ALASKA RESEARCH AND EVALUATION SERVICES

David Tarcy, Ph.D.
(907) 980-6447
david.tarcy@nyu.edu

ENVIRONMENTAL LITERACY THROUGH ALASKA CLIMATE STEWARDS (ELACS) GRANT, EXECUTIVE SUMMARY

Award #: NA18SEC0080011

Project Title: Environmental Literacy Through Alaska Climate Stewards (ELACS)

Recipient Name: Chugach School District

Principal Investigator: Doug Penn

Project Evaluator: David Tarcy, Ph.D.

Date: 28th September 2022

Submitted to:

Doug Penn
Principal Investigator, NOAA ELP Grant
Chugach School District
9312 Vanguard Drive
Anchorage, Alaska 99507

Sheryl Sotelo
Principal Director, NOAA ELP Grant
Chugach School District
9312 Vanguard Drive
Anchorage, Alaska 99507

TABLE OF CONTENTS

DESCRIPTION OF PROJECT

Abstract

The Environmental Literacy for Alaska Climate Stewards (ELACS) served rural K-12 Alaskan students and teachers in predominantly Alaska Native coastal villages. It provided opportunities to build understandings of how climate change impacts local environments, increase overall climate literacy, and contribute to community resilience. Participants were primarily from the Chugach School District and the Kenai Peninsula Borough School District, both located in the southcentral region of Alaska. Students and teachers in the Aleutian Region School District, Nome City Schools, and the North Slope Borough School District (southwestern, northwestern, and northern Alaska, respectively) participated to a lesser extent in novel learning experiences made available through collaborative partnerships that emerged during the grant period.

Participants from coastal Alaskan communities

Place-based, project-based learning experiences

Teachers and students were connected to a sizable network of expertise and resources

The project focused on three areas: teacher professional development, classroom instruction, and community engagement. Professional development included training in project-based learning and co-teaching/coaching sessions with master teachers. Classroom instruction engaged students in meaningful, innovative, place-based, project-based learning, and citizen-science activities focused on site and community needs. Students monitored their local environments, built or otherwise used ocean observation systems, collected data, and represented their new knowledge through presentations and art.

Significant outcomes included student work on the relationship between phytoplankton and salmon conservation in Chenega Bay, a Living History Project that engaged community members and elders with traditional ecological knowledge in Tatitlek, and engagement in weather and environmental monitoring plans for the community of Whittier (potentially threatened by tsunamis generated by unstable slopes in a nearby fjord). Students shared active research regarding impacts and available resources. ELACS aligned with and supported NOAA's educational mission by helping the target populations understand and predict changes in climate, weather, oceans, and coasts. This project promoted students' environmental stewardship and a deeper understanding of a changing environment at both local and global levels.

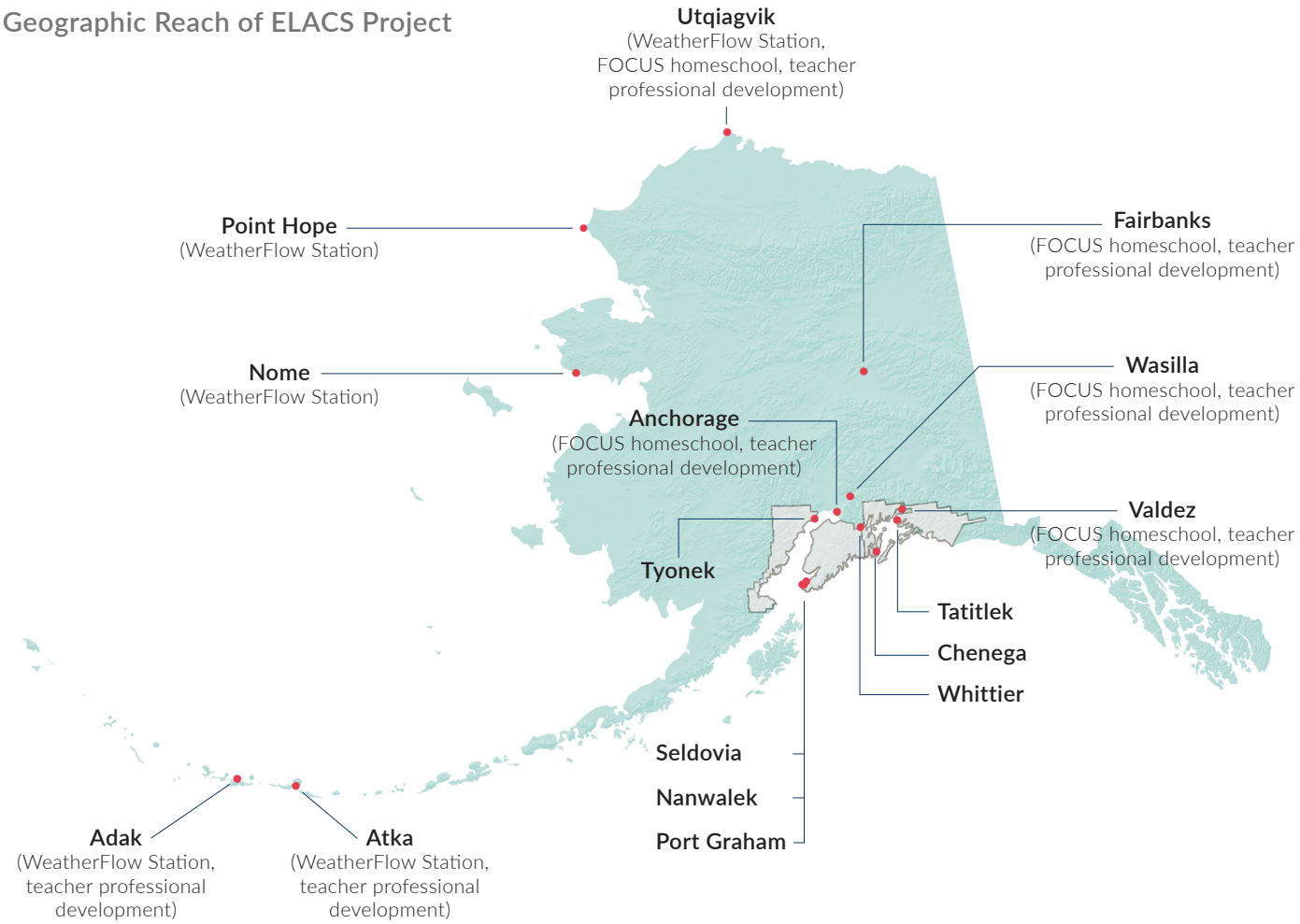
Throughout the four-year project, students and teachers worked with scientists and experts in education, climate change, and marine science using project-based learning approaches and educational technology. A notable (but not exhaustive) list of partners included researchers from NOAA's Kasitsna Bay Laboratory, the College of Fisheries and Ocean Sciences and the International Arctic Research Center (both at the University of Alaska Fairbanks), the Polar Science Center (University of Washington), Ground Truth Trekking, and the Center for Alaska Coastal Studies. Educational consultants included STEMisEd, Teknikio, NexMap, Build-A-Buoy, and EcoArt Expeditions. Corporate and non-profit partners included WeatherFlow, Inc., Batelle, Inc., Cook Inlet Tribal Council, and Alaska Science Teachers Association.

DESCRIPTION OF PROJECT

Participants & Geographic Reach

Over the course of the grant, approximately 84 teachers and administrators, and 1,080 students across six school districts were served by the ELACS project. The bulk of instruction was delivered to students in the Chugach School District, which includes an extensive home-school program (FOCUS Home School) that reaches into interior Alaska. Other school districts served included Kenai Peninsula Borough School District, Valdez City Schools, Nome City Schools, North Slope Borough School District, and the Aleutian Region School District.

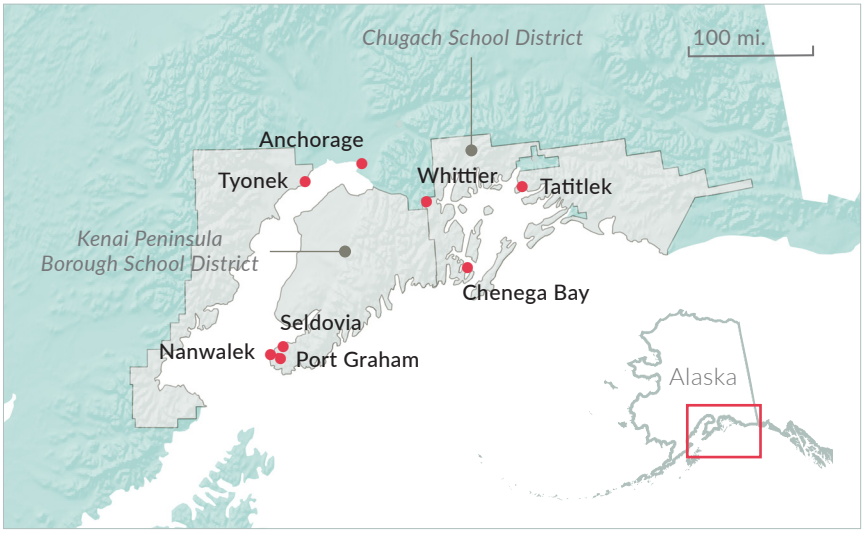
Geographic Reach of ELACS Project



Rural Alaskan students live in one of the most vulnerable regions of the planet, areas that are highly susceptible to the impacts of climate change. Alaska has warmed twice as fast as the rest of the nation and the impacts are widespread. Seasonal sea ice is rapidly declining. Thawing permafrost affects wildlife habitat and infrastructure through coastal erosion. Rising ocean temperatures and ocean acidification will alter valuable marine fisheries. In September 2022, the remnants of Typhoon Merbok exacerbated these problems for many coastal villages when they were flooded by the storm's surge.

DESCRIPTION OF PROJECT

Participating School Sites



Activities

The following list of activities was chosen to provide a sense of the scope and type of professional development and student instruction provided through the ELACS project. This list is not exhaustive.

Sea ice monitoring and research data

Three Ocean Ice Buoys, on loan from the Polar Science Center at the University of Washington, were sent to schools in the Chugach and Kenai Peninsula Borough school districts, and to FOCUS home-school sessions. Students personalized the sea ice monitoring equipment before they were returned to the Polar Science Center. The Ocean Ice Buoys are buoys that monitor ice break-up and ice floes. They were deployed into the Beaufort Sea along Alaska's northern coast in 2021 as part of the International Arctic Buoy Programme. Data collected from the ocean ice buoys and their positions can be tracked on-line by teachers and students through the Polar Science Center's website.

The school and community of Tyonek participated in the September 2019 NOAA Fisheries' Citizen Science Project, the Cook Inlet Beluga Whale Count.

Instruction in scientific illustration

A short-course in Scientific Illustration was offered on-line in two, 5-hour sessions by Lee Post, a naturalist and science educator from Homer, Alaska. Students from six different locations participated: Tatitlek, Chenega Bay, Whittier, Fairbanks, and two different locations in Anchorage. Supplies and materials for the course were distributed to teachers during an in-service training prior to the sessions.

Dr. Lee Ann Woolery, Research Director at Citizen Artist, conducted four days of professional development sessions entitled "Other Ways of Knowing

DESCRIPTION OF PROJECT

Infusing science and art

Ecological Systems in Coastal Communities Using Art-Based Perceptual Ecology (ABPE) Research Methodologies." These sessions taught teachers to applied participatory science research projects to local environmental issues. Data collection, observation, and measurement methodologies were presented that covered a broad range of environmental issues. An emphasis was placed on student engagement through haptic and sensory experiences, and reinforcement of concepts by producing art that reflected student understandings and story-telling. This on-line event replaced an in-person training scheduled to be held at the Peterson Bay Field Station, a facility of the Center for Alaska Coastal Studies located on the south shore of Kachemak Bay near Seldovia, Alaska. Because this session was held virtually, all Chugach School District teachers participated, including the FOCUS homeschool staff and the Voyage staff (who are not regular classroom instructors but run short-term, residential programs for students across the state).

Professional Development through ED570 Citizen Artist and Participatory Science Research was a 3-credit graduate-level course offered through the University of Alaska Anchorage. 17 teachers in participating schools enrolled.

Local weather observations

WeatherFlow weather stations were installed in participating and partner schools in the Chugach School District, the Kenai Peninsula Borough School District, Aleutian Region School District, Mat-Su Borough School District, Nome City Schools, Valdez City Schools, and the North Slope Borough School District: 15 school sites in total. The weather stations were purchased with moneys secured from the Batelle corporation's non-profit arm, leveraging the NOAA grant funds and project activities to secure additional funds. WeatherFlow staff were available to trouble-shoot stations if they did not accurately reflect weather conditions. Students can track weather patterns over time.

Project partners collaborated to create something new out of the resources and materials available through the project. WeatherFlow provided access and support to Teknikio so students could write code that transferred data from weather stations to personalized data displays.

Computer coding and creation of custom data displays

The founder of Teknikio, Deren Guler, instructed 80 students and 11 teachers how to write computer code to transfer data from Weather Flow Stations and seismic activity from the Alaska Earthquake Center to student projects. The students and teachers were from Port Graham, Nanwalek, Valdez, Fairbanks, Girdwood, Whittier, Chenega Bay, Tatitlek, Adak, and Atka. The students learned to code microcontrollers that were then connected to the WeatherFlow stations in various communities. The microcontrollers monitor various weather inputs. Students created customized alert systems for their schools and communities. One of the goals of this activity was to have students become producers of technology and not just consumers of it. These activities were offered to all sites that are served.

Teknikio began work with new partners Chibitronics and NexMap to produce materials and lessons for a notebook (a literal, paper notebook) that displays

DESCRIPTION OF PROJECT

real-time WeatherFlow data through the use of paper circuitry, LEDs, and microprocessors.

The University of Alaska Fairbanks worked with FOCUS middle and high school home-schoolers through an on-line course in Hydroponic Gardening. This work is tied to the NOAA grant through community resilience and food security. Additionally, the ELACS Project Director conducted on-line hydroponic sessions for students in through the Fairbanks Future Farmers of America organization, FOCUS Homeschoolers, and in Adak and Atka.

Interaction with field researchers

- Sue Saupe, with the ShoreZone program (a NOAA resource), oriented teachers to the ShoreZone website and the tools available to explore the Alaska coastline, tidal zones, and species within various bio-bands. These data sources serve as baseline for changes in the marine environment.
- A plankton study was conducted with support from Katie Gavenus of North Gulf of Alaska Long-Term Ecological Research. Water samples were collected from tidal pools. Students created a presentation of the study results. Katie also conducted a presentation about tide pools and Sea Star Wasting Disease.
- Dr. Bretwood Higman provided lessons about geological changes occurring in Prince William Sound due to receding glaciers, the destabilization of fjord walls and the potential for a landslide in Barry Arm - some 20 miles northeast of the community of Whittier - that may result in a tsunami.

Fab Lab Training and coordination with the lead instructor in Tatitlek Village. Incorporated NOAA lessons and content with the fabrication lab equipment that was acquired through a Cook Inlet Tribal Council grant secured by leveraging the NOAA ELP grant work with the school in Tatitlek. Students made a barometer with the 3D printer.

Culminating student projects in Tatitlek (Living History with Alaska Native Elders), Chenega (salmon/plankton relationship), and Whittier (environmental monitoring).

Contextual Challenges

COVID-19 created significant disruptions to programming. Some in-person professional development sessions were canceled or modified. Schools were closed at the end of the 2019-2020 school year. In-person co-teaching sessions were moved to an on-line format during the 2020-2021 school year as many villages did not permit non-residents to visit their communities on a short-term basis without first following quarantine safety protocols. These types of disruptions added layers of logistical complexity to the planning and implementation processes as educational materials needed to be shipped to sites well in advance of the scheduled co-teaching sessions, which needed to be conducted on-line rather than in-person. Over time, both teachers and students exhibited signs of "Zoom fatigue," and teachers needed more support and scaffolding than expected.

Teacher turnover is an on-going, endemic problem for schools in rural Alaska. This impacted the implementation of the ELACS project in most of the Kenai Peninsula Borough School District's (KPBSD) participating schools and in

DESCRIPTION OF PROJECT

Whittier, a school in the Chugach School District. New administration and staff in the KPBSD's participating schools needed to be recruited beginning in the second year of the grant, which also coincided with the COVID-19 closures. This lead to a lack of participation in most of the KPBSD schools.

EVALUATION APPROACHES

Developmental Evaluation

The educational content of the ELACS program, while outlined in a general manner, emerged as the program progressed. This is the nature of novel, innovative educational programs that are derived from collaborative relationships. (The same is true for Collective Impact projects in which social innovations and interventions emerge from dynamic processes intended to address difficult social problems.) Specific learning goals wee identified in advance of individual lessons. Lessons delivered by guest speakers and experts in fields other than education may not have had any articulated learning objectives at all. This emergent-design approach was amplified with adaptations required by a new set of COVID-19 conditions that disrupted normal educational processes. Adjustments were made to continue the work within the constraints imposed by state and local, civic and educational leaders.

These conditions precluded our ability to conduct a more traditional summative evaluation that examined outcomes using the pre-post design described in the original proposal. Further, a suitable and meaningful measure of climate literacy could not be developed (nor one identified and accessible) to meet the needs of this project. To that end, a Developmental Evaluation approach was used to understand the context and the design of the initiative, and examine implementation processes. A Developmental Evaluation is best suited to address the ill-structured space between the end of programs and the beginnings of new ones, or in this case, the introduction of innovative programming into the static structure of current educational practices. Three key functions of Developmental Evaluation are to support real-time learning, decision-making, and program development.

Most Significant Change

The Most Significant Change approach examined program outcomes using qualitative data, typically stories and insights that emerge from dialogue with program leaders and participants.

Ripple Effects Mapping

Ripple Effects Mapping explored the unintended outcomes and untold stories of the ELACS project. These are impacts beyond the scope of the project that have value for both participant and non-participant organizations.

KEY FINDINGS & RECOMMENDATIONS

Value of Network Orchestration

An important insight into this work revealed itself in the role of the Project Director. Ms. Sotelo functioned as a 'network orchestrator,' bringing to teachers and students an impressive array of outside expertise, learning resources, and opportunities that classroom teachers and school administrators simply would not have had the time nor the requisite experience and background to discover on their own. This lesson cannot be overstated. The role of a network orchestrator creates value by introducing and facilitating novel approaches to the teaching and learning process.

The value of 'network orchestration' is a lesson borrowed from business and finance, but applicable and apt for use in educational settings. Deloitte Touche Tomatsu Limited, a multinational professional services firm, authored an article about the relative value of different business models in a 2014 CFO Insights publication (https://www2.deloitte.com/content/dam/Deloitte/fr/Documents/Pages/Finance/deloitte_CFO-insights-l-ere-du-digital_mars-15.pdf). The author stated that most companies can be grouped into one of four business models defined by the way the business creates value: asset builders, service providers, technology creators, and network orchestrators. Network orchestrators, companies that create a network of peers in which members interact and share in value creation, were calculated to be almost twice as valuable as the next most valuable class of companies, 'technology creators,' and nearly four times as valuable as 'asset builders' and 'service providers.' These value coefficients were derived from the companies' price to revenue ratio for the S&P 500 in 2013. Companies labeled as network orchestrators included credit card companies, telecommunication companies, ride-sharing services, social media companies, and others that facilitated the exchange or communication of people, ideas, or products. In the opinion of this author, the application of this concept to value creation in educational settings should change the way educational organizations structure and conduct their work. Someone in each educational organization or school district should be tasked with exploring the exciting pedagogical strategies, techniques, methods, materials, and experiences that are either identified as evidence-based practices or promising practices, and then make those items available to local classroom teachers in such a way that they can be implemented in a meaningful manner. This often happens in organic ways within classrooms as teachers bring their own personal interests and enthusiasms to the teaching and learning process, but educational institutions should endeavor to make this happen through purposeful, systematic processes. NOAA's educational resources are excellent, but just like the What Works Clearinghouse of evidence-based educational practices available through the Institute of Education Sciences, a person or persons needs to be the nexus between those resources and the people who can benefit most from them – teachers and students.

The list of project activities described above serve as examples and evidence of the value of a 'network orchestrator.' The learning experiences afforded to teachers and students in this project would not have occurred otherwise. It

should be noted NOAA's Environmental Literacy Program grants also function to connect people to resources, and that network orchestration is a nested concept that can occur at varying levels within a system.

Local Champions

The ELACS approach to professional development is based on a train-the-trainers model and a coaching/modeling approach to demonstrate pedagogical methods. Professional development for classroom teachers occurred through two primary avenues: concentrated sessions held before the beginning of each school year as part of the Chugach School District's annual preparatory meetings before the beginning of the school year, and in-service, co-teaching sessions with individual teachers working alongside the Project Director.

The pre-service sessions included all instructors from the Chugach School District, and invited cooperating teachers from participating schools within the Kenai Peninsula Borough School District. (The Kenai Peninsula Borough School District teachers were unable to attend the training sessions because their school year calendar did not correspond with the Chugach School District's calendar and their teachers were not yet on contract.) Feedback from the Chugach School District teachers indicated that not all of the teachers in the district had a role to play in the ELACS project, so the district-wide in-service as it related to hands-on science education was scaled back in years three and four of the grant.

The in-service, co-teaching model met with mixed results. Some teachers embraced the opportunity and fully, enthusiastically engaged in the process. Other teachers may have viewed the Project Director's classroom visits as an opportunity to work on other tasks while Ms. Sotelo conducted the sessions. This uneven application of the model has led the school district to re-evaluate the classroom teachers' roles and experiences with this model. To be certain, most teachers in these small, rural, and remote schools wear many different hats. In one instance, a building maintenance issue needed to be addressed, in another, a mail plane finally arrived in the village and needed to be unloaded. These are the facts of life in small, rural Alaskan villages that compete for teachers' time. Time is a limited resource and grant-funded projects are not always given the attention and effort they require due to competing demands and other responsibilities. Going forward, if additional funding is found to continue this approach to professional development and community engagement, the district plans to pay an additional stipend to lead teachers in their schools to organize and facilitate grant activities. The amount of the stipend would be commensurate with other types of extra-duty pay, and the expectations for participation and responsibilities of the lead teachers would be more clearly communicated. This local lead teacher would be a local champion in the community.

KEY FINDINGS & RECOMMENDATIONS

Most Significant Changes

The most significant changes observed during the course of the grant project was the amount of science taught through project-based methods. This approach aligns and fits well with the Chugach School District's emphasis on competency-based assessments and individualized progress. The climate literacy lessons and resources were relevant and gave the teachers many different angles from which they could approach science learning and investigations.

Increased student interest in science stemmed from the different methodologies that were utilized. These methods included using art to record and display data, interaction with Alaska Native elders, and the hands-on, experiential learning and action projects. An emphasis on collecting, recording, and displaying local environmental data was thought to have contributed to greater awareness of issues related to climate change.

Ripple Effects

Ripple effects included increased conversations with Alaska Native elders about changes in the local environment and the chance to interweave Traditional Ecological Knowledge with a western science approach to observing the environment. This also was a pathway for students to meet some of their communities' cultural standard bearers.

The salmon conservation projects with students in the Chenega school are continued into the next school year even though external support for this work and grant requirements have ended. This occurred in large part to individual teachers in Chenega taking advantage of the relationships they developed with university researchers and ocean monitoring equipment available through the College of Fisheries and Ocean Science at the University of Alaska Fairbanks.

Development of an Ocean Observation Notebook through a collaboration with Teknikio and NexMap were being explored at the time of this report. The Ocean Observation Notebook - as envisioned - consists of a standard composition notebook outfitted with a microprocessor, paper circuitry, and Light Emitting Diodes. Students will construct displays of both curated and real-time data about their local and regional environments. This is a low-cost and high-tech approach to engage students with concepts in computer and electrical engineering, electrical circuitry, data collection, and data transmission. Students will learn critical thinking skills needed to assess and parse the authenticity and reliability of data sources while creating their own data displays. The Ocean Observation Notebook is expected to provide opportunities for civic engagement through the presentation of environmental data in public venues.

Teknikio's Bluebird microprocessor currently affords students opportunities to monitor and display real-time local temperature, barometric pressure, wind direction, wind speed data, and current seismic activity. When fully developed, the Ocean Observation Network will display data about ocean temperatures, phytoplankton and algal blooms, and ocean acidification among other data

KEY FINDINGS & RECOMMENDATIONS

types and sources. A precursor to the Ocean Observation Notebook, the Tidal Notebook, can be viewed at http://www.nexmap.org/open-data-open-minds. This product carries the potential for wide-ranging applications in hands-on, project-based science education in other locations.

At the time of this report, the Prince William Sound Stewardship Foundation is using data from an In-Situ HydroVu sensor installed in the Whittier Harbor for their shellfish study/research. This sharing of data across non-profit and educational agencies strengthens and enhances a sense of common purpose and community as we learn about and care for our local environment.