FINAL REPORT
2017 Oceanography Program
Kaktovik, Alaska

prepared for

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Sponsored by

Bureau of Ocean Energy Management

City of Kaktovik

United States Geological Survey

The University of Texas at Austin, Marine Science Institute

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Program Organization

The annual Kaktovik Summer Oceanography Program (KOP) was taught at the Kaktovik Community Center and the Harold Kaveolook School in Kaktovik, Alaska from 7-12 August 2017. The University of Texas at Austin, Marine Science Institute (UTMSI), U.S. Fish and Wildlife Service (USFWS), and the United States Geological Survey (USGS) jointly designed and implemented the program. Cliff Strain, an ocean sciences middle school teacher at Flour Bluff School District, Texas and Marilyn Cook, an elementary school teaching at the Port Aransas School District, Texas served as the lead program teachers. UTMSI graduate student Craig Connolly, along with Dr. Ken Dunton (UTMSI) and Allyssa Morris, Arctic National Wildlife Refuge (ANWR) Outreach Coordinator, coordinated the program, and were assisted by UTMSI graduate students Christina Bonsell and Arley Muth. In addition, Will Wiese, Elyssa Watford, and Jessica Herzog (USFWS) led a guest scientist lesson on capturing Eider birds and bird egg dissection. Dr. Vanessa von Biela (USGS) led a guest scientist lesson on common lagoon fish species capture and identification, and otolith aging and dissection. Linsday Carron (USFWS Artist in Residence) led an imaginative activity connecting students with ocean animals in local lagoon ecosystem food webs. Cathy Coon, BOEM Program Manager and Chief of the Environmental Sciences Section, also assisted the instructors for activities conducted in both the lab and the field.

Students (*older than 9) Mon-Wed	
Edwin Solomon*	Kaden Kulukhan
Dora Gordon*	Mya Arshanas
JD Tikluk*	Collin Solomon
Jim Allen Killbear*	Zachary Tagarook
Janette Killbear*	Gizelle Gorden
Billy Fred Killbear*	Trinity Thompson
Troy Soplu*	Maria Solomon
Cora Soplu	Lucas Aishanna
Damion Rexford	Skyla and Sady

This year, we focused our program on all school level students, ranging from elementary to high school. Our theme was “Exploring our Oceans!” Humans have explored less than 5% of our world’s oceans and scientists are discovering new ocean species and features daily. Our aim was to expose students to diverse techniques and technologies that scientists use for ocean

exploration, and help them better understand the unique coastal zone of the Beaufort Sea. As a part of the KOP, students had the opportunity to become scientists and experience how ocean exploration takes place by learning fieldwork skills and lab techniques from expert biologists, chemists, and geologists. We took advantage of our unique location on an Arctic barrier island and used Kaktovik lagoon as a natural classroom. With the advantage of having two public schools teachers who specialize in the elementary and middle school levels, we were able to conduct simultaneous, but separate program activities specifically targeted for the ages 6-9 and 10+ learning groups. Moreover, for the very first time our team successfully facilitated in-classroom lab and field activities that were integrated into the first two days of class for all K-12 school grade levels. We hope to continue this trend and collaboration with Kaktovik teachers Eric Krauss, Ann Washburn, and Todd Washburn (Principal). As an attendance incentive, students who attended every day of the program prior to the start of school (Mon-Wed) were entered into a drawing to win a monocular prize. On average, 14 students attended the program Monday through Wednesday and nine were eligible to enter the drawing for the monocular lenses. Seven students in our target age range (9+) attended the program for at least one day Monday through Wednesday (Table 1). Instructors had the opportunity to work with the entire K-12, including 8th grade and high school level classes Thursday and Friday (30+ students total).

Summaries of Daily Activities

	Age 10+ Learning Group/ High School Main Activities
Monday	Welcome and fish collection and seining at lagoon; guest scientists (USFWS): Eider capture and release strategies, Eider egg dissection and biology; aquarium set-up
Tuesday	Food web discussion and game; algae pressing; food web drawing, role play, and face painting with guest, Lindsay Carron
Wednesday	Groundwater hydrology and sampling; testing freshwater and saltwater salinities using a refractometer; guest scientists (USGS): lagoon fish identification and collection on the *RV Proteus*

Thursday (High School)	Guest scientist Dr. Vanessa von Biela (USGS): Otolith aging, dissection, and analysis; introduction to using a handheld GPS; GPS latitude/longitude and tracking activity around Kaktovik Village
Friday (High School)	Guest Scientist Dr. Ken Dunton: Beach erosion and climate change lecture; beach erosion activity on north side of Barter Island; data analysis (following Monday)
Saturday	Open House: fish printing and t-shirts; pancake breakfast; attendance prize give-away
	Age 6-9 Learning Group/ Elementary School Main Activities
Monday	Science safety; using science tools (thermometer, wind meter, cloud chart, map, hand lens); field observations of clouds; tundra model-plants; water collection and microscope observation from lagoon; animal sorting book
Tuesday	Cloud observations w/ field notebook; making a cloud demonstration; tundra model-mammals; fur and feathers book
Wednesday	Cloud observations w/ field notebook; tundra model-birds; Eider group presentation; activity w/ Lindsay, Artist in Residence; water collection and microscope observation from lagoon
Thursday (Elementary School)	Grades 1-2: The Glaciers are Melting book, tundra model, birds, research presentation; grades 3-4: tundra model, eclipse, On the Move migration book; grades 5-7: eclipse, discussion and model
Friday (Elementary School)	Grades 1-2: tundra model-fish, food chain with research presentation, making a food chain; grades 3-4: On the Move book about migration, food chain, tundra model, eclipse; grades 5-7: research presentation on diving and oceanography, making a food chain
Saturday	Community open house; blubber mitten; fish printing; cloud observation award; young scientist award

Age 10+ Learning Group/ High School Main Activities

On the first day of the program (Monday), students learned to pull a seine net to capture fish and invertebrates along the shoreline of Kaktovik Lagoon. Students later identified these organisms and added them to an aquarium tank in our classroom for observation. The biota collected included various fish, mysids, amphipods, and seaweeds. In the afternoon, the USFWS Eider Crew joined us for a guest scientist lesson. They led an activity on various techniques their team uses to capture eiders in the field, allowing students to use different equipment to capture plastic eiders. Following, the Eider Crew led a laboratory exercise where students had the opportunity to dissect eider eggs to learn about and observe their biology.

On Tuesday morning, Christina Bonsell led a food web discussion with an emphasis on the concept of energy transfer from the sun through primary producers, primary consumers, secondary consumers and apex predators. These trophic linkages were discussed in detail in terrestrial and marine ecosystems around Barter Island. Christina then led a discussion on seaweeds, initiating conversations about the role of primary producers in ecosystems and compared seaweeds with terrestrial plants. The students then created seaweed herbarium pressings and marine art. With USFWS Artist in Residence, Lindsay Carron, students continued to learn about trophic levels and played a food web game that included drawing their favorite Arctic plant or animal and discussing how these organisms are connected in a hypothetical food web by role playing their interactions. As a part of the role-playing activity, Lindsay painted the faces of several students to resemble the animal that they embody.

Wednesday morning students started the day with Craig Connolly, learning about groundwater hydrology, and where groundwater flows on Barter Island. Students had the opportunity to collect groundwater samples using piezometers (groundwater wells), which were analyzed in the lab for salinity using a refractometer and compared to lagoon water. In the afternoon, Dr. Vanessa von Biela conducted a fish identification and collection activity on the *RV Proteus* with Dr. Ken Dunton and co-boat captains Ted and John Dunton. During the activity, students learned the science of taxonomy using pre-made keys to identify and classify the various kinds of fish species that live in the lagoon

habitat. Following, we conducted a zooplankton and phytoplankton species identification lab using compound and dissecting microscopes. Students were asked to draw and identify the species of plankton.

Thursday was our first day with the 8th and high school grade levels. Dr. Vanessa von Biela began the day with an introduction of her work as a USGS scientists, and discussed the how otoliths (fish ear bones) can be used to understand fish biology and the age of the species of interest. Vanessa than demonstrated how to dissect the head of the fish (that were caught in the lagoons the previous days) using a dissecting kit. Following, students formed teams of two and extracted the otoliths using the method Vanessa outlined. Cliff Strain led a lesson on how to dissect and extract the stomachs of the fish, and how to perform a gut analysis using compound microscopes to determine fish diet. Instructors and teachers assisted students throughout the dissecting activities. Following, students had the opportunity observe the otoliths under dissecting and compound microscopes. Vanessa then reinforced the topic of aging with otoliths by using Play-Doh to demonstrate how fish form new layers to their otolith each year, and how scientists take a cross section of the otolith to count age rings. Students had the opportunity to slice through layers of Play-Doh that they had made and count the age of their "otolith." Thursday afternoon, Cliff demonstrated how latitudinal and longitudinal measurements are made on earth and began teaching students how to use hand-held GPS units. As a part of the activity, students were asked to write down the latitude and longitude, and make a waypoint, at three designated locations around Kaktovik village. They were also given GPS coordinates to locate and write down where the coordinates took them (for instance, the Kaktovik Village welcome sign).

On Friday morning, Ken Dunton gave the 8th grade and high school classes a presentation on climate change and coastal erosion in the Arctic to provide context and background knowledge for the afternoon erosion survey activity. Students were very knowledgeable about current and on-going impacts of warming on Barter Island and it's surrounding ecosystems. We then ventured out towards the bluffs for our annual GPS-based survey of beach cliff erosion. Students were given a specific protocol to conduct a more systematic survey of coastal erosion that could be easily repeated year after year. In

doing so, our hope was to create a more standardized protocol to estimate coastal erosion, providing the students and teachers ownership of the data they collect and the responsibility to analyze the data in subsequent years. During the activity, students were divided into groups of three and four with an instructor in each group. Two groups conducted the survey from above the cliff, while two groups conducted the survey at the base of the cliff. Each group was responsible for recording GPS coordinates at the top or base of the bluff as a mark of the extent of the cliff, and as a baseline to make future erosion estimates. Each group was also responsible for taking a picture of the extent of erosion (from top-down and bottom-up views) and making field observations of thermokarst features (such as exposed permafrost or large hanging cliffs). A stake was put into the ground ~50 ft from the edge of the top of the cliff where GPS coordinates were taken, which will be used as a baseline for changes in cliff erosion over time. Following, Eric Krauss gave each group responsibility to enter in the data they collected, and consolidate photos and field observations. The following Monday, Craig, Cliff, and Eric continued the activity, demonstrating how the students can enter the GPS coordinates into Google Earth (which was installed on each students laptop computer) and use the "historic view" feature to compare the current and past extent of the bluffs. Data entered into Google Earth can also be used for future comparisons as more survey data is collected in subsequent years. We followed this with a discussion of the accelerated rates of erosion on Barter Island.

On Saturday, all KOP instructors participated in a Kaktovik "Fun Run" with the community. Following, the KOP held an open house at the Community Center, where we displayed all of the activities of the program for the parents and students. We also provided refreshments. Students demonstrated to their parents and local teachers how to use microscopes to examine plankton, how to dissect fish heads, and showed off their algae pressings and other artwork. Over twenty community members, including elders and adults, attended the open house.

Age 6-9 Learning Group/ Elementary School Main Activities

Texas public school teacher, Marilyn Cook and UTMSI graduate student, Arley Muth led daily activities with the age 6-9 learning group. On Monday, students started

the day learning about science safety; they created their own field book and began learning about the variety of tools that we as scientist use everyday to measure and observe climate. Some of these tools included a thermometer, wind meter, cloud chart, map, and hand lens. Following, field observations of cloud cover were made with the cloud chart. Instructors then demonstrated how this data can be used by the scientific community as a whole by inputting the data into NASA's climate observation website. Here students were given another chance to learn about ground-truthing data by entering the date, time, air temperature, cloud chart, and name of the cloud type. Following, students began making a tundra model diorama. Each day, the students learned something new about the tundra ecosystem and added some artwork related to what they learned to their tundra model. The first day, students learned about and included tundra plants in their model. As a break, instructors read the book "What's the Difference," which discussed differences in various animals. Afterwards, students were taken to the edge of Kaktovik Lagoon to collect water samples, which were used for microscope observations back in the Kaktovik Community Center.

On Tuesday, students continued their daily cloud observation and classification with their data field notebooks. Students learned about tundra mammals, which they included in their models. Tuesday's book reading "Fur and Feathers" was about animal classification.

On Wednesday, students continued their daily cloud observation and classification with their field notebooks. Arctic birds were included in their tundra model, which built on the presentation given by the FWS Eider group. Following, Lindsay Carron (FWS Artist in Residence) conducted an activity with the students and painted their faces to resemble their favorite Arctic animal. To end the day, students collected more water at the edge of Kaktovik lagoon, which they took back to observe under the microscope once again.

On Thursday, instructors and KOP activities were integrated into the classrooms of grades K, 1-2, 3-4, and 5-7. For the kindergarten students, instructors read the book; "In Arctic Waters," and discussed various animals with sorting cards at a visual learning aid. In grades 1-2, Marilyn and Arley taught students about Arctic warming and melting

glaciers by reading the book: “The Glaciers are melting.” Students also continued working on their tundra model. Arley then gave a presentation on her graduate research. Instructors ended the classroom activity with a discussion on birds. In grades 3-4, students began the lesson by continuing to work on their tundra model. Students also learned about how solar eclipses develop over time. Instructors taught students about animal migration by reading the book: “On the Move.” In grades 5-7, instructors began the lesson by teaching students how solar eclipses form, but more in a more advanced way for the old kids. Instructors facilitated a discussion on eclipses with the students.

On Friday, instructors and KOP activities were again incorporated into the school schedule. For the kindergarten, students learned about animal migration and adaptation while instructors read the book: “On The Move.” They also created a whale model and participated in the “blubber mitten” activity, demonstrating how Arctic animals thermally insulate themselves to resist the extreme Arctic temperatures. In grades 1-2, students added fish to their tundra model and learned about food chains from a research presentation by Arley. Students participated in making their own food chain. In grades 3-4, students learned about animal migration from the book: “On the Move.” Students also continued to work on their tundra model, and learned about food chains and solar eclipses. In graders 5-7, Arley gave a more advanced presentation on diving and oceanography. Students also learned about food chains and participated in making a food chain.

On Saturday, the community center open house was held. The younger age groups were allowed to show their parents what they learned about animal adaptations by making a blubber mitten. Students also participated in fish printing and cloud observations. To end, the Young Scientist Award was given to a couple of selected students for their participation and leadership in the program.

Program Assessment

Overall, the 2017 program was very successful. We were fortunate to include nearly all K-12 students from the Kaktovik Community in KOP activities throughout the week. In total, 19 students and kids participated in the KOP on Monday through

Wednesday. An additional 10+ students from the 8th grade and high school grade levels participate in field and classroom activities on Thursday and Friday. This was also the first year that we had the chance to work with the Kaktovik school teachers to integrate the KOP with the first two days of school. The teachers and principal expressed enthusiasm to continue this collaboration as a part of future KOPs. Students developed skills in a wide range of tools and technologies for exploring their local environments and investigating marine biology, geology, and chemistry. The program included hands-on science activities that focused on several important principals in marine environmental science that were interconnected across lessons throughout the week. Students applied knowledge gained in discussions and activities later in the week. They enjoyed the outside activities most of all. They especially found the hip-waders a unique way to immerse themselves in deep water without getting wet.

The high school students were very engaged in the beach erosion survey and were excited about the idea of continuing this work in future years. Prior to the start of the activity, Dr. Ken Dunton gave a presentation on the effects of Arctic warming on coastline erosion. We were happy to see that students were already very knowledgeable about the impacts of Arctic warming on Barter Island. The activity was designed and implemented to allow the students to take ownership of the data they collected and use critical thinking skills to analyze the data. Wooden stakes were installed with names of individual KOP participants or group names to encourage these students to track changes in the coastline throughout the year and for future survey efforts. The all-day field erosion activity also allowed the opportunity for high school students and instructors to work together more personally. Building these relationships are important for the continued participation and success of future KOPs. Data analysis including learning how to add erosion data onto Google Earth in order to assess current and future beach erosion. This was a particularly valuable and enjoyable learning opportunity for the students that brought together field measurements with satellite imagery. The addition of a new standardized beach erosion protocol excited Kaktovik school teachers, Eric Krauss and Ann Washburn. Their help facilitating this activity with the 8th grade and high school grade levels ensured a successful first data collect to establish baseline measurements.

Microscopy was also very popular and students really enjoyed looking at their collections of biota and geological samples up close. In addition, many students responded favorably to more creativity-based educational activities. These included the algae-pressing activity and food web drawings, using a dichotomous key to identify fictional characters, and the food web game. Artist in Residence, Lindsay Carron, led a fun activity that allowed the younger age groups to express the role of their "spirit animal" in local food web dynamics. Students had the opportunity to have their faces painted like their spirit animal and acted out their animal's role in a food web game (e.g., roles of predator versus prey). Together, KOP lessons centered around Arctic warming and coastal erosion, Eider capture and conservation, as well as food web dynamics in local lagoon ecosystems provided unique learning opportunities to connect science-based activities with important conservation and awareness initiatives of the Arctic Refuge. We hope that by inspiring the youth of Kakotvik, awareness will increase in parents and other community members, and thereby transcend joint UTMSI and ANWR outreach and learning objectives throughout the entire Kaktovik Village and other Arctic Refuge communities.

Future Suggestions

- Set expectations for safety and learning on the first day of the program and reiterate these expectations throughout the week.
- Wrap-up each day with a discussion and a take-home message.
- Provide workbooks with handouts for each planned activity instead of blank notebooks. Students seem eager to use their notebooks, but need some direction on what to write. Workbooks will help their writing skills and also help synthesize the lessons in their minds.
- Emphasize the scientific lessons. While this is more difficult with younger students, they engaged with several of the lessons this year. This would be enhanced by more discussion and writing.
- Continue with the tradition of designing and distributing t-shirts to all participants.

Acknowledgements

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Photo 1. KOP participant is observing a lagoon fish species for identification.

Photo 2. Group of high school students conducting the beach erosion survey.

Photo 3. Craig Connolly leading food web discussion and game.

Photo 4. Students pressing marine algae with Christina Bonsell.

Photo 5. Students viewing plankton under a compound microscope with Dr. Ken Dunton.

Photo 6. Students holding groundwater wells in preparation for extracting groundwater.

Photo 7. KOP participants seining in Kaktovik lagoon for fish collection and species identification.

Photo 8. USFWS Eider Crew demonstrating how to capture Eider birds.