Use of a Conservation Canine for Marine Mammal Scat Collection in Hawaii – Pilot Study

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Abstract

Analysis of scat samples from animals is a non-invasive technique that can provide important data on animal diet, hormone levels, microbiome, and genetics. The use of a trained Conservation Canine (K9) to detect marine mammal scat at sea has been proven to be useful in the Pacific Northwest with Southern Resident Killer Whales (Lundin et al. 2016) and in other unpublished reports and media, but until now, had not been documented in Hawaii. In order to explore the viability of this method in Hawaii, the Navy invested in a pilot study, where the K9 was successfully trained to detect and 'direct' boat drivers – via changes in behavior – to the scat of three species of marine mammals (*G. macrorynchus, K. breviceps, and P. crassidens*). If this method were refined in the future, analysis of scat samples from animals that had been in close proximity to training and testing events may provide important data on stress responses in the animal during the 24 hours preceding the collection, and the potential consequences of that response.

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14. ABSTRACT
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Introduction:

Analysis of scat samples from animals, including marine mammals, can provide important data to scientists such as information on animals' diets, hormone levels, microbiome, and genetics. While much of this information can also be obtained from biopsy samples, collection of scat is one non-invasive alternative.

The U.S. Navy invested in this pilot study under its Marine Species Monitoring Program, which explores a continuum of scientific objectives under an "Occurrence, Exposure, Response and Consequences" paradigm. The Navy has ongoing projects focusing on exposure and response in Hawaii (www.navymarinespeciesmonitoring.us). For future projects, analysis of scat samples from animals that were in close proximity to training and testing events may provide important data on stress responses (e.g. consequences) in the animal during the 24 hours preceding the collection.

The specific objective was to ascertain whether a Conservation Canine (K9) can detect scat samples from wild populations of cetaceans in the Hawaiian Islands. This project was conducted under a Cooperative Agreement with the University of Hawaii (UH) Marine Mammal Research Program (MMRP). The use of a trained K9 to detect marine mammal scat at sea has been proven to be useful in the Pacific Northwest with Southern Resident Killer Whales (SRKW; Lundin et al. 2016) and in other unpublished reports and media, but had not been documented in Hawaii.

Many marine mammal species in Hawaii are migratory and not feeding (it stands to follow, not defecating), so this limited the target species available for this study. Secondly, the target species needed to be those that might be found within a few nautical miles offshore Oahu. And, most importantly, the training aids (e.g. scat) needed to be available from frozen marine mammals at the UH Health and Stranding Lab.

Methods:

The scat: Fecal material from six individuals of three species (pilot whale [*Globicephala macrorhynchus*], pygmy sperm whale [*Kogia breviceps*] and false killer whale [*Pseudorca crassidens*]) was provided by the UH Health and Stranding Lab. The samples were obtained from frozen intestines of necropsied animals archived at the lab. Although scat from six individuals were provided, only scat collected from fresh dead animals (e.g. code 1) were used as training aids. This was so that the scent profile of the scat would be as close to living animals as possible.

The K9: The K9 that was chosen for this project began his training when he was <1 year old and, at the beginning of this project, had six years of experience in traditional nose work, followed by conservation scent detection work. Since this was a short duration pilot study the training team (e.g. dog handler plus trainer) felt it was crucial to have an experienced K9 given how rigorous the training and field conditions would be. It was important to know the K9 was comfortable on boats and did not get seasick. Since the dog was already well-trained in the basics of scent detection work, he was able to quickly imprint on the new training aids (e.g. frozen scat from three species) and understand the task immediately.

The training: The training team conferred with experts from two US mainland-based Conservation K9 organizations (Rogue and Conservation Canines) on training methods used by K9s in the Pacific Northwest for detecting the scat of SRKW. Their input was very valuable and their methods followed in most cases, only altered in response to the specific K9 behavior and field conditions as training progressed. Since in this study, the K9 would be harnessed into the vessel, initial training sessions provided a good baseline for how the K9's changes of behavior (COBs) would 'show' the trainers which direction to move the vessel.

The training occurred in two phases: on land and on a small vessel. A brief summary of training methods are provided below.

1) On land: The K9 was first introduced to the scat odor on land while the training aids were being thawed and put onto Q-tips in small vials. The three species were introduced to the K9 over approximately two months as they were made available. The K9 was run through traditional training methods followed by hiding training aids around different landscapes (e.g. parking lot, piers at a boat harbor, on a beach). The on land sessions were conducted with a Q-tip in a small sample vial. As the dog became more and more imprinted on the scent, the training team added sea water to the vial to ensure the K9 would still detect the sample when diluted.

   Next, the K9 was maneuvered around in a custom-made cart. The cart allowed the trainers to push the dog in transects downwind of the training aid, mimicking the methods that would be used at sea. The K9 participated in four sessions in the cart and gradually developed clear movement from port to starboard and COBs to indicate which direction the trainers should maneuver him.

2) Small boat: Five, two-to-four hour training sessions were conducted aboard a small boat (approximately 12 foot long Whaler) off Oahu. The partially thawed vials of scat were placed in a stainless steel dog food bowl with a styrofoam tube wrapped around the lip to float it. A sea anchor was also attached to slow the movement relative to deployment location.

   Both the handler and trainer were certified by the Institutional Animal Care and Use Committee (IACUC) and animal handling protocol had undergone safety review by UH. The K9 wore a life vest and a harness and was positioned in front of the center console. This allowed the K9 to walk from port to starboard and to put his paws on a tiny platform towards the bow. But he was not able to reach the rail, or most importantly, jump/fall off the boat.

   The bowl with scat was deployed behind the boat in a way that the K9 did not notice. The boat was driven upwind to get upwind of the sample, then driven around and downwind up to 1500 meters before beginning transects (~300m long) perpendicular to the wind, gradually making way upwind towards the food bowl. The driver kept the boat at speed low (1-2 knots) in order to give the K9 a better chance to catch the scent in the scent cone.

   At all times the trainers monitored the K9's COBs in response to and in relation to the location of the food bowl. COBs were logged using the Geographic Positions System (GPS) unit. The trainers saw that he became alert and sniffed into the wind when the vessel was directly downwind of the food bowl. If the driver switched directions to do a new transect, the trainers saw that the K9 would swing his whole body to the opposite side of the boat. When we switched direction to go directly upwind into the scent cone, the K9 typically placed two paws on the platform on the bow and continued to sniff into the wind until we arrived at the food bowl. He would often do a deep head bow and a whine would become a bark once we got closer to the training aid, but this varied. Once the K9 provided a very strong COB (e.g. final response) the team would turn the boat towards the sample, pick the bowl up and give the dog high-value food rewards and praise. The K9 was free to take breaks for water and to lie down, which he often did until he detected the sample. The K9 would often remain lying down, resting at the beginning of the transects, only to jump up and begin showing COBs once he detected the scat.

After the small boat training, the team transitioned to the 23-foot MMRP Research Vessel (RV) *Sedna* off the Waianae Coast of Oahu for five consecutive days to conduct sea trials.

Results

The K9 was successfully trained to detect and 'direct' the boat drivers/captains – via his changes of behavior - to the scat of three species (*G. macrorhynchus*, *K. breviceps* and *P. crassidens*) of marine mammals during training on land and small boat. Figures 1 and 2 are the GPS waypoints and tracks taken during two of the training trials.

Figure 1. Tracks and waypoints for training trial. Red X represents the start of the transects, the blue pins are the COBs, the green star is the floating dog bowl with scat sample, yellow line measures the distance from the start of the K9s COBs to the scat sample, which in this trial was approximately 269m.

Figure 2

Tracks and waypoints for training trial. Red X represents the start of the transects, the blue pins are the COBs, the green star is the floating dog bowl with scat sample, yellow line measures the distance from the start of the K9s COBs to the scat sample which in this trial was approximately 304m.

The team embarked on the RV *Sedna* off the Waianae Coast of Oahu for five consecutive days after the small boat training. For the first 1.5 days, the team focused on getting the K9 acclimated to the layout of the larger vessel and doing trial runs using the floating dog bowl with scat. He was still harnessed into the bow, but unlike the smaller vessel, he was unable to remain there during the transits to and from Ko Olina Boat Harbor due to faster speeds and rough sea conditions.

On the final 3.5 days, the RV transited up and down the Waianae coast searching for offshore cetaceans. No training transects were conducted on days 3, 4, 5. Although transects were conducted between about 3 miles offshore approximately 6 hours per day with several marine mammal observers aboard, marine mammals were only observed on Day 4.

On Day 4, the RV received a report that a group of pilot whales had been observed about three miles offshore. Once on location and the pod located with human visual observers, the K9 was moved to the bow and harnessed in and the RV attempted to conduct transects downwind and behind the whales. The team initially tried to conduct transects behind the entire group, but then focused on one subgroup, as it became evident that there were ~30 animals in dispersed subgroups. The K9 showed strong COBs (e.g. closed mouth cheek puffs) but the swell precluded being able to go directly towards where the COBs were suggesting. Additionally, the wind was quite variable, so what constituted 'downwind' of the animals kept changing.

The training team noticed that the K9 was showing a new COB where he was moving his head down and alongside the bow, as if indicating that the odor was right alongside. He did this a several times and the handler suspected the scat was very close to the boat. At the same time as noticing this COB, one of the visual observers noticed what she thought was scat right beside the boat where the K9 had also been 'pointing' to. Scat was visually detected by the humans, collected in buckets and brought to the dog's nose to confirm and reward.

It is suspected that with a large group of animals, there is likely scat in more than one location and (unlike when contained in the bowl), being distributed over a larger area (particularly with the high sea state). During this encounter, the K9 was showing strong COBs for approximately an hour and sniffing along the side of the bow, however, the scent did not appear to be strong enough to elicit whining or barking.

<u>Discussion</u>:

The use of conservation K9s has been well-documented as a valuable tool to confirm the presence of protected and invasive species on land, among a breadth of other uses. The K9s can detect miniscule amounts of a target odor that is either buried, diluted or too small for the human eye to readily detect. And, as mentioned, earlier, K9s have also been used at sea to detect marine mammal scat, most notably and currently with SRKW.

This pilot study sought to determine whether the marine mammals, sea state/weather and survey conditions would support using a K9 for this work in Hawaii.

Sea state/weather/survey conditions: The scope of work called for the use of a drone off the RV during cetacean sightings, but unfortunately the sea state and wind were deemed incompatible to launch the drone during the five days allocated on the RV. So, unfortunately, no comparison (e.g. ground-truthing) of the K9 detection of scat and overall presence of scat was conducted during this pilot study.

The team had planned that during a marine mammal sighting, that transects would be conducted downwind just as had been done during the small boat work to allow the K9 to show COBs and lead the team to the wild scat. However, during the one marine mammal sighting that we had, the captain was unable to safely follow the transects due to large swell and variable wind.

Marine mammals: As mentioned, only non-migratory marine mammals feed while in Hawaiian waters, so there are limited animals where scat would be available in the field. Further, whether being searched for by drone, human or K9, some portion of the scat needs to float for at least minutes in order to be detected. There is no evidence that the scat from spinner dolphins floats, therefore, we did not focus on this species. As more become interested in collecting and analyzing scat, it is expected that additional information about which species may be available for future collection will be documented.

During the training portion of the pilot study, it was clear from the K9s behaviors that he was not detecting the floating dog bowl visually until the boat was very close. Although floating, the lip of the bowl was only 3 inches above the surface of the water and the floatation device was blue and blended into the water. In fact, even the human visual observers/trainers had a difficult time seeing it until within approximately 30m. The team had an several opportunities to 'test' the theory that his COBs were not based upon visual cues when the boat came close to white moorings that sat about 2 feet above the waters' surface. The K9 showed a COB, but it was very different than those with his nose, mouth or pivoting from port to starboard. Instead, he stared at it with ears perked, glancing back at the handlers, hoping for a reward. After a few occurrences of this with no reward, he stopped cuing on the moorings.

The K9 also often indicated his first COB by standing up from a resting position. More specifically, once the bowl was deployed and the boat moved away from it, he would lie down to rest. The team would begin the transects regardless and gained confidence during repeated trials that if the K9 smelled the training aid, he would stand up and sniff. In those occurrences, this was logged as the first COB for the trial.

Conclusions:

It is difficult to draw many conclusions from one encounter with wild cetaceans during this pilot study. However, using conservation K9s for marine mammal scat collection in Hawaii appears to be a promising additional tool to complement other methods of obtaining samples for hormone levels, microbiome, and genetics.

It would be ideal for any future work to use a vessel that allows the K9 to remain harnessed in a ready-to-work position at all times, if feasible to find one that can also withstand offshore conditions. The RV used in this case did not allow for that, requiring the RV to reduce speed to move the K9 to the working position on the bow. In contrast, if the K9 were allowed to freely rest, but then alert to work when he/she detected a target, it would allow the K9 to be an additional survey tool, instead of the primary focus.

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