

Submitted in Support of the U.S. Navy's 2021 Annual Marine Species Monitoring Report for the Pacific

Annual report for activities occurring in 2021 for Tasks 3, 4, and 5 of MIPR N00070-21-MP-0EQ8Q

Autonomous acoustic recorder monitoring for southern resident killer whales and anthropogenic noise in Washington waters

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Abstract

Autonomous passive acoustic recorders have been used for the past 15 years to monitor the coastal occurrence of Southern Resident killer whales (SRKW), other marine mammals, and anthropogenic noise in and adjacent to the Navy's NWTRC in Washington State. The five autonomous acoustic recorders in and adjacent to the Navy's NWTRC were successfully recovered in early September 2021 and new moorings were redeployed at each site. Recovery and redeployment of the recorders, which was originally scheduled for late July 2021, were delayed until September 2021 due to logistical complications associated with COVID-19 which also delayed data processing and analyses. Recent acoustic detections on the Juan de Fuca recorder suggested an increase in SRKW occurrence at the west entrance of the Strait of Juan de Fuca in the summer and fall months. This shift in occurrence is supported by a recent decrease in sightings in the inland waters of Washington and British Columbia as well as a recent increase in visual and acoustic detections in Canadian waters adjacent to the Juan de Fuca recorder in the summer and fall months. The significance of this occurrence shift is that SRKWs have recently begun spending substantially more time in an areas adjacent to the Navy's NWTRC.

Three tasks were required for autonomous acoustic recorder monitoring of Southern Resident killer whales (SRKW) in 2021.

- **Task 3: Recover and redeploy autonomous acoustic recorders in and adjacent to the Navy's NWTRC in Washington State. Autonomous acoustic recorder moorings will be recovered and redeployed in and adjacent to the Navy training range in Washington State in summer 2021. Deployment locations will be determined based on analysis of the previous data collected on SRKW occurrence to increase the likelihood of detection and thus provide an improved resolution of whale occurrence and movements through this region.**

The five autonomous acoustic recorders in and adjacent to the Navy's NWTRC in Washington State were successfully recovered and new moorings were redeployed at each site in early September 2021 (Figure 1). Because the Ecological Acoustic Recorders (EARs) we have been using since 2008 are no longer produced or supported, we began transitioning to new recorders (Soundtraps) in the fall of 2018. However, because the Soundtrap recorders differ slightly from the EARs in their specifications, one of each recorder was co-located on each mooring each year to assess the degree to which the Soundtrap differed from the EAR in its detection capability.

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14. ABSTRACT Autonomous passive acoustic recorders have been used for the past 15 years to monitor the coastal occurrence of Southern Resident killer whales (SRKW), other marine mammals, and anthropogenic noise in and adjacent to the Navy's NWTRC in Washington State. The five autonomous acoustic recorders in and adjacent to the Navy's NWTRC were successfully recovered in early September 2021 and new moorings were redeployed at each site. Recovery and redeployment of the recorders, which was originally scheduled for late July 2021, were delayed until September 2021 due to logistical complications associated with COVID-19 which also delayed data processing and analyses. Recent acoustic detections on the Juan de Fuca recorder suggested an increase in SRKW occurrence at the west entrance of the Strait of Juan de Fuca in the summer and fall months. This shift in occurrence is supported by a recent decrease in sightings in the inland waters of Washington and British Columbia as well as a recent increase in visual and acoustic detections in Canadian waters adjacent to the Juan de Fuca recorder in the summer and fall months. The significance of this occurrence shift is that SRKWs have recently begun spending substantially more time in an areas adjacent to the Navy's NWTRC.		
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Figure 1. Locations of autonomous passive acoustic recorders recovered and deployed off the Washington coast in September 2021.

A comparative assessment of the detection capabilities of these two recorder types was conducted for sites where data were obtained for both an EAR and SoundTrap in 2018-19 (Cape Flattery Offshore, Juan de Fuca, and Columbia River). The findings of this comparison included that both recorders had similar deployment duration, there were more detections days in all months but June and at all sites in the SoundTrap recordings, the patterns of occurrence are similar to those previously published, but the magnitude of peaks in occurrence changed between recorders, the encounter lengths increased on the Soundtraps for both killer whale populations when compared to those previously published, the differences between recorders were most pronounced at the Juan de Fuca site indicating that the increased bandwidth and low self-noise of the Soundtraps are important in noisy environments, and the previous gaps in detections may have been missed detections, especially at Juan de Fuca. Consequently, we have been prioritizing analyses of Soundtrap data over EAR data following post-processing and back up. Further analyses will be needed to determine how to potentially correct for this incongruity when comparing to prior detections collected only on EARs.

For 2021-22 deployments, we co-located SoundTraps and EARs, to extent available, on each mooring deployed in early September 2021. Recovery and redeployment of the recorders, which was originally scheduled for late July 2021 was delayed until September 2021 due to logistical complications associated with COVID-19 and thus, subsequently also delayed data processing and analysis.

Of the five moorings recovered in September 2021, data were available from: Juan de Fuca; September 7, 2020- August 23, 2021, Cape Flattery Offshore; Sept 2020- July 2021, La Push; EAR data, no SoundTrap data, Westport; September 2020- Apr 25, 2021 (Soundtrap, EAR data past this end date), and Columbia River; Sept 2020- September 2021.

- **Task 4. Identification and classification of Southern Resident Killer Whale detections from acoustic recorders. Task 4 will involve the manual review of acoustic data files for each of the recovered recorders deployed along the U.S. west coast from fall 2020 to summer 2021. SRKW stereotypic calls will be used to determine which pod is present, and assign behavior state.**

Analyses were completed for the data collected from fall of 2019 – summer 2020 for killer whale detections. Southern resident killer whales (SRKWs) were detected on 127 of 1457 days of effort (Table 1). In addition, a preliminary, partial analysis of the Juan de Fuca recorder data from 2020-21 was initiated through 1 April 2021 and yielded 46 SRKW detections in 205 days. These data are presented with recent prior years, 2017-2018 and 2018-2019.

Table 1. Autonomous passive acoustic recorder effort and detections of Southern resident killer whales from moorings in and adjacent to the NWRTC in Washington State.

Year (Sept-Aug)	Location	Effort (days)	Total Detections	Detections thru 1 April
2017-18	Juan de Fuca	265	34	29
	Cape Flattery Offshore	316	5	
	La Push	315	10	
	Westport	0	0	
	Columbia River North	158	4	
Total		1054	53	
2018-19	Juan de Fuca	262	24	23
	Cape Flattery Offshore	257	8	
	La Push	254	1	
	Westport	307	9	
	Columbia River North	328	7	
Total		1408	49	
2019-20	Juan de Fuca	293	107	84
	Cape Flattery Offshore	294	1	
	La Push	270	4	
	Westport	295	6	
	Columbia River North	305	9	
Total		1457	127	
2020-21	Juan de Fuca	205		46

The large increase in total detections in 2019-2020 was driven largely by the substantial increase in detections (107) on the Juan de Fuca recorder. Although the Juan de Fuca recorder had more detections than all of the other locations combined for each of the past three years, at 84%, in 2019-2020 it was 20% and 34% greater than 2017-2018, and 2018-2019, respectively. Although analyses are ongoing for 2020-21, detections through 1 April (see Table 1) suggest that 2020-21 will also have a high number of detections at this site compared with 2017-2018 and 2018-19.

The increasing number of detections on the Juan de Fuca recorder is consistent with the relatively frequent acoustic and visual detections obtained by Department of Fisheries and Oceans Canada in recent years (DFO unpubl., data), particularly in the summer and fall months. This increase in detections on the Juan de Fuca recorder is also commensurate with the decreasing number of visual sightings of SRKW in inland waters during the summer (Whale Museum, Orcamaster unpubl. data). Taken together, these data indicate that the SRKW have made a substantial seasonal shift in their seasonal occurrence, particularly summer and fall, from inland waters of the Salish Sea to near the western entrance of the Strait of Juan de Fuca, an area that is adjacent to the NWRTC.

- **Task 5: Reporting. Project Summary: A short annual project summary of work completed within each calendar year will be submitted to the Navy. The cost assumption is that two Project Summaries will be delivered: one covering efforts in 2021 (date of award through December 2021) and a second summary covering January-December 2022. Each of the annual summaries will be delivered to the Navy no later than 31 January following the end of the previous calendar year. These reports must be submitted by the Navy to NOAA Fisheries' Office of Protected Resources as part of the Navy's formal range complex reporting no later than 1 April of every calendar year. The summary will briefly detail the methods, field accomplishments, and next steps for the project and the project schedule.**

The above listed accomplishments represents a summary of our 2021 annual reporting requirements.