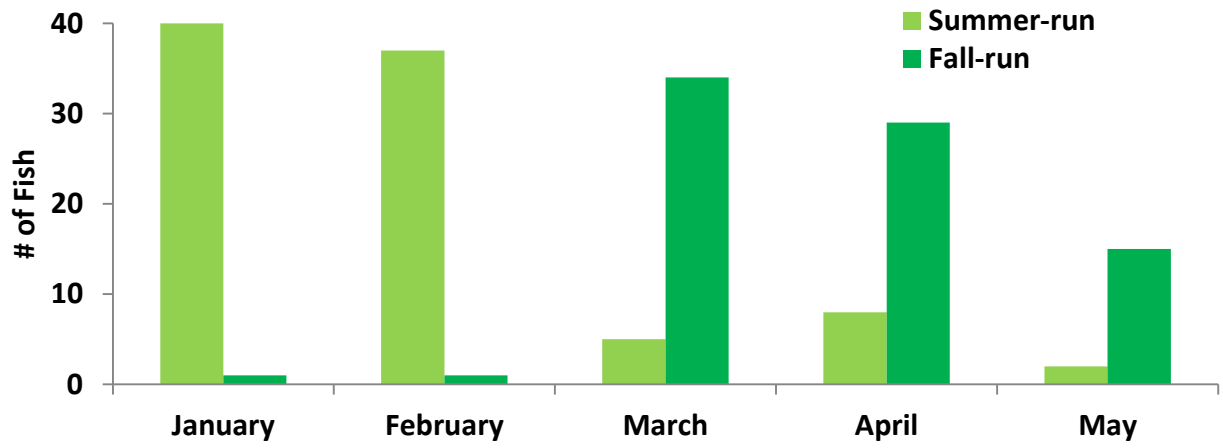

Figure 23. Run assignment of Chum Salmon captured in Hood Canal, by month in 2016.

Discussion

Forage Fish and Salmonids in 2015-16

Beach seine surveys were completed to assess ESA-listed forage fish and salmonid species' use of marine nearshore habitats, specifically with regard to their timing, distribution, and relative abundance adjacent to the NAVBASE Kitsap Bangor facilities and the BNRA. This report combines both 2015 and 2016 survey years with the intent to update and compare past surveys of forage fish and salmonids, conducted with a similar design, using a beach seine along the Bangor shoreline and other areas of Hood Canal. Past studies have also focused their sampling efforts from January through early and late summer to assess the different outmigration patterns of each salmonid species (see Schreiner et al. 1977; Bax et al. 1978, 1979, 1980; Salo et al. 1980; SAIC 2006, 2009a). Due to increased security restrictions, the sampling sites in 2015-16 were not accessible inside the FSB where these past studies have sampled. Therefore, comparisons of the 2015-16 survey results with previous reports are limited by their discrepancy in ranges of shoreline and diversity of Navy facilities' overwater structures.

In Puget Sound, forage fish species occupy every marine and estuarine nearshore habitat, and their spawning habitats all commonly occur within the nearshore zone of Pacific Northwest beaches (Penttila 2007). However, little is known about any forage fish species away from their spawning grounds (Penttila 2007). Due to their critical role as prey species for salmon and marine mammals, conservation efforts regarding their abundance trends and spawning habitats have been considerably emphasized. Overwater structures (e.g., docks, piers, floats, boathouses) have potential negative impacts on these spawning habitats, but they vary depending on the species and the size and configuration of the structure (Nightingale and Simenstad 2001, Penttila 2007). The extent of which the many overwater structures at the NAVBASE Kitsap Bangor that may impact forage fish spawning grounds remains uncertain. The Bangor shoreline consists of several areas historically documented as Pacific Sand Lance spawning beaches in late fall and winter (WDFW online); most of which are located immediately adjacent to complex DoN structures. Documented spawning grounds for Surf Smelt and Pacific Herring are largely absent throughout much of the north-central portion of Hood Canal, and such sites have not been historically documented along the Bangor shoreline (WDFW online).

Forage fish were primarily captured with the beach seine during June through September sampling in both 2015 and 2016, though no ESA-listed forage fish were encountered. The timing of forage fish species at the NAVBASE Kitsap Bangor in 2015-16 is one to two months later than other recent beach

seining studies have documented along the same shoreline (SAIC 2006, 2009a). Regarding abundance, catches of forage fish in 2015-16 showed high variation and inconsistency, which was similar to recent studies along the same shoreline (SAIC 2006, 2009a). The disparities among these six different survey years (2005-08 and 2015-16) could be indicative of natural interannual variation driven by sea surface temperature, prey abundance, or other factors affecting both broad-scale population demographics and localized habitat usage. Pacific Sand Lance peak catch rates occurred in June, and continued to be captured through August for both survey years. Surf Smelt were captured in greater numbers during 2015 with peak catch rates in June and August, however relatively low densities of this species were captured throughout the 2016 sampling season, and the peak catch rate was observed in September. Pacific Herring were encountered at high densities in July 2015 and August 2016 but only captured in abundance from one or two sets; however, sampling during subsequent months resulted in minimal catches from all sites. Northern Anchovy were only captured during August and September 2016 sampling at very low catch rates. Fork length data for all species of forage fish indicate presence of both age-0 juveniles and sexually mature adults simultaneously utilizing nearshore habitat within the sampling areas. No ESA-listed species of forage fish (i.e., Eulachon) were captured during the 2015-16 sampling, and are not documented to commonly occur in Hood Canal (Pietsch and Orr 2015). The SAIC (2006, 2009a) survey reports indicated the capture of very few Eulachon in 2006 (n=5) and 2008 (n=2), which could plausibly be transient migrants from Canadian stocks (i.e., Fraser River).

Pacific Salmon (*Oncorhynchus* spp.) depend upon a wide range of habitats throughout their life cycle (Groot and Margolis 1991, Nightingale and Simenstad 2001). The nearshore zone along the northern reaches of Hood Canal, including the Bangor shoreline, serves as an essential migration route for nearly all juvenile salmonids (natural and hatchery) produced in the Hood Canal region. When these juveniles enter the marine environment from their natal streams, they depend upon nearshore vegetated habitats for prey resources and shelter from predation. In this way, shallow nearshore habitats are critical to the survival of such species (Naiman and Seibert 1979; Simenstad 1979, 1980, 1982; Healey 1982; Johnson et al. 1997; Nightingale and Simenstad 2001). Overwater structures have been well documented to impact fish migration behavior and increase mortality by creating sharp underwater light contrasts in ambient daylight conditions as well as artificial lights cast during nighttime conditions (Nightingale and Simenstad 2001). Salo et al. (1980) studied the effects of construction of Naval facilities on the outmigration of juvenile salmonids from Hood Canal; they concluded that the long-term effects of construction and operation upon the prey communities of outmigrating Chum and Pink Salmon fry were expected to be minimal as long as extensive areas of shallow eelgrass habitat were not destroyed. They also speculated that the illumination of the nearshore environment during nighttime was likely to alter the composition and standing stock of prey communities available to the salmon fry during their normal crepuscular feeding periods.

Past studies have documented the presence and timing of outmigrating juvenile salmonids along the Bangor shoreline to begin in January and continue through the summer (Schreiner et al. 1977; Bax et al. 1978, 1979, 1980; Salo et al. 1980; SAIC 2006, 2009a). Each of these studies reported that juvenile Chum Salmon was the predominant salmonid species captured with a beach seine, followed by Coho and Pink (in even years), while relatively few Chinook and Cutthroat Trout were encountered. They also reported that juvenile steelhead were very rarely captured. Overall, the relative abundance and timing of each juvenile salmonid species reported in these past studies appears to have remained stable, coinciding with the 2015-16 survey results. Hatchery releases also corresponded to abundance and timing of salmonids captured in past studies and the 2015-16 surveys. Millions of hatchery produced juvenile salmonids are released throughout Hood Canal every year to provide increased recreational and commercial harvest opportunities, as well as supplement the recovery and conservation of naturally-spawning salmon populations. In 2015 and 2016, approximately 80% of all the Hood Canal hatchery releases were composed of unmarked fish, meaning they could not be visually distinguished from naturally produced fish (see Appendix B and C).

Chum Salmon dominated the catch from January to April 2016, which was missed in 2015 due to the later sampling start date in May. In fact, such high densities of Chum Salmon were captured in April 2016 that sampling was aborted after two sets to reduce any negative impact potentially caused by capturing and handling that many salmon fry, as well as limit the 'expected takes' of ESA-listed fish authorized by the NOAA 4d permit. Unmarked Chum Salmon fry comprised over 76% of all Hood Canal hatchery released fish in both survey years, with the vast majority (>26 million) being released in April. Hood Canal summer-run Chum Salmon are an ESA-listed species stock, but they are indistinguishable from fall-run Chum Salmon stocks by visual identification methods. We did not conduct the genetic analyses necessary to differentiate the two stocks potentially encountered during 2015 sampling. However, tissue samples were collected during January through May 2016 sampling in Hood Canal and Admiralty Inlet. Hood Canal summer-run Chum Salmon are typically expected to emerge into the marine environment earlier (January to March) than fall-run Chum stocks (March to June), which are greatly supplemented with hatchery fall Chum Salmon releases in April (Ames et al. 2000, Cook-Tabor 1995, Fletcher et al. 2013). A five year study at a WDFW screw trap in the Duckabush River showed that peak outmigration of summer-run Chum occurred between the last week of February and the middle of March, while fall-run Chum migrated over a more protracted time period (Weinheimer 2016). The presence of Hood Canal summer-run Chum Salmon at the NAVBASE Kitsap Bangor was confirmed by genetic analysis of the 2016 samples, and is detailed in a separate report funded by another cooperative agreement (Small et al. 2017a). These 2015-16 data are consistent with recent genetic assignment studies for Chum in the Hood Canal region, as the majority (97%) of Chum sampled in January and February were summer-run fish.

High densities of Pink Salmon juveniles were also captured during April 2016 sampling, which corresponds with the species' dominant biennial spawning (during odd years) in Puget Sound rivers and hatchery release of nearly half a million unmarked fish in March 2016. The timing and abundance for Pinks observed in 2016 closely aligns with past studies along the Bangor shoreline (Schreiner et al. 1977; Bax et al. 1978, 1979, 1980; Salo et al. 1980; SAIC 2006, 2009a).

Coho Salmon were captured at relatively moderate catch rates (less than Chum/Pink, more than Chinook) that peaked in May and sharply declined after June of both survey years. This trend corresponds with the hatchery releases of over 1.3 million total Coho in both April and May of 2015-16, consisting of approximately 90% adipose clipped fish. However, only 21% of captured Coho in 2015-16 were hatchery produced (adipose clipped). The SAIC surveys in 2005-06 and 2007-08 also reported a similar capture rate (21-37%) for adipose clipped Coho. This 2015-16 data for Coho is consistent with the timing and moderate catch rates reported from past studies along the Bangor shoreline (Schreiner et al. 1977; Bax et al. 1978, 1979, 1980; Salo et al. 1980; SAIC 2006, 2009a).

Chinook Salmon was a confirmed ESA-listed species captured at the NAVBASE Kitsap Bangor, predominantly from Carlson Spit but also present at other sites. Overall, juvenile Chinook catch rates were quite low but peaks were apparent in June of both survey years, and steadily decreased through September. This corresponded to the hatchery releases of over six million fish in both May and June of 2015-16, consisting of 93% (2015) and 86% (2016) adipose clipped fish. During both survey years, the majority (79%) of captured Chinook were hatchery produced (adipose clipped) rather than naturally produced (non-clipped) fish, which is consistent with the hatchery release marked fish rate. This 2015-16 data for Chinook is consistent with the timing and relatively low catch rates reported from past studies along the Bangor shoreline (Schreiner et al. 1977; Bax et al. 1978, 1979, 1980; Salo et al. 1980; SAIC 2006, 2009a).

Hybridization between Cutthroat Trout and steelhead (Rainbow trout) has been documented in several streams along the North American west coast, and confirmed specifically from Big Beef Creek into Hood Canal (Moore et al. 2010). Cutthroat Trout of various life stages have been captured with the beach seine at Bangor and other Naval properties during the 2015-16 sampling, but no ESA-listed steelhead. Tissue samples collected from captured Cutthroat Trout at Bangor in 2016 detected hybridization with steelhead

in one sampled fish at Floral Point in May. The genetic analysis results are detailed in a separate report funded by another cooperative agreement (Small et al. 2017b). These data can provide some evidence to confirm our visual identification of Cutthroat Trout versus steelhead based on occasionally equivocal phenotypic traits observed in juveniles. Further recommendations for these data may include the involvement of WDFW fishery managers to better understand their stock status and genetic stock structure.

Rockfish Juveniles in 2015-16

The early life-history of rockfish (*Sebastes* spp.) begins with free-swimming larvae that transform in to pelagic juveniles 30-60 days after partruition, which then settle into demersal habitats from April to June (Laidig 2010, Ralston et al. 2012). Most of these transient juveniles will recruit to rocky areas, algae, drift algae, eelgrass, kelp beds, and artificial structures before moving to deeper rocky habitat (Love 2011). Nearshore habitats including rocky areas, macroalgae, and eelgrass have been documented along the Bangor shoreline by the WDFW rockfish surveys in 2014-15 (Frierson et al. 2016) and other recent surveys (SAIC 2009b). Rockfish juveniles were only captured with the beach seine during 2015 sampling, but previous studies along the Bangor shoreline captured them (unidentified to species) every year from 2005 through 2008 (SAIC 2006, SAIC 2009a). These other studies were also granted access to sample inside the restricted areas, therefore broadening the range of sampling sites and increasing their proximity to complex structures. Although the rockfish and critical habitat surveys conducted by the WDFW in 2014-15 did not observe any of the ESA-listed rockfish species or habitat considered critical for adults outside the restricted areas, the nearshore areas do qualify as potential habitat critical to juveniles. The transient nature of rockfish during their pelagic juvenile stage means that a temporary and seasonal presence of ESA-listed rockfish juveniles is plausible, but unlikely due to the limited quality of nearshore vegetation and complex rocky habitat. In 2017, dive and trap surveys focusing specifically on juvenile rockfish will be conducted outside the restricted areas. While fish surveys located outside the restricted areas may be reasonably sufficient to meet the needs of the CA, future surveys at the NAVBASE Kitsap Bangor would benefit from sampling inside the restricted areas.

Conclusions

Overall, the relative timing and abundance of forage fish and salmonids sampled with a beach seine in 2015 and 2016 were consistent with historical surveys conducted along the NAVBASE Kitsap Bangor shoreline. Collectively, these studies indicate that whatever impacts to the nearshore habitat, as used by juvenile salmonids and forage fish, due to the Bangor facilities have remained consistent over time. Since the many complex overwater structures along the Bangor shoreline occur over 'saltwater habitats of special concern' (WAC 220-660-320), mitigation including periodic monitoring of fish and habitat is recommended to ensure optimal health.

Rockfish surveys conducted by the WDFW in 2014-15 found that neither the habitats nor depths recorded were consistent with known associations of ESA-listed rockfish species elsewhere in Puget Sound. We further concluded that the BNRA is unlikely to support adult ESA-listed rockfish species or their preferred deep-water habitats. However, there were areas recorded within the shallow water (i.e., nearshore) zones of the BNRA where extensive eelgrass beds and mixed algal growth on harder substrates could provide productive rearing habitat for juvenile rockfish. In 2017, dive and trap surveys focusing specifically on juvenile rockfish will be conducted outside the restricted areas.

The two confirmed ESA-listed species captured with the beach seine at the NAVBASE Kitsap Bangor were Hood Canal summer-run Chum and Chinook Salmon. Hood Canal summer-run Chum Salmon were detected in nearshore areas earlier (January-February) than fall-run Chum Salmon (March-April). The peak catch rate for Chinook occurred in June during both 2015 and 2016 surveys. A single Cutthroat

Trout captured in May 2016 was detected as a hybrid with ESA-listed steelhead utilizing genetic analysis. Based on these results from the 2015-16 surveys, we preliminarily conclude that in order to reduce impact on juvenile salmon, the work window (July 15 to January 15) for the NAVBASE Kitsap Bangor facilities' in-water maintenance, military construction (MILCON), mitigation projects, future Fleet training and testing should not include February through July, as is consistent with the measures outlined in WAC 220-660-330.

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Appendix A: Comprehensive list of all fish species recorded at the NAVBASE Kitsap Bangor in 2015 and 2016 with the beach seine. Taxonomic nomenclature and phylogenetic organization follows arrangement from Pietsch and Orr (2015).

TAXON	COMMON NAME
CLUPEIFORMES	**HERRINGS**
Engraulidae	**Anchovies**
Engraulis mordax	Northern Anchovy
Clupeidae	**Herrings and Sardines**
Clupea pallasii	Pacific Herring
OSMERIFORMES	**FRESHWATER SMELTS**
Osmeridae	**Smelts**
Hypomesus pretiosus	Surf Smelt
SALMONIFORMES	**TROUTS**
Salmonidae	**Trouts and salmon**
Oncorhynchus clarkii	Cutthroat Trout (coastal)
Oncorhynchus gorbuscha	Pink Salmon
Oncorhynchus keta	Chum Salmon
Oncorhynchus kisutch	Coho Salmon
Oncorhynchus tshawytscha	Chinook Salmon
GADIFORMES	**CODS**
Gadidae	Gadidae unidentified
GASTEROSTEIFORMES	**STICKLEBACKS**
Aulorhynchidae	**Tubesnouts**
Aulorhynchus flavidus	Tubesnout
Gasterosteidae	**Sticklebacks**
Gasterosteus aculeatus	Threespine Stickleback
Syngnathidae	**Pipefishes**
Syngnathus leptorynchus	Bay Pipefish
SCORPAENIFORMES	**MAIL-CHEEKED FISHES**
Scorpaenidae	**Scorpionfishes**
Sebastes caurinus	Copper Rockfish
Sebastes diploproa	Splitnose Rockfish
Hexagrammidae	**Greenlings**
Hexagrammos stelleri	Whitespotted Greenling
	Greenling unidentified
Cottidae	**Sculpins**
Artedius fenestralis	Padded Sculpin
Clinocottus acuticeps	Sharpnose Sculpin
Enophrys bison	Buffalo Sculpin
Leptocottus armatus	Pacific staghorn Sculpin
Myoxocephalus polyacanthocephalus	Great Sculpin
Oligocottus maculosus	Tidepool Sculpin
Oligocottus snyderi	Fluffy Sculpin
	Sculpin unidentified

PERCIFORMES	**PERCHES**
Embiotocidae	**Surfperches**
Brachyistius frenatus	Kelp Perch
Cymatogaster aggregata	Shiner Perch
Rhacochilus vacca	Pile Perch
Embiotoca lateralis	Striped Seaperch
Stichaeidae	**Pricklebacks**
Anoplarchus insignis	Slender Cockscomb
Lumpenus sagitta	Snake Prickleback
Pholidae	**Gunnels**
Apodichthys flavidus	Penpoint Gunnel
Apodichthys fucorum	Rockweed Gunnel
Pholis laeta	Crescent Gunnel
Pholis ornata	Saddleback Gunnel
	Gunnels unidentified
Ammodytidae	**Sand lances**
Ammodytes personatus	Pacific Sand Lance
Gobiidae	**Gobies**
	Goby unidentified
Scombridae	**Mackerels**
Scomber japonicus	Pacific Mackerel
PLEURONECTIFORMES	**FLATFISHES**
Pleuronectidae	**Righteye Flounders**
Lepidopsetta spp.	Rock Sole
Parophrys vetulus	English Sole
Platichthys stellatus	Starry Flounder
Pleuronichthys coenosus	C-O Sole
	Flatfish unidentified

Appendix B: Hatchery releases in the Hood Canal (HOOD) region during 2015. Data summarized from the Regional Mark Information System (RMIS).

Species	Release Region	Release Year	Release Month	CWT only	CWT + Ad Clip	Unmarked	Ad Clip only	Mean Length (mm)
Chinook	HOOD	2015	April		98,666		24,940	168
Chinook	HOOD	2015	May	495,167	227,775	22,237	5,544,930	84
Chinook	HOOD	2015	June		199,169	5,761	818,297	79
TOTAL				**495,167**	**525,610**	**27,998**	**6,388,167**	
Chum	HOOD	2015	February			290,000		
Chum	HOOD	2015	March			79,930		58
Chum	HOOD	2015	April			27,692,461		54
Chum	HOOD	2015	December			210,400		
TOTAL						**28,272,791**		
Coho	HOOD	2015	April	122,218	162,222	6,576	668,693	136
Coho	HOOD	2015	May	2,595	47,140	4,862	342,422	
TOTAL				**124,813**	**209,362**	**11,438**	**1,011,115**	
Cutthroat	HOOD	2015	January			200		
Cutthroat	HOOD	2015	May			27,967		
Cutthroat	HOOD	2015	June			7,030		
Cutthroat	HOOD	2015	September			6,750		
TOTAL						**41,947**		
Steelhead	HOOD	2015	February				78	498
Steelhead	HOOD	2015	March				467	535
Steelhead	HOOD	2015	April				300	182
Steelhead	HOOD	2015	May			11,322	8,786	182
TOTAL						**11,322**	**9,631**	

Appendix C: Hatchery releases in the Hood Canal (HOOD) region during 2016. Data summarized from the Regional Mark Information System (RMIS).

Species	Release Region	Release Year	Release Month	CWT only	CWT + Ad Clip	Unmarked	Ad Clip only	Mean Length (mm)
Chinook	HOOD	2016	April	122,483		7,650	121,065	174
Chinook	HOOD	2016	May	423,410	221,164	51,992	2,885,833	86
Chinook	HOOD	2016	June		200,979	4,446	2,218,283	80
Chinook	HOOD	2016	August	277,780		2,236		
TOTAL				**823,673**	**422,143**	**66,324**	**5,225,181**	
Chum	HOOD	2016	February			165,024		
Chum	HOOD	2016	March			30,220		
Chum	HOOD	2016	April			26,755,074		53
TOTAL						**26,950,318**		
Coho	HOOD	2016	April	117,540	117,719	2,298	524,739	125
Coho	HOOD	2016	May		83,127	384	496,235	
TOTAL				**117,540**	**200,846**	**2,682**	**1,020,974**	
Cutthroat	HOOD	2016	January			350		
Cutthroat	HOOD	2016	May			39,184		
Cutthroat	HOOD	2016	August			310		
Cutthroat	HOOD	2016	October			6,437		
TOTAL						**46,281**		
Pink	HOOD	2016	March			491,572		51
TOTAL						**491,572**		
Steelhead	HOOD	2016	April			9,691	2,749	208
Steelhead	HOOD	2016	May			5,478	2,790	205
TOTAL						**15,169**	**5,539**	