Imam Cimiucia
Our Changing Sea

Through the lens of Western science and traditional Native knowledge, art, and photography, the authors uncover the ecological, social, and economic causes of coastal ecosystem change on Alaska's Kenai Peninsula. The reader is offered a rare opportunity to share experiences, perspectives, and knowledge of Sugpiaq Elders and village residents whose lives and intuitions are shaped by the rhythms of the sea. This collaboration illuminates the resilience and limits of marine ecosystems and the vast archive of knowledge and expertise held by different cultures. Given the pressure humans now impose on marine ecosystems worldwide, this book offers insights to coastal communities throughout the world that have witnessed dramatic changes in their ocean home. First author Anne Salomon is an assistant professor in the School of Resource and Environmental Management at Simon Fraser University.

This book provides a rich account of the long history of human habitation and its impact on the coastal marine ecosystem of southcentral Alaska. By joining hands in a common research endeavor that brings together deep local knowledge of the Sugpiat and detailed instrumentation provided by marine scientists, we come to better understand the effects of the cultural and ecological changes under way in the region.

Raymond Barnhardt, Co-Director,
Alaska Native Knowledge Network, and
Director, Center for Cross-Cultural
Studies, University of Alaska Fairbanks

Imam Cimiucia: Our Changing Sea reveals the true spirit of the Chugach people. It is alive with the sights, sounds, and heartbeat of the land and its people. A true collaboration of research and community, this book has lessons for all humanity on stewardship, ecosystem-based management, and the wisdom of traditional knowledge, and expresses the needs of future generations. And I loved it!!

Patricia A.L. Cochran, Executive Director,
Alaska Native Science Commission,
Past Chair, Inuit Circumpolar Council

This book emphasizes the points of convergence between the knowledge of ecological science and the wisdom of the ages found in traditional knowledge. Anybody interested in coastal ecosystems should read this book. Natural scientists in particular will profit from the astute insights into the natural history of this coastal ecosystem available from the traditional understanding of natural systems that have sustained people over several millennia.

Paul Dayton, Professor, Scripps
Institution of Oceanography,
University of California San Diego

In *Our Changing Sea*, the traditional ecological knowledge of the Sugpiaq people of Port Graham and Nanwalek is skillfully blended with biological and social sciences to tackle a complex problem—the causes of change to the intertidal and marine environment of lower Cook Inlet, Alaska. The prominent Alaska Native voices contribute a historical perspective and a sense of interconnectedness based on generations of observations and interactions with the natural world. The outcome is an instructive model of a collaborative endeavor seeking not only explanations but also sustainable solutions that incorporate traditional management practices.

James A. Fall, Research Director, Division of
Subsistence, Alaska Department of Fish and
Game. Co-Author of *Shem Pete's Alaska: The
Territory of the Upper Cook Inlet Dena'ina*

USD/CAD $39.95
ISBN 978-1-56612-159-0
53995>
9 781566 121590

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Imam Cimiucia Our Changing Sea

Imam Cimiucia

Our Changing Sea

Anne Salomon • Henry Huntington • Nick Tanape Sr.
Principal Photographer Lisa Williams

Storman Norman hauls his net in front of Passage Island, Port Graham Bay, Lower Cook Inlet, Alaska. Summer 2005.

with contributions from

Peter Anahonak Sr., Anthony Brewster, Annie Evans, Emerson Kvasnikoff, James Kvasnikoff, Jolene Kvasnikoff, Nina Kvasnikoff, Simeon Kvasnikoff, Natalie Kvasnikoff, Vivian Malchoff, Elenore McMullen, Jeff McMullen, Lydia McMullen, Quentin McMullen, Vera Meganack, Walter Meganack, Anesia Metcalf, Dorothy Moonin, Ephim Moonin, Herman Moonin Jr., Uncle John N. Moonin, Johnny Moonin, Karen Moonin, Margaret Moonin, Rhoda Moonin, Richard Moonin, Sam Moonin, Becky Norman, Pat Norman, Robin Otis, Gerald Robart, Feona Sawden, Demetri Tanape, Irene Tanape, Jennie Tanape, Nick Tanape Sr., Vivian Ukatish, and Violet Yeaton

Sugt'stun language translations by Sally Ash, Kathy Brewster, Herman Moonin Jr., Emilie Swenning, and Becky Norman

Artwork by Nancy Radtke

Bidarki field ecology research by Moose Anahonak, Brenda Dolma, David Glahn, Kyle Lestenkoff, Justin Malchoff, Jeff McMullen, Lydia McMullen, Matt McMullen, Jim Miller, Marlene Norman, Marvin Norman, Anne Salomon, Nick Tanape Sr., Liz Villarreal, Nancy Yeaton, and Violet Yeaton

Elmer E. Rasmuson Library Cataloging in Publication Data

Salomon, Anne K.

Imam cimiucia = Our changing sea / Anne Salomon, Henry Huntington, Nick Tanape. – [Fairbanks, Alaska : Alaska Sea Grant College Program, University of Alaska Fairbanks], 2011.

p. : ill. ; cm.

Includes bibliographical references.

1. Pacific Gulf Yupik Eskimos—Ethnobiology—Alaska—Kenai Peninsula. 2. Ethnoscience—Alaska—Kenai Peninsula. 3. Marine resources—Alaska—Kenai Peninsula. 4. Subsistence fishing—Alaska—Kenai Peninsula. I. Title. II. Huntington, Henry P. III. Tanape, Nick.

E99.E7 S3158 2011

ISBN 978-1-56612-159-0

Credits

This book is published by the Alaska Sea Grant College Program, supported by the U.S. Department of Commerce, NOAA National Sea Grant Office, grant NA10OAR4170097, project A/161-02; and by the University of Alaska Fairbanks with state funds. Funding contributors include the Rasmuson Foundation, Chugach Alaska Corporation, Chugach Heritage Foundation, Pratt Museum, and University of Alaska Press.

All proceeds from the sale of this book will be donated to Port Graham's Environmental Program and Nanwalek's Resource and Fisheries Program.

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Book design, layout, and cover design by Jen Gunderson with assistance from Garry Utermohle; photo editing by Dave Partee; project management by Kurt Byers; production management and editing by Sue Keller, of Alaska Sea Grant.

Alaska Sea Grant College Program
University of Alaska Fairbanks
P.O. Box 755040
Fairbanks, Alaska 99775-5040
(888) 789-0090 • (907) 474-6707
www.alaskaseagrant.org

Dog (chum) and red (sockeye) salmon dry in the Malchoff's smokehouse. Port Graham, summer 2006.

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Foreword

Protecting marine resources is a top priority in our culture. Bidarkis, like other marine resources, are a survival resource. Here in Nanwalek, jobs aren't as they are in cities. There are some families that have no income. They are completely dependent on subsistence resources. It is a meal put on the table. It is survival. We have no choice.

The research described in this book has helped us recognize that bidarkis are in high demand among our people. They are a delicacy here, and yet, we are depleting them. When I last went out with my son we couldn't find any decent sized bidarkis. It was less of a problem when our village population was smaller. As our population has grown, the demand has grown. Even as we become intertwined with the Western world, some of our traditions are still being passed down to younger generations.

This project has changed our community. It made us open our eyes and see that overharvesting can cause problems in the whole ecosystem. It made us think about all of our subsistence resources and it prompted local leadership to ask: How do we manage this? How do we regulate harvest so that the ecosystem can sustain itself and people can be fed at the same time?

Many of us worked on the research you will read about in this book. Local people provided important information about how much gathering is done throughout the year and what the marine ecosystem was like in the past. Knowledge from the past is key to everything, in all forms of learning, whether it be scientific or passing down our traditions to younger generations. Other communities can learn from this project and the way we worked together.

In this new world that we are in, passing down our knowledge at times can be difficult. This book will be a reminder of our ways and will help us share our knowledge.

—James Kvasnikoff
Second Chief, Nanwalek, Alaska, 2010

This is a book that combines traditional observational knowledge and scientific research to tell a combined story about one of our most valued resources and our connections to the sea—past, present, and future. On behalf of the Port Graham Village I want to thank all of the people who gave of their time and knowledge to this project and to the development of this story. My hope is that it is used by our people to teach our younger generations about the bidarki, the sea around us, and to reinforce our responsibility to protect and preserve these wonderful food sources for ourselves and future generations.

—Pat Norman
Chief, Port Graham, Alaska, 2010

Right: Port Graham Village Chief Pat Norman pulls a dog salmon from his net. Port Graham Bay, June 2005.


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How This Book Came to Be

In southcentral Alaska, on the tip on the Kenai Peninsula, the Sugpiaq* Elders of Port Graham and Nanwalek have observed remarkable changes in their ocean home. Throughout their lives, they have watched marine resources, once plentiful, become increasingly scarce. The story is a familiar one among coastal communities from Barrow to Baja: fish and shellfish are becoming increasingly harder to find. Along the surf-swept shores of the Kenai, sea urchin, crab, shrimp, clams, and cockles are now fewer and smaller than they once were. The most recent shellfish to decline is the black leather chiton, an intertidal mollusk and important subsistence resource for the Sugpiat. Known scientifically as *Katharina tunicata*, here on the tip of the Kenai this chiton goes by its Sugt'stun name urriitaq, and even more commonly "bidarki," Russian for "little kayak."

*Sugpiaq (singular), Sugpiat (plural). Also known as Alutiiq (or spelled Alu'utíq).

Lydia McMullen counts and measures bidarkis. Summer 2002.

Kyle Lestenkoff and Marvin Norman return from a morning of bidarki monitoring on Flat Island. Summer 2006.

Nancy Yeaton examines a bidarki's gut contents. Summer 2003.

Left: Black leather chitons (*Katharina tunicata*), locally known as bidarkis, surrounded by tagged ribbon kelp (*Alaria marginata*) and pink articulated coralline algae (*Corallina vancouveriensis*).

Tanya Anahonak and a tub of red salmon. Nanwalek, summer 2006.

Bidarkis were harvested by early inhabitants of this area. Their shells are found in nearby shell middens, some dating back 3,000 years or more.[1,2] Local Elders report that villagers have been harvesting this chiton throughout their lives and the lives of their parents and grandparents. However, between 1990 and 1995, residents of Port Graham and Nanwalek began to observe declines in bidarki numbers and sizes. Prompted by local concern about this unexpected change, we began a collaborative research project in 2002 to uncover the causes of bidarki declines. Our research team included Elders, village residents, a social scientist, and a doctoral student in marine ecology at the University of Washington. As ecological detectives, we began to piece together the clues.

Locally, our research became known as the "Bidarki Project." Working together in the field and sharing stories back home, we combined our unique yet complementary knowledge of the sea, and learned from one another. Investigating the causes of bidarki declines required an understanding of the entire ecosystem, including humans, their relationship with the sea, and their history and prehistory on the Kenai Peninsula.

We interviewed tribal Elders and village residents to learn more about how their marine environment had changed and how Sugpiaq subsistence harvest practices had transformed as a result. Elders also shared their observations of the social and economic changes that had occurred in the villages throughout their lifetimes. Importantly, Elders offered their views on why things were different now, identifying the drivers of change that may have been responsible for shaping the coastal ecosystem we see today.

During our research, it became increasing clear that present-day ecological data alone could not explain the recent bidarki declines. Rather, understanding the historical changes in human settlement patterns, local subsistence practices, regional commercial harvest, and local sea otter abundance became critical to our understanding of the factors driving the broad decline of shellfish species, including the most recent decline in bidarkis. Traditional knowledge held by Elders provided important information on ecological, socioeconomic, and cultural conditions, past and present, that was otherwise not available. By weaving together evidence gathered from contemporary field surveys, archaeological data, historical records, fisheries landings, and local traditional knowledge, the ultimate cause driving bidarki declines became increasingly clear.[3] It is this story that we share here.

During our team research, a common challenge and serious concern was identified by the Elders. Nowadays, they rarely have the chance to share their knowledge of the old ways. What they know is seldom passed on to younger village residents. Many Elders felt that traditional avenues for sharing their knowledge had eroded due to the realities of modern day living and with the loss of their Native language, Sugt'stun. They feared that important knowledge about marine subsistence practices and traditional management were becoming lost. Elders wanted a venue to share their wisdom with the youth and revitalize their language. At the same time, Bidarki Project researchers were keen to share their research findings with village residents and other coastal communities. And so blossomed the idea for this book. Five local Sugt'stun translators, a photographer, and an artist joined the team and graciously shared their skills and artwork to help capture the deep significance of the Sugpiaq subsistence way of life and to help us tell our story.

As our words show in this book, the researchers, community members, artists, and Elders became "we" and "us." Thus, our story is written in the first person,

Right: Nanwalek artist Nancy Radtke uses an ulu to filet a red salmon. Nanwalek, summer 2006.

Kathy Brewster, Nanwalek Elder and Sugt'stun language translator.

plural, and is told together: an integration of Western science, traditional knowledge, history, archaeology, anthropology, art, and photography, woven together and conveyed through many voices.

During the process of co-creating and co-editing this book, it became clear that the insights from our story might be valuable to a much wider audience. If we replaced the major characters, the tale we tell here could be told by countless coastal communities throughout the world that have witnessed dramatic changes in their ocean home, given the mounting pressure humans now impose on marine ecosystems worldwide. Our sense was that coastal communities around the world could learn from and add to our story.

We start long ago, in the days when only the Sugpiat lived on the tip of the Kenai Peninsula. The story moves forward through time, to the Russian era and into our living memory of the twentieth century, with the arrival of fish canneries, the return of the sea otter, the 1964 earthquake, the 1989 *Exxon Valdez* oil spill, and other events, the ecological and social legacies of which remain today. Integrating our knowledge, our unique ways of knowing, and a deep time perspective led us to a possible explanation for the successive declines in various shellfish, including the recent decline in bidarkis. The story then navigates through current threats to our ocean and asks you, our reader, to look ahead and consider the challenges we all face to sustain our marine resources, ecosystems, and coastal communities well into the future.

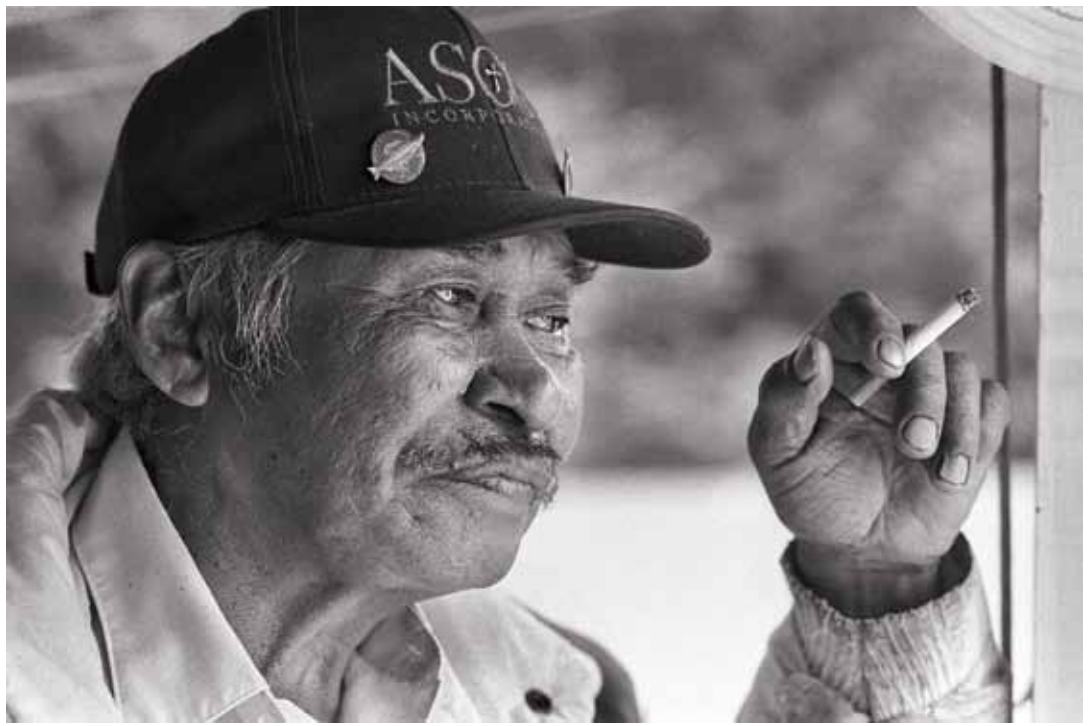
We hope that readers can draw parallels to their own experiences and expand our understanding and appreciation of our ocean's resilience and limits. We hope that this story will inspire readers to reflect upon the intricacies of our oceans, the wisdom of our Elders, and our responsibility to future generations.

Right: On her way to jig for halibut in Port Graham Bay, Vera Meganack rows her skiff as they did in the past before outboard engines, facing forward to watch for oncoming seas. Summer 2005.

Imam Suga

Person from the Sea

"Imaq iluma qupi. Caqama, atrarlartua naryaturluku imaq."
"The ocean is part of me. Sometimes, I just have to go down there to smell the ocean."
Simeon Kvasnikoff, Elder, Port Graham, 2004



Left: Killer whales (*Orcinus orca*) cruise past Mount Bede, on the tip of the Kenai Peninsula in southcentral Alaska. Summer 2004.

Right: Simeon Kvasnikoff, Port Graham Elder. Summer 2005.

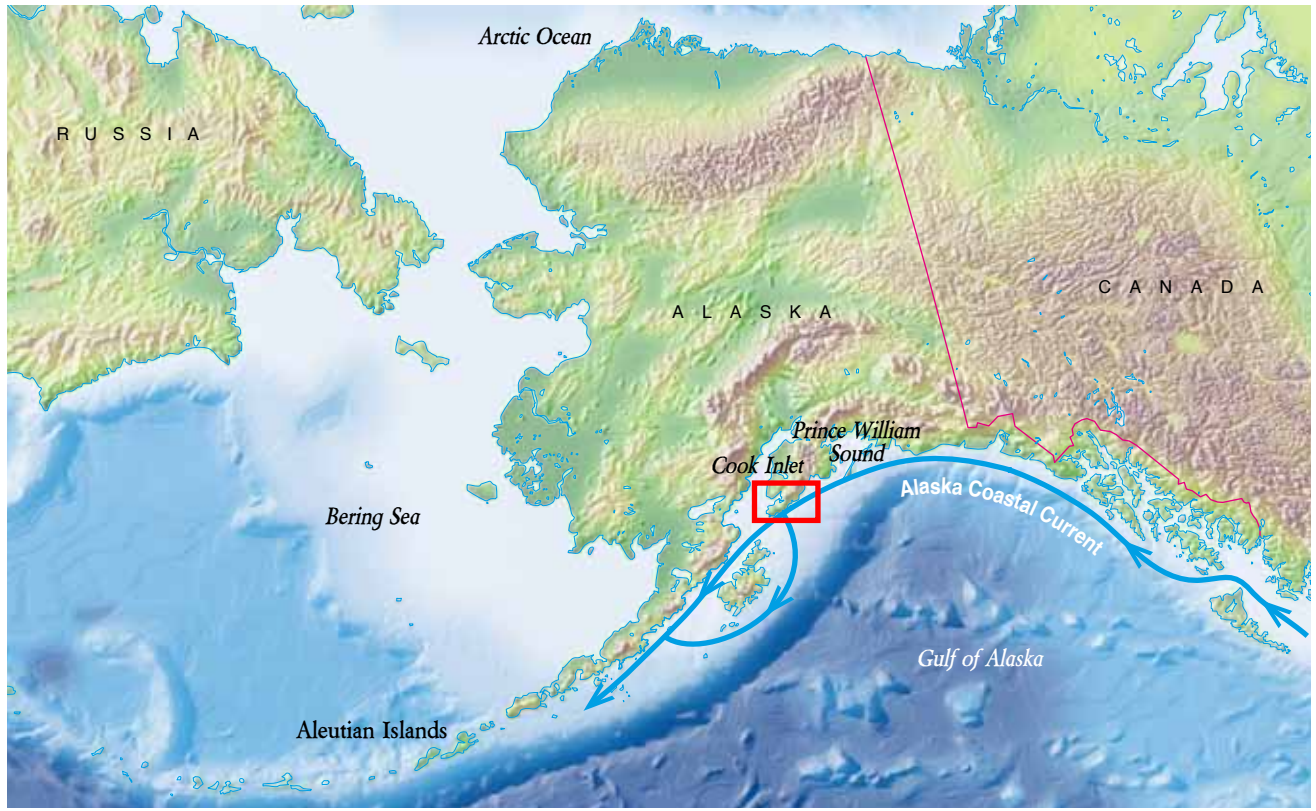
We, the Sugpiat, are sea people. Our lives are sustained by the sea. The sea is part of our spirit, our stories, our history, and our future.

Left: Charlemagne Active and Melissa Hetrick clean salmon on a bed of ferns to stop the fish from slipping. Nanwalek, summer 2006.

Right: Sea otter pictographs from Kachemak Bay, Alaska. One of our legends explains that the sea otter was originally a man. While collecting chitons he was trapped by an incoming tide. To save himself, he wished to become an otter. His transformation created all otters, arhnaq (sea otters) and aaquyaq (river otters). Alutiiq Museum and Archaeological Repository.

Below: The Northeastern Pacific coast. The red box indicates the detailed area of the Kenai Peninsula shown on the opposite page.

Right: Outer shores of the Kenai Peninsula, and local Sugt'stun place names.



The Northeastern Pacific coast.


CUNGACIQ
COOK INLET
TAMALKUAQ
KENAI PENINSULA
Aialiq
Aialik Bay
Kuinerraq
Anchor Point
Bear
Island
Ilaraa'alek
Homer
CACIRPAK
KACHEMAK BAY
Cainiim Nunii
China Poot Bay
Nikraq
Yukon Island
Tasiitnuuq
Tutka Bay
Yaaliq
Yalik Bay
Angagkitqnuuq
Seldovia
Qikertaawaq
Passage Island
Qikertaurluut
Nuka Bay
Atanenguaq Nuutqat
Nanwalek Reef
Port Graham Bay
Nanwalek
Nanwalek
Paluwik
Port Graham
Yuuyaa'am Cingia
Point Adam
Rocky Bay
Windy Bay
Qugyugtuliq
Dogfish Bay
Chrome Bay
Qikertaurluut
Port Dick
Arrulaa'ik
Port Chatham
East Chugach
Island
Qikertarlluaq
Elizabeth Island
Perl Island
N
0 3 6 12 18 24 30 Kilometers
0 2 4 8 12 16 20 Miles

Our Ocean Home

On the rocky shores of Alaska's Kenai Peninsula, at its westernmost tip, lies our ocean home. Look to the west and you will see the imposing volcanoes of Cook Inlet; to the south, the rugged slopes of the Chugach and Barren islands; to the north, around the waters of Dangerous Cape, lies Kachemak Bay. Here, steep mountains descend from alpine ridges, through alder meadows and spruce forests, to high cliffs that stand before curving beaches and rocky headlands. Islands and rocky reefs dot the coastline, growing and shrinking with the tides. Along the coastal arc of the Gulf of Alaska, the northward-bound Pacific Plate collides with and descends beneath the landmass of Alaska, creating an active area of earthquakes and volcanic eruptions. In the ocean, the Alaska Coastal Current flows westward along the continental shelf, bringing nutrient-rich water from the Gulf of Alaska, fueling our marine food webs, our subsistence culture, and our spirit.

We, the Sugpiat of Port Graham and Nanwalek, have been observers, beneficiaries, and part of the marine ecosystem for centuries. Any ripple of change is reflected directly in our daily lives. We have witnessed our ocean home transform through the years, and as a result, we too have changed. Our marine ecosystem is shaped by multiple factors, acting and interacting simultaneously. Furthermore, contemporary changes occur within the context of the past such that coastal ecosystems we observe today reflect in part the pre-historic and historical alterations that came before.[4-6] The past not only shapes our present—it informs our future.

This is a story seen through the eyes of tribal Elders, subsistence hunters, village residents, an artist, a social scientist, a photojournalist, and a marine ecologist, each one of us bringing our observations, skills, and knowledge to tell, with many voices, a single story about our changing sea.

Across lower Cook Inlet stands Iliamna Volcano. Summer 2001.

Left: Peter Anahonak Sr. in his smokehouse. Summer 2005.

Living from the Sea

"Ungualartukut imamek taumi qut'mek. Tamatum tuknigkuart'slaraakut."
"We survived by the ocean and beach. That's what sustained us."

Walter Meganack Jr., Port Graham, 2004

For centuries, we have sustained ourselves on food from the sea. Salmon and halibut make up the bulk of our harvest. We catch red salmon, pinks, dogs, and silvers throughout the spring and summer, and king salmon and halibut year-round. We hunt harbor seal and Steller sea lion, although fewer now than we used to. But our most accessible food from the sea comes from the intertidal, the part of the shore that disappears twice daily at high tide and re-emerges as the waters recede. During the full and new moon, when the tides are at their extremes, you'll find us out harvesting, early in the morning on a calm summer day, or in the middle of a chilly winter night.

"Unguacimtun, Ggwi nuryuglaqa qutem seni. Katurqiluanga piliarkamnek tamaa akguam piturkamek. Neqnek nuryukuma, nalluntua naten aquaciqsia. Qutem minarlaraakut."
"All my life, I depended on that shoreline. I would go down to the beach to collect anything to make chowder for that night's dinner. If we needed food I knew where to get it. The beach provided for us."

Elenore McMullen, Elder and past chief, Port Graham, 2004

Pete Moonin with seal in Port Graham, ca. 1970.

Right: Fred Toko, Port Graham Elder. Summer 2005.

The Tides That Fed Us

"Ken'aq qaillun stuuluq caskiumaqaq kentaqan cumi."
"The sea back then was a dinner table set at low tides."
James Kvasnikoff, Second Chief, Nanwalek, 2004

"When the tide is out, the table is set." This old adage applies to many of us who live on the coast. In the past, our seashore was akin to a refrigerator full of food, accessible only at low tide. Beneath the sand and pebbles, we collected clams and cockles. Above the sand, Dungeness crab. On rocky shores, we would harvest sea urchins, sea cucumbers, octopus, and chitons. Today, many of these intertidal shellfish are scarce, the ghosts of ecosystems past.[4]

"Cumi amlerlalrit neqet imarmi. Umiyarteqllanngukut naken pngciqukut, tawani et'ciqut."
"There used to be so much to eat from the ocean. You didn't have to worry about getting them, they would be there."
Simeon Kvasnikoff, Elder, Port Graham, 2004

Today, in the intertidal, we can still find subsistence foods if we search long enough. But the animals we collect now are smaller and fewer, and some are rarely even seen. These days, we have to go farther to collect what we used to be able to gather close to home.

"Cacat piutut, kiputeggkunateng."
"Things are disappearing and not coming back."
John Moonin, Elder, Port Graham, 2004

"Luumaciq cimirlartuq, nupallkiaq cimirlartuq, tama piciq? Cimilrit nallulantait cimirpilata. Cimirtuq nutam cukaaqamek."
"Nature changes. Man changes. Is it natural? I feel that changes are more pronounced now. Change is happening at a faster pace now than before."
Walter Meganack Jr., Port Graham, 2004

Intertidal reef in front of Nanwalek. Summer 2004.

John Moonin in his skiff. Summer 2006.

Left: Marta Hetrick harvests sea snails (ipuks, *Littorina* spp.). Summer 2006.

The Most Recent Decline

"Maamam piturt'slaqikut 'mellkiici' neryamek. Ukut uritanek neryarluta. Igwilrarat melkilluteng pakiutegkunateng aqililuteng."

"Mom used to make us eat 'shut-up dinner.' This would be a dinner of bidarkis. The kids would be quiet because we were all busy chewing."

Anesia Metcalf, Elder, Port Graham, 2004

"Nalluniqenka uriitat pellaluteng. Nutan tangerlartuten mikelngunek."

"I started noticing bidarki declines 10-15 years ago. Now you only see the little ones."

Walter Meganack Jr., Port Graham, 2004

The most recent decline that we have observed is that of the bidarki. Also known as the black leather chiton, or urriitaq in Sugt'stun, this intertidal invertebrate is not only an important source of food, it is part of our stories, our songs, our culture, and our traditions. This mollusk is found along the seashore from southcentral Alaska all the way to central California. Here, the name bidarki refers to this chiton's shape. Stuck to the rocky shore among ribbon kelp (*Alaria marginata*) and sea cabbage (*Saccharina sessile*), this oval-shaped mollusk resembles a tiny overturned kayak. In Russian, a kayak is called a baidarka. Bidarki refers to a little kayak. We eat bidarkis in casseroles and seafood salads, pickled, smoked, or raw, right off the rock.

We started observing declines in the number and size of bidarkis somewhere between 1990 and 1995. Bidarki shells found in lower Cook Inlet middens, prehistoric garbage heaps as old as 3,000 years or more, suggest that these chitons have been harvested for thousands of years in this area.[1,2] According to our Elders, bidarkis have been collected for at least a century. Yet local bidarki declines have been recent.

Not only was there widespread interest to explain this decline, we wanted to understand why so many other marine invertebrates had already declined or disappeared from our shores. Many explanations were possible and it was by no means clear that any single reason was to blame.

Left: A bidarki underneath the sporophylls (reproductive blades) of the ribbon kelp *Alaria marginata*. We tagged individual kelp specimens with small colored zip ties around their stipes, and punched small holes in their blades to measure how fast they grow.

Local residents have been harvesting bidarkis throughout their living memory. They started noticing declines in bidarki numbers and sizes between 1990 and 1995. Summer 2005.

A Story of Multiple Causes

"Pellaaluteng allingutaarluteng. Nutan tauaten etuq, cin pellaaluteng."

"Declines are likely due to a chain reaction. There is still, to this day, no one reason for all of these declines."

Walter Meganack Jr., Port Graham, 2004

Untangling the various factors that have contributed to species declines and marine ecosystem change is a difficult task. In an ecosystem, nothing happens in isolation: if one thing changes, other changes soon follow. However, some drivers of change may matter more than others. Identifying the primary causes of change can help us slow, or possibly reverse, future declines.

Both human and nonhuman causes of change can contribute to species declines and ecosystem alterations. Some of these are short, temporary disturbances, such as earthquakes, while other disturbances are sustained over longer periods of time, such as fishing pressure. Temporary and sustained disturbance can occur in small areas or extend over larger regions. Furthermore, some changes don't happen gradually. Long-term cumulative effects can sometimes push an ecosystem beyond a "tipping point," a place where change may occur suddenly and be very difficult to reverse. In such a case, small disturbances can have big effects over a short period. Once a system tips, rapid change can cause a cascade of events that may ripple throughout an entire ecosystem, including both its social and ecological components.

"Ikamatqaa, uqulaaitqaa, allrak sugem, kinaq paciumiaqa, nalluaqa kinaq."

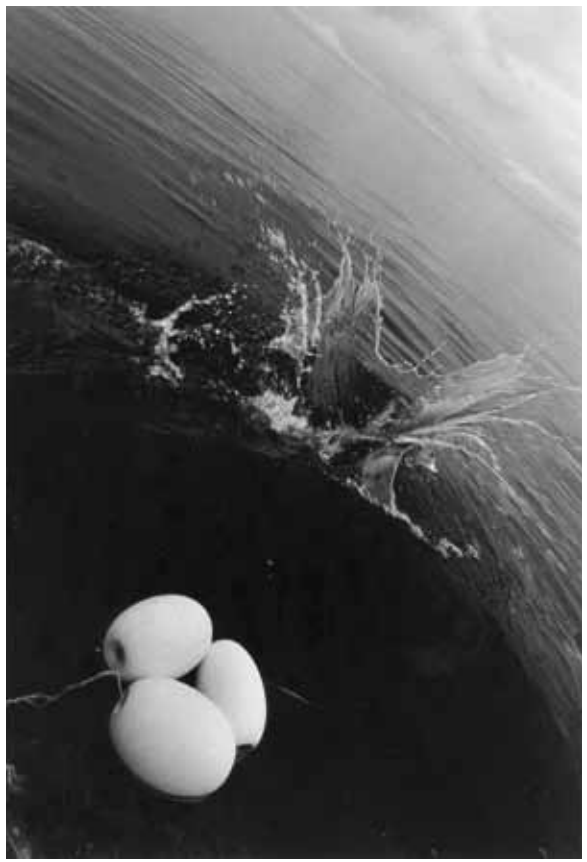
"Sea otters, oil pollution, or people. I want to blame one but I don't know which one."

John Moonin, Elder, Port Graham, 2004

To understand why bidarkis and other marine species have declined in Port Graham Bay, we delved into the past, broadened our scope, and combined our ways of knowing to examine the various disturbances that have altered our ocean home. In the chapters that follow, we describe historical and contemporary disturbances—temporary and sustained—that have likely altered our coast. By investigating the strength, spatial extent, and timing of these disturbances and the changes we have witnessed, we pinpoint the causes that most likely have contributed to our transformed marine ecosystem. When pieced together, a plausible explanation for the decline in bidarkis and other marine invertebrates begins to unfold. As a result, we are now better able to identify the actions we can take to do our part to stop and reverse the declines.

We begin by plunging into our deep past.

Left: Walter Meganack Jr. and his son walk the dock in Port Graham. Summer 2005.



A dog salmon is released. Summer 2005.

Marlene Norman stands near an eroding shell midden com-posed of blue mussel, snail, clam, and cockle shells, chiton plates, urchin spines, halibut vertebrae, and bird bones. This unexcavated midden in Port Graham Bay, known as the Selenie Lagoon site, is thought to be from the Kachemak Tradition, and may be between 1,000 to 3,000 years old. Alaska Historic Resource Survey, Office of History and Archaeology.

Our Past

In Deep Time

Toward the end of the last ice age, at least 10,000 years ago, the climate warmed, glaciers melted, plant and animal life flourished, and people began to inhabit Alaska's southern coast.[7,8] It is thought that human occupation of the Sugpiaq region began during this warming period. Some say that our ancestry can be traced to the hunters of eastern Siberia who crossed into Alaska almost 2,000 years earlier.[8] Today, prehistoric village sites, shell middens, streamside camps, fish traps, ancient seaside trails, and images painted on cliff faces offer clues from our deep past and chronicle our connection to the sea.

The oldest known prehistoric communities in Prince William Sound and on the Kenai Peninsula are about 4,500 years old.[8] The absence of earlier settlements, however, may reflect a loss of cultural evidence from rising sea levels and sinking shorelines rather than a true lack of settlement.[9,10] Excavations of shell middens show that we relied heavily on intertidal invertebrates, marine mammals, seabirds, and fish.[1,2,8] These and other coastal archaeological sites suggest that we have been interacting with, modifying, and relying on nearshore ecosystems for at least the past 4,500 years.

Back then, we lived seminomadic lives, traveling from small settlements to numerous seasonal camps depending on the availability of marine resources.[8,11,12] Kayaks were our main form of transportation and we moved far.

"Umiaqlan-qa cin Alutiit naugtart'lrit Taya'umek? Neqaiqalrit. Neqeq alliutekuqait. Kiarat'lrit asirqamek nunamek neqeng'qamek."

"Did you ever wonder why the Aleuts moved out through the Aleutian chain? They were running low on food. They fought for food. They were looking for a better place and better food."

Simeon Kvasnikoff, Elder, Port Graham, 2004

"Allingurrmi kimii pisurlanngut, nangumirrkunaki neqteng."

"They conserved by using different areas."

Herman Moonin Jr., Port Graham, 2006

Rock paintings, also known as pictographs, can be found on secluded rock walls in Kachemak Bay and offer a rare glimpse into the life of people during prehistoric times. These ancient images speak silently of the things most meaningful to these people. In our ocean home, most pictographs appear to represent marine mammals: plump seals, floating sea otters, and leaping whales, although some land animals are also depicted. The origin and age of these images are not known with certainty, but our ancestors could have painted these images as many as 1,500 to 3,000 years ago. This pictograph from Sadie Cove, in Kachemak Bay, appears to portray three killer whales leaping among, or perhaps transforming from, land animals.

A Sugpiaq man with a spruce root hat and woman with a nose pin and labret (lip ornament), Prince William Sound. Engraved by Cook Expedition artist John Webber, 1780.

The Russian Era

From Seasonal Camps to Established Villages

In 1741, Vitus Bering and the naturalist Georg Steller sailed from Kamchatka, Russia, to Alaska,[13] opening the way for Russian missionaries and fur traders. With the Russian occupation of Cook Inlet, Alaska, in the 1780s, both commercial fur trading companies and the Russian Orthodox Church sought to centralize services in larger villages. Regional consolidation eventually led to the demise of smaller settlements and the creation of larger, more permanently established villages,[11,12,14] like Nanwalek, and later, Port Graham.

Before living in the villages of Port Graham and Nanwalek, our ancestors inhabited the Kenai Fjords, on the southern shores of the Kenai Peninsula.[11] It was there—in Nuka, Yalik, and Aialik bays—that our rich maritime culture thrived. Archaeological data suggest that our previous village sites are at least 800 years old, although earlier sites may have been destroyed by major earthquakes, coastal subsidence, and sea level rise.[10]

With the Russian occupation, our people were coerced to hunt sea otter for the burgeoning fur trade. Large Native hunting crews were assembled by the Russians. In 1786, our ocean home in Nanwalek became a fur trading post, by which time Russian hunting parties had decimated sea otter populations in Cook Inlet, forcing Native hunters to enter Prince William Sound and push farther south toward Yakutat.[11] Tragically, disease epidemics, starvation, and loss of political sovereignty came with this exploitation of our labor.[15]

"Cacat pellakengapet qaterqat taingata nunanpt'nun, pelaten'lkepet uy'uucarnipet mermen. Meq unguarpet. Pirpak meq unguakan, Chuchachermiut unguaciqut."

"Of all the things we have lost since non-Natives came to our land, we have never lost our connection with the water. The water is our source of life. So long as the water is alive, Chugach Natives are alive."

Walter Meganack Sr., past chief, Port Graham, 1989

Right: At Port Dick, on the southern shores of the Kenai Peninsula, Captain George Vancouver's expedition encountered a large Sugpiaq sea otter hunting fleet of over 400 men in two-man baidarkas led by Russians.[11] Henry Humphreys, 1794.

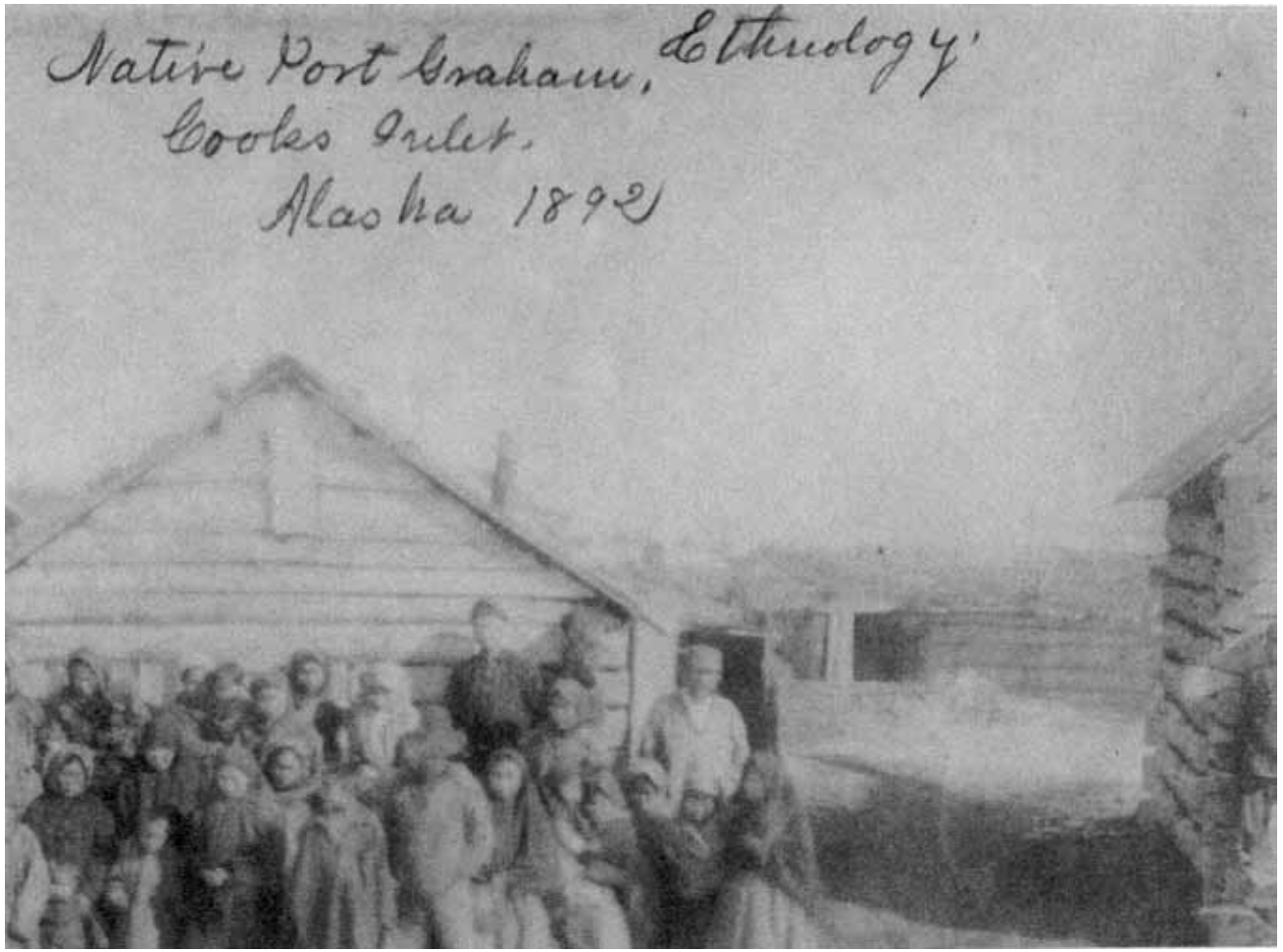
In 1778, James Cook arrived in Prince William Sound and then sailed west along the Kenai Peninsula to Cook Inlet in hopes of finding a Northwest Passage to link the Pacific and Atlantic oceans.[11] This illustration shows Sugpiaq trading parties in kayaks and large open skin boats (angyat) meeting Cook's *Resolution* and *Discovery* at Snug Corner Cove (Snug Harbor) in Prince William Sound, 1778.

Overturned open skin boats (angyat) were used as shelters at a seasonal camp in Prince William Sound, 1790.

Russian exploration and enterprise along the outer Kenai coast irrevocably changed Sugpiat settlements. Most Russian endeavors, from the sea otter hunt to coal mining, employed Sugpiat, contributing to regional consolidation.[11]

"Kinam nunagpet akicaaqerki, guangkuta apqarkunata."
"Someone sold our land but didn't ask us."
Herman Moonin Jr., Port Graham, 2006

In 1867, the Russian era ended with the purchase of Alaska by the United States. During the early 1880s, our ancestors were relocated by Russian missionaries from the last villages in Nuka and Aialik Bay to the more populated village of Alexandrovsk in English Bay (now Nanwalek) and Paluwik (now Port Graham).[11] In 1890, 100 Sugpiat lived in Nanwalek,[14] by then the only remaining fur trading station on the Kenai Peninsula. By 1910, Port Graham was a settlement with 100 residents. As we settled in these villages, we traveled less than we did previously. Subsistence gathering, fishing, and hunting became increasingly concentrated in space as we became increasingly tied to place.



Port Graham, Cook Inlet, Alaska, 1892.

Port Graham, Alaska, ca. 1906-1932.

Extinctions and Extirpations

"Kasaakat taingata, tuquskait nangpia ikamaq. Uksurngama qula arwinlen (1953) ikamanek piit'llra Paluwik."
"When the Russians came, they cleaned the sea otters out. When I was 18 years old [1953] there were no sea otters around Port Graham."

Simeon Kvasnikoff, Elder, Port Graham, 2004

With the Russian, then American, occupation of Alaska, two dramatic ecological events ensued. The Steller's sea cow became extinct within 23 years, thereby becoming the fastest extinction on record,[16] and with the lucrative fur trade, sea otters became locally extirpated from Alaska's coastline by the early 1900s, with only several pockets of animals remaining.[17]

"Qangirlat nupukllaqait ikamat, am ggwangkuta nallukuki cacautaciat. Tangsumirluku allinguq."
"The Elders used to talk about sea otters but we didn't know what they were. We wanted to see one."

John Moonin, Elder, Port Graham, 2004

From the early 1900s to the 1950s, sea otters were never observed in Port Graham Bay or its surrounding shores by those who grew up to become today's Elders. However, sea otter prey were plentiful! Along the seashore, sea urchins, crabs, clams, cockles, mussels, octopus, and chitons could be found in abundance.

"Cumi pitaqllaqepet naateqiinaq yual'ayagnek nuryugt'sta. Katurlaqepet salat taumi taugtat, kinaqinam anailan'llki ken'aq. Nallulaqegka nakllegnarluni ggwallu qasqerruluni qaterqat luumacis'stun. Qasqerrulalraakut cacalruakarluta unani."
"We used to be able to get all the Dungeness we wanted. We used to collect clams and cockles, nobody ever missed a tide. I didn't have a concept of poor or rich in a Western world sense. We were so rich because there was so much out there."

Walter Meganack Jr., Port Graham, 2004

With the extirpation of sea otters from Alaska south to California, intertidal and nearshore shellfish populations likely flourished throughout the area in the early 1900s.[18] At the same time, in front of Nanwalek kelp was sparse.

"Tamatekcaq qahnguit'llra Nanwalem ketiini mikhngama."
"There was not as much kelp in front of Nanwalek when I was young [early 1940s]."

John Moonin, Elder, Port Graham, 2004

With the signing of the International Fur Seal Treaty in 1911, large-scale fur hunting officially ended. By that time, a new economy, which had emerged in the late 1880s with the decline of the sea otter and falling fur prices, began to blossom. Commercial fishing and canneries gradually replaced hunting and fur trading as our major source of local income.

Right: Sea otter hunters in Bear Cove, Kachemak Bay, 1905.

Today's Elders. Port Graham children, 1940s.

In Living Memory

Following the Fish, Then the Jobs

"Ayay, ariinarlalra. Ingirpiaq katurngaqat iqallullret. Cilla kiagmi tauaten. Iqallut, iqalluarpit, nasqut, pamyut, nanet. Nangpia putmen eglaqait."

"Wow, this place would stink! It was like a mountain. Piles and piles of carcasses. Every summer it would happen. Salmon, herring, head, tails, bones. Everything went on the beach."

Dorothy Moonin, Elder, Port Graham, 2004

By the early 1900s, salmon canneries dominated the local economy on the Kenai Peninsula. The Fidalgo Island Packing Company built a cannery in Port Graham in 1912, which it maintained until 1960. With the commercial fishing industry and canneries came cannery jobs. In 1915 a cold storage plant for halibut and cod was established in Portlock, also known as Port Chatham, and in 1928 a salmon cannery was built and remained active until the late 1950s.[11] Port Graham, Seldovia, and Nanwalek all had canneries that processed king crab, shrimp, and salmon. By the early 1900s, can-

Simeon Kvasnikoff, George Anahonak, and Tim Malchoff, 1949.

Peter Anahonak Sr., Port Graham Bay.

Old cannery in Port Graham, ca. 1950.

Right: Port Graham Cannery, 1912.

neries dominated the local economy on the Kenai Peninsula. In the past we followed our food—the fish and the seals. Once the canneries arrived, we followed the jobs—the fish to be canned.

"Suget ilalrit mikhnemni, 40s taumi 50s, iqallut maliglluki. Supet Arulayamek nunakuarlalrit Paluwigmen. Salayaq patungan Arulayagmi, suget naugtat'llrit Nanwalekgmen, Paluwigmen, Kiaut."

"People were still nomadic when I was a kid in the '40s and '50s. They migrated with the fish. Our people living in Portlock would come to Port Graham over land. When the cannery closed down there in Portlock, people moved to Nanwalek, Port Graham, and Seldovia."

Elenore McMullen, past chief and Elder, Port Graham, 2004

With the closing of the canneries in Portlock and Seldovia in the late 1950s and 1960s came the centralization of cannery work to Port Graham. Like the centralization of services by Russian missionaries and fur traders almost a century earlier, canneries had social impacts that may have indirectly influenced our local marine ecosystems. Prior to the 1920s, we used to travel as part of our seasonal round of hunting, fishing, and gathering. The establishment of canneries disrupted our seasonal cycle of movement because cannery work was available during the months when we traditionally put up salmon for winter supplies. We stopped moving as much as we did in the past. Consequently, our hunting, fishing, and shoreline gathering became increasingly concentrated around the village. Sustained localized harvest likely had a profound effect on local marine resources.



Port Graham Cannery workers from left to right: Polly Meganack beside a fish filler, ca. 1970. Dorothy Norman (Moonin), Jenny Malchoff, Theresa Kvasnikoff, and Susan Tabios at the canning line, ca. 1960. Polly Meganack, Luba Meganack, Alice Meganack, and unknown person, ca. 1960.

A raft of sea otters (arhnaq, *Enhydra lutris*).

Sea Otters Return

"Kiput'llrit 60-mi. Pianekcak amlerilrit 70-mi taumi 80-mi."
"They came back in the late 1950s, early '60s. The population exploded in the late '70s early '80s."

John Moonin, Elder, Port Graham

"Taagua taugkut amlerilartut." *"Boy, those things multiply!"*

Simeon Kvasnikoff, Elder, Port Graham, 2004

Cannery culture was in full swing in Port Graham when a notorious shellfish predator began to recover and reestablish itself along our coastline. Sea otters returned to the waters in front of Port Graham and Nanwalek in the late 1950s and early 1960s. Back then, we might have caught a glimpse of a furtive, solitary otter. Today, rafts of 30 or more float around rocky headlands in the summer from Point Adam to Point Pogibshi. During winter storms, hundreds of sea otters take shelter in Port Graham Bay. Although their ecological effects are localized, sea otter recovery is an example of a natural sustained perturbation, one that intensifies as sea otter populations swell.

This coastal marine predator is well known as a keystone species.[17,19] Like the keystone in an archway that keeps the arch from collapsing, sea otters play a paramount role in coastal ecosystems. Remove sea otters, and the stability of the system is compromised. Have them return, and the ripple effects of their recovery can be detected throughout coastal ecosystems.

"Ikamat caktunart'slara … piturlarait cacat ggwangkuta pituqengapet."
"Sea otters are part of the problem. . . . They eat everything we eat."

Walter Meganack Jr., Port Graham, 2004

A sea otter eats a giant red sea cucumber (*Parastichopus californicus*).

Green sea urchins (*Strongylocentrotus droebachiensis*) graze the stipes (trunks) of the palm kelp (*Pterygophora californica*), a perennial seaweed that can live up to 28 years.

Local Shellfish Begin to Decline

"Tangerlaqepet wegngaqat uutut naniqiinaq Nanwalek Kenani 1940-mi. Uutut 1950-mi pellapaiyalrit. Qangirlat piturlaqait inarngalrit. Asikllaqepet urritat ciplluki unaihngata . . . pitunirait awa."

"We used to see green sea urchins all over Nanwalek Reef in the early 1940s. By the late '60s sea urchins were mostly gone. Sea cucumbers were eaten by the Elders, too. We liked them better than bidarkis because they were softer. Not much eaten now."

John Moonin, Elder, Port Graham, 2004

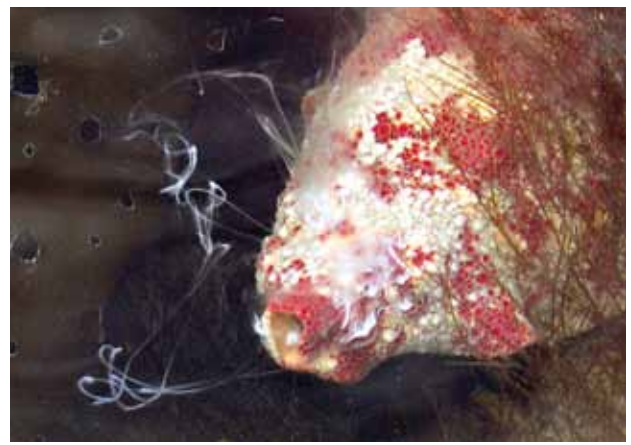
Green sea urchins and sea cucumbers, which were plentiful on the reef in front of Nanwalek in the 1940s, were mostly gone by the late 1960s. These were the first marine invertebrates that we saw decline, at the same time that the sea otter began to return to our shores. It took less than ten years for sea otters to locally deplete the urchins. With the decline in urchins came an increase in kelp covering the reefs. These spiny herbivores are particularly well known for mowing down kelp. Where urchins are absent or reduced in numbers, kelp forests tend to thrive.

Sea otters are well equipped to consume many species of echinoderms and mollusks, including the Pacific giant octopus (*Octopus dofleini*) seen here.

“Urritarpanek pituqsiitua qangikcagninek.”
“I haven’t had lady slippers for years.”
Annie Fomin, Elder, Port Graham, 2004

“Cuumi urriitarpagnek ikuullalraakut aqllatekcallruaqan taumi qailikcallruaqan, awa nutaan ikuut’rrarpiarlartukut, ikuutaqamta mikllartut.”
“We used to find them [lady slippers] after a big storm. Now we don’t find many. If we do, they are smaller now.”
Irene Tanape, Nanwalek, 2004

According to our Elders, the next marine invertebrate to begin to disappear was the lady slipper, or gumboot chiton (*Cryptochiton stelleri*), the largest chiton in the world.[20,21] This chiton is a close relative to the bidarki but is much larger, up to eight inches long (about 20 cm). Its large size makes it a more rewarding meal than a bidarki. Furthermore, lady slippers are easier to spot. Because this giant chiton is brick-red in color, it is not as well camouflaged on dark, wet rocks as the dark brown to black bidarki. Today, only occasionally and only during a very low tide, can we find a lady slipper.



Known locally as a lady slipper, this chiton is a broadcast spawner like the bidarki. Males release white streams of sperm (above) and females (far right) release olive green eggs.

The Earthquake of '64

High tides in Port Graham in November 1966, over 2.5 years after the '64 earthquake.

"Aulallrungan, nuna kit'llra, kenat pelaaluteng staaman uksurluteng. Kiput'llra qaillun cumi ellalra."

"After the earthquake, there was sunk land and no minus tides for about 4 years. After that it came back to normal."

John Moonin, Elder, Port Graham, 2004

With the Good Friday earthquake of 1964 came land displacement and a tsunami that swept the Gulf of Alaska. These events drastically altered the shoreline. Both subsidence and uplift caused extensive damage to coastal forests, salmon streams, and shellfish habitats. Some parts of the lower Kenai Peninsula dropped as much as 7.5 feet (about 2 m) while some areas of Prince William Sound rose as much as 38 feet (over 11 m).[22]

The shoreline of our ocean home in Port Graham and Nanwalek subsided. Because the land was lower, the high and low tide lines moved up the beach. Formerly productive intertidal zones were now fully under water and formerly dry land was now intertidal. In addition to land displacement, tsunami waves surged into bays and inlets, sweeping away soft sediment, scouring out clam beds, and carrying layers of mud and debris elsewhere.

"Aulakciim asiiyareskai salat eggwiit am p'llagkwarkunaki urriitat, iput, cali allat imarmiutat. Am p'llagkwaumakaki kiputut."

"The earthquake damaged the clam beds. This quake did not take the bidarkis, snails, and other invertebrates. If it did, they came back."

James Kvasnikoff, Second Chief, Nanwalek, 2004

Although this brief, intense perturbation in 1964 had dramatic immediate effects on seashore life, recovery was quick for most species. Intertidal studies in 1968, five summers after the earthquake, confirmed that intertidal communities around the corner in Prince William Sound had, with few exceptions, essentially returned to their pre-earthquake condition.[22] Snails and limpets, scarce in 1965, were abundant in 1968, and mussel beds were back at their pre-earthquake intertidal height. Nonetheless, Alaska sustained heavy economic losses from the immediate impact of the earthquake on fish and shellfish resources plus the intense damage to ports, canneries, and vessels used by the fishing industry. Port Graham felt immediate hardships, but things quickly returned to normal. Unfortunately, the human-caused disturbances to come likely had greater and more lasting impacts on our ocean home.

Electricity Comes to the Villages

“Asiupilataa piturlaqepet.”
“We would eat them within 2 days. We had to.”
Vera Meganack, Port Graham, 2004

“Cumi uriitat popcorn-eqllapet, pitaqinarluki piturlaqepet. Nutan ekllapet kumlaciwimen.”
“In the past, bidarkis were like our popcorn, we would eat them fresh like snacks. Now I keep them in my freezer.”
Anesia Metcalf, Elder, Port Graham, 2004

“Cumi pitaqllaqepet neaten piturciqapet. Kenerkun kumangamta taumi kumlaciwit piyarailluteng sugnun, amlerqanek pisurluta lliinarluki. Q: Kenteq miktuq, naken taugtangelraaten? A: Kumlaciwimnek.”
“In the past we used to pick just enough to eat and snack on. When electricity and then freezers became available, people began to pick more because they could store them.
Q: The tide is small, where did you get those cockles?
A: From my freezer!”
Feona Sawden, Elder Port Graham, 2004

“Nutan perrerrcarlapet taumi kumelacesluki, paigluki kenat mikllitaitnun. ”
“Now, we clean them, freeze them, and put them away for the smaller tides.”
Peter Anahonak Sr., Elder, Port Graham, 2004

In 1970, Port Graham got electricity and a decade later almost everyone had a freezer. With the modern conveniences of freezers and refrigerators came a new way of storing food. Salting and drying worked well, but they took time and effort. Freezing was relatively fast and easy. Before freezers, we typically ate shellfish right away. We would take only what we could eat soon after. Any extras would be shared with others. With freezers, however, we could harvest many more shellfish on a single trip and stock up for later.

“Kulat’sluki—taugum iliilirlaraakut.”
“Our ability to freeze things—that has increased our impact.”
Walter Meganack Jr., Port Graham, 2004

Today, vacuum sealers are a modern convenience that allows us to preserve food for even longer.

The Gulf of Alaska Commercial Crustacean Crash

In Cook Inlet, commercial crab and shrimp landings peaked in the early 1960s, with inshore harvests in bays like Port Graham providing much of the catch.[11] As local abundance declined, increased fishing effort and movement offshore was needed to maintain commercial harvest levels. By the early 1980s, crustacean stocks had collapsed sequentially in the Gulf of Alaska.[23] Dungeness crab, red king crab, Tanner crab, pink shrimp, spot prawns, brown king crab, and sidestripe shrimp catches had declined one after another.

At the same time the crab and shrimp catches were collapsing in series, there was a conspicuous shift in the composition of bottom trawl catches. In the 1970s, the catch was mostly shrimp. By the 1980s, almost all the catch was groundfish such as halibut.[24] The distribution and abundance of marine mammals and seabirds also suddenly changed.[25] These abrupt shifts in species composition coincided with the 1977 "regime shift," a change in ocean conditions associated with long-term oscillations in Pacific Ocean temperatures, surface winds, and air pressure.[26]

What was the reason for the demise of so many crustacean species in such a brief slice of time, over such a large area? Were these declines related to the dramatic shifts in species observed in the Gulf of Alaska? In few cases is there certainty about the causes of collapse. There is always evidence that supports a competing hypothesis, and every decline could conceivably have more than one cause. While changes in climate had an effect on the survival of juvenile crustaceans in the Gulf of Alaska, the trends in catch also provide compelling evidence of overfishing.[23] The pattern of collapse was not haphazard: the rise and fall of these fisheries proceeded sequentially, starting with the most lucrative resource.

By the mid 1980s, we found Dungeness crab increasingly hard to collect while our main competitor, the thriving sea otter, was observed consuming juvenile Dungeness crab and other invertebrates.

"Y'ualaiat p'lalrit siitkarpaka taumi qamurluteng. Egmirpia kangiyamen. Awa y'ualaiyat kiputentut ikamat pitekllluki."

"Dungeness were wiped because of commercial crab fisheries and dragging. They [the vessels] came right into this bay. Now they [the Dungeness crab] haven't been able to come back because of the sea otters."

Jeffrey McMullen, Port Graham, 2004

A sea otter eating a Tanner crab (*Chionoecetes bairdi*) in Prince William Sound.

Clams and Cockles, the Next to Go

"Salat angelrit, arwinlenek nuryugluten supalinek. Nutan wit*ruumek nuryugtuten mikpakarluki. Nutan pihnayartuten, am pektarnarlartut. Lagkauluten, lagkauluten taumi lagkauluten. Nupukanak angqat salat. Allu mikelngunguasagat. Tangerlanka suget wit*ruit mikelngunek imangq'rluteng. Tawaten all p'llaut. Angligkuarlantait."

"The clams were so big, you only needed six to make a chowder. Now, you need a bucket because they are so small. You can still get them, but you have to work hard for them. You have to dig and dig and dig. I'm talking about these big clams. Not these tiny ones. I see people with buckets of small ones. No wonder they're declining. They don't let them grow."

Dorothy Moonin, Elder, Port Graham, 2004

After the disappearance of sea urchins and sea cucumbers by the early 1970s, followed by the collapse of crab and shrimp fisheries in the mid 1980s, came the decline of clams and cockles. They were the next shellfish to become increasingly difficult to find. Alive, that is. Their broken shells were increasingly found along the shores of Port Graham Bay.

Right: Mary Malchoff. Port Graham, summer 2006.

When the Water Died

"Uquq imarmi. Amlerqaq uquq. Tuqulluku amlerqaq imaq. Tupagpakarluten kangircinailluni. Llumacimt'stun umiartunngukut imarpet tuquciqa. Kaguaglartukut qutemp'tni. Am i'put, qauget taumi uriitat igqaqlluteng yamanek. Tuqumaqaq. Tuqumaqaq Imaq."

"Oil in the water. Lots of oil. Killing lots of water. It is too shocking to understand. Never in the millennium of our tradition have we thought it possible for the water to die. But it is true. We walk our beaches. But the snails and the barnacles and the chitons are falling off the rocks. Dead. Dead water."

Walter Meganack Sr., past chief, Port Graham, 1989

On March 24, 1989, the *Exxon Valdez* tanker ran aground on Bligh Reef in Prince William Sound, spilling an estimated 11 million gallons (42 million liters) of crude oil, which spread through lower Cook Inlet to Kodiak Island and beyond. Although relatively little oil came to Port Graham and Nanwalek compared with the heavily oiled beaches of Prince William Sound, the spill and its aftermath had a huge effect on our communities, ecologically and socially.

"Uquq kugellrat cimirt'skiat kiaget. Kiaget casaat pekllartuq llumacirpet taumi unguarpet. Cimirt'ski sumacirpet. Takilngurmek pinguq. Cillakcak et'llra imarmi kiimi, am unguacimt'ni cali."

"The oil spill impacted nature's cycles, the seasonal clockwork of our culture, our life ways. It affected who we are as people. It wasn't just for a short period of time. It had lingering effects, not only in our water but in our lives."

Violet Yeaton, environmental planner,
Port Graham Village Council, 2004

"Kagwaglaapet qut'pet. Ungualrit pisurpilamta, tuqumaqat pisurluki. Tuqumaqat saqulet. Tuqumaqat Caqallqat. Angaqurpilamta, s'naqlluki qiapet, angq'rnapet, pellacipet, alla angq'rnaq tailuni uqum pektaanek. Minarluta pektaanek, nallikcagluta. Akirpakanek. Tupagngalrakut. Uquq p'rircarkauarpek, anlluku imarmek, tailluku tuqumaqaq unguamen."

"We walk our beaches. But instead of gathering life, we gather death. Dead birds. Dead seaweed. Before we have a chance to hold each other and share our tears, our sorrow, our loss, we suffer yet another devastation; we are invaded by the oil company. Offering jobs, high pay. Lots of money. We are in shock. We need to clean the oil, get it out of our water, bring death back to life."

Walter Meganack Sr., Elder and past chief, Port Graham, 1989

Right: Melania Kehl, Nanwalek Elder. Summer 2006.

Hundreds of millions of dollars have been spent to assess the environmental impacts of the spill. In Prince William Sound, the spill has had long-lasting effects on coastal food webs.[27] Although it occurred around the corner from us, the spill had several important indirect effects on our culture and our beaches.[12]

"Suget ggwaken pekt'skai, uquq perircarluku. Cali, akiq tailuni nunampt'nun. Akim tuut'sluki qayanek taumi angqanek qayanek, asirqanek masinanek, sugpakat awa tengurterluteng cumi agenngut."

"People locally were hired to help clean up the spill. Then, there was more money that came to the village. More money allowed more people to own more boats and bigger boats with better outboards, so many people could now go to places that they couldn't go to in the past."

Anesia Metcalf, Elder, Port Graham, 2004

"Akilikcarlrit uquq perircarluku taumi akiq atuqit tulluteng masinanek, kugyanek. Allangarkauqi, agegkuarluta asitengran."

"Big wages were made [cleaning up the oil spill] and that money was used to purchase motors, gear, and nets. It made a difference, it increased accessibility even when the weather was marginal."

Gerald Robart, Port Graham, 2004

"Nutan, nangpiarluteng tulang'qerlartut, tang'qernaiyaten cukaaqamek cimirtut pisuqengapet."

"Now, everyone has a skiff and we can see the immediate impact on our resources."

Walter Meganack Jr., Port Graham, 2004

With the flood of oil came a flood of money as many coastal residents were hired to help with the oil spill cleanup. With the new income that was generated, people in our village bought new skiffs and motors. More boats and faster boats led to changes in the way we hunted, fished, and gathered from the shoreline. Although initially we avoided subsistence foods for fear of oil contamination, subsistence harvest largely resumed within a few years. With faster, larger, and safer boats, we could visit more stretches of shoreline per tide, access more distant beaches, and go out to sea in weather that may previously have kept us ashore.

"Cumi tamatekcak tulait'llrakut. Suget nutan tulang'qertut pisuryarsutmek. Cumi ilakut'llrit tulanek tucilanngut. Nutan pektat amlertut nunampt'ni ciplluku cumi qaillun ellalra. Tawaten akiq amlerluni. Suget aking'rtut pektat amlerngatat tauaten tulanek tuqaqlluteng."

"There never used to be so many skiffs. People now have skiffs to go hunting. Before, families couldn't afford skiffs. There is more work in the village than there used to be, this has led to more money. People have more money because of more jobs so they buy skiffs."

Quentin McMullen, Port Graham, 2004

Consequently, and ironically, a delayed effect of the oil spill was an increase in the efficiency of our subsistence harvest.

"Salat, taugtat taumi y'ualaiyat pelalrit uquq kuguilan. Uquq kugngaut anaut'skit. Uqum anaut'skai, am pelalrit uquq kuguilan."

"Clams, cockles, and Dungeness crab were declining before the oil spill. The oil spill may have made it worse but they were already declining before the spill."

Feona Sawden, Elder, Port Graham, 2004

Nearshore Marine Invertebrates Decline One After the Next

"Utulalra mikhngama. Utut pellalrit cuqllirpauluteng. Y'ualayat taumi salat. Nutan uritat cimirtut, awa pellaut."
"There were more urchins when I was a kid. The urchins were the first to go, then crab and clams. Bidarkis, they're the most recent change, now they're declining."

Richard Moonin, Port Graham, 2004

After the decline of sea urchin and sea cucumbers, followed by crab and shrimp, and then clams and cockles, came the decline of bidarkis. According to our Elders, the decline of these invertebrates happened one after the next, after the next.

"Umiaq'gku cillakcak, ikugciqan cacat uy'ullartut. Allinguq cimiqan, nangpia cimirciqut."
"If you think about it long enough, you'll find that all things are connected. If you are affecting one, you are doing a whole chain reaction."

Walter Meganack Jr., Port Graham, 2004

Walter Meganack Jr., Port Graham Elder. Summer 2002.

Identifying the Problems to Create the Solutions

Young adults and children from Nanwalek paddle an umiaq during Tamamta Katurlluta (All of Us Gathering). Homer, 2010.

Serial Depletion and Ecosystem Overfishing

The serial decline of marine resources is a symptom of ecosystem overfishing.[28] Typically, fishermen first target the most lucrative stock and, when it has declined too far to be worth catching, they switch to the next most profitable stock. Serial depletion has been proposed as the mechanism driving the sequential decline of crustaceans in the Gulf of Alaska,[23] and abalone in California.[29] Despite regulation, management of commercial fisheries on a stock-by-stock basis can lead to a myopic perception of what is in fact a complex system, and can thus mask phenomena such as serial depletions.

A progression of multispecies declines can also occur when other predators, such as sea otters, switch among alternative prey, from most preferred to least preferred. Different users or predators may switch target species at different times. If sea otters, commercial fisheries, and subsistence harvesters all exploit shellfish in the same place, their combined fishing effort may keep shellfish numbers down even after one or two of the users have moved on to another species.

Prey switching by predators, a common phenomenon in natural systems,[30,31] may have led to the consecutive decline of marine mammals in the North Pacific Ocean and Bering Sea.[32] Yet sequential declines are often difficult to identify because research tends to consider single species over short periods of time, rather than an entire ecosystem over many decades. Furthermore, multiple causes of changes and interactions among them tend to muddy the picture. Fortunately, archaeological data, historical records, and traditional knowledge can provide ecological and social context and insight into variability and patterns of change within entire ecosystems, extending further back than contemporary scientific research.[6,33,34]

Putting It All Together: Why Have Bidarkis Recently Declined?

On the outer tip of the Kenai Peninsula, recent localized declines in bidarkis can be explained by changes in both socioeconomic and ecological dynamics. Strong evidence from our contemporary field studies of bidarkis suggests that present-day variation in bidarki numbers and size across the Kenai's westernmost rocky reefs is driven by a combination of shoreline collection by humans and predation by sea otters, with the relative strength of these two predators varying among sites. But the causes driving variation in bidarki numbers across space today does not explain why bidarkis have recently declined through time. The likely long-term cause was revealed only through our investigation into the prehistoric, historical, ecological, and socioeconomic dynamics of both the local and regional marine ecosystem. This temporal depth was provided by archaeological data, historical records, and traditional knowledge. Our perspective on the whole system arose from our different ways of knowing and our growing appreciation of the subtle interactions between ecological and social systems.

We think that five salient historical events likely triggered the serial decline of marine invertebrates along the seashore of Port Graham and Nanwalek, leading to localized reductions of bidarkis: (1) spatial restriction of human impacts, (2) disappearance and subsequent return of sea otters, (3) new technologies leading to increased fishing efficiency and effort,

Sea otters returned to Port Graham Bay by the late 1950s and early 1960s.

Left: Fred Toko, Annette Singh, and son Eric, with dog Coco. Summer 2005.

This pictograph may depict a person in a boat approaching a marine mammal. The dashed line represents a crack in the rock on which the image was painted.

(4) regional commercial exploitation of crustacean stocks, and (5) indirect socioeconomic effects of the 1989 *Exxon Valdez* oil spill.

"Makut neqet pisurkat ekgiliqatarpiil'ata naugtarllalrit taumi naugtarllaqait cacateng nangpia ciqlluateng ilaklluki taumi kipulluteng amleriaqata nangkutaaqamegt'ki. Nunilanengut all'ingurmi, cilla naugtarllaqait enteng taumi ag'urluteng uksuamek iciwamen tull'uteng. Nutaan nat'en agen'irluta cacat nang'urpia."

"When resources became limited, people moved on. They took all of their camp out. Then they would go back when resources returned. Villages didn't exist, there were seasonal camps. They always traveled, from fall to spring. That's what is happening here, we're not moving."

Nick Tanape Sr., Elder, Nanwalek, 2004

Historical harvests differed in several ways from today's practices. In prehistoric times, prior to European contact, harvest effort was less spatially concentrated because communities shifted among seasonal camps to subsist. With the migration of regional clans to trading posts throughout the 1800s, intentional consolidation of our villages by Russian Orthodox missionaries in the 1880s, and the creation of canneries in the early 1990s, mobile and dispersed harvest practices became more localized and concentrated. The introduction of modern technologies (freezers and better boats) led to increased harvest effort and efficiency, contributing to increased pressure on our resources. Yet even with the increased ability to travel with better boats, shoreline gathering right by our villages remains common today, particularly in the winter when our supply of salmon caught the previous spring becomes low and dangerous weather prohibits travel.

"Qangikcak sug'et maani urriitarlliinanek pisurlanengut, allat piturkat amlerllalriit. Cin-mi urriitarlliinaat pisurnayarait? Pingq'rllalriit yual'ayagnek, amyanek taumi uutugnek. Ikam'at cimirlarait pituqengateng qaillun allat unguwalriit, gguangkumt'stun cali. Cacanun cauciqut urriitanun. Elliin tawa awa pituqengarkapet."

"Years ago, people didn't only go for bidarkis, everything was available. Why would they want to just hit the bidarkis? They had crab, mussels, and urchins. The sea otter will change their diet, like any other animal, like us. What are they going to turn to? They turn to bidarkis, because that's our only diet from here now."

Nick Tanape Sr., Elder, Nanwalek, 2004

According to our Elders, subsistence diets from the 1920s to 1950s included a wider range of invertebrates, such as whelks, sea urchins, sea cucumbers, crab, mussels, clams, and cockles, because all of these invertebrates were present in abundance. Over the last decades of the twentieth century, these resources became scarce.

Based on our contemporary fieldwork, traditional knowledge, and a deep perspective in time, we believe

Right: Nick Tanape Sr., Nanwalek Elder and hunter. Summer 2006.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that the recent localized decline of bidarkis is a consequence of the serial depletion of alternative shellfish resources. This depletion has led to increased harvests of bidarkis by both humans and sea otters. Sea otters are well known to locally deplete shellfish from rocky reefs and muddy bays.[17,34] In the early 1900s, our diet was more varied than it is today, due to the availability of a wide range of nearshore invertebrates to gather. Consequently, human and sea otter predation used to be distributed over several species with preferred and most accessible prey items targeted first. As predation increased and preferred species became less abundant, predation pressure intensified on the species that remained. Because fewer and fewer species were left, our diet became narrower and narrower.

Sequential prey switching is a plausible explanation for serial declines, like the one seen in our waters. Bidarki declines may be simply the latest step as each person and each sea otter take more bidarkis to make up for the lack of alternative options. The recent localized depletion of bidarkis therefore may reflect a concentration in the distribution of human harvest pressure in space, an increase in harvest efficiency, and the serial depletion of various nearshore shellfish.[3]

Left: A sea otter paddles toward the rocky reefs of Port Graham Bay. Summer 2003.

"Cumi neqpet piturlaqepet. Nutan suget ell'hmaq piturlarait. Am-gem suget piturlarait uritat."
"People always used to have Native food. People eat less Native food now, but people still eat bidarkis."

Vera Meganack, Port Graham, 2004

The trends in shellfish landings from Port Graham and Nanwalek from 1987 to 2003 support our theory. Landings of invertebrates like whelks, sea urchin, sea cucumber, mussels, Dungeness crab, Tanner crab, and shrimp were low between 1987 and 2003, remaining well below 2% of the mean annual local harvest during this period. These data are consistent with the explanations offered by local harvesters that the invertebrates were in short supply. Relative to sea urchin and crab, a greater amount of clams and cockles was landed during the late 1980s, in accordance with the observations that these species declined later than sea urchin and crab. Landings of clams and cockles began to drop by the early 1990s, yet bidarki landings were greater in 1991 and 1992 than in 1987, despite a dip in 1989 due to the scare from the *Exxon Valdez* oil spill. Bidarki harvests remain high, yet it takes more time and effort to gather them.

Our People and Sea Otters: Predators and Competitors

"Uritarsurlantua away. Ketguarlartut urtuisutemni. Suget minartuilartut ggwani Paluwigmi."
"I don't pick bidarkis anymore. Now they appear in my sink. People are so generous here in Port Graham."
John Moonin, Elder, Port Graham, 2004

Amid all that has changed in our ocean home, some things have stayed the same. Sharing remains important, valued, and practiced. In particular, we look after our Elders. People grew up with the expectation that they would provide for our Elders, and that they would give away the first animals they harvested. Providing for oneself came afterward. These practices persist, connecting people not just to their surroundings, but also to one another.

"Caqama qanerlaanka ikamat. Qunukllaanka uritat."
"I curse sea otters sometimes. I'm being selfish with bidarkis."
Vera Meganack, Elder, Port Graham, 2004

Sharing, however, has its limits. We have a strong sense of connection to the land and sea and we recognize that all creatures have a place and need to eat. Yet, when predators such as sea otters build up in numbers, they can cause dramatic declines in their prey, in this case sea urchin, clams, cockles, crab, octopus, even bidarkis. As a consequence, we perceive sea otters as one of our main competitors, an uninvited guest feasting at our table.

"Uksurmi tangerpakarlantapet suget urritasurluteng. Lla asirpiakaulartuq. Am ikamat piturlartut cilla. Pihnayartut tungyumakan. Ggwangkuta pisurlartukut kenhnginan."
"In the wintertime, you don't see many people getting bidarkis. The weather has to be perfect. But the otters are eating all the time. They can get them at high tide. Our time to get them is limited."
Lydia McMullen, Port Graham, 2004

Many of us identify the increase in sea otters as a cause of invertebrate decline, and as one of the largest causes of changes to our local marine ecosystem. Our field research around Port Graham Bay agrees with the observations we have made while gathering. The studies

suggest that the variation in bidarki numbers and size is driven in part by sea otter predation. In places where sea otter numbers were observed to be consistently high, we counted fewer and smaller bidarkis. Over the past decade or two, sea otter numbers have increased dramatically within the bay. Our field studies suggest that approximately 170 adults and 40 pups were living between Point Adam and Point Pogibshi during the summer of 2004.

We also know that many plants and animals are connected directly and indirectly via a web of species interactions. When keystone predators such as sea otters recover, multiple changes may cascade through the entire food web. Their prey may decline, while their prey's resources may increase.

Right: Lydia McMullen with king salmon in Port Graham. Summer 2006.

Ecosystem Effects of Sea Otters

In the case of sea otters, there are important consequences to keep in mind. As sea otters feed on sea urchins and other herbivores, more kelp can grow and survive. Places with sea otters are known to become very productive for several reasons. First, kelp provides critical habitat and shelter for rockfish, greenling, lingcod, and even for young salmon on their way out to the ocean. Kelp also provides food, fueling coastal food webs from the bottom up. As waves toss the growing kelp around, bits of kelp break off and become food for filter feeders like clams, cockles, barnacles, and mussels. As a result, these filter feeders benefit. Barnacles and mussels in the Aleutian Islands have been shown to grow two to five times faster at islands with sea otters compared with otter-free islands, because more kelp particles in the water column were available to ingest.[35] Finally, kelp beds calm our ocean, allowing the larval stages of many fish to settle and grow. A seascape without sea otters or subsistence harvesters may indeed look very different. If grazers like bidarkis and urchins were abundant, they would mow the seafloor clean of kelp until their populations, too, would suffer from a lack of food.

Despite some of their ecological benefits, as sea otter numbers have increased, we feel an increasing sense of competition. Although we are allowed to hunt sea otters for our own use and for handicrafts, otters are not regarded as good to eat and only a few of us in the villages use their pelts. So sea otters are essentially undisturbed as they float in the bay, eating great quantities of clams, cockles, crabs, and bidarkis, animals that we, too, like to eat.

"Kulailrit ikamat tang'qerniryuglarait, am kamugka atumakuneg'tki allat'stun umiarturnayartut."
"To the tourists, those sea otters are beautiful animals, but if they were in our shoes they would think differently."
Simeon Kvasnikoff, Elder, Port Graham, 2004

The sea otter increase touches on another aspect of recent times. People from other places, with different values and perspectives, have a greater influence on national and regional policies about the environment. The fact that sea otters are protected is just one sign. The importance of bidarkis, seals, sea lions, sea ducks, and other marine creatures to our diet and culture is not always recognized outside the villages. Instead, we now find ourselves defending practices that we have always viewed as normal and natural.

"Ek'gitut uritat nutan, miklluteng."
"There are fewer bidarkis now and they are smaller."
Feona Sawden, Elder, Port Graham, 2004

And yet the bidarkis decline. There are many challenges to our culture, and much strength within our people. But for the bidarkis, for clams and crabs and cockles, the numbers keep going down. Fifty years ago, the seashore provided plenty of food. Although shellfish were more common at times and less common at others, there were always things to eat. Today, most shellfish are declining and it is a great concern.

"Kasakat qayagurkauapet kiptulsluki."
"It's time to call the Russians back again!"
Comment at the Port Graham Elders' Lunch in January 2004

Consequently, sea otters are a frequent target of people's frustration. The increase in sea otter populations has inevitably caused changes in the ecosystem. Nonetheless, sea otters are unlikely to be the only factor.

"Ikamat pacilapet. Piturlarait nangpiarluki pituqengapet. Am uriitat liullarat imaq. Ggwangkuta liullantaakut."
"Sea otters are part of the problem. They eat everything we eat. But bidarkis can adjust to nature. It's us they can't adjust to."
Walter Meganack Jr., Port Graham, 2004

We humans have a role, too.

Right: Young rockfish take shelter in the canopy of a kelp forest.

Overexploitation

"Nutaan sug'et amlerqat pisurlartut urriitanek. Pisurpakarluki nangegkwa'apet."
"There are more people out harvesting bidarkis these days. Overharvesting is the biggest factor."

Anonymous, Nanwalek, 2004

"Pellaut suget pisurpakarluki."
"The decline is because so many people pick them. That is the main reason."

Sam Moonin, Port Graham, 2004

"Atanenguarpet imaiyumauq urriitanek, agwakanirtukut, uksumi kiimi."
"Nanwalek reef is picked out so we go there less often, only in the winter."

Johnny Moonin, Nanwalek, 2004

Just as bidarki numbers and sizes are smaller where sea otters are found, our field research showed that bidarkis are far fewer and smaller where we spend most of our time gathering shellfish. This suggests that bidarkis are likely being overharvested in some places. As the demand for the resource increases, harvest increases. This is not only a problem in our ocean home, it's a problem worldwide.

According to the Food and Agriculture Organization, in 2007 19% of the world's fish stocks were overexploited, 8% were depleted, and 1% were recovering from depletion and therefore yielding less than the maximum they could produce due to excess fishing pressure.[36] Fortunately, data collected from 1974 to 2006 tell us that the proportion of overexploited, depleted, and recovering stocks around the world appear to have stabilized since the mid 1990s after a noticeable increasing trend in the 1970s and 1980s with the expansion of fishing effort.

"Makut am aprutet amleriut, amleriwakarluki sug'et awa nat'eqiinaq pisurwignun tuq'aqllartut pisurluki urriitat. Tawaten awa agwiiqautut urriitat ekgililuteng, sug'et taumi amleriluteng."
"The road increased access. Now people can access these sites, more people can get to these sites so there are less refuges [for the bidarki]."

Nick Tanape Sr., Elder, Nanwalek, 2004

As with many fisheries, increased access, either through better fishing technologies, bigger and speedier boats, or roads providing new beach access, allows

Right: *Picking Bidarkis.* Watercolor by Nancy Radtke. 2004

us to fish in places we would not have been able to previously. Therefore, natural refuges, which may have in the past sheltered animals from our hooks, nets, or knives, get found out. Those natural refuges may have been the source of young that replenish the beaches and shorelines where we harvest. Increased access typically leads to more harvest and, usually, overharvest. There are two main ways that overharvest can affect animal populations, such as bidarkis.

"Kayagnartuq ikunit angqat awa."
"It's harder to find the big ones now."
Demetri Tanape, Port Graham, 2004

"Ekgiliut urriitat pisurpakarluki taumi kayagniurluteng amlerigiigkunateng urriitat."
"They are getting wiped out and are having trouble reproducing."
Emerson Kvasnikoff, Nanwalek, 2004

Large bidarkis produce many more eggs or much more sperm than smaller bidarkis. When many of the larger-sized bidarkis are picked, fewer young are produced. As a consequence, fewer young will grow and become available for harvest or be able to spawn in following years. This "recruitment overfishing" means fewer young (also known as recruits) are produced due to fewer potential parents. The result is that the population simply cannot replace itself. This is clearly a serious threat to any species.

"Suget pisurlaqait miktengrata, suget pisurluteng taumi pisurluteng."
"Some people pick them even though they are small, people just pick and pick."
Jennie Tanape, Nanwalek, 2004

"Ukut angqat kayagna'igut ikun'it. Miktengraata pisurla'anka."
"It's harder to find the bigger ones so I'm getting the smaller ones."
Jolene Kvasnikoff, Nanwalek, 2004

With many of the large bidarkis gone, people resort to picking the little ones. However, this can actually lead to an overall lower amount of bidarki meat to eat. This type of overfishing is called "growth overfishing." It occurs when small individuals are collected before they have a chance to reach their maximum size. Therefore it takes more individual animals to make a meal, so more bidarkis are harvested. Reducing or eliminating the harvest of juveniles would lead to better bidarki picking in the future.

Changing Life Ways

"Nu'tan, nutaaq lumaciq nallulartuq kangircilant'at cacaq pia. Taugum misairlaranga. Igwilrarurlut cacaq nallugat. Ggwangkuta cuqllitni qulirullantapet qaillun ilarpet ellarta. Nutan lumaciiat nalunrauluteng—qulirullantait cin unitkaugait."

"Now, the new generation doesn't have an understanding or meaning. That kinda bothers me. Poor kids don't know no better. We Elders haven't told the younger ones what the nature does. This new generation don't know a damn thing—they aren't told reasons why they should leave them."

Simeon Kvasnikoff, Elder, Port Graham, 2004

Our Elders point to the deterioration of information transfer to the younger generation of harvesters as a serious problem contributing to overall resource declines. Harvest sizes deemed acceptable by younger harvesters are smaller than those used by today's Elders in their own youth. Furthermore, traditional management practices such as seasonal restrictions are no longer being followed. Lastly, we harvest bidarkis for more people than within our own villages. Teenagers, young adults, and Elders leave the villages for schooling or health care[12] and are often sent subsistence foods. Ultimately, ecosystems are driven by the interaction between social and ecological factors[37,38]; thus, we need to further understand our own behavior and the socioeconomic factors that motivate it.[39]

"Pacilaapet kinguqllimta picit, ggwangkumt'nek pacikaukut. Ggwangkuta litnaun'tapet."

"We are blaming the younger generation but we are to blame. We are not teaching them."

John Moonin, Elder, Port Graham, 2004

One important aspect of change is the loss of knowledge, although perhaps it would be more accurate to speak of changes in knowledge, because there are many things that we understand better today than ever before. Yet many of our Elders feel that they have not passed on the knowledge they received from their Elders to our children. There may be several reasons for this. With modern conveniences, people today are several steps removed from their environment. Furthermore, fewer of our people speak our Native language, Sugt'stun.

Agrapinna Jimmy peers over the rails of an umiaq. Homer, 2010.

"Nupugt'kaulanengukut Sugt'stun skuulumi, pigkwarlan'llkiikut. Nupugt'kaulalraakut melikaan'saat'stun."
"We couldn't speak Sugt'stun in school, we weren't allowed. We had to speak English."

Irene Tanape, Elder, Nanwalek, 2004

Our language is threatened by extinction due to the harsh restrictions imposed by early American colonizers in Alaska. Establishing English-only schools back in the 1950s likely contributed to the gradual erosion of traditional knowledge transfer from Elder to youth. Today's Elders still speak Sugt'stun, but most adults, teenagers, and children do not. With that loss comes the loss of stories about traditional practices, traditional life ways and skills, cultural values, and the traditional management of our marine resources. The knowledge that is disappearing is specific: it is the understanding, the wisdom, of how to look after oneself and one's surroundings. Luckily, Sugt'stun immersion programs in our schools and various other efforts are helping to revitalize our language and our culture. Supporting the recovery of the Sugt'stun language is one way to promote coastal conservation among us.

"Sugt'stun nupugtaqamta niillapet culiallret erinit…nu'tan piicaglarpet nutaat Alutiit lumacit liicumirluteng Sugt'stun nupugnermek tauaten nalluninitut kinautacirteng."
"When we speak our language we hear our ancestors' voices. . . . It is our desire that each new Alutiiq generation will learn to speak Sugt'stun so they will always know who they are."

Rhoda Moonin, Nanwalek, 1999

School children in Port Graham.

Bidarkis Go by FedEx

"Igguillrama apqarrlaranga: 'mamma urritanekqaa taituten?'"
"My kids ask me, 'Mom, are you bringing some bidarkis?'"
Vera Meganack, Port Graham, 2004

"Uritat tuyaqllapek ilamp'tnun Qitegyamen misugwani."
"We ship bidarkis to friends and family. Most go to Anchorage in ziplock bags."
Gerald Robart, Port Graham, 2004

"Kinaq agkan Qitergyamen, tuyuilartua panimnun."
"Every time someone goes to Anchorage, I send some bidarkis up to my daughter."
Vivian Malchoff, Port Graham, 2004

The number of people in Port Graham and Nanwalek has not changed much over the past 100 years. Although there has been a recent baby boom, more people are leaving the village. Those from the village who now live elsewhere still enjoy their Native foods from home. With the modern convenience of fast postal delivery, seafood, including bidarkis, can be shipped around the world. Those who have moved away from the village often return to visit in the spring and summer and go bidarki picking. This means that the number of people enjoying bidarkis from the shores of Port Graham and Nanwalek may be greater than the number of people who actually live here. This also means that the numbers of bidarkis harvested by each person locally may be increasing for two reasons: first, the lack of alternative subsistence shellfish and, second, an increasing demand from outside the village.

Left: Three young boys in Port Graham bait a halibut skate. Summer 2005.

Shifting Baselines

"Miktengraata pisurterluki ukut urriitat angligkwarkunaki taumi amlerigkwarkunaki."
"You are cradle robbing!"
Nina Kvasnikoff, Nanwalek, 48 years old, 2004

"Tawatekcak piukugki ayuqut'siiqai anglit miklli."
"Well, if you want them bad enough!"
Jolene Kvasnikoff, Nanwalek, 22 years old, 2004

"Sug'et all nutaan pisuqengateng amlert'sllarait taumi angegkwarluki."
"Maybe people's range of acceptable harvest sizes has now increased."
Ephim Moonin, Elder, Nanwalek, 2004

The bidarki size range that people pick in our villages varies. Older folks generally are choosy and pick bidarkis greater than three inches (about 8 cm), about the length of their palms. They are aware of how big bidarkis can get in areas that are rarely harvested. Younger folks, who generally harvest locally, pick smaller sized bidarkis in part because in their lifetimes, they have never seen how large bidarkis can grow.

The tendency to lose track of how much things have changed from the past is known as "shifting baselines."[4-6] All of us, including scientists, politicians, fishermen, and today's young subsistence gatherers, can suffer from this syndrome. Essentially, each generation of harvesters, researchers, or managers regards the environmental conditions they first experience as "baseline" or "normal" conditions, against which future changes can be measured. When the next generation comes along, they do not realize that things have already changed. Unaware that bidarkis are fewer and smaller than in the past, for example, they simply assume that current conditions are normal, creating a new baseline. The result is a gradual shift in perceived baselines from one generation to the next. Over time, a resource declines or disappears, and people scarcely notice.

One way around this problem is to look into the past and get a sense of "how big" and "how much" and "what species" used to be out there. As mentioned

Left: Ruben and Kristan Norman and Kyle Lestenkoff on their way back from setting their halibut skate. Port Graham Bay, summer 2005.

earlier, historical data are vital for evaluating change in ecosystems today and setting expectations for ecosystems in the future. Unfortunately, historical data are often hard to come by. This is where the value of our Elders' knowledge is especially profound. Many Elders have knowledge and observations from the past that can be used to prevent the shifting baselines syndrome for both young subsistence harvesters and scientists alike. For this reason, their observations and knowledge are extremely valuable in allowing us to evaluate the true social and ecological changes that are occurring in our ocean home today.

"Awa akmuut agyaurhngama, urriitat anglikcaumuut."
"Now that I've started going around the corner, bidarki sizes have increased."

Anthony Brewster, Nanwalek, 2004

Another way of curing the shifting baseline syndrome is to witness the abundance, size, and species composition in less impacted sites, sites that have seen little harvest by humans. This new, more realistic baseline may make us reflect upon the severity of change in the places where we usually collect, hunt, or do research. However, the danger of becoming aware of this new baseline is the temptation to simply shift our fishing effort to the new location and carry on as usual. These once-pristine areas then become heavily harvested, and the cycle and syndrome repeat themselves. This is a common occurrence among fisheries that tend to deplete the most accessible resources and then move to new areas as local abundances dwindle. As described above, this phenomenon occurred with the Dungeness crab fisheries of Kachemak Bay, Cook Inlet, and the Gulf of Alaska.

Nick Tanape Jr. prepares a Pacific giant octopus as his wife Kilann and daughter Shania look on. Nanwalek, summer 2006.

Gas flare on an oil and gas platform, Cook Inlet, Alaska.

Contaminants and Pollution

"Makut pacininiitanka kiigiita ikam'at. Gguangkuta cali pinarqukut taumi cacat masiinapet kaasait uquit maqllartut. Gguangkuta cali asiiyutapet piturkat taumi imarpet. Nutaan awa sug'et caktuugt'stait unguwaqat piturkat imarmi. Caktuugt'sllarait urriitat pisurpakarluki amlerigkwarkunaki."

"I wouldn't blame the sea otters, it's us. Our exhaust, gas, and oil. We are the ones damaging all that. The problem now is human impact, it's a heavy impact."

Nick Tanape Sr., Elder, Nanwalek, 2004

Humans are exerting unparalleled pressure on marine systems around the world. Even here in our ocean home, the impacts are great. In addition to increased harvest pressure, pollution from the oil industry and our own households and outboard engines introduces toxins to our waters. Charter boats from neighboring towns and our own skiffs are loud and may scare breeding seals and sea lions away from rookeries. All of these threats should be considered as we develop conservation and management plans for the future.

Oil Platform Discharge

"Elephant aqumagkuarpiarluku enemni. Naten-mi ukut awa agut? Aglartut imam web-ranun. Nalluntapet angliuq cadmium. Metal-ret tailartut uqum taumi kasam ellngalrit. Am anluteng nunamp'tnek. Scientist-ret kangircintat."
"It's like an elephant sitting in our living room. Where is all of this stuff going? It goes through the marine web. We know that there are elevated levels of cadmium. We know that this is one of the metals that comes out of the discharge from the oil and gas platforms. But it's also naturally occurring. That is an uncertainty that scientists can't answer."

Violet Yeaton, environmental planner,
Port Graham Village Council, 2004

Cook Inlet Spill and Response, Inc. barge. 2008.

In 1998 the Environmental Protection Agency (EPA) set a zero-discharge limit on produced water and drilling waste for all coastal oil and gas facilities in the United States. Produced water is highly saline water brought up by the drilling process. Drilling waste includes fluids and materials that are generated during the drilling process, such as drilling muds and cuttings, chemical additives, and cooling water. When the EPA set these zero-discharge limits, it exempted the coastal facilities of Cook Inlet, Alaska, our ocean home.

There are currently 24 oil and gas platforms in Cook Inlet.[40] These platforms create jobs for people on the Kenai Peninsula and extract crude oil and natural gas that we use to run our cars and boats and to heat our homes. But, taken together, they also produce an estimated two billion gallons of wastewater per year, which is discharged directly into Cook Inlet. Contaminants such as heavy metals, dioxins, and polycyclic aromatic hydrocarbons (PAHs), molecules found in most oil byproducts, have been detected in clams, snails, chitons, and salmon sampled from the shores where we traditionally harvest.[41] Yet it is difficult to pinpoint the source of this contamination. While some of the contaminants that were found in our foods are the same as those discharged by the platforms, natural oil seeps, source rocks, and coal also release PAHs.[42] Furthermore, some of the contaminants are global contaminants, spread around the world by ocean and air currents. Regardless of the source of these contaminants, their presence is bad for species and bad for ecosystems. Adding more toxins to our ocean simply increases the likelihood of those negative consequences. Oil industry discharge is an example of a long-term disturbance that likely has regional effects. Sadly, the burden of proving that there is a problem lies on the shoulders of citizens.

Our Own "Nuclear Waste"

"Maani sug'et amlerqat qayakcangq'rtut masiinangq'rlluteng maqelraanek, kaasam uqulaayiim tamaatum tuqurqai taumi yaataq kug'kengarpet gguangkuta kugurwimt'hnun tamaana imarmen maq'uq."
"Everyone has big boats with outboards. Our exhaust, gas, and oil are killing those. Our own 'nuclear' waste from the dump goes into the ocean."

Nick Tanape Sr., Elder, Nanwalek, 2004

"Atanenguaq pisurwikllaarpet pisurwiiyutaqamta urriitanek, tawani anarwimta kugurwimta maqgwillri asiiya'askai piturkapet pitun'unirt'slluki."
"The reef right in front of Nanwalek is a desperation site [for bidarki picking]. It is likely contaminated by dump runoff and our sewers."

Anthony Brewster, Nanwalek, 2004

But there are other sources of pollution that we can do something about. And those are our own. There has been a big change in the number and use of skiffs in our villages and thus an increasing use of oil and gas. Furthermore, our own dumps are growing at a faster rate as we import more items. Like the cannery waste, our garbage dump attracts many visitors looking for a free meal.

"Nanwalegmi qanitiirpait'llrakut 1980-mi."
"There were never ravens down in Nanwalek in the early '80s."

Lydia McMullen, Port Graham, 2004

"Qallqanat ing'ini cilla qangikcak elluamalrit atrarkunateng iqaurq'suumirkunaki pilit'hniiteng iqalluut augitnek. Uksumi kiimi atrarluteng aniungq'rtaqan iqaurq'suumirkunateng ing'imi ell'uteng kiagmi. Nutaan awa ell'artut uksuq nangluku. Cin ima."
"The magpies used to live up on the mountain. The reason they stayed up in the mountains was they didn't want to get their aprons dirty with fish blood. They only came down in the winter. Now you see them in the village all year round."

Becky Norman, Port Graham; Margaret Moonin, Port Graham; and Natalie Kvasnikoff, Nanwalek, 2006

Luckily, there is now more effort in controlling solid waste and hazardous waste with our tribal environmental program.

"Nangpia cacat urturwigkun atrarlartut imarmen."
"Everything that goes down the kitchen sink ends up in the bay."

Walter Meganack Jr., Port Graham, 2004

After electricity, the local sewer line arrived, funneling household and other waste directly into the bay. It is not clear if the currents and tides in the bay effectively flush sewage and wastewater away from Port Graham. During strong tides, it is likely that the flushing action is strong. During weak tides, there is not as much water flow, and it is possible that the waste remains in the bay for longer periods. In either case, the steady addition of wastewater and sewage is a change from the past. At Nanwalek, on the open coast, currents and tides are more effective at taking the wastewater away at all times. Regional and global pollution, however, is another story altogether.

"Salayam taumi iqallut naut'staarwiata egt'llrita tagllarait kelumen angqat unguwaqat. Qaillun piciqsit, 'kita taici, awa pituryaraurtaaci.'"
"Cannery waste and hatchery waste attract many predators. It's just like saying 'come on, dinner time.'"

Nick Tanape Sr., Elder, Nanwalek, 2004

"Amlerluteng ilasngaluteng agyarnat Fidalgo salayam llernallri."
"There were all sorts of starfish with the Fidalgo cannery waste."

John Moonin, Elder, Port Graham, 2004

"Agyarnat amlerilrit 1980-mi. Taugkut angqiarta."
"Sunflower starfish have increased since the 1980s. That's another big impact."

Lydia McMullen, Port Graham, 2004

The cannery and hatchery brought much needed jobs to Port Graham Bay, but with this opportunity came a cost. Hatchery and cannery waste may have contributed to shifts in the bay's ecosystem in both direct and indirect ways. The dumping of processing waste produced noticeable changes to the water quality in the bay. This practice lasted for many years.

Some species benefit from this temporary food source. Seagulls congregate above water and seafloor scavengers such as sunflower stars gather below. Sunflower stars are quick-moving predators that eat clams and cockles, especially the small ones left behind after a sea otter has dug its dinner pit. On the other hand, many other bottom-dwelling marine species, such as clams, suffer from concentrated nitrogen and carbon introduced by large quantities of processing waste. This seasonal disturbance can also leave the seabed without oxygen and can physically smother bottom-dwelling animals.

Left: Cleaning a setnet. Port Graham, summer 2005.

Charter Boats and Our Own Skiffs

"Qayat kalliita qaigyat taumi wiinat alingiyurq'rlarait-
pitaqait allat iqallut, neqait taumi qaigyuat taumi wiinat.
Yuantarluteng amutanek, amutat nuryuglapet neqem
siipani. Cimirluku taugna taumi cimirciqan neqem siipa."
"The noise of charter boats disturbs seals and sea lions and they are catching fish that are the food of other fish and seals and sea lions. They even jig for cod and cod are an important part of the food chain. Change that and you are changing the food cycle."

Walter Meganack Jr., Port Graham, 2004

Adding to the many changes observed in our ocean home are the direct and indirect effects of fishing charters on coastal ecosystems. Fishing charters are also a symbol of change beyond the control of the community. Charter boats start in Homer, Ninilchik, Anchor Point, Deep Creek, and other communities along the peninsula, providing employment and income for many people there. But the boats simply pass by Port Graham and Nanwalek, leaving impacts but no benefits. The charter boats are regulated according to the species they seek, typically halibut, which is a major predator on the seafloor. But the charter fishery's impacts to the ecosystem receive little or no attention.

Right: Bob McMullen in skiff. Port Graham Bay, summer 2005.

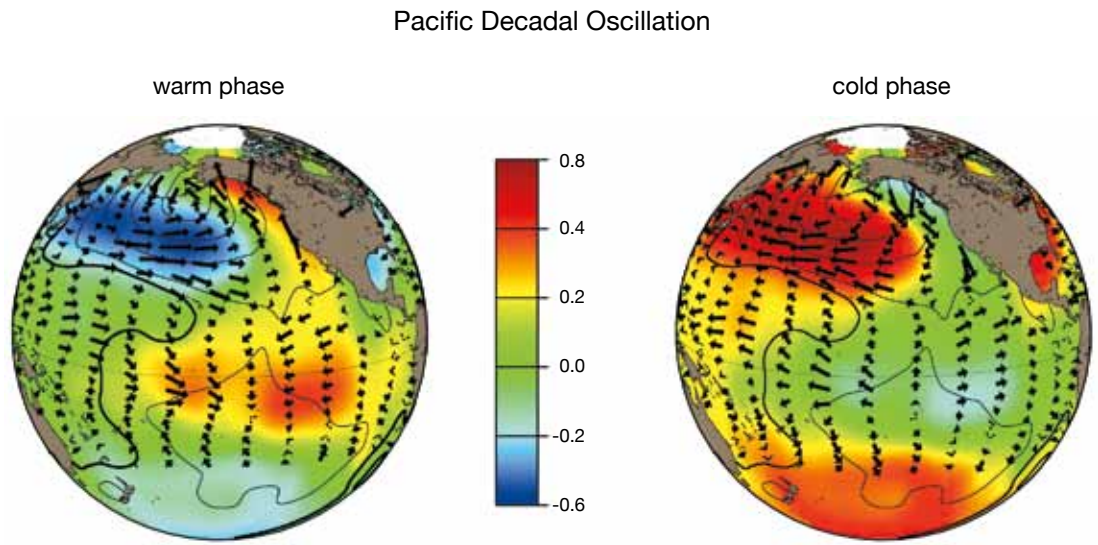
Changing Ocean Temperatures

Natural Cycles of Ocean Temperature

Temperatures in the Pacific Ocean naturally cycle between warm and cold regimes on a multi-decadal time scale. This large-scale pattern, known as the Pacific Decadal Oscillation (PDO), affects the Gulf of Alaska marine food web,[26,43,44] as discussed in our description of the collapse of crustacean fisheries in lower Cook Inlet. In the mid 1970s, the Aleutian low-pressure system shifted south and intensified, causing stronger westerly winds and warmer surface waters in our sea. With that shift, the Gulf of Alaska swung from a cold phase (1946 to 1976) to a warm phase (1977 to present). This shift in ocean temperatures during the late 1970s may have triggered an alteration in the Gulf of Alaska marine ecosystem.[24] The growth and survival of young groundfish improved and salmon catches soared. In sharp contrast, some forage fish populations such as capelin and herring collapsed around this time. In small-mesh trawl surveys, the catch changed dramatically from predominantly shrimp and capelin to halibut, cod, and pollock. This ecosystem change may have had negative effects on fish-eating seabirds such as puffins and kittiwakes that rely on capelin and other fatty forage fish. At the same time that ocean temperatures were changing in the Gulf of Alaska, possibly favoring groundfish over crab and shrimp, harvest of shrimp and crab was intensifying.

People often debate whether fisheries or changing ocean temperatures are responsible for declining fish stocks. Yet the respective roles and relationships of these factors change through time and are difficult to tease

apart. The fact that many marine species changed in abundance in the Gulf of Alaska and in front of our ocean home in the late 1970s, whether they were fished or not, suggests that changing ocean temperatures were at least in part responsible for the ecosystem-wide shift. Furthermore, there is a strong association between shrimp catches and water temperatures. On the other hand, large-scale fisheries can cause major changes even in species that are not being fished, by removing their predators or competitors. Plus, an increase in predators (cod and halibut) and decline in their prey (shrimp and crab) suggest that pressure from top predators, rather than ocean temperatures alone, may now play an important role in structuring the Gulf of Alaska marine ecosystem.



Typical wintertime sea surface temperature (colors), sea level pressure (contours), and surface wind stress (arrows) anomalies during the warm (positive) and cool (negative) phases of the Pacific Decadal Oscillation (PDO). Note that "warm" and "cold" refer to seawater temperature anomalies along the Pacific coast, not the anomalies in the central North Pacific Ocean.

Human-Induced Changes to Ocean Temperatures

"Llarpet maqa'iyanartuq, taumi lla maqa'ikan meq cali cimirciquq maqa'iluni."
"The climate seems to be warming and with climate warming, water temperatures change."

Nick Tanape Sr., Elder, Nanwalek, 2004

Although natural variability in ocean temperatures exists, global climate change, caused by rapid increases in carbon dioxide (CO_2) emissions by humans, is also warming our oceans. During the twentieth century, increasing atmospheric CO_2 has caused an increase of about 1.3 degrees Fahrenheit (0.74°C) in global average ocean temperature and a rise of about 7 inches (17 cm) in sea level.[45] Coastal ecosystems, along with the economic and social systems that depend on them, are threatened by warming seawater, changes in ocean circulation patterns, and sea level rise.[46,47]

Right: Sunset over Johnson Slough, Port Graham Bay, Alaska. Fall 2010.

Climate Change, Sea Ice, and Ocean Acidification

In the Arctic, north of our ocean home, scientists and Yupik and Iñupiat residents have observed profound changes in sea ice.[48,49] With the rapid loss of summer sea ice, ice-dependent species such as walrus, polar bears, and ice seals are predicted to decline, while Steller sea lions, gray whales, and other subarctic species will likely expand their range northward.[50] What will this northern shift in our subsistence resources mean for us here in Cook Inlet? An alteration in the spatial distribution of fish and seabirds in the Arctic will likely trigger the reconfiguration of arctic food webs.[51] How will this impact the marine food web at our doorstep? These ecological changes, in addition to mounting human activity, will have profound impacts on coastal peoples in the Arctic[52] and will likely have ripple effects all along Alaska's coastline.

The consequences of an atmosphere loaded with extra CO_2 go beyond ocean and atmospheric warming. As oceans absorb CO_2 from the air, they become more acidic, reducing the concentration of minerals that marine organisms like clams and snails use to build their shells. As the acidity of seawater rises, some marine invertebrates will find it more difficult to construct their shells. In some cases, seawater can become acidic enough to break down existing shells.[53] Furthermore, as marine invertebrates deal with increasing acidity, their larvae may have to adjust their metabolism to successfully make a shell. This could come with a cost. The physiological changes in response to acidity make animals less able to withstand warmer waters. On the flip side, some species may profit from higher acidity levels. For example, coccolithophores, a type of phytoplankton, and some lobsters and crabs, have been shown to build thicker shells under more acidic conditions.[54,55]

Alaska's coastal oceans, from the Gulf of Alaska to the Bering Sea and the Arctic Ocean, are showing signs of increased acidification.[53,56,57] There are multiple sites in the Gulf of Alaska where concentrations of

Left: The swimming sea butterfly, *Limacina helicina*, and sea angel, *Clione limacina*.

shell-building minerals are so low that shellfish are compromised in their ability to build strong shells. Because many invertebrates are a vital part of marine food webs and play a major economic role in several fisheries, changes in their health and abundance could have serious repercussions for coastal communities. For example, the shells of tiny pteropods, also known as sea butterflies or swimming sea snails, have been shown to begin to dissolve within 48 hours of being exposed to the level of acidity expected to occur in seawater by the year 2100.[58] Pteropods, along with other plankton species, fuel marine food webs in the Gulf of Alaska and in some years can make up more than 60% of a juvenile pink salmon's diet.[59] These swimming sea snails are also prey for pollock, cod, and mackerel. Ocean acidification can therefore affect commercially important species by reducing their food supply. Warming and acidification are expected to continue, and likely accelerate, over the next decade, further altering our changing sea.

Other Ecological Changes

There are other signs of change in our ocean home. Marine invertebrates, for example, were not the only animals to have declined in numbers in our living memory. Sea lions and seals are much less common now than they used to be. Our subsistence harvesters have been forced to go as far as Elizabeth Island, Anchor Point, or China Poot Bay to hunt for seals. The decline in Steller sea lions in the Gulf of Alaska, Bering Sea, and Aleutian Islands has become so widespread that they were listed as threatened under the Endangered Species Act in 1990. Why the decline? Groundfish fisheries in these areas target some of the same fish species that form a large part of the sea lions' diet. At the same time, large-scale changes in the North Pacific Ocean may have altered the distribution and abundance of fish. Furthermore, killer whales, the main predator of sea lions, may have shifted their diet.

"Arrlut pitularait wiinat taumi qaigyat. Ulutekenka mal'luk arrluk malirqarluku wiinaq-amlerluki arrlut tunuatni maliglukek. Qaucikcagnek tang'rsaqegka. Arwinlenek uksut (1997). Cuqllirpamek tangqenka arllut piturluteng ikamanek Tuqaqguigmi. Piturluki culurtumaita. Nutan tang'qsillua, cuqllirpam tangerluku. Arrlut cilla ellartut, am tangeqsillua piturluteng ikamanek. Ggwallu kaigpakarluteng piturluki."

"Killer whales eat sea lions and seals. I've watched two killer whales chasing a sea lion with a bunch of killer whales behind them. I've seen this many times. Six years ago, I saw killer whales eating sea otters at Coal Mine for the first time. They eat them fur and all. I've never seen this before, this was the first time. Killer whales have always been around but I've never seen them eat sea otters before. They must have been pretty hungry to eat them."

Simeon Kvasnikoff, Elder, Port Graham, 2004

Killer whales in Alaska belong to three ecotypes: fish-eating "residents," the "offshores," and mammal-eating "transients" known to eat seals and sea lions. Recently, we have seen killer whales eating sea otters by Coal Mine Beach. Some of us have observed that killer whales seem to spend more time closer to shore now than they did in

Gulf of Alaska transient killer whales prey on Steller sea lions, but studies in the region suggest that this alone is not the likely cause of sea lion declines, although it could slow their recovery. This transient, AT109, frequently visits Steller sea lion rookeries and haulouts with her daughter, AT111.

the past. Interestingly, the sea otters that had recovered around the Aleutian Islands by the early 1970s now appear to be declining at a steady pace, possibly due to predation by killer whales.[60] Why might killer whales have shifted their diet from plump seals and sea lions to these less-appetizing "furballs"? Possibly for the same reasons that we harvest more bidarkis now relative to other shellfish than we did in the past. In the Bering Sea and Aleutian Islands, killer whale prey such as baleen whales, harbor seals, northern fur seals, Steller sea lions, and most recently sea otters, have declined sequentially, with the decline of baleen whales beginning in the mid 1960s. Fin and sperm whales, once an important prey resource for killer whales, were dramatically reduced due to post–World War II commercial whaling. This may have triggered killer whales to begin feeding more intensively on smaller marine mammals.[32] Alternatively, the declines in seal, sea lion, and sea otter populations may be due to a combination of factors including nutritional stress, incidental mortality associated with commercial fishing, directed harvest, and predation by killer whales.[61] Much like the declining bidarki on our shores, this is probably yet another case of multiple causation.

Left: Marta Hetrick hooks a rockfish. Summer 2006.

"Nutan qalunayaten sagit."
"Now you can dipnet for halibut!"
Walter Meganack Jr., Port Graham, 2004

Other animals have shown changes in behavior. Halibut are feeding higher in the water column. They have been filmed jumping out of the water. It is not clear why this has happened. It may reflect changes in the food items that are now available to them or changes in the water column itself. At the same time, halibut are less common and smaller than they used to be. The changes our ocean is undergoing are affecting everything in the ecosystem, not just one or two species, and not just in one or two habitats.

"Nangluten salat pellaut. Agyarnat misairatnga. Pit'lranga salamek qana ping'rlluni."
"All the clams are gone, but the starfish are in my way. I caught one with clams in its mouth."
Vera Meganack, Elder, Port Graham, 2004

In the intertidal zone, many changes are taking place. Sea stars, like the sunflower star, are more common than they used to be, perhaps due to the waste from the canneries in the past and the present-day fish hatchery. There are fewer flounder and Irish lords and more greenling. The kelp seems thicker in most places. So why have all of these changes occurred? Are they natural? Will our ocean home support a productive ecosystem in the future?

Enjoying Our Marine Resources in the Future

Quyaanaa-naa-naa-ruq, culiaret
Quyaanaa-naa-naa-ruq, culiaret

Aulukllluta, nayurluta, piturcesluta
Una urriitaq tuluku, lliiluku qutmen,
amlercesluki neqpet
Piturcesluki kukupet, ellitaa kukuit piturcesluki, cali

Quyaanaa-naa-naa-ruq, culiaret
Quyaanaa-naa-naa-ruq, culiaret

Thank you, please ancestry
Thank you, please ancestry

Taking care of us, being with us, letting us eat
This bidarki, take it, put it on the beach,
make plenty of our food,
Let our children eat, let their own children eat, again

Thank you, please ancestry
Thank you, please ancestry

Song by Lydia Robart, Port Graham Elder, 1947-2001
Translated by Becky Norman

"Cacat lliikengapet cipt'kaun'tapet, naliit sug'et pisurlartut cip'arlluki. Sug'et amleriut urriitasurlalriit. Pisurpakarluki nangciqait."
"There are limits, limits of what you can harvest. Some people go beyond it."

James Kvasnikoff, Second Chief, Nanwalek, 2004

"Elpenek apqarkauten, 'Um-qa qutem unguagkuarciqai.' Elpet umiaqegkauaten igwillraaten asikhnaiyarait."
"You have to ask yourself, 'Can that beach sustain that?' You have to think about these things if we want our kids to enjoy it."

Walter Meganack Jr., Port Graham, 2004

Thinking about the future, there are grounds for concern and reasons for hope. There is no question that the local ecosystem has changed. There is also no question that human communities have changed. But these changes have also forced us to think about the

Right: *Bidarki Lady.* Watercolor by Nancy Radtke. 2004.

Our past, our present, and our future. Port Graham, 2005.

future, to think about the consequences of our own actions. We are asking what we can do to make things better.

"Suget cilla aguqata, nangciqait. Caken'llkugki amlerqat angqat tang'rciqaten."
"If people keep going back, it will get picked out. If you leave it alone, you'll see a lot of the big ones."
Vivian Malchoff, Port Graham, 2004

There are many ideas for how we can better manage our actions. This is what management boils down to: changing human behavior. We cannot manage ecosystems but we can consider carefully how we act and how our actions affect the rest of the system. If we want to make positive changes, we should start within our own villages, drawing on the wisdom of our Elders.

Traditional Management of Marine Resources

"Cuqllimta pisusqegkunak iciiwami taumi kiagmi. Cak'llankepet kiagmi; salat, uritat. Cuqllirpak uksuallami pisurlaqepet, unilluki iciiwaq nangpia. Cuqllimta qulirullaqiikut qenaq'rciquten pituqugki iciiwami. Alingcarluta piturts'tegkunaki kukungkata."

"Our Elders told us not to pick in the spring and summer. We never bothered with them in the summertime: clams, bidarkis. Early October we'd go after them, leaving them alone all summer. Our Elders used to tell us, 'You'll get sick if you eat them during the springtime.' I think that was their way to scare us out of eating them during the time that they were hatching."

John Moonin, Elder, Port Graham, 2004

Traditional management practices were designed to sustain populations so they could be harvested in the future. The rules included not picking bidarkis in the spring and summer when they are reproducing. Similar rules applied to clams, cockles, and other species. Seals and ducks were also left alone in the spring when they were reproducing. These traditional seasonal closures during spawning, calving, and fledging periods made sense. Some people may have continued to harvest bidarkis year-round, but the main harvests took place in winter.

"Iciwallaq Tanqimi cuqllimta aulirt'staqikut pisunit. Ungualrit mikelngunek ping'telrit. Tang'sumiqugki unuaqu cakegkunaki. Nutan piciat ellantuq, cacaqinarnek picagtat."

"March was the month our Elders stopped us from hunting. The animals had little ones inside. If you want to see them in the future, leave them alone. New generation, it's not that way, they go out and get whatever they want whenever they want."

Simeon Kvasnikoff, Elder, Port Graham, 2004

Equally important is the way that people understand their own actions and the consequences of those actions. Traditional harvest practices and the hard-won lessons from which they arose helped sustain local resources. In recent years, however, those practices and beliefs have not been passed on to younger generations. Furthermore, the loss of resources locally has less of an immediate consequence for us than it did in the past. In the old days, failure to take care of resources meant that they would be depleted, and people would have to go without.

"Anglingama, atuqugki neqet imarmek—aulukegkauluki cali. Pisurluten naaten nuryugcit taumi unilluki mikelngut, pisurlantuten quta nangnati. Pisurlantuten ekgikata. Tawaten lit'lrakut."

"When I was growing up, if you were a resource user you had to be a resource manager, too. You pick only what you need and leave the small ones alone, you don't pick a beach clean. You stayed away when things were scarce. That is what we were taught."

Walter Meganack Jr., Port Graham, 2004

But the situation is not beyond hope. Much knowledge remains with our Elders today. If we can pass it on, if our younger people are willing to learn it, those hard-won lessons from countless generations may still be sustained in our communities, together with the healthy ecosystems that nourish us.

Right: Mariah Marquez with toddler Vasya Sajaev in skiff. Port Graham, summer 2005.

Teaching the Next Generation

"Neqet nangut. Qangirllat litnauntakut. Pisurpakarluki."
"The resource is depleted due to a lack of teaching by the Elders and a lack of management."

Walter Meganack Jr., Port Graham, 2004

The starting point within our villages is knowledge. The connections and communication between Elders and youth have weakened. The realities of shifting baselines are becoming increasingly apparent. We are the only ones who can reverse this trend. Already people are discussing how to do this.

"Nuryugtukut katurwigmek taumi igwilrarat taigkuarluki quliruhnaluki quliaruamt'nek."
"We need a gathering place and invite the kids of all ages so we can share our stories."

Elenore McMullen, Elder and past chief, Port Graham, 2004

"Nutaan awa pisurlartua angqanek urriitanek elliin cuumi nallun'iqelraanga."
"Now I pick larger bidarkis because in the past I didn't know any better."

Vivian Ukatish, Nanwalek, 2004

Practices of restraint and the knowledge to recognize when a species needs to recover are in danger of being lost. We need to facilitate the transfer of knowledge and traditional management practices from Elders to our youth.

"Igwilrarat nallunirt'sumirluki lumacimt'stun. Liitent'lkata caktugciqukut. Igwilrarat liitkaut, litnaun'llkumtki nutan, tamana tuquciquq."
"Getting the kids to learn their cultural ways of living because if they don't we are going to have troubles. Kids have to learn about that, if we don't teach them now, it's going to die."

Simeon Kvasnikoff, Elder, Port Graham, 2004

Traditional foods and traditional practices may not be strictly necessary for survival today. But if our culture is to continue and adapt to a changing world, then people must heed the lessons of their Elders. Traditional foods and practices are a source of strength, both nutritionally and spiritually. This foundation is irreplaceable.

"Ukeqekcaglaqa, 'egtegkunaki, picagkunaki.' Caqamta kumlawimt'ni pingqerlartukut nangent'llepet. Atranqigtaqamta ikullantukut litnauraakut."
"I am a firm believer in 'waste not, want not.' Sometimes if we have some bidarkis left in our freezer because we didn't finish eating them, the next time we go out for a tide, we don't find any. It is a lesson to us."

Vivian Malchoff, Port Graham, 2004

Left: Michael Anahonak tells his grandmother, Stella Meganack, about "the one that got away." Summer 2005.

Qaillumi Kipucesnaiyarrtaa: How Can We Bring It Back?

"Aturyumiqumt'ki, asircarluki aulukegkauapet. Elwigpet pektaqegkaugat qaillun aulukegkauapet."

"In order for us to continue to enjoy these resources, we have to manage them better. It is up to the village to come up with a management plan."

Walter Meganack Jr., Port Graham, 2004

"Nutan igaumuq qaillun aulukciqapet. Igaumuq am cimirnayartuq qangirllat picagtat. Qaku aguciqarpet tribal council-men taumi aturluku litnaursut'mek."

"Currently we have a draft natural resource management plan. It is considered a living document that can change depending on what the Elders decide. Eventually it is going to be brought to the tribal council and used as a teaching tool."

Karen Moonin, natural resource planner, Port Graham, 2006

On the foundation of Sugpiaq knowledge and wisdom, we can take action to protect the animals we use and the ecosystem that sustains them. Those actions may be similar to or different from the traditional management practices that the Elders refer to. A combination of local knowledge and science can be used to develop alternative management strategies. The effectiveness of those strategies can be monitored by using scientific techniques as well as traditional observations. A management plan for bidarkis may include size limits or seasonal closures during spawning season, protecting nursery areas, or closing some beaches entirely to harvest to promote the recovery of bidarki populations.

"Unillanka mikelngut, nalluntua angliciqut. Pisuqugki mikelngut, taku piciquten."

"I leave the small ones 'cause I know they're going to grow. If you pick the small ones, you won't have them later on."

Robin Otis, Port Graham, 2004

Right: Elmer Anahonak and Terry Kvasnikoff count red salmon at the Nanwalek fish weir. Summer 2006.

"Pisunlkiki mikelngut, nauyumirtut elpet'stun, nalluntan."
"Don't pick the little ones, they want to grow like you, you know."

Peter Anahonak Sr., Elder, Port Graham, 2004

Suggesting size limits might be a good place to start. A minimum size requirement would help with the problem of growth overfishing described earlier. If small bidarkis were left to grow to a large size, each individual bidarki would be more of a meal tomorrow than if it were picked today.

"Unitkauapet iciwami ggwallu pisuapet imalget."
"We need to leave them alone in the spring, otherwise we are probably harvesting the spawning ones."

Pat Norman, Chief, Port Graham, 2004

"Ggwallu cakeniqumt'ki, ggwally kipuciiqut."
"Maybe if we left them alone, maybe they would come back."

Jennie Tanape, Port Graham, 2004

There are many things from the past that are worth perpetuating. Traditional seasonal closures during the spawning period, once used in the past by our Elders, would be a helpful management tool worth using today. By collecting bidarkis after they spawn, we will have given the next generation of bidarkis the chance to be created.

"Pisurwipet aulukegkauapet. Aulukegkauapet nanni qingaguiat."
"Our harvest areas need to be protected. We need to protect rearing habitats."

Walter Meganack Jr., Port Graham, 2004

A promising way to help bidarkis recover would be the full protection of some shorelines. These untouched areas would act like natural refuges. Individual bidarkis would grow, and over time there would be a greater abundance of large individuals with their high quantities of eggs and sperm. Because they are broadcast spawners, which release egg and sperm into the water column, when bidarkis are close together the likelihood of sperm meeting egg is much greater. After fertilization occurs, bidarki larvae then travel in the ocean for about eight days before they settle on rocks and start their life as a bottom-dwelling animal. During those eight days, larvae can travel great distances depending on ocean currents, waves, and local eddies. Some of those larvae from the protected area could replenish harvested sites with new young bidarkis. The spillover of larvae and adults from marine protected areas into adjacent fished areas has been documented in numerous places around the world.[62,63]

"Ilait pisurwit aulukengraam'tki pekniniituq, allat sug'et teg'ikauciqut. Taumi nuryugciqukut cacanek kamisiinkut taigkwarluki maa'ut ulutegt'slluki, National Guard-kut cali taiqurkauluki cali taumi asirnayangraan tamaana, taumi am-ggem sug'et allt'snayarait. Nupuguat cuglluki ggwani taumi. Tawaten liihneq piupiartuq litnaurt'slluki angli."

"Protecting some areas wouldn't work because it would have to be voluntary compliance and some people would cheat. We'd need bylaws. Fish and Game would have to come in. We'd have to call in the National Guard! It is a good idea but it would cause social feuding and rumors would spread. That is why education is so important."

Nick Tanape Sr., Elder, Nanwalek, 2004

The social realities of setting aside protected areas need to be carefully considered. It is true that marine protected areas will help replenish adjacent fished areas only if everyone in the village abides by the guidelines. This could be difficult because some people may find themselves drawn to the opportunity to collect large bidarkis, even if they are protected. Guidelines to protect these areas would have to be enforced in some way, and that may be a very difficult thing to do socially. To overcome this hurdle, education on the benefits of marine protected areas would help our community recognize the value of investing in them. The community might be convinced, once people see the positive consequences of

Alison Seville, Agrapinna Jimmy, and Mathias Ukatish Evans at Tamamta Katurlluta. Homer, 2010.

protecting some shorelines. Consequently, it is important to demonstrate that the long-term gains of preserving spawning areas and protecting ecosystem integrity outweigh short-term losses of reduced harvest.

Although protected areas may be an important component in the recovery of the bidarki and other marine species, alone they would not be sufficient. This is because displacing harvest pressure from one area will concentrate it in another. Setting aside protected areas must be coupled with an overall reduction in fishing pressure outside of their boundaries. It may take a combination of tools: education, size guidelines, seasonal closures, protected beaches, and a reduction in overall collection to promote the recovery of bidarkis and other subsistence shellfish resources. Ultimately, however, recovered populations can sustain higher harvest rates than today's depleted populations.

"Liitkaukut qaillun auluk'gkauapet ggwangkuta kimta allu am allat cali."
"We need to figure out how to protect the resources, not only from ourselves but from others too."

Walter Meganack Jr., Port Graham, 2004

As we, the people of Port Graham and Nanwalek, take the initiative to manage our own activities, it is only fair to look also at impacts from beyond the villages. Developing regional research and management plans is one approach. Convincing government agencies and others to participate may not be easy in a time of declining funding for management and increasing competition for space and resources. But fragmentation of effort and regulations will not help the marine resources and services we depend on.

"Cali cimirciqut cacat taugkut tangeqsit'kengapet"
"There are still changes that will happen that we haven't foreseen."

Walter Meganack Jr., Port Graham, 2004

Sometimes the best-laid plans can still go astray. It is impossible to predict what will happen in a complex and dynamic system such as the marine environment of lower Cook Inlet. What is important is to establish a system that can adapt quickly as conditions change. This requires careful monitoring to detect what changes do occur, targeted experiments to determine the causes of change, communication to disseminate the results, and support for conservation and management programs. In other words, it requires that we take an active role in planning for our future.

Left: Port Graham dock. Summer 2005.

The Future of Our Ocean Home

"Kipucumirtua qangirlat piciatnun."
"I want to go back to the old ways."
Anesia Metcalf, Elder, Port Graham, 2004

Not everyone wishes to go back in time. But a past when marine resources were plentiful is more desirable to many of us than our dwindling shoreline resources of today. Our present and our future are shaped by events that came before. Here in our ocean home, lower Cook Inlet in the Gulf of Alaska, today's bidarki numbers and sizes are driven by both our shoreline gathering and predation by sea otters. Traditional knowledge and historical records of our catches revealed that several marine invertebrates—sea urchin, crab, clams, and cockles—declined one after another beginning in the 1960s, with reduced numbers and sizes of bidarkis among the most recent. These shellfish declines took place alongside changes in human behavior. We switched from living in seasonal camps to increasingly permanent villages, concentrating our subsistence practices close to home. As our harvest technologies improved, our culture-based season and size restrictions began eroding. At the same time, commercial crustacean fisheries intensified, and by the early 1980s crustacean stocks had collapsed in the Gulf of Alaska. Amid all these changes, sea otters began to recover along our shores. Taken all together, we believe that the concentration of our harvest effort, our increased harvest efficiency, and the disappearance of multiple marine invertebrates available to us in the past, have led to intense harvest effort by humans and predation pressure by sea otters on bidarkis and thus their recent decline in our area.

Humans now have the power to influence the future more than ever before. By facilitating the transfer of knowledge from Elders to youth, and from scientists to local ocean observers, we can enrich our ability to determine the causes of our changing sea and develop solutions.

You have listened to a story told through the voice of many storytellers. We have pieced together parts of our history, combined our knowledge, and merged our ways of knowing to more fully understand the complex drivers of change in our ocean home. By integrating knowledge systems and delving into our ecological and social past, we hope to foster a culture of sustainability, one that values both ecological and social needs and the wisdom that comes from looking into the deep past and far into the future.

Boys with three-hole kayaks on the beach at Kiniklik, Prince William Sound, 1930s. A paddle leans against the covered boat.

Fishing off the dock in Port Graham. Michael Anahonak (right) and friend. Summer 2005.


YAMAHA

Acknowledgments

This story was truly a combined effort inspired by many. It sprung through friendships that grew over five summers of fieldwork, late night boat repairs, many cups of coffee, and the openness and good humor of everyone involved. It is with deep gratitude that we thank the Elders, tribal councils, and residents of Port Graham and Nanwalek for their enthusiasm and steadfast support of this project. Quyanaa. Special thanks to Chief Pat Norman, Second Chief James Kvasnikoff, past Chief Emilie Swenning, Environmental Planner Violet Yeaton, Tribal Administrator Fran Norman, and Lydia McMullen for their guidance and encouragement.

Over eighty residents of Port Graham and Nanwalek contributed their knowledge and expertise to the Bidarki Project and this collaborative book project. Their wisdom infuses these pages. We honor and thank our collaborators: the late Peter Anahonak Sr., Elmer Anahonak, Tanya Anahonak, Charlemagne Active, Kathy Brewster, Anthony Brewster, Jeremy Cook, Annie Evans, Mathias Ukatish Evans, the late Annie Fomin, Sherry Glahn, Tim Green, Marta Hetrick, Melissa Hetrick, Eloise Huntsman, Agrapinna Jimmy, Melania Kehl, Emerson Kvasnikoff, Jolene Kvasnikoff, Nina Kvasnikoff, Eric Kvasnikoff, Vincent Kvasnikoff, Katrina Kvasnikoff, Simeon Kvasnikoff, Natalie Kvasnikoff, Terry Kvasnikoff, James Kvasnikoff, Kyle Lestenkoff, Mary Malchoff, Mariah Marquez, Vivian Malchoff, Elenore McMullen, Bob McMullen, Jeff McMullen, Lydia McMullen, Quentin McMullen, Deborah McMullen, Bobbi McMullen, Vera Meganack, Walter Meganack Jr., Stella Meganack, Ben Meganack Sr., Anesia Metcalf, the late Dorothy Moonin, Ephim Moonin, Herman Moonin Jr., Uncle John N. Moonin, Johnny Moonin, Karen Moonin, the late Margaret Moonin, Rhoda Moonin, Richard Moonin, Sam Moonin, Ralph Moonin, Isaac Moonin, Nick Moonin, Becky Norman, Pat Norman, Marlene Norman, Ruben Norman, Kristan Norman, Robin Otis, Millie Peterson,

Left: Chief Pat Norman with king salmon. Port Graham, summer 2005.

Nancy Radtke, Gerald Robart, Vasya Sajaev, Feona Sawden, Thomas Sawden, Christine Seville, Auggie Seville, Alison Seville, Annette Singh, Eric Singh, Nick Tanape Jr., Kilann Tanape, Demetri Tanape, Irene Tanape, Jennie Tanape, Melinda Tanape, the late Fred Toko, Vivian Ukatish, Nadia Ukatish, Nancy Yeaton, and Violet Yeaton.

This book is unique for many reasons but perhaps its most important legacy will be its small contribution toward the revitalization of the Sugt'stun language, made possible by the hard work and dedication of Sugt'stun language translators Sally Ash, Kathy Brewster, Herman Moonin Jr., Emilie Swenning, and Becky Norman. Thanks also to Jeff Leer for sharing his knowledge of the Sugt'stun language.

Many thanks to Nanwalek artist Nancy Radtke, Elder Feona Sawden, the late Dorothy Moonin, the late Luba Meganack, and Herman Moonin Jr. at the Paluwik Cultural Display Center, whose artwork and historical photographs help us tell our story. Josh Anahonak from Port Graham, Josiah Campbell from Homer, Randall Davis of Alice Cove Research, Craig Matkin and Kyra Wagner of the North Gulf Oceanic Society, Alan Parks of the Alaska Marine Conservation Council, Heloise Chenelot and Russell Hopcroft of the University of Alaska Fairbanks, Thomas Kline of the Prince William Sound Science Center, and Rowan Trebilco of Simon Fraser University kindly shared their photographs of west coast marine life and culture. We are also indebted to Steve Baird, of the Kachemak Bay Research Reserve, who co-created our local place-name map with Emilie Swenning and co-author Nick Tanape Sr.

This book would not have been possible without the vision and support of Paul McCollum, who played a key role in initiating the Bidarki Project back in the summer of 2001. Greg McMullen and the staff of the Port Graham Hatchery were instrumental in supporting the field component of our research. Field assistance from Moose Anahonak, Brenda Dolma, David Glahn, Kyle Lestenkoff, Justin Malchoff, Jeff McMullen, Lydia McMullen, Matt McMullen, Jim Miller, Marlene Norman, Marvin Norman, Nick Tanape Jr., Liz Villarreal, Nancy Yeaton, and Violet Yeaton was invaluable and

informed our understanding of the Kenai Peninsula's coastal rocky reef ecosystem.

Marilyn Sigman and Bree Murphy of the Center for Alaskan Coastal Studies, Molly Dutton, Kim Donahue, and Coowe Moss-Walker of the Kachemak Bay National Estuarine Research Reserve, and the folks at Smokey Bay Air played a pivotal role in getting the Bidarki Project to take flight.

Bill Workman, University of Alaska professor emeritus, and Ron Stanek, Alaska Department of Fish and Game Subsistence Division, shared key data that enriched our understanding of the system. Paul Dayton of the Scripps Institution of Oceanography and Jane Watson of Vancouver Island University provided valuable insights on the peer-reviewed journal article that formed the basis of this book. Patricia Cochran of the Alaska Native Science Commission, Aron Crowell of the Smithsonian Institution Arctic Studies Center, and Terry Johnson of the University of Alaska Fairbanks carefully reviewed this book manuscript and provided thoughtful advice. Special thanks to friends and colleagues at the University of Washington for helping us hone the ecological aspects of this project: Jennifer Ruesink, Bob Paine, Daniel Schindler, Dee Boersma, Chris Harley, Wendy Palen, Heather Tallis, Brice Semmens, Jon Moore, P. Sean McDonald, Kirstin Holsman, and Eric Buhle.

Many thanks to Aleesha Towns-Bain of the Rasmuson Foundation, Joan Braddock and Amy Simpson of the University of Alaska Press, Mike McCanna of the Chugach Heritage Foundation, Sheri Buretta of the Chugach Alaska Corporation, and Heather Briggs of the Pratt Museum for helping us make this book a reality. It is with great appreciation that we thank the Alaska Sea Grant publications production and marketing team: Kurt Byers, Jen Gunderson, Sue Keller, Garry Utermohle, and Kathy Kurtenbach. We are especially grateful to skilled graphic designer, Jen Gunderson, whose talents make this story lift from the pages.

Ecological field research for this book was funded by the Gulf of Alaska Ecosystem and Monitoring Research Program and the National Oceanic and Atmospheric

Adam Hilts (left) and Frank Berestoff at Tamamta Katurlluta. Homer, 2010.

Administration. Funding from the Rasmuson Foundation, Chugach Alaska Corporation, Alaska Sea Grant College Program, University of Alaska Fairbanks, and the Pratt Museum contributed to the design and printing of this book. The Sugt'stun language translations were funded by the Chugach Heritage Foundation and Alaska Sea Grant. Lisa Williams' photographs were funded in part by the Alaska State Council on the Arts and the Alaska Humanities Forum. Use of her photographs in the this book was paid for by Alaska Sea Grant. While compiling this book, Anne Salomon was supported by a Natural Sciences and Engineering Research Council of Canada scholarship while at the University of Washington, a David H. Smith Conservation Research Fellowship at the University of California Marine Science Institute, and the Simon Fraser University School of Resource and Environmental Management in the Faculty of Environment.

Finally, we honor and celebrate Elders from the past whose extraordinary repository of knowledge, skills, and intuitions have been transmitted from generation to generation. May their memory be eternal.

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Photographer Credits

Lisa Williams, Principal Photographer
Lisa Williams has been taking photographs since 1990. Her interest in diverse cultures inspired her to earn her B.A. in anthropology from the University of California at Berkeley and her M.A. in social documentation from Sonoma State University. Ms. Williams has worked to combine her multitude of interests—photography, anthropology, and the environment—into an expression of visual anthropology.

Photographs by
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Front: the late Peter Anahonak Sr.
Back: Vera Meganack.

Illustrations and Artwork
Nancy Radtke p. 49, 79
Joint Institute for the Study of the Atmosphere and Ocean, University of Washington p. 69
All pictograph images were originally drawn by Frederica de Laguna in 1934.

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