

AOOS

ANIMAL TELEMETRY NETWORK

WORKSHOP SUMMARY REPORT

Identifying Regional Needs and Priorities for Animal Telemetry Observations of Aquatic Species

DECEMBER 5-6, 2017
ANCHORAGE MARRIOTT
DOWNTOWN HOTEL
ANCHORAGE, ALASKA



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WORKSHOP SPONSORS

Thanks to our planning committee, sponsors, and all who helped to make this workshop a success. Special thanks to Molly, Carol, Holly, Rosa, as well as Helen Worthington, for their valuable assistance in preparing this report. We also thank Vemco and Axiom for hosting the evening reception.



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Cover Photo: Tagged bearded seal in Kotzebue, Alaska. Photo Credit: Michael Cameron

Permits: NMFS Permit #15126

WORKSHOP OUTLINE

As called for in the U.S. Animal Telemetry Network (ATN) Implementation Plan, the Alaska Ocean Observing System (AOOS) and the U.S. Integrated Ocean Observing System (IOOS) convened an Alaska regional ATN workshop on December 5–6, 2017. Workshop participants from multiple agencies and organizations, including the National Oceanic and Atmospheric Administration (NOAA), the National Park Service, the Bureau of Ocean Energy Management, the Alaska Department of Fish and Game, U.S. Fish and Wildlife Service, U.S. Coast Guard, Alaska tribal communities, and others worked together over the two days to address four objectives:

Objective I. Identify and prioritize regional telemetry research and potential keystone monitoring and observational needs.

Objective II. Review the existing regional telemetry observing assets and scientific capabilities in the region.

Objective III. Document existing examples of commercial and resource manager stakeholder uses of telemetry data.

Objective IV. Identify data management challenges and mechanisms for regional data aggregation with national linkages for data management, sharing, and collaboration.

Twenty-three speakers covered topics that provided perspectives from the resource management, commercial, local/tribal, and research communities.

Breakout sessions were held to address the following topics:

Topic A—Create a matrix (or set of matrices) of the animal telemetry observation needs in the AOOS Region versus the assets that are currently in place to collect them and identify gaps;

Topic B—This topic addressed three separate issues:

- Identify challenges and concerns with animal tagging efforts in Alaska.
- Discuss the value of Alaska researchers participating in the ATN....what would be the value added from a network approach to individual research goals?
- If money was no object, or if we had \$1 million per year for ten years, define what a baseline ATN (acoustic and satellite) in the AOOS Region could/should look like. Identify priority items.

Topic C—Describe the effective telemetry data aggregation and sharing pathways within the AOOS Region, what sharing outside the region is/could be valuable and with whom, and whether there are additional capabilities that would improve the ability of AOOS to aggregate and share.

<https://atn.ioos.us>

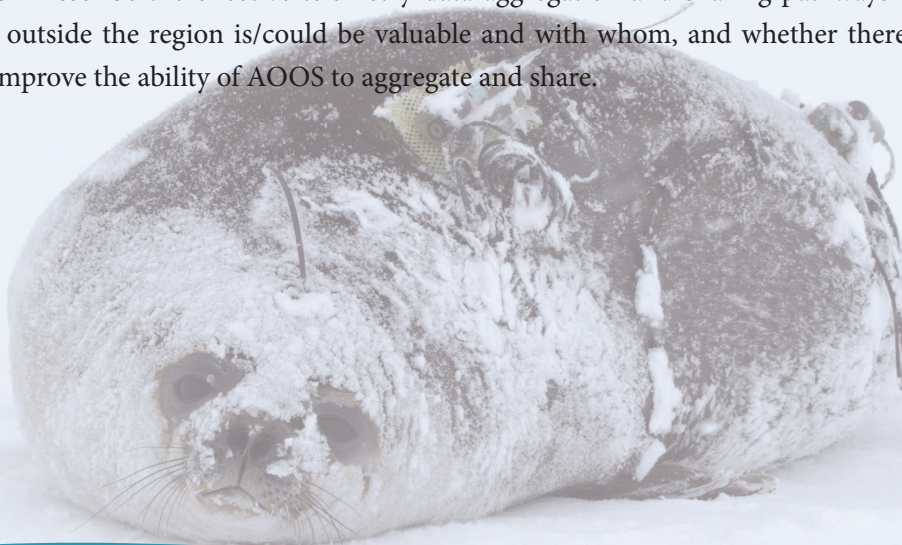


Photo: A Weddell seal with tracking and heat sensors in McMurdo, Antarctica.

Image Credit: John Skinner

Permits: NMFS Permit #15748; Antarctic Conservation Act #2012-003

WORKSHOP HIGHLIGHTS

I. STAKEHOLDER MONITORING/OBSERVATIONAL NEEDS

- As a broad baseline of information is established, it has become possible to focus on more topical studies in smaller areas to answer science questions through observations of polar bears, bowhead whales, walrus, seals (ice bearded, ringed, spotted) using tagging (including CTD tags with location), aerial methods, and passive acoustic monitoring.
- Telemetry/tracking data are collected for multiple species including Steller sea lions, northern fur seals, bowhead whales, beluga whales, and North Pacific right whales to assist with the recovery of these threatened and endangered species as well the co-management of subsistence species.
- Early community involvement at the proposal stage of a tagging project is critical to get the tribal subsistence communities engaged on the science questions that help meet THEIR NEEDS and to ensure integration of traditional/local knowledge with the science... Scientists can't just show up, ask questions, and leave.
- Commercial activities benefit the most from animal telemetry data if their operations needs are explicitly considered when observational studies are being defined.
- Orca pod specificity and temporal variation is so clear that we find that 1,300 tag-days of data with 11,000 locations is suddenly too small for answering our questions.
- A primary observational challenge is the attachment technology of tracking devices. Less invasive/safer long-term tag attachment methods, e.g., LIMPET tags and degradable hardware on collars, are needed as well as post-tagging studies to assess long-term effects.

II. EXISTING OBSERVING ASSETS

- U.S. Geological Survey: Decades of polar bear, Pacific walrus, sea otter, and migratory bird research studies have used telemetry technologies that over time have included VHF radios, satellite-linked Doppler and GPS tags, and light-based geolocators, many of which incorporated sensors.
- Alaska Department of Fish and Game (AKF&G) Marine Mammal Program: Extensive satellite tagging of bowhead and beluga whales, walrus and ice seals—some with CTD tags—since 2006.
- U.S. Fish and Wildlife Service: Hundreds of Argos satellite tags on polar bears since 2008.
- Ocean Tracking Network/Prince William Sound Science Center: Array of 54 receiving stations creating acoustic gates around Prince William Sound.
- NOAA/Marine Mammal Laboratory: Extensive seal ecology studies with satellite tags since 2006.
- Improved coverage from satellite tags using Argos could come from installing land-based Mote™ listening stations to capture data from animals that frequent coastal areas, e.g., Steller sea lions, which have high site fidelity.
- Young whales will swim with their mothers forever and have pod-specific calls. Passive hydrophones are an effective method for this research.

III. STAKEHOLDER USE OF TELEMETRY DATA

- Assist National Environmental Policy Act (NEPA) analyses that support exploration and development plans, advise Incidental Harassment Authorizations (IHA), implement the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), and the Fur Seal Act (FSA), determine habitat use, assess changes in migratory routes in relation to oil and gas activities and changes in climate, and understand diving and swimming parameters to improve abundance and distribution estimates and to protect important areas for the animals; ecology, behavior, health and disease, and human impacts; designate/revise critical habitats, determining boundaries around sea lion haul-outs and rookeries, conduct effects analyses to advise leasing in the region, impose speed limits/revising ship routes, and assist with Section 7 Interagency Consultations.

- Support species population monitoring to ensure responsible wildlife management that enables sustainable harvests of fish and marine wildlife species including: beluga and bowhead whales; ice seals; spotted, bearded, harbor, and ringed seals; sea otters; Steller sea lions; polar bears; and Pacific walrus.
- Identify changes in animal movement patterns as Arctic ice-cover changes. By using CTD tags with location, we can watch the cold pool form.
- Communicate to all stakeholders the importance of fish tagging. Need coordinated efforts to enhance the currently under-represented Alaska fish tagging research portfolio.
- ADF&G radio tag data specifically are used to determine the proportion of run that each tagged reporting group represents, identify spawning locations throughout the river system, estimate the abundance of each stock that makes up the Susitna River salmon runs, and provide the run timing information to managers so they can better manage the fisheries.

IV. IDENTIFY DATA MANAGEMENT CHALLENGES

- Telemetry data are big and messy (although not really “big data”) so access is needed to modern infrastructure and software. The ATN can help with this, e.g., machine-to-machine APIs, R, python, etc.
- Easy access to ALL telemetry data and geodatabases is needed, e.g., a central data repository where others can access and use the data. Depositing data in multiple locations is not desirable; we would like to have one process and final solution to avoid policy changes going forward.
- To enable rapid mitigating actions for endangered and threatened species, we want to acquire and use telemetry data in real-time or near real-time—then share the data within one week of collection so the results can be used for mitigation monitoring.
- Some questions cannot be answered by maps alone. Investment in accessible statistical analysis tools and models is just as important as tags and infrastructure.
- We must do a better job of bringing the data and science back to the tribal communities by getting them involved in the proposal writing, presenting, and providing of the data and results before it gets out to the world.
- Long-term commitment to fund tagging and data collection/management is essential. Language mandating that researchers contribute data to the ATN Data Assembly Center should be included in contracts.
- For managers, the raw data are not important; they need interpreted data and data products, e.g., heat maps of beluga whale density to enable more accurate Section 7 Consultations. Data layers that are analyzed and processed are helpful because managers do not have the time to do that synthesis. Defining what level of tracking data needs to be stored would also help.
- Industry wants to work more closely with the telemetry community to understand the purpose of collecting the data so they can help to influence the focus of the efforts to get the answers and results that they need.



A PSAT-tagged anadromous Dolly Varden from northwest Alaska. Photo Credit: Andy Seitz, University of Alaska Fairbanks.

WORKSHOP CONCLUSIONS

OBJECTIVE I: Identify and Prioritize Regional Telemetry Stakeholder and Research Keystone Monitoring/Observational Needs

THEME A: Promote respectful, collaborative efforts between the science and the subsistence communities to ensure wildlife management success.

THEME B: Identify changes in animal movement patterns as Arctic ice cover changes.

THEME C: Integrate Traditional Knowledge with western science.

THEME D: Consider the operations needs of commercial activities when defining observational studies so that they derive the greatest benefit from animal telemetry data.

FEDERAL AGENCIES

The Bureau of Ocean Energy Management (BOEM) has historically sought to obtain baseline information on the vast regional biological resources and their associated physical characteristics. As a broad base of information is established, it has become possible to focus on more topical studies in smaller areas to answer specific questions. Observations of polar bears, bowhead whales, walrus, and ice/bearded seals using tagging, aerial methods, and passive acoustic monitoring are currently being collected in 60 ongoing research projects. The observations collected are synthesized to, among other things, examine habitat use by season. A major goal is to increase the ability to integrate Traditional Knowledge with western science by incorporating local hunters into the tagging programs.

The National Marine Fisheries Service (NMFS), Protected Resource Division, Alaska Region seeks telemetry/tracking data for multiple species including Steller sea lions, northern fur seals, bowhead whales, beluga whales, and North Pacific right whales to assist with both the recovery of these threatened and endangered species as well the co-management of subsistence species.

The U.S. Fish and Wildlife Service (USFWS) is tasked with collecting key information about core habitat and feeding areas for sea otters and Pacific walrus including population estimates, birthing rates, and timelines for re-colonization. There is also a strong focus on collecting tagging data for polar bears to determine what type of ice the bears are most associated with and to get accurate estimates of bear populations.

The U.S. Coast Guard (USCG) assets monitor 151 marine mammal critical habitats each month throughout Alaska District 17, support survey flights on the Copper River delta to help NMFS' marine mammal stranding network, and runs cutters and aircraft in the Bering and Arctic seas to aid in supporting the MMPA and ESA training.

The U.S. Geological Survey (USGS) is the science agency for the Department of the Interior and in Alaska, the USGS Alaska Science Center provides information on the distribution, abundance, and migratory patterns of wildlife for management agencies. Over the past few decades, this information has often come from satellite transmitters and other tracking devices. The USGS not only collects and uses these data but has helped developed publicly accessible tools for the processing of ARGOS data from satellite telemetry units (<https://www.movebank.org/node/38>) and is in the process of making all USGS Alaska satellite tracking data publicly available.

STATE AGENCIES/RESOURCE MANAGERS

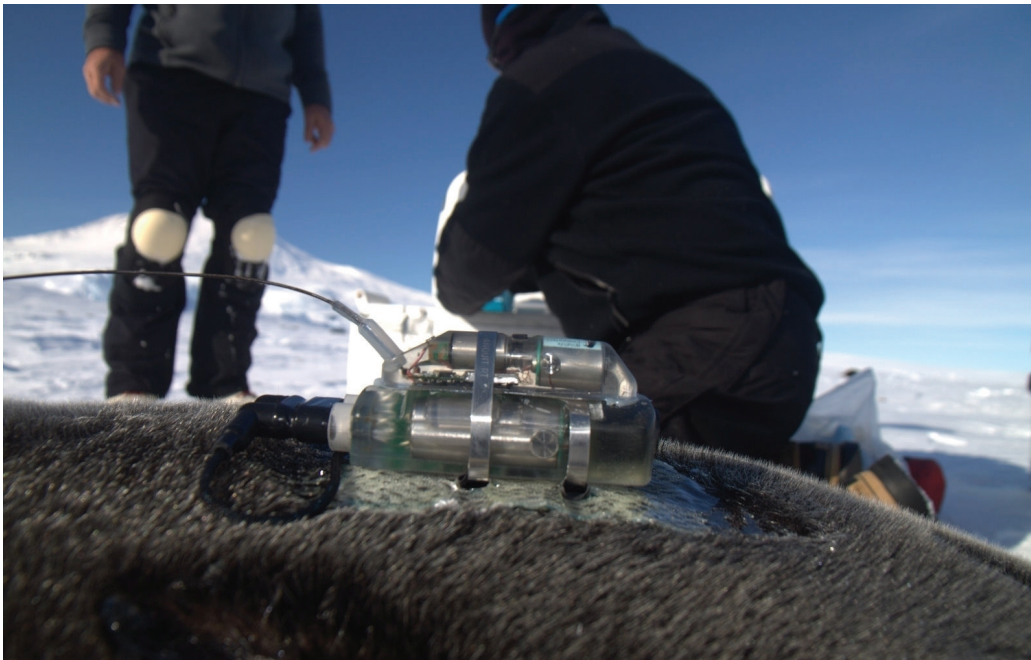
The Alaska Department of Fish and Game (ADF&G), Sport Fish Division biologists, researchers, and technicians are in the field 12 months per year, monitoring and managing a wide range of fish species. This includes a focus on collecting observations to estimate spawning distribution and abundance of several species of salmon (Chinook, coho, and pink) in the Susitna River using as many as 2000+ Dart-PIT tags received by up to 14 stationary towers, as well as by aerial surveys.

COMMUNITY/TRIBAL STAKEHOLDERS

The North Slope Borough (NSB) is the largest county-level political subdivision in the United States by area and is located on the northern slope of Alaska along the coast of the Chukchi Sea on the west and the Beaufort Sea on the east. Wildlife management is an important responsibility of the NSB government that facilitates sustainable harvests and monitors populations of fish and marine wildlife species including beluga and bowhead whales, ice seals polar bears, and walrus. However, wildlife management success in the NSB requires respectful collaborative efforts between the science and the subsistence communities plus an understanding of and respect for the fundamental difference in the world views of these two communities. The Science View: Gathering information and testing hypotheses. The Subsistence View: Animals are food so science must be respectful towards them.

Bristol Bay Native Association (BBNA) is a Tribal Consortium made up of 31 tribes and is organized as a nonprofit corporation to provide a variety of educational, social, and economic services to the Native people of the Bristol Bay region. The BBNA mission is to promote self-determination of tribes of the Alaskan Bristol Bay region, and the betterment, well-being, culture, and interests of the Native people of the Bristol Bay region. The BBNA Marine Mammal Program (MMP) in particular is dedicated to integrating Traditional Ecological Knowledge with western science in relation to marine mammals and the tribal way of life (subsistence harvesting). At the same time they are open to collaborative efforts involving tagging projects that consider the specific concerns of the tribal communities. Marine mammal annual subsistence harvests include beluga whale, ice seals-spotted, bearded, and ringed seals, harbor seals, Pacific walrus, sea otters, and Steller sea lions. Tribal members are encouraged by the BBNA to submit information on their annual harvests.

Aleut Community of St. Paul Island (ACSPI)/Ecosystem Conservation Office (ECO) The federal government formally recognizes the Aleut Community of St. Paul Island as a group of people in the Pribiloff Islands having a time-honored common bond of living together—a nation born, living, and self-governing before the United States of America was conceived. The ACSPI supports and has benefited from a significant amount of telemetry activity focused in large part on Steller sea lions, Northern fur seals (50% of the world's population breed on St. Paul Island), seabirds, and reindeer. Tagging studies provide information on fur seal migration and movement, specifically on winter movement of pups and on diving and foraging strategies. Pribiloff communities would like to have greater research capacity in the region and increase their influence on and participation in the work so their specific needs can be addressed. This includes, in particular, increased communications with researchers using telemetry on subsistence resources.



*Preparing a tracking package on a Weddell seal in McMurdo, Antarctica. Photo Credit: Henry Kaiser
Permits: NMFS Permit #15748; Antarctic Conservation Act #2012-003*

COMMERCIAL/PRIVATE SECTOR

Hilcorp Alaska LLC conducts oil and natural gas operations in Cook Inlet and on the North Slope. Hilcorp does not gather baseline animal data but instead relies on resource management agencies to provide it. They do request, though, that the agencies ask in advance how the baseline data can help Hilcorp operations, for example, to ensure that data collected are useful for their operational needs. Hilcorp use of telemetry is limited, but they anticipate that it could be a useful addition to their activities and want to continue working together with the telemetry/tagging community.

Port of Alaska. The Port is undergoing a significant modernization program over the next two years to replace aging docks and infrastructure. This will improve operational safety and efficiency, as well as create a resiliency-enabled facility to survive weather and seismic events. Construction at the Port is subject to MMPA regulations regarding incidental harassment of marine animals, so permitting is required due to the likelihood of exposure to significant noise levels. Beluga whales are regularly observed along the wharf face; therefore, marine mammal monitoring programs, which include physical observers, are required to identify where the animals are to avoid any kind of 'take' during construction and/or operations. Because it is difficult for observers to determine beluga reactions to noise/activity and to assess impacts on individual whales (e.g., changes in habitat use), animal telemetry can help with these efforts.

Crowley Fuels provides transportation, distribution, and sales of petroleum products to more than 280 communities across the state of Alaska. Of great importance to them is the information determined by animal telemetry with respect to the changes that are occurring, e.g., how the ice cover is changing in the Arctic. They are more interested in the animal movement patterns than in a particular species or their location. As the ice changes, so do the migrations and haulouts of mammals and birds; this information is needed by the mariners.

Alaska Longline Fishermen's Association (ALFA) and Southeast Alaska Sperm Whale Avoidance Project (SEASWAP). Created in 2003, SEASWAP is a unique collaboration between commercial fishermen, scientists, and fisheries managers. It is aimed at recommending strategies to reduce economic loss to fishermen from depredation on their commercial fishing gear and entanglement risk to the whales by using biology to understand the complex relationship between sperm whales and fishing—longliners in particular. Acoustic techniques are used to locate the whales. Information on the timing and movement patterns of sperm whales in the Gulf of Alaska using satellite tags can also help fishermen avoid whales by giving them an option to avoid fishing at known whale hot spots.



Mother and baby sperm whale: CC BY-SA 2.0. Photo Credit: Gabriel Barathieu

OBJECTIVE II: Identify the Existing Telemetry Observing Assets and Scientific Capabilities in the Region.

FEDERAL

U.S. Geological Survey (USGS)

- Polar Bears 1986–Present: 389 Satellite Doppler and GPS
- Migratory birds (seabirds, waterfowl, loons) 1993–Present: 864 Satellite Doppler and GPS, and >100 birds with other types of tags
- Pacific Walrus 1987–Present: 893 Satellite Doppler

U.S. Fish & Wildlife Service (USFWS) Polar Bears

- Argos glue-on tags N=22; (2011, 2013, 2016)
- Argos ear tags - N=54; (2010, 2011, 2015, 2016)
- Argos collars + Sensors - N=27; (2008-2010)
- Argos-GPS collars + Sensors - N=60; (2010, 2011, 2013, 2016, 2017)
- Iridium-GPS collars + Sensors - N=31; (2015-2017)

NOAA/Alaska Fisheries Science Center/Marine Mammal Lab

2006–Present: Seal Ecology Studies - extensive satellite tagging to study abundance, distribution and behavior

Ocean Tracking Network (OTN) - Prince William Sound Array (PWS): 54 VR3, VR4, VR2W, VR2AR stations creating acoustic gates around Prince William Sound

STATE

Alaska Dept. of Fish & Game (ADF&G) Sport Fishing Division - 2013–2017: 600–2,200 Dart-PIT tags/year received by up to 14 stationary towers along the Susitna River plus aerial surveys tracking Chinook, coho and pink salmon

Marine Mammal Program 2006–Present: extensive satellite tagging of bowhead and beluga whales, walruses and ice seals, some with CTD equipped tags

ACADEMIC

University of Alaska Fairbanks - 2006–Present: extensive basic and applied research on Pacific halibut, Chinook salmon, big skates, and Dolly Varden char with pop-up satellite tags and some acoustic tags

University of Alaska Southeast - Whale tracking studies using satellite and 3-D archival suction cup tags with depth finder/echo sounder capabilities

University of Washington – Joint Institute for the Study of Atmosphere and Ocean - Extensive satellite tagging work on hump-back, North Pacific gray, and right whales to study large whale habitat use in breeding and feeding grounds

NGO

Alaska Sea Life Center (ASLC) - Long-term tagging efforts on marine seabirds, mammals, and fish with satellite tags/pop-up tags, life history transmitters, archival and acoustic tags

North Gulf Oceanic Society - Long-term marine mammal research using satellite telemetry and acoustic monitoring

Prince William Sound Science Center (PWSSC) - 2007–present: extensive acoustic tagging of Pacific herring, Pacific cod, ling-cod, and copper rockfish

OBJECTIVE III: Document Existing Examples of Commercial and Resource Manager Stakeholder Uses of Telemetry Data

THEME A: Assist with National Environmental Policy Act (NEPA) analyses, support exploration and development plans, advise Incidental Harassment Authorizations (IHA), assess changes in migratory routes relative to oil and gas activities and climate change, and improve abundance estimates.

THEME B: Support ESA, MMPA, FSA by designating/revising critical habitats, conducting effects analyses to advise regional leasing, assist in conducting Section 7 Interagency Consultations.

THEME C: Ensure a high quality, local source of food for the subsistence communities by addressing questions of declining species abundance and lack of food in overwintering grounds, and supporting efforts toward a more formal ecosystem management process with improved co-management of subsistence species.

THEME D: Monitor changing movement patterns and increasing ship traffic to support both marine mammal avoidance and responsibly sustained subsistence livelihoods while maintaining industry presence.

FEDERAL AGENCIES

The Bureau of Ocean Energy Management (BOEM) multiple uses of telemetry data include: assisting with NEPA analyses, supporting exploration and development plans, advising Incidental Harassment Authorizations (IHA), determining habitat use, assessing changes in migratory routes in relation to oil and gas activities and changes in climate, and understanding diving and swimming parameters to improve abundance estimations and protect important areas for the animals.

The National Marine Fisheries Service (NMFS), Protected Resource Division, Alaska Region is responsible for implementing the ESA, the MMPA, and the FSA. Telemetry data are used for designating/revising critical habitats, determining boundaries around sea lion haul-outs and rookeries, identifying changes in habitat use, conducting effects analyses to advise oil and gas exploration and development in the region, indicating the need for speed limits/ship route changes, and minimizing the effects of development through ESA Section 7 interagency consultations.

The U.S. Fish and Wildlife Service (USFWS) is tasked with implementing the MMPA mostly around oil and gas developments, mitigating their impacts on the slope. This includes learning how sea otters use lower Cook Inlet, understanding why the outer Aleutians have not recovered from a substantial decline, estimating polar bear populations to regulate subsistence hunting, locating polar bear dens to mitigate traffic and restrict activities from these areas as necessary, and assessing how the ever-changing ship traffic in the region may be affecting Pacific walrus habitat use.

The U.S. Coast Guard (USCG) drives large ships in the region and could benefit from using real-time movement information of marine mammals to mitigate routes, speeds, and avoid disturbing them. Major cutter patrols in the Arctic can supplement the tagging data by reporting sightings.

The U.S. Geological Survey (USGS) provides science information on wildlife migration, habitat use, distribution, and their response to disturbances and changes in habitats such as declines in sea ice in the Chukchi and Beaufort Sea. This information is of high value for informing management decisions and future research directions regarding subsistence harvest and management and recovery actions, as well as improving estimates of abundance.

STATE AGENCIES

The Alaska Department of Fish and Game (ADF&G), Sport Fish Division is responsible for protecting, maintaining, and improving the valuable Alaskan sport fisheries by overseeing the state's wide range of sport fisheries, as well as many personal use fisheries. The radio tag data they collect are used to specifically determine the proportion of run that each tagged reporting group represents, identify spawning locations throughout the river system, estimate the abundance of each stock that makes up the Susitna River salmon runs, and provide the run timing information to managers so they can better manage the fisheries.

COMMUNITY/TRIBAL STAKEHOLDERS

The North Slope Borough (NSB) is finding that animal tagging provides useful and revealing information on distribution, movements, habitats (feeding areas), and behavioral responses to industrial activities. Also, the right story about seasonal movements is being revealed by the tracking data, where previously it was guestimated. Understanding where the animals go and why is illuminating to both science and to the subsistence communities and is essential to the NSB wildlife management activities.

Bristol Bay Native Association (BBNA) Marine Mammal Program recognizes that Cultural preservation is a very important priority in ensuring a healthy marine mammal population and habitat and to preserve traditional harvests for future Alaska Natives. Tribes, federal and state agencies, institutions, and Alaska Native organizations are partnering to take an ecosystem approach to addressing marine mammal issues and to support a Marine Multi-Species Conservation Plan to benefit all tribal, as well as federal and state agencies stakeholders. Information, data, and Traditional Knowledge are all being used by tribal experts to develop a BBNA Subsistence Resource Baseline Database that will document marine mammal habitat and subsistence resource areas as well as updated population surveys of sea otters and bearded seals. There is concern about some species not coming back to where they were born and whether that is due to disturbance from the seasonal yellow fin sole trawl fishery.

Aleut Community of St. Paul Island (ACSPI)/Ecosystem Conservation Office (ECO) can use telemetry data to address questions of declining abundance of fur seal stocks, the decline in fur seal pup production, plus the effects of lack of food in overwintering grounds, predation by whales/sea lions, and interaction with commercial fishing activities. All this information will support the ongoing ECO efforts toward a more formal ecosystem management process that will ensure a high quality, local source of food for the community.

COMMERCIAL/PRIVATE SECTOR

Hilcorp Alaska LLC is interested primarily in animal (polar bear) observations they can use to adjust their operations so they can avoid interactions with sow and cubs. The platform inspection drones they use could also be useful for tracking animals.

Port of Alaska could use telemetry data to help understand how daily, seasonal, tidal variations, and salmon/eulachon runs influence the variability in animal density estimates, to identify movement corridors in the Knik Arm region, and to correlate sound-level observations with animal responses.

Crowley Fuels' major interest and concerns include using marine animal telemetry data to help them responsibly sustain subsistence livelihoods while maintaining industry presence, particularly with respect to increasing ship traffic and changing migration patterns of the animals. They are not part of a Conflict Avoidance Agreement such as the one in Prudhoe Bay; therefore, for Crowley, the telemetry information helps them monitor changing movement patterns to support marine mammal avoidance. From the Arctic Waterways Safety Commission perspective, the telemetry data can help identify safety concerns for new waterways users as the shipping lanes open in the Arctic.

Alaska Longline Fishermen's Association (ALFA) and SEASWAP cooperative research with fishermen, government, and scientists focus on three key questions: i) How do sperm whales locate the longline deployment? ii) What strategy do sperm whales use to take fish off, or predate the line? iii) How are whales finding particular fish of interest, especially at night?



Asveq (Yup'ik Eskimo name for Pacific walrus). Photo Credit: Helen Chythlook Aderman, BBNA Marine Mammal Program Manager – Main Beach - Round Island, Alaska

OBJECTIVE IV. Identify Data Management Challenges and Mechanisms for Regional Data Aggregation with National Linkages for Data Management, Sharing, and Collaboration

DATA MANAGEMENT CHALLENGES AND RECOMMENDATIONS FOR COLLABORATIVE ANIMAL TELEMETRY

- **Challenge:** Depositing data in multiple locations is time-consuming.
Recommendation: Some type of central data repository is needed so that others can access and use ALL telemetry data.
- **Challenge:** Data are big and messy (although not really “big data”).
Recommendation: ATN can provide the needed access to modern infrastructure and software to address this.
- **Challenge:** Data are often not available unless tags/receivers are retrieved.
Recommendation: Acoustic telemetry data need to be available without tag/receiver retrieval.
- **Challenge:** Raw data without analysis are not helpful to managers because they do not have the time to do that synthesis.
Recommendation: Interpreted data and data products, e.g., heat maps of beluga whale density, can enable more accurate Section 7 consultations. Data layers that are analyzed and processed are also desirable, as well as defining what level of tracking data needs to be stored.
- **Challenge:** Invasive tag technology cannot be used on certain species.
Recommendation: Enhancements of tag technology and analysis capabilities are needed at the national level.
- **Recommendation:** Long-term commitment to fund tagging and data collection/management is essential. This commitment should include contract language that mandates researchers to contribute data to the ATN DAC.
- **Challenge:** Animal telemetry data are very messy. Animal tagging is conducted a certain way to meet certain objectives.
Recommendation: Animal taggers should work with ALL users of data to provide a better product and get the results needed by the stakeholders.
- **Challenge:** Subsistence communities have traditionally opposed tagging studies as not being respectful to animals and endangering their welfare.
Recommendation: Early community involvement at the proposal stage of a tagging project is critical to get the community engaged on the science questions to be investigated, to identify science objectives from the subsistence community that help meet *community* needs, and to integrate Traditional/Local Knowledge with the science objectives.
- **Challenge:** Tribal communities are sometimes brought into the data projects late in the process.
Recommendation: Explaining to the tribal communities why it is important that particular data are being collected is essential. Things have improved over time at the front end of the process with community involvement but not so much on the back end. We must bring the data and science back to the tribal communities by getting them involved in the proposal writing, presenting, and providing of the data and results before it gets out to the world.
- **Challenge:** Waterway users cannot easily access telemetry data.
Recommendation: Telemetry data need to be translated into usable information for the safety of new waterways users in the Arctic. ATN should share this data/information with the Arctic Waterways Safety Commission.
- **Challenge:** Cross (geopolitical)-boundary animals can present issues with data-sharing. For example, fur seal adults usually stay on the U.S. side, but pups go over into international waters (Russia).
Recommendation: Find a way to work together to establish the infrastructure needed to share data.
- **Challenge:** Data supplied by fish tags are used, but there is a lack of infrastructure along the coast capable of collecting an adequate sample size. There are separate tagging programs, but none are linked to help address ecosystem level questions, and they are not sharing data.

Additional Recommendations

- Investment in accessible statistical analysis tools and models is just as important as tags and infrastructure.
- Rapid, mitigating actions for endangered and threatened species need telemetry data in real-time or near real-time so that data can be shared within one week of being collected to enable mitigation monitoring.
- Industry wants to work more closely with the telemetry community to understand the purpose for collecting the data so they can help to influence the focus of the efforts to get the answers and results that they need.
- Advancing scientific collaboration requires improved data sharing and data explorations (visualization, statistical summaries), standardized and persistent data citations (DOIs), telemetry tag metadata standards, and linking archival data with derived products.
- Use Automatic Identification System (AIS) data along with tagging data to assess how ship traffic in the region may be affecting habitat use.
- It is important that ADF&G continue to do regional and statewide telemetry; however, eliminating duplicate work through better coordination will have tremendous value in clearing up the big picture and help with in-season management.



Josh London and Shawn Dahle with a ribbon seal mother and pup in the Bering Sea. Photo Credit: NOAA Fisheries Permits: NMFS Permit #19309

SPEAKERS

RESOURCE MANAGEMENT, PRIVATE/COMMERCIAL, COMMUNITY/TRIBAL, AND RESEARCHER PERSPECTIVES

Over the two-day workshop, representatives from the commercial sectors, resource management agencies, as well as the coastal, tribal, and research communities discussed regional telemetry applications and stakeholder needs.

U.S. Animal Telemetry Network

Bill Woodward, NOAA-IOOS Animal Telemetry Network Coordinator

The goal of the U.S. Animal Telemetry Network (ATN) is to provide long-term sustainable support for animal telemetry in the U.S. The ATN is hosting workshops for all eleven Regional Associations during 2017-2019 to gather information about existing telemetry activities, network gaps, and stakeholder observational needs within each region. The workshops bring together regional experts from the commercial, resource management, and research sectors to identify how ATN can help coordinate efforts to sustain current activities and add to them as needed.

Because existing telemetry assets are funded, owned, and operated by multiple institutions with different regional objectives, there is limited or no interconnectivity; data sharing is limited with no centralized access to the telemetry data.

Our ATN mission is to build trust and form alliances with community members, create a national-level repository for marine animal telemetry data that will serve the community, and to engage with existing U.S. and international efforts to support baseline observations as needed. The operational ATN data management and delivery repository, the ATN Data Assembly Center (DAC), is operated by Axiom Data Sciences and includes both marine animal tracks and ocean profile data. The ATN is guided by a steering group of representatives of nine federal agencies involved in animal telemetry and four nonfederal organizations.

RESOURCE MANAGEMENT PERSPECTIVES

Federal and state resource management agencies discussed regional telemetry activities and applications, explained regulatory issues, and identified core regulatory and resource manager stakeholder needs.

BOEM's Interest in ATN and Tagging - Using Marine Mammals to Illustrate

Carol Fairfield, Bureau of Ocean Energy Management (BOEM), Alaska Outer Continental Shelf (OCS) Region

BOEM OCS is in charge of oil and gas leasing and takes an adaptive, integrated, science-informed and ecosystem based approach to management, with over \$500 million invested in more than 1,000 reports and publications and 60 ongoing research projects.

Primary interests include tracking how oil and gas/human activities affect marine mammals and monitoring changes in the Arctic ecosystem through aerial methods and passive acoustic monitoring. BOEM also integrates TK (Traditional Knowledge) with western science, as well as recruiting hunters to help with the tagging programs.

Challenges include Alaska's environment, Native subsistence use, climate variability, and a long-term plan for collecting/archiving real-time and near-real-time data, as well as stable funding. Some challenges can be met through ATN.

Using Telemetry to Determine Spawning Distribution and Estimate Abundance of Susitna River Salmon

John Campbell, Alaska Department of Fish and Game, Sport Fish Division

The goal is to use telemetry to determine distribution and abundance of fish in the Susitna River. With 600–2,200 transmitters a year, stationary towers (up to 14) that listen 24/7, and aerial tracking surveys, the Department of Fish and Game generates lots of data. Data help them manage the fisheries by determining the best spawning locations throughout the drainage area.

Better coordination of telemetry is needed to ensure that efforts are not duplicated. This can also help with in-season management, especially when there is a limited resource that must be allocated (i.e., for subsistence). A central data repository would help overall data access among multiple organizations. ATN could help with this effort.

Animal Telemetry Network and Marine Mammals: What We Do, What We Need, AND Concerns We Have

Greg Balogh, NOAA/National Marine Fisheries Service (NMFS), Protected Resource Division

NMFS is tasked with implementing the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), and the Fur Seal Act. Threatened and endangered species recovery can benefit from the use of telemetry data. Permits are required to tag species covered under these acts.

Although NMFS collects extensive data, more data are needed when considering designations/revisions to critical habitat, such as Steller sea lions, Pacific right whales, or beluga whales. A big concern with tagging beluga whales is injury to the whale. Therefore, less invasive/safer long-term attachment methods are needed, as are post-tagging studies to assess long-term effects.

Using Tagging To Mitigate Oil and Gas Impacts on Marine Mammals on the Slope

Patrick Lemmons, U.S. Fish and Wildlife Service (USFWS) Alaska Region, Chief of Marine Mammals Office in Anchorage

USFWS is tasked with implementing the MMPA around oil and gas development. They also closely monitor populations of sea otters in Cook Inlet, the Pacific walrus in Chukchi Sea near Hannah Shoals, and polar bears in Chukchi Sea.

The most urgent projects include determining how sea otters use lower Cook Inlet around oil and gas interests, what walrus are doing in the western Chukchi Sea near Russia, and obtaining accurate estimates of the polar bear population to regulate subsistence hunting. Tagging information can also help locate polar bear dens; this information can be used to mitigate traffic and restrict activities from these areas if necessary, as well as to mitigate oil and gas impacts on the slope.

Alaska Marine Protected Resources – U.S. Coast Guard

Corrie Sergent, LCDR U.S. Coast Guard Office of Response and Enforcement, District 17– Domestic Fisheries Section

The USCG Marine Protected Resource missions are to monitor 151 marine mammal critical habitats each month throughout Alaska District 17. This includes supporting marine mammal necropsy work in remote Alaska and assisting with wildlife investigations. USCG also provides interagency support and outreach to the cruise ship industry to support MMPA and ESA training.

The USCG can use telemetry data to monitor real-time movement of marine mammals, mitigating routes, speeds, and avoidance with aviation to support species protection.

PRIVATE AND COMMERCIAL SECTOR PERSPECTIVES

Representatives from the private sector discussed their interest in regional telemetry activities and how they might relate or be useful to commercial operations, identified applications of animal telemetry information to private commercial organizations working in marine systems, and identified commercial/private industry stakeholder needs and concerns.

Monitoring Effects of Oil and Gas Operation on Marine Animals

Bill Britt, Hilcorp Alaska, LLC– Environmental Management

Hilcorp relies on baseline data from resource management agencies to help monitor the effects of their work on North slope operations, pinpoint the location of bear dens on slope so they can adjust operations accordingly, and avoid interactions with sows and cubs.

Various technologies, including drones, are used for automating pipeline surveillance, which could also be useful for tracking animals, but it is not clear whether it might be possible to automate a signature of a whale or land mammal to identify something with drones that we could not get with observers. However, it is clear that telemetry benefits Hilcorp efforts, and working together with ATN should continue.

Port of Alaska Modernization Program – Information Needs: Animal Telemetry

Steve Ribuffo, Port of Alaska, Director

Infrastructure upgrades at Port of Alaska will improve operational safety and efficiency and is needed to accommodate modern shipping operations. However, the improvements will have an impact on marine life in/around the port. Concerns center on the effect of pile-driving noise on beluga whales and other marine mammals. Animal telemetry can help with these efforts by identifying where the animals are during construction/ operations.

Marine mammal monitoring around port construction activities create issues because the zones are so large. Currently observers do this type of monitoring, but is expensive. It is also difficult to observe beluga whale reactions to noise or activity (no underwater observations) or to assess impacts to individual whales.

Telemetry has the potential to improve density estimates that address variability in numbers (seasons, time of day, tide, salmon and eulachon runs), identify movement corridors in Knik Arm, and assess sound levels received and responses by CIBW-sound levels at which responses occur, distances at which critical or detrimental responses occur, types of responses, etc. It is crucial to have this information peer-reviewed before being used by regulatory agencies and environmental groups.

How We Interact Safely with the Fauna of Alaska

Greg Pavellas, Crowley Fuels, Director of Marine Operations - also represents Arctic Waterways Safety Committee

Crowley Fuels has delivered fuels, including aviation and heating fuel, to remote Alaska for 65 years. They use information gathered by animal telemetry to understand how the ice is changing in the Arctic, migration and location patterns of marine mammals, and how shipping traffic patterns are changing with respect to migration routes of marine mammals, documenting any changing marine mammal routes.

Crowley vessels are slow-moving, so there have been no collisions with marine mammals. Issues include the timing of subsistence hunting throughout the operating season (telemetry could help us monitor this), identifying the purpose of the telemetry data so we can focus efforts to get the answers or results that are needed, and identifying migration and haul-outs of mammals and birds to avoid disturbing feeding areas.

From the perspective of the Arctic Waterways Safety Committee, which brings together local marine interests in the Alaska Arctic in a single forum, the goal is to help create a standards of care document as a guide for new waterway users and help identify the safety concerns for the new waterway users as the shipping lanes open in the Arctic, as well as translating those concerns to usable information.

SEASWAP: The Southeast Alaska Sperm Whale Project

Jan Straley, Co-PI, Southeast Alaska Sperm Whale Avoidance Project (SEASWAP) and Linda Behnken, Collaborating Investigator, Alaska Longline Fishermen's Association (ALFA)

SEASWAP was formed to investigate how to keep sperm whales out of fishing lines. Sperm whales use sound to navigate, so SEASWAP uses towed passive array and stationary recorders to detect biological sounds. There have been experimental decoy deployments to lure whales away from fishing lines.

The current solution is to communicate avoidance areas to fishing boats by recording whales, setting up regions, and identifying where the whales are.

COMMUNITY AND TRIBAL PERSPECTIVES

Representatives from Alaska Native villages, coastal communities, and related organizations discussed interest in and current involvement with animal telemetry activities and research, shared perceptions, issues and concerns with tagging animals, and identified subsistence community stakeholder needs.

North Slope Borough Perspective on Tagging Wildlife and Fish

Robert Suydam, North Slope Borough, Wildlife Biologist

Animal tagging provides useful information on distribution, movements, habitat (feeding areas), behavior (diving, response to industry), proximity to industrial activities, and survival (band birds). Collaboration is critical to success but highlights different perspectives about how tagging is perceived.

The scientific method of gathering information and testing hypotheses is not always harmonious with the subsistence community's view of animals as a food source, which needs to be respected. The two communities must engage to integrate indigenous and scientific knowledge that results in a solution that addresses the concerns of both perspectives.

BBNA Marine Mammal Program

Helen Aderman, Bristol Bay Native Association (BBNA), Marine Mammal Coordinator

The BBNA supports a unified voice on a range of cultural, economic, and educational issues to benefit Tribes and Native people of Bristol Bay. With a multi-species approach, the BBNA blends the Traditional Knowledge with goals of state and federal marine mammals programs to ensure that the concerns of local Tribes are addressed and tribal support is obtained.

Animal Telemetry Research on Subsistence Resources: Community Involvement is Essential

Lauren Divine, Aleut Community of St. Paul Island - Ecosystem Conservation Office

The Pribilofs Community/Tribal Perspectives on Telemetry reveal the need for increased research capacity that recognizes community-specific differences for such species as the Steller sea lions, Northern fur seals, seabirds, reindeer, and orcas.

Management of these species must occur with communications between researchers utilizing telemetry on subsistence resources and local Tribes so that the community is informed about

the results of research projects. An important example is seen with unmanned aerial systems operations. The tribal policy requires that a tribal pilot be used if outside entities wish to do drone work in Pribilof Islands. This ensures community involvement in writing the proposal, as well as presenting and providing the data and information to the community in advance of publication.

RESEARCHER PERSPECTIVES

Representatives from academia, resource agencies, and non-profit organizations showcased telemetry projects focused on a range of species important to the region and explained the purpose of the research. They also discussed current telemetry assets in Alaska, benefits of and issues with various current animal tracking technologies being deployed in the region, alternative or new/innovative technologies and methods, and identified research sector needs for these efforts.

Multi-modal Tagging for Marine Animals

*Markus Horning, Alaska Sea Life Center (ASLC),
Science Director*

Multiple types of tags are used by ASLC scientists on marine seabirds, mammals, and fish to study their physiology, movement, and behaviors. Examples include internal, post-mortem pop-up tags used on Steller sea lions and harbor seals for data transmitted after the animal's death (LHX tags), external pop-up tags and acoustic transmitters used on Pacific sleeper sharks, and LHX tags used on sea otters. ASLC is a strong proponent of multi-modal tagging (combining multiple tag types in one deployment), and they work closely with tag manufacturers on creative tag technology solutions.

Tagging issues include limited data returns for remote locations and cryptic species and extensive delays in post-mortem data return/recovery from life history tags, as well as biases in the datasets, since more data are returned early on from animals that do not live very long.

Improved coverage for increased data returns from satellite tags using Argos could come from installing land-based Mote™-style, short-range listening stations to capture and maybe relay data from animals that frequent coastal areas, e.g., Steller sea lions, which have high site fidelity. A larger/sustained acoustic tag monitoring receiver network in the region would be very useful for tracking coastal animals equipped with acoustic tracking pingers. ASLC supports the Argos Alliance to promote funding for continuity of U.S. satellite launches carrying Argos receivers.

Whale Tagging and Tracking

Jan Straley, SEASWAP, University of Alaska Southeast, Co-PI

Whale tracking uses multiple technologies. Humpbacks can be tracked using suction cup tags, which are attached to a VHS transmitter that, after 24 hours, falls off and transmits a signal and then must be physically retrieved. Advances in data visualizations can display the data collected as a 3-D roller coaster ride. Less expensive photo ID techniques that are easier on the animal can sometimes be used, and depending on the purpose of the research, echo-sounders can also be used to find whales feeding on schools of herring. It has also been discovered that blue whales respond to simulated mid-frequency military sonar.

Physio-Ecology Studies of Alaska Marine Mammals

*Russ Andrews, Marine Ecology and Telemetry Research
(MarEcoTel), Research Wildlife Biologist*

MarEcoTel first came to Alaska to study Steller sea lions in the 1970s, when the population dropped off dramatically. These animals are cross-boundary animals, which can present issues with sharing data. Fur seal adults usually stay on the U.S. side, but pups go over into international waters (Russia). Cameras on Steller sea lions capture 3-D spatial and temporal data. It is important also to incorporate other data, including animal-borne cameras, to capture video of foraging underwater.

It is more difficult to work with cetaceans; we must try to be minimally invasive. LIMPET tags are low-impact, minimally percutaneous external electronics transmitters and have been used on 22 different species of whales. However, the LIMPET tag is also thought to have led to the death of a southern pod orca whale, which could be a risky species for tagging because their source of food is sparse. A recent workshop on tag development, tag follow up, and best practices recommended endorsement of the Cetacean Tagging Best Practice Guidelines developed during the workshop.

They also developed the 'Whaletracker' tool to support the SEASWAP avoidance network, are testing Bristol Bay beluga tracking with GPS LIMPET tags, and are installing passive acoustic receivers to identify sperm whale feeding events.

Telemetry-Based Polar Bear Research in Alaska

*Todd Atwood, U.S. Geological Survey (USGS),
Research Wildlife Biologist*

Polar bear research telemetry has evolved from the 1980s in the southern Beaufort Sea with VHF collars (locate dens and distribution on ice), through the mid-1990s and 2000s with satellite and GPS tags (learning responses to human disturbance, migration projections, and habitat delineation) through the sensor era of the 2010s (determining changes in behavior, energetics, population and fitness). Data are being used for determination of long-term denning behavior of polar bears. A key finding using collar-borne temperature sensors is that denning behavior has changed, probably because the quality of sea ice as a den substrate has declined. Although denning in the Arctic National Wildlife Refuge (ANWR)-1002 area is very dense, the mitigation measures for this region are old. The hope is that, now that ANWR is opening up for oil and gas exploration, mitigation measures can be revised to reduce the impact on the polar bears.

Also significant is Anthony Pagano's foundational work using location and sensor data, including accelerometers to capture energy expenditure for specific behaviors and examining how human activities may influence bear behaviors and overall energy demands.

The primary challenge is the attachment technology of tracking devices. Failing release mechanisms on collars are a problem from an animal welfare perspective. USGS will no longer use collars until this issue is resolved.

Polar Bear Telemetry Activities in the Chukchi Sea

*Ryan Wilson – U.S. Fish and Wildlife Service (USFWS),
Wildlife Biologist (Polar Bears)*

USFWS began their work in 2008 to gain understanding about the status of population, including basic ecology of polar bears in the Chukchi region, feeding, body condition, habitat, and space use.

Telemetry data uses include the effects of sea ice loss on polar bears, changes in resource selection patterns and land use, activity patterns, oil spill modeling, and population estimation. Various types of tags are used to collect data, including radio collars, Argos glue-on tags, and ear tags using GPS and Iridium.

Major concerns are about animal welfare, antenna failure, length of battery life, and reliability of tracking beyond one year. Current priority needs include reliable ear tags with a 1-year lifetime, reliable drop-off mechanism for collars, and overlapping (with polar bear data) spatial and temporal telemetry data from prey species.

A Fish Researcher's Perspective on Telemetry in Alaska

*Andy Seitz, University of Alaska, Fairbanks (UAF),
Associate Professor, Fisheries Ecology*

Satellite pop-up tag and some acoustic tag research at UAF focus on several fish species in Alaska including Dolly Varden char in the Arctic, Pacific halibut in Gulf of Alaska and Bering Sea, Chinook salmon in the Bering Sea and Cook Inlet, and big skates in Prince William Sound and Gulf of Alaska. The research addresses both basic biology and ecology, as well as applied aspects for management and assessing impacts of human activities. To accomplish this, there are several tagging programs, but currently none are linked to help address ecosystem-level questions, and rarely do they share data. ATN/AOOS is a positive step forward to address these research questions beyond individual behavior.

To assist in this effort, technology needs include semi-permanent receiving stations, a portfolio of technologies beyond infrastructure, and development of new tags, technologies, and analyses. These will help address the under-representation of electronic tagging in the Alaska fish research portfolio. ATN/AOOS can also coordinate efforts to communicate the importance of fish tagging to a variety of stakeholders.

Satellite Telemetry and Acoustic Monitoring

Dan Olsen, North Gulf Oceanic Society, Wildlife Naturalist

The North Gulf Oceanic Society works mostly with satellite telemetry and acoustic monitoring of orca whales to learn more about their winter activities, especially where they go when they disappear from monitoring devices and how deeply they dive. Some orcas have been known to chase salmon to the bottom of the sea bed. Pod specificity and temporal variation is so clear that we find that 1,300 tag-days of data with 11,000 locations is suddenly too small for answering our questions. Young whales will swim with their mothers forever and have pod-specific calls. Passive hydrophones are an effective method for this research.

Researchers are concerned about the length of time a tag is attached and the damage that can result. So, hydrophones can be used to collect year-round data with a cost of less than \$5,000 per mooring. They can be re-deployed for multiple years and are non-invasive; but they are limited to finite locations and cannot perform fine-scale movement or multiple depths.

Marine Mammal Tracking with Satellite Telemetry and CTD Tags

Lori Quakenbush – Alaska Department of Fish and Game (ADF&G), Marine Mammal Program, Wildlife Biologist

Research on bowhead, beluga, walrus, and ice seals using satellite telemetry has been done in Alaska since 2006 by partnering with community experts who are the whalers. Extensive data are being collected, such as the density of bowhead locations, where they spend the most time, and relating whale position and transit patterns to oceanography to understand why they are spending time in these locations.

In 2017, there was no ice in the most southern portion, so research about where whales went is needed, as they typically stand and stay next to the ice. Tagging has also contributed to understanding belugas' eating habits and the different populations' genetics, village-based walrus habitats, and ice seals. Beluga whale tagging in Bristol Bay requires assistance and permission from local residents; Helen Aderman is a great asset for ADF&G.

Capturing and Tracking Seals in Alaska

Josh London, National Marine Fisheries Service (NMFS), National Marine Mammal Laboratory, Alaska Fisheries Science Center, Wildlife Biologist,

Research objectives for the National Marine Mammal Laboratory include determining abundance and distribution (aerial surveys, telemetry, genetics), ecology and behavior (telemetry, haul out behavior, dive, scats), health and disease (tissue sampling, blood, emerging threats), and human impacts.

Data are big and messy (although not really “big data”), so access to modern infrastructure and software is needed. Research results are shared with the public through various repositories, such as GitHub, DataONE, NCEI, Socrata, and ArcGIS Online, though there are some limits imposed by the federal government on what data they share.

Researcher needs identified for the ATN include access to modern infrastructure and software for data management, advanced scientific collaboration, advanced science and reproducibility of results (methods, SOPs), ability to meet agency requirements for archival and access, advanced availability of statistics tools and model results, improvement on existing options, and use of MOVEBANK data repository to improve the ATN. The ATN is nothing new so best to focus efforts on building and improving, not reinventing.

Using Satellite Telemetry Data to Describe Large Whale Habitat Use in Breeding and Feeding Grounds

Amy Kennedy, University of Washington, Joint Institute for the Study of Atmosphere and Ocean, Cetacean Research Biologist

This large whale satellite tagging work uses a small sample size and piggy-backs on existing projects. Highlights of findings include: significant movement of North Pacific humpback whale (3,000 km in 26 days) can impact stock delineations; North Pacific gray whales range movement is small; the North Pacific right whale is the most endangered, and data collection has helped to support critical habitat boundaries; tagging humpback whales in the Gulf of Maine has shown significant tag wound impacts and a possible reduction in survival.

There is a need for more funding for North Pacific right whale and follow-up studies to assess the physiological effects of tag deployment of the North Pacific right whale and other whales, as well as training for both tag manufacturers and taggers. Further tag design evaluation is needed to assess technological improvements to reduce impact to animals. Spatially/temporally relevant, remotely sensed data are also needed to complement the telemetry data.

Ocean Tracking Network – Who We Are and What We Do

Jon Pye, Ocean Tracking Network (OTN), Assistant Director of Data Management

OTN started to measure marine animal movements and survival in 2008. There are 1,734 OTN acoustic receivers worldwide, and OTN's electronic tags track over 140 keystone commercially important and endangered species. Data are shared globally, along with shared analysis and visualization tools.

Data from OTN provides evidence-based decision making, assists in training and engaging next-generation scientists, and enables increased governmental research capacity. The data also fill knowledge gaps about fish management, equitable quotas, and fish independent mortality, and assist in monitoring highly migratory species.

OTN is an operational national/international science network with industry partners for technology development, an experienced communications staff, and a strong governance structure. With global and local partners, OTN can participate in new telemetry research worldwide and work to assist telemeters in defining data analysis techniques.

BREAKOUT SESSIONS

Three breakout groups were created, and each group was asked to consider the following three topics:

Topic A: Create a matrix (or set of matrices) of the animal telemetry observation needs in the AOOS Region versus the assets that are currently in place (that we know of) to collect them and identify gaps.

Topic B: This topic addressed three separate issues:

- Identify challenges and concerns with animal tagging efforts in Alaska.
- Discuss the value of Alaska researchers participating in the ATN...What would be the value-added from a network approach to individual research goals?
- If money was no object, or if we had \$1 million per year for ten years, define what a baseline Animal Telemetry Network (acoustic and satellite) in the AOOS Region could/should look like? Identify priority items.

Topic C: Describe the effective telemetry data aggregation and sharing pathways within the AOOS Region, what sharing outside the region is/could be valuable and with whom, and whether there are additional capabilities that would improve the ability of AOOS to aggregate and share.

The breakout discussions of all groups organized by topic are summarized below.

TOPIC A

Bill Woodward, Facilitator

Matrix of Needs Versus Assets Currently in Place: The first group began mapping needs to existing capabilities; the second and third groups built on that matrix. The X-axis describes existing assets, the Y-axis is the needs, and the Z-axis represents the location. The full range of needs is complex (i.e., multiple needs), so the group began with animal movement/presence and species.

Questions and challenges began to emerge, such as how to cross-check with needs and species, whether the full species list is needed, whether observing data should be part of the matrix, and the scope of the information needed and methods used for data collection. Another issue affecting the matrix is the importance of identifying the organizations that define and drive needs, e.g., federal/state agencies, industries, and conversation groups. Defining needs involves legislative mandates, policy requirements, and consideration need in terms of the impact of tracking on each animal species. Identifying the most important needs and ensuring that the technology required to collect and manage data on the various needs is part of the matrix are essential to understanding the gaps between existing capabilities and unmet needs.

The session provided valuable exchanges among the participants. Nevertheless, it was clear that creating a suitable and useful matrix of regional animal telemetry data needs versus data collection assets is beyond the scope of a workshop breakout session and will depend significantly on the ATN Asset Inventory survey currently underway.



Subset of the Workshop Attendees. Photo Credit: Holly Kent

TOPIC B

Molly McCammon, Facilitator

Challenges: Alaska's remoteness and the large, dark, and cold ocean area surrounding it make access and communications difficult for both tagging and telemetry, as do the high field and fuel costs and challenging logistics.

Concerns: Animal welfare is a top concern, as are subsistence use and cultural issues, misuse of raw data, and tag attachment techniques. Animal telemetry projects are not always well-integrated into larger ecosystem projects and are usually opportunistic add-ons. Lack of stable funding is partially responsible for this.

Value-add of the ATN: ATN is a valuable resource and has the potential to play an important role to assist in meeting the collective needs of various interests in Alaska. It can be a larger voice to help show the value of animal telemetry in order to increase community involvement and resource opportunities. The ATN can also serve as a clearinghouse for past and current projects in Alaska, as well as a conduit through which the community can identify future needs. Identifying needs, matching the needs with the available resources, and communicating what is happening in those areas can help communities, stakeholders, policy makers, and resource managers meet the most critical requirements for ecosystem management. The ATN can also help with standardizing data/metadata, creating bridges to other data repositories, and providing loaner equipment.

Alaska Baseline Animal Telemetry Network: Development of the baseline would need the input of the community to address the unique needs of Alaska (remote, subsistence, animal welfare). It would include identifying what has already been done, as well as the data gaps, and ensuring that data collected would be formatted and interpreted to create open source products/analysis tools instead of publishing raw data. IT infrastructure would be built (including shore-based acoustic with long-term operations and maintenance support).

A \$1 million/year investment for individual projects would be ideal. However, for long-term, sustained monitoring across Alaska, \$10 million–\$100 million would be needed. Several suggestions for investing \$1 million/year over ten years include development of receiver infrastructure, access to training and professional development, and tools/products that assist with data/metadata analysis.

TOPIC C

Rosa Meehan, Facilitator

Current data aggregation and sharing pathways inside/outside the AOOS Region and what could help AOOS do better: Some animal telemetry data aggregation and sharing is ongoing within AOOS led by personal sharing based on direct contacts, as well as regional organizations, solving their needs in-house (e.g., SEASWAP: linking fishing spots to whales; ADF&G: managing/storing their data locally). To be effective, though, significant challenges to creating a useful data-sharing network need to be addressed. For example, data providers and users are concerned about incorrect data interpretation (e.g., drawing conclusions from data without knowledge about data caveats), ensuring easy access to data via user-friendly queries, providing project profiles to put data into context, controlling biases, and establishing interoperable data requirements that ensure standard metadata, digital object identifiers (DOIs), and the ability to archive data in a standard format.

Data sharing outside the region is generally done peer-to-peer and through some existing repositories like MOVEBANK and OBIS, particularly with species that travel across geographic boundaries. Effective data-sharing outside the region also requires broader, more uniform observational coverage of covariates, as well as a tool to help bridge these among regions.

AOOS could benefit from a broader ATN that could link together the existing tools to provide a data repository and management system that would allow access to web services and to data for specific purposes, e.g., to develop maps. An ATN outreach effort is critical, however, to make data providers and users aware of the goals and capabilities and to get buy-in from researchers and resource managers. Data users and providers in some rural areas without internet access might encounter particular challenges, so architects of such a network must develop solutions for those areas. Citation tools, including DOIs, must also be in place to ensure that credit is given to data collectors. The ATN value includes providing a single place for public accessibility to discoverable data, creating a forum for stakeholders to network within, coordinating techniques and training, and implementing standardizations that meet scientist, stakeholder, and public needs.

PRE-WORKSHOP SURVEY

AOOS conducted an extensive pre-workshop survey of members of the broad Alaska Region's marine animal telemetry community. The three questions most relevant to the ATN implementation and the answers to them are itemized below.

Do you see value in networking animal telemetry efforts in Alaska as part of the broader national ATN effort?

- Connects Alaska research with the broader community.
- There is a long history of tracking animals in Alaska. We have learned much about animal movements. However, we have yet to really employ animals as oceanographic platforms, and that is the next step.
- Archives data sets.
- It's valuable to compare datasets across all species—it fosters collaboration and encourages an ecosystem-based scientific approach.
- Ensures that people are aware of other activities that may affect their own.
- Relates data from multiple projects to one another, increase use and value of animals as platform of opportunity environmental samplers.
- Coordination of efforts is useful to avoid duplication of objectives, e.g., share data on tag reliability and design, and share information generally from results.
- If there are benefits, such as access to funding.
- Dramatically increasing the geographic scope of a project would be a huge value added at low extra cost.
- ATN needs to be diversified to include the mechanisms that drive the behaviors.
- ATN will be critical for much-needed meta/synthetic analyses of movements and behaviors of guilds of animals in relation to environmental factors.
- Shares information on telemetry systems working collectively with vendors to advance/enhance equipment systems.
- Provides a foundation for coordinated logistics and research; increases the opportunity for ecosystem level analysis.
- Reduces impact to animals, and through collaboration, we can maximize resources and gain an integrated knowledge of animal movements.
- Coordinates among agencies, researchers, industry, etc.
- It is important to have coordination and exchange of information with those working at lower latitudes.
- Provides potential to tap into larger data sets and broader use of data sets, avoiding effort overlap with others.
- Shares information and understands which species are being tagged.
- Unique resources and broad scale efforts with expensive logistics make such a network a value added.
- Provides help in training people to do tagging in acceptable ways.
- Promotes economy of effort.
- Important to understand movements of migratory animals.
- Enables identification of big-picture patterns, interactions with oceanography, comparison of species differences.
- Allows more holistic analyses of environments, rather than just species-by-species accounts of behavior and migration.



Tagged seal. Photo Credit: John Skinner

Permits: NMFS Permit #15748

What kind of assistance with data management of animal telemetry data would you like to see from the national ATN?

- An interface that is simple and easy to use. The ability to assimilate a range of data types from different tags. A system that archives data so that researchers don't have to create their own complex data storage systems.
- Archival and management of telemetry data.
- Data archiving, public availability, and regulation compliance.
- Standard data metadata and their reporting formats.
- Standard best practices for tagging to maximize results and minimize animal impact.
- Inclusion of the physiological status of the individuals is needed.
- Standards for minimum reporting requirements are critical. Tag data are extremely diverse at this time, and it can be nearly impossible to decipher data from other users without the relevant metadata.
- Contact information on other users and a repository for archival/metadata.
- The national ATN needs to provide researchers a framework for ingesting data from typical locations/formats, managing/editing metadata, data exploration, QA/QC processes, and linking telemetry data with a wide range of environmental covariates.
- Real-time reporting.
- Data management, consistency where possible, data security, and meeting agency confidentiality statutes.
- Standard formats for storing geolocator data.
- Retrieving, archiving, managing data from providers, offering analytical tools, data sharing, managing, and archiving metadata.
- Access to data (filtered and raw) for collaborators.
- Visualization tools.
- Archiving and mapping.
- Help with basic mapping and analysis, especially with analyzing relative to currents, ocean patterns, ice, and other environmental data. This is hard to do without sophisticated statistical support.
- Assistance in archiving data, basic visualization of data, and production of quality metadata. Easy-to-access "best practices" guidelines for all of these would be very useful.

In particular, what kind of assistance would be helpful from the centralized ATN Data Assembly Center?

- Translate unique data types into a common uniform system and be able to seamlessly input and recover data streams.
- Facilitate collaboration and cooperation within the community to operate and maintain the existing tagging and acoustic receiver infrastructure as a cohesive national network.
- Provide contact info for researchers whose work overlaps.
- Connect data with other tagging data centers to reduce the effort to submit data to multiple locations.
- Fit project-specific data and metadata into standardized ATN databases. Obtain financial support to increase use of animals tags that can provide quality environmental data. Provide financial support for installation and maintenance of new data receiving/relaying infrastructure.
- Connect folks with different parts of the data puzzle for long-ranging species or species that use the same habitats.
- Aggregate data from all detection and standardize methods, protocols, etc.
- Discover and make accessible the decades of data on Arctic animal movements that are sometimes in the archives of researchers, both active and inactive. Develop a library of the complete range of tag types and their data variants for those tasked with interpreting old data when the original data collectors are no longer available.
- Provide contact information on other users. Develop repository for archival/metadata.
- Fund research and development for tag technology.
- Encourage consistency in data management, security, privacy, and access where possible.
- Aggregate data and develop sharing protocols.
- Increase interoperability and data sharing and integrate disparate data streams, including remote sensing data.
- Develop more data storage.
- Compare movement patterns across species and taxa with the aim to look for multi-species habitat use, hotspots, and hot-times.
- Develop knowledge of ongoing research in different areas, connect and coordinate with other researchers to enable data archiving for public access.
- Generate ways to archive data in a safe place for the future. Work with investigators to facilitate comparison of data sets formatted in very different ways (e.g., different tag manufacturers).
- Make data upload easier, including basic visualization of time series data and locations and metadata help.

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IOOS
Integrated Ocean
Observing System

AF4 salmon specialists, Inian and her 2-year-old calf, swimming across Aialik Bay, Kenai Fjords.

Photo credit: Dan Olsen, North Gulf Oceanic Society, taken on NMFS permit #15616.