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CHARACTERIZING THE DISTRIBUTION OF ESA LISTED SALMONIDS IN THE NORTHWEST TRAINING AND TESTING AREA WITH ACOUSTIC AND POP-UP SATELLITE TAGS

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14. ABSTRACT
The Northwest Fisheries Science Center conducted a study to characterize the distribution of salmonids (Chinook salmon, coho salmon, bull trout) within the Northwest Training and Testing (NWTT) area in 2019. In May 2019, we deployed 107 stationary receivers in a grid pattern along the coast of Washington State. We retrieved, downloaded, and redeployed stationary receivers in September 2019. Receivers were retrieved and downloaded in March 2020 and not redeployed due to COVID-19 restrictions. In July 2020, receivers were redeployed in a new line pattern designed to detect Chinook salmon tagged in Kodiak, AK and Yakutat, AK returning to the Columbia River. In October 2020, we tagged 80 Chinook salmon with acoustic transmitters in Kodiak, AK. In February 2021 we tagged 14 steelhead kelts with pop-up satellite tags and 41 steelhead kelts with acoustic tags in the Willapa River, WA. We plan to tag 80 Chinook salmon with acoustic tags in in Yakutat, AK in March. We plan to download and redeploy acoustic receivers in the summer of 2021.

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Abstract:

The Northwest Fisheries Science Center conducted a study to characterize the distribution of salmonids (Chinook salmon, coho salmon, bull trout) within the Northwest Training and Testing (NWTT) area in 2019. In May 2019, we deployed 107 stationary receivers in a grid pattern along the coast of Washington State. We retrieved, downloaded, and redeployed stationary receivers in September 2019. Receivers were retrieved and downloaded in March 2020 and not redeployed due to COVID-19 restrictions. In July 2020, receivers were redeployed in a new line pattern designed to detect Chinook salmon tagged in Kodiak, AK and Yakutat, AK returning to the Columbia River. In October 2020, we tagged 80 Chinook salmon with acoustic transmitters in Kodiak, AK. In February 2021 we tagged 14 steelhead kelts with pop-up satellite tags and 41 steelhead kelts with acoustic tags in the Willapa River, WA. We plan to tag 80 Chinook salmon with acoustic tags in in Yakutat, AK in March. We plan to download and redeploy acoustic receivers in the summer of 2021.

Background:

The U.S. Navy conducts military training and testing in Pacific Northwest range areas to prepare combat-ready military forces, whereas NOAA Fisheries is responsible for managing threatened and endangered species in marine waters and providing permits to the U.S. Navy for incidental take and letters of authorization for training and testing activities. NOAA Fisheries and the U.S. Navy share the common goals of minimizing the impact of military training and testing activities on endangered species without compromising training and testing efforts and of reducing adverse environmental effects. This work provides vital geographic and distributional data within the Navy's range areas, allowing the Navy the flexibility to proceed with training and testing activities while providing protective measures for both salmonids and killer whales.

The U. S. Navy Pacific Fleet funded an unprecedented study at the NOAA Northwest Fisheries Science Center to fill an important knowledge gap regarding the relationship between salmonids and critically endangered southern resident killer whales (SRKW) along the Washington Coast. This project characterized the ocean distribution of salmon using acoustic and satellite tags to understand how salmon affect the distribution and effort expended by foraging SRKW, thus affecting their survival. This internationally coordinated effort with scientists from the Canadian Department of Fisheries and Oceans, the University of Washington, Oregon State University, and others largely began in late April 2019; acoustic receivers have been deployed along hundreds of miles of the Washington Coast and to date 222 Chinook salmon, 35 coho salmon, 17 bull trout, and 55 steelhead kelts have been captured, tagged, and tracked. An additional 80 Chinook salmon are scheduled to be tagged Yakutat, AK in March 2021.

Summary of Tasks:

Task 1 – Augment current acoustic receiver array

In March 2020 receivers were retrieved and were unable to redeploy due to COVID-19 restrictions. In July 2020 we were able to redeploy receivers in a new configuration designed to detect Chinook salmon tagged in Alaska. These receivers were deployed in three lines (North

Jetty-NJ 1-km spacing, Long beach – LB 1-km spacing, and Willapa – W 4-km spacing) perpendicular to the coast of Washington state (Figure 1). An additional 4 receivers will be deployed in February 2021 across the mouth of the Columbia River (1-km spacing) to determine river entry timing. These receivers will allow us to determine migration route details including the distance from shore (inside or outside the NWTT) and timing of Chinook salmon as they return to the Columbia River along the coastal shelf of Washington State. Receivers will be downloaded and redeployed in the summer of 2021.

Task 2 - Tag Chinook salmon with acoustic tags in Alaska

Chinook - Kodiak, AK: We implanted Vemco V16 acoustic tags in 80 Chinook salmon (48.5 – 80 cm fork length) in the coastal waters of Kodiak Alaska between 16 October 2020 and 28 October 2020 (Table 1). Scales and fin clips were collected to determine natal river origin, age, and life history (ocean migration as a sub-yearling vs. yearling) of each individual.

Chinook - Yakutat, AK: We plan to implant Vemco V16 acoustic tags in 80 Chinook salmon in the coastal waters of Yakutat Alaska in March 2021. We will also collect scales and fin clips to determine natal river origin, age, and life history (ocean migration as a sub-yearling vs. yearling) of each individual.

Steelhead – Willapa, WA: In addition to tagging Chinook salmon in Alaska, we were able to deploy 41 Vemco V9 acoustic tags (52-82 cm fork length) and 14 pop-up satellite tags (PSAT) on steelhead kelts (66 – 84 cm fork length) on 03 February 2021 (Table 2 acoustic tags, Table 3 PSAT). Fish were collected at the Forks Creek Hatchery in Raymond, WA. Steelhead tagged with PSAT tags were transported to the mouth of Willapa Bay, outfitted with a Wildlife Computers miniPAT tag using methods developed by Michael Courtney and Andy Seitz (University of Alaska Fairbanks), and released. This work was scheduled for year 1 of this project but was delayed due to logistical constraints. PSAT tags are scheduled to release 120 days (n = 5) and 180 days (n = 9) after deployment. Tags will log temperature, depth, and light intensity. Data will be transmitted via satellite at 450 second intervals. The light intensity measurements will allow us to construct an estimated trajectory path for each individual. From this, we will be able to estimate the amount of time spent within and outside of the NWTT during the tag deployment. The miniPAT ARGOS fees are being covered by the Animal Tracking Network (ATN) and these data will be available via the ATN website. Data from acoustically tagged steelhead will provide survival and directional data that can help inform use of the NWTT by steelhead.

Collaborations: This project collaborates with other Navy funded protects including Andy Seitz (UAF, Chinook salmon), Michael Courtney (UAF, Chinook salmon), Laura Heironimus (WDFW, green sturgeon), and Mary Moser (green sturgeon). All projects share data to improve the overall impact of each independent study.

Figure 1. Acoustic receiver locations from this project as well as other collaborators that share data.

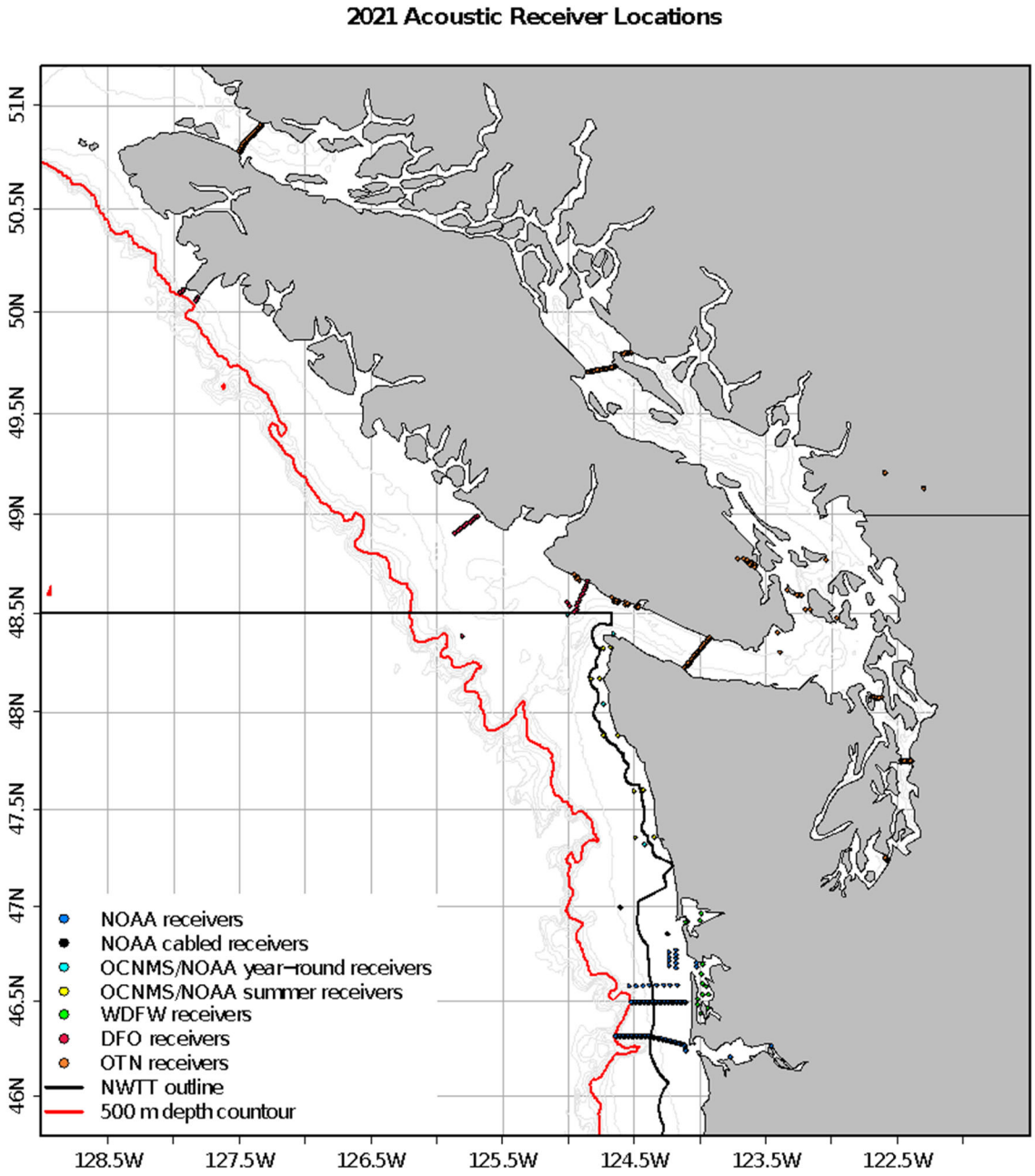

Table 1. Tagging metadata for Chinook salmon tagged with Vemco V16 acoustic tags in Kodiak, AK.

#	Species	VEMCO ID	Mark	Deploy date	Deploy Time AKST	Fork Length cm	Deploy latitude	Deploy longitude
1	Chinook	2395	None	2020-10-16	09:25	58	57.85132	-152.27163
2	Chinook	2396	None	2020-10-16	10:05	64	57.85132	-152.27127
3	Chinook	2397	None	2020-10-16	10:10	65	57.85252	-152.26738
4	Chinook	2398	None	2020-10-16	11:29	76	57.85103	-152.27373
5	Chinook	2399	None	2020-10-17	12:52	70	57.85078	-152.27502
6	Chinook	2400	None	2020-10-17	16:27	74	57.86447	-152.26743
7	Chinook	2401	None	2020-10-17	16:38	81.5	57.85028	-152.26532
8	Chinook	2402	None	2020-10-18	09:08	80	57.85442	-152.27048
9	Chinook	2403	None	2020-10-18	09:37	58	57.85442	-152.27048
10	Chinook	2404	None	2020-10-18	9:46	59	57.85442	-152.27048
11	Chinook	2405	None	2020-10-18	09:51	60	57.85442	-152.27048
12	Chinook	2406	None	2020-10-18	10:01	63	57.85070	-152.26375
13	Chinook	2407	None	2020-10-18	10:24	66	57.85380	-152.25618
14	Chinook	2408	None	2020-10-18	10:45	61	57.85605	-152.26870
15	Chinook	2409	Adipose clip	2020-10-18	11:02	66	57.85248	-152.27037
16	Chinook	2410	None	2020-10-18	12:22	64	57.85648	-152.26753
17	Chinook	2411	None	2020-10-18	14:09	75	57.84135	-152.21767
18	Chinook	2412	None	2020-10-18	14:28	77	57.84063	-152.21590
19	Chinook	2413	None	2020-10-18	14:45	63	57.84063	-152.21590
20	Chinook	2414	None	2020-10-18	14:53	72	57.84063	-152.21590
21	Chinook	2415	None	2020-10-18	14:53	65	57.84063	-152.21590
22	Chinook	2416	None	2020-10-18	14:58	70	57.84208	-152.21523
23	Chinook	2417	Adipose clip	2020-10-18	15:04	65	57.84208	-152.21523
24	Chinook	2418	Adipose clip	2020-10-18	15:19	62	57.84208	-152.21523
25	Chinook	2419	Adipose clip	2020-10-18	15:22	65	57.84208	-152.21523
26	Chinook	2420	None	2020-10-18	15:36	64	57.84208	-152.21523
27	Chinook	2421	None	2020-10-18	15:47	71	57.83928	-152.21723
28	Chinook	2422	None	2020-10-18	16:47	74	57.83587	-152.21850

#	Species	VEMCO ID	Mark	Deploy date	Deploy Time AKST	Fork Length cm	Deploy latitude	Deploy longitude
29	Chinook	2423	None	2020-10-18	17:09	69	57.83953	-152.21553
30	Chinook	2424	Adipose clip	2020-10-19	09:19	79	57.84648	-152.27077
31	Chinook	2425	None	2020-10-19	09:27	66	57.84648	-152.27077
32	Chinook	2426	None	2020-10-19	09:37	68	57.84726	-152.27177
33	Chinook	2427	None	2020-10-19	09:55	69	57.84400	-152.27443
34	Chinook	2428	None	2020-10-19	10:05	77	57.84468	-152.27339
35	Chinook	2429	None	2020-10-19	10:40	77	57.84641	-152.27055
36	Chinook	2430	None	2020-10-19	11:00	60	57.84960	-152.27052
37	Chinook	2431	None	2020-10-19	11:22	53	57.84951	-152.27100
38	Chinook	2432	Adipose clip	2020-10-19	11:35	67	57.84448	-152.27247
39	Chinook	2433	Adipose clip	2020-10-21	09:45	70	57.84570	-152.27264
40	Chinook	2434	None	2020-10-21	10:31	55	57.84509	-152.26724
41	Chinook	2435	None	2020-10-21	10:36	70	57.84691	-152.27132
42	Chinook	2436	None	2020-10-21	10:47	60	57.85206	-152.26817
43	Chinook	2437	Adipose clip	2020-10-21	11:20	57	57.84451	-152.27272
44	Chinook	2438	None	2020-10-21	11:34	57	57.84451	-152.27272
45	Chinook	2439	Adipose clip	2020-10-21	11:51	54	57.84116	-152.27399
46	Chinook	2440	None	2020-10-21	11:51	60	57.84116	-152.27399
47	Chinook	2441	Adipose clip	2020-10-21	12:34	65	57.84236	-152.27636
48	Chinook	2442	None	2020-10-21	12:51	74	57.84209	-152.27877
49	Chinook	2443	None	2020-10-21	13:01	64	57.84209	-152.27877
50	Chinook	2444	None	2020-10-21	13:08	48.5	57.84468	-152.27114
51	Chinook	2445	None	2020-10-21	13:27	53.5	57.84523	-152.27252
52	Chinook	2446	None	2020-10-21	13:48	54	57.84546	-152.27244
53	Chinook	2447	Adipose clip	2020-10-21	14:03	70	57.84546	-152.27244
54	Chinook	2448	Adipose clip	2020-10-21	14:37	57	57.84364	-152.27524
55	Chinook	2449	None	2020-10-21	15:13	74	57.84648	-152.27163
56	Chinook	2450	None	2020-10-21	15:41	66	57.82887	-152.29293

#	Species	VEMCO ID	Mark	Deploy date	Deploy Time AKST	Fork Length cm	Deploy latitude	Deploy longitude
57	Chinook	2451	Adipose clip	2020-10-24	10:48	67	57.84301	-152.27383
58	Chinook	2452	Adipose clip	2020-10-24	11:08	53	57.84281	-152.26907
59	Chinook	2453	Adipose clip	2020-10-24	11:34	56.5	57.85085	-152.26972
60	Chinook	2454	None	2020-10-24	11:50	64	57.84652	-152.27069
61	Chinook	2455	None	2020-10-24	11:55	65	57.84339	-152.27254
62	Chinook	2457	None	2020-10-24	12:29	71	57.84608	-152.27260
63	Chinook	2456	None	2020-10-24	13:02	63	57.84424	-152.27358
64	Chinook	2458	None	2020-10-24	13:06	72	57.84252	-152.27470
65	Chinook	2459	None	2020-10-24	13:42	64	57.84980	-152.27089
66	Chinook	2460	None	2020-10-24	14:07	70	57.84798	-152.27168
67	Chinook	2461	None	2020-10-24	15:10	53	57.84692	-152.27107
68	Chinook	2462	None	2020-10-24	15:18	66	57.84507	-152.27283
69	Chinook	2463	None	2020-10-24	15:26	73	57.84491	-152.27387
70	Chinook	2464	None	2020-10-24	15:32	64	57.84572	-152.27438
71	Chinook	2465	None	2020-10-24	15:36	69	57.84323	-152.27599
72	Chinook	2466	None	2020-10-24	15:50	63	57.84442	-152.27533
73	Chinook	2467	None	2020-10-24	15:55	68	57.84281	-152.27600
74	Chinook	2468	None	2020-10-24	16:04	68	57.84619	-152.27147
75	Chinook	2469	None	2020-10-24	16:24	63	57.84445	-152.27565
76	Chinook	2470	None	2020-10-24	16:40	89	57.84327	-152.27774
77	Chinook	2471	Adipose clip	2020-10-24	16:55	73	57.84633	-152.27297
78	Chinook	2473	None	2020-10-27	14:27	79	57.84008	-152.21730
79	Chinook	2474	None	2020-10-27	15:05	56	57.84210	-152.21700
80	Chinook	2472	None	2020-10-28	12:36	79	57.64193	-152.15257

Table 2. Tagging metadata for steelhead tagged with acoustic tags in Willapa Bay, WA. Tagged steelhead are being held at the Forks Creek Hatchery and will be released on 09 February 2021.

#	Species	Date	Hatchery/Wild	Length cm	VEMCO code
1	Steelhead	2021-02-03	W	74	7538
2	Steelhead	2021-02-03	W	71	7546
3	Steelhead	2021-02-03	W	63	7556
4	Steelhead	2021-02-03	H	67	7532
5	Steelhead	2021-02-03	H	74	7537
6	Steelhead	2021-02-03	H	79	7551
7	Steelhead	2021-02-03	H	72	7543
8	Steelhead	2021-02-03	H	65	7557
9	Steelhead	2021-02-03	H	80	7552
10	Steelhead	2021-02-03	H	79	7553
11	Steelhead	2021-02-03	H	80	7539
12	Steelhead	2021-02-03	H	65	7534
13	Steelhead	2021-02-03	H	78	7462
14	Steelhead	2021-02-03	H	62	7531
15	Steelhead	2021-02-03	H	72	7544
16	Steelhead	2021-02-03	H	80	7558
17	Steelhead	2021-02-03	H	58	7542
18	Steelhead	2021-02-03	H	79	7545
19	Steelhead	2021-02-03	H	52	7548
20	Steelhead	2021-02-03	H	63.6	7535
21	Steelhead	2021-02-03	H	78	7549
22	Steelhead	2021-02-03	H	79	7550
23	Steelhead	2021-02-03	H	62.5	7533
24	Steelhead	2021-02-03	H	67	7555
25	Steelhead	2021-02-03	H	62.5	7541
26	Steelhead	2021-02-03	H	60	7540
27	Steelhead	2021-02-03	H	59	7547
28	Steelhead	2021-02-03	H	58.5	7536
29	Steelhead	2021-02-03	H	64	17335
30	Steelhead	2021-02-03	H	59	17333

#	Species	Date	Hatchery/Wild	Length cm	VEMCO code
31	Steelhead	2021-02-03	H	68	17364
32	Steelhead	2021-02-03	H	60.5	17352
33	Steelhead	2021-02-03	H	65.5	17359
34	Steelhead	2021-02-03	H	61	17363
35	Steelhead	2021-02-03	H	81	17353
36	Steelhead	2021-02-03	H	82	17351
37	Steelhead	2021-02-03	H	81	17332
38	Steelhead	2021-02-03	H	61	17358
39	Steelhead	2021-02-03	H	61.5	17349
40	Steelhead	2021-02-03	H	67	17356
41	Steelhead	2021-02-03	H	62	17338

Table 3. Tagging metadata for steelhead tagged with miniPAT pop-up satellite tags in Willapa Bay, WA.

#	Species	miniPAT_ID	Deploy_date	Deploy_time_PST	Expected_pop_date	Fork_length_cm
1	Steelhead	210755	2021-02-03	16:47	2021-06-03	74
2	Steelhead	206629	2021-02-03	16:56	2021-08-02	77
3	Steelhead	210756	2021-02-03	17:00	2021-06-03	79
4	Steelhead	210750	2021-02-03	17:02	2021-08-02	80
5	Steelhead	206630	2021-02-03	17:05	2021-08-02	77
6	Steelhead	210747	2021-02-03	17:08	2021-08-02	78
7	Steelhead	210753	2021-02-03	17:11	2021-06-03	76
8	Steelhead	210749	2021-02-03	17:15	2021-08-02	74
9	Steelhead	210754	2021-02-03	17:17	2021-06-03	84
10	Steelhead	210748	2021-02-03	17:19	2021-08-02	66
11	Steelhead	206770	2021-02-03	17:22	2021-08-02	80
12	Steelhead	210752	2021-02-03	17:24	2021-06-03	80
13	Steelhead	206769	2021-02-03	17:26	2021-08-02	77
14	Steelhead	210751	2021-02-03	17:28	2021-08-02	73