OCS Study
MMS 2003-042

Alaska OCS Region

NINTH INFORMATION TRANSFER MEETING AND BARROW INFORMATION UPDATE MEETING

Final Proceedings

March 10, 11, and 12, 2003
Anchorage, Alaska

March 14, 2003
Barrow, Alaska

MMS
U.S. Department of the Interior
Minerals Management Service
Alaska OCS Region

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** Presentation only given at the Barrow Information Update Meeting.

INTRODUCTION TO THE MMS INFORMATION TRANSFER MEETING AND THE ENVIRONMENTAL STUDIES PROGRAM

Cleve Cowles, Ph.D.

Chief, Environmental Studies Program
Alaska OCS Region
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Good Morning. Welcome to the MMS Alaska OCS Region Environmental Study Program's 9th Information Transfer Meeting. The Fur Rondy sprint races were canceled and the Iditarod went somewhere else to start this year, but you can always count on an MMS ITM this time of year. Once again it is a pleasure to see so many familiar faces, not only of Principal Investigators eager to give their presentations, but also those of you representing diverse agencies and groups who follow the progress of the Alaska environmental studies.

For those of you don't know me, my name is Cleve Cowles and I'm Chief of the Environmental Studies Section for the MMS Alaska OCS Region. As most of you are aware, the essence of the MMS mission is to manage offshore oil and gas leasing, exploration and development in an environmentally sound and safe manner. The Environmental Studies Program seeks to support those goals in a variety of ways. Most importantly, we are seeking to obtain and move quality science in a timely and useful format into MMS decision processes.

The specific goals of this 9th Information Transfer Meeting include:

1. To provide and exchange information obtained by the Environmental Studies Program in Alaska openly. Particularly to provide an opportunity for Alaska Region Environmental Assessment analysts, and the public, to refresh familiarity with the progress and results of various studies thereby enhancing use of the information.

2. Sharing and integrating information with that of other agencies, researchers, and the public, particularly that which is relevant to Outer Continental Shelf decision making.

3. Obtaining additional input from attendees regarding potential study topics or information exchange useful to MMS decision making.

In the past I have used this introductory moment to talk about the Environmental Studies participatory planning process, interagency coordination and cooperation, other functions, and accomplishments. Since this is all a matter of easily accessible record on our web site, in the 8th ITM report released in 2001, and in the interest of time, I will forego the details today. Suffice it to say that our program has been quite successful in achieving the our goals due to our basic foundation of staying focused on our mission, seeking to do quality and timely science, and considering and respecting local communities and their role in the studies process. We also coordinate and cooperate with other programs as much as possible.

Currently MMS supports more than 45 ongoing Alaska OCS studies in diverse disciplines, a major portion of which are cooperatively funded or have in-kind partners. Many of the cooperative studies are co-funded and managed under the MMS/University of Alaska Fairbanks Coastal Marine Institute which is a multi-year cooperative cost-sharing agreement designed to obtain the benefits from the world-class scientific expertise available at the UAF. We have a number of other interagency agreements with other research organizations offering specific capabilities in needed areas.

Additional information has been included in your packet along with the agenda. There's a summary of Environmental Studies Program purposes, list of all ongoing studies, list of recent reports, and a form which can be used to capture your ideas and hypotheses for testing. Please feel free to drop those off at the registration desk for our consideration.

Each session of the meeting will be co-chaired by at least one or more of the MMS Environmental Studies staff scientists who will help to introduce speakers and relevancy of topics. They can be identified by their spiffy name tag

with the "Session Chair" red lettered label. Please feel free to ask both PI's and our staff any questions you might have, there will be Q and A periods at the end of the presentations.

There are a few special welcomes I'd like to mention this morning. First, we are very pleased that Dr. Mike Castellini, UAF, will be representing the MMS Scientific Committee. The MMS Scientific Committee provides our program with advice on the appropriateness and quality of the scientific activities within the Environmental Studies Program at regional and national level.

Also, we will be welcoming Dr. Vera Alexander, Director of the MMS/UAF cooperative Coastal Marine Institute who will be presenting later today. We appreciate the technical vision Dr. Alexander brings to the CMI steering committee and the UAF scientists'expertise she encourages. We are entering our 11th year for the CMI and Dr. Alexander's leadership has been most helpful.

Mr. Mark Shasby, Chief Biology and Geography of the USGS' Alaska Science Center is here. The center provides interagency research capabilities to MMS, and I'd like to acknowledge Biological Resource Division's contribution to our knowledge.

Mr. George Valiuis, from our Headquarters Environmental Division, has come all the way from Herndon, Virginia, thank you for coming George.

Also I'd like to welcome from the North Slope Borough Todd O'Hara and Robert Suydam, who will be giving a presentation later. We appreciate your comments and cooperation through a number of CMI cooperative projects, thank you.

And now, it is with great pleasure that I introduce Mr. Paul Stang, Regional Supervisor, Alaska MMS Office of Leasing and Environment who without hesitation agreed to speak about "Alaska OCS Activities and Environmental Assessment Processes".

MMS ALASKA OCS REGION MISSION AND CURRENT MANDATES

Paul Stang

Regional Supervisor, Leasing and Environment
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The MMS mission is to manage the mineral resources on the outer Continental Shelf in an environmentally sound and safe manner and to timely collect, verify, and distribute mineral revenues from federal and Indian lands (Figure 1).

Under the OCS Lands Act, the MMS is mandated to "preserve, protect, and develop oil and natural gas resources of the OCS in a manner that is consistent with the need

a) to make such resources available to meeting the nation's energy needs as rapidly as possible;
b) to balance orderly energy development with protection of the human, marine, and coastal environments; and
c) to ensure the public a fair and equitable return on the resources of the OCS..."

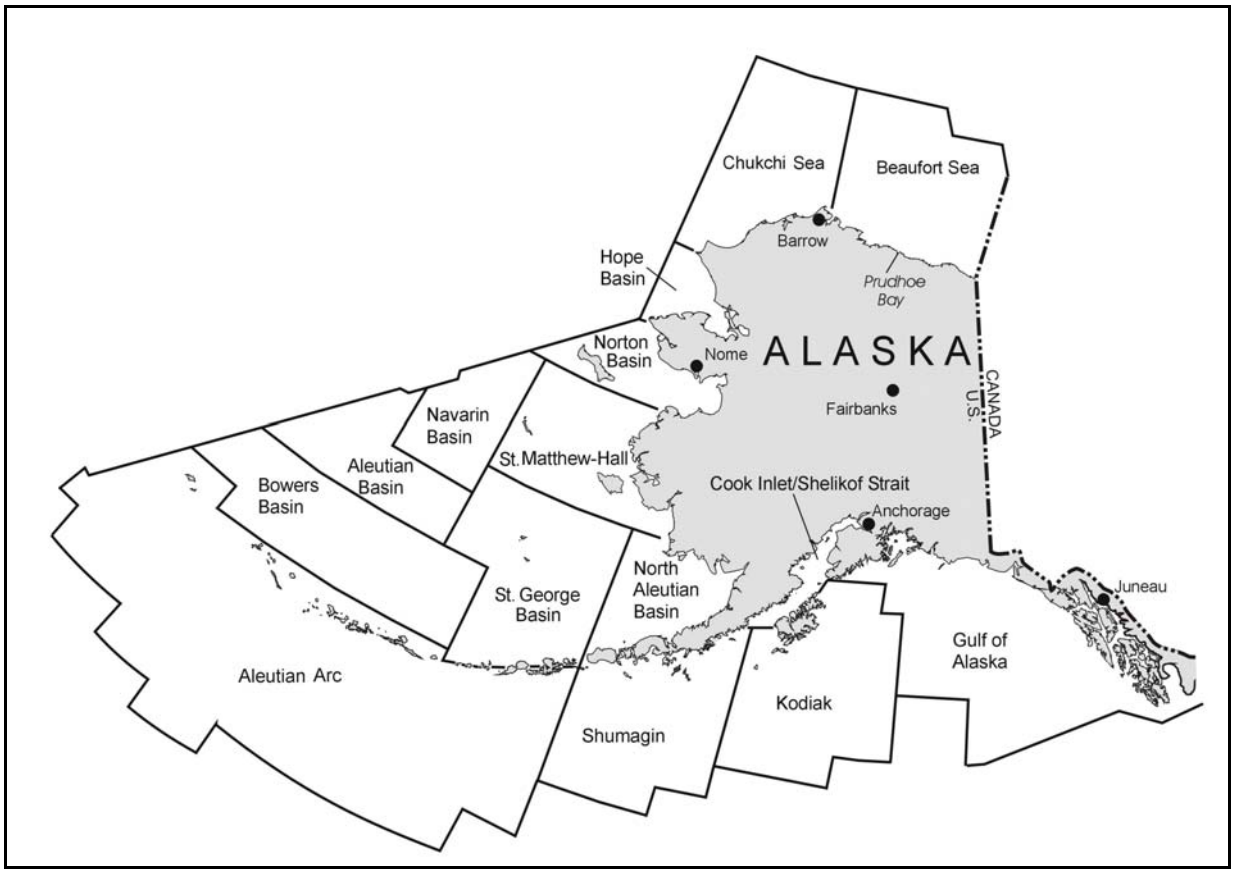

Figure 1. Map of the Alaska OCS Planning Areas.

In striking a balance, we consider, among other things, the very high and still increasing dependence of our National economy on foreign oil; the importance of Alaska production, approximately 17% of US production; the national mandates and growing international emphasis on environmental protection; effects on Alaska natives and other residents along the coast, and concerns about effects of Arctic climate change and cumulative effects.

MMS implements these mandates through:

1) the conduct of environmental and socio-economic studies;
2) the preparation of lease-sale schedule;
3) the preparation of Environmental Impact Statements in accordance with National Environmental Policy Act (NEPA);
4) attention to the Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA), and Coastal Zone Management Act (CZMA);
5) conduct of specific lease sales;
6) timely review and response to industry proposals for exploration or development; and
7) regulatory and safety role of Field Operations.

The first of these is the foundation for the rest of our mandates. Your role in that is critical. Cleve and his staff with your help and that of our Scientific Advisory Committee and others have built a solid foundation.
MMS also coordinates with others such as the Bureau of Land Management's (BLM) in their oversight of the National Petroleum Reserve-Alaska (NPR-A), the US Army Corps of Engineers (COE), Biological resources Division of US Geological Survey, Fish and Wildlife Service, National Oceanic and Atmospheric Administration/National Marine Fisheries Service, US Environmental Protection Agency and other federal agencies, as well as state agencies with responsibility for near shore waters and onshore lands, local municipalities, Cook Inlet Regional Citizens Advisory Committee (CIRCAC), North Slope Borough (NSB), the boroughs of Cook Inlet, tribes, Native corporations, lessees, etc .

MMS stresses public involvement in most all of our processes. We actively solicit participation and give long lead-times for lease sales, environmental assessments, and approval actions

Conferences such as this help us achieve that balance.

Pre-lease Considerations in Alaska

The most important use of our environmental and socio-economic studies in the pre-lease process is for environmental impact statements.

The 5-Year Program, officially the *Final Outer Continental Shelf Oil and Gas Leasing Program 2002-2007*, proposes lease sales:

Beaufort Sea Sales in 2003, 2005 and 2007
Cook Inlet Sales in 2004 and 2006
Chukchi/Hope Basin Special Interest Sales in 2004 and 2007
Norton Basin Special Interest Sale in 2004
Chukchi/Hope and Norton Planning Areas will be offered for nomination annually 2003-2007 to determine in companies have interest in specifics parts of these planning areas.

The status of EIS's is:

Beaufort Sea FEIS was issued 2/03
Cook Inlet Multi-sale DEIS was issued 12/02

Steps of the 2-year pre-lease process are:

Call, Area ID, Scoping, Draft Environmental Impact Statement, Public Hearings, Final Environmental Impact Statement/PNOS, Final Environmental Impact Statement, FNOS, Sale

An important outcome of the scoping/EIS process is development of mitigation measures, including lease stipulations.

Post-lease Considerations in Alaska

Not all information needs can be filled prior to a sale. In the post-lease phase, MMS acquires additional information for environmental analyses related to development and production in the post-lease phase environmental analyses. Thus, an increasing number of studies have become more closely related to development schedules and monitoring and evaluation in addition to those broader studies related to the pre-lease phase. As with the pre-lease phase, the wide range of environmental conditions from Cook Inlet to the Arctic and planning lead times are accounted for in the process of formulating new studies for the Annual Studies Plan.

Post-lease activities that raise issues and require environmental data and assessment are:

Geophysical surveys.
Exploration drilling.
Development, construction, and production activity.
Oil transportation, including pipelines and tankers.
Lease termination or expiration (platform abandonment).

An important part of the post-lease phase is enforcement of stipulations on leases, most of which relate to protection of the environment and/or mitigation of potential environmental effects.

As of February 2003, exploration, artificial-island construction and abandonment, unitization agreements, and including suspension of leases have occurred on the Alaska OCS.

In the Beaufort Planning Area, 716 tracts have been leased in eight OCS Lease Sales between 1979 and 1998. Currently, 42 leases are active (Figure 2). Thirty one exploratory wells have been drilled and 11 were determined to be producible.

The BP Northstar development project is located about 10 miles north of Prudhoe Bay (Figures 2 and 3). While the Northstar Island is in State waters, 6 to 7 wells will be on the OCS. The project was approved by the U.S. Army Corps of Engineers in May 1999 and by MMS in September 1999. Construction started in the winter of 2000. Production started the last day of October 2001. Recoverable reserves are estimated at 158 million barrels of oil, with peak daily production estimated at 65,000 barrels per day. This is the first production from the Alaska OCS.

In winter 1998 BPXA proposed development of the Liberty Unit in Foggy Island Bay (Figure 2). It is located about 6 miles east of the State Endicott Project. Recoverable reserves are estimated at 120 million barrels of oil. In January 2002, BPXA put the Liberty project on hold, but because the *Final Environmental Impact Statement* was essentially complete, MMS issued it a few months later. BP is considering submitting a new development plan for Liberty later this year.

AEC Oil and Gas (USA), Inc., drilled an exploration well on the McCovey prospect near Cross Island in December 2002 (Figure 2). The firm plugged and abandoned it in February 2003.

The only other active leases are in the Cook Inlet Planning Area. Cook Inlet Lease Sale 149 was held in June 1997 and generated two leases (Figure 4).

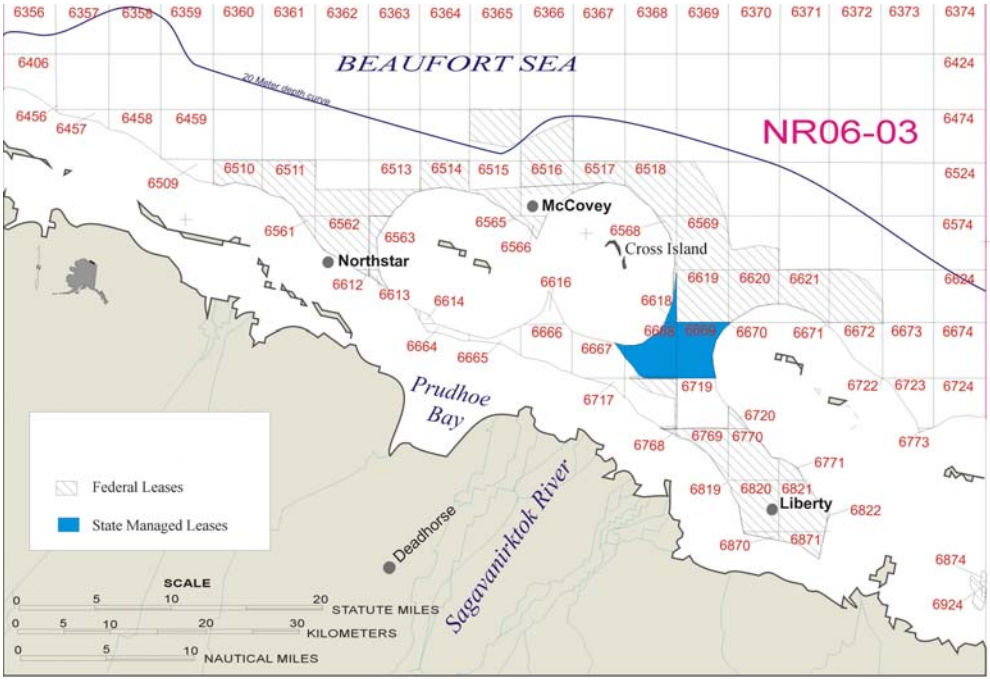

Figure 2. Beaufort Sea Oil and Gas Leasing Activity.

Figure 3. Northstar Island, looking north, September 2001. Production started November 2001.

No leases are active from previous lease sales in the Chukchi Sea or Hope Basin portions of the Arctic Sub-region, or in the Bering Sea or Gulf of Alaska Subregions (Figure 1)..

Conclusion

In conclusion, I would especially like to welcome those attending from other organizations, the public, and all the invited speakers. For the invited speakers I wish to express my thanks for your work towards making this meeting a success. We look forward to your presentations.

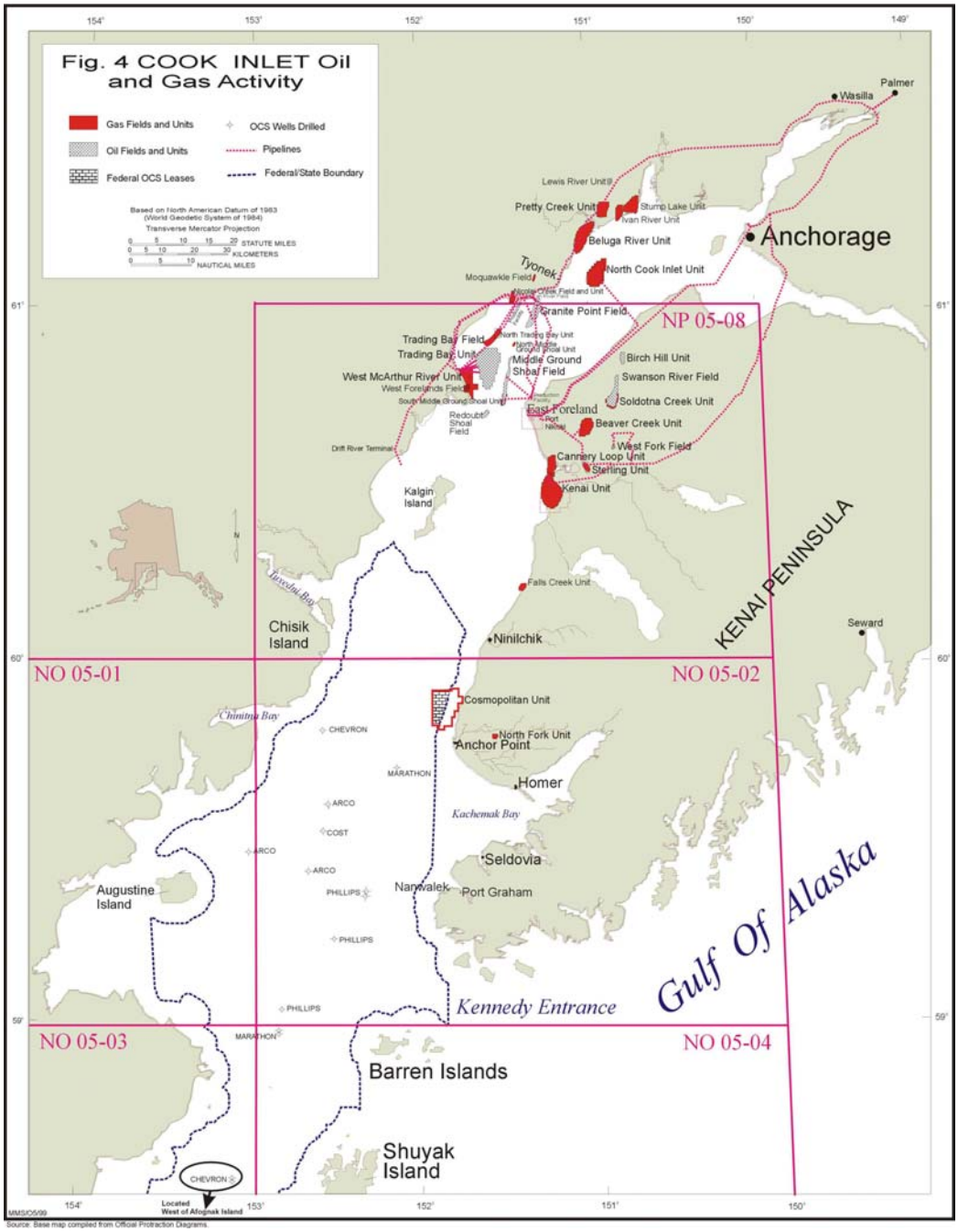

Figure 4. Cook Inlet Oil and Gas Activity.

PHYSICAL OCEANOGRAPHY

WATER AND ICE DYNAMICS IN COOK INLET

Mark Johnson[1], Andrey Proshutinsky[2], and Steve Okkonen[1]

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Our goal is to investigate the dynamics of the water and ice in Cook Inlet using a high resolution numerical model, satellite-tracked drifting buoys, and satellite imagery. We focus on mapping the tide rips to understand their temporal and spatial variability. Drifting buoys are currently under construction and will be deployed in early Spring and tracked through late Fall. Data will be transmitted to the ARGOS satellite system along with global positioning system (GPS) data to give highly accurate position information. In the winter, satellite imagery will allow us to track ice motion to evaluate the rip location.

We start with the conceptual model that Cook Inlet behaves as a simple fluid with salty fluid on one side and fresher fluid on the other with the front separating them defining the rip zones. Our working hypothesis is that the vertical structure of the rips migrates horizontally with the flood and the ebb tides. We also recognize that high resolution models are needed in order to reproduce tidal currents and surface elevations in Cook Inlet. We are currently evaluating the existing bathymetry data sets to ensure that our model uses the best available data for Cook Inlet.

The model will begin with tidal forcing and determine how well the rips are simulated. Model results will be validated by comparing model output to the drifter tracks. Model results will also provide information to predict zones of significant sediment transport known to exist in many areas of the Cook Inlet floor that may affect placement and safety of submarine power and telecommunications cables and oil and gas pipelines.

In this presentation we will review some of the historical information from Cook Inlet, present our research plan, and invite comments from interested stakeholders.

Discussion

Susan Saupe: What kind of resolution will you be able to incorporate into the model using the CODAR technology?

Mark Johnson: The CODAR technology gives surface current velocity. The CODAR system deployed now and will be removed in the next two months.

Dick Prentki: Where are you getting the bathymetry data from?

Mark Johnson: It's a proprietary data set. We're combining data from sets purchased by UAF and developing new sets as well.

MEASUREMENTS OF TEMPERATURE, SALINITY AND CIRCULATION IN COOK INLET, ALASKA

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Temperature and salinity were measured in central and lower Cook Inlet, Alaska during the spring and fall of 2002 to assess seasonal changes in frontal characteristics, improve understanding of variability of the local density-driven circulation, and to provide measurements for validation of numerical circulation/oil spill trajectory models. These hydrographic measurements showed that there is a spring-to-fall freshening of ~ 1.5 psu in the lower inlet and ~ 3 psu in the central inlet. Frontal gradients were also observed to be stronger during the fall than in the spring. Multiple hydrographic observations along a fixed transect showed that the inclination of the middle rip front decreased during the flood tide, which had the effect of diminishing the speed and vertical extent of the southward-flowing baroclinic jet. Also during the flood tide, average temperature decreased ~ 0.5 °C and the average salinity increased ~ 1.3 psu.

The spring and fall hydrographic surveys showed that significant freshening of the inlet occurs during the intervening months. The addition of fresh water to the inlet strengthens the gradients of three main fronts–the west, middle, and east rip fronts–and promotes southward extension of the west rip beyond the Anchor Point line.

Northward-flowing baroclinic currents occur in association with the west and east rip fronts, whereas a southward-flowing baroclinic current occurs in association with the middle rip front. The west and east rip currents will locally augment the barotropic tide during the flood and act in opposition during the ebb. Conversely, the middle rip current will locally oppose the barotropic tide during the flood and locally augment the barotropic tide during the ebb.

The most significant hydrographic response observed during the transition from flood tide to ebb tide was the structural change of the middle rip front. During the flood tide, the surface portion of the front migrated eastward (# 2 n mi), whereas the bottom portion of the front migrated westward (# 2 n mi) and shoaled, thereby reducing the overall inclination and depth of the middle rip front. The baroclinic geostrophic response to this frontal adjustment was a reduction in the speed and vertical extent of the southward-flowing middle rip jet. Flood-to-ebb variation in the magnitude of the west rip and east rip baroclinic currents was also observed.

The interaction between the baroclinic currents and barotropic tidal currents result in a local current regime that is well known to local commercial salmon fisherman. That is, the onset of northward surface flow near the middle rip front lags the onset of northward surface flow near the eastern beaches in the central inlet and that southward-flowing surface currents near the middle rip are typically faster than southward-flowing currents near the beach.

The hydrographic results presented above indicate that temperature and salinity (buoyancy) effects at seasonal to semidiurnal time scales need to be included in Cook Inlet numerical oil spill trajectory models to improve their forecasting skill. The large observed changes in salinity between the Drift River/Kenai transects and the Forelands and, to a lesser extent, between Humpy Point and Ninilchik suggest that additional hydrographic surveys in these locations would improve understanding of these dynamic subregions.

SYNTHESIS AND COLLECTION OF METEOROLOGICAL DATA IN THE NEAR SHORE BEAUFORT SEA

Steve Mackey

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The goals of this study are to collect new meteorological data from the deployment of meteorological stations and to collect historical meteorological data from the Beaufort Sea region subject to immediate development. This study provides a comprehensive time-series of wind data for MMS modelers and researchers for use in their ongoing modeling of the nearshore Beaufort Sea. Meteorological data are collected at both offshore and nearshore locations to provide data for MMS models, such as the Coastal Zone Oil Spill Model (COZOIL), the MMS oil weathering model, or the nearshore circulation model. The project now includes a total of five meteorological monitoring stations. Four new meteorological stations were established for this study at Badami, Endicott, Northstar, and Milne Point in January 2001. To address concerns about wind data collected at Northstar, a fifth meteorological station was installed on Cottle Island in August 2002. The observed parameters for this study are wind speed, wind direction, air temperature, barometric pressure, relative humidity, and solar radiation. All parameters are monitored continuously. Collected data is processed and downloaded every working day to an Anchorage-based server. The data are then reviewed and posted to a web site that is available for public access. The web site address is www.resdat.com/mms/. Data collection is now scheduled to continue through October 2004. This presentation will summarize the first two years of the study (2001 and 2002).

Discussion

George Valiulis: During the open water season, and with regard to the windrose, which way is the predominant wind direction? It could have important implications to oil spills.

Steve Mackey: In general, these stations exhibit a bi-directional flow. A vector analysis would likely result in a low average wind speed because wind from the East-Northeast can somewhat cancel out wind from the West-Southwest. However, we are still analyzing the data and haven't specifically looked at only the open water periods.

Tom Newbury: The McCovey operation is now abandoned, that is to say the rig is no longer being used. Is it possible to acquire wind data from there?

Steve Mackey: A weather station was run there by the McCovey operators, we should be receiving that data soon. Compiling historical wind data requires cooperation with the facilities, that is a lot of negotiations are necessary in order to use the station.

Jia Wang: What time intervals did you use in recording the data?

Steve Mackey: Hourly averages are being recorded, 8760 hours per year for two years. An exception is barometric pressure, which is recorded only at the top of the hours. All data are available on the website per hour and the data capture rate is over 90%.

Unidentified: How were data collected here varies with respect to the Deadhorse data.

Steve Mackey: We got similar data from the wind roses for QA.

Ken Dunton: What are the units for solar radiation? What about calibration?

Steve Mackey: Watts per meter squared. The manufacturer guarantees the calibration for two years.

Steve Treacy: You said offshore winds are less than onshore winds, but when we fly over Barrow we find the opposite to be true. Can you comment on the difference?

Steve Mackey: That covers outside the immediate range. The area is defined by Northstar and Liberty; Badami is the only unit that's quite a way inland.

Warren Horowitz: The website, www.resdat.com/mms, is intended for public access. We have provided access to other researchers so that they may have access to the data for their research needs.

Ed Owens: In 2001 we had a meteorological station in Harrison Bay, on the west side of the Colville Delta. Data were collected hourly. If you would like the data to compare to your sites, I'm sure it could be available.

Steve Mackey: Yes, we would be interested in obtaining the data, and if Conoco Phillips collected it, I'm sure they would share it. Conoco Phillips has already provided us with two sets of data.

Mark Savoie: Have you looked at onshore/offshore open water versus the winter time? Minerals Management Service funded some work that showed onshore winds larger during the winter.

Steve Mackey: No significant conclusions as of yet. There didn't appear to be a drastically different wind speed, we're putting together graphics showing wind speed on a month to month basis.

A GIS-BASED ALASKA SEA ICE ATLAS

William J. Lee[1] and Orson P. Smith[2]

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A GIS-based atlas of sea ice conditions in the territorial waters of Alaska has been created. It updates previously printed ice atlases and provides risk analysis information for engineers and resource managers. The Alaska Sea Ice Atlas includes a comprehensive collection of georeferenced digital historical data on Alaska sea ice and other environmental factors that bear directly on ice processes and conditions. Historical ice reports of the US National Ice Center form the foundation of the database of ice conditions. This information is supplemented by ice data from the US National Weather Service and other sources. The Alaska Sea Ice Atlas incorporates tools for analysis and mapping of sea ice effects on ships and fixed structures. These products are delivered via a customized implementation of ArcView GIS and at a public web site that is enhances with ArcIMS map services. There is also an Internet searchable collection of meteorological data developed from the National Climatic Data Center's first and second order station databases. The Alaska Sea Ice Atlas is a major improvement in the ability to access and analyze the vast amount of spatial data on sea ice that is available.

Discussion

Steve Treacy: Have you correlated any of the sea atlas data?

Bill Lee: The Atlas presents ice information that is the product of extensive correlations of multiple ice records by the U.S. National Ice Center. We transformed National Ice Center weekly summaries for web presentation and statistical treatment.

Frank Bercha: What did you modify ice data in?

Bill Lee: Canadian Ice Numeral System. This was designed to be done as a hand written process, but we had non-navigable regimes and need to develop a way to apply the same thinking to the existing process. The higher the number the less navigable the regime for a particular class of ship. The quantity and quality is based on Canadian applications.

NEARSHORE CIRCULATION ON THE ALASKAN BEAUFORT SHELF

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Presented by Steve Okkonen.

We measured current velocity, temperature, salinity, and transmissivity (a proxy for suspended sediment load) at hourly intervals for three years at from 3-4 mooring sites in the nearshore region of the Beaufort Sea near Prudhoe Bay. The primary purpose of the program was to measure under-ice and open water currents for evaluating oil-spill trajectories and sedimentation risk in this nearshore environment. Mean currents are westward but weak (~2 cm s-1) and polarized in the along-shore direction. The mean currents vary little in magnitude seasonally, although there are two distinct seasonal circulation regimes. The open water/loose ice regime lasts from early July through mid-October during which time the currents are swift, highly variable, and significantly correlated with the alongshore winds. Current speeds typically exceeded 10 cm-s-1 and maximum currents can exceed 100 cm-s-1. Landfast ice covers the region from mid-October through the end of June. Mean currents at this time were also feeble (~1 cm-s-1) with current variations primarily tidal. Less than 1% of the current speeds exceeded 20 cm-s-1 and less than 10% of the current speeds exceeded 10 cm-s-1. Although semi-diurnal tidal variations account for the bulk of the current variations, the largest currents are associated with subtidal current fluctuations with periods of 4 - 10 days, but are not correlated with local winds. Currents are horizontally coherent throughout the year over the 35 km separating the moorings. Vertical current shears are weak beneath the landfast ice, but can be significant during the spring freshet when river plumes spread beneath the ice and on occasion during the open-water period. Acoustic backscatter suggests that the under-ice plumes are ~1.5 m and salt conservation budgets suggest that the plume salinity is <5 psu. Vertical salinity gradients can be ~28 psu/m. There are no significant sources of kinetic energy available for mixing when the landfast ice is present. Substantial offshore currents (~10 cm/s) are associated with the underice plume. The results suggest that the river plume and its associated suspended load could be carried at least 20 km offshore during the duration of the spring freshet and prior to the breakup of the landfast ice. Once the landfast ice melts mixing the plumes can be easily mixed by the winds, although the rapidity with which this is accomplished depends critically on the wind speed.

The transmissivity data indicates a frequently turbid nearshore environment during the open water season with re-suspension events occurring during storms. The suspended sediment load diminishes when landfast ice forms, but there are frequent events during which sediment is either re-suspended or advected from elsewhere through the region. Under-ice river plumes carry an enormous sediment load as transmissivity values attained minimum values during the spring freshet in June but before the landfast ice melted. The results suggest that sediments settle rapidly beneath the landfast ice and then are re-suspended and transported after the ice melts.

Discussion

Ed Owens: What date did the data collection begin?

Steve Okkonen: In mid August of 1999, then we returned in late August 2000, recovered moorings, and redeployed. The moorings were finally removed in August 2002.

Ken Dunton: Is there movement during the summer coastal-in winter, pulsing is sometimes related to storms-is there a pulsing effect that goes on during storms?

Steve Okkonen: There are a couple moorings with pressure sensors, but no correlation with pressure per say. But we suggest looking at a time derivative. In the first year of deployment during ice cover period a net onshore or offshore flow of 1 cm/s (very slow).

SUMMARY OF WORKSHOP ON PHYSICAL OCEANOGRAPHY IN THE BEAUFORT SEA

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Presented by Steve Okkonen.

This report summarizes the results of a 2.5-day workshop on the physical oceanography of the Alaskan Beaufort Sea, held in Fairbanks, Alaska in February 2003. The workshop reviewed knowledge of the physical oceanography of the Beaufort shelf and recommended studies to support Minerals Management Service's mission with respect to industrial development on this shelf or along the coast. There are fundamental unknowns pertaining to the ocean and ice circulation, ocean density field, and the forcing mechanisms that influence sea ice and ocean dynamics. The study recommendations consist of a mix of field (observational) and idealized model studies to improve understanding of poorly understood physical processes and boundary conditions and to provide data sets necessary for the proper evaluation of regional pollutant transport models. Critical issues requiring study are the:

1. wind and surface stress fields established by mesoscale variations in the regional meteorology and sea ice distribution and deformation fields,

2. effects of freshwater discharge and freezing (convective) processes on the shelf circulation,

3. controls exerted on the circulation and water property fields by the lateral ocean boundaries of the Alaskan Beaufort Sea: the Chukchi shelf (western boundary), the Canadian Beaufort shelf (eastern boundary), and the shelfbreak and continental slope (offshore boundary), and

4. shelf/slope bathymetry

These topics affect the time and space scales of the ice and ocean circulation, which have not been well-resolved in the Beaufort Sea. Consequently, the recommended studies are also designed to delineate the major scales of spatial and temporal variability.

Discussion

Steve Treacy: Although there was no meteorological station farther out, the conclusion was that winds diminish from onshore to offshore. An offshore station might generate a totally different result. For instance, we often see a lee effect on the nearshore areas.

Steve Okkonen: Along the coast winds are relatively high and weaker farther offshore. This applies to large-scale circulation models. Large climatologies on a very coarse scale underestimate nearshore winds along the coast. Winds that are relatively higher near the coast are associated with sea breeze or land breeze effects.

Ken Dunton: If you trace the path of Bering Sea water, the nearshore is different than what's going on offshore. In the future, you might look at signatures to try to determine where some of these water masses are moving. Can you collect information on water without moorings?

Steve Okkonen: In the nearshore, temperatures are pretty flat, although outside the barrier islands what is happening is questionable. Mark Savoie has done CTD casts outside the barrier islands.

ARCTIC NEARSHORE IMPACT MONITORING IN DEVELOPMENT AREA (ANIMIDA)

THE MINERALS MANAGEMENT SERVICE ARCTIC NEARSHORE IMPACT MONITORING IN THE DEVELOPMENT AREA (ANIMIDA) PROGRAM: INTRODUCTION TO A MULTI-YEAR MONITORING PROGRAM IN THE NEARSHORE BEAUFORT SEA

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This presentation was also given at the Barrow IUM.

Offshore oil and gas development and production activities have been initiated at Northstar Island and are proposed for the coming years at a modified Liberty prospect site in the nearshore Beaufort Sea. There is concern about the long-term effects of these developments, as well as, long-term effects of any development associated with future offshore lease sales and exploration activities. Historical chemical and physical data have been collected in the region over several decades. Nevertheless, the sensitivity of the region adjacent to Northstar and Liberty, and the highly variable and complex environmental conditions, make further monitoring necessary. In response to interagency reviews of related environmental impact statements (EISs) and development and production plans, the U.S. Department of Interior, Minerals Management Service (MMS) initiated the ANIMIDA Program as a long-term study for monitoring potential impacts of the Northstar and Liberty developments. ANIMIDA Phase I was started in June 1999 and included hydrocarbon and metals chemistry measurements in sediment and tissue samples, as well as acoustic measurements adjacent to the Northstar and Liberty sites. Phase II of the ANIMIDA Program was initiated in July 2000 and incorporates seven tasks including hydrocarbon and metal chemistry studies, suspended sediment studies, an assessment of subsistence whaling at Cross Island, biota contaminant assessment, and a study of the "boulder patch" area. An overview of the ANIMIDA Program status to date will be presented.

Discussion from the Barrow IUM

Cleve Cowles: Commented on the involvement of the North Slope Borough in Phase I and extended appreciation for their help in defining the important issues. Minerals Management Service web site has summary information.

Craig George: You talked about moderate PCB levels in some fish–which species and,– size class; and how do you define moderate?

John Brown: A total PCB concentration from several hundred parts per billion (ppb) would be considered moderate. The highest concentrations were in the four horn sculpin (single outlier) and we didn't look at age class. The next highest was the Arctic cod and most of them were 4.0 to 5.0 cm (total length)-so not large. Next were whitefish and at the bottom were Arctic cisco and several flounders.

Craig George: Can you put that in perspective compared to the lower 48?

John Brown: Total PCB concentrations in bluefish can be about 5.0 to 10.0 ppm, about 100-500 times higher. As far as other Alaska fish, few studies have been done on PCBs, except for sculpin, whose levels were low, cisco concentrations were also low averaging about 1.0 to 3.0 parts per billion (ppb). Levels were about the same range in other Alaska fishes.

Harry Brower Jr.: Have you made any predictions using these results? Do you need information to make predictions or has Minerals Management Service made any predictions?

John Brown: Predictions for Northstar thus far haven't caused any discernable measurable increase in contaminants in the area. In over three years post-construction, there has been no indication of an increased amount of contaminants. We have sediments with hydrocarbons and metals in them, but the concentrations are of variable levels and they do not pose a risk to the biota. We're just getting data on fish contaminants now-no conclusions thus far.

Unidentified: Since the settling of the island has there been erosion?

John Brown: We're not looking at erosion.

Todd O'Hara: The Department of Environmental Conservation is regulated by the state and the Army Corps of Engineers have looked at erosion.

ANIMIDA: HYDROCARBON CHEMISTRY OF SEDIMENTS AND BIOTA IN THE NEARSHORE BEAUFORT SEA

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Hydrocarbon chemistry is one component of the multidisciplinary MMS ANIMIDA Program. The hydrocarbon chemistry study has focused on sediments and biota (clams and amphipods) from the nearshore Beaufort Sea. During the 1999 and 2000 summer field seasons surface sediments and biota were collected from stations throughout the study area, including site specific stations adjacent to the Northstar and Liberty prospects. In the summer of 2001 sediment core samples were collected from suspected depositional areas to evaluate the historical record of nearshore sediments. The samples were analyzed for a full suite of hydrocarbons useful in determining petroleum contamination, including: saturated hydrocarbons, polynuclear aromatic hydrocarbons (PAH), and chemical biomarkers (steranes and triterpanes). The hydrocarbon data are being used to develop a monitoring database that can identify potential trends and inputs of petroleum contamination in the region and the development areas.

The 1999 hydrocarbon data serve as an important pre-development baseline for the Northstar and Liberty area. The 1999 results reveal that the area sediments generally contain low levels of naturally occurring background hydrocarbons, consistent with historical data from 1989 and earlier Beaufort Sea Monitoring Programs. However, there were two stations where small increases in petroleum hydrocarbons, likely due to anthropogenic inputs, were identified in the 1999 data set. The hydrocarbon levels in clams and amphipods were very low, and within the range of past studies. The 2000 data from the study area generally revealed no differences in sediment hydrocarbon concentrations or composition between the 1999 and 2000 data sets, and very trace levels of hydrocarbons in area biota. However, a subset of Northstar stations showed an increase in several key hydrocarbon parameters from 1999 to 2000. Detailed evaluation of the Northstar station data indicated that the observed trend showed no shift to anthropogenic hydrocarbon inputs, and was likely a function of the depletion of fine-grained sediments (and associated hydrocarbons) in 1999 due to storm activity, and not due to the development at Northstar Island. The 2001 sediment core results revealed low sedimentation rates in the study area (~0.1 cm/year to no recent deposition), supporting previous findings that the overall nearshore study area is a net erosional environment. The data from a subset of sediment cores where deposition rates can be well established, generally show uniform levels and distributions of background hydrocarbons extending back some 50 years and greater, with no discernable increases from recent offshore development activities.

The overall hydrocarbon data set can also be compared to sediment quality guidelines to gain a preliminary assessment of potential adverse effects to biota. No exceedences of petroleum hydrocarbon sediment quality guidelines have been noted thus far (1999 through 2001). Preliminary results from the 2002 field season reveal hydrocarbon levels in sediment and biota within the range of previous years, and no exceedences of sediment quality guidelines.

ANIMIDA: SOURCES, CONCENTRATIONS, AND DISPERSION PATHWAYS FOR SUSPENDED SEDIMENT

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The concentrations and composition of suspended sediment in the coastal Beaufort Sea directly influence penetration of light in the water column and the transport and fate of potential contaminants. The work described here was designed to determine the amounts and composition of suspended sediment carried to the Beaufort Sea by local rivers and to determine the concentrations, composition, distribution patterns and fate of suspended sediment in the coastal Beaufort Sea, especially in areas influenced by offshore activities.

The Sagavanirktok, Kuparuk and Colville rivers were sampled intensely during the spring breakup of 2001 and 2002 and again during summer. More than half the annual load of suspended sediment is carried by these rivers in two to three weeks. For example, concentrations of total suspended solids (TSS) in the Sagavanirktok River increased within 10 days from ~40 mg/L to 600 mg/L on June 12, 2001, and then decreased to ~30 mg/L by June 18. During late July and August 2001, concentrations of TSS were ~2 mg/L. For the Sagavanirktok River, we calculate a total annual sediment transport of ~0.25 million metric tons per year. Previous estimates for the Colville River are 5-10 million metric tons of sediment per year. These inputs can be compared with ~1.6 million metric tons of sand and gravel used to construct Northstar Island (800,000 yd^3 x 0.76 m^3/yd^3 x 2.6 metric tons/m^3 = 1.6 million metric tons).

Suspended sediment carried by rivers during break-up flows out over and under the 2-m thick ice that covers the Beaufort Sea during June. At the mouth of the Sagavanirktok River, concentrations of TSS averaged ~40 mg/L in a 2-m thick lens of freshwater immediately under the ice that extended ~20 km offshore. This suspended sediment was rich in fine-grained aluminosilicates (clays) as shown by levels of Al and other metals. The trapped lens of turbid, freshwater moves riverine sediment well offshore before being deposited.

During the brief open-water season, turbidity in the coastal Beaufort Sea is directly related to wind speed and duration. For example, TSS levels >100 mg/L (turbidity >50 NTU) were observed following a 6-day, >25-knot storm in 1999 relative to TSS levels as low as ~2 mg/L (1 NTU) in calm waters, sheltered by floating ice. Transects made by towing a turbidimeter-CTD package around Northstar Island showed uniform levels of turbidity (at ~2.5 NTU in August 2001) just above the pycnocline at a water depth of 1.5 m. The turbidity decreased below the pycnocline to 1.2-1.5 NTU. No significant deviations in levels of turbidity were observed during 2000 and 2001 along various transects adjacent to the island at distances as close as 100-500 m. Sedimentation rates in the study area, determined using ^{137}Cs and excess ^{210}Pb techniques, range from ~0.1 cm/yr to no discernible recent deposition. These results support previous conclusions that the ANIMIDA study area is a net erosional environment with sediment most likely being carried off the shelf into deeper water.

Discussion

Jia Wang: What are the effects of tide on the sediment?

John Trefry: One of the advantages of the Minerals Management Service vessel 1273 is that it is very slow and we can travel at tidal speeds. We haven't seen any differences within our statistical limits to suggest that tides have an important role.

Jerry Brown: Fifty percent of sediment comes from the rivers? From shoreline erosion? Because according to old USGS estimates, the amount of sediment entering the Beaufort Sea is seven times as much as discharged through the Colville River–that is, coastal erosion, retreat along the coastline.

John Trefry: Greater than 50% of the annual input from rivers comes within three weeks, almost all from the rivers, but I don't know what proportion is coming from erosion of the shoreline.

Jerry Brown: It's probably an order of magnitude more coming from coastal erosion. August floods out of Kuparuk and Sag rivers show differences in the spring and the suspended sediment load is considerably lower.

John Trefry: That's very fine sediment though, and in many cases the bank material is not very fine grained.

Jerry Brown: It's both.

John Trefry: But nothing like the river suspended sediment.

ANIMIDA: PARTITIONING OF POTENTIAL CONTAMINANTS BETWEEN DISSOLVED AND PARTICULATE PHASES

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Concentrations of dissolved and particulate metals in the water column can be sensitive indicators of low levels of environmental contamination in a coastal setting. The primary pathway for uptake of most contaminants by biota is ultimately from the water column, at least at some trophic level. In addition, any spills in the area, whether oil, liquid or solid discharge, will first impact the water column. This component of the ANIMIDA program was designed to determine concentrations of dissolved metals (As, Ba, Cd, Cr, Cu, Hg, Pb and Zn) in snow, rivers, under ice, and in the Beaufort Sea during the open water season. Samples for dissolved metals were collected during the 2000, 2001 and 2002. Concentrations of dissolved metals in river water increased in response to the flushing of dissolved organic carbon from decaying vegetation associated with soils and surface ponds during the spring floods. Snow samples collected during June had concentrations of trace metals that were significantly lower (10 to 25 fold) than dissolved levels observed in the rivers during peak discharge. The riverine discharge of freshwater under the ice (2-3 m thick lens) was physically separated from the underlying seawater by a thin layer of (freshwater) ice. The discharge of metal-rich river water was detected 20 km offshore from the Sagavanirktok River. Concentrations of dissolved metals below the turbid riverine discharge were more typical of concentrations found during the open water period in summer and fall. Concentrations of dissolved trace metals in the saline waters of the coastal Beaufort Sea are generally lower than found in the rivers with the following observations: Pb at 4-7 ng/L, Cu at 0.5 µg/L and Ba at 13 µg/L. Concentrations of total dissolved Hg in the coastal Beaufort Sea are low at about 0.5-0.8 ng/L relative to concentrations of 2.1 to 3.8 ng/L in the Sagavanirktok River during the spring floods.

The forms of the metals and controls on concentrations of dissolved metals in rivers are important to understanding subsequent behavior in the saline water of the coastal Beaufort Sea. For example, concentrations of dissolved and particulate Ba vary directly among the rivers, suggesting that a simple distribution coefficient (K_d) may be used to explain observed concentrations. When this approach is used for Ba, the fit is good with the K_d for Ba averaging $2.4 \pm 0.5 \times 10^4$ for all the rivers. This trend supports the concept that concentrations of Ba in suspended sediment regulate concentrations of dissolved Ba. The same approach also has been applied to Pb and Cu; however, the fit is less consistent, suggesting that other factors, such as complexation with organic matter influences concentrations of dissolved Pb and Cu.

Discussion

Dick Prentki: You did two years of spring river sampling. Did you find that ice layer between salt and freshwater in both years or just one?

Robert Rember: Both years.

Sathy Naidu: How do you define dissolved? How do you explain covariance between dissolved arsenic and salinity?

Robert Rember: Less than 0.4 microns. Arsenic accumulates in seawater because it is very stable in the form of arsenate in seawater, so it has a long residence time.

ANIMIDA: LINKING WATER TURBIDITY AND TSS LOADING TO KELP PRODUCTIVITY WITHIN THE STEFANSSON SOUND BOULDER PATCH

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Stefansson Sound, located 20 km northeast of Prudhoe Bay in the Alaskan Beaufort Sea, encompasses many boulders, cobbles, and pebbles collectively known as the Stefansson Sound Boulder Patch. Growth and production of the Boulder Patch community, largely dominated by the endemic arctic kelp *Laminaria solidungula*, are regulated primarily by PAR (photosynthetically active radiation) availability during the summer open-water period. Variation in underwater PAR, caused by changes in water transparency, can have significant effects on the annual productivity of the arctic kelp bed community. However, the relationship between PAR and water turbidity (measured in terms of total suspended solids [TSS]) is poorly understood in Stefansson Sound.

During the 2001-2002 summer periods, the inherent optical properties (IOPs), including absorption and attenuation, of Stefansson Sound waters were measured in conjunction with suspended sediment concentrations for input into a radiative transfer equation (RTE). Data input to the RTE provided a TSS concentration specific attenuation coefficient (K^*_d) used in conjunction with a productivity model. Using these methods, we were able to estimate the amount of daily productivity throughout the Boulder Patch based on the known depth and the concentration of suspended solids in the water column.

The highest TSS levels (23.0 – 24.2 mg L^{-1}) were measured in near-shore areas during summer 2001 and were coincident with increased light attenuation (11.4 – 14.0 m^{-1}). Lower TSS concentrations and attenuations were measured in offshore waters overlying the Boulder Patch community during both summers. Although water column light attenuation was generally less across Stefansson Sound in summer 2002 compared to 2001, the correlation between attenuation and TSS was still significant ($p < 0.001$).

Using the calculated $K^*_{d,}$ we were able to successfully interpolate daily productivity estimates throughout the Boulder Patch based on the known depth and ambient TSS concentration. Our results clearly demonstrate that TSS concentrations were clearly more important than other factors (including water depth) in regulating open-water photosynthetic production by kelp. Highest kelp productivities generally occurred offshore areas characterized lower TSS concentrations.

Discussion

Jia Wang: Do you have vertical distributions of growth of productivity?

Ken Dunton: No, these are benthic plants so all the kelp is on the bottom. The blades are very heavy and lay on the bottom so they don't deal with that complication of attenuation or different light levels in the water column. But this same model can be used for phytoplankton

Dick Prentki: Have you seen a decrease in kelp production in the last 25 years?

Ken Dunton: No. Typically, measurements near the coast are always less. In shallow waters, they grow and produce less whereas offshore areas always seem to be higher. But we haven't seen any long term trends in decreases, which is good.

BASELINE CHARACTERIZATION OF ANTHROPOGENIC CONTAMINANTS IN BIOTA ASSOCIATED WITH THE ALASKA OCS LIBERTY AND NORTHSTAR OIL AND GAS PRODUCTION UNITS IN THE NEARSHORE BEAUFORT SEA

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The bioaccumulation of trace substances, including anthropogenic contaminants was investigated in five species of fish at a number of sites in and near the North slope oil field developments, including the Liberty and Northstar Platform areas. The fish were evaluated for whole body concentrations of polynuclear aromatic hydrocarbons (PAH), organochlorine compounds (PCBs and pesticides) and trace metals. Two biomarkers of contaminant exposure were also evaluated: P4501A in liver and gut epithelial cells and bile hydrocarbon metabolites. The fish species were: Arctic Cisco, Arctic Cod, Four Horn sculpin, broad and humpback whitefish. In general there was evidence for only slight anthropogenic contamination in some species at some sites. For example, in Four Horn sculpin there were indications at Stump Island and Bullen Point of PAH uptake and metabolism, low level contamination by some pesticides, and mercury and arsenic above low regional background levels. A variety of other trends in the data will be discussed and presented.

Discussion

Jeff Child: Did you age any fish and consider that in analysis over the course of sites and between species?

Bob Spies: Unfortunately there was no funding available to age fish, but we at least have anadromous size and age relationships in the literature for humpback whitefish. Those are interesting because most fish we picked up appear to be one and several years old–not yet reproductive. There's a whole complex movement pattern relating to fish; having the anadromous fish data to follow up more on that will be quite useful.

Dick Prentki: EPA comparisons show standards and criteria–do you have a prediction of how other fish in the area will come out in that comparison? Are ours worse or better, the same?

Bob Spies: Fish will have "better" results; PAH concentrations are about 50% of what you'd see on the national average. According to the National Oceanic and Atmospheric Administration Status and Trends report, PAH sediment data taken from the Beaufort Sea showed again, relatively low concentrations.

Tom Newbury: I think you picked up on significant site differences in regards to mercury (Hg) in two species. It was possible because cisco are inshore and sculpin and arctic cod are offshore. It's also possible because sculpin are more closely associated with the benthos; if it is a benthic/pelagic difference as opposed to an inshore difference then it would be interesting to follow that further.

Bob Spies: There was also a lot of evidence of year-to-year variability in the sediment at some of these sites. Whether that will affect the biogeochemistry of Hg and methylation of Hg or not will be interesting to consider.

Maggie Ahmaogak: In one of your conclusions you stated that PCB levels of fish were higher for Bullen Point. Is there an age difference in fishes with higher concentrations of PCBs; do younger or older fishes have higher concentrations? Is this something that might be related to the dual line pipe?

Bob Spies: In our ANOVA, we included the weight of fish to see if it explained any PCB differences in concentration. We did see a difference, which might suggest there's something in that area in terms of source low molecular weight, but this is published in a broader area by National Oceanic and Atmospheric Administration Trends and Status report. There was no difference in concentration between younger and older fishes.

FATE AND EFFECTS

A NOWCAST/FORECAST MODEL FOR THE BEAUFORT SEA ICE-OCEAN-OILSPILL SYSTEM: MODEL DEVELOPMENT AND VALIDATION

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This study is to validate a high-resolution coupled ice-ocean model using available observations and to investigate the fine structure of the ice and ocean motion, and in the near future to provide a precise prediction of ice-ocean-oil spill system. During the first year of this three-year project, a nested ocean model (3.4km) was set up (Wang et al. 2002). Numerical experiments were conducted to test the ice-ocean model sensitivity.

To validate the model, we focused on model-data comparison during the second year. We found that the modeled circulation revealed the observed Beaufort Sea coastal current and the Beaufort Gyre. Vertical temperature and salinity profile revealed the observed dense water sinking process on shelf areas. The model reproduces reasonable seasonal cycle in sea-ice concentration, temperature, salinity, water masses, and other variables. The nested model reproduces mesoscale eddies, consistent with satellite images taken in the same region. Some important processes such as winter halocline ventilation, dense water formation are well captured in the model. The towed ADCP and CTD data from JAMSTEC and other investigators are used for the validation.

During the third year, we implemented the proposed oil spill model to the ice-ocean model to establish a stand-alone ice-ocean-oil spill modeling system. The trajectory model uses a 3-D random walk model. Numerical experiments were conducted for the following topics: 1) surface oil spills with water in summer, and with ice in winter, and 2) coastal dense water formation during winter. The modeling system is ready for a further application to a nowcast/forecast operational forecast.

Discussion

Dick Prentki: On finer grid resolution for the 500 m model, do you expect to resolve eddies much better with that one?

Jia Wang: If the eddy is really big we see it. Observations show that eddies are 20 km in diameter and this is why we need to refine the model. Otherwise, you always simulate at larger scale than the observed eddies.

THE WORKSHOP ON SMALL-SCALE SEA ICE AND OCEAN MODELING (SIOM) FOR NEARSHORE BEAUFORT AND CHUKCHI SEAS

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The workshop held during August 7-9 2002 at University of Alaska Fairbanks discussed the present status and future direction of small-scale sea ice and ocean modeling, leading to a working plan for the state-of-the-art sea ice and ocean modeling. The focus of the workshop was the future ice-ocean modeling and Minerals Management Service

(MMS) needs in the inshore Beaufort Sea waters, including seasonal land-fast ice. The workshop produced recommendations on modeling approaches based on the updated advance in small-scale sea ice and ocean modeling.

The workshop had four research themes: sea-ice mechanics modeling, sea-ice dynamics, small-scale and basin-scale coupled ice-ocean modeling, and sea-ice/ocean observations. There were 32 presentations. Each theme had a rapporteur to chair the discussions and summarize the recommendations at the end of the workshop. The workshop produced approaches and recommendations for small-scale ice-ocean modeling over the next 5-10 years, which will be valuable for the Coastal Marine Institute and MMS missions and International Arctic Research Center-Frontier Research System for Global Change (IARC-FRSGC) modeling strategies. This workshop also promoted the collaboration between the US scientists, including those at IARC and Institute of Marine Science of UAF, and the international community.

The workshop has produced a working plan for the small-scale ice-ocean modeling over the next 5-10 years. The summary is as follows:

1. Although viscous-plastic (VP) ice model is generally good for the large-scale climate modeling, the recommendation is that a VP plus elastic (EVP) ice model would be better to both large-scale and small scale modeling.
2. Sea ice distribution for ridged ice and rafted ice should be used to better study sea ice of difference types (multiple categories such as new ice, first year ice, and multi-year ice).
3. Land-fast ice is crucial to the coastal processes. Thus, landfast ice models including scouring and anchoring processes should be developed. At the same time, parameterization of landfast ice is also necessary.
4. Discontinuous Lagrangian ice models such as granular models should be compared to the continuum models such as Eulerian models to find out the advantages and disadvantages.
5. As spatial scale becomes less than 10km, satellite observations show sea ice has strong anisotropic property, while most models used so far are isotropic. Thus, anisotropic models should be developed to better capture sea ice properties such as sea ice fractures, stresses, ridging, rafting, etc.
6. Coupled ocean-ice model should consider mixing of ocean tides and surface waves. The coupling of sea ice stress, convergence/divergence to the ocean should be taken into account. A turbulence closure model should be implemented in the ocean model.
7. Ocean model resolution has to be eddy resolving to resolve coastal eddies, upwelling/downwelling, dense water formation, the Arctic halocline ventilation.
8. For climate atmosphere-sea ice-ocean models with grid size larger than 10km, a parameterization of 10km processes for anisotropic is necessary.
9. Observation of landfast ice and deployment of the land-based CODAR.

Discussion

Cleve Cowles: In the pan-Arctic model, you used a 10-day averaging for your boundary condition. What was the rationale for that?

Jia Wang: We output the boundary condition to the small model. We can output every 10-step, but it increases our computation. We have to save these data for the nested high resolution model.

Frank Bercha: In an Arctic ice dynamics joint experiment carried out in the U.S. in 1980-1990, they considered a lot of these anisotropies, homogeneities in regional scale ice modeling. The Canadian Beaufort Sea Project carried out by the Department of the Environment (during early 1980s) considered the forcing effects of surface winds on ice fields and how the mesoscale interactions result from those.

ENVIRONMENTAL SENSITIVITY INDEX (ESI) CLASSIFICATION FOR THE BEAUFORT SEA AND CHUKCHI SEA COASTS

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Environmental Sensitivity Index (ESI) shoreline data are a key component of planning and response for coastal oil spills. The ESI concept is based on a classification of shoreline types according to a standard ranking scheme that has been applied throughout the United States. The central part of the North Slope coast had been previously classified by industry and this data was digitized for use in production of ESI maps for the North Slope. The eastern and western regions were unclassified and the Chukchi Sea was the last section of shoreline in Alaska that had not been mapped under previous projects. Therefore, MMS supported completion of the ESI shoreline classification for these areas, to create a state-wide, consistent dataset. The project objectives were to: (1) classify the unmapped shorelines of the Beaufort Sea and Chukchi Sea using the ESI classification scheme; (2) create digital ESI data and incorporate the data into the MMS Technical Information Management System (TIMS) Coastal and Offshore Resource Information System (CORIS) data base format; and (3) create video products from the aerial video imagery obtained during the survey.

The study involved a low-altitude video survey of the coastline to obtain digital video imagery with an audio commentary that describes the physical character of the shore-zone. This information was then used to create a shoreline classification data base for parts of the Beaufort Sea and the entire Chukchi Sea. The 2001 VTR survey generated 1000 minutes (~17 hours) of videotape. The total shoreline length Canadian border to Point Hope is 7,100 km and the entire coast is now covered by this survey combined with a further 10 hours of videotape from a prior (1994) survey between the Colville and Canning Rivers.

The ESI shoreline classification for the Beaufort Sea and Chukchi Sea coasts involved three "new" shoreline types: tundra cliffs; peat shorelines; and inundated lowland tundra. These three shore types make up 54 % of the coast (15.6, 15.5, and 22.8% respectively).

In addition to use of the ESI data for oil spill planning and response, the information can be applied to: coastal planning, permitting, and zoning; environmental assessments and impact statements; habitat protection and restoration; managed area planning and selection; and protected species management.

Discussion

Caryn Smith: In the tundra cliff, did you classify the ice-rich and ice-poor separately or were they all lumped in tundra cliff? What about the Chukchi Sea coast?

Ed Owens: In the ESI classification, the tundra cliffs are basically the ice-rich tundra cliffs. For the Chukchi, there are one or two places where it would be classified as ice-rich, but I don't recall ice-rich tundra cliffs on the Chukchi, unless maybe in the backshore lagoon areas. All tundra cliffs are ice-rich.

Tom Newbury: What's the estimated persistence of oil on the new shoreline types? A decade?

Ed Owens: It's always an estimate, but oil will stay on peat (if in a slurry), which is where oil will most likely persist for a long time. If cleaned up, it won't stay for a decade. Persistence is always a function of the amount of oil and type of oil. In this environment, there is sufficient natural microbial action that's going to take place in the attenuation of the oil. The rate of attenuation is dependent on the amount of oil; if a large surface area is exposed to bacteria it will attenuate faster than a thick layer of oil. Lowland tundra is the area to worry about. On a scale of 10, they are ranked

a 10 because they are areas to protect first and foremost. The whole aim of the scheme is to identify the high numbers, which are the ones that would then be given a higher priority of protection.

Ted Eschenbach: Do you have a table that summarizes what fraction of the coast falls into each of those categories?

Ed Owens: No, the work product is a set of maps and databases and the one thing we didn't do is generate the lengths of each particular one. If we put this into a GIS, then those numbers are generated by the GIS. If we started to generate a set of numbers from our original non-GIS shoreline, we would have been creating a number that would have to be revised, and, when you have to revise, you have to explain why you're revising. As the maps are generated by Minerals Management Service, the new set of ESI maps eventually comes out. It will be an integral part; so, at the moment no, but in the future yes.

Jerry Brown: We're working with the International Program for Arctic Coastal Dynamics and we are segmenting the entire coastline according to a modified classification based on earlier years of experience and we'll have some good numbers on classification of the Beaufort and Chukchi. It's very important to understand the permafrost dynamics and associated hazards.

PETROLEUM HYDROCARBON DEGRADING MICROBIAL COMMUNITIES IN CHUKCHI-BEAUFORT SEA SEDIMENTS

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Interest remains high in oil development off the northern coast of Alaska. An important question related to this development is "what is the fate of oil if a spill or leak occurs?" In the 1970s and 1980s several published studies examined the populations of hydrocarbon-degrading microorganisms in Arctic Ocean water and sediment. No microbial studies have been published since that time, despite the fact that extensive development has occurred since then. In 1999 (near Barrow) and 2000 (near Prudhoe Bay) we collected sediment samples from the Chukchi and Beaufort Seas to estimate the populations of hydrocarbon-degrading microorganisms and to assess their ability to degrade petroleum hydrocarbon compounds. We found populations of hexadecane (a linear alkane), phenanthrene (a polycyclic aromatic hydrocarbon), and crude oil degraders to be significantly higher in sediments collected offshore of Prudhoe Bay than those collected offshore of Barrow. However, microscopic direct counts, total viable heterotrophic microorganisms, and crude oil-degrading microbial populations were similar to those measured in the 1970s despite some methodological differences in estimating the populations. Thus, it is likely that the difference in populations between the Chukchi Sea samples and the Beaufort Sea samples is related to factors other than oil development. Interestingly, microscopic direct counts of microorganisms indicate high populations in these sediments relative to populations measured in more temperate ocean sediments, such as those in the Gulf of Alaska. We also measured the ability of the microbial populations to mineralize several model hydrocarbon compounds, including hexadecane and phenanthrene. Sediments collected from both sites had low mineralization potentials indicating that the microbial populations are not acclimated to use these substrates. Finally, we have conducted preliminary experiments to determine how some petroleum hydrocarbons, particularly polycyclic aromatic hydrocarbons, interact with sediment and how interactions with sediment might affect the bioavailability of these compounds to microorganisms that degrade them. These data indicate that the model compound, phenanthrene, rapidly adsorbs to sediments. In experiments where phenanthrene-degrading microorganisms were added at high populations to sediment/phenanthrene/seawater slurries, the presence of sediment had little effect on the ability of those organisms to degrade phenanthrene. Experiments that more closely match conditions occurring in the environment are ongoing. Microbial population and activity data are important in predicting the fate of oil should a spill occur in this environment.

Discussion

Todd O'Hara: Is there an interest to do work in deltas, rivers and lakes to see if biodegradation capacities are comparable to marine systems where there's less activity in the systems to remove oil?

Joan Braddock: We haven't yet done that but it would be really interesting to make the comparison. We need to get samples from natural seeps as well; we've done the terrestrial work, but none on freshwater in the Arctic as of yet.

Don Hansen: Did you look at Cape Simpson large oil seeps?

Joan Braddock: No, we need to do that.

Kate Wedemeyer: What temperature were the microbes kept at?

Joan Braddock: We've done nearly everything at 10°F, which is a nice compromise to get experiments done within the lifetime of a Masters student and not being so far off. It's warmer than natural temperature, but not at room temperature. We compromise a little bit and do nearly everything at 10°F .

TRACE METALS AND HYDROCARBONS IN SEDIMENTS OF ELSON LAGOON (BARROW, NORTHWEST ARCTIC ALASKA) AS RELATED TO PRUDHOE BAY INDUSTRIAL REGION

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This presentation was also given at the Barrow IUM.

A one-year study (2001-2002) in Elson Lagoon consisted of determining the concentrations of total mercury (THg) and methylmercury (MeHg) in five van Veen grab gross sediment samples from the lagoon, and a suite of heavy metals (Cu, Cr, V, Ni, Zn, Sn, As, Cd, Ba, Mn and Pb) in the mud fraction (<62 μm size) of the sediments as well as from the stratigraphic sections of a gravity core sample. Additionally, hydrocarbons (normal and isoprenoid alkanes, triterpanes, steranes and PAHs) were analyzed in three of the five gross sediments. The geochronology of the core was established by the 210Pb- and 137Cs-based methods.

The concentrations levels of all the trace metals in the lagoon are below or similar to those in unpolluted marine sediments and shales. Encompassing the past 70-83 years, stratigraphic samples show a net significant increase ($P < 0.05$) up the core in Cr, Mn and Ba accompanied by a down core decrease in THg, and no significant change in the other metals. The up core increase in the three metals may either suggest that the lagoon is getting contaminated in the metals, or may be a manifestation of up core stratigraphic changes in lithology and/or organic matter. Further studies will be required to resolve the two possibilities. At any rate, the concentrations of all the metals are below the thresholds that are known to cause adverse effect on resident benthic and demersal organisms. The overall molecular compositions of alkanes and PAHs, which are very similar to those reported in our previous study for sediments of the Colville Delta-Prudhoe Bay region, are characteristic of biogenic origin and very little petroleum input is reflected by their composition. Preliminary analyses indicate presence of small amounts of coprostanol, a sewage sterol, and coprostanone, but no Linear alkylbenzenes, a sewage tracer from household laundry. This suggests that sewage input in the sediments, if at all present, may not be important.

The trace metal data in mud from the urban-impacted Elson Lagoon were compared with those from the oil-related industrialized region of Colville Delta-Prudhoe Bay. By comparison, the Elson Lagoon muds have significantly higher concentrations ($P < 0.05$) of V, Cr, Ni and THg, and no significant difference in other metals. A possibility for the higher concentrations of the four metals in the Elson Lagoon is higher in put of natural or anthropogenic metals from local sources, and/or local focusing in Elson Lagoon of anthropogenic metal contaminants derived from Eurasia via long-distance atmospheric transport and subsequent deposition in precipitating snow and rain. The latter explanation is consistent with the report of Snyder-Conn, Garbarino and associates of relatively higher concentrations of several metals in snow samples of Elson Lagoon than Colville Delta-Prudhoe Bay region. A lack of significant ($P < 0.05$) correlations between all the trace metals and clay % in mud either suggests that the sediment granulometry is not an important factor partitioning the metals, or it is an artifact of the limited samples analyzed.

In summary, our study indicates that Elson Lagoon, as the Colville Delta-Prudhoe Bay nearshore region of the North Slope of Alaska, has remained essentially a relatively clean environment, as far as sediment hydrocarbons and trace metals are concerned, despite the accelerated anthropogenic activities there during the past 30 years. The database on the Elson Lagoon should be considered baselines for monitoring inorganic and organic chemical contaminants in the lagoon region, urban-impacted sections of the North Slope of Alaska. These data will be critical for efforts relating to ecological risk assessment of the study area in context of contaminants inputs.

Discussion from the Barrow IUM

Craig George: In regards to contaminants in the local food, how does this environment compare to others, for example, California?

Sathy Naidu: This area is significantly lower in contaminants, but it is up to you (local community) to maintain this. But it still needs to be monitored.

Craig George: Contaminants are everywhere, but they're lower here (Barrow) generally than most places on Earth. There are positive aspects to clean food and we're fortunate to have some of the best [uncontaminated] food here.

Kristen Bomengen: Have there been similar studies conducted in other parts of the Arctic?

Sathy Naidu: Yes, there have been in Greenland and Scandinavia. Siberia has increased pollutants, but you have to credit the local community and industry (here) – they have very stringent policies and requirements.

James Patkotak: I commend the industry in development of the Bay, but I'm concerned about how industry affects ocean in all activities going to the ocean through the delta. Is that affecting our seals and walruses in that area with heavy traces of metals?

Sathy Naidu: Not with the metals; maybe other contaminants, but not with metals.

BIOLOGY

RECENTLY INITIATED COASTAL MARINE INSTITUTE BIOLOGICAL/ECOLOGICAL STUDIES

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Five projects have been recently funded through the University of Alaska Coastal Marine Institute. These are all in their early stages, with, at the most, preliminary results to date. Below is a brief synopsis of the scope of some of the new studies.

Role of Grazers in the recolonization of hard-bottom communities in the Boulder Patch. Principal Investigator: Dr. Brenda Konar. School of Fisheries and Ocean Sciences, UAF.

This project is studying a kelp and invertebrate community in the Beaufort Sea, known as the Boulder Patch. It is highly atypical, since most of the bottom in the area is dominated by sand and gravel. There is a need to study the biologically productive system of this unique environment, in order to ensure its protection. This study is looking at rates of recolonization of the rocks, and the role of grazing in curtailing recovery rates. Very preliminary results are provided.

Susceptibility of sea ice biota to disturbances in the shallow Beaufort Sea: Phase 1. Biological coupling of sea ice with the pelagic and benthic realms. Principal Investigators: Drs. Rolf Gradinger and Bodil Bluhm. School of Fisheries and Ocean Sciences, UAF.

This project is looking at the diversity and biomass of sea ice meiofauna and under-ice fauna in comparison to planktonic and benthic communities, including: algal biomass in sea ice, water column and sediment, life stages of those benthic taxa that seem to depend on sea ice to complete their life cycles, and the relevance of sea ice produced particles for the nutrition of sea ice fauna, zooplankton and benthos based on stable isotope analysis. The project also will determine the relation between abundance and composition of ice biota and sediment load in the sea. Preliminary results show a clear evidence for habitat for benthic algae in sea ice, and also that sea ice algae have a distinct isotopic signature.

King and Common Eider migration past Point Barrow, Alaska. Principal Investigators Lori Quakenbush, School of Fisheries and Ocean Sciences, UAF and Robert Suydam. North Slope Borough.

The objectives of this study are to estimate passage of King and Common Eiders in spring and fall 2002-2004, compare 1996 and 2002-2004 estimates for trend, document timing of migrations, document species and sex composition of migrations and evaluate use of # juveniles returning in fall as index of annual productivity. Only very preliminary results are available, showing the timing and numbers for the 2002 count.

Breeding biology and habitat use by king eiders (Somateria spectabilis) on the Alaska's North Slope. Principal Investigators: Abby Powell, Alaska Cooperative Fish and Wildlife Research Unit, UAF and Robert Suydam, North Slope Borough.

The objectives of this project are to document the timing of nest initiation, nest success and causes of failure, nest site characteristics, rate and direction of movement of broods and to compare data collected at Teshekpuk and Kuparuk over two field seasons.

Little is known about the breeding biology of King Eiders *(Somateria spectabilis*). The western North American population of King Eiders has declined by more than 50% between 1979 and 1996 for unknown reasons. Information on the basic breeding biology of King Eiders is needed to understand the impacts of development.

Population structure of Common Eiders nesting on coastal barrier islands adjacent of oil facilities in the Beaufort Sea. Principal Investigators: Sarah A. Sonsthagen, Institute of Arctic Biology, UAF, Sandra L. Talbot, U.S. Geological Survey, Alaska Science Center, Kim T. Scribner, Department of Fisheries and Wildlife Michigan State University, Richard B. Lanctot, U. S. Fish and Wildlife Service, and Kevin McCracken, Institute of Arctic Biology, UAF.

The objectives of this work is to use microsatellite, nuclear genes and mitochondrial DNA analyses to assess levels of population subdivision within Common Eiders breeding on the barrier islands in the Beaufort Sea, assess level of gene flow in Common Eiders breeding throughout Alaska and Canada and determine relatedness of Common Eider populations in a phylogeographic context. Conclusions to date show that Common Eider populations were historically subdivided, with recent gene flow via female and male dispersal. Differences in level of population structuring between maternally and bi-parentally inherited markers suggest that females are exhibiting philopatry and males are dispersing,

Discussion

Craig George: I have a question about ice-based invertebrate systems and water column critters like copepods. We are seeing that in years of ice retreat (this is unpublished information) the bowheads tend to be heavier and girthier when we measure them in the fall in the subsistence zone. What is your opinion on the relative contribution of ice-based algal systems and the water column systems in terms of contributing to the overall biomass of zooplankton in the Eastern Beaufort Sea?

Vera Alexander: In earlier days I was convinced that the ice system was critical and the most important part with an estimated 25%, if not more of the total production. Recently it seems more likely that a lot of the production on which the bowhead whales depend, such as the large population of amphipods found nearshore, are probably water-derived rather than ice-derived. I don't know whether this is assisted by an earlier retreat of ice or not, but it seems likely that if it's mixed coastal primary production in the nearshore areas, the lack of ice is help to the pelagic photosynthesis. I think now that nearshore Arctic ice production may be important seasonally and may be important in providing input into the benthos. It may be less important in the water column processes, which may be more important for the bowheads, but this is speculation.

Cleve Cowles: Most of the studies are very new and haven't had a chance yet to achieve their goals. There is a 9th annual report available from the Coastal Marine Institute (CMI) office in Fairbanks, which summarizes the projects Vera had reviewed in her talk. Next year in February some of these talks may be presented at the CMI Research Review in Fairbanks.

MODELING THE RECOVERY RATES OF AVIAN POPULATIONS

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More than twenty species of birds are known to use the near-shore waters of the Beaufort Sea, which makes them potentially vulnerable to industrial activities associated with offshore oil and gas extraction. Industrial developments for the extraction of petroleum deposits in offshore areas along the Beaufort Sea coast are an increasingly important issue for federal and state resource managers in Alaska. New developments are underway in the Prudhoe Bay area and additional developments are proposed in adjacent areas. Detailed assessments of the potential effects on bird populations for each project are required before environmental impacts can be objectively determined. Assessments may take the form of predicted recovery and extinction probabilities and times based on the growth potential of bird populations. Population recovery is inherently dependent on population growth rate. Populations that are stable or declining may never recover from perturbation, but those populations with positive or potentially positive growth rates may be capable of recovery to pre-perturbation levels. Additionally, some species may be susceptible to suppression

of vital rates, which could prolong recovery times. Conversely, reductions in populations that are near saturation levels could result in increased rates of population growth and rapid recovery. Furthermore, stochastic effects (e.g., environmental variation) can result in variability in vital rates that contribute to population growth and introduce uncertainty about the likelihood of population recovery regardless of pre-perturbation population trends.

In 2001, the USGS Alaska Biological Science Center (ABSC) and Alabama Cooperative Fish and Wildlife Research Unit (ALCFWRU) began a research project intended to develop modeling tools that would be useful to biologists and managers for predicting the recovery and/or extinction of Beaufort Sea waterbird populations following a catastrophic-mortality event such as an oil spill. Our objectives are to: develop a generalized framework for modeling the recovery times of avian populations from perturbations; provide a compendium of the published literature pertinent to selected species of birds found in the region; develop mathematical models that are suitable for estimating recovery time and associated uncertainties; identify information requirements and gaps for modeling recovery probabilities and times; and develop a stand-alone, interactive computer program to estimate recovery rates, times, and uncertainties for selected bird populations in the region.

In October 2001, we hosted a workshop to provide input into this research effort. Participants delivered presentations on the Beaufort Sea region, available data, and a multitude of approaches for modeling populations and interpreting implications. Our goal was to provide an open discussion of approaches to population modeling for conservation and management that could set the stage for the development of modeling tools that would be of use to resource managers. The workshop participants were in agreement that matrix population models offered the best alternative to other methods considered. Additionally, studies of short-term (transient) population dynamics appeared to be a very useful framework for examining effects of catastrophes on populations. One informative type of analysis would be to compare the effects of perturbation across life-history strategies, thus allowing the development of broad management recommendations. Finally, due to the lack of data for most species, simple approaches with fewer data requirements and fewer assumptions should be favored in the development of the modeling tools. We are compiling literature on 24 species of waterbirds in habiting the region, and approaches to modeling the effects of catastrophic events on bird populations. The literature review is being compiled in an online database that combines bibliographic information, electronic copies of each reference, data on vital rates, and general information about the life cycle of each species. A theoretical paper addressing non-equilibrium population dynamics is in partial draft form and research has begun on our next manuscript, which will focus on the use of population models in spill-related injury assessment using Arctic tern and common eider as examples. With the modeling framework beginning to take shape we have established the mathematical framework for the software and selected a platform for development. At present we are assembling the available libraries of algorithms that will be used in the program.

Discussion

Tom Newbury: It's difficult to see the cumulative effects of spills for the North Slope, but the cumulative effects from "disturbance species" (they are opportunistic species) are important to look at because you can predict the effects of spills. It would also be good to study the recovery of disturbance species. That would influence perhaps to some extent the species you model. I'm glad to see that you're using the Arctic tern, perhaps not the waterbird most vulnerable to spills, but they certainly have been affected by opportunistic species. The North Slope is like the Gulf of Mexico in that it is a production area and difficult to see the cumulative effect of spills there contrasted to places where there's a lot of tankering like Galveston, Puget Sound, etc. I encourage you to orient your work toward effects of recovery from opportunistic species on the North Slope.

James Grand: The models we're working with are single species models, but I think to do what you're talking about would require us to build community-based models and have some ability to look at interactions among species–if I'm interpreting your comment correctly.

Mike Castellini: In relationship to your discussions in trying to define recovery, you could probably get help from the EVOS Trustee Council because they've had to come up with legal definitions for recovery for all their species. Also, several people on the Endangered Species Act recovery team would have definitions.

James Grand: The problem is that definitions of recovery are different between agencies, people, etc. Recovery plans for a lot of different endangered species and the definition of recovery is different in almost every one of them. A lot of that depends on trying to meet the needs of Minerals Management Service and Fish and Wildlife Service in terms of looking at recovery as well.

PROTECTED SPECIES

MONITORING BEAUFORT SEA WATERFOWL AND MARINE BIRDS

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The Alaskan Arctic Coastal Plain is home to the largest oil and natural gas discovery in North America. Recent expansion of oil and gas development into the near shore waters of the Beaufort Sea has raised concerns that wildlife using these waters (and the nearby barrier islands) may be at risk to disturbance and oil spills. Of particular concern are more than one hundred thousand sea ducks and other marine birds that use the Beaufort Sea each summer. Impacts on sea ducks may be especially important given their recent declines in Alaska and along the Arctic Coastal Plain.

In 2002, we completed the fourth season of a research program designed to assess the breeding ecology of Pacific Common Eiders (*Somateria mollissima v-nigra*) and molting ecology of Long-tailed Ducks (*Clangula hyemalis*) along the Beaufort Sea Coast of Alaska. Our study area was split into an *industrial* area slightly west of Prudhoe Bay ('Western Area') and an undeveloped *control* area 50 miles to the east ('Eastern Area').

Nesting effort by Common Eiders has declined each year of the study and was particularly low in 2002 (likely due to late ice breakup). Hatching success has varied considerably through the course of the study but has always been below that of Pacific Common Eiders breeding on the Yukon-Kuskokwim Delta. No Common Eider broods tracked by radio-telemetry were known to fledge. A mark-recapture study of adult female survival has been limited by low nesting effort and nest survival.

We used radio-telemetry to study movement, habitat use, and feeding activity of molting Long-tailed Ducks. Analysis of triangulation data shows that, in general, Long-tailed Ducks follow a diurnal pattern of feeding in the lagoons during the day and roosting along the barrier islands at night. Analysis of larger scale movement data collected by automated data-logging radio-receivers shows a high degree of movement within and among areas and years. Weather (esp., wind) is suspected to play an important role in Long-tailed Duck movements, but not in feeding patterns.

We found no support for a negative influence of disturbance on behavior or body condition in Long-tailed Ducks. They were able to meet the nutritional requirements for maintenance and feather growth from the environment. It appears that the initial mass loss may be an adaptation allowing re-attainment of flight before primary feather growth is complete.

Common Eiders and Long-tailed Ducks had lower concentrations of Pb and Hg in their blood than levels reported from sea ducks in the Yukon-Kuskokwim Delta. Accordingly we found no evidence of contaminants that may be influencing eiders at the population level. However, a die off of Long-tailed Ducks in 2000 was related to an outbreak of a previously undescribed virus. We conclude that natural variation in movements, conditions and mortality exceeds any anthropogenic effects.

Discussion

John Richardson: The air gun array used in Simpson Lagoon in 2001 was a small array. Also, because the water was so shallow, sounds would not propagate as well as in deeper water. Even so, the small array would still produce a strong sound pulse for any ducks within a reasonable distance so I'm surprised that foraging data don't show more disturbance reaction than they do. I wondered if you had looked at the any specific measures of foraging that might be more sensitive than just a percentage of time, such as diving or any other parameters.

Paul Flint: Analysis at that level is ongoing, but we haven't gotten into the details of that yet. But it's very difficult because we have individuals tagged through time, so the specific samples that are there are relatively small and you have to control for repeated sampling of specific individuals. Statistically it will be a difficult thing to represent given our sample size of marked birds within and outside the seismic area. The other thing is that they're not spending a lot of time foraging. They're losing weight and perhaps they want to lose weight. Foraging is not their dominant activity so we're trying to detect a significant change in what is a rare activity, which is going to be a difficult thing to demonstrate. I doubt we're going to be able to detect that in our data at all. We may not be able to quantify foraging behavior to a greater extent.

John Richardson: Given the negligible amount of data that exists on the reaction of birds to seismic programs, it is good to see that this project was done, and I hope you can tease out whatever information there is to find.

Paul Flint: We were surprised to a certain extent, given our observations that birds would not have left the area. It's clear that from earlier telemetry studies, birds move a fair amount to find more optimal conditions. We wouldn't have been surprised to see the birds move out of the area and see a mass movement out of the area from the west to the east. Obviously when boats were working birds were displaced from specific locations, but it didn't seem to change their overall distribution and we didn't see the mass exodus we would have expected.

Robert Suydam: In the common eider section of your talk you mentioned the storm of August 2000, the same year of the die off of long tail ducks. Is there a relationship in the timing in terms of the storm and the die off? Did the storm contribute to the prevalence of the virus and the population of the long tail ducks?

Paul Flint: The storm occurred after the die off. After we captured the birds, we attempted to minimize boating activity so we weren't out on the lagoon on a regular basis. There were several outings when we had to travel to download data loggers, etc. and started encountering carcasses and saw gulls feeding on dead birds in the lagoon. We started recovering carcasses and that's where the virus came from. So we didn't recover that many carcasses, but we spent too little time on the lagoon to give us any probability of detecting those carcasses. The storm event occurred in August essentially terminating our study, so we lost all of our data recording stations because islands eroded. All common eider broods were decimated by the storm and we essentially vacated the study area within four to five days of the storm. So all of our evidence relative to the viral outbreak and the die off was prior to the storm event.

IMPORTANCE OF THE ALASKAN BEAUFORT SEA TO KING EIDERS (*SOMATERIA SPECTABILIS*)

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The importance of the Beaufort Sea as a spring and fall migratory corridor for hundreds of thousands of sea ducks (e.g., common, king, and spectacled eiders; long-tailed ducks) and other waterbirds has been well established. However, the biology of king eiders of the Beaufort Sea is poorly known. Although their population appeared to remain stable between 1953 and 1976, a recent analysis of migration counts off Point Barrow, Alaska, determined king eiders declined 56% (3.9% year -1) from approximately 802,556 birds in 1976 to about 350,835 in 1996. Existing data suggests declines in western arctic-breeding populations of king eiders. While the importance of the Beaufort Sea for migrating king eiders has been clearly established at Pt. Barrow, little is known about the distribution and timing of spring and fall migration in other areas of the Beaufort Sea, and the relative importance of the Beaufort Sea for staging and molt.

During molt migration (July-August) and fall migration to wintering areas (August-October), king eiders move west along the Beaufort Sea coast to areas in Chukchi and Bering Seas. Eiders often follow open leads in ice on migration, and the routes and timing of migration paths are thought to be strongly influenced by weather and ice conditions. This study was prompted by the need for more information about king eider use of the Beaufort Sea during molt migration. Offshore oil leasing in the Beaufort has the potential to lead to mortality of king eiders from collision with drilling structures or from oil spills, to the disturbance of king eiders from support vehicles and drilling activity, and to the displacement of king eiders by developing foraging or staging habitat.

During the summer of 2002, we surgically implanted 21 (11 females and 10 males) with satellite transmitters at the Kuparuk oil field. Satellite transmitters were programmed to transmit signals every 48 hours for 6 hours throughout fall migration. The best location per 6 hour on cycle was used in this analysis. Molt migration was defined as late-summer migration to molting areas: these areas were defined as no long-distance movement for a period of three weeks (when eiders are flightless). Stopover and staging sites are defined as areas where individuals spent >3 days, but longer movements than would be predicted if molting

Males left the study area between 14 - 27 June, while females dispersed on 1 - 28 July. Males staged 7 to 17 days (mean = 10) and females 9 to 32 days (mean = 20) in the Beaufort Sea prior to migration. Mean water depth for males in the Beaufort Sea was 11 ± 7 m, and for females 8 ± 5 m. Mean distance to the shore was 17 ± 6 km for males and 14 ± 3 km for females. Preliminary analysis of location data suggests that Harrison Bay, Smith Point and Tangent Point are important use areas for King Eiders in the Beaufort Sea.

Males reached molting areas 22 July through 12 August. Molting areas for males included areas along the Chukotsk Peninsula, the Kamchatka Peninsula, St. Lawrence Island, and Kuskokwim Bay. Females reached molting areas 11 August through 18 September. Molting locations were similar to males', but also included areas along the Alaska Peninsula and Arctic Coastal Plain of Alaska.

Future plans include refining analysis of data and implanting 39 additional king eiders during the summer of 2003.

Discussion

Craig George: The males leave very quickly and then go off into the offshore broken ice and then we don't see them at Barrow for at least two weeks. So are they just hanging out or feeding or what? One suggestion I would have would be to get some satellite imagery.

Abby Powell: We don't know. I thought the reason they weren't seen at Barrow was that nobody was looking for them yet.

Robert Suydam: They're usually seen in mid-July.

Abby Powell: We just don't really know but we'll try to tease that out if we can. We do need better ice coverage.

Craig George: If you could get a Synthetic Aperture Radar scene that would be the best case during that staging period.

Abby Powell: The problem is that we need a lot of different coverages. It's easier to get coverages for males because they're more clustered in time than females, but the females are out there from August through September and it will be harder. We'd have to take little snap shots and look at what's happening then.

MONITORING THE DISTRIBUTION OF ARCTIC WHALES

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This presentation was also given at the Barrow IUM.

Since 1987, the Minerals Management Service (MMS) Bowhead Whale Aerial Survey Project has used MMS personnel to monitor the fall migration of bowhead whales across the Alaskan Beaufort Sea. Selected goals of the ongoing program are to: (1) define the annual fall migration of bowhead whales, significant inter-year differences, and long-term trends in the distance from shore and water depth at which whales migrate; (2) monitor temporal and spatial trends in the distribution, relative abundance, habitat, and behaviors (especially feeding) of endangered whales in arctic waters; and (3) provide real-time data to MMS and National Marine Fisheries Service (NMFS) on the general progress of the fall migration of bowhead whales across the Alaskan Beaufort Sea, for use in protection of this Endangered Species.

While some aspects have been updated from time to time, the data recorded have remained remarkably parallel (especially 1982-2002), thus permitting many one-to-one comparisons between years. Such continuous, long-term, wide-area, aerial monitoring of a large whale migration is unique. Information from previous surveys continues to be used by MMS in writing Environmental Impact Statements and Environmental Assessments. The data also augment sample sizes of marine mammals observed by oil-industry monitoring required by NMFS under the Marine Mammal Protection Act (Incidental Harassment Authorizations). Such site-specific analyses show localized deflections of up to 20 km by bowhead whales near certain types of active seismic exploration.

Using a Geographic Information System, whale sighting rates were calculated as the number of sightings per km flown for each grid cell (5' latitude by 15' longitude) while on northerly-southerly transect. Visual comparison of fall sighting rates (1982-2000) showed that in the Central Alaskan Beaufort Sea (142°W. to 155°W. longitudes) bowheads generally occupied nearshore waters in years of light sea-ice severity, somewhat more offshore waters in moderate ice years, and were even farther offshore in heavy ice years. While other factors may have localized effects on site-specific distributions, broad-area distributions of bowhead whale sightings in the central Alaskan Beaufort Sea were related to overall sea-ice severity.

An index of relative occurrence of behaviors was calculated as the total number of individual whales exhibiting a particular behavior per transect km for each grid cell. A greater relative occurrence of feeding and/or milling behaviors of bowhead whales was observed in six of the 20 years (1982-2001) near the mouth of Dease Inlet, Alaska, with similar relative occurrence of these behaviors observed in four of the six years near Cape Halkett, Alaska. There were nine other years when feeding and/or milling behaviors were noted on transect but not near Dease Inlet or Cape Halkett. In the remaining five years, neither feeding nor milling behaviors were observed on transect anywhere in the study area.

Discussion

Brad Smith: In observations west of Barrow, they suggested that the few sightings seemed to be more along the coast rather than taken off on the broad front that's often described, especially given that there's at least a possibility of some lease sales to the west. Do you have any thoughts about ever relocating the effort? Maybe possibly out of Barrow to pick up on waters west of the point?

Steve Treacy: I would suspect that if the Minerals Management Service has some serious leasing in the Chukchi Sea and a lot of industry response, you might see something like that. Historically, we have a lot of data out of the Chukchi Sea collected by our predecessors who were on Minerals Management Service contracts (Naval Ocean Systems Center in San Diego, SEACO, and SAIC) and those contractors were using the same methodology. We have a lot of data from

an historical perspective, but in a real-time context, I think it would take actual industry activity to pull us that far west again.

Craig George: In terms of the initiation of fall migration, for instance this year, we reported that there were bowheads in mid-August (15th). Do you suspect that those whales migrated across the study area before the surveys began? Or do you suspect that they were summering in that area?

Steve Treacy: I suspect partially summering. Last year we went up two weeks early to look at whales, but I doubt if they were early migrators.

Craig George: Wouldn't you need to initiate your transects earlier to determine that?

Steve Treacy: We did last year. Historically, we've focused on the migration. We feel fairly confident that it starts around first of September, which is why we've gone up there every year at that time and try to be in place and ready to go. Sometimes it doesn't start until September 10th. The beginning of a migration is a little subjective. It depends on how you define the start of the migration.

Maggie Ahmaogak: I noticed the distribution of whales was feeding around Barrow and Cape Halkett. Are you just centering on that area to tell people that is where they are mainly feeding? Or are there some farther to the east like Camden Bay?

Steve Treacy: No, that's everything we saw, including milling and feeding whales, but again, this is not a dedicated feeding study.

Maggie Ahmaogak: In this report are you showing the distribution of whales feeding off the coast of this inlet and Cape Halkett–you didn't show the ones that may have been feeding off Camden Bay or Flaxman Island, but I thought that had triggered the bowhead feeding study area.

Steve Treacy: I don't think our data would have triggered it, but those are all the feeding whales we saw on our north-south transects and that's the best set of data we have.

Maggie Ahmaogak: There are bowheads feeding off Camden Bay.

Discussion from the Barrow IUM

Arnold Brower: Where do they go in the west?

Steve Treacy: Once they pass Barrow, they go across the Chukchi Sea and on to Russian waters. Some of our data show where whales have been seen in the Chukchi. As the ice moves down farther, they stay just ahead of the pack ice.

Arnold Brower: There is no information given for the spring, but we see them from five to ten miles east of Barrow.

Steve Treacy: They're farther north from shore overall, but still close to Barrow and hunted there in the spring. Whales generally look for leads or thinner ice areas.

Craig George: In surveys in September out of Deadhorse, it has been reported that bowheads were west of Barrow in August. In terms of migration initiation, maybe you're clipping the front end of the migration.

Steve Treacy: We started ten days earlier this year. From September first is usually sufficient, but now there are more whales, so we tried starting sooner. There were also August surveys in the early 1980s that did show some sightings in that month.

John Richardson: Acoustic monitoring around Prudhoe Bay usually shows whales in the last few days of August.

Steve Treacy: Sometimes we don't see them until ten days after September, thus it's a judgment call.

Craig George: There's major feeding off of Barrow.

BOWHEAD WHALE FEEDING IN THE EASTERN ALASKAN BEAUFORT SEA: UPDATE ON SCIENTIFIC AND TRADITIONAL KNOWLEDGE

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This presentation was also given at the Barrow IUM.

The *overall objective*, as specified by MMS, was as follows: "Based both on traditional knowledge and scientific studies (existing and new), assess the importance of the eastern part of the Alaskan Beaufort Sea [EAB] as a feeding area for bowhead whales, including its importance both to individual whales and to the bowhead population." For many years it has been known that bowheads feed in the EAB near Kaktovik, AK, in late summer and fall. A 1985-86 MMS study concluded that the EAB provided only a small (but variable) part of the annual food requirements of the bowheads. Local residents and whalers thought that the 1985-86 study underestimated the importance of the EAB to feeding bowheads. A follow-up study was conducted, mainly in 1998-2000. This included close collaboration with Native groups, specific efforts to incorporate local and traditional knowledge (LTK) into the planning and interpretation of the results, and integration of previous data and knowledge with three additional seasons of biological field studies. There was extensive consultation with Kaktovik hunters, the Alaska Eskimo Whaling Commission (AEWC), North Slope Borough Dept. of Wildlife Management (NSB-DWM), and a Scientific Review Board (SRB) including both independent scientists and stakeholder representatives. Kaktovik residents were involved in plan development, fieldwork, and report review, and Kaktovik hunters allowed sampling of stomach contents and tissues of harvested whales.

Project participants included the following: *LGL Ltd.* (zooplankton and bowhead studies; energetic calculations, integration), *Applied Sociocultural Research* (local coordination and assembly of LTK), *Alaska Dept of Fish & Game* (stomach contents of harvested bowheads), *Univ. Alaska Fairbanks* (stable isotopes in bowheads and prey), *Dalhousie Univ*. (pilot study of fatty acids in bowheads and prey), *WEST Inc*. (sensitivity analyses), in consultation with the Kaktovik hunters, AEWC, NSB, and SRB.

Local and traditional knowledge (LTK) was assembled during meetings and individual discussions with local hunters and residents, including interactions during fieldwork involving Kaktovik residents. LTK and whaling records are summarized in the final report; transcripts of individual discussions are also included. LTK relevant to various technical chapters of the report is brought into each of those chapters.

Field studies of food availability were done using net-sampling and quantitative echosounder surveys of zooplankton in the EAB during September of 1985-86 and 1998-2000, providing data on geographic and among-year variation. The sampling was done from a 13-m boat, and included both • broad-scale surveys of the EAB and • specific sampling around locations where bowheads were observed feeding (and at nearby reference sites without feeding whales). The average zooplankton biomass available at locations near feeding whales was ~2 g/m3 (wet weight), much higher than the overall average in the EAB. Copepods were the dominant zooplankton taxon on a biomass basis.

Aircraft-based studies of bowheads during the five field seasons included the following: • Systematic aerial surveys to assess distribution and numbers (and their variability). • Aerial observations of bowhead behavior to derive correction factors for whales missed during aerial surveys and to characterize the frequency and nature of feeding. • Aerial photogrammetry to assess size/age segregation in use of the EAB, and to determine residence times of

recognizable individual whales. Data from MMS BWASP surveys (1979-2000) were also used; the broader areal and temporal coverage of BWASP provided important perspective. Bowheads were found to feed for an average of 47% of their time in the EAB, but average residence times were relatively short (~3.8 d).

Stomach content analyses of whales harvested in fall at Kaktovik, and at more westerly locations in the Beaufort, showed that the majority had been eating shortly before death. At Kaktovik, 83% of 29 stomachs contained food, and 39% (7 of 18) had >20 L. Copepods dominated the diet near Kaktovik.

Stable isotope analyses of bowhead tissue continue to suggest that bowheads acquire most of their annual energy intake from the Bering-Chukchi system, not the eastern and central Beaufort. This conclusion is based on the small spring-fall differences (and strong Bering-Chukchi signature) in isotopic composition of bowhead tissue, in comparison with the isotopic composition of potential prey in the Bering-Chukchi vs. eastern Beaufort areas. On the other hand, bowheads apparently have larger circumferences and more fat when leaving the Beaufort in fall than when arriving in spring, and they are known to feed for much of the summer in the Canadian Beaufort and during fall migration across the Alaskan Beaufort.

The most parsimonious (though incomplete) *seasonal feeding scenario* is this: • Bowheads feed and become "fatter" in the eastern and central Beaufort during summer and early fall. • They feed even more when in postulated richer prey concentrations occurring in fall in Bering-Chukchi water in the Barrow, western Chukchi, and perhaps northern Bering regions. • They feed little if at all in winter, such that they are thinner when they return to Beaufort in spring than when they left in fall.

In conclusion, the results show that bowhead whales feed commonly when in the EAB in late summer and early fall. The EAB is, without question, a feeding area for bowhead whales. However, few individuals linger there for more than a few days, and food availability in that area is not unusually high compared with other regions (e.g., the main summering range in the Canadian Beaufort Sea, farther east). Subject to many assumptions and approximations, it was estimated that in an average year, about 2.4% of the annual food requirements for the Bering-Chukchi-Beaufort population may be obtained in the EAB. The best estimates for the five years of study varied from 0.2% to 7.5%. Despite the uncertainties, it is implausible that the bowhead population consumes more than a few percent of its annual food requirements in the EAB in an average year. However, the EAB is more important to some individual whales that linger in the area for longer than the average residence time.

This project has been notable because of its extensive collaboration with Native groups during planning, conduct, and interpretation. Traditional knowledge was taken into account. The project provided a better understanding not only of bowhead feeding in the EAB, but also of the annual nutritional needs and feeding cycle. The methods developed and applied here could be used to assess bowhead feeding elsewhere, providing better comparative data on the importance of feeding in different areas. The results have been used in MMS's recent Beaufort Sea EIS, and will be of value for future endangered species consultations. The results will be of use to all those participating in discussions about the impacts of potential development in the EAB.

Discussion

Steve Treacy: Can you comment on what you now take to be the annual cycle of feeding by bowhead whales all across their range?

John Richardson: We know that they feeding a little as they travel up the west coast of Alaska in the spring, but it seems that they do not feed heavily then. Food availability in the spring is quite low and therefore it is not the best time of the year to feed. We know that they feed extensively in the Canadian Beaufort Sea in the mid and late summer. Summer feeding was studied in the early-to-mid 1980s. Bowheads feed for a higher percentage of their time in the Canadian Beaufort Sea during mid-late summer (about 73%) as compared with 47% of their time in the eastern Alaskan Beaufort Sea during early fall. We know from the stomach contents of whales taken at Barrow in fall, and from observations of feeding behavior, that the whales in at least some years feed intensively in areas just east of Barrow in the fall. How the amount of feeding that goes on east of Barrow compares to that in the Kaktovik area is not known. There hasn't been a detailed feeding study in the area east of Barrow, but stomachs of whales harvested near Barrow in the fall certainly

indicate that feeding is common and intensive in that area. Many whales migrate across to the northeast coast of Russia's Chukotsk Peninsula in the late fall, and feeding has been observed there. Prey availability is probably high in parts of that areas given that highly-productive Bering Sea water moves north through the Bering Strait to the southwest Chukchi Sea. Whether feeding occurs at all in the Bering Sea during winter is unknown. In any event, there is feeding across the Beaufort and Chukchi area for a period of many months. Perhaps there is more feeding in the Chukchi and Barrow areas combined, mainly in the latter part of the year, than there is in the eastern and central parts of the Beaufort in the summer and early fall. That hypothesis is the one that is most consistent with the data available at this point.

Brad Smith: Were you able to identify any physical features that might be predictive of where prey concentrate or where the whales feed?

John Richardson: In the 1985-1986 study we put considerable effort into the physical oceanographic measurements, but we were not very successful in developing an ability to predict where zooplankton is most concentrated, and therefore where bowheads feed most intensively. Why zooplankton concentrates in particular areas has not been well worked out for the eastern Alaska area. In general, the linkages from physical oceanography to zooplankton have not been very well established in this area. Given the limited results on this topic from the 1985-1986 study, we chose not to put much effort into physical oceanographic work during the 1998-2000 study. In both projects, all sampling was from a 43-foot boat, which had limited capabilities for physical oceanographic work. For the 1998-2000 project, we felt that the limited resources would be better spent on other aspects of the study.

Lisa Rotterman: With respect to the animals that tended to linger, was there anything noteworthy about them in terms of their age, reproductive class, sex?

John Richardson: We did not notice anything specific, but sample sizes weren't large enough to be very convincing on this question. The majority of the animals for which residence times were determined were young because the majority of data came from close to shore. That is where younger animals (subadults) tend to concentrate.

Mayor George Ahmaogak: I appreciate your work on the bowhead feeding study, especially in light of using traditional knowledge. For the first time we're seeing an organization like yours conducting a scientific study and from the design and collection of data taking in the concerns of local traditional groups. That is a giant step forward. Based on what you said, it's apparent to me that bowhead whales, when migrating from eastern Canadian waters, are feeding as they go along and in one central area where you did your study. Is this area, based on your conclusions, a designated bowhead feeding area or not? I ask this question because in our OCS comments in EISs, that study area near Kaktovik ought to be deferred from Lease Sale 186. And also, looking at Steve Treacy's visual observations of whales feeding right near Barrow, we're saying these areas ought to be deferred from any leasing activities, but I need to hear what your response is.

John Richardson: There's no doubt that this is a bowhead feeding area. A more general conclusion is that it is a bowhead feeding area, but there are lots of other feeding areas across the Beaufort Sea as well as the Chukchi. There may be places that are less important as feeding areas than this one, but there are probably places in the Beaufort Sea that are more important. It's not unique–the animals feed in this area and in others.

Mayor George Ahmaogak: The irony is that we're commenting on Lease Sale 186. The results of the scientific evidence here don't seem to have paid attention to local comments as well as the scientific evidence that supports what we've been saying all along. The scientific evidence now concurs with what the locals are trying to convey in Washington.

Robert Suydam: The number of whales seen per 100 km surveyed in four to five years seems large. Do you have any idea if these were large or small whales? From census work in Barrow, we've seen every 3, 4, or 5 years, a peak in the number of calves. Is there any relationship in terms of a calving year relative to what you're seeing in the eastern Beaufort? Residence times were based on photo ID work, is that correct? Also, did the six studies rely on recognizing individual animals?

John Richardson: I can't comment from memory in regards to calving years. Years when peak overall numbers were seen were mainly the years when high numbers were seen in the outer-shelf and shelf-break area, 40-200 m deep. Years

with peak numbers were not always the same when shallower water depths were considered. Residence times presented in the report were averages from six different methods, including not only the photoidentification work but also the documented speeds at which animals were moving in the area, telemetry studies by other researchers, and "whale-days" estimates from aerial surveys. There was wide variation in the results obtained from the different methods. The "overall speed", telemetry, and "whale-days" methods did not rely on data from resightings of individual animals.

Maggie Ahmaogak: When I was last in Kaktovik, the conclusion portion of the report was not to say exactly what I just saw because of the number of whales--Kaktovik is three per year. For the number of whales that were sampled from their stomachs, that was an inadequate number of whales to use and base a conclusion on, especially now for it to be cited in the EIS.

John Richardson: A number of concerns were raised at the Kaktovik meeting in January 2002, and we attempted to address these in the final version of the report. You are correct that the stomach content data from Kaktovik for each year are from a small number of whales. We would like to have more data, but only a certain number of whales are landed each year. The Alaska Department of Fish and Game, who did this part of the study, sampled every whale landed at Kaktovik during 1997 to 2000. They also used all the stomach content data available for Kaktovik from previous years.

Maggie Ahmaogak: I was alluding to the number of whales that were used given the quota that they had and that your study had Kaktovik people feeling that this was an important feeding area. Now that this report is being cited in the EIS for the lease sales for the OCS–remember that the villagers understood that the number of whales to provide such a conclusion was very inadequate and that further research needed to be done to answer that specific question. That your conclusions are being used in the EIS makes me very uncomfortable.

John Richardson: One of the important things that the Kaktovik people asked us to do was to change a series of hypotheses listed in the draft report into questions. Rather than provide a yes/no answer for each of them, we tried to estimate some measure of feeding that addressed each of those questions. For most of the questions, the answer was that yes, the Kaktovik area is a feeding area. For example, over three-fourths of the animals caught near Kaktovik had food in their stomachs. The report describes the utilization of the area rather than just concluding, yes or no, whether it is an important feeding area.

Craig George: Did you ever estimate the portion of feeding ground relative to the entire feeding area?

John Richardson: No, but when one looks at the map showing the study area as compared with the full area where bowheads are known to feed, the study area is a small percentage. Part of the problem is that we don't know all the other places the bowheads feed so we can't really say what percentage of the total feeding area the present study area constitutes. If they obtain about 2.4% of their annual diet in the study area, that may be roughly in proportion to the size of the study area relative to the total feeding area.

Unidentified: Residence times for whales was greater than 10 days-the study period was quite short-but you couldn't have caught whales that were there for two or three weeks, for instance.

John Richardson: It is true that the duration of the study each year was short—not as long as we would have liked it to be. This could lead to some underestimation of residence times when they are derived from photoidentification data. However, some of the analyses that have been applied to the residence time question are not very sensitive to the fact that we weren't there for the whole season—the "stopover duration analysis" method, for example. Travel speeds are also insensitive. I don't deny that there are uncertainties in the residence time estimates, but I don't think our estimate of the average residence time was very far off.

Discussion from the Barrow IUM

Steve Treacy: For your 'local involvement' slide, what kind of cooperation do you have with the Native groups? As you know, Minerals Management Service made a large effort to coordinate that.

John Richardson: There was local involvement in the initial planning, the field work, and the review of the draft report. Before the fieldwork began, there were meetings in Kaktovik, interviews with whaling captains and others in Kaktovik, and compilation of local and traditional knowledge. We met with the Kaktovik Whaling Captains Association (KWCA) before and after each field season. We also met with representatives of the Alaska Eskimo Whaling Commission (AEWC) and North Slope Borough (NSB). The project's Scientific Review Board (SRB) met before, during and after the fieldwork, and it included representatives of the KWCA, AEWC, and NSB. Kaktovik residents participated in local-boat surveys in August prior to the main field season, and each year a Kaktovik resident was a member of the boat-based crew that studied zooplankton near Kaktovik. Also, some of scientific field crew were based in Kaktovik, and they coordinated with the Kaktovik whalers. After the draft report was prepared and discussed with the Scientific Review Board, it was also discussed at a workshop in Kaktovik.

Craig George: In the early local boat surveys, how many whales were seen?

Michael Galginaitis: One in the last year (2000). For earlier years, a combination of weather, etc., made that effort ineffective. We also used a hydrophone and during the last year that detected whales twice.

Craig George: To address the importance of residence time, if it had started in early August, how would results change? Were results skewed by the length of the study period?

John Richardson: I don't think it would have made much difference, partly because the number of whales present in August on the continental shelf is low. However, the field seasons in 1998-2000 were limited to two weeks to three and a half weeks of aerial work. It would have been desirable to have had longer study periods, but it was just not possible during this study. Also, the photoidentification work is limited to certain weather conditions, and that is another limiting factor. Aside from the short field seasons in 1998-2000, there are other limitations in the estimates of residence times. If anything, the estimates may actually be too high.

Craig George: Would that [i.e., the short field seasons] have affected the results?

John Richardson: Not very much, because residence times were not based just on photographic re-identifications. Some of the resighting analyses were not very sensitive to duration of field season, even though it did not extend for the full duration of the migration. Also, the estimates based on speeds of travel as observed during behavioral surveys do not require observations many days apart.

Steve Treacy: Whalers asked us to hold off moving our vessel into the study area until part-way through the season—they didn't want it east of Kaktovik until after they got two of the three whales in the Kaktovik quota. That's also a reason why we didn't start work until after the whale migration was underway. For 1998-2000, we do not have photographic data for the whole season, partly because we couldn't start work until later.

Craig George: The importance of this study is based on five years of work. Some years have had significant feeding, but perhaps not disproportionate to the area.

John Richardson: Yes, the amount of feeding is variable, with more feeding in some areas and years than others. There was very little feeding in 2000, and more feeding in the other four years of feeding studies near Kaktovik. Similar studies have been conducted in the Canadian Beaufort Sea, and those show that feeding is more frequent, and over a more prolonged period, in the Canadian Beaufort than near Kaktovik. Stomach contents and direct observations indicate that there may be as much or more feeding east of Barrow as in the Kaktovik area. Feeding has also been observed near the Russian coast in late fall. The Kaktovik area is a feeding site, but it is apparently not unusual relative to other sites.

Craig George: It's hard to reconcile the isotope data, but how much of the total energy do they get from the eastern Beaufort Sea (including Canada)? Food has different signatures in different ranges; if [only] 10-26% is from the Canadian [and eastern Alaskan] Beaufort Sea [, as the isotope data suggest,] then the question is what are they doing there? If they're filter feeding the entire time, how much food is gained during that period?

John Richardson: That has been calculated in the report based on the available bowhead and zooplankton data for the Canadian and eastern Alaskan Beaufort Sea, but there are no data on feeding during the early part of the summer. Also, there are more analyses that could be done with the available energetics data.

Craig George: Whales of certain size are about two tons lighter in spring than they are in the fall (in spring they're lighter). They gain a significant amount of weight in summer, indicating a significant amount of feeding.

John Richardson: Yes, they gain some weight while in the Beaufort during the summer based on your measurements of whales harvested in spring and fall, and on our aerial photographs of whales in spring and fall. From the photos we can also measure their girths in each season as a function of whale length, and this method also shows that they are "fatter" in late summer and early fall than in spring. But maybe they gain even more weight later in the fall; by the time they get to the Bering Sea in the late fall, they may be "fatter" than when they are leaving the Beaufort in the early fall. That might be expected because zooplankton are believed to be especially abundant in the areas where bowheads feed near the Russian coast in late fall. This possible weight gain in late fall has not been studied. If much feeding occurs in late fall in the Chukchi Sea, that could help account for the isotope data showing that most bowhead food comes from Bering-Chukchi water (possibly including the area just east of Barrow). Most other whales do not feed very much in the winter. If that is true of bowheads, that might account for them being "thinner" in spring when returning to the Beaufort than in fall when leaving the Beaufort.

Arnold Brower: Once we had a gathering in Greenland. They have seen some bowheads.

John Richardson: There is a Davis Strait/Baffin Bay population of bowheads, but there is a gap in the central Canadian arctic where the two populations don't meet. The population occurring west of Greenland has not recovered from commercial whaling.

Arnold Brower: I noticed a difference in texture of the blubber. It's pink in color on the blubber when the whales come back in the fall. Is there a change in their food? The ones in the spring have a smooth texture and taste better.

Waska Williams, Jr.: Have you used satellite tags?

John Richardson: We have not, but other researchers have placed satellite tags and UHF radio tags on some bowheads in the Canadian Beaufort Sea. Satellite-tagged bowheads have been tracked as far west as the Chukchi Sea. A few UHF-tagged bowheads have been followed by aircraft from the Canadian Beaufort Sea into the Alaskan Beaufort. We used the results from both of those studies to help determine the duration of stay in the eastern Alaskan Beaufort.
John Richardson: We have UHF tags on several whales in the Canadian Beaufort and followed them by airplane across the Alaskan Beaufort Sea. Some Canadian bowheads were tagged and followed to the Chukchi.

Steve Treacy: Six different methodologies were used to determine the residence times.

REFERENCE MANUAL AND GIS GEOSPATIAL DATABASE OF OIL-INDUSTRY AND OTHER HUMAN ACTIVITY (1979-1998) IN THE BEAUFORT SEA

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The objective of this study was to compile detailed information describing the locations, timing, and nature of oil and gas related and other human activities in the Alaskan Beaufort Sea between 1979-1998. Information obtained is stored in ArcView shapefiles and a Visual Foxpro database.

An important objective is to compile a spatial and temporal GIS database that can be used to document the occurrence of seismic survey, drilling, oil and gas support vessel activities, and other activities which may have an effect on the behavior of marine mammals, especially the bowhead whale. Such an analysis requires an adequate level of detail. This effort included the search of archives of both public and proprietary documents and data sets. The majority of the data in the database relate to drilling activity ice management, and seismic survey activity. The main sources for information were: Common Depth Point (CDP) surveys conducted under Federal OCS permit, geohazard surveys for Federal OCS wells, USGS geophysical surveys, and daily drilling reports for Alaska Beaufort OCS and State of Alaska wells.

With the exception of ice management activity, the compiled information on oil and gas activity for the period 1990 to 1998 is relatively complete and considered adequate for the statistical analysis of covariance of factors potentially affecting bowhead whale behavior. There are significant gaps in the data for the period 1979 to 1989, and for other human activities during that period.

Due to the inclusion of the CDP seismic survey navigation data, the reports and databases from this study are considered proprietary. The Alaska Environmental Studies Program (ESP) is working toward the potential release of volume 1, which contains a summary of the result

ANALYSIS OF COVARIANCE OF HUMAN ACTIVITIES AND SEA ICE IN RELATION TO FALL MIGRATIONS OF BOWHEAD WHALES

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The objective of this study, as defined by MMS, is "…to estimate the relative importance of the effects of development-related and environmental factors on the distribution and/or density of bowhead whales in the vicinity of oil- and gas-related developments in the central Beaufort Sea."

The approach involves use of relevant data from several existing sources, including (1) the Human Activities Database (HAD) for the Alaskan Beaufort Sea, prepared during a previous MMS/LGL project (see summary by P. Wainwright); (2) MMS's Bowhead Whale Aerial Survey Project (BWASP-see summary by S. Treacy); and (3) various

site-specific aerial surveys sponsored by industry. Multivariate statistical analyses will be applied to characterize the probability of sighting bowhead(s) at a given location in the Alaskan Beaufort Sea during late summer and autumn in relation to:

- proximity of various specific industrial activities;
- proximity of whaling (insofar as this is documented);
- ice conditions;
- spatial and temporal factors such as location, date, distance offshore, depth;
- factors affecting sightability, including sea state, visibility, etc.

Logistic regression (with refinements) will be used.

This project has been planned as a two-phase effort: Phase (1), which is underway in FY2003, includes planning the analyses and developing the statistical approach, organizing the data from one season, and testing the statistical approach on one season's data. Phase (2), which is planned for FY2004, will include organizing the data for additional seasons in the 1990-1998 period, applying the multivariate analyses to the multi-year database, and reporting and publishing the results. MMS will decide whether to proceed with Phase 2 depending on the outcome of Phase 1, which is effectively a pilot study.

Discussion

Craig George: Given the uncertainties in the database, it seems that the analysis is going to be messy. It's going to be difficult to tease out environmental effects from natural changes in whale distribution from industrial effects and it would warrant a power analysis, but can you give a general idea of how to handle missing data and those sorts of things to be able to conclude anything?

John Richardson: In the 1990s, not a lot was missing. The limited records of ice breaking are a problem, but we already know generally where it has occurred and when. We can get some limited information for each day about whether or not ice breaking was occurring around the drill ships. That information is not in the human activities database right now, but it will be incorporated. The data on ice breaking are less adequate than we would like, but there is useable information so it is not a fatal flaw in the overall analysis. Other than that the only concern for the 1990s is the possibility that there may have been a few seismic surveys in state waters for which records are unavailable. If there were any surveys of this type, there were very few and they were close to shore (in state waters). Any missing data of this type would not affect a very large fraction of the time or area, so we're not overly concerned. We would like to use data from the 1980s because the many additional aerial survey data from that time would, if used, increase the power of the statistical analysis. However, too much of the human activity in the 1980s is at this point undocumented. The logistic regression approach we are planning is very flexible in its ability to accommodate different levels of survey effort. It will be a complicated analysis, but some of the most relevant questions have been studied before. These questions include as how seismic surveys, drillships, ice, etc., affect whale distribution. We have a good idea of what to expect from the more comprehensive analyses now planned.

Maggie Ahmaogak: There are too many inadequacies. You're going to have a lot of missing information for years that are expected to come up with some kind of variance. What major question are you trying to answer with this project? What kind of time frame does this project have? Is this information geared towards providing more citings to the EIS for the lease sale?

John Richardson: We are trying to sort out the influences of many different factors that we know or suspect are affecting bowhead whale occurrence and distribution in various areas. We know that bowheads are affected by natural factors like ice, seasonal progression, and various industrial activities. In the past, the effects of those factors have been studied one at a time. However, that type of analysis has limitations because several factors often change from one time to the next. This makes it very difficult to be sure which factor is causing any change in whale abundance that one might see. The purpose of the new analysis is to try and look at all these factors together, combining them into one overall analysis that takes into account the variety of factors that are suspected to affect the bowheads. From the multivariate analysis, we hope to be able to determine which factors are more and less important in affecting the likelihood that a bowhead

will be found at a particular location. This will include analyzing the effects in terms of distance from industry, duration of exposure, etc. Phase I is to be finished by September 2003. Phase II might be completed a year after that if the Minerals Management Service decides that it is worthwhile to proceed with Phase II after reviewing results from the initial work.

Charles Monnett: Any report released to the public is citable by anyone. At this point some major issues need to be resolved over the proprietary nature of the industry databases and how many of them can be released, but MMS is working through that. Right now this is a very active project, but it is still an uncertain project and the products are uncertain at this point.

Brad Smith: For the seismic data, is it probable that in those data from the 1980s that they would have the size arrays and source levels or would you only know that they operated?

John Richardson: The airgun array characteristics are documented in publicly-available reports for some but not all of the seismic projects in the 1980s. However, for the kinds of analyses we need to do, data on the characteristics of the airgun array are less important than just knowing for sure whether or not there was a seismic survey at a particular nearby location at the time in question. One of the main problems with data concerning seismic surveys in the 1980s is that we often have records of the locations of the seismic lines, but do not have records of the specific times when those lines were surveyed. For the planned analyses, it doesn't do much good to know where the seismic survey occurred if we don't know when each seismic line was surveyed. That is one of the main reasons why data from the 1980s are not likely to be very useful in the planned analyses.

BEHAVIOR OF RINGED SEALS AND RE-INTERPRETATION OF AERIAL SURVEYS

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Ringed seals spend much of the year hidden from view in snow caves (lairs) on the shorefast ice of the Arctic Ocean. Each spring, as the snow melts, seals abandon their snow caves and rest on the surface of the ice. In the past, aerial surveys have been used to relate seal numbers to ecological variables and industrial activities. Aerial surveys, however, count an unknown proportion of the population that is visible on the surface of the ice and assumes that the proportion does not change over time.

We are testing the implicit assumptions of aerial surveys and investigating how the proportion of visible seals changes over time and between years. The results will be used in a reanalysis of past ringed seal surveys.

From 1999-2002, we tagged 48 ringed seals (8, 10, 14, 16 respectively) in Prudhoe Bay. During May and June each year, we recorded hourly the proportion of tagged seals in the water, hidden in snow caves, or visible on the surface of the ice. The proportion of tagged seals that were visible 1) had a strong diurnal pattern, peaking at 3:00 pm and 2) was highly variable, changing from as much as 100% to 13% by the next day. Lastly, the timing of lair abandonment varied greatly from year to year.

In 2001 and 2002, in conjunction with the Jet Propulsion Laboratory, we found that spaceborne Ku-band scatterometer data were sensitive to snow deterioration and remotely indicated the timing of lair abandonment. We are continuing to test the utility of scatterometer data and we plan to model the effects of environmental covariates on the proportion of seals visible. The model will then be used in a reanalysis of previous ringed seal surveys.

Discussion

Steve Amstrup: In picking the timing for aerial surveys it is my understanding that you have to avoid the time after snow has completely collapsed because then the surface of the ocean becomes gray and/or black. And even if the seals are hauled on it, they are difficult to see. How do you deal with that in your model?

Oriana Harding: That is correct. There is a time between when snow caves are abandoned and before that real wetness occurs. There is a better time for surveys, but we won't know that each year unless we can be remotely signaled when the snow caves are abandoned. However, that would also be difficult because then the survey crews have to be sitting out there waiting for the melt to occur.

Ted Eschenbach: Would you be able to adjust numbers by observing where you are in the cycle though, so it wouldn't matter?

Oriana Harding: That might be something we are able to do. I have a sense that when seals are in lairs, on the surface or in water, it might be more difficult to do that because of that rapid change. Maybe if it happens earlier or later, but in the transition when seals are abandoning their snow caves it would be very difficult.

DETECTING DENNING POLAR BEARS WITH FORWARD LOOKING INFRA-RED IMAGERY (FLIR)

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Polar bears give birth in snow dens in mid winter, and remain in dens until early spring. Survival and development of neonates is dependent on the stable environment within the maternal den. Petroleum related activities currently span approximately 200 km of the Alaskan Beaufort Sea coastal area. New and proposed developments are expected to dramatically expand the area influenced by petroleum activities. These activities are a potential threat to polar bears, especially as they might disturb denning females.

In order to help manage and mitigate potential disruptions of polar bear denning, we tested whether we could detect heat, rising through the roofs of maternal dens, with forward-looking infrared (FLIR) viewing devices. We tested detectability of dens by flying transects, over habitats known to hold dens, with FLIR equipped aircraft. We recorded flight and weather conditions at each observation and tallied whether or not the den was detected.

Eight previously unknown dens were discovered during searches for 15 dens of radio-collared bears. We surveyed the 23 dens on 67 occasions (1 to 7 times each). Four dens were never detected (17%), but 3 of those only were visited under marginal conditions. Nine dens were always detected and 10 dens visited more than once were detected on some flights and not on others. Conducting survey flights only during conditions favorable for detection should result in detection rates substantially higher than the 83% we experienced during our tests. For every one degree (C) increase in Temperature Dew-point spread, the Odds of detecting a den increased 3X. We were 4.8X more likely to detect a den when airborne moisture (snow, blowing snow, fog etc.) was absent than when it was present, and we were approximately 28X more likely to detect a den at night than we were after sunrise. Our data suggest some dens never will be detectable with FLIR. Conversely, we feel FLIR surveys conducted during conditions that maximize odds of detection will locate most dens most of the time and can be an important management/mitigation tool.

Discussion

Mike Williams: Is there any value in trying to put the day after the blizzard into the model to help explain some of that? Or is there any point in trying to include the day after the blizzard so as to tease out the deterioration of snow from the surface?

Steve Amstrup: There may be a value in it, but I'm unsure if we have the data recorded in a way that we can make use of it. In the univariate analysis, the mean wind speed for times we didn't see a den was only 10 knots, but it doesn't take very much wind to actually create this blowing effect. We must look to see if we can make use of it.

Craig George: We've used FLIR to look at bowheads, specifically to look at the temperature signal coming off the animal's back instead of the flukes. We couldn't see them at all–they were invisible with the same instrument. We could see eiders, muskox, but not the whale. I wonder if that was an (this is open water) effect of water vapor screwing up the signal?

Steve Amstrup: Well, it certainly could. In fact, moisture in the air was a factor that the manufacturers of the instrument warned us about, so we suspected that it was going to be an important variable. Moisture in the air could have negative effects on detection. I wonder if the countercurrent blood flow system in whales, when submerged, wouldn't still be in play if they're just sitting at the surface just breathing. That may have something to do with it.

Craig George: That was the obvious conclusion–that their skin was at ambient temperature, but still, the instrumentation is very sensitive and you'd think it'd pick something up. Unless they raised their flukes they were absolutely invisible. Is it worth trying in the spring when the air is drier and there's less water vapor?

Steve Amstrup: I would think that may be useful. The density on sea ice is very difficult to see because in the winter time, the sea is relatively very hot compared to the air so any cracks, fissures, seal holes, etc. create a mosaic of different temperatures. But you couldn't be sure if you saw a den because there are so many other targets that looked similar, so early on we abandoned the idea of trying to use this for looking for sea ice dens. Fortunately most of the dens likely to be influenced by human activities are on land.

Steve Treacy: Are you aware of any next generation FLIR, or something like it, that will be worth testing as well?

Steve Amstrup: My understanding is that they are continually upgrading these devices. A different kind of sensor array is available. We tried to test that unit, but it froze up on the first day out. The internal instrumentation froze in -15°F and it was supposedly good to -40°F.

THE USE OF SEA ICE HABITAT BY FEMALE POLAR BEARS IN THE BEAUFORT SEA

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This presentation was also given at the Barrow IUM.

Polar bears (*Ursus maritimus*) depend on ice-covered seas to satisfy life history requirements. Modern threats to polar bears include oil spills in the marine environment and changes in ice composition resulting from climate change. Managers need practical models that explain the distribution of bears in order to assess the impacts of these threats. We used stepwise procedures to create resource selection models of habitat use for radio-collared female polar bears in the Beaufort Sea. Sea ice characteristics and ocean depths at known polar bear locations were compared to the same features at randomly selected locations. Models generated for each of four seasons confirmed complexities of habitat use by polar

bears and their response to numerous factors. Bears preferred shallow water areas where ice concentrations were > 80 % and different ice types intersected. Variation among seasons was reflected mainly in differential selection of ice stages, floe sizes, and their interactions. Water depth, total ice concentration and distance to the nearest interface between different ice types were significant terms in models for most seasons. Variation in ice stage and form also appeared in three models, and several interaction effects were identified. Habitat selection by polar bears is likely related to prey abundance and availability. Use of habitats in shallow water possibly reflects higher productivity in those areas. Habitat use in close proximity to ice edges is probably related to greater access of prey in those habitats.

Discussion from the Barrow IUM

Todd O'Hara: In regards to young ice, could it be that over the year the proportion that is young is changing and that 30 cm, which is most of the young ice, is extremely thin and wouldn't support a polar bear?

George Durner: It may be important habitat to them. Maybe they have a better chance of catching seals there, but they still need some refuge habitat. Models are complicated because it's not a simple thing what/where polar bears are looking for. There are a number of variables a polar bear needs to consider.

Craig George: Did that include denning females? Were the free ranging bears all females?

George Durner: Yes.

Harry Brower, Jr.: What percentage were males or females out of the 53 bears tagged? What was the number that would have been affected by the oil spill?

George Durner: All bears were females because the males' necks are too fat, and we're assuming that the movements of males are similar to that of the females. To answer your second question, this is a hypothetical oil spill scenario–just a demonstration. We did do a similar type of analysis based on a separate data set to see how many bears are affected. But the sole purpose of this study is to show the capabilities of GIS.

Steve Treacy: In the event of a real spill, a lot of changes occur from day to day, hour to hour, but that wouldn't show up as an overlay. It needs an entire profile along the spill path over about 24 hours to see how many bears would be affected or how many other animals would be affected or would respond as well.

George Durner: Yes, in the event of a real oil spill, you need a 24 hour survey. The response to a spill may be an attractant due to curiosity.

Cleve Cowles: Is it reasonable that there were outliers, clusters that weren't explained by ice alone. Maybe other variables involved in the distribution of polar bears on ice. The resolution of the data is a shortcoming, but gives us an index of the habitat. Some locations are occurring as a cluster farther offshore than the color shading representing the average over three. It maybe useful to show annual data.

Craig George: A dead whale stranded could be a polar bear magnet and could mess up selection functions.

John Richardson: Despite the outliers, there seems to be a good match in terms of predictions and where the polar bears really settle. The data set is independent.

George Durner: It's not the same function. We do have data available prior to 1997, and we use that data in order to make those assessments. The ice systems in the early 1990s and late 1980s are different than now, so we're curious to look at that.

Harry Brower, Jr.: If male bears are tagged would that be different?

George Durner: We have very little data on males. We're making a big assumption that females are representative of males as well. In 1992, we radio collared a female that came within two degrees of the North Pole.

Harry Brower, Jr. Male migrations do occur. They have gone beyond 76°.

Todd O'Hara: Hunters, while spring whaling, notice a higher proportion of male bears in the spring challenging for whale carcasses.

Steve Treacy: Have you considered subcutaneous tags?

George Durner: In the late 1990s, they provided limited information on movement rates. They require an external antenna and the technology is prone to mechanical failure.

SATELLITE TRACKING OF EASTERN CHUKCHI SEA BELUGA WHALES IN THE BEAUFORT SEA AND ARCTIC OCEAN

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Beluga whales occur in northern and western Alaska and are important for subsistence to many Alaska Native hunters. Despite this importance little was known about the movements and distribution of belugas from the eastern Chukchi Sea prior to the initiation of this study. Much was known about the distribution of belugas in coastal waters during portions of the summer but little was known during the rest of the year. Satellite tagging provides a means to determine beluga whale distribution and movements outside of coastal summering areas.

With the assistance of subsistence hunters at Point Lay, Alaska, we live captured and attached satellite tags to 23 belugas between 1998 and 2002. We captured and tagged 12 adult males, 2 adult females, 4 immature males and 5 immature females. Timing of captures was associated with the annual drive hunt that occurs in late June or early July. Hunters drove belugas from the Chukchi Sea into Kasegaluk Lagoon. Not all of the belugas that are driven into the lagoon are hunted. Thus the belugas that remain in the shallow lagoon provide an opportunity for capturing and tagging. We tracked the movements of the whales from capture until the transmitters ceased functioning, from 2 weeks to approximately 5 months. Movements of the belugas were tracked through NOAA satellites and data were provided through the ARGOS system.

The animals we tagged spent much of the summer in the Beaufort Sea and the Arctic Ocean north of the Beaufort Sea. Male belugas moved the farthest north and east during July and August. Female and immature belugas tended to stay over the outer continental shelf or near the shelf break but did not use coastal waters. Data were received from three belugas until December. All three of these belugas passed south through the Chukchi Sea and through Bering Strait. There were located north of Saint Lawrence Island or west of the Seward Peninsula at the time their tags ceased transmitting.

Belugas from the eastern Chukchi Sea use much of the Beaufort Sea, the Arctic Ocean north of the Beaufort Sea, and portions of the northern Chukchi Sea during the late summer. Many of the adult males traveled farther north than expected and utilized very deep, ice-covered waters. Females and immature animals tended to remain along the shelf break or close to the break during the summer. The extent of use of the Beaufort Sea was surprising as belugas occurred throughout the sea with the exception that coastal areas were little used. We do not know why belugas travel into such deep and ice-covered waters during the summer but they may seek out large schools of cod or other sources of prey.

Discussion

Don Hansen: What type of ice was in the 90% ice area if not old ice floes? Because the old ice floes have keels on them and that may have been something they were keying in on.

Robert Suydam: We haven't characterized ice that far north, but without a doubt there is old ice, undoubtedly they did have to deal with large pans of old ice. They were obviously able to navigate through the ice and find breathing holes.

Don Hansen: I'm not concerned with breathing holes, but keels, places where there may be Arctic cod productivity–something they may key in on as a source for food. How much do Arctic cod like old versus new ice, or relatively young first year ice?

Robert Suydam: I have seen video of Arctic cod hanging out in cracks of ice or relatively young, first year ice. There's no doubt that there are a lot of Arctic cod out there; whether the population is dense enough or if belugas are able to get them is still up in the air.

Mike Williams: The first year you had all adult males, the second year all males went north, but did the immatures go north as well? The next year it was all immatures and females so without a male there are you confident that this is just a year to year phenomenon when going well offshore, or is there some segregation?

Robert Suydam: There is some segregation. The first year we had a small female that basically hung out 40 to 50 miles north of Barrow, but in 2001 we caught some adult males when they mostly hung out in the shelf break in the western Beaufort Sea. So I think what's going on is that in 1998-1999 belugas that were driven into the lagoon were the first that came by. There is traditional and scientific knowledge that the first group of a stock that comes in is essentially a bachelor herd of belugas. The 1998-1999 hunt consisted almost entirely of males (45 males, 5 males that we captured and tagged in those two years), in 2001-2002 the hunt happened later in the year, so it probably wasn't the first group to appear, so breeding females were coming through–probably breeding males and immatures as well. I really think it's a sexual difference. It's analogous to sperm whales in the Antarctic, where the bachelor herds go much closer to the poles while the females and young stay closer to the Equator.

Chuck Monnett: It's possible we're overexploiting or nearly overexploiting the patience of hunters, and it may not be feasible to do this work in the near future. Can you give insight to interactions there and where you might think the best potential would be to do additional work of this type?

Robert Suydam: As mentioned before, the only reason we were successful is that the hunters were enthusiastic and interested in movements of the belugas. They've been very tolerant of us scientists since I've been going to Point Lay in 1990. Most of the work has been collecting biological samples from subsistence animals. So when we started in 1996 people were enthusiastic, but over a few years, people starting to be less enthusiastic about us attaching transmitters to the belugas. I think it would be possible to go back and tag again (in Point Lay), but a lot of the elders and hunters say maybe take a break for a while. We have tags on 23 belugas and I don't know if we'll learn much more about the Eastern Chukchi Sea stock of belugas with the technology that we have now. If we can keep tags on for a year, I'd be enthusiastic in going back to Point Lay and asking to tag again, but don't think we'll gain much more by tagging right now. We need to change the tag design or attachment design. There is a new paper out on using belugas as oceanographers, i.e., attaching CTDs to them and sending that information back through satellites. That may be another good reason to go back to Point Lay and capture belugas, get oceanographic data there from the Chukchi and Beaufort Seas. In terms of other places to capture, I don't think there are other places to capture this stock; it would be difficult unless we knew where this stock was moving at certain times of the year. Other stocks we know about are in Bristol Bay according to the Beluga Committee at National Marine Fisheries Service and Department of Fish and Game. There's a possibility of tagging in Russia, and try to get eastern Beaufort sea stock as it comes back by in the fall time. We have lots of options.

USGS ALASKA TISSUE ARCHIVAL PROJECTS: AN UPDATE ON FY02 ACTIVITIES

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The banking of environmental specimens under cryogenic conditions for future retrospective analysis has been recognized for many years as an important part of environmental monitoring programs. Since 1987, the Alaska Marine Mammal Tissue Archival Project (AMMTAP) has been collecting tissue samples from marine mammals for archival in the National Biomonitoring Specimen Bank (NBSB) at the National Institute of Standards and Technology (NIST) in Gaithersburg, Maryland, USA. The USGS, Alaska Biological Science Center (ABSC), the NOAA Fisheries, Office of Protected Resources (NMFS), and the NIST conduct this partnership project, which began under the Mineral Management Service (MMS) Outer Continental Shelf Environmental Assessment Program. MMS remains the primary client agency for the AMMTAP providing programmatic guidance and review. The purpose of the project is to collect tissue samples from Alaska marine mammals and to store these specimens under the best conditions so that they can be analyzed for environmental contaminants and other constituents. A substantial part of the sample collection is from Arctic species and, since most of the animals sampled are from Alaska Native subsistence harvests, the project relies on cooperation and collaboration with several Alaska Native organizations and local governmental agencies.

Although a substantial amount of recent research has been conducted on contaminants in Alaskan marine mammals, few data exists on colonial seabirds nesting in Alaska. Like marine mammals, seabirds are an important group of upper trophic level marine organisms with a potential for accumulating lipophilic contaminants and are identified by MMS as species of interest for monitoring activities. More than 95% of the seabirds breeding in the continental United States nest at colonies in the Bering and Chukchi seas and Gulf of Alaska (see USFWS 1992). Realizing the value of colonial seabirds in environmental monitoring and the lack of recent data from Alaskan seabird colonies, the U.S. Fish and Wildlife Service Alaska Maritime National Wildlife Refuge (USFWS-AMNWR), the U.S. Geological Survey Biological Resources Division (USGS-BRD), and the National Institute of Standards and Technology (NIST) initiated the Seabird Tissue Archival and Monitoring Project (STAMP) in 1998. The project was designed as a 100-year-long program to monitor long-term trends in environmental quality by collecting eggs at nesting colonies using standardized protocols, banking the egg contents under conditions that ensure chemical stability during long-term (decadal) storage, and analyzing subsamples of the stored material to establish baseline levels for persistent bioaccumulative contaminants (e.g., chlorinated pesticides, PCBs, mercury).

Discussion

Steve Treacy: If other lines of PAH analysis or exposure to petroleum analysis are developed–your program has a very rigorous collection/transport and storage protocol–would they be able to easily adapt to collecting additional tissues?

Geoff York: Yes, it's quite easy for AMMTAP to adapt. We've been working with National Marine Fisheries Service and National Oceanic and Atmospheric Administration on formalizing the blood sampling protocol, particularly with polar bears, which we do quite a bit of live capture with. We're actively looking at blood; bile is of interest, but has a very quick degradation.

Todd O'Hara: The U.S. Department of Agriculture has new regulations–how is that going to impact this program because they're obviously worried about terrorist activities and moving fresh biological samples across the country. Is there going to be something within Alaska where this will be relaxed because this is also going to impact subsistence user when they move food? The bottom line is that we're going to be regulated and costs are going to go up, and I think your program will suffer because of the way rural Alaska has been contributing samples that haven't been heavily regulated–other than having permits in place. But now biological samples in general will be regulated by Homeland Security and the United States Department of Agriculture is coming up with new strict guidelines as to how we can move them. Furthermore, because communities are going to use air travel to move samples, I think we'll have a problem and we need to address this problem.

Geoff York: It sounds like something we'll have to address with our other agency partners like National Oceanic and Atmospheric Administration, and possibly at the congressional level to seek some sort of in-state exemption, but not I'm not sure where United States Department of Agriculture is headed.

Cleve Cowles: Can you characterize the proportions of the collection of Cook Inlet versus the Arctic and your recent efforts for collections in Cook Inlet?

Geoff York: In general, 80% of the samples collected by AMMTAP are from Arctic regions, primarily related back to OCS interests in the Beaufort Sea, historically in the Chukchi and maybe Chukchi in the future. Sampling has been sporadic in Cook Inlet with belugas in part because of the decrease take. We are working with new partnerships and folks associated with Chugachmiut, Southern Cook Inlet, Nonwalak(?) to look at Steller sea lion and harbor seal sampling and working with the U.S. Fish and Wildlife Service to increase sea otter sampling 2003-04.

Todd O'Hara: From the North Slope Borough perspective, the archive great. But when you talk about oil spills, those probably aren't the appropriate tissues. So when they were forced to do PAH analyses on these tissues, these weren't surprising results. Getting back to adapting a program to an issue, if you look at oil spills, tissues such as GI, mouth, lungs, skin, epidermis are important, but liver although very good at metabolizing hydrocarbons, unfortunately is not the place to focus on. It would make more sense to adapt the program to become more of a spill response perspective as opposed to a biomagnification one. The sampling strategy should probably change, as blubber and liver don't always work.

Craig George: Are you saying that these archive samples aren't useful for any DNA analysis?

Geoff York: Not at all. Bowhead liver tissue samples were deemed too degraded for DNA adduct analysis, which takes 3-12 hours to get samples from the animal and that's too long of a time period. Other samples, like ringed seal, were very high quality and they were useful for that analysis. So it looks like the smaller animals–species that we can access more quickly–and some other animals will be useful for adduct DNA analysis. Other animals with no exposure to PAHs don't take as long to extract and get tissue from.

Todd O'Hara: In regards to adducts, some carcinogens and chemicals are reactive and bind DNA. When you isolate DNA you look for the adducts because that's a monitor of exposure, but DNA is also a target for toxicity so it's a good thing to look at how suitable tissues are for DNA adducts. Actually the macromolecules attach to DNA and of course, that's bad for DNA.

DEMOGRAPHY AND BEHAVIOR OF POLAR BEARS FEEDING ON STRANDED MARINE MAMMAL CARCASSES

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Polar bears spend most of their time on drifting pack ice and feed primarily on ringed seals (*Phoca hispida*) and bearded seals (*Erignathus barbatus*) (Stirling and Archibald 1977; Smith 1980). In Alaska, polar bears have also been observed feeding on stranded marine mammal carcasses during fall months while traveling along the coast and barrier islands of the Beaufort, Chukchi, and Bering seas (U.S., Fish and Wildlife Service 1995, Kalxdorff 1997). Marine mammal carcasses may be an important food source for polar bears, particularly if polar bears are nutritionally stressed.

An increase in polar bear numbers occurring along coastal areas, as well as more protracted use of the coastline and barrier islands of the Beaufort Sea has been noted in recent years (Amstrup 2000). The near shore environment is an area that is subject to increasing oil and gas development and other anthropogenic activities. Recent estimates of mortality of polar bears due to potential oil spilled from off shore developments (Liberty Draft EIS) suggest that oil may occur on or near barrier islands and coastal areas where polar bears aggregate.

In 2001, the Minerals Management Service (MMS) funded a study to increase understanding of foraging and carcass utilization patterns of polar bears using the near shore environment. The objectives of this study are to: 1) determine the number, age/sex composition, behavior, and habitat use of polar bears using bowhead whale carcasses at Barter and Cross Islands during fall months; and 2) determine the magnitude of interchange of polar bears between Barter Island and Cross Island during fall months. This information will be used by MMS in pre-lease sale environmental assessments and other planning activities.

The U.S. Fish and Wildlife Service, in cooperation with the North Slope Borough, Alaska Nanuuq Commission, and the Native villages of Kaktovik and Nuiqsut, conducted field work during September 11-25, 2002 on Cross Island and September 3-29, 2002 on Barter Island. A combination of scan, continuous, and focal sampling methods were used to record data. Preliminary results indicate a presence of 9-13 polar bears at Cross Island and 43-53 polar bears at Barter Island during the respective study periods. The majority of animals observed were adults (including adult males, females without cubs, and unknowns). In addition, at Barter Island, over 25% of the animals observed were adult females accompanied by first and second year cubs. Overall, polar bears spent the majority of their time inactive during day and feeding at night at both study areas. At Barter Island, polar bears frequently swam from Bernard Spit (an off shore barrier island) to the carcass site, and also frequently entered water between feeding bouts. Polar bear interchange between the study sites was not successfully determined. A final report will be prepared following field work currently planned for fall 2003.

Discussion

Robert Suydam: Do you have any data to indicate whether the same bears are coming back year after year to the same sites? Do they know that these are good places to eat from year to year? Have you explored the use of Platform Terminal Transmitter (PTT) tags for the polar bears? The range for detecting PTT tags is much greater now. Are there any plans to start putting PTT tags in polar bears so you can scan bears that show up?

Susi Kalxdorff: This is the first year of the study, so hopefully we'll be able to address whether bears recurrently visit whale carcass sites after next year. We are planning on working with the USGS Biological Resources Division (BRD) to movement information for the collared bears that we saw are Barter Island (they can wear collars up to three years). When you look at other places like Canada and Churchill, there is definitely a learned behavior to come back to feeding

places like the Churchill dump. In that case managers knew they were getting repeat visitors and that those bears taught their offspring to feed at the dump. The use of PTT tags is still in the development phase. The BRD is actively pursuing that, but the funding is not yet available.

Taqulik Hepa: Are you documenting human and bear interactions at the carcass sites? Because it is a concern in Barrow and we had to deal with a large number of bears over the last year.

Susi Kalxdorff: Yes, it's not necessarily a specific objective of this study, but it is something that is of interest to us and we were collecting information opportunistically on that in Kaktovik and Nuiqsut as well. We have started to develop a database to house those data. We are interested in working with the community to develop safety guidelines or a bear management plan so nobody gets hurt.

Craig George: Have you considered doing some energetic modeling to try and estimate what the contribution of whale carcasses is to the total energetic needs (annual energetic need) of bears?

Susi Kalxdorff: No, we haven't done that yet. What our Canadian colleagues have recommended is that we start recording what specifically polar bears are feeding on (meat vs. blubber; younger bears need protein for growth whereas adult bears probably eat blubber). Geoff York and Todd O'Hara have a student that will be doing some energetic work this fall, but USFWS has not done an energetics model as of yet. We're just trying to characterize bears that are present at the feeding sites.

Craig George: Are females selecting den sites near carcasses disproportionately to other habitats-what's causing the clustering of denning?

Susi Kalxdorff: Not that I'm aware of. I'm not aware of clustering of denning around Kaktovik or Cross Island, but there appears to be a trend of increased use of the coast in the fall. There's been more terrestrial denning in the last decade as compared to earlier times; that might be because these females have figured out they can get fat on the carcasses prior to denning.

Jim Lima: You mentioned traditional knowledge as an objective to incorporate in next year's study. Is there any way to determine changes in the pattern of hunting and taking as causing the aggregations at these bones piles. Something that's changed through anthropogenic interactions that might be causing this phenomenon or are bears coming in from the ice for some other reason?

Susi Kalxdorff: That is something we want to look at through Traditional Ecological Knowledge (TEK). Some of the questions to ask residents are, "have you seen changes in the number of bears," "have you seen bears feeding in other locations besides this," "how long have you been hunting," "where did you hunt before," "are there other areas bears use," etc. Hopefully we'll see if there is some change over time from this more historical perspective they can provide.

Todd O'Hara: There will be a feeding ecology project in cooperation with USGS, which is going to be an assessment of trophic level and location of where animals are sampled and will look at their contaminant profiles. We think chemically we can determine the significance of carcass scavenging versus preying on higher trophic animals, and a component is to look at fatty acids and some energetics. Of interest to the US Fish and Wildlife and USGS is an assessment of the nutrient value of bowhead carcasses. They may be of less nutritive value if it deteriorates over time and has a potential to introduce pathogens to the bear. Maybe sampling carcass piles over time to see how nutritive value might deteriorate would be useful. If it were a landfill we'd be concerned about the health of the bears more, but it does have some similarities if they become too dependent on it.

Susi Kalxdorff: That's a good point.

Geoff York: Are we seeing repeat bears? We did do an analysis looking at collared animals; we have about 60 animals with collars on right now. Over the past four years we drew activity circles of maybe five miles from known whale carcass sites and came up with a list of about 20 animals over four years that had been in the vicinity of the bone piles. Only four of the 20 had been repeats and only one had repeated every year and that bear is about 33 years old this year.

It's unclear, but it doesn't look like there's a learned behavior yet-no evidence of learned behavior of returning to bone piles, but hopefully we can get that information with collared animals. And to address the denning question, again, there is no evidence from collared animals that there's any change in denning location based on the location of the bone pile sites. There were actually no collared animals in the area of Barter Island this year at all. Lastly, what might have changed over the years? One thing that USGS thinks is happening is the general increase in polar bear population since sport hunting stopped. That might be allowing animals to return to shore that were historically there, but were hunted out.

Taqulik Hepa: Another factor why bears are there is because they're stranded. I know for the past two years that has been the case in Barrow.

Susi Kalxdorff: We know from village residents and other workers on the Slope that the farther off shore ice is during the fall months, the more bears tend to be on shore.

Charles Monnett: From a Minerals Management Service perspective, it is interesting that the bears are spending a lot of time in and out of the water. From a perspective of someone trying to analyze the effect of an oil spill, spending time on land is not as risky as if the bears are spending a lot of time in the water. There are also carcasses we see occasionally when flying polar bear surveys so one question is, what will you be able to tell about the general problem away from the two deposition sites where hunting is going on and also, what about the management implications? It sounded like the bears were swimming across to the bone pile. Is a recommendation for a relocation of the Kaktovik bone pile a sort of thing the might come out of this?

Susi Kalxdorff: They're complex issues and the situation varies among sites, i.e., Barrow, Cross Island, and Kaktovik. At Kaktovik, people are very invested in polar bears, e.g., one of the major activities is to watch bears at bone piles. I think there would be considerable opposition to moving the bone pile away from Kaktovik, even to Bernard Spit. Kaktovik is not as likely to be affected by an oil spill from existing facilities. A place like Cross Island is more likely to be affected by an offshore oil spill. We talked about moving the carcasses, but some problems exist. You have to wait until the ice is set up enough to get the carcass out far enough from land, but the current may bring them back to a less desirable place than they were originally deposited. We don't have an answer to that yet.

Craig George: Just an observation-all ursids have this behavior of congregating around super abundant food sources, but I've been keeping notes on these aggregations of dead marine mammals (bowheads, etc.) and it seems to be from your presentation that there's a limit of 30 to 50 animals in an aggregation within a 300 to 400 m perimeter. There are definitely bears scattered outside that, but that's a very common aggregation number (30-50), 50 being quite high around stranded bowheads and gray whales. There might be some sort of interesting behavioral things going on there.

Steve Treacy: Do you have anything to say about investigator safety?

Susi Kalxdorff: When you're working around the clock among large numbers of bears, safety is a big issue. The USFWS has made every effort to employ experienced people and ensure that they have the appropriate training, especially at Cross Island, which is a very remote location. The field crew at Cross Island also benefited from the presence of Nuiqsut whalers and the use of a whaler's cabin, which was "bear proofed" using an electric fence/alarm, as well as bear boards (nails protruding from the cabin to prevent bear entry).

SOCIAL SCIENCE AND ECONOMICS

BOOK/SYNTHESIS OF INFORMATION ON SOCIOECONOMIC EFFECTS OF OIL AND GAS ACTIVITIES IN ALASKA

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The impetus and funding for this book came from the Minerals Management Service (MMS). In 1976, the U.S. Department of Interior Bureau of Land Management initiated a Social and Economic Studies Program (SESP) to help assess the potential effects of offshore oil development in Alaska. Since 1973, the Alaska OCS Region of the MMS has supported a socioeconomic component in its Environmental Studies Program that has resulted in the publication of 163 Technical Reports and nine Special Reports at a cost of over $19 million. These reports are often lengthy, use different methodological approaches, and have different study objectives. MMS is sponsoring a synthesis of its socioeconomic studies with the objective to produce a single-volume, scientific reference book that synthesizes selected Alaska social and economic research findings in a series of peer-reviewed chapters. One of the goals of this book is to make accessible this major body of research that has informed numerous environmental impact statements prepared in connection with the MMS Alaska offshore leasing program.

The book begins with an 1) introductory chapter that includes a brief review of the history of social science research in Alaska, making the point that the SESP program has been one of the largest contributors to the body of social science research in the state. The introduction then describes how the SESP was initially organized, and how it evolved over its 25 year-plus existence. The following independently authored eight chapters include: 2) Context: Petroleum Development in Alaska; 3) Petroleum and the Alaska Economy; 4) Regional and Community Economic Effects; 5) Sociocultural Synthesis; 6) An Overview of Subsistence in Alaska, 7) Subsistence and Oil Development on Alaska's North Slope; 8) Long-Term Consequences of the Exxon Valdez Oil Spill on Subsistence Uses of Fish and Wildlife; and 9) Community Impacts of the Exxon Valdez Oil Spill: A Review, Synthesis and Elaboration of Research Findings. Chapter 10, Summary and Conclusions: Toward Effective Future Social and Economic Research Contributions to Management of Oil and Gas Activities On the Alaska OCS, is a collaboration of all the book's authors and editors.

Discussion

Tom Newbury: I suggest that when the book is published you find a way to include a CD-ROM of the book. We did that with an EIS; with real complex documents it's a real benefit. It allows the reader to search on a particular person's name, particular subject, on a technical report or date. And rather publishing it separately from the book, include it with the book.

Taylor Brelsford: Earlier on when you identified the search criteria, you had a separate category at the bottom regarding traditional ecological knowledge that somehow it fell out, did you treat it separately? The question is in regards to the "transmission of cultural values and knowledge;" where did it fall? More generally, how is the theme of the growing importance of traditional knowledge developed through the course of the chapters? Is it nested within subsistence use patterns? It may be something you end up looking at for future research.

Stephen Braund: We tried to incorporate it because we didn't want to lose it, but there wasn't a lot of it.

Cleve Cowles: As a development in the peer reviewed literature, traditional knowledge is definitely a newer entity. For example, in recent years there are a few new articles in *Arctic*. But in relation to the socioeconomic studies program, there's been a linkage over the long haul. I think that distinction would be helpful to make if we have a part of the book that addresses that.

You made a comment early on that there appears to be shortage of articles, peer-reviewed articles, in the literature in relation to the number of reports that were generated. From my experience with this kind of project in other disciplines where that hasn't been the case, I feel that the mix of practitioners that have been involved with the program was roughly the same. There might be a hypothesis that an academic researcher would publish more than a private firm might. In other projects you see incentives in both sectors to publish broadly and prolifically. I'm wondering if you can comment on what you think the mechanisms are that are affecting publication in the social sciences in this particular arena if Alaska is a unique arena. Is there something different that hasn't provided the incentives that the social science community needs to publish?

Stephen Braund: I can only speak from personal experience. I've been a consulting anthropologist for 26 years. I've worked in 130 communities and have a lot of reports and some sitting on my shelf that are Xeroxes that I've done–I've never had time. I don't know what the incentive is other than what you have now and in the next project I'll report on after the next talk. One of the contract requirements was a peer-reviewed article. That's an incentive because it's there in the contract. You haven't had a lot of academics doing a lot of the Social and Economic Studies Program reports, and the ones that do tend to publish because they live in that environment and know that peer review is how you get it out there and they're right. But, I don't think the contractors and consultant types have just had the time to do it. I know I haven't. I've had things from the 1980s that belong in print; we've quantified cultural and subsistence need for bowhead whales and there's probably no one in this room that has a clue how we did that, but we said the need is not 18 it's 48, or 56, but how can you quantify cultural need? That should be in the peer-reviewed literature so someone can look at it, take a shot at it, or at least know how it was done. It sits on my shelf and gathers dust because I'm just too busy. From your perspective I would put what you're doing, "peer-reviewed article" at the bottom and you at least know that these things will be out there. It was a lot of good work, I was very impressed. Having lived through twenty-some years of that program and had contracts–and contract work is not that easy–it was pretty impressive. I think most of the authors went through that all came out and said that this was a pretty impressive program, these 170-something reports. So the next question is to get this published, I don't know. But you're in the right direction–you're requiring it in your contracts.

Cleve Cowles: Well, we have for quite some time. I guess I feel like there's some distinction here that's different.

Brad Smith: I probably don't think like an anthropologist or economist, but I was wondering, is there anything that you see in the book or in the chapters that would relate back or look at things from a national perspective (maybe other Minerals Management Service studies for other regions of the United States) that would help us understand some of the other issues that are associated with this that might have to do with disproportionate costs, social costs, etc. on communities in Alaska? Maybe you have some thoughts or recommendations on coastal impact assistance that type or provide advocacy for some of these affected communities, or maybe something about the environmental justice or demographics related to that issue.

Stephen Braund: Am I hearing disproportionate effects in rural areas relative to national benefits somewhere else?

Brad Smith: Yes, that theme and also whether or not we can compare/contrast what's going on in Alaska to the Gulf of Mexico.

Stephen Braund: What's been pointed out is the uniqueness of the Alaskan community. It's not really easily comparable, it's somewhat unique. I think that's been the focus of the program. Here's where effects are going to be and that's why it's been primarily in these coastal rural areas and talking about what they may be. And in terms of national scheme, I noted that it was quite interesting that the whole program started in Beaufort Sea in late 1970s with oil, and in 1848 is when the Yankee whalers went through the Bering Strait into the Chukchi Sea into the Beaufort Sea and they were going for national oil for the streetlights in Boston. And here you are 150 years later and you have the same dynamic going on for oil as 150 years ago and now oil and bowheads, which is one of the biggest issues up there. So it really has come full circle. I wrote about that in the chapter.

Craig George: Do you offer any advice on how to apply this research in terms of developing oil and gas in the least disruptive way possible for these borough communities that take the brunt of developmental effects?

Stephen Braund: I think maybe in the last chapter we can offer a way in assessing effects that may be insightful and informative. I think maybe out of this we can make a way of thinking about those impacts that would be readily available to a larger audience that could then think about oil and gas effects and how it might trickle down to the community and I'm thinking specifically of subsistence and land use and harvest.

Craig George: What about mitigation?

Stephen Braund: To me that's a negotiation between an agency and developer.

A DESCRIPTION OF POTENTIAL IMPACTS OF OCS ACTIVITIES ON BOWHEAD WHALE HUNTING ACTIVITIES IN THE BEAUFORT SEA

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This presentation was also given at the Barrow IUM.

Subsistence hunting for marine mammals and especially bowhead whales has a long history as an organizing element of Iñupiat social, cultural, religious, and economic life. Archaeological evidence shows that Iñupiat dwellings were sometimes made with whale ribs and other skeletal parts. Whales were prominent in religious beliefs, practices, and symbols; and, sharing of whale products among kinsmen and other Iñupiat defined and reinforced social bonds. Muktuk, whale meat, and other whale products also provided an essential source of protein and fat that Iñupiat believed essential for their diet and health.

When European and American whalers entered the Arctic they employed Natives as whalers and exposed them to new whaling technologies. Post-contact, whaling has remained essential to modern Iñupiat values and lifestyles: the Barrow High School mascot is the "Whalers;" employers allow time off for whaling crew members to hunt; Nalukataq and related whaling ceremonies are important cultural events; and, muktuk and other whale products have cultural, economic, and health-values for community members.

Oil development activities in the late sixties and early 1970's resulted in new change agents affecting Iñupiat communities: new sociopolitical institutions emerged; settlement and residence patterns began to change; transportation technologies such as snow machines became more available as did wage employment with the newly formed North Slope Borough. Modernization of Iñupiat communities accelerated with exposure to these and other change agents. Outer Continental Shelf (OCS) oil activities were perceived to present unique threats and consequences, including ones specific to whaling. Iñupiats expressed concern that OCS oil development activities could deflect whale migration father off-shore, contribute to whale skittishness, and otherwise adversely affect whale behavior. These types of concerns are perceived to have negative influences on whale hunting; and, any threats to whale hunting also affect other aspects of community and personal life connected to whaling.

Using multiple data sources, this project examines Iñupiat assessments of the influences of development on participation in traditional activities, especially whale hunting and its related sociocultural components. A focus is to identify Iñupiat assessments of OCS activities as a particular type of development threat or opportunity; and, the perceived affects of OCS activities on whale hunting and related traditional activities. In addition to observational (ethnographic) and secondary source data, three surveys are being administered (whaling captains, randomly selected households, and high school juniors and seniors) to examine variation in these assessment among and within three North Slope communities (Barrow, Kaktovik, and Nuiqsut) and one "control" community in western Alaska. The data should assist communities to identify and plan for sociocultural problems related to ongoing development in the Arctic.

Discussion

Jim Lima: I noticed you are surveying high school juniors and seniors. If they're under the age of 18 are there any special procedures you have to go through like getting parents' or guardians' permission? Anything like that?

Mike Galganaitis: Yes, we need parental consent for any high school contacts. There's a procedure set up so that that will be obtained before any high school students are approached.

Steve Treacy: Just as a point of reference, I was going to recommend consideration of a study we did in 1995. A focus sheet in your packet mentions this study, a seismic synthesis report that we did. We talked with whaling captains in Barrow and brought in whaling captains from other villages, and went over a lot of their concerns, e.g., how whales may be moving farther offshore. Anyway, there may be some literature like this here and there that, while not developed as part of the Technical Report series, might be helpful to you as well.

Brad Smith: National Marine Fisheries Service is often asked to issue small take authorizations under the Marine Mammal Protection Act for the incidental harassment of marine mammals including bowhead whales during oil and gas exploration and other activities. One of the conditions for us to issue those authorizations is that work and harassment cannot have anything more than a minor impact on the availability of the marine mammal for subsistence uses. I think we're still struggling with what that means, but certainly locally we're going to be very broad in the context of that clause in that not only would the activities that scare an animal away from a traditional hunting area be unacceptable, but also in activities that may just result in people not (...inaudible). This type of information will be very useful in how we handle that constraint and our issuance of small take permits. I noted that your title deals with potential effects, parts of this will be a retrospective look as well. There's probably some data from North Slope Borough. Do you have anything akin to a peer review process within the affected communities to where if one citizen offers an opinion about whether the whale meat has been tainted they can discern a taste difference that would last ten years. I'm just interested in how you would deal with those and be able to put those into something similar to a peer reviewed concept, if you'd have to hear that comment repeatedly before it would become part of your study.

Michael Downs: Thank you. As far as community review process, there is a built in community review process for the reports and there will be opportunity for that type of input.

Taqulik Hepa: If you're planning on doing the survey this spring and summer, just to let you know that in the three communities that you mentioned there have been recent surveys done within past year, I think the people in communities are feeling a cumulative impact from people coming into the communities and doing surveys and from what I remember of your survey it was pretty lengthy. In order to get more success in interviews, you might consider giving them some type of compensation.

Michael Downs: Yes, there will be compensation for respondents, which is part of the design. As far as the timing of surveys, what's going to be taking place in the spring and fall is more of the ethnographic work, the key person will go talk to people in the communities–not the survey itself. The earliest we can do the survey is when Office of Management and Budget approval comes, but when we actually do it, we will work closely with the Borough to make sure that the timing is appropriate for the communities involved. We're cognizant of not overburdening people and Minerals Management Service has clearly recognized the value of providing people with compensation for their time.

Discussion from the Barrow IUM

Mike Downs: This study is designed as a one point in time study looking backwards at changes. Everything is changing at once–whaling is also changing and it's very complex. There is great value in doing a study in a later point in time.

Unidentified: Is the survey available to the public?

Mike Downs: Yes.

Todd O'Hara: It's a good design; my question is in regards to your control or reference site. I do more than would recommend that you select more than one reference site–one in the Borough and one outside–because if the environment changes at the reference site, then you have a lousy control so you have two reference sites in case of environmental change.

Arnold Brower: How are the scientists going to assess changes over time?

Mike Downs: We will ask captains and elders regarding changes over time. Everything is changing at once so there is value in doing a similar study in the future.

Taqulik Hepa: Are there separate studies for high school students?

Mike Downs: The information is very specific in terms of historical data, but more detailed information is not appropriate for high school students. We'll have a representative sample of juniors and seniors who are only native and that might be active in whaling. In Barrow, that's about 100%.

Arnold Brower: How are you going to sample the public? What about households? Random sampling?

Mike Downs: We will sample randomly and then try to increase the sample if that's not enough, in order to encompass more people, if not enough elders. We'll do random household surveys. Typically, we have criteria in screening, but that does not mean that the same criteria will be the same for the next household.

SUBSISTENCE MAPPING: NUIQSUT, KAKTOVIK, AND BARROW

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This presentation was also given at the Barrow IUM.

The purpose of this project is to develop and implement a GIS mapping system to describe Barrow, Nuiqsut, and Kaktovik subsistence hunting and fishing activities. The focus is on the collection and description of contemporary subsistence patterns while accommodating the incorporation of past and future subsistence data to enable the analysis of changes in patterns over time. A sample of hunters in each community will be systematically selected using social networking methods. Contemporary subsistence hunting and harvest patterns are to be collected for selected species including bowhead whales, ringed seals, caribou, Arctic cisco, Broad whitefish, Arctic char, and various species of edible birds (empirically determined to be significant subsistence food resource). In addition, the project will document camps and travel routes. This presentation discusses the status of this project.

The results of this project will be used in MMS's evaluation of potential effects of OCS exploration and development in the Beaufort Sea OCS region as needed for future Environmental Assessment and Environmental Impact Statement analyses. Empirically based and methodologically documented subsistence information on the locations of subsistence activities is a necessary element in those assessments. Furthermore, an effective GIS system could facilitate monitoring of subsistence patterns over time and assist in identifying mitigation measures.

Discussion

Susi Kalxdorff: What is the process that will be used to select your key informants?

Stephen Braund: In Barrow, we'll rely on social networking. The North Slope Borough Wildlife Department is working with us. You develop a huge list of every person you could talk to. And then you go by the seven species and get people for each species. Then go to each of those persons and ask them to network, to tell you everybody else. So you have a laundry list of the universe, of everyone you can talk to. And then it's, "how do you start focusing that list?" Actually I read Jeff Johnson's book when I proposed this, and he had all kinds of mathematical ways–you look at the linkages back and identify the different nodes, and quantify it. In Nuiqsut and Kaktovik it's not going to be as complex. We have a list of 18 people: the tribal council said, "Here are the people you need to talk to for this area or for these species." There are only 293 people in the community so it won't be that hard. We're moving slowly on this project, but there's a lot of activity going on in these communities so we're not moving really fast to jump in the field. And as we try to coordinate, we're going to have a meeting with the Borough and try to coordinate our study and the one Dr. Downs is doing. You can imagine these are small communities.

Craig George: What sort of time depth do you think you can get for Nuiqsut?

Stephen Braund: We're not doing time depths; we're doing most recent season and most recent hunt other than going back to existing information. We're talking with Alaska Department of Fish and Game Subsistence Division in Fairbanks. We're trying to get everything they've done on mapping subsistence in Nuiqsut and Kaktovik, which is considerable over the years and will probably be at a community level. So I'm not sure what we'll get, but it will give us some time depth into the 1980s.

Craig George: So that wasn't really a study objective, to look at changes through time?

Stephen Braund: Secondarily, it was. The focus really was to start to develop a GIS and get contemporary, current information. I think if we can, we will. We're trying to bring in all that material from the 1980s, which is from Barrow. We're trying to get it all from the Alaska Department of Fish and Game Subsistence and that will allow me or anyone else with these data to look at it and look at changes over time.

Cleve Cowles: One editorial suggestion: in one of your first transparencies you mentioned the Minerals Management Service mandate. I think that probably it's a different perspective as to why we're doing this study; I don't think it will go down well with your average hunter on the street. Our primary purpose is to use the information for evaluating potential offshore oil and gas development. I really think in a study like this, it'll be important to start off on the right foot, and "mandate" doesn't do it for me! One other thought on the time comparisons: if you do that, how will you separate out the potential relationships of changing distributions of wildlife populations to changes in harvest patterns?

Stephen Braund: I'm not sure we'll even have in this GIS the changes in wildlife distributions. This is a beginning to get in one place the subsistence mapped information and collect one set of time series. In hindsight the strength of the 1986-1988 subsistence study pegged those three years in Barrow and Wainwright. We didn't go there and try to say for specific years, "Where have you ever hunted or gone" because now you have 5,700 records for Barrow of harvest locations.

Cleve Cowles: So it's not that you'd be making comparisons but you would be cautioning the interpretations of those comparisons.

Stephen Braund: For sure. In fact, the danger of this map stuff–and I see the maps of what we did in the 1980s for Minerals Management Service in the current Bureau of Land Management/National Petroleum Reserve EIS reports and I groan because they're just kind of snap shots. They're lifted out and they're set in there and they say "harvest areas" and they're not.

Taqulik Hepa: As a next step or a future project we may want to consider making a radio collar for hunters to see the areas that they cover just to go and harvest one research. With our Subsistence Harvest Documentation Project we're looking at the specific location of where the animal was actually harvested. But when you're interviewing the hunters you get more information about the areas they had to cover just to catch the wolf or the wolverine. It's taking a lot more effort and time for people to actually harvest a bowhead whale or a caribou or whatever it may be. That's just a suggestion.

Discussion from the Barrow IUM

Todd O'Hara: You have information from 1937 to 2001, but not every year?

Stephen Braund: Yes.

Craig George: The map could be broken down by species (in reference to amend the "spaghetti map", which showed travel routes of whaling captains).

Stephen Braund: That map represents that year, that point in time and that species.

Taqulik Hepa: How was the map generated?

Stephen Braund: The map was hand drawn and digitized.

Arnold Brower: Are there any changes in locations of the species, especially the Arctic char?

Stephen Braund: Both species are on the list; we have that information from the 1980s, but haven't collected the current data. We can tailor the surveys.

ANIMIDA: ANNUAL ASSESSMENT OF SUBSISTENCE BOWHEAD WHALING NEAR CROSS ISLAND

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This presentation was also given at the Barrow IUM.

This study, funded by the Minerals Management Service (MMS) has as its broad objective the description of subsistence whaling as currently conducted near Cross Island by residents of Nuiqsut. This effort is designed to measure basic descriptive parameters of Cross Island whaling so that observed changes (if any) can be analyzed in relation to such factors as oil and gas activities, weather and ice conditions, or other variables. Special attention is devoted to geospatial information through the sharing of GIS information by participating whaling crews. Project reports are only for the purposes of reporting information collected, with no analysis of the information either as a self-contained database or in conjunction with the many pertinent external databases. As a second broad objective, the project is designed as a collaborative effort of MMS and its contractor, Applied Sociocultural Research (ASR), the subsistence whalers from Nuiqsut, and the Alaska Eskimo Whaling Commission (AEWC). Beyond the goal of two years of

descriptive information, it is planned that the project will develop a system for collecting such information that local whalers themselves can adopt, adapt, and maintain.

Three methods of information collection are employed - systematic observations, collection of daily vessel location information from handheld GPS units, and whalers' self-reports and perceptions. Most information is recorded on daily boat report forms. Pertinent measures are:

- Number of crews actively whaling (observation)
- Size and composition of crews, and fluctuation over the whaling season (observation)
- Number of whales harvested (observation, self-report)
- Days spent whaling, and days prevented from whaling (weather, equipment failure or repair, etc.) (observation, self-report)
- Days suitable for whaling when whaling did not occur (observation, self-report)
- Subsistence activities occurring other than whaling (self-report, observation)
- Location of whale sightings and whale harvest (GPS, self-report)
- Location of whale searching (GPS, self-report)
- Local weather and ice conditions (observation, self-report)
- Bowhead whale behavior in the Cross Island area, and indicated differences from past experience (self-report)
- Changes in access or other issues related to the whale hunt, such as increased effort for the same (or reduced) harvest, increased risk, increased cost (self-report)

In 2002, three crews from Nuiqsut whaled from Cross Island. At least two boats went whaling on 12 to 14 different days. Whalers were on Cross Island a total of 24 days (counting day of arrival and day of departure). Weather prevented whaling on 3 to 5 days, three days were devoted to butchering a whale taken the day before, and two days were devoted to travel. Information for two days is uncertain. Four whales were harvested, and one was struck and lost. Two of the harvested whales sank when killed, and were recovered later as "stinkers." The report and attached daily vessel trip forms present information on crew size (2 to 6 per boat per day, most commonly 3 to 5) and daily trip characteristics (duration, GPS track, marked points, self-report of significant sightings and other perceptions). The report also summarizes Nuiqsut whalers' observations and perceptions on how whale behavior in 2002 was different from that of other years, and the implications of those differences for subsistence whaling.

Discussion

Susi Kalxdorff: For the two years you were out did you notice a difference in the timing of the hunt between 2001 and 2002? It was my impression that the hunt in 2002 was earlier than normal. Or from what you can assess, is the hunting occurring, relatively speaking, around the same time?

Mike Galginaitis: It's hard to talk about because, as with Kaktovik, the norm in people's minds is around Labor Day in September, but then you get people anxious to go out and depending on conditions–if whales are sighted, weather is good–people are going to want to go. My own impression is that for 2001-2002–if you take those dynamics into account–it is probably fairly typical. People will go when ready, when whales are out there. As you can see, at the end of September, you're running into conditions where you might be shut out. And in fact, in 2001, Nuiqsut essentially left the whale on the table because they didn't want to get caught out there in bad conditions or in a worse case scenario, in conditions where they'd have to leave their boats because they couldn't get back. So I think ideally, people would like to get out there as soon as possible; what they're running up against there is they don't want get out when it's too warm either. Otherwise, you run into problems when butchering your whale because you're stuck with this whale with the muktuk and if it's too warm, it's going to deteriorate before you can put it away adequately. So a short answer to summarize the long one is no. I think probably all things considered, both these years were not untypical in terms of timing.

Frank Bercha: What would be the limit to weather conditions that you would go whaling?

Mike Galginaitis: Again that's an interesting question because it's contingent on the circumstances. If it's early in the whaling season, people are going to want a pretty calm day–five mph wind or less. Wind tends to be the determining

factor because that determines what the sea conditions are going to be. However, if it's late in the season and you need to get some whales and you know there are whales out there, some Cross Island whalers will be willing to go out in maybe 15 mph winds, though they realize it's not optimal and maybe not prudent. It depends on the situation. It also depends on if you're just looking for a whale that you've already killed and sunk, you'll go out in more marginal conditions than if you're going out to look for whales to strike. It's harder to strike a whale in marginal conditions than it is to actually see them and find one that is dead. I guess ideally, whalers say they want to go out in winds that are five mph or less. In practical terms it depends on a number of other contingencies and sometimes they'll go out in weather you'd think is pretty marginal.

Craig George: We just completed some analysis on just that in a paper we submitted to a volume on whale hunting. It's really interesting that in the spring at Barrow for instance, whaling success is almost entirely dependent on wind direction. That's because leads need to be maintained, but it can be fairly high velocity-up to 20 knots-because you're in the lee of the ice. But a westerly wind shuts everything down there, essentially no whales were caught over a 20-year period with westerly winds. But in the fall, wind direction isn't the key variable–it's wind speed. Almost always when the wind is down is when whales are caught. So you can model fairly accurately when whales will be taken based on weather data. Now there are some exceptions like you've said. If you go out and it's calm, and kill a whale and then the winds pick up, that can be a life-threatening situation. Are you planning on doing whaling in association with environmental variables, ice density?

Mike Galginaitis: Right now, this project is data collection only. In terms of what may be funded for analysis, I certainly would not be adverse to that whether it's Minerals Management Service sponsorship or somebody else. But that's to be developed yet. Certainly that kind of analysis is what they're heading towards.

Taqulik Hepa: In relation to the discussion right now, I know in Barrow, whalers consider a number of different factors. It's weather–whalers in Barrow won't start whaling until temperatures are cooler. And they also consider the size class of the whale so they wait until the later part of the season so they can get the preferred size class–the smaller whales. And I'm not sure if the Kaktovik and Nuiqsut people take that into consideration when they decide to go out hunting.

Mike Galginaitis: Well I would say that size is definitely a consideration for Nuiqsut. Though, there is clearly some difference in opinion as to what the threshold between what small and large is for different captains and crews. The first whale was, even by Nuiqsut standards, probably a little small, 20 or low 20s (feet) in length. The first stink whale was 40 or 45 feet probably. Forty or 45 feet for Nuiqsut is a big whale; they definitely don't want anything bigger than that. Ideal size, I've been told, is maybe high 20s, 30, maybe 35 feet. So there is consideration. But also if it's late in the season and they need a whale, they're not going to be picky about what size it is.

Craig George: In Barrow, in recent years in particular, they have chosen to wait later, even into October to initiate whaling. Size function is a function of date at Barrow and this is something I don't think we quite understand yet. In late August and early September, there are essentially only huge whales. Essentially they're going to get very large animals. Then these sub-adults come through around the 20th of September and by the end of the hunting season in Barrow, there are very few large adults. So they can select the size class they want by timing. But in the feeding report, in your chapter with Kosky, that pattern is not evident nearly as much, but it might be because it's a feeding area where you have multiple size classes there at one time. I don't know, frankly, but it is quite different to the west.

Mike Galginaitis: Yes, and well especially for Cross Island and Nuiqsut, because it's not a village-based whaling operation as it were. They also have the constraint of the time available for the humans to be out there whaling, which is another constraint on their choice. Now for Kaktovik, because it is village-based, I'm not familiar enough with the migration patterns to know if maybe the pattern in Barrow hasn't developed at that point–at an earlier stage in migration–or if it's a feeding area factor. I have no clue on that.

Discussion from the Barrow IUM

Unidentified: Are changes in the activities attributable to Northstar?

Mike Galginaitis: Not demonstrably. Are changes due to OCS activity in general? They travel farther and there are fewer whales. But I had not heard anything regarding Northstar.

THE NORTH SLOPE ECONOMY: 1965 TO PRESENT

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Information from this study will be useful to MMS in assessing potential economic impacts of OCS development activity on the North Slope and its residents. In general, this study will provide a region-wide perspective of the long-term changes in the North Slope economy against which to gauge the potential effects of proposed OCS activity.

The North Slope Economy: 1965 to Present study offers an historical perspective on the evolution of the North Slope economy. The study explores the structural changes that had significant economic, institutional, and social impacts on the region. These structural changes are reviewed according to:

- *Revenue and expenditure patterns of the North Slope Borough (NSB) and the local governments.*

  Incorporation as a Borough allowed the new regional government to rise above years of neglect and isolation and to address overwhelming public needs. The Borough began to levy property taxes on oil and gas facilities, which started a new era of economic growth and development, providing both physical and economic infrastructure. Tax laws also provided the incentive for NSB to maximize debt; from 1985 to 2000 debt servicing on the average accounted for 40% of total Borough expenditures (the largest expense item). The declining property tax revenues are causing significant budgetary challenges, leading to reductions in the scale of capital projects and local services.

- *The changes in employment and economic activities of the region, and the transformation from subsistence economies to a more cash-based economy*.

  The discovery of oil in Prudhoe Bay, the inception of the NSB in 1972, and the formation of the regional and village corporations changed the structure of the North Slope economy. Prior to 1968, employment opportunities in the region were very limited and the North Slope villages could only afford limited local government. The average monthly employment in 1968 was recorded at about 600 jobs; in 2001 it was recorded at over 7,000 jobs (ADOLWD). Economic activities in the region have been primarily driven by activities in the oilfields, the construction sector, and the public sector (particularly by the NSB).

- *Role of the Arctic Slope Regional Corporation (ASRC) and the other village for-profit corporations in the economy.*

  ASRC and the eight village corporations have been a significant economic force in the region, providing jobs to residents and opportunities to be involved in all sectors of the economy (i.e. construction, oilfield activities, retail, services sectors, etc.). Since 1973, the Corporation has increased its revenues at an average rate of 39 percent per year. In 2001, ASRC's revenues amounted to $1.1 billion. These corporations are vehicles to channel Native assets and capital toward productive investments on behalf of their shareholders. While they are required by law to make good faith efforts at earning financial returns for their shareholders, they also put emphasis on hiring their shareholders, providing for educational needs of their shareholders and children, and are also involved in political and social issues.

- *Individual and household economic response to changes.*

  The substantial expansion of public facilities and services that has occurred in North Slope communities over the past twenty-five years has significantly improved the quality of village life. Basic amenities, such as public water and sanitation facilities, have been upgraded, and improvements in educational facilities have resulted in a dramatic increase in the educational level of the North Slope Iñupiat. While long-standing income inequalities between Iñupiat and non-Iñupiat households continue, income increases among Iñupiat households appear to be fairly evenly distributed. To some extent, the income increases experienced by North Slope households have been offset by the high cost of living. Surveys indicate that subsistence resources continue to be of economic and cultural importance to residents, although the adoption of modern technology has raised the cost of participating in subsistence activities. While North Slope residents generally agree that the overall quality of life in their communities has improved, they continue to express concern about the social effects of rapid economic development in the region.

Discussion

Dee Williams: You've shown the importance of the regional and village corporations. I'm wondering if you have more data to share or to speak about or whether you even collected data on shareholder status in the North Slope with regard to those distinctive corporations and whether you can report any significant changes in the proportionality of shareholder status among the local population.

Leah Cuyno: I believe we got information from the Arctic Slope Regional Corporation. Unfortunately I don't have the details here with me. We have some draft reports that are available at our office, you can give me a call and I could probably give you some more details. We're still in the preliminary stages and we also need to validate some of data. I think we expect to have data from three corporations (Arctic Slope Regional Corp., Ukpeagvik Iñupiat Corp. and one other); with respect to the other corporations, we'll interview some managers and see what we can get.

Dick Prentki: I'm curious about the settlement going from 2,000 to 7,000 residents. Is that a lot of back immigration?

Leah Cuyno: I think the task for the report alluded to people going back to the North Slope; there were three communities that were abandoned and were later resettled after the 1970s with the advent of more jobs. There was some evidence of reinflux of residents.

Frank Bercha: I think you've done a great job of showing the effects of transient gross income; but as far as quality of life, gross income is only one of the indicators. Do you have any quantitative data on the other indicators of quality of life like disposable income, education, medical care and so forth?

Leah Cuyno: Yes, we do have more information on quality of life indicators; unfortunately I can't put everything in, but we do have some educational levels and some major public services that are available, like water, sewer that are now available that weren't before.

OTHER PRESENTATIONS

OIL SPILL OCCURRENCE IN THE BEAUFORT AND CHUKCHI SEAS FAULT TREE APPROACH

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In order to plan for future offshore developments in the Arctic, the U.S. Department of the Interior, Minerals Management Service, needs to predict oil spill occurrences and their characteristics for realistic development scenarios over the next half century. The development of such a capability and its application to answer questions such as the following are described in this presentation:

- What are realistic offshore oil and gas development and production scenarios over the next 50 years in the region? Production volumes, numbers of wells, subsea pipeline length and diameter, and location?
- What is the frequency of oil spills and its size, temporal, and spatial distribution?
- What is the distribution of spills among facilities-well drilling, production wells and platforms, and subsea pipelines? How does it vary with location and water depth?
- How would the spills from similar facilities located in temperate regions compare to those of the Arctic facilities? Better or worse?
- What is the accuracy of the predictions?

The capability to predict oil spills in the Arctic offshore was based on the application of fault tree methods to model Arctic influences on known and expected types of accidental spill occurrences. Such Arctic spill characterizations were then applied to each of the production and development scenarios to generate future spill estimates together with their characteristics as indicated in the above questions. Accuracy was assessed using distributed inputs and conducting the computations using a Monte Carlo method.

Discussion

Tom Newbury: You made a distinction between wells and platforms and I wonder if you meant a well without a platform (isolated well head) or a well on the platform as a source of spills.

Frank Bercha: Platform spills are simply non-well spills and the only well spills we considered were blowouts. So whether wells were on or off platforms, the only spillage from wells either for drilling, exploration, delineation or during production were the blowouts. Platform spills are production equipment spills, etc.

Jim Craig: In the absence of any historical data or much historical data in the Arctic, how did you come up with those Arctic risk factors? You showed how calculations worked, but you didn't show where you came up with the numbers. As a corollary to that, it seems like there are a lot of time factors involved in that estimation, e.g., corrosion would be an ongoing thing, ice gouging would be a seasonal thing, and third party anchor drags would be a very, very rare event I would think in most of these areas.

Frank Bercha: Let's start with ice gouging. We used some published work primarily from the Northstar Project to get some of the parameters and frequencies (obviously they were the annual frequencies, freq/km*yr). Things like corrosion - the Gulf of Mexico database covers a period of about 20 years, so it's the average annual rate for corrosion. We're not saying it's going to happen in the first year or the last year, it's just over that period there are so many breaks, as they were in the original database. But we modified them as described in the report to account for things like smart pigging,

better technology and so on. Those would be some technological factors included, but time was not explicitly factored in because we are looking at roughly the same period as that of the database.

Craig George: We need to go a step further and make cost benefit decisions based on the results of the risk estimates. In that regard, one of the criticisms that the Borough had when we reviewed some of the risk modeling was how to clearly state variability in the EISs (generally point estimates were made) and we would like to see some of the analyses that you've done here reflected more clearly in the EISs for managers to make decisions on. In that regard, how would you do this analysis and allow variation on historic spill frequency data? Can you give us an idea of how you might approach that?

Frank Bercha: Yes, it's relatively simple actually. There are two primary sources of variability in the historical data: one is the frequency per year and the other is spill volume in each spill size class. We would analyze the history and create a distribution of annual spill frequency variations that gives us a distribution of annual spill frequency per kilometer year or per platform year. The second source of variation is in the database, is the distribution of spilled volume in each category. We've only used the mean value of the distribution, Then you'd put these distributions (frequency and volume of spill) into the model and could either remove the Arctic effect distributions just to see what the impact of the historical data distributions is, or include both of them. The model is capable of doing that with some modifications.

Craig George: It seems like we had a little trouble with how you take professional judgement and quantify it and put confidence intervals on it and that's something we should continue to investigate and come up with something everyone's comfortable with. It's a sensible approach, but must be done in a way that everyone signs off on it and agrees with the methodologies.

Frank Bercha: I agree with that. We should not belittle the definition of those Arctic unique effect inputs; all of these are large studies in themselves. In the case of ice gouging, we had the benefit of millions of dollars worth of work. This was not the case for other effects such as upheaval, buckling; I'd be happy to receive and use any better data than this.

MMS NORTH SLOPE PIPELINE GIS

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The MMS has primarily used the historical spill record on the Outer Continental Shelf (OCS) as an indicator of future spill occurrence rates. In future environmental impact assessments, the MMS intends to calculate spill rate occurrences based on Regional considerations, such as North Slope production and pipeline experience. The OCS spill record does not include pipeline spill data on State land or waters, which is the predominate oil producing areas on the North Slope. Previous studies collected spill data, but did not collect pipeline attribute data to enable an evaluation of the usefulness of pipeline length as a predictor or co-predictor for spillage rates. This project is intended to construct a database of that information, using the format of the MMS Technical Information Management System, to be used to determine that usefulness.

The project will be executed in two phases. Phase I is intended to inventory the data type, quantity, quality and source of the spatial and attribute data for the pipeline segments for common carrier and gathering lines for the North Slope, Beaufort Sea, and Trans Alaska Pipeline systems. In addition, Phase I will obtain data use authorization from the owners, determine the data configuration, build a prototype database and submit a plan including cost and schedule.

If Phase I is successfully completed, then Phase II will consist of data gathering and construction of a spatial database containing the attribute data.

The project is currently nearing the close of Phase I, the investigation and scoping phase. Required data has been identified and contacts have been made with all data owners. Data sharing agreements are currently being formulated. A prototype database has been built with attribute fields established. It is anticipated that Phase I will be completed by the end of March.

Discussion

Dick Prentki: One of the advantages of this work that we see in Minerals Management Service is if you want to look at North Slope spill statistics, in terms of pipeline length by year, you need to know how much pipeline was built per year, and you can't just look at a map and pull those off because multiple pipelines are on the same road on the maps. This is one reason why we're doing this study. How do the pipeline owners feel about this – does this look like something that will be useful to them?

John Eldred: It's a mixture of all. Some say that it's valuable, some say it's redundant for them. It really depends on who you talk to. As far as the GIS part of it, the historical way to relate spills in that–a mixture there too, as you would expect.

Ted Eschenbach: Are you gathering data on things like if the pipeline segments are pigable, last date they were pigged, have they added cathodic protection or any other kinds of maintenance issues?

John Eldred: In the attribute database is whether the pipelines have the cathodic protection, the design basis. We do not have plans to collect pigging data though. At least that's not right now in the scope to collect owner frequency of pigging data and results.

Ted Eschenbach: I would encourage you if at all possible to add whether or not they consider it pigable.

John Eldred: OK. I guess I misstated. The database will contain whether the line is pigable, whether it has pig receivers, etc. but it won't actually contain pig data, like smart pig runs, frequency of intervals, etc.

Frank Bercha: What percentage of the pipeline length in your database or ultimate database is already covered by the United States Department of Transportation statistics for transmission lines?

John Eldred: I'm guessing now, but of the common carrying lines versus the gathering lines probably, 10% - less than that maybe. There's a tremendous amount of gathering lines in the field versus the DOT.

Doug Ruppert: There are 14 controlled DOT lines including TAPS. So the miles on that is probably 100 miles carrier. And gathering lines, I think 1,000 miles of line. At least 1,000, maybe 2,000.

Unidentified: Who permitted these pipelines. Do they have to apply for a permit? It seems like DOT and/or the state ought to have some information that you can verify. Your purpose of going to the companies is to get more data than is available?

John Eldred: It's two fold. One is to get more detailed-things like in that 50 attribute list, there are a lot of data that aren't in the public. We would like to get specific longitude and latitude information in order to build the database very accurately. One of the scenarios of the four is where the owners don't see the value in sharing a lot of the information so we go to the public and start digging through records to find construction permits and get what data we can. In that case, we end up with a much more limited attribute field than what we're shooting at in that first case. One of the nice things about going through the owners is that they have a lot of the information built in to a database format, which saves a lot of time and effort.

Craig George: Could you comment on the applicability of this database for estimating subsea pipe failure?

Caryn Smith: The purpose of this is for the onshore spills for the cumulative case. So that's the purpose of collecting the pipeline mileage for the Alaska onshore North Slope pipeline spill rate.

SEABIRD SAMPLES AS RESOURCES FOR MARINE ENVIRONMENTAL ASSESSMENT

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The presence and accumulation of persistent contaminants at high latitudes from long-range transport is an emerging environmental issue. Atmospheric transport has been identified as the source of pollutants in several arctic ecosystems and has the potential to severely impact high-latitude populations. Elevated levels of contaminants in Aleutian Island avifauna have been documented on several islands, but the great distance from potential industrial sources and the region's complex military history has confounded identification of contaminant origins. We sampled bird species (cormorants and sandpipers) across the natural longitudinal transect of the Aleutian Archipelago to test three hypotheses of contaminant sources: (1) long-range transport, (2) point sources, and (3) migratory prey. Stable isotopes were used to confirm trophic and non-migratory status in cormorants. Carbon was distinct among islands, enabling us to link cormorants to local island food webs and rule out transfer through migratory prey as a contaminant source. We detected patterns in some PCB congeners and mercury that indicate abandoned military installations as likely local point sources. The long-range transport hypothesis was supported by significant west-to-east declines in contaminant concentrations for the majority of detected organochlorines and trace metals. Although relatively low at present, concentrations are likely to increase in Aleutian fauna as Asian industrialization increases and emitted contaminants are atmospherically transported into the region, necessitating the continued monitoring of this unique ecosystem.

Discussion from the Barrow IUM

Steve Treacy: Sathy (Naidu) showed data that contamination increased from west to east, the source possibly coming from Russia. In regards to the Aleutians, what's the source of that contamination?

Deb Rocque: Seasonal inputs of contaminants in the winter, low-pressure storms going west to east. That shows for the Aleutians annually, but Asia is the source of pollutants for the Aleutian Islands. Combustion is a big deal and whatever industry uses. It's hard to pinpoint one industry. The use of pesticides is also a factor.

Sathy Naidu: How do you normalize the carbon isotope analysis?

Deb Rocque: Carbon and Nitrogen are not correlated to this; we used a lipid covariate in the analysis.

Sathy Naidu: What is the half-life of DDE?

Deb Rocque: I don't know.

Cleve Cowles: If a hunter found a specimen, how could he help you or contribute to the museum? How can the public help?

Deb Rocque: If there's no date and location when people contribute, then the specimen is useless. But if you find a bird, make sure there's a date, your name, and a location to match. We prefer fresh kills, but we will accept all sorts of conditions.

James Patkotak: Can you explain the increased contaminants in the western Aleutian Islands and the currents that bring up the contaminants towards the North Slope?

Deb Rocque: The atmosphere and sea current act as sources of contaminants in the North Slope, but they are more likely from Asia or Russia.

Dee Williams: What kind of expectations do you have for mortality? Is there an accumulation correlated with the age of the birds?

Deb Rocque: Generally if an animal is high in one contaminant, then they'll be high in others as well. It depends on the stresses an individual goes through. While concentrations don't seem like they may be a concern, they may be after all due to stress and high levels of chemicals-there may be a synergistic effect-but this has not been investigated closely yet. We didn't age the birds.

Harry Brower Jr.: Have you made any predictions using your results?

Deb Rocque: Overall, the contaminant load has not shown to affect the health of the bird, but an interesting factor to look at is retention in fat tissue. There may be a bird that's high in contaminants but low in fat. Maybe the contaminants are in other tissues. We looked at methyl mercury (MeHg) stored in fat, either metabolized and excreted or accumulated. It's hard to answer.

ARCTIC CISCO IN THE MID-BEAUFORT SEA AND COLVILLE RIVER FISHERIES

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In recent years, Nuiqsut residents have complained about poor catches of arctic cisco (Qaaktaq) in the Colville River Delta. Concerns from Native fishermen and resource agencies about impacts to the arctic cisco date to the late 1970s and mid-1980s when the West Dock and Endicott causeways were constructed. A tremendous amount of research to address industry effects was conducted the mid-Beaufort area from the late 1970s to present. Fyke nets, or fish traps that are used for research, sampled between the Mackenzie River area and the Colville River as part of these studies. Considerable data were gathered and the biology of key fish species (including: least cisco, arctic cisco, broad whitefish, Dolly Varden) was examined in detail.

Regarding arctic cisco, the current understanding is that possibly all successful spawning for this species takes place in the Mackenzie River drainages. The life history pattern is as follows: the young-of-the-year move down the Mackenzie River in the spring, they become 'entrained' in the wind-driven currents along the Beaufort coast, and depending on the strength of those currents, drift to the west. If the east winds are consistent and sufficiently strong, the young fish will make it to the Colville River. If not, they do not make it there. This model was sufficiently consistent that researchers could reasonably predict when the young-of-the-year (YOY) would arrive at different net sites along the Beaufort coast; based solely on wind speed and direction.

Once the YOY arctic cisco become established in the Prudhoe area and they grow to catchable size (in a 3" net) in 5 to 7 seven years. Their growth rates are variable so they are not necessarily caught at one specific age. In fact, there is some evidence that in the "heavy" recruitment years there are some density-dependent effects that slow fish growth (i.e., if there are many fish in the Colville they do not grow as fast).

In catch data for the Helmericks commercial fishery and at Nuiqsut, there is great annual variability. Researchers believe that this variability is explained mostly by good recruitment years and poor recruitment years but also by the salinity of the Colville Delta and other factors such as Mackenzie recruitment. Variation in the abundance of young-of-the-year arctic cisco caught in Prudhoe in fish traps also demonstrates the variable nature of the recruitment.

Dr. Larry Moulton found that fyke net (fish traps) catches at specific stations can be used to predict the following year's catch in the Colville. Dr. Benny Gallaway noted that YOY catches translate to potential catch in Nuiqsut many years later but density-dependent survival can "muddy" these long-range predictions.

An examination of all the YOY recruitment data since the early 1980s, shows that there was variable but 'consistent' recruitment through the 1980s, peaking in summer 1990. From 1991 to 2002, YOY recruitment has been spotty and there are several year classes were essentially absent. The thinking is that these gaps are now reflected in the low catches in Nuiqsut.

Previous work on arctic cisco was mainly associated with permit requirements for the Endicott and West Dock causeways. The NSB Scientific Advisory Committee reviewed a large amount of data and reports. Their review suggested that the key concerns regarding: (a) whether certain fish species could migrate around the Endicott causeway, and (b) whether the causeway caused major detrimental habitat effects, were satisfactorily answered. Using accepted fisheries research techniques, major effects were not noted, however, minor delays and changes in water quality did occur. Therefore, the Endicott causeway (and likely the West Dock causeway) likely does not block arctic cisco recruitment into the Colville.

Fisheries models predicted that the arctic cisco catches should have increased in fall 2002 at Nuiqsut. Catches were higher than 2001 but were not considered acceptable by village fishermen. Dr. Moulton pointed out that this could be partly explained by recent fall flooding bringing more fresh water into the Colville Delta. Arctic cisco prefer brackish water for overwintering so the fresh water may have 'pushed' the fish into the Delta front and away from the traditional fishing areas. There is evidence from the summer 2002 fish studies, that a "large" size class of YOY arctic cisco will be available for the 2003 fall fishery at Nuiqsut. The 2003 catch levels in 2003 will be critical in determining if: (a) current fisheries models are useful for predicting catches, or (b) if other factors are now driving arctic cisco abundance in the Colville River. Other factors include: recruitment changes in the Mackenzie River, more fresh water in the Colville Delta, mortality from unknown sources, unknown industry effects (e.g., near Prudhoe Bay), and changes in arctic weather patterns that may have affected along-shore transport.

Discussion from the Barrow IUM

Chuck Mitchell: Were they catching the same size class?

Craig George: The same net was used so they were always catching the same size class. They hit the fishery when they are five to six years old; there seems to be a decadal cycle.

Chuck Mitchell: It follows a similar decadal pattern as what we see in southern California.

Craig George: They should have shown that long-term pattern. We expect that the catch will increase soon if we are right about the decadal pattern.

STATUS OF THE ARCTIC CISCO POPULATION IN THE CENTRAL ALASKAN BEAUFORT SEA

Robert G. Fechhelm, Ph.D.

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For over two decades BP Exploration (Alaska), Inc. has conducted summer fish monitoring programs in the coastal water of the Beaufort Sea near Prudhoe Bay, Alaska. The goal of these studies is to monitor the health and status of regional fish stocks that are important to local subsistence and commercial fisheries. Fish are collected using fyke nets, which are life-capture entrapment devices. Fyke netting is conducted on a continuous basis from about late June through August of each year. Information collected over the years probably represents one of the largest continuous databases ever compiled on Arctic fishes anywhere in the world. One species of particular interest is the Arctic cisco (*Coregonus autumnalis*).

Arctic cisco spend each winter in freshwater river systems, but they disperse out into coastal waters during summer to feed. One of the unique features of the central Alaskan population is that in some years large numbers of newly hatched fish, or young-of-the-year (YOY), are collected in the nets, while in other years very few are caught. In years in which there are large numbers of YOY, they typically appear in the nets very suddenly in mid to late August. Over the years, a rather consistent pattern has been observed. Summers in which large numbers of YOY are caught are characterized by strong persistent east winds. Summers in which few YOY are caught are characterized by weak east winds or west winds. This correlation between wind and the arrival, or recruitment, of YOY Arctic cisco has led to the "Canadian Recruitment" hypothesis first put forth by Gallaway et al. (1983). Under this hypothesis, many of the Arctic cisco found in the central Alaska Beaufort Sea are believed to originate from spawning grounds in the Mackenzie River system of Canada. In spring, YOY are flushed downriver. In summers with strong and persistent east winds, many YOY are transported westward to Alaska by wind-driven coastal currents. Once in Alaska they take up residence in some of the larger river systems like the Colville. They remain in the Colville River until the onset of sexual maturity beginning at about age 7, at which point they migrate back to the Mackenzie River to spawn.

The correlation between summer wind patterns and the abundance of different year classes in Alaska that is regularly observed in the fyke net studies can also be observed in the Colville River fisheries. Comparisons between commercial catches dating back into the late 1970s with summer wind patterns also show a strong correlation. Year classes that strongly contribute to the fishery were spawned in years characterized by strong easterly winds during summer. Year classes that have been absent in, or have weakly contributed to, the fishery were spawned in years characterized by weak east to west winds.

Two decades of analysis indicate that in summers characterized by weak east to west winds, few YOY Arctic cisco are recruited into Alaskan waters. These missing year classes will subsequently be absent from the Colville River subsistence and commercial fisheries some 5 to 8 years later when they would normally have grown to a size that would make them susceptible to gill nets.

The summers of 2000 and 2001 were characterized by weak easterly and westerly winds. There was no recruitment of YOY Arctic cisco into the Prudhoe Bay region in either year. These missing year classes should negatively affect the Colville River fishery beginning in about 2006-2007 and lasting through 2009-2010.

Discussion from the Barrow IUM

Waska Williams, Jr.: Won't there always be a fluctuation? You can't always blame industry.

Bob Fechhelm: If there is recruitment, the population is staying healthy. Some do well, some don't. The 1985 year class was strong and then declined after that.

Emma Mongoyak: The fish were squishy in the nets; they looked unhealthy.

Bob Fechhelm: I don't know. Overwintering may be a factor; in 1997 they may have done well because they have access to an overwinter area.

Todd O'Hara: If you find unhealthy fish, a state fish pathologist can analyze the problem. They will find that mechanism rather than funding a research study.

MMS STUDY PLANS FOR ARCTIC CISCO

Cleve Cowles, Ph.D.

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MMS study plans for Arctic cisco include a workshop on the Variability in Abundance of Arctic Cisco in the Colville River and a study on Beaufort Sea Anadromous Fish Overwintering Habitat

The purpose of the *Variability in Abundance of Arctic Cisco in the Colville River* workshop is to gather individuals with traditional and scientific knowledge about Arctic cisco abundance and fishing success, stock exploitation, long-term climate related changes, fisheries modeling and Arctic cisco genetics to identify factors that might contribute to observed variation in Arctic cisco abundance and to recommend a study design for further scientific inquiry.

The MMS Alaska OCS Region is interested in use of scientific methods, remote sensing sources, local and traditional knowledge to update our understanding of overwintering habitat in the Beaufort Sea. The *Beaufort Sea Anadromous Fish Overwintering Habitat* study is envisioned to be a 2 1/2 year effort that shall review scientific, local and traditional knowledge on overwintering locations, focus additional scientific attention on potential synthetic aperture radar (SAR) and other remote sensing techniques for identifying habitat, and verify conclusions from remote sensing methods with field work to detect fish presence or absence and the characteristics of the identified habitats. The study shall emphasize close coordination between the project's scientists, local subsistence fishers, local organizations, and MMS in its execution. Study information is essential for identifying potential effects of offshore development in the Beaufort Sea through environmental impact analysis.

The purpose of this study is to collect scientific, local, and traditional knowledge about anadromous fish overwintering habitats that could be affected by oil spills or ice roads constructed to support offshore oil and gas development. The habitats that anadromous fish use for overwintering may include rivers and lakes that serve as water sources for ice roads and nearshore estuarine areas. The information from this study is needed to support environmental assessments, Environmental Impact Statements, and other pre- and post-leasing decision documents related to Federal offshore gas and oil leasing in the Beaufort Sea.

Discussion from the Barrow IUM

Harry Brower, Jr.: In monitoring Nuiqsut in the fall, do you know of timing changes? Now we are seeing more rain coming down, increasing the depth in the river. Can you use that in predictions associated with low recruitment or movement into the river? Or are they not coming into the river?

Cleve Cowles: That could be another factor. We're not making any predictions right now, but we will take that into consideration in future studies. Rain is likely an influence for fishes in the river.

Craig George: Whoever does the analyses might want to consider an adjustment for the late season flooding because it changes the catch rates.

Harry Brower: Will patterns continue to affect river systems in terms of tidal movements? Salt in water is more preferred for the fish.

Cleve Cowles: That might be a recommendation.

Vera: Because of the Alpine berm, bigger fish aren't coming. Are the fish smaller due to the vibrations occurring at Alpine? Possibly it's the water temperature difference around the causeway. There's one area where it's warmer on one side and colder on another side. Have they fixed that? They have gone as far as fixing the temperature of the water-it should be equal on both sides.

Cleve Cowles: There is information out there on industry studies that might explain that. We have industry data.

Bob Fechhelm: The only change I noticed is the second causeway (the West Dock), which was mitigated in 1995. In 1996, as soon as they put in a 200 m breach, the humpback whitefish extended their distribution far to the east.

Unidentified: Bigger fish haven't arrived or aren't coming through.

Craig George: The bigger fish might not be hitting the nets until next fall. The villagers were wondering about the causeways, whether the young make it over and more recently, over the installation of a pipeline under the river, which is a concern. There's been more development and people are wondering if that affects fish catches. Some other theories like storms, which form berms, and ice across the delta. If the roads are grounded, it makes a dam preventing the fish from coming in. You can model the flow volume to calculate flood and river flow.

Steve Treacy: There will be a workshop to discuss all of these possibilities.

Sathy Naidu: Is there a time series on river flow? There are so many environmental parameters.

Craig George: USGS can model this and have gauges and a fair amount of information on river flow. They take temperature and salinity measurements.

ATTACHMENT I - AGENDAS

Minerals Management Service (MMS) – Alaska Outer Continental Shelf (OCS) Region
9th Information Transfer Meeting (ITM): March 10-12, 2003
Sheraton Anchorage Hotel

AGENDA

Monday, March 10, 2003

8:00 am **Registration**

8:45 am **Minerals Management Service Introduction**

Welcome to the ITM and the Alaska Environmental Studies Program
Cleve Cowles, Ph.D, Chief, Environmental Studies Section, Minerals Management Service, Alaska Outer Continental Shelf (OCS) Region

Alaska OCS Region Activities and Environmental Assessment Processes
Mr. Paul Stang, Regional Supervisor for Leasing and Environment, MMS, Alaska OCS Region

Questions and Answers of MMS speakers

Physical Oceanography

9:15 am **Water and Ice Dynamics in Cook Inlet**
Mark Johnson, Ph.D., School of Fisheries and Ocean Sciences, University of Alaska Fairbanks (UAF)

Measurements of Temperature, Salinity, and Circulation in Cook Inlet, Alaska
Steve Okkonen, Ph.D., Institute of Marine Sciences, UAF

9:45 am **Break**

10:00 am **Synthesis and Collection of Meteorological Data in the Near Shore Beaufort Sea**
Steve Mackey, Hoefler Consulting Group

10:30 am **Alaska Sea Ice Atlas**
Orson Smith, Ph.D. and William J. Lee, UAA School of Engineering

11:00 am **Beaufort Nearshore Under-Ice Currrents**
Tom Weingartner, Ph.D., Institute of Marine Science, UAF, *Presented by Steve Okkonen, Ph.D.*

11:30 am **Summary of Workshop on Physical Oceanography in the Beaufort Sea**
Tom Weingartner, Ph.D., Institute of Marine Science, UAF, *Presented by Steve Okkonen, Ph.D.*

11:45 am **Lunch**

Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA)

1:00 pm **ANIMIDA Introduction**
Paul Boehm, Ph.D., Battelle, Coastal Resources and Ecosystems Management

1:15 pm **ANIMIDA Subtopic: Hydrocarbon and Metal Characterization of Sediments, Bivalves and Amphipods**
Mr. John Brown , Battelle, Coastal Resources and Ecosystems Management

1:45 pm **ANIMIDA Subtopic: Sources, Concentrations, and Dispersion Pathways for Suspended Sediment**
John Trefry, Ph.D., Division of Marine and Environmental Systems, Oceanography Program, Florida Institute of Technology

2:15 pm **ANIMIDA Subtopic: Partitioning of Potential Contaminants Between Dissolved and Particulate Phases**
Robert Rember, Ph.D., Division of Marine and Environmental Systems, Oceanography Program, Florida Institute of Technology

2:45 pm **ANIMIDA Subtopic: Monitoring in the Boulder Patch**
Ken Dunton, Ph.D., University of Texas at Austin, Marine Science Institute

3:15 pm **Break**

3:30 pm **ANIMIDA Subtopic: Baseline Characterization of Anthropogenic Contaminants in Biota**
Bob Spies, Ph.D., Applied Marine Sciences

* **ANIMIDA Subtopic: Annual Assessment of Subsistence Whaling Near Cross Island**
*(*For presentation time see Social Science and Economics discipline section on day 3)*

Fate and Effects

4:00 pm **A Nowcast/Forecast Model for the Beaufort Sea Ice-Ocean-Oil Spill System**
Jia Wang, Ph.D., International Arctic Research Center, Frontier Research System for Global Change, UAF

4:30 pm **Workshop on Sea Ice Circulation/Interaction Modeling for Nearshore Beaufort and Chukchi Sea**
Jia Wang, Ph.D., International Arctic Research Center, Frontier Research System for Global Change, UAF

4:45 pm **End of Day One**

Tuesday, March 11, 2003

Fate And Effects (continued)

8:00 am **Registration**

8:30 am **Environmental Sensitivity Index Shoreline Classification in the Arctic**
Ed Owens, Polaris Applied Sciences, Inc.

9:00 am **Petroleum Hydrocarbon Degrading Communities in Beaufort Sea Sediments**
Joan Braddock, Ph.D., Institute of Arctic Biology, UAF

9:30 am **Trace Metals and Hydrocarbons in Sediments of Elson Lagoon (Barrow, Northwest Arctic Alaska) as Related to Prudhoe Bay Industrial Region**
Sathy Naidu, Ph.D., Institute of Marine Science, UAF and M. Indira Venkatesan, Ph.D., Institute of Geophysics and Planetary Physics, University of California at Los Angeles

10:00 am **Break**

Biology

10:15 am **Recently Initiated Coastal Marine Institute Biological/Ecological Studies:**
- **Role of Grazers on the Recolonization of Hard-Bottom Communities in the Alaska Beaufort**
- **Susceptibility of Sea Ice Biota to Disturbances in the Shallow Beaufort Sea, Phase I: Biological Coupling of Sea Ice with Pelagic and Benthic Realms**
- **King and Common Eider Migrations Past Point Barrow**
- **Population Structure of Common Eiders Nesting on Coastal Barrier Islands Adjacent to Oil Facilities in the Beaufort Sea**
- **Breeding Biology and Habitat Use of King Eiders on the Coastal Plain of Northern Alaska**

Vera Alexander, Ph.D., Director, Coastal Marine Institute, UAF

10:45 am **Modeling Recovery Rates for Avian Populations**
James Barry Grand, Ph.D., Alabama Cooperative Fish & Wildlife Research Unit, Auburn University

Protected Species

11:15 am **Monitoring Beaufort Sea Waterfowl and Marine Birds**
Paul Flint, Ph.D., U.S. Geological Survey (USGS), Biological Resources Division

11:45 am **Lunch**

1:00 pm **Use of the Beaufort Sea by King Eiders**
Abby Powell, Ph.D., Institute of Arctic Biology, UAF

1:30 pm **Monitoring the Distribution of Arctic Whales**
Mr. Steve Treacy, MMS, Alaska

2:00 pm **Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information**
John Richardson, Ph.D., LGL Ltd., Environmental Research Associates

2:30 pm **Reference Manual and GIS Overlays of Oil-Industry and Other Human Activity (1979-1998) in the Beaufort Sea**
Mr. Peter Wainwright, LGL Ltd., *Presented by W. John Richardson*

Analysis of Covariance of Human Activities and Sea Ice in Relation to Fall Migrations of Bowhead Whales
W. John Richardson, Ph.D., LGL Ltd.

3:00 pm **Break**

3:15 pm **Correction Factor for Ringed Seal Surveys in Northern Alaska and Timing and Re-interpretation of Ringed Seal Surveys**
Oriana Harding, Juneau Center, School of Fisheries and Ocean Science, University of Alaska Southeast

3:45 pm **Polar Bear Den Surveys**
Steve Amstrup, Ph.D., USGS, Biological Resources Division,

4:15 pm **Use of Sea Ice Habitat by Polar Bears in the Southern Beaufort Sea**
George M. Durner (and Steve Amstrup, Ph.D.), USGS, Biological Resources Division

4:45 pm **End of Day Two**

Wednesday, March 12, 2003

Protected Species (continued)

7:30 am **Registration**

8:00 am **Satellite Tracking of Eastern Chukchi Sea Beluga Whales in the Beaufort Sea and Arctic Ocean**
Robert Suydam, Ph.D., North Slope Borough, Department of Wildlife Management

8:30 am **Alaska Marine Mammal Tissue Archival Project: Website Development**
Geoff York, USGS, Biological Resources Division

9:00 am **Demography and Behavior of Polar Bears Feeding on Stranded Marine Mammal Carcasses**
Ms. Susi Kalxdorff, U.S. Fish and Wildlife Service

9:30 am **Break**

Social Science and Economics

9:45 am **Publication of a Book/Synthesis on the Socioeconomic Effects of Oil and Gas Industry Activity on the Alaska OCS**
Mr. Stephen R. Braund, Stephen R. Braund & Associates

10:15 am **Quantitative Description of Potential Impacts of OCS Activities on Bowhead Whale Hunting and Subsistence Activities in the Beaufort Sea**
Michael Downs, Ph.D., and John Russell, Ph.D., EDAW, Inc.

10:45 am **Subsistence Mapping at Nuiqsut, Kaktovik, Barrow, and Wainwright: Past and Present Comparison**
Mr. Stephen R. Braund, Stephen R. Braund & Associates

11:15 am	**Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA) Subtopic: Annual Assessment of Subsistence Whaling Near Cross Island** *(see day 1 for other ANIMIDA subtopics)* Mr. Michael Galginaitis, Applied Sociocultural Research
11:45 am	**North Slope Borough Economy, 1965 to Present** Mr. Pat Burden and Leah Cuyno, Ph.D., Northern Economics Inc.
12:15 pm	**Lunch**

Other

1:30 pm	**Fault-Tree Approach to Alternative Oil Spill Occurrence Estimators for the Beaufort/ Chukchi Sea OCS** Frank Bercha, Ph.D., Bercha Group
2:00 pm	**Beaufort Sea and North Slope Pipeline GIS Database** Mr. John Eldred, Michael Baker, Jr. Inc.
2:30 pm	**End of meeting**

Minerals Management Service (MMS) Alaska Outer Continental Shelf (OCS) Region
Information Update Meeting - Iñupiat Heritage Center, Barrow, Alaska

Agenda

Friday, March 14, 2003

8:00 am	**Registration**
8:15 am	**Introduction** Cleve Cowles, Ph.D., Chief, Environmental Studies Section, MMS, Alaska OCS Region, Anchorage, Alaska Mr. J. Craig George, Wildlife Biologist, Department of Wildlife Management, North Slope Borough
8:30 am	**Trace Metals and Hydrocarbons in Sediments of Elson Lagoon (Barrow, Northwest Arctic Alaska) as Related to Prudhoe Bay Industrial Region** Sathy Naidu, Ph.D., Institute of Marine Science, University of Alaska Fairbanks, Fairbanks, Alaska
9:00 am	**Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA) – Overview of a Multi-Year Monitoring Program in the Nearshore Beaufort Sea** Mr. John Brown, Coastal Resources and Environmental Management, Waltham, Massachusetts
9:30 am	**Seabird Samples as Resources for Marine Environmental Assessment** Ms. Deb Rocque, University of Alaska Fairbanks Museum, Fairbanks, Alaska
10:00 am	**Break**
10:15 am	**Seabird Samples as Resources for Marine Environmental Assessment** Ms. Deb Rocque, University of Alaska Fairbanks Museum, Fairbanks, Alaska
10:45 am	**Qaaktaq (Arctic Cisco)** **Harvest Trends**: Mr. J. Craig George, Wildlife Biologist, NSB, Department of Wildlife Management **Population Status**: Robert Fechhelm, Ph.D., LGL Alaska Research Associates, Inc. **MMS Study Plans**: Cleve Cowles, Ph.D., Chief, Environmental Studies Section, MMS, Alaska OCS Region, Anchorage, Alaska
11:15 am	**Use of Sea Ice Habitat by Polar Bears in the Southern Beaufort Sea** George M. Durner and Steven Amstrup, Ph.D., U.S. Geological Survey, Biological Resources Division, Anchorage, Alaska
11:45 am	**Lunch**
1:15 pm	**A Description of Potential Impacts of OCS Activities on Bowhead Whale Hunting and Subsistence Activities in the Beaufort Sea** Michael Downs, Ph.D. and John Russell, Ph.D., EDAW, Inc, San Diego, California
1:45 pm	**Subsistence Mapping at Nuiqsut, Kaktovik, Barrow, and Wainwright: Past and Present Comparison** Mr. Stephen R. Braund, Stephen R. Braund & Associates, Anchorage, Alaska
2:15 pm	**ANIMIDA Subtopic: Annual Assessment of Subsistence Whaling Near Cross Island** Mr. Michael Galginaitis, Applied Sociocultural Research, Anchorage, Alaska
2:45 pm	**Break**
3:00 pm	**Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information** W. John Richardson, Ph.D., LGL Ltd., environmental research associates, King City, Ontario, Canada
3:30 pm	**Monitoring the Distribution of Arctic Whales** Mr. Steve Treacy, MMS, Alaska OCS Region, Anchorage, Alaska
4:00 pm	**General Question and Answer Period**
4:30 pm	**End of Meeting**

ATTACHMENT I I -ATTENDEE LISTS

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