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Plenary Presentation

Gulf of Alaska – Mammals
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Is real-time acoustic monitoring an effective mitigation measure for Cook Inlet beluga whales?

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Abstracts

Gulf of Alaska – Ecosystem Perspectives

Quantifying phthalates in Alaska marine organisms

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The plastic debris in the North Pacific Gyre also known as The Garbage Patch has seen enough of its victims. It has been estimated that millions of seabirds and thousands of marine mammals die each year because they entangle themselves in the debris or ingest it. Aside from entanglement and ingestion, the harmful threat of plastic is the potential leaching of their toxic additives such as bisphenol A, phthalates, styrene, vinyl chloride and flame retardants in the marine environment. Uptake of these compounds by adsorption or absorption through the skin or binding to proteins and lipids poses a hazard to marine organisms throughout all trophic levels. Little work has been done to determine the level of toxic plastic additives in the tissue and organs of these organisms. The focus of this research was to determine the levels of six common phthalates in different trophic levels found in the coastal regions of Alaska. Tissues from marine birds, Alaskan salmon, halibut and clams were analyzed using liquid chromatography tandem mass spectrometry (LC MS/MS) with atmospheric pressure photo-ionization (APPI) to detect trace levels of six common phthalates. Significant levels of two of the most common phthalates were seen in the clam and bird tissue samples. These compounds are toxic to higher trophic levels and have already been banned in most of the European Nations and the United States.

Gulf of Alaska – Ecosystem Perspectives

Marine plastic debris: A potential vector for POPs in the marine ecosystem

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Marine debris is one of the major pollutants affecting the marine environment. The buoyant nature of plastics has facilitated its spread by ocean and wind currents, extending from industrialized coast lines to some of the most remote areas throughout the world. Worldwide, plastic litter has had an impact on marine biota, affecting nearly every tropic level from planktivorous fish, to seabirds, and marine mammals. These organisms have been documented to ingest or become entangled in the plastic debris. The ability of plastics to concentrate high quantities of toxic organic contaminants from the marine environment through partitioning has been well documented. These plastics - laden with high levels of contaminants - can be ingested, possibly making them bioavailable to organisms. The bioavailability and efficiency of transfer of the ingested Persistent Organic Pollutants (POPs) and the potential damage to the marine ecosystem is not known. Some evidence suggests a correlation between plastic ingestion and contaminant load in some organisms. This research seeks to better understand the transfer mechanism of organic contaminants, using the model POP phenanthrene. By examining the transfer of phenanthrene from simulated seawater to plastics, and its' desorption from the plastic by simulated digestive fluids, we are attempting to better understand the potential risks that plastics pose as a vector for POPs in the marine ecosystem.

Bering Sea – Humans

Examining vulnerable seal populations in Lake Iliamna using local knowledge and western science techniques

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In response to concerns about the absence of information on the status of the seals found within Iliamna Lake, the tribal communities of Iliamna, Kokhanok, Newhalen, Levelock, and Igiugig, in partnership with Bristol Bay Native Association, UAA, ADFG, and NOAA have gathered baseline information on seasonal shifts in abundance and distribution of the unique freshwater seal population, and documented subsistence use patterns and local traditional knowledge (LTK) from communities that traditionally harvest seals from the lake. To assess harvest levels and changes in subsistence use patterns, team members worked with local research assistants to conduct subsistence household surveys (SHS) and a few key respondent interviews. These data from 2009-

2011 are compared data to SHS data collected by ADFG in 2004 and 2005. Traditional knowledge about seal abundance and habitat use was also compared with that obtained through aerial surveys flown prior to spring ice breakup, during seal pupping and molting periods, and prior to fall ice formation. Aerial surveys suggested that seal abundance and use of the lake is highly variable seasonally. This project will continue to work with communities to integrate western and local knowledge, so that an accurate synthetic understanding of the role of seals in the human and lake ecosystem can be developed.

Gulf of Alaska – Lower Trophic Levels

State of the Sound: Recent oceanographic conditions in Prince William Sound

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Regular (~monthly) oceanographic surveys have been conducted since November 2009 as part of the Exxon Valdez Oil Spill Trustee Council supported Prince William Sound Herring Survey program. Those surveys visit 12 stations located within herring nursery bays (Eaglek, Simpson, Whale and Zaikof Bays); the main entrances to PWS (Hinchinbrook Entrance and Montague Strait); and in central PWS. Each station consists of a CTD cast, water samples for nutrients and phytoplankton, and a zooplankton tow. As might be expected, the heads of the bays warmed more quickly in spring, but that did not lead to an earlier onset of the spring bloom: open water stations showed increases in productivity prior to the heads of the bays. Total productivity varied between locations, and did not vary in a consistent way. Clustering analysis of plankton taxa broke down fairly well into geographic areas, with an open water cluster and inshore cluster; bays on the eastern side of PWS tended to occur in clusters distinct from the western side. Indicator species analysis showed that the taxa characteristic of the different groups was generally not unique. Rather, the relative importance of several common taxa (including copepods, larvaceans, chaetognaths and larval euphausiids) differed among the different clusters. Analysis of the hydrography at the different stations suggests that the differences between the groups are partially attributable to transport patterns (i.e. transport of oceanic taxa into the Sound). Local production was also potentially important, as evidenced by meroplanktonic taxa, such as barnacle larvae, particularly in the bays.

Arctic – Ecosystem Perspectives

Biogeochemical indicators of change in Arctic and Subarctic marine bird communities: Alaska and Greenland

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Understanding the complex dynamics of environmental change in northern latitudes is of paramount importance today, given documented rapid shifts in sea ice, plant phenology, temperatures, deglaciation, and habitat fidelity. This knowledge is particularly critical for Arctic avian communities, which are integral components by which biological teleconnections are maintained between the mid and northern latitudes. Furthermore, Arctic birds are fundamental to Native subsistence lifestyles and a focus for conservation activities. Since 2009, we have been studying the foodweb ecology using stable isotopes ($\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$) of contemporaneous coastal and marine bird communities in High Arctic (Northwest Greenland) and Low Arctic (western Aleutian Islands, AK). We are quantifying the isotopic values of blood, organ tissues, and feathers, and have carried out comparisons between native and lipid-extracted samples. Although geographically distant, these communities comprise similar taxonomic and ecological congeners, including several species common to both (e.g. Common Eider, Black-legged Kittiwake, Northern Fulmar). Generally, High Arctic species have tissues that are more enriched in $\delta^{15}N$ compared to their Low Arctic counterparts, but $\delta^{13}C$ values are similar in both regions. These patterns follow observed regional differences in Arctic isoscapes, and are probably related to isotopic variations in food rather than trophic level differentiation. Both Low- and High-Arctic bird communities show decadal-period shifts in stable isotope profiles, based on prior published results and previously collected specimens. For example, Aleutian birds feeding in upper trophic levels have tissues are more enriched in both $\delta^{13}C$ and $\delta^{15}N$ compared to specimens collected in 2000-2001. We anticipate broadening the time depth of this initial study using museum archival and archeological material, as well as continuing studies in 2013 and 2014.

Bering Sea – Mammals

Using telomere length to age northern fur seals, *Callorhinus ursinus*, from the Pribilof Islands, Alaska

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Telomeres are a repeat sequence found on the ends of eukaryotic chromosomes. They are incompletely replicated each time cell division occurs resulting in degradation of length over time. This makes them a useful indicator of age in many mammal and bird species. As part of a larger study of vital rates, lower post-canine teeth were pulled from female northern fur seals, *Callorhinus ursinus*, (NFS) on the Pribilof Islands (N = 103 St. Paul Island, N = 160 St. George Island) and used to determine age. Flipper tissue was also collected from these animals and telomere length determined via QPCR. Analysis showed that telomeres did in fact get shorter with age, and combining telomere length with mass will allow for unaged NFSs to be put into age bins (r2=0.506, p=0.000, St. Paul; r2=0.585, P=0.000, St. George). Removing tooth extraction from the capture protocol would result in greater sample sizes for the vital rates work as well as a reduction in handling time and stress for the animals. Telomere length for a given age was longer on St. George Island than on St. Paul Island (P=0.001), which might indicate greater stress among St. Paul fur seals. Telomere length has been shown to correlate to life expectancy. Although both populations have been in decline, in recent years the St. George population is declining more slowly than the St. Paul population and was stable in the last two censuses (2008, 2010).

Gulf of Alaska – Mammals

First noise measurements of an oscillator system for drilled shafts: Its implications for the endangered Cook Inlet beluga whale (*Delphinapterus leucas*)

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The Knik Arm Crossing project is proposed to be built in Upper Cook Inlet, within critical habitat for the endangered Cook Inlet beluga whale (CIBW). Marine pile-driving produces high sound pressure levels that are often of concern for marine mammals. Alternatively, oscillator systems have been used to excavate and place piles for various bridge construction projects; until now, only qualitative assessments of the associated noise were previously available. In order to provide a quantitative assessment of the sound levels and potential impacts to CIBW, noise measurements were collected at the Gilmerton Bridge Replacement project in Chesapeake, Virginia, during the placement of large diameter (3.7 m) steel casings. Recordings of the oscillator system (Leffer VRM 3800) during operations were collected using a Cetacean Research CR-3 hydrophone and an M-Audio acoustic recorder (96 kHz sampling rate). The most noticeable noises' presumed to be associated with the oscillator - were transient, broadband, short tones at 15 kHz, and harmonics at 30 kHz and 45 kHz. Baseline ambient noise was measured at a distance of 30 m from the pile installation site; the mean rms SPL value was 115.9 dB re 1 uPa (SD = 0.4 dB). The mean rms SPL values for the oscillator were 121.6 dB re 1 uPa (SD = 6.4 dB) and 116.9 dB re 1 uPa (SD = 0.6 dB) at distances of 30 m and 300 m, respectively. Most of the oscillator noise dissipated near baseline with increased distance. Even if the frequency range of the oscillator overlaps with the hearing range of CIBW, the rapid dissipation of sounds over distance indicates that the oscillator represents a good mitigation solution. The noise measurements of this system are the first documented and provide baseline data for other environmental impact assessments where this method for drilling shafts could be used.

Bering Sea – Seabirds

Breeding ecology of Kittlitz's murrelet at Agattu Island, Aleutian Archipelago, Alaska: 2011 progress report

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The Kittlitz's murrelet (*Brachyramphus brevirostris*) is one of the rarest breeding seabirds in the North Pacific and one of the least known in North America. During the final year of a 4-year study on the breeding biology of Kittlitz's murrelets at Agattu Island, we located and monitored 21 nests. During the nestling period, time-lapse cameras were deployed at all nests once the egg hatched and still images were used to quantify chick diets, adult attendance patterns, and nest survival.

Both frequency of nest visits and types of fishes provisioned to chicks varied among nests. Of the 21 nests discovered in 2011, six chicks fledged. Chicks fledged at 24-32 days post-hatching and departure masses ranged from 104 to 139 g. Overall nest survival from clutch initiation to fledging of first nest attempts, calculated as the stage-specific rates over the incubation and nestling periods, was 0.284 ± 0.143. Compared with the three previous years of research on nesting murrelets at Agattu Island (2008-2010), breeding success was greater, chicks fledged at heavier masses, and adults made more frequent nest visits. The continued study of the murrelets breeding in the Aleutian Islands will provide further insight into the breeding biology of this rare and elusive seabird and provides a unique opportunity to elucidate its life history.

Bering Sea – Seabirds

Identifying nesting habitat of *Brachyramphus* murrelets: Old nests lead to a new breeding record

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The Kittlitz's murrelet (*Brachyramphus brevirostris*) is one of the least known seabirds in North America. To date, 87 nests (44% of the world's known nests) have been monitored at Agattu Island in the western Aleutians. In 2009, we noted that nests from previous years had dense vegetation (grasses and/or mosses) directly in and around the nest scrape, owing to nitrogen rich fecal material deposited by the nestling. Using these cues, we searched for 'non-active' nests, defined as nests used in previous breeding seasons but not monitored during our research efforts. Breeding use at non-active nests was confirmed by the presence of eggshell fragments, chick remains, and/or a fecal ring. At Agattu, 74 non-active nests were found between 2009 and 2011. To examine the broader application of using vegetative cues to identify nesting habitat, we searched habitat at Adak Island, located in the central Aleutians, during July and September 2010 and September 2011. Two non-active nests were located in 2010. In 2011, one non-active and three active nests (1 abandoned egg, 2 fecal rings) were discovered. We provide the first breeding record of a *Brachyramphus* murrelet nesting at Adak Island and confirm the utility of using non-active nests. This tool has great potential for identifying the breeding range of murrelets at other Aleutian islands and possibly throughout this species range.

Gulf of Alaska – Fish and Fish Habitat

Estimating overwinter mortality of age-0 Pacific herring based on loss of energy and implications for recruitment

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An overwinter mortality model based on empirical mortality and energy density levels following forced fasting was applied to age-0 Pacific herring (*Clupea pallasii*) of Prince William Sound, Alaska. The frequency distribution of energy density measured during November 2007-2010 was used as model initial conditions. The model was validated by comparing observed energy distributions in March 2008-2011 to model predictions. Modeled mortality from November to March, April, and May resulted in survival rates of, respectively, 22, 5, and 1.2%. Mortality from starvation from November through May thus explains the two orders of magnitude range observed for herring recruitment in Prince William Sound if there is no starvation mortality for cohorts leading to peak recruitment levels (~ 1 billion age-3 herring). Observations of November and March energy density

for cohorts recruiting at 1 billion are needed to resolve whether low energy conditions at the beginning of winter or starvation during winter drives recruitment. Low energy levels in November may be due to lack of sufficient high-energy forage as well from energy losses such as those caused by external parasites. For example, recent in-situ observations of multiple sea lice, actually parasitic copepods, on age-0 herring during their first months following metamorphosis suggest this as a possible energy sink.

Gulf of Alaska – Fish and Fish Habitat

Food sources utilized by herring in relation to other juvenile fishes rearing in nursery habitats during the high latitude winter

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Recruitment of Pacific herring in Prince William Sound, Alaska (60 degrees N) is presently very low. A posited recruitment driver is competition with sympatric fishes in nursery bays. Juvenile herring were found in 9 of 15 sites surveyed in March 2010. Of these sites, herring and other fishes were sympatric in 8. Juvenile gadids and herring were sympatric at 7 sites and allopatric in 5. Capelin and herring were sympatric at 5 sites and allopatric in none. Stable isotope analysis of these fishes suggested that there was relatively little competition for food sources by sympatric gadids. Each species had consistent isotope values regardless of whether they were sympatric or allopatric. Competition with gadids would thus be for space rather than for food. There was partial overlap in the isotope value range of capelin with herring. The isotopic values of yearling and older juvenile herring fell within the range of sub-yearlings suggesting that intra-specific competition may be more important than inter-specific competition. It would be interesting to speculate how these interactions would differ with 2-3 orders of magnitude more herring.

Gulf of Alaska – Mammals

Is real-time acoustic monitoring an effective mitigation measure for Cook Inlet beluga whales?

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The Knik Arm Crossing (KAC) project is proposed to be built within critical habitat for endangered Cook Inlet beluga whales (CIBW). One planned mitigation measure to minimize potential impacts to CIBW is a construction monitoring program. Previous passive acoustic studies in Upper Cook Inlet indicate that acoustic detections of CIBW are often difficult due to the high ambient noise and potentially to the vocal behavior of CIBW. Additionally, visual observations of can be difficult because of the cryptic nature of this species (particularly younger, darker animals). A "proof of concept" study was designed to: (1) assess the effectiveness of acoustically detecting CIBW and (2) determine if 25X binoculars increased sighting rates and improved group counts and composition

(compared to 7X binocular and naked eye observations). CIBW whistles and echolocation clicks were collected using an omnidirectional hydrophone (C75, CRT, Seattle, WA, USA) with a frequency response of 15 Hz to 95 kHz and real time acoustic monitoring software (SeaPro Bioacoustic Analysis, CIBRA, Italy). A land-based, visual observation team was used to confirm whale presence. There were 90 acoustic and 92 visual hours of effort over 14 days during 6-22 September 2011. A total of 15 encounters with CIBW occurred: 3 acoustic detections and 15 visual sightings. All CIBW were sighted before they were detected acoustically. The 25X binoculars enabled CIBW sightings at distances of over 4.8 NM. Results suggest that visual monitoring (with 25X binoculars) would be a more effective mitigation measure than acoustic monitoring during construction of the KAC project.

Gulf of Alaska – Ecosystem Perspectives

Distribution and ecology of zooplankton and juvenile pelagic fishes in the Copper River plume

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The Copper River is the largest point-source of fresh water to the northern Gulf of Alaska, and is an important development environment for a variety of local pelagic fish. Salmon smolts and other juvenile fish are known to subsist on zooplankton, but their location and feeding patterns are little studied in the region. Juvenile fish use the plume to take advantage of concentrated zooplankton populations, and may use the highly turbid water to evade predation. The influence of the plume biochemistry and physical dynamics creates a nonhomogeneous distribution of zooplankton and other forage material that correlates with fish feeding behavior, while fluctuations in marine conditions and changes in zooplankton concentrations and fish behavior have been implicated as drivers of year-class strength. We sampled fish and zooplankton across the Copper River plume, and made concurrent measurements of salinity, temperature, and turbidity with an undulating towed vehicle to develop an oceanographic description of the plume. Further description of the trophic status of fish and zooplankton were conducted via gut content and stable isotope analysis, and age and growth rates were estimated from otolith measurements. The relationship between zooplankton and juvenile fish concentrations correlates with plume dynamics in a way that supports optimal juvenile fish growth and survival.

Gulf of Alaska – Mammals

Agent-based modeling of mammal-eating killer whales and their prey: Not your lynx-hare cycle

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The role of mammal-eating killer whales *Orcinus orca* in the decline of various marine mammal populations in Alaska is controversial and potentially important in their recovery. We developed an agent-based model of killer whales with plausible energetics and behavior, calibrated and validated the model against published expectations for killer whale consumption rates, group dynamics and demography, and explored the emergent properties of single-prey and 3-prey models using small, abundant "seals" as primary prey, a generic small population of "sea lions" and seasonally available "whales" the single-prey model gave results that were intuitively responsive to underlying parameters, but were sensitive to killing rates, similar to classical predator-prey models. The dynamics showed long time lags (~ 30 years) between troughs of prey and predator numbers and highly variable predator age structure. In scenarios where the importance of seasonally available whales was manipulated, the large whales had the potential to augment killer whale numbers somewhat, but had minimal effect on the dynamics of either predators or alternate prey. Perturbing the carrying capacity of primary, small prey created strong shifts in killer whale population size and consequent indirect effects on alternate prey. No predictive inference is suggested for these models due to the absence of more realistic elements (e.g., explicit prey-switching, more realistic prey structure) than we used, but the models do suggest that we expect more complicated dynamics than have thus far been considered in discussions of transient killer whales and their prey.

Arctic – Mammals

Isotopic (δ13C, δ15N, δ34S) variation of Beaufort Sea Polar Bear tissues

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Polar bears in the Southern Beaufort Sea subpopulation (SB) are spending increased time on the coastal North Slope of Alaska between July and October. This change in polar bear ecology maybe related to a host of parameters including reduction in sea ice or food available from at bone piles of harvested bowhead whales on the North Slope. We are interested in any changes in feeding ecology and in the fundamental isotopic properties of different tissues and whether interannual variation is evident in apparent diets and whether this may be associated with years of relatively high or low sea ice. We have collect samples over the past 5 years and have undertaken analyses on hair, fat, and blood of male and female bears and their likely and possible prey.

We have found that: a) serum is typically enriched in $\delta^{15}N$ compared to red blood cells and hair by up to 6 per mil, b) interannual differences in serum, blood and hair are minimal for $\delta^{13}C$ and $\delta^{15}N$, and c) the variance between the $\delta^{15}N$ values of individual bears was however greatest in 2009. This variability suggests the possibility that some bears may be using a mixture of terrestrial and marine diets or that there are differences in the degree of in situ catabolism associated with fasting or differences in the degree to which individual bears are consuming prey fat as opposed to prey muscle.

Bering Sea – Humans

Freshwater harbor seals of Lake Iliamna, Alaska seasonal haulout and pupping patterns with possible covariates influences

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Lake Iliamna is home to a unique colony (~200+) of freshwater harbor seals. NOAA's National Marine Mammal Laboratory, along with the University of Alaska-Anchorage and our native partners from the Bristol Bay Native Association and the Newhalen Tribal Council have combined resources to census these seals multiple times each year. In addition to gathering baseline information on seasonal shifts in abundance and distribution, a companion study was initiated which documents subsistence use patterns and local traditional knowledge (LTK) from communities that harvest seals, by interviewing village elders and hunters. We documented pupping (N=63 in 2010; N=43 in 2011) for the first time in the lake, which takes place in July rather than the usual mid-May to mid-June as seen elsewhere in the state. Aerial surveys in early April, when the lake is completely frozen-over, revealed the presence of seals (N=11 in 2010; N=73 in 2011) along pressure cracks in the ice and in pools which form in some shallow water areas. Seals responded differently than expected to covariates influencing haulout behavior such as time of day and lake water height. Seasonal differences in haulout numbers suggest some seals may not over-winter, however there are no known accounts of immigration or emigration despite access to Bristol Bay via the Kvichak River (120 km in length). Three genetic samples were collected during the 2011 subsistence hunt which should help to determine if this group of seals is different from the Bristol Bay stock of harbor seals, or is possibly a new sub-species.

Posters

Gulf of Alaska – Ecosystem Perspectives

Marine plastic debris: A potential vector for POPs in the marine ecosystem

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Arctic – Ecosystem Perspectives

Biogeochemical indicators in High- and Low-Arctic marine and terrestrial avian community changes: Comparative isotopic ($\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$) studies in Alaska and Greenland

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Bering Sea – Humans

Examining vulnerable seal populations in Lake Iliamna using local knowledge and western science techniques

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Gulf of Alaska – Lower Trophic Levels

State of the Sound: Recent oceanographic conditions in Prince William Sound

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Bering Sea – Mammals

Using telomere length to age northern fur seals, *Callorhinus ursinus*, from the Pribilof Islands, Alaska

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Gulf of Alaska – Mammals

First noise measurements of an oscillator system for drilled shafts: Its implications for the endangered Cook Inlet beluga whale (*Delphinapterus leucas*)

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Bering Sea – Seabirds

Breeding ecology of Kittlitz's murrelet at Agattu Island, Aleutian Archipelago, Alaska: 2011 progress report

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Bering Sea – Seabirds

Identifying nesting habitat of *Brachyramphus* murrelets: Old nests lead to a new breeding record

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Gulf of Alaska – Ecosystem Perspectives

Distribution and ecology of zooplankton and juvenile pelagic fishes in the Copper River plume

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Arctic – Mammals

Isotopic (δ13C, δ15N, δ34S) characteristics of Beaufort Sea polar bear tissues and diet: Food web ecology of a top predator

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Gulf of Alaska – Mammals

Agent-based modeling of mammal-eating killer whales and their prey: Not your lynx-hare cycle

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