Final Assessment of Threatened and Endangered Marine and Anadromous Fish Presence Adjacent to the NAVMAG Indian Island: 2015-16 Beach Seine Survey Results

Prepared for:

Naval Facilities Engineering Command Northwest (NAVFAC NW)

Submitted by:

The WDFW Marine Fish Science Unit

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FINAL REPORT

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Washington Department of
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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 Magazine (NAVMAG) Indian Island, 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 NAVMAG Indian Island, specifically the areas adjacent to the Walan Point Naval Restricted Area (WPNRA), 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 WPNRA and immediate adjacent areas. 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. 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 NAVMAG Indian Island, 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 July for both survey years. However, based on the results from the 2015-16 surveys we preliminarily conclude that in order to reduce impact on juvenile salmon, the work window (July 15 to February 15) for any of the NAVMAG Indian Island facilities' in-water maintenance, military construction (MILCON), mitigation projects, future Fleet training, and testing should not include February through July, as is consistent with 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 NAVMAG Indian Island installation.

Methods

Study Area

The NAVMAG Indian Island is located along the eastern shore of Port Townsend Bay (Figure 1a) extending from the Walan Point Naval Restricted Area (WPNRA) to Port Townsend Canal, and encompasses an area of approximately 1.0km^2 around the ammunition pier (Figure 1b). The study area was not restricted by security measures and included all areas within and adjacent to the ammunition pier, floating security barrier, and the WPNRA (Figure 2). The majority of bottom habitat is considered featureless mud and sand (NOAA nautical chart 18464), 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).

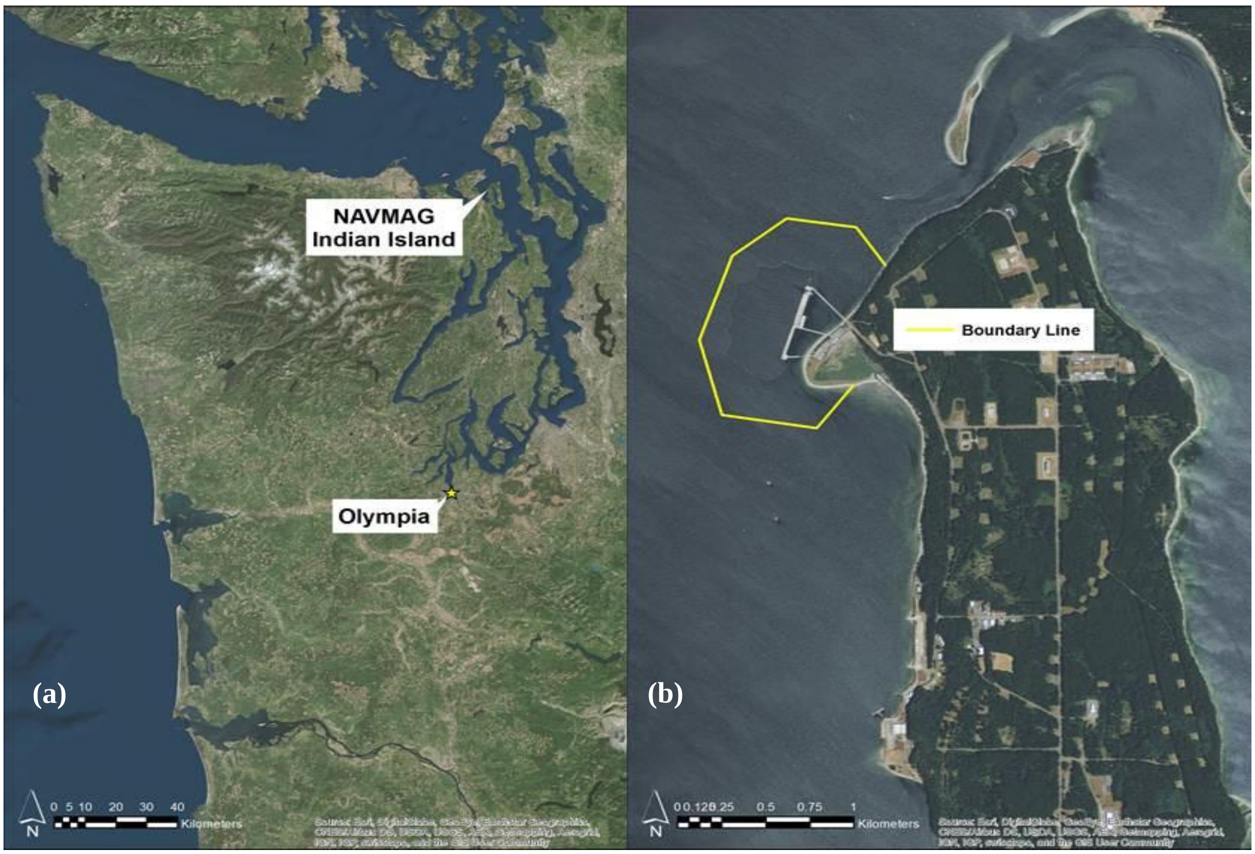

Figure 1. Orthophoto of the NAVMAG Indian Island location in Puget Sound (a) and the Walan Point Naval Restricted Area (WPNRA) boundary line in yellow (b). Image from Esri DigitalGlobe.

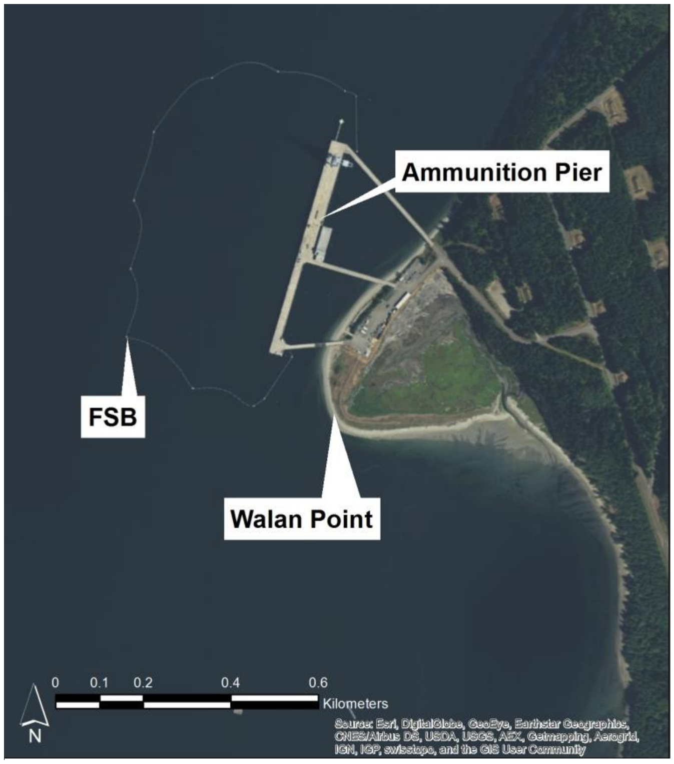

Figure 2. Orthophoto of the NAVMAG Indian Island identifying the survey sites: ammunition pier, floating security barrier (FSB), and Walan Point. Image from Esri DigitalGlobe.

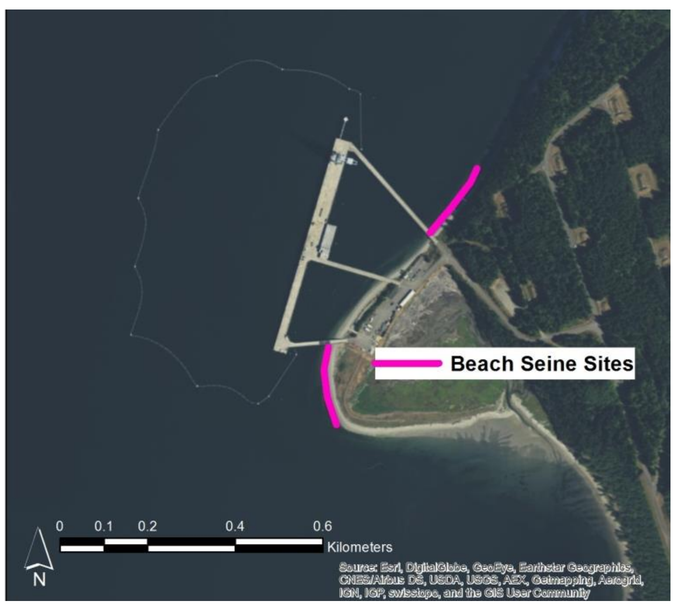

Figure 3. Orthophoto of the NAVMAG Indian Island pier identifying the beach seining survey sites: north and south of the ammunition pier. Image from Esri DigitalGlobe.

Within the study area, survey sites were sampled with a beach seine at shorelines adjacent to the north and south sides of the ammunition pier within the WPNRA (Figure 3). Both the north and south sites are historically documented Pacific Sand Lance (*Ammodytes personatus*) and Surf Smelt (*Hypomesus pretiosus*) spawning beaches, and are also adjacent to nearshore Pacific Herring (*Clupea pallasii*) spawning beds and pre-spawner holding areas located offshore (WDFW online). The north site lies within a transport zone north of the pier and is exposed to northerly wind-waves with increased wave action from ferry and shipping traffic in transit along Admiralty Inlet. Substrate composition at the north site was a coarse cobble-pebble mix, with boulders visible on the beach just north of the sampling location. Beach seining at the south site occurred on an accretion beach south of the pier, separated from a tidal marsh immediately to the east by a sandy low-bank berm in the backshore. Nearshore habitat within the south site sampling zone included substrate composition of fine to medium gravel with a sand base. Dense *Ulva* beds and drift vegetation extended from the pier to the north and south through both sampling zones.

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 the priorities of Navy personnel to determine fish presence and occupancy timing adjacent to the ammunition pier. 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 three beach seine "sets" were performed at each of the sites on a single date each month. Sampling typically began at the south boundary on the beach closest to the pier structure, and subsequent sets were deployed along the beach towards Walan Point. Sets at the northern boundary always began closest to the pier structure and subsequent sets were deployed north along the beach. 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.

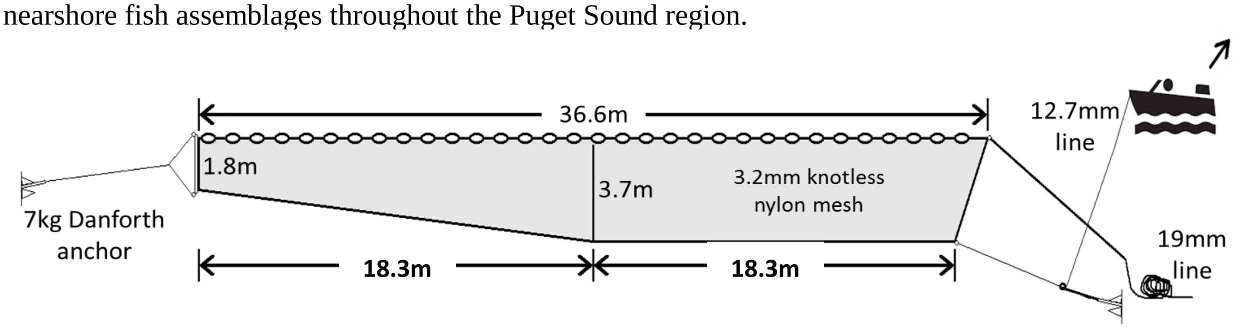

Figure 4. Diagram of the beach seine with dimensions used for sampling.

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 eight 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. 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 the north and south boundaries of the ammunition pier adjacent to the NAVMAG Indian Island once a month from May to September 2015 (see Figure 3). A total of 20 sets were completed in 2015, with two to three sets occurring at each site on each date. The maximum nearshore water depths recorded while sampling both sites averaged 2.4m.

A total of 38 fish species (including unidentified taxa) were captured over the five months of sampling at both sites. Overall catch composition consisted primarily of Shiner Perch (*Cymatogaster aggregata*), Pacific Sand Lance, Surf Smelt, and gunnels (Family: Pholidae) (Table 1). Species richness varied monthly from 15 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 272 forage fish and 96 salmonids during the five months of sampling at both sites (Table 2).

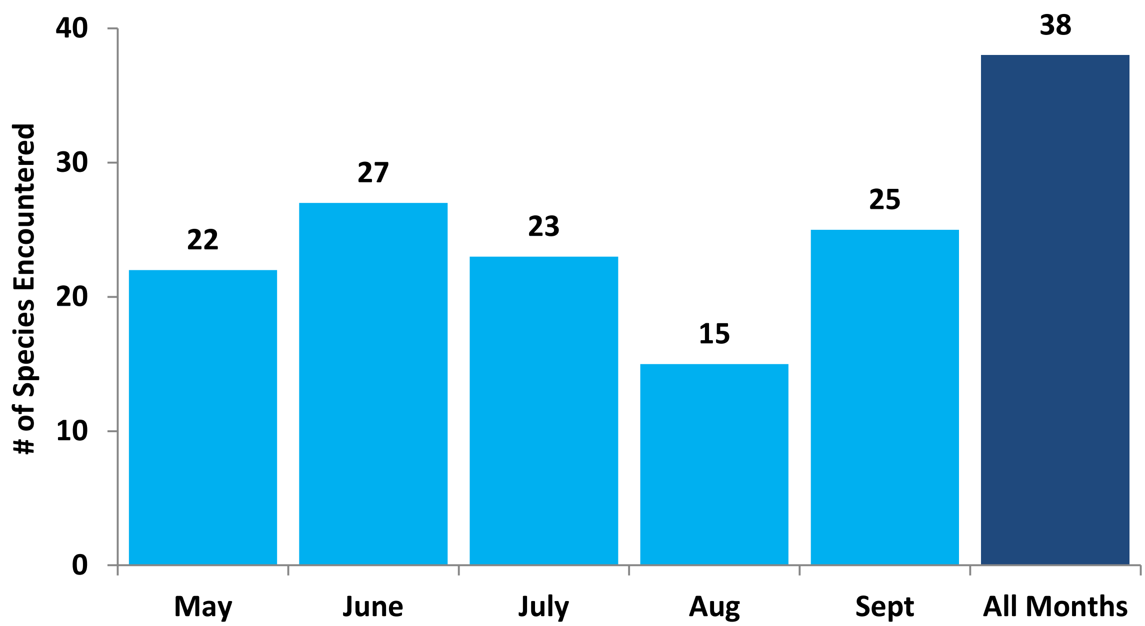

Figure 7. Species richness (including unidentified taxa) of all fish captured during beach seining, by month and all months combined in 2015.

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

Species	13-May	10-Jun	8-Jul	24-Aug	9-Sep	Total	% of Total
# of Sets Completed	3	4	5	2	6	20	-
American Shad		2				2	0.02 %
Bay Pipefish	40	42	68	18	74	242	2.24 %
Buffalo Sculpin		6	6	1	6	19	0.18 %
Cabezon					1	1	0.01 %
Chinook Salmon	1	1	28			30	0.28 %
Chum Salmon	238	6				244	2.26 %
Coho Salmon	39	2	12			53	0.49 %
Crescent Gunnel	27		1	5		33	0.31 %
Cutthroat Trout	2				1	3	0.03 %
English Sole	18	15	218	38	62	351	3.25 %
Flatfish (unidentified)	31	60	6		1	98	0.91 %
Greenling (unidentified)		2				2	0.02 %
Gunnel (unidentified)	74	523	638	7	664	1906	17.64 %
Kelp Perch		1			6	7	0.06 %
Lingcod	3					3	0.03 %
Pacific Herring		264	28			292	2.70 %
Pacific Sand Lance	571	1000	265	98	15	1949	18.03 %
Pacific Staghorn Sculpin	32	145	244	14	57	492	4.55 %
Padded Sculpin			12	3	26	41	0.38 %
Penpoint Gunnel	3		3	28	78	112	1.04 %
Surfperch (unidentified)		2				2	0.02 %
Pile Perch		3	6	2	1	12	0.11 %
Plainfin Midshipman	1	17				18	0.17 %
Rockweed Gunnel		1	12	1	1	15	0.14 %
Saddleback Gunnel			19	151		170	1.57 %
Sculpin (unidentified)	15	34		1	3	53	0.49 %
Shiner Perch	120	405	1003	268	548	2344	21.69 %
Silverspot Sculpin					1	1	0.01 %
Snake Prickleback	101	45	59		10	215	1.99 %
Starry Flounder	1	1	2		1	5	0.05 %
Striped Seaperch					2	2	0.02 %
Sturgeon Poacher	1					1	0.01 %
Surf Smelt	29	1311	467		23	1830	16.93 %
Tadpole Sculpin		29			4	33	0.31 %
Threespine Stickleback	1	10	14		108	133	1.23 %
Tidepool Sculpin		3	2	1	2	8	0.07 %
Tubesnout		6	61		15	82	0.76 %
Whitespotted Greenling	4					4	0.04 %

Table 2. Fork length (mm) data summaries for juvenile salmonid (left) and all forage fish (right) species sampled in 2015. Cutthroat Trout includes juvenile and adult fish.

Species	Mean ±SD	CV	n
Chinook hatchery	122.27 ±11.91	0.10	18
Chinook natural	125.42 ±11.84	0.09	12
Coho hatchery	121.50 ±13.44	0.11	2
Coho natural	120.50 ±15.55	0.13	32
Chum Salmon	94.45 ±11.84	0.13	29
Cutthroat Trout	264.33 ±127.18	0.48	3

Species	Mean ±SD	CV	n
Pacific Sand Lance	87.31 ±15.80	0.18	133
Surf Smelt	118.29 ±39.83	0.34	92
Pacific Herring	60.21 ±12.94	0.21	47

Forage fish species catch rates were generally higher for the south sampling site, while salmonid species catch rates were higher for the north sampling site (Figure 8). Forage fish species captured in 2015 included Pacific Sand Lance, Surf Smelt, Pacific Herring, and American Shad (*Alosa sapidissima*) with peak catch rates all occurring in June (Figure 9). The most commonly captured forage fish species over all five months was Pacific Sand Lance, with the highest catch rates encountered at the south site in May (190 fish/set) and June (250 fish/set). Pacific Sand Lance fork lengths indicate mixed broods up to age-2 present during surveys (Emmett et al. 1991, Greene at al. 2011) (Figure 10). While Surf Smelt were captured at both sites, greater densities were recorded from the south site with a peak catch rate in June (328 fish/set), and declined in July (93 fish/set). Surf Smelt fork length data for all months combined resulted in high variation (CV=0.34), and a bimodal distribution of age-1 and age-2+ fish (Penttila 1978) as well as variation in length between sexes of the same age class (Figure 11). Pacific Herring were encountered at both sites, but were more prevalent at the south site with a peak catch rate in June (66 fish/set), that then declined by July (6 fish/set). Pacific Herring captured in June and July fit age-length estimates for age-0 and age-1 fish (Buchanan 1985) (Figure 12). No ESA-listed Eulachon were captured during any beach seine sampling.

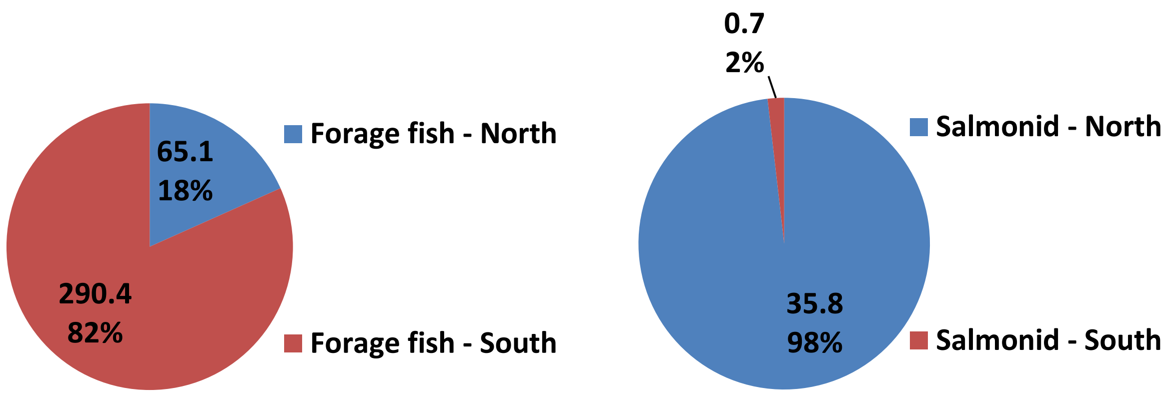

Figure 8. Catch rates (fish/set) and percentages within forage fish and salmonid species groups separated by north and south sampling sites for all months combined in 2015.

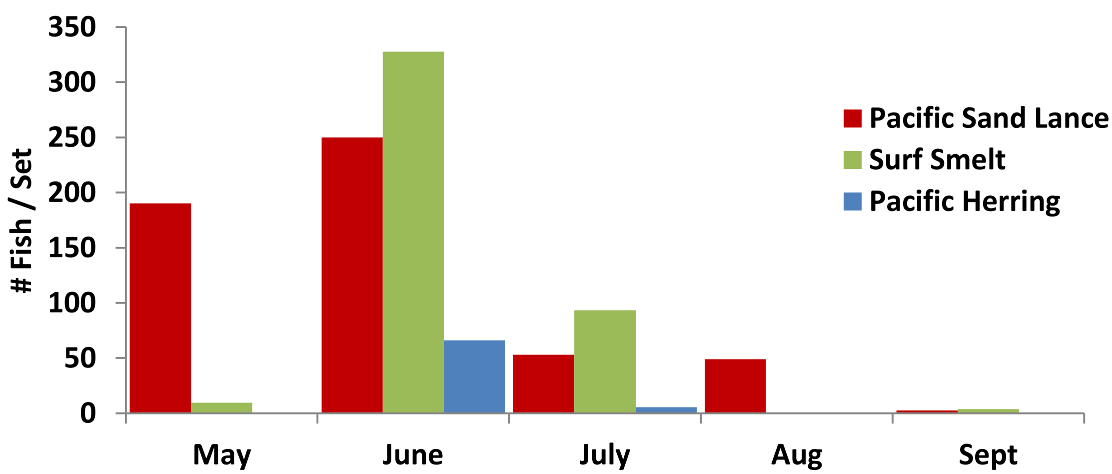

Figure 9. Catch rates for forage fish species captured during beach seining for all sites combined in 2015.

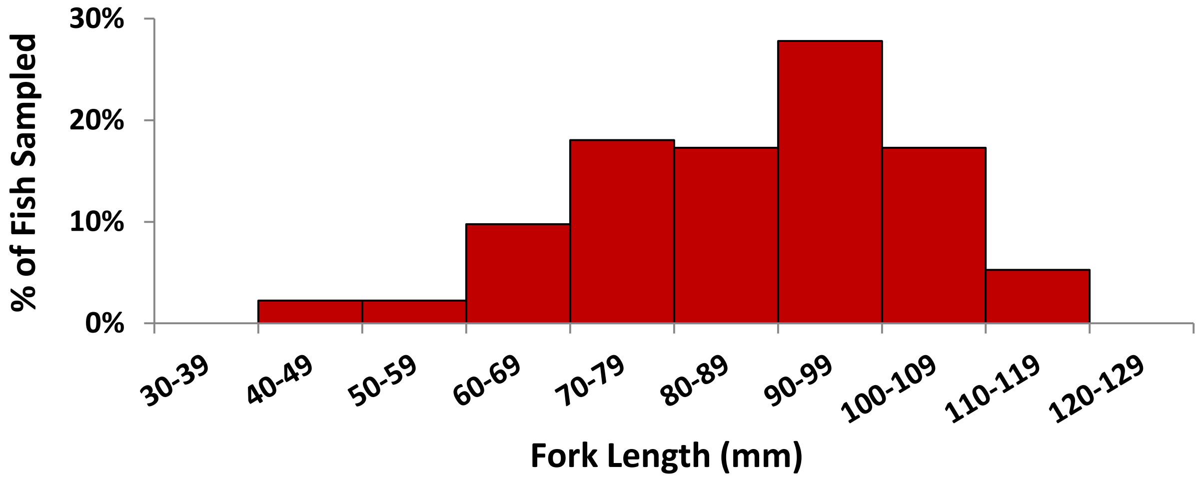

Figure 10. Pacific Sand Lance fork length histogram for all months and sites combined in 2015.

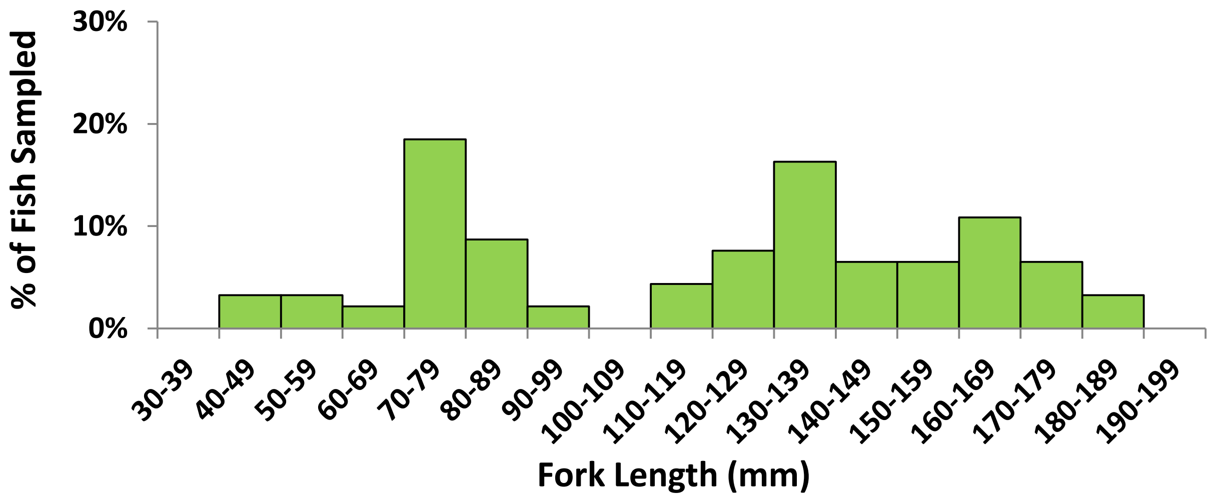

Figure 11. Surf Smelt fork length histogram for all months and sites combined in 2015.

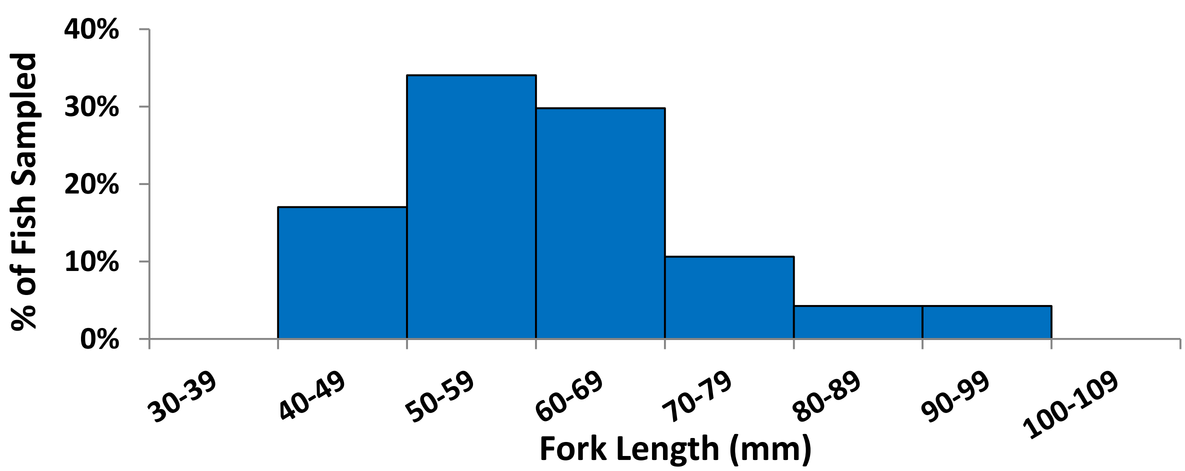

Figure 12. Pacific Herring fork length histogram for all months and sites combined in 2015.

Salmonid species captured in 2015 included Chinook Salmon, Chum Salmon, Coho Salmon (*O. kisutch*), and Cutthroat Trout (*O. clarkii*) with variable catch rates occurring in May, June, and July (Figure 13). Salmonid fork lengths generally increased for each species' cohort, as a consequence of seasonal growth after outmigration from local watersheds, from May through July (Figure 14). Juvenile Chinook Salmon was the only confirmed ESA-listed species captured at the NAVMAG Indian Island in 2015, and was recorded only from the north site. Chinook Salmon catch rates were low in May (n=1) and June (n=1) with peak catches observed in July (9.3 fish/set), and consisted of 17 hatchery and 11 natural-origin fish. Chum Salmon were mostly captured at the north site, with a peak catch rate in May (79.3 fish/set) that greatly declined in June (1.5 fish/set). Natural-origin Coho Salmon were only captured from the north site with variable monthly catch rates observed; the peak occurred in May (13 fish/set), declined in June (<1 fish/set), and increased in July (2.4 fish/set). Hatchery-origin Coho Salmon were only captured in July (n=2). Cutthroat Trout were only encountered at the north site during May (n=2) and September (n=1) surveys.

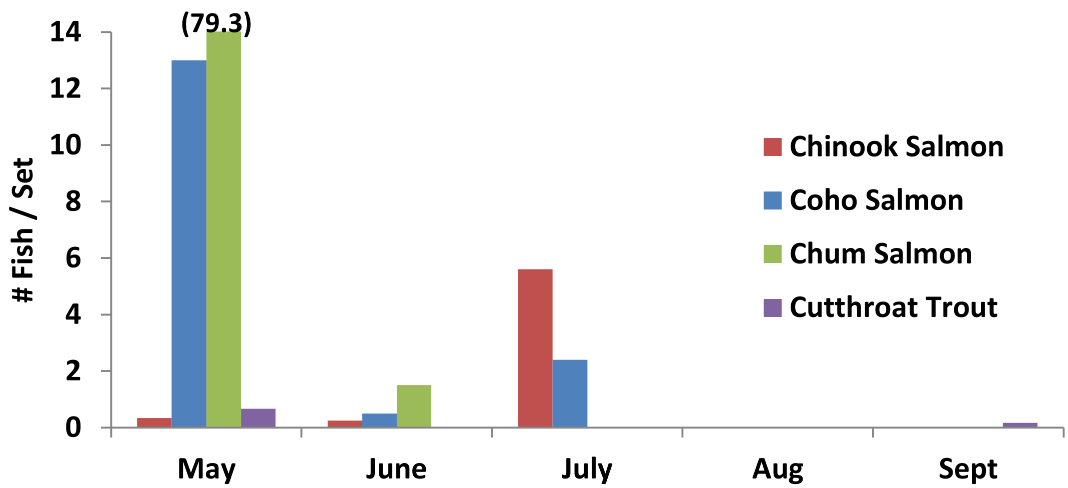

Figure 13. Catch rates for salmonid species captured during beach seining for both sites combined in 2015. Values are labeled for catch rates exceeding the vertical axis.

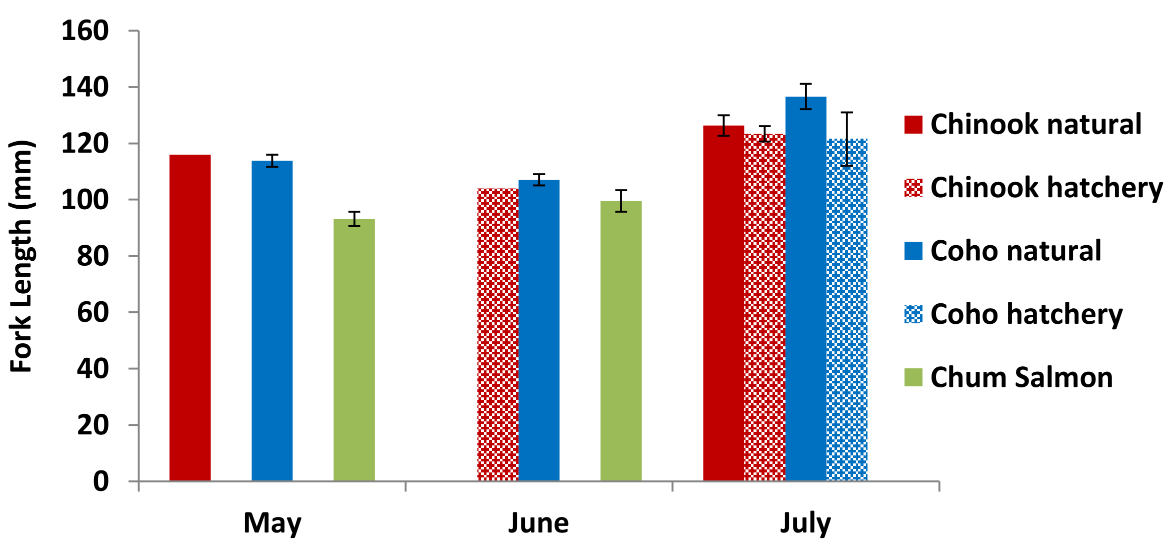

Figure 14. Mean fork length (± 1SE) for juvenile salmonid species, by month for both sites in 2015.

Three age-0 Lingcod (*Ophiodon elongatus*) were captured in the beach seine from the south site during May sampling (Figure 15). All three of these Lingcod were considered to be age-0 due to their small lengths (47 to 65mm), and were likely rearing in the nearshore vegetation.

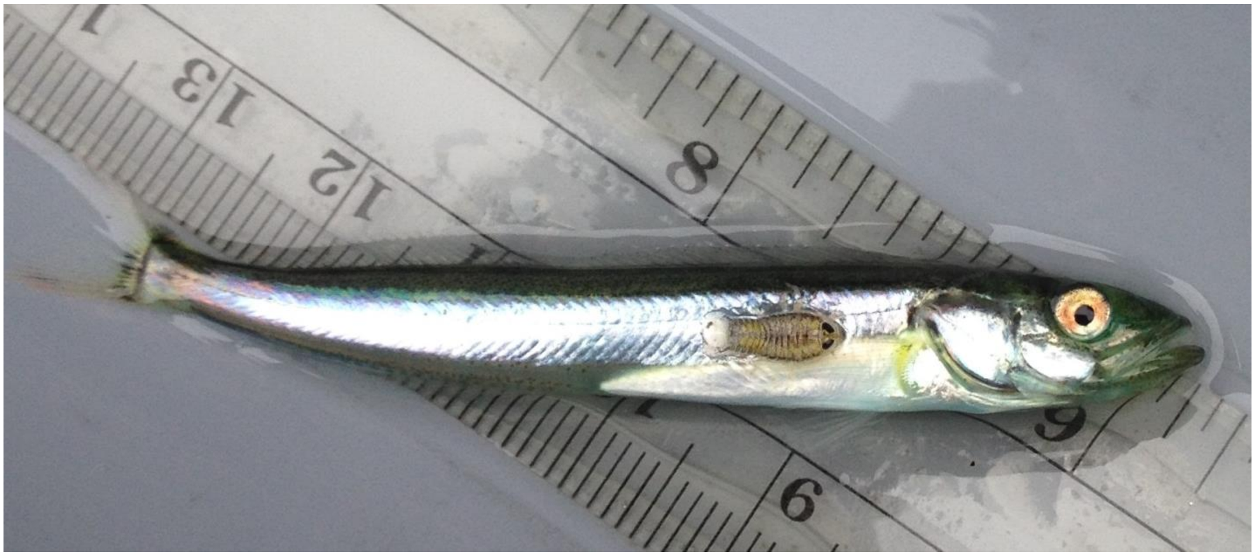

Figure 15. Photo of an age-0 Lingcod (with parasitic isopod) captured with the beach seine.

During August sampling, high densities of drift algae were captured in three attempted sets, prohibiting effective processing of the net's contents, and were omitted from the data set. The beach seine crew attempted to remove large quantities of the drift algae before releasing the net's contents to facilitate fish enumeration, but observable stress to the captive fish necessitated immediate release. There did not appear to be any salmonids or significant densities of forage fish in the omitted sets.

Beach Seine Surveys in 2016

Beach seine sampling occurred at the north and south boundaries of the ammunition pier adjacent to the NAVMAG Indian Island once a month from January to September 2016 (see Figure 3). A total of 50 sets were completed in 2016, with two to three sets occurring at each site on each date. Maximum nearshore water depths recorded while sampling both sites averaged 2.8m.

A total of 33 fish species (including unidentified taxa) were captured over nine months of sampling at both sites. Overall catch composition consisted primarily of Pink Salmon (*O. gorbuscha*), Shiner Perch, Chum Salmon, and Surf Smelt (Table 3). Species richness varied monthly from 12 to 23 species captured during each sampling trip, with peak species richness observed in June (Figure 16). Fork lengths were recorded from a total of 292 forage fish and 205 salmonids during the nine months of sampling at both sites (Table 4).

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

Species	4-Jan	1-Feb	17-Mar	14-Apr	25-May	29-Jun	29-Jul	25-Aug	22-Sep	Total	% of Total
# of Sets Completed	**6**	**6**	**5**	**5**	**5**	**5**	**6**	**6**	**6**	**50**	**-**
Bay Pipefish	6	6	2	2	18	29	20	15	3	101	1.07%
Buffalo Sculpin	1	3	4	2	2	2	2	3	1	20	0.21%
Cabezon								1		1	0.01%
Chinook Salmon					1	130				131	1.39%
Chum Salmon	2	21	560	269	444	1				1297	13.79%
Coho Salmon					24	7				31	0.33%
Crescent Gunnel				1	2	6	1	3	4	17	0.18%
English Sole		1	8	14	58	119	7	31	10	248	2.64%
Flatfish (unidentified)	3	10	27	23	3	40				106	1.13%
Fluffy Sculpin						1				1	0.01%
Great Sculpin	1		2			1			1	5	0.05%
Greenling (unidentified)		2	14	1						17	0.18%
Lingcod	1									1	0.01%
Pacific Herring	1		1		9	1	1	1	1	15	0.16%
Pacific Sand Lance	36	4	4	36	16	125	274	2		497	5.29%
Pacific Staghorn Sculpin	14	27	33	29	92	296	213	82	80	866	9.21%
Padded Sculpin	1		1		2	7	1	7	11	30	0.32%
Penpoint Gunnel					6	62	3	12	18	101	1.07%
Pile Perch				2					3	5	0.05%
Pink Salmon		23	2014	190	223	1				2451	26.07%
Plainfin Midshipman						1				1	0.01%
Rock Sole			1					1	1	3	0.03%
Saddleback Gunnel				6	76	254	43	135	93	607	6.46%
Sculpin (unidentified)	1		1		10					12	0.13%
Shiner Perch				5	31	404	1180	46	100	1766	18.78%
Slender Cockscomb			1							1	0.01%
Snake Prickleback					4	4				8	0.09%
Starry Flounder	4	6	1	4	1	10	4	23	16	69	0.73%
Surf Smelt	14	9	1	1	121	771	6	1	16	940	10.00%
Threespine Stickleback			2	1	10		5	2		20	0.21%
Tidepool Sculpin	6	11							4	21	0.22%
Tubesnout	2		2			7	1			12	0.13%
Whitespotted Greenling					1					1	0.01%

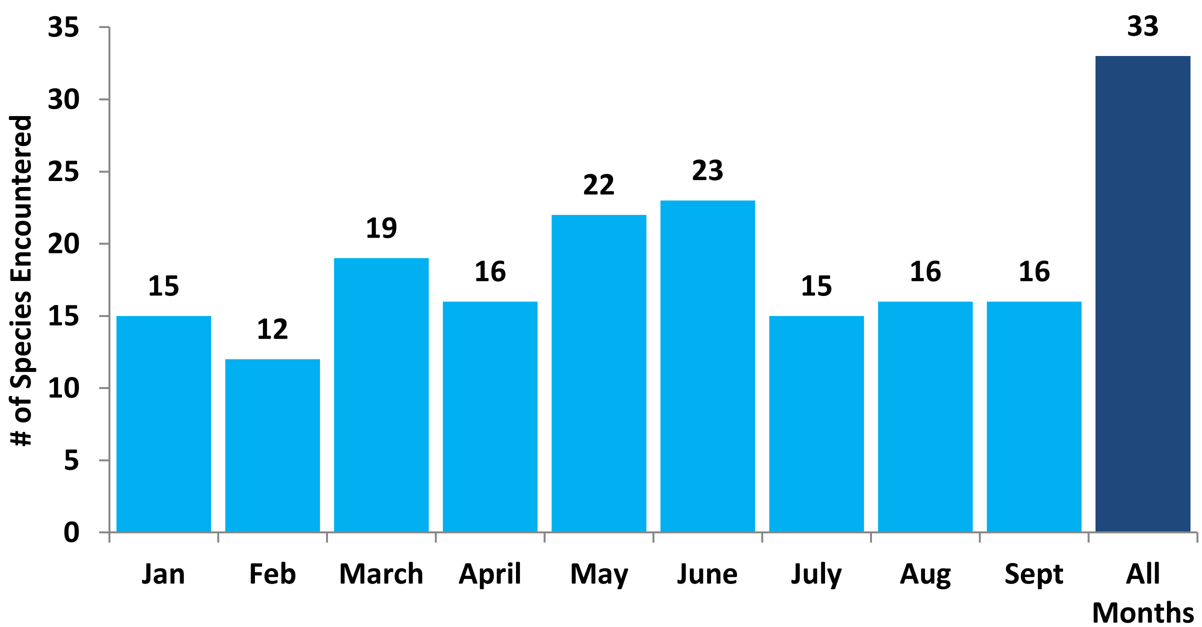

Figure 16. Species richness (including unidentified taxa) of all fish captured during beach seining surveys, by month and all months combined in 2016.

Table 4. Fork length (mm) data summaries for juvenile salmonid (left) and all forage fish (right) species sampled in 2016.

Species	Mean ±SD	CV	n
Chinook hatchery	119.86 ±9.83	0.08	8
Chinook natural	113.15 ±10.80	0.10	13
Coho hatchery	157.71 ±45.64	0.29	7
Coho natural	121.77 ±14.45	0.12	22
Chum Salmon	66.76 ±25.85	0.39	84
Pink Salmon	51.37 ±22.62	0.44	71

Species	Mean ±SD	CV	n
Pacific Sand Lance	91.52 ±19.54	0.21	153
Surf Smelt	107.82 ±43.41	0.40	124
Pacific Herring	122.47 ±36.37	0.30	15

Forage fish and salmonid species catch rates were higher for the north sampling site during sampling in 2016 (Figure 17). Forage fish species captured in 2016 included Pacific Sand Lance, Surf Smelt, and Pacific Herring with combined peak catch rates occurring in May through July (Figure 18). Peak catch rates for Pacific Sand Lance were observed at the north site in June (25 fish/set) and July (46 fish/set). Pacific Sand Lance fork length data for all months combined resulted in high variation (CV=0.21), and a bimodal distribution of fish up to age-2 present during surveys (Emmett et al. 1991, Greene at al. 2011) (Figure 19). Surf Smelt were captured at both sites, with greater densities recorded from the north site and peak catch rates in May (24 fish/set) and June (154 fish/set). Surf Smelt mean fork length data for all months combined resulted in high variation (CV=0.40), and a multimodal distribution of age-0 to age-2+ fish (Penttila 1978), as well as variation in length between sexes of the same age class (Figure 20). Pacific Herring were encountered almost exclusively at the north site with a peak catch rate in May (2 fish/set), and declining in June (<1 fish/set). The few Pacific Herring captured in 2016 fit age-length estimates for age-0 to age-3 fish (Buchanan 1985) (Figure 21). No ESA-listed Eulachon were captured during any beach seine sampling.

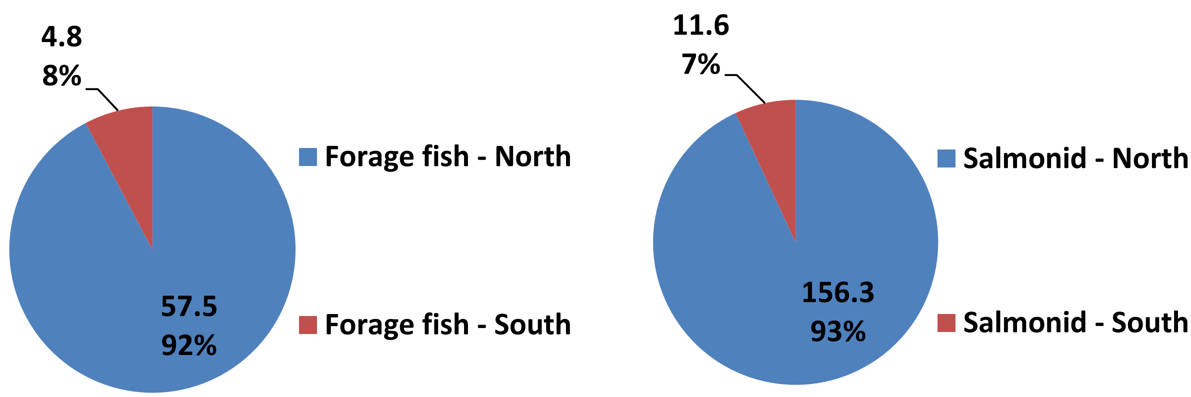

Figure 17. Catch rates (fish/set) and percentages within forage fish and salmonid species groups separated by north and south sampling sites for all months combined in 2016.

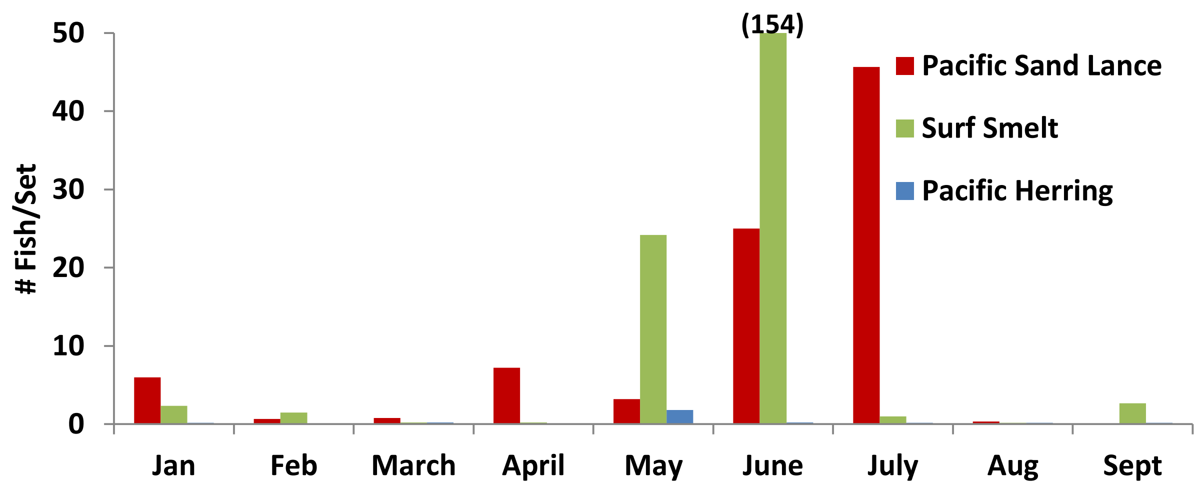

Figure 18. Catch rates for forage fish species captured during beach seining for all sites combined in 2016. Values are labeled for catch rates exceeding the vertical axis.

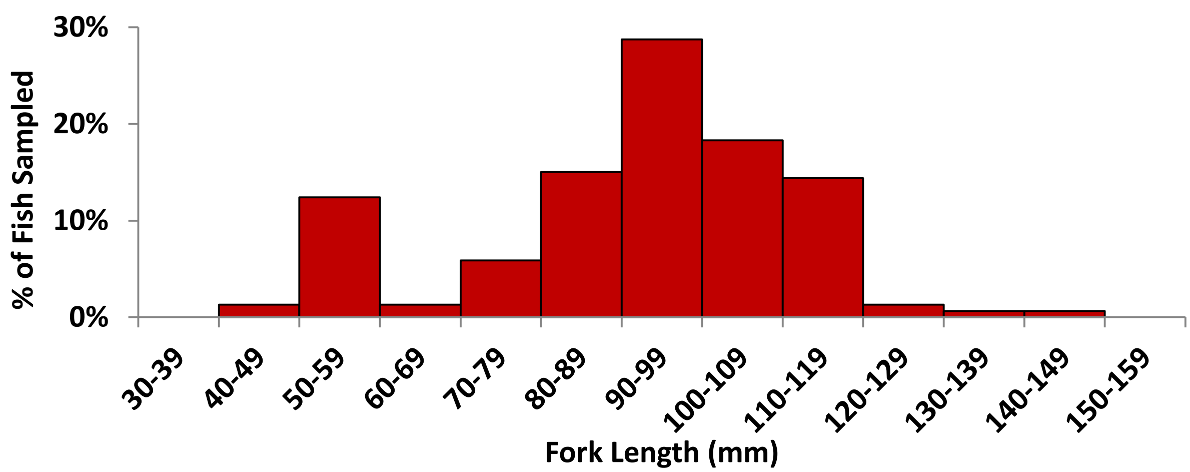

Figure 19. Pacific Sand Lance fork length histogram for all months and sites combined in 2016.

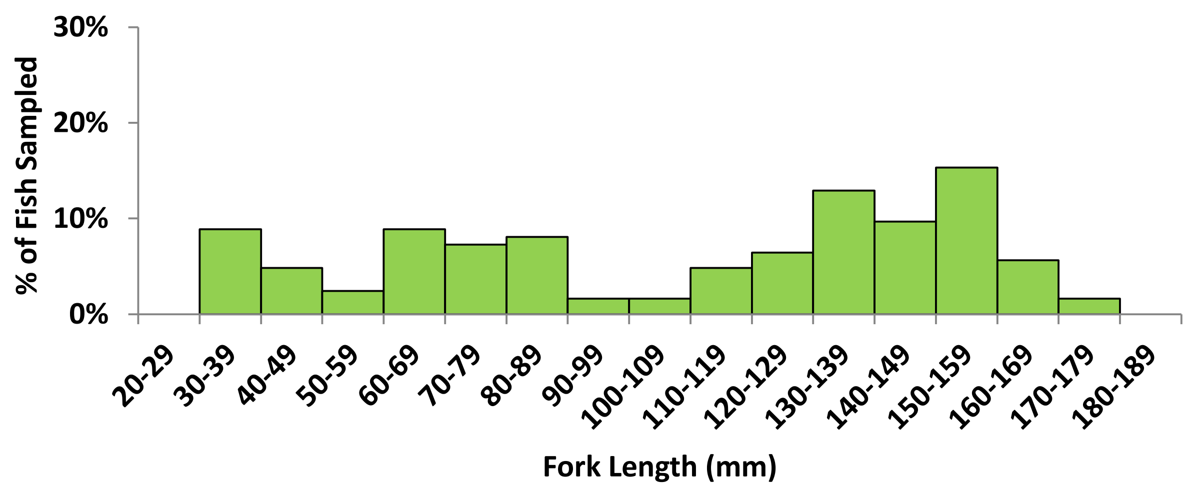

Figure 20. Surf Smelt fork length histogram for all months and sites combined in 2016.

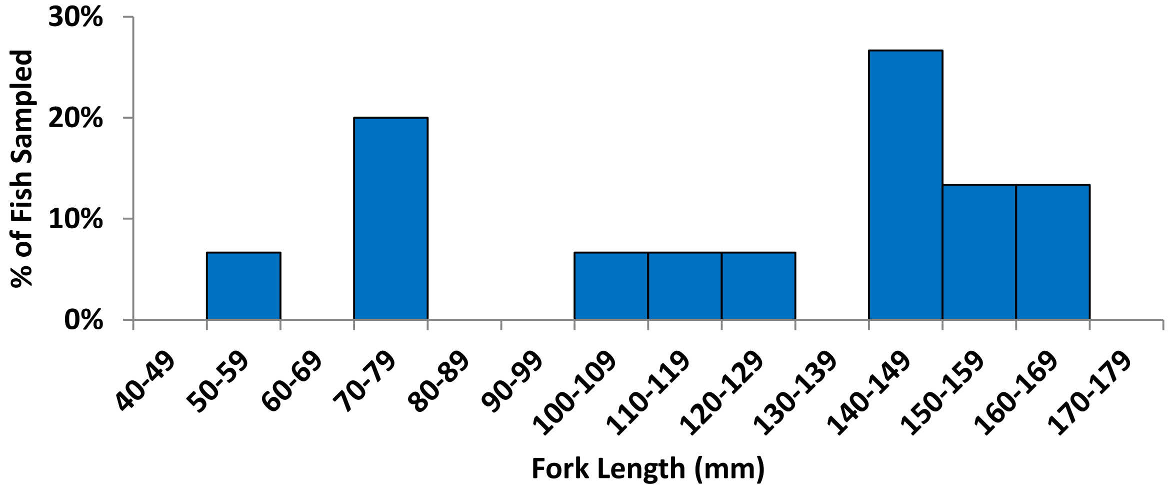

Figure 21. Pacific Herring fork length histogram for all months and sites combined in 2016.

Salmonid species captured in 2016 included Chinook Salmon, Chum Salmon, Coho Salmon, and Pink Salmon with variable catch rates occurring from January through June (Figure 22). Salmonid fork lengths generally increased for each species' cohort, as a consequence of seasonal growth after outmigration from local watersheds, during the sampling period (Figure 23). Chinook Salmon were captured at both sites with a peak catch rate in June (26 fish/set), which consisted of 31 hatchery and 99 natural-origin fish. Chum Salmon was the only salmonid species captured in January (n=2), quickly increasing to a peak catch rate in March (112 fish/set) and primarily captured at the north site. Genetic analysis of Chum tissue samples revealed that ESA-listed Hood Canal summer-run fish comprised 95% of all Chum captured in both January and February, while 80% of all Chum captured from March through May were fall-run fish (Figure 24). Coho Salmon were only captured in May (4.8 fish/set) and June (1.4 fish/set), with the majority of fish encountered at the north site. Overall, natural-origin Coho (n=24) outnumbered hatchery-origin Coho (n=7). Pink Salmon were first detected in February (3.8 fish/set) before dominating the catch in March (403 fish/set).

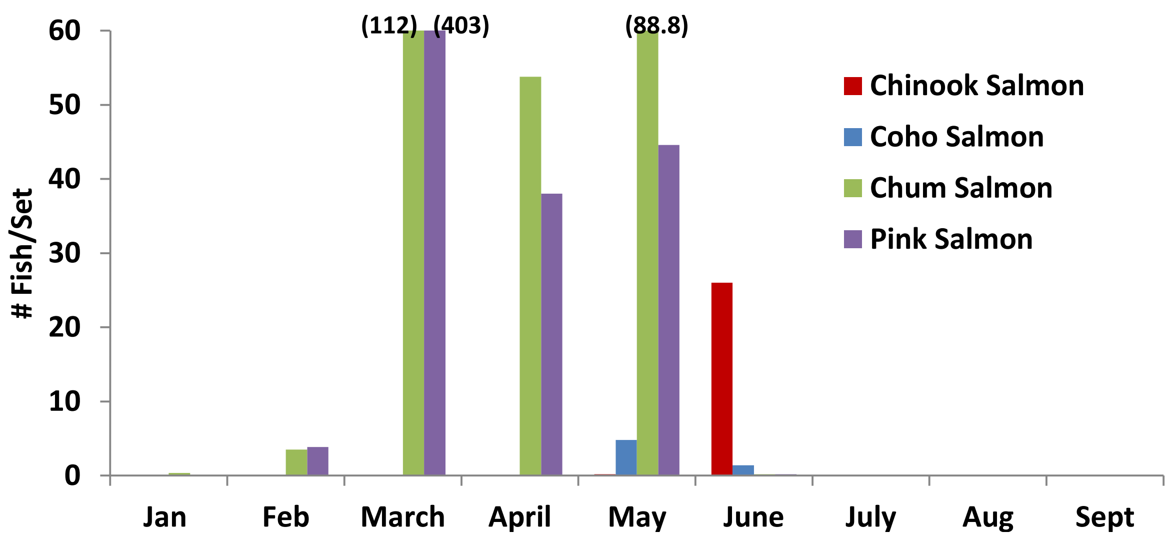

Figure 22. Catch rates for salmonid species captured at all sites combined in 2016. Values are labeled for catch rates exceeding the vertical axis.

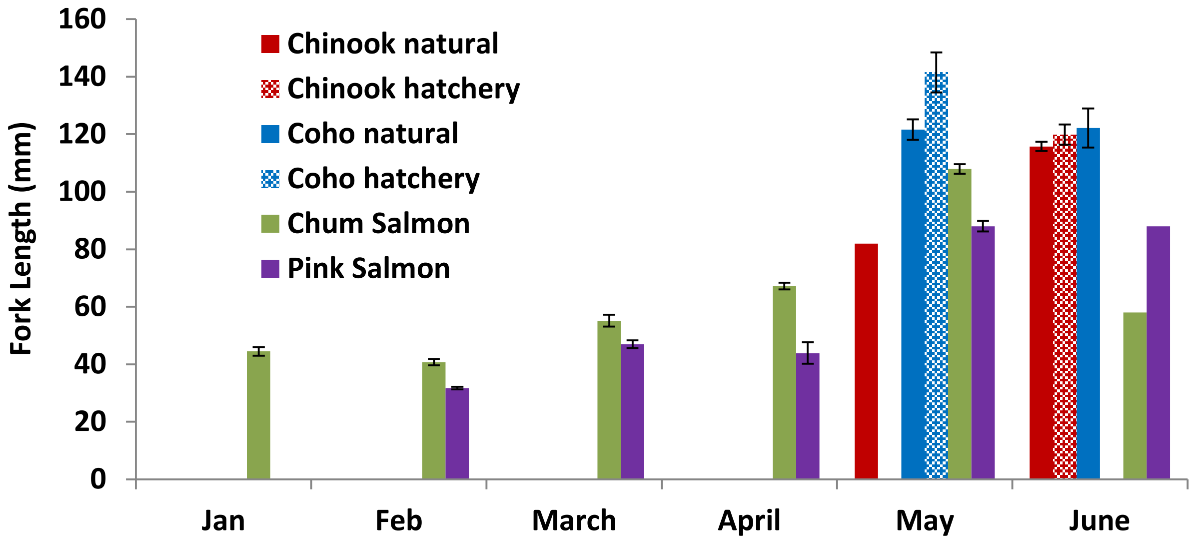

Figure 23. Mean fork length (± 1SE) for juvenile salmonid species, by month for all sites in 2016.

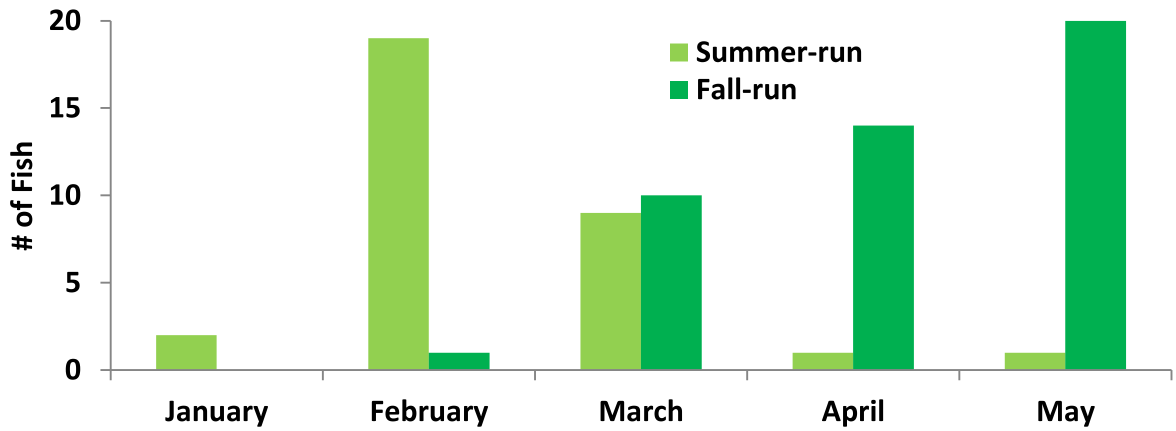

Figure 24. Run assignment of Chum Salmon captured at the NAVMAG Indian Island, by month in 2016.

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 NAVMAG Indian Island facilities and the WPNRA. 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 Walan Point shoreline and other areas of Admiralty Inlet. 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, but did not report on forage fish catches (see Moore et al. 1977, Wait et al. 2007).

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 NAVMAG Indian Island that may impact forage fish spawning grounds remains uncertain. The WPNRA shoreline consists of historically documented Pacific Sand Lance and Surf Smelt spawning beaches, nearshore Pacific Herring spawning beds, and Herring pre-spawner holding areas located offshore (WDFW online). All of these forage fish habitats are located immediately adjacent to the ammunition pier.

Forage fish were primarily captured during May through July sampling of both 2015 and 2016, with greater overall densities of all forage fish species encountered in 2015. The timing of forage fish species at the NAVMAG Indian Island was consistent between both survey years, but inconsistent among other DoN locations sampled by the WDFW throughout Puget Sound. Regarding abundance, catches of forage fish in 2015-16 showed high variation and inconsistency, which was relatively similar to other DoN locations sampled by the WDFW throughout Puget Sound. The disparities among these different survey locations 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. The overall mean catch rate for Pacific Sand Lance in 2016 was only 9% of the rate observed in 2015, but they were captured at very similar rates in July of both survey years. Surf Smelt peak catch rates for both survey years occurred in June, however the rate during June 2016 sampling was only 47% of the rate recorded in June 2015. Pacific Herring were captured at their highest rates in June 2015, but very light catches were observed for all other months during both survey years. Fork length data taken for Surf Smelt indicate presence of both age-0 juveniles and sexually mature adults simultaneously utilizing nearshore habitat throughout each year. This is consistent with documented Surf Smelt spawning events known to occur nearly year-round throughout different regions of the Puget Sound (Penttila 1978; WDFW unpublished data). Length data for Pacific Sand Lance and Pacific Herring also indicated age-0 juveniles and sexually mature adults simultaneously utilizing nearshore habitat within sampling areas.. Pacific Sand Lance and Herring spawn timing is documented to primarily occur during winter, which may correlate to the many age-0 fish captured during summer months. No ESA-listed species of forage fish (i.e., Eulachon) were captured during the 2015-16 sampling.

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 Admiralty Inlet, including the WPNRA shoreline, serve as an essential migration route for nearly all juvenile salmonids (natural and hatchery) produced in Puget Sound. 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 WPNRA shoreline and Admiralty Inlet to begin in January and continue through the summer (Moore et al. 1977, Wait et al. 2007). Both of these studies reported that juvenile Chum and Pink (in even years) Salmon were the predominant salmonid species captured with a beach seine, followed by Coho and Chinook. 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 Puget Sound 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 60% of the entire regional Puget Sound hatchery releases were composed of unmarked fish, meaning they could not be distinguished from naturally produced fish (see Appendix B and C). The 2005-06 survey along the western shoreline of Whidbey Island (Admiralty Inlet) reported that over 85% of the recovered Chinook with a coded wire tag (CWT) came from the Snohomish, Stillaguamish, Skagit, and Samish Rivers (Wait et al. 2007). They also recovered hatchery origin tagged Chinook and Coho released in Hood Canal and central Puget Sound. In 1977, Hood Canal hatcheries released 890,000 Chum Salmon 'spray-marked' with fluorescent pigment, of which five were recaptured with a beach seine at Walan Point (Moore et al. 1977). These mark-recapture data recapitulate the importance of nearshore outmigration pathways for juvenile salmonids throughout Admiralty Inlet, including Indian Island and the WPNRA.

Juvenile salmonid species showed similar trends in catch rates during corresponding sampling months in 2015 and 2016, and were primarily captured at the north site. It is unclear why salmonids were primarily captured at the north site for both survey years. While the sampled depths and proximity to Navy pier structures are similar at both sites, the substrate compositions are different; the north site is coarse pebble-cobble and the south site is fine gravel with sand. The north site lies much closer to the entrance of Kilisut Harbor, which exposes the site to stronger tidal currents and may increase prey availability during ebb tides.

Chum Salmon dominated the catch during May 2015 and from January through May 2016 sampling. Unmarked Chum Salmon fry comprised over 40% of all regional Puget Sound hatchery released fish in both survey years, with the vast majority (30-40 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 Chum Salmon 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 NAVMAG Indian Island was confirmed by genetic analysis of the 2016 samples, and is detailed in a separate report funded by another cooperative agreement (Small et al. 2017). These 2015-16 data are consistent with recent genetic assignment studies for Chum in the Hood Canal region, as the majority (95%) of Chum sampled in January and February were summer-run fish.

High densities of Pink Salmon juveniles were captured during March 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 the more recent survey in 2006 (Wait et al. 2007).

Coho Salmon were first encountered in May of both survey years at their respective peak catch rates, and quickly declined in June. This trend corresponds with the hatchery releases of over 8 million total Coho in both April and May of 2015-16, consisting of approximately 92% adipose clipped fish. However, only 11% of captured Coho in 2015-16 were hatchery produced (adipose clipped), which is inconsistent with the hatchery release mark rates. Surveys at other Navy installations in 2015-16 also observed this disproportionately low catch rate of hatchery produced Coho. This 2015-16 data for Coho is consistent with the timing and moderate catch rates reported from past studies conducted along the WPNRA and western Whidbey Island shoreline (Moore et al. 1977, Wait et al. 2007).

Chinook Salmon was a confirmed ESA-listed species captured at the NAVMAG Indian Island, first encountered in May of both survey years. The peak catch rate for Chinook Salmon occurring in July 2015 was only 21.5% of the peak catch rate recorded in June 2016. Hatchery releases of approximately 30 million Chinook from April through June 2015-16 correspond to the peak catch rates observed, consisting of 70% (2015) and 75% (2016) adipose clipped fish. However, only 30% of all captured Chinook in 2015-16 were hatchery produced (adipose clipped) rather than naturally produced (non-clipped) fish, which is inconsistent with the hatchery release mark rates. This 2015-16 data for Chinook is consistent with the timing and moderate catch rates reported from past studies conducted along the WPNRA and western Whidbey Island shoreline (Moore et al. 1977, Wait et al. 2007).

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 NAVMAG Indian Island 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 complex overwater structures along the WPNRA 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 (see Frierson et al. 2016). We further concluded that the WPNRA 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 WPNRA 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.

The two confirmed ESA-listed species captured with the beach seine at the NAVMAG Indian Island 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). Peak catches of Chinook juveniles occurred in July 2015 and June 2016. 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 February 15) for any NAVMAG Indian Island 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.

Acknowledgements

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Appendix A: Comprehensive list of all fish species recorded at the NAVMAG Indian Island in 2015 and 2016 with the beach seine. Taxonomic nomenclature and phylogenetic organization follows arrangement from Pietsch and Orr (2015) unless otherwise noted.

TAXON		COMMON NAME	
CLUPEIFORMES		**HERRINGS**	
	Clupeidae		**Herrings and Sardines**
	Alosa sapidissima		American Shad
	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
BATRACHOIDIFORMES		**TOADFISHES**	
	Batrachoididae		**Toadfishes**
	Porichthys notatus		Plainfin Midshipman
GASTEROSTEIFORMES		**STICKLEBACKS**	
	Aulorhynchidae		**Tubesnouts**
	Aulorhynchus flavidus		Tubesnout
	Gasterosteidae		**Sticklebacks**
	Gasterosteus aculeatus		Threespine Stickleback
	Syngnathidae		**Pipefishes**
	Syngnathus leptorynchus		Bay Pipefish
SCORPAENIFORMES		**MAIL-CHEEKED FISHES**	
	Hexagrammidae		**Greenlings**
	Hexagrammos stelleri		Whitespotted Greenling
	Ophiodon elongatus		Lingcod
			Greenling unidentified
	Cottidae		**Sculpins**
	Artedius fenestralis		Padded Sculpin
	Enophrys bison		Buffalo Sculpin
	Leptocottus armatus		Pacific staghorn Sculpin
	Myoxocephalus polyacanthocephalus		Great Sculpin
	Oligocottus maculosus		Tidepool Sculpin
	Oligocottus snyderi		Fluffy Sculpin
	Scorpaenichthys marmoratus		Cabezon
	Hemitripteridae		**Spiny Sculpins**
	Blepsias cirrhosus		Silverspot Sculpin
	Agonidae		**Poachers**
	Podothecus accipenserinus		Sturgeon Poacher
	Psychrolutidae		**Flathead sculpins**
	Psychrolutes paradoxus		Tadpole Sculpin
			Sculpin unidentified

PERCIFORMES	**PERCHES**
Embiotocidae	**Surfperches**
Brachyistius frenatus	Kelp Perch
Cymatogaster aggregata	Shiner Perch
Embiotoca lateralis	Striped Seaperch
Rhacochilus vacca	Pile Perch
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
Ammodytidae	**Sand Lances**
Ammodytes personatus	Pacific Sand Lance
PLEURONECTIFORMES	**FLATFISHES**
Pleuronectidae	**Righteye Flounders**
Lepidopsetta spp.	Rock Sole
Parophrys vetulus	English Sole
Platichthys stellatus	Starry Flounder
	Flatfish unidentified

Appendix B: Hatchery releases in Puget Sound regions during 2015. Regions include Northern Washington (NOWA), Skagit (SKAG), North Puget Sound (NPS), Mid Puget Sound (MPS), Hood Canal (HOOD), and Strait of Juan de Fuca (JUAN). Data summarized from the Regional Mark Information System (RMIS).

Species	Release Year	Release Month	CWT only	CWT + Ad Clip	Unmarked	Ad Clip only	Mean Length (mm)
Chinook	2015	February			317		
Chinook	2015	March	32,705		1,597		
Chinook	2015	April	483,083	921,254	218,123	2,425,435	143
Chinook	2015	May	1,714,148	1,107,358	3,587,550	11,782,432	79
Chinook	2015	June	518,764	1,292,888	2,896,832	3,600,297	86
Chinook	2015	July		100,694	1,883	830,183	98
Chinook	2015	September			119	34,881	95
Chinook	2015	November				353,641	80
TOTAL			**2,748,700**	**3,422,194**	**6,706,421**	**19,026,869**	
Chum	2015	February			1,349,388		
Chum	2015	March			4,429,592		51
Chum	2015	April			40,885,937		51
Chum	2015	May			84,323		50
Chum	2015	October			863,000		
Chum	2015	December			210,400		
TOTAL					**47,822,640**		
Coho	2015	January			50,235	120,000	152
Coho	2015	February	1,456	106,062	35,515	1,248	123
Coho	2015	March	75,654	126,276	164,887	652,982	114
Coho	2015	April	219,723	351,538	116,018	4,043,496	126
Coho	2015	May	96,228	425,629	140,576	3,561,361	133
Coho	2015	June			159,315		
Coho	2015	July				250	
Coho	2015	September			12	120	
Coho	2015	December			72,000		
TOTAL			**393,061**	**1,009,505**	**738,558**	**8,379,457**	
Cutthroat	2015	January			1,124		
Cutthroat	2015	February			75		
Cutthroat	2015	May			29,695		
Cutthroat	2015	June			88,604		
Cutthroat	2015	July			2,130		
Cutthroat	2015	August			775		
Cutthroat	2015	September			7,140		
Cutthroat	2015	October			54,064		
Cutthroat	2015	November			18,040		
TOTAL					**201,647**		

Sockeye	2015	January	186	4,456	139
Sockeye	2015	February	2,041,563		32
Sockeye	2015	March	3,847,964	5,119	86
Sockeye	2015	April	4,484,080		32
Sockeye	2015	May	470,511		
Sockeye	2015	November	6,473	325,243	109
Sockeye	2015	December	26	838	109
TOTAL			**10,850,803**	**335,656**	
Steelhead	2015	February	120	6,047	498
Steelhead	2015	March	2,559	192,703	535
Steelhead	2015	April	45,687	605,156	184
Steelhead	2015	May	57,244	8,786	182
Steelhead	2015	June	17	16,807	192
Steelhead	2015	October	137	15,863	
Steelhead	2015	November	59	6,861	
TOTAL			**105,823**	**852,223**	

Appendix C: Hatchery releases in Puget Sound regions during 2016. Regions include Northern Washington (NOWA), Skagit (SKAG), North Puget Sound (NPS), Mid Puget Sound (MPS), Hood Canal (HOOD), and Strait of Juan de Fuca (JUAN). Data summarized from the Regional Mark Information System (RMIS).

Species	Release Year	Release Month	CWT only	CWT + Ad Clip	Unmarked	Ad Clip only	Mean Length (mm)
Chinook	2016	January	204,701	307,557	206,834	2,121,448	75
Chinook	2016	February				1,300	78
Chinook	2016	March	157,985		2,214		161
Chinook	2016	April	171,063	260,892	24,498	1,140,918	143
Chinook	2016	May	1,649,912	1,339,391	951,300	13,773,264	81
Chinook	2016	June	609,066	1,162,526	3,628,657	3,067,264	88
Chinook	2016	July				485,000	74
Chinook	2016	August	277,780		2,236		
Chinook	2016	October				294,318	74
Chinook	2016	November				213,000	78
Chinook	2016	December		208,863		1,261	81
TOTAL			**3,070,507**	**3,279,229**	**4,815,739**	**21,097,773**	
Chum	2016	January			80,000		
Chum	2016	February			245,024		
Chum	2016	March			4,314,344		49
Chum	2016	April			32,645,171		52
Chum	2016	May			571,908		55
Chum	2016	June			200		
TOTAL					**37,856,647**		
Coho	2016	February			123,579		
Coho	2016	March	1,092	50,318	139,437	71,641	
Coho	2016	April	220,109	561,452	189,202	3,290,731	122
Coho	2016	May	93,134	436,857	123,317	2,953,699	136
Coho	2016	June			38,415		
TOTAL			**314,335**	**1,048,627**	**613,950**	**6,316,071**	
Cutthroat	2016	January			750		
Cutthroat	2016	February			18,900		
Cutthroat	2016	April			26,400		
Cutthroat	2016	May			52,689		
Cutthroat	2016	June			74,510		
Cutthroat	2016	July			585		
Cutthroat	2016	August			1,140		
Cutthroat	2016	September			335		
Cutthroat	2016	October			37,609		
Cutthroat	2016	November			19,891		
Cutthroat	2016	December			10,000		
TOTAL					**242,809**		

Pink	2016	March	491,572		51
Pink	2016	May	67,087		
TOTAL			**558,659**		
Sockeye	2016	February	839,153		34
Sockeye	2016	March	4,429,846	3,035	85
Sockeye	2016	April	4,963,025		
Sockeye	2016	May	150,590		
Sockeye	2016	November	2,868	283,938	93
Sockeye	2016	December	18	1,782	101
TOTAL			**10,385,500**	**288,755**	
Steelhead	2016	January	40,000		
Steelhead	2016	March	11,610	92,723	148
Steelhead	2016	April	110,138	682,951	187
Steelhead	2016	May	48,166	51,465	181
Steelhead	2016	June	9	3,088	184
Steelhead	2016	November	82,000		
TOTAL			**291,923**	**830,227**	