Geementok Tar-uk;

Our Changing Sea

Killer Whales (*Orcinus orca*) cruise past Mnt. Bede, Cook Inlet, Alaska. Summer 2004.

Mehahm Shugha; Person from the Water

"*The ocean is part of me. Sometimes, I just have to go down there to smell the ocean*."
(Simeon Kvasnikoff, Elder, Port Graham)

We, the Sugpiaq people, are sea people. Our lives are sustained by the sea. The sea is part of our spirit. When it changes, we change.

Prologue;

How this Book Came to Be

As the Sugpiaq have always known, the sea is always changing. Young salmon swim out to sea and years later return to spawn. Seabirds arrive in spring to congregate, feed, and rear their young. Along the shoreline kelp reaches for the sunlight in ribbons beneath the sea, starting fresh each year while sea stars cling to the rocks as the tide ebbs. The numbers of these creatures change with the seasons and throughout the years, as do their behaviors, and their interactions with one another. Yet, some things change very little. The Sugpiaq people still come to the beach to gather, set out in boats to fish, teach their children, and provide for their elders.

But now the sea is changing in new ways, ways that are both puzzling and troubling. Sea urchins, which used to be plentiful, are now rarely seen. Clams and cockles are few. Crabs have disappeared. The most recent shellfish decline has been that of the black leather chiton, know locally as a bidarki. The foods that have sustained the Sugpiaq of Port Graham and Nanwalek are becoming harder to find. The shoreline, the people's pantry since time immemorial, is becoming bare. Why? We begin to explore this complex question here in this book.

Violet Yeaton, Environmental Planner, Port Graham Village Council & Bidarki Team Volunteer, monitoring bidarkis on Nanwalek reef. Summer 2002.

This book grew out of a study on the ecology of the bidarki, known scientifically as *Katharina tunicata*. As part of my doctoral thesis at the University of Washington, I started examining the role of herbivores in shaping the ecology of the intertidal, that area of the shoreline that lies between high and low tide. As I began this research with the help of local volunteers from the villages of Port Graham and Nanwlaek, I quickly found out that bidarkis are considered a delicacy locally and their gathering meant that there were fewer bidarkis on the beaches closer to the villages. The differences in abundance provided an interesting opportunity to examine the ecological effects of removing bidarkis from intertidal ecosystems. Like many fisheries, the removal of an organism may lead to a domino effect throughout the marine environment.

Known locally by its Russian name Bidarki and in Sugcestun as urriitaq.

Curiously, while bidarkis had been traditionally harvested for over a hundred years in this area, villagers had only recently observed a decline in bidarki numbers and size. Tribal members were worried about this change and wanted to understand its causes. After a community meeting to discuss the state of subsistence resources and the concerns and questions held by local residents, we wrote and were awarded a collaborative grant to investigate the causes and consequences of bidarki declines.

Nick Tanape, Lydia McMullen, Nancy Yeaton, Matt McMullen, Marleen Norman, Robin Otis, Lars Moonin and many others from both Port Graham and Nanwalek helped with fieldwork and shared their knowledge of bidarkis and their ocean home. Working together, we realized we could learn a great deal from each other. We also realized that understanding bidarki declines required an understanding of the whole ecosystem, including humans, their relationship with the sea, and their history on the Kenai Peninsula.

Thus our research expanded. Locally, it became known as "The Bidarki Project" and I, "The Bidarki Lady." In addition to our ecological field work, we began interviews with tribal elders and surveys with village residents. To help with this part of the project, Henry Huntington joined the Bidarki research team. Through the interviews, we expanded our scope to discuss changes in the conspicuous animals which inhabit nearshore waters, social changes that have taken place in the villages, and other events that have shaped what we see today.

In the course of several years of fieldwork and discussions, we also experienced a wonderful transformation in our relationships with one another. As our words show in this book, the researchers and the community members became "we" and "us." Thus, our book is written in the first person, plural, and conveyed through many voices.

This style is perhaps awkward on occasion, as myself and Henry are not Sugpiaq, but we hope any awkwardness is more than made up for by the fact that the story is ours collectively, scientific and traditional knowledge pieced together and told by us all.

As our project progressed, it became increasing clear that events from the past helped explain the changes that we see today. After all, the sea around us is the product of many forces, interacting through time. We decided that it was important to pass on what we had collectively learnt to others in our communities and beyond.

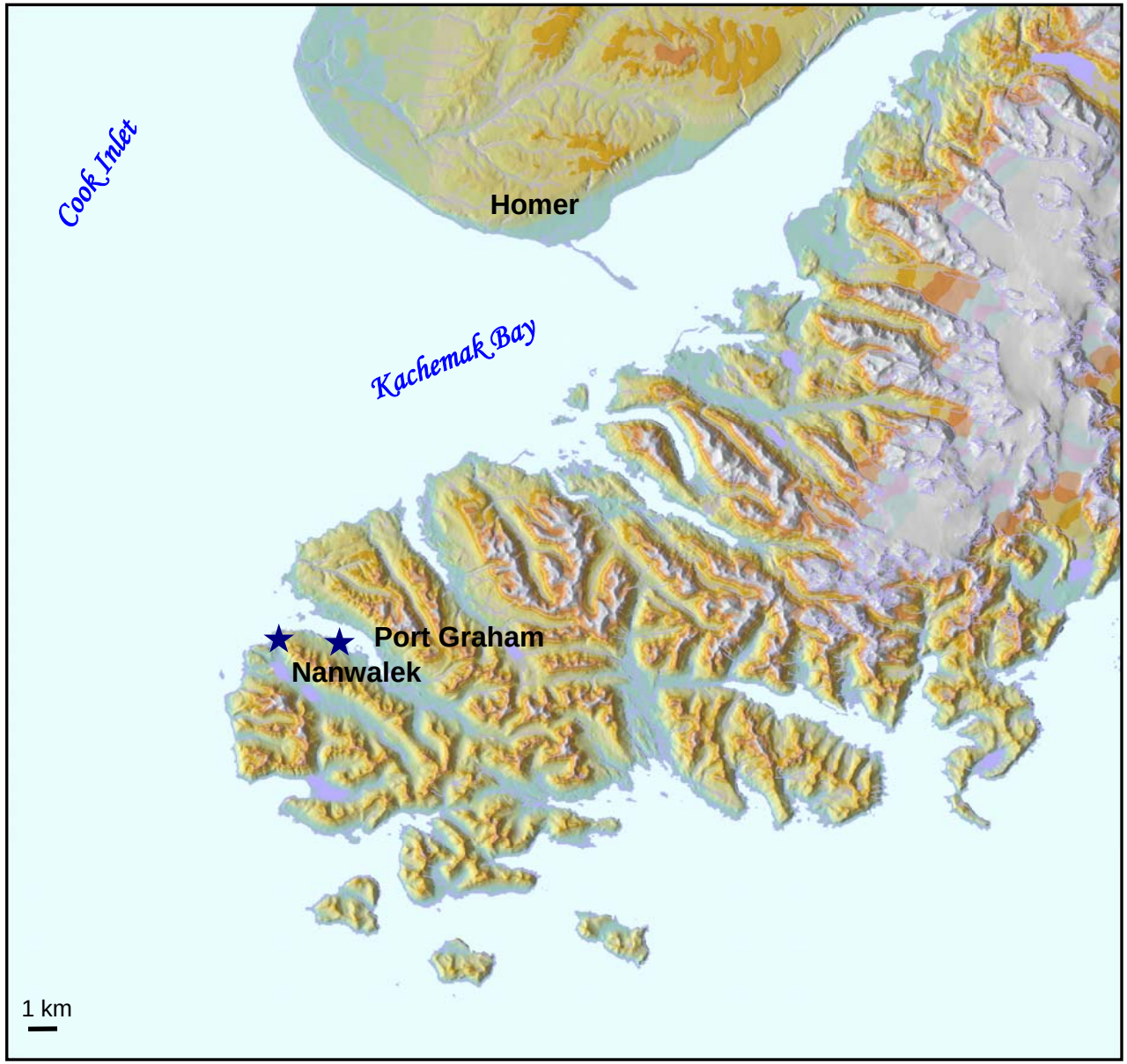
We start long ago, in the days when only the Sugpiaq were here. The story moves forward, through the Russian era and into the 20th Century, with the 1964 earthquake, the 1989 *Exxon Valdez* oil spill, and other events large and small. This history, integrated with traditional and scientific knowledge, leads us to a possible explanation for the decline in shellfish, including the recent decline in bidarkis. The story then navigates us through the current day threats to our ocean and asks us to look ahead and consider the challenges we face in the future to sustain our marine resources, ecosystem and our communities.

Replace the major characters and the story that we tell here could be told by countless coastal communities throughout the world who have witnessed drastic changes in their ocean home given the pressure humans now impose on marine ecosystems worldwide. We hope that readers can draw parallels to their ocean home thereby expanding our collective understanding and appreciation of our ocean's resilience and limits. Finally, we hope that readers will reflect upon the wisdom of our elders, the intricacies of our oceans, and our responsibility to future generations.

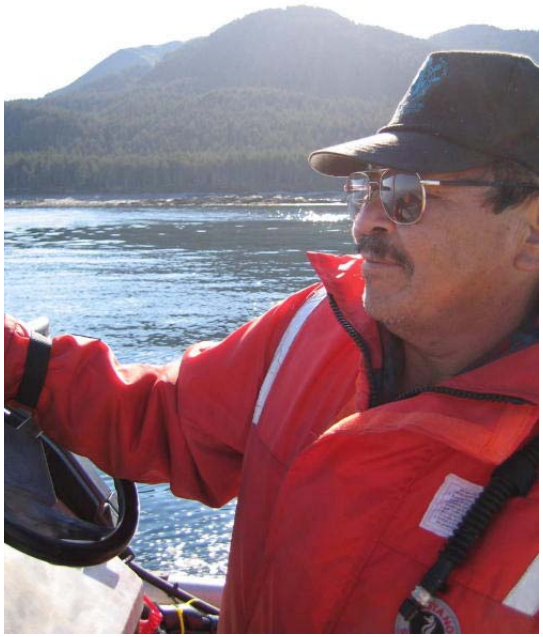
- Anne Salomon (Spring 2005)

The Bidarki Lady (Anne Salomon) and Peter Anahonak Sr., Port Graham, Fall 2004.

Outer Kenai Peninsula, Alaska



Our Changing Sea



The eyes of change. Nick Tanape Sr., Elder and Subsistence Hunter, Nanwalek Summer 2003.

On the surf swept rocky shores of the outer Kenai Peninsula, Alaska, we, the Sugpiaq people of Port Graham and Nanwalek, have been observers, benefactors and part of the marine ecosystem for decades. Because our lives are sustained by the sea, any ripple of difference is reflected directly in our daily lives. With a keen and contemplative eye, we have witnessed our nearshore ecosystem transform throughout the years. We are holders of this knowledge, we are the eyes that see this change.

The causes of change lie buried in history. As such, science alone is too recent to determine the drivers of change in the sea. Yet traditional knowledge coupled with science can reveal key insights in to the causes of our changing marine ecosystem. For the past shapes our present and informs our future.

This is a story told through the eyes of tribal elders, subsistence hunters, village residents, an anthropologist and a marine biologist, each one of us bringing our observations, skills and knowledge to collectively tell a story about our changing sea.

Our next generation's eyes of change. Kalina Glahn holding a red-banded star (*Orthasterias koehleri)* on Flat Island. Summer 2004

Subsisting From The Sea

Peter Anahonak Sr. and his smoke house in Port Graham. Fall 2004.

"*We survived by the ocean & beach. That's what sustained us*."

(Walter Meganack Jr., President Port Graham Corporation)

For centuries, we have sustained ourselves on food from the ocean. We catch king salmon in early spring, red salmon, and halibut in the summer, followed by humpies, dogs and then silver salmon in the fall, and tomcod in the winter. Harbor seal and sea lion are also part of our diet. Yet, our most accessible food from the sea comes from the intertidal zone, that part of the seashore that disappears at high tide and remerges at low tide.

"***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)

The Tides That Fed Us

"*The sea back then was a dinner table set at low tides*." (James Kvasnikoff, Second Chief, Nanwalek)

When the tide is out, the table is set. This old adage is used by many coastal natives. In the past, our seashore was akin to a refrigerator full of food, accessible only at low tide. Below the sand and pebbles we collected clams and cockles, above the sand, Dungeness crab. On rocky outcrops, sea urchins, sea cucumbers, octopus and chitons were collected. Unfortunately, many of these intertidal invertebrates are now scarce and are becoming ghosts of ecosystems past.

"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)

Nanwalek Reef, Western tip of the Kenai Peninsula, Alaska. June 2004.

Kelp bed west of Point Pogibshi, at the mouth of Kachemak Bay. Spring 2004.

"*We used to be able to get all the Dungeness we wanted. We used to collect clams and cockles, no body ever missed a tide. I didn't have concept of poor or rich in a western world sense. We were so rich because there was so much out there*."

(Walter Meganack Jr., President Port Graham Corporation)

In the intertidal, we can still find subsistence foods if we search long enough but the animals we now collect are smaller and fewer, some are rarely even seen. Now, we have to go further to collect what we used to be able to gather close to home.

"*Things are disappearing and not coming back.*" (John Moonin, Elder, Port Graham)

"*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., President Port Graham Corporation)

Bidarkis; The Most Recent Decline

Lydia McMullen is lucky to find a large Bidarki.

"Mom used to make us eat 'shut–up dinner.' This would be a dinner of bidarkis. The kids would be quiet as they would be busy chewing." (Anesha Metcalf, Elder, Port Graham)

"*I started noticing Bidarki declines 10-15 years ago. Now you only see the little ones*."
(Walter Meganack Jr., President Port Graham Corporation)

The black leather chiton, known locally by its Russian name 'bidarki' and its Sugcestun name 'urriitaq,' is an intertidal mollusk that remains an important subsistence resource for us. Bidarkis are found in the rocky intertidal amongst ribbon kelp (*Alaria marginata*) and sea cabbage (*Hedophyllum sessile*). We eat bidarkis in casseroles, seafood salads, or raw, right off the rock.

"*They used to be bigger than my palm*." (Emerson Kavasnikoff, Nanwalek)

Unfortunately, we started observing declines in the number of Bidarkis about 10-15 years ago. The ones that we do see now seem to be smaller. Bidarki plates found in Cook Inlet middens, dated back to 3000 BC, suggest that the black leather chiton has been traditionally harvested for thousands of years in Cook Inlet. In our ocean home, bidarkis have been collected throughout our living memory. Yet strangely, localized bidarki declines are recent. Not only was there widespread interest to determine the causes of this decline, we wanted to understand why so many marine invertebrates had begun to disappear from our 'nearshore refrigerator.' Bidarkis were but one of many marine species declines. Things were changing. Why? There may be many possible reasons for the declines we have witnessed, some natural while others human caused. It is by no means clear that any single factor is to blame.

A Story of Multiple Causes

"*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., President, Port Graham Corporation)

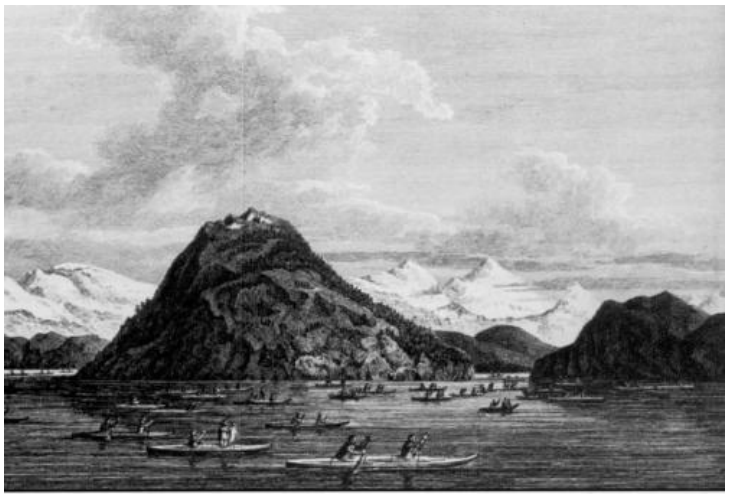
Untangling the various factors that have contributed to species declines and marine ecosystem change is a near impossible task. In an ecosystem, nothing happens in isolation, if one thing changes, other changes soon follow. However, some drivers of change may matter more than others. Identifying those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

Both human and natural drivers of change contribute to species declines and marine ecosystem alterations. Some of these are short term, pulse disturbances while others are press perturbations sustained over longer periods of time. Pulse and press disturbance can occur in small areas or extend over large spatial areas. Some changes don't happen gradually. Long term cumulative effects can sometimes push an ecosystem beyond a tipping point. 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 can reverberate through an entire ecosystem, both its social and ecological components.

"Sea otters, oil pollution or the people. I want to blame one but I don't know which one."
(John Moonin, Elder, Port Graham)

To understand what has happened to the bidarkis and the other marine species in Port Graham Bay, it is necessary to examine the pulse and press disturbances that have altered this area. In the two chapters that follow, we describe the disturbances, both natural and human-caused, that have altered our ocean home. By investigating the magnitude, spatial extent, length and timing of the disturbances and changes we have witnessed, we attempt to pinpoint those causes which have most likely contributed to our transformed marine ecosystem. When pieced together, a possible reason for the recent decline in marine invertebrates, including the most recent bidarki decline, begins to appear. To explore these drivers of change, we will begin by delving into history.

The Russian Era



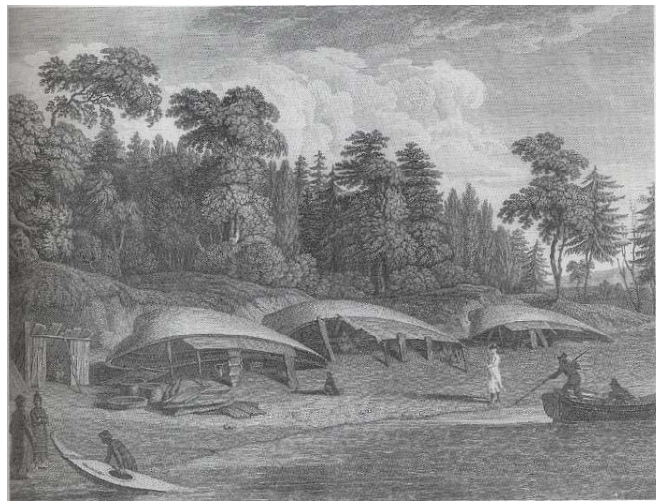
”Port Dick, near Cook’s Inlet,” engraved from a 1794 watercolor by Henry Humphreys, showing Sugpiaq sea otter hunters in a fleet of kayaks. Courtesy of the Anchorage Museum of History and Art.

Drawing of a Russian mine located on the northwest shore of Port Graham Bay, ca. 1850. Courtesy of the Anchorage Museum of History and Art.

From Seasonal Camps to Established Villages

Towards the end of the last Ice Age, when glaciers were receding 9000 – 6000 years ago, people began to inhabit the coast of Alaska[1]. There were no permanent villages then. People moved among seasonal camps and sought food where it was available[1-3]. In 1741, Vitus Bering and the naturalist, Georg Steller sailed from Kamchatka, Russia to Alaska[4], opening the way for Russian missionaries and traders. With the Russian occupation of Cook Inlet, Alaska in the 1780s[2] came the establishment of permanent native villages. As a result, subsistence collecting and hunting became increasingly spatially concentrated. The sustained and localized human disturbance of harvest likely had a profound effect on local marine resources.

Sugpiaq woman and man. Engraving by J.Webber, 1780.
Courtesy of Anchorage Museum of History and Art



Seasonal camp in Prince William Sound (1700s). Courtesy of Alaska and Polar Regions Collection, University of Alaska-Fairbanks.

"When resources became depleted, 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)

Our Ocean Home is Formed

Before living in the villages of Port Graham and Nanwalek, our ancestors inhabited the Kenai Fjords, on the southern shores of the Kenai Peninsula[5]. It was there, in Nuka, Yalik, and Aialik Bay that our rich maritime culture thrived. Archeological data suggest that most of our historic village sites known today are about 800 years old[3]. Early estimates by Russians in 1800 suggest that there may have been 600 inhabitants on the southern Kenai Peninsula. We were a people few in number.

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. Tragically, disease epidemics, starvation and loss of political sovereignty came with this exploitation of labor[2]. Both the Russian Orthodox Church and the commercial companies sought to centralize services in larger villages. Regional consolidation led to the demise of smaller villages. During the early 1880s, our ancestors were relocated 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) by Russian missionaries[3]. In 1890, 100 Sugpiaq lived in Nanwalek[5], by then, the only remaining fur trading station on the Kenai peninsula. By 1910, Port Graham was a settlement with 100 residents.

Nanwalek, Cook Inlet, Alaska, ca. 1892. Courtesy of the National Archives, Albatross Collection.

Port Graham, Cook Inlet, Alaska, 1892. Courtesy of the Paluwik Local Display Facility, Port Graham.

"*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)

Our ocean home is here now, on the westernmost tip of the Kenai Peninsula. Look to the west and we see the imposing volcanoes of Cook Inlet, to the south, the Chugach and Barren Islands in the distance, North, around the troubled waters of Dangerous Cape and Point Pogibshi, lies Kachemak Bay. 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 reefs dot the waters, growing and shrinking with the tides. Here, along the coastal arc of the Gulf of Alaska, the Pacific Plate collides and descends beneath the North American Plate creating a active area of earthquakes and volcanic eruptions[1]. In the ocean, the Alaskan coastal current hits the continental shelf causing the upwelling of nutrient rich water, the basis of our marine food web and our spirit.

Mnt. Iliamna and Mnt. Redoubt stand before Cook Inlet, Alaska and our ocean home. Winter 2005

Extinctions & Extirpations

Sea otters (*Enhydra lutris*) were highly coveted for their dense fur by Russian, Asian and North American markets.

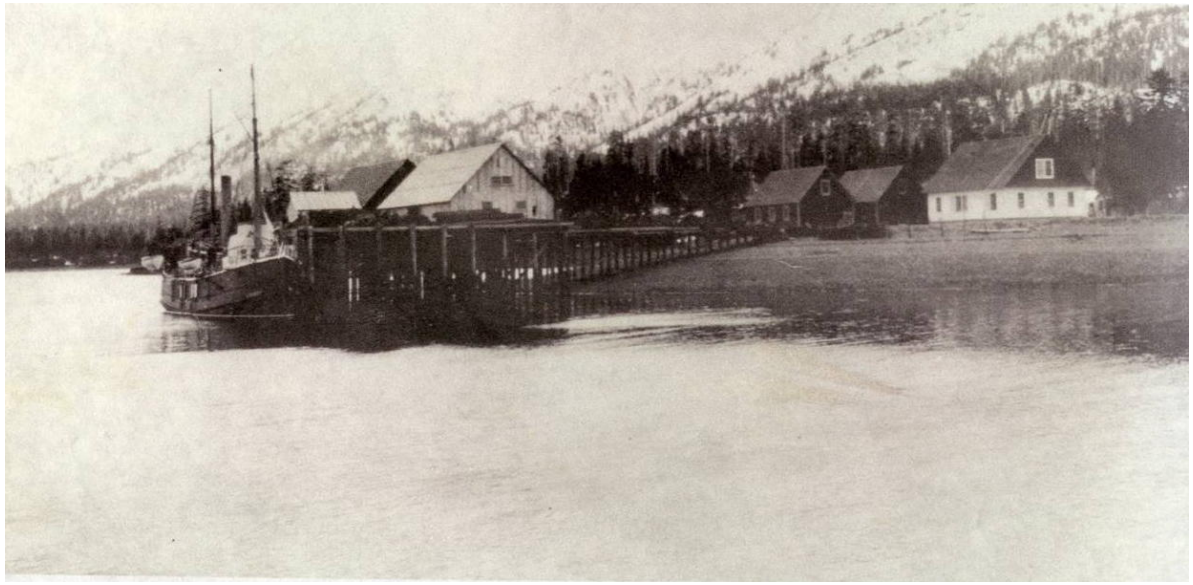
Sea Otter hunters in kayaks, known as bidarkas in Russian. ca. 1800s.

"*When the Russians came they cleaned the sea otters out. When I was 18 yrs old [1953] there were no sea otters around Port Graham*." (Simeon Kvasnikoff, Elder, Port Graham)

Immediately after the first Russian sighting of Alaska back in 1741, two dramatic ecological events ensued. The Steller sea cow became extinct within 23 years, thereby becoming the fastest extinction on record[6]. With the Russian occupation of Cook Inlet in the 1780s, and a rampant fur trade, the sea otter became locally extirpated from Alaska's coastline by the early 1900s with only several pockets of animals remaining[7]. When today's Elders were young, sea otters were never seen in front of Nanwalek. The localized extinction of sea otters would have significantly altered the abundance of marine invertebrates in Port Graham Bay[7-9]. Without these voracious predators, their invertebrate prey, including sea urchins, crab, clams, cockles, octopus and chitons, would have increased in number. With an increase in herbivores, such as urchin and chitons, beds of bull kelp and ribbon kelp would have likely declined.

"*There was not as much kelp in front of Nanwalek when I was young [early 1940s].*"

(John Moonin, Elder, Port Graham)



Port Graham Cannery 1912. Courtesy of the Paluwik Local Display Facility, Port Graham.

In 1867, the Russian era ended with the purchase of Alaska by the United States. Large-scale fur hunting officially ended by 1911[2]. By that time, a new economy, which 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.

In Living Memory

Today's Elders. Port Graham children, 1940s. Photograph by John Poling. Copyright Chugach Heritage Foundation. Courtesy of the Paluwik Local Display Facility, Port Graham.

Cannery Conundrum

"*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 Norman, Elder, Port Graham)

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. The cannery brought jobs to Port Graham Bay but with opportunity came a cost. Canneries 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. Still today, the pink salmon hatchery sends most of its fish waste into the middle of the bay.

Port Graham Cannery, ca. 1950. Photo By Feona Sawden. Courtesy of the Paluwik Local Display Facility, Port Graham.

The Chacon, a Fidalgo Cannery fish tender beside a fish trap in Cook Inlet, Alaska. Courtesy of Dorothy Moonin.

Marvin Norman's salmon seiner, the Kaleen ca.1960. Courtesy of Dorothy Moonin.

"*Sunflower stars have increased since I was a kid. That's another big impact*."
(Lydia McMullen, Port Graham)

Some species benefit from this temporary food source. Sea gulls congregate above water and sea floor scavengers such as sunflower sea stars gather bellow. Sunflower sea stars are quick moving predators that eat clams and cockles, especially those small ones left behind after a sea otter's dinner pit. Like clams, many other bottom dwelling marine species suffer from this introduced source of concentrated nitrogen and carbon. This pulse disturbance that still happens seasonally can render seafloor sediments anoxic, meaning without oxygen, and can physically smother bottom dwelling animals.

Canneries had another important social implication which may have indirectly influenced our local marine ecosystem. Prior to the 1920s, we used to travel as part of our seasonal hunting, fishing and collecting rounds. The establishment of canneries in Port Graham, Seldovia and English Bay during the 1911-1920 period 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 and collection became increasingly concentrated locally.

Port Graham Cannery Workers from left to right:

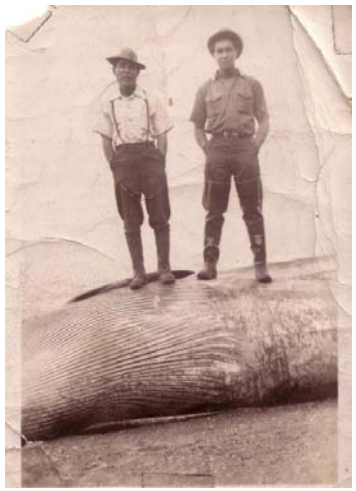
Unknown, Dorothy Norman, Jenny Malchoff, Theresa Kavasnikoff, and Susan Tabios at canning line ca. 1960.

Polly Meganack, Luba Meganack, Alice Meganack, and unknown at fish filler in the cannery ca. 1960.

Polly Meganack by fish filler ca. 1970.

Courtesy of the Paluwik Local Display Facility, Port Graham.

Following the Fish



Sergius Moonin and Marvin Norman standing on top of a stranded whale. Courtesy of Dorothy Moonin.

Even after settling in Nanwalek and Port Graham in the 1880s, our people would travel east of Gore Point to hunt and trap. Nuka Island was a favored fall camp whereas winter and spring camps were established in Nuka, Yalik and Aialik bays[3]. We would also set up seasonal hunting camps out at Port Dick and Windy Bay[10]. We followed, the fish, the seals, our food.

Then came the cannery and mining jobs. In 1915 a cold storage plant for halibut and cod was established in Portlock (also known as Port Chatham) and two years later a chrome mine was opened on Claim Point. Later in Portlock, a salmon cannery was built in 1928 and remained until the late 1950s[3]. Port Graham, Seldovia and English Bay also had canneries. We then followed the jobs, the fish to be canned.

"People were still nomadic when I was a kid in the 40's and 50's. 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)

With the closing of the canneries in Portlock and Seldovia, and the centralization of the cannery culture to Port Graham, people again became increasingly concentrated and Port Graham and Nanwalek became increasingly permanent villages. People moved less and fishing effort became, once again, more concentrated in space.

Wayne, Pat and Randy Norman with Willy Moonin 1967. Courtesy of Dorothy Moonin.

Sea Otters Return

A raft of 25 sea otters float in front of Passage Island, Port Graham Bay, summer 2004

"*They came back in the early 60's. The population exploded in the late 70's early 80's*."

(John Moonin, Elder, Port Graham)

"*Boy, those things multiply*!"

(Simeon Kvasnikoff, Elder, Port Graham)

"When I was a kid [1980s] there were less, they used to be scattered about the bay, now they are all 'podded up' and there are more pods instead of being scattered. There used to be just a few loners out there." **(Quentin McMullen, Subsistence Hunter, Port Graham)**

With the cessation of the Russian fur trade in the early 1900s and later, with the listing of the sea otter under the US Endangered Species Act in 1974, this notorious marine mammal began to reestablish along Alaskan coastlines. They returned to the waters in front of Port Graham and Nanwalek in the early 60's. Back then, we might have caught a glimpse of a furtive individual. Today, rafts of 30 or more float around rocky headlands in the summer from Point Adams to Point Pogibshi. During the winter storms, hundreds of sea otters take shelter in Port Graham Bay. Although their ecological effects are localized, sea otters are and example of a natural press perturbation, one that is sustained, and in this case intensified as populations rise.

"*Sea otters are part of the problem…they eat every thing we eat*."
(Walter Meganack Jr., President Port Graham Corporation)

Many people in our villages identify the increase in sea otters as the leading cause of invertebrate decline, including Bidarkis, and the largest cause of change to the local ecosystem. In the past decade or two, sea otter numbers have increased dramatically within the bay. Today, sea otters are plentiful and are regarded as our major competitor for shellfish and thus a pest. Our surveys suggest that at least 173 adults (+/- 14) and 43 pups (+/- 8) were living between Point Adam and Point Pogibshi during the summer of 2004. This is likely a minimum estimate as some individuals are difficult to see while others remain offshore during parts of the tidal cycle.

"*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)

A raft of sea otters in Port Graham Bay. August 2003.

Local Shellfish Begin to Decline

"We used to see green sea urchins all over Nanwalek Reef in the early 1940s. By the late 50's 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)

Green sea urchins were plentiful on Nanwalek Reef in the 1940s, but by the late 1950s they were mostly gone. Sea urchins and sea cucumbers were the first marine invertebrates that we observed decline, just as the sea otter began to return to our shores. At the same time, commercial trawling was increasing along our coastline and urchins were often caught as bycatch. With the decline in urchins came an increase in kelp covering the reefs. These spiny herbivores are particularly well known to mow down kelp. As mentioned earlier, where urchins are absent or reduced in numbers, kelp beds thrive[7,8].

"Sea urchins. There used to be a big batch of them in the past. We used to get them in pots and seines. They suffered as bycatch from the trawling that used to happen close to shore, now most of the trawling occurs further away from the coastline."

(Walter Meganack Jr., President Port Graham Corporation)

Green sea urchin (*Strongylocentrotus droebachiensis*).
Courtesy of the National Wildlife Federation.

Known locally as lady slippers, this chiton, like the bidarki, is a broadcast spawner. Males (left) release white streams of sperm and females (right) release olive colored eggs. These chitons are easy picking for sea otters and humans alike.

"*I haven't had lady slippers for years*." (Annie Fomin, Elder, Port Graham)

The next marine invertebrate to decline was the ladyslipper, also known as the gumboot chiton (*Cryptochiton stelleri)*, the largest chiton in the world[11]. This chiton is a close relative to the bidarki but is generally much larger, up to 20 cm (about eight inches). Its large size makes it a much more rewarding snack than a bidarki. Furthermore, ladyslippers are easier to spot. Because this chiton is brick red in color, it is not as well camouflaged as the bidarki. Unfortunately for us, yet fortunately for the otter, this chiton is found mostly subtidally, below the lowest low tide, unlike the bidarki which is primarily intertidal. Although we can find the occasional ladyslipper on a really good minus tide, they are usually out of our reach. Furthermore, because they live on both sandy and rocky sea floors, their foot, which is able to adjust to both habitats, does not have as much suction power to stick tightly to the rock as a bidarki's foot. As a result, it is easier for us and for the sea otters to collect off the rocks compared to a bidarki.

"We used to find them after a big storm. Now we don't find many. If we do, they are smaller now." (Irene Tanape, Nanwalek)

The Earthquake of ‘64

High tides in Port Graham in November 1966, over 1.5 years after the ’64 earthquake. Courtesy of Dorothy Moonin.

“*After the earthquake, there was sunk land and no minus tides.*”
(John Moonin, Elder, Port Graham)

With the Good Friday earthquake of 1964 came a tsunami that swept the Gulf of Alaska and land displacement that 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 subsided as much as 7.5 ft while uplift in some areas of Prince William Sound was as high as 38ft[12]. In areas of great uplift (>9ft), intertidal zones that had once been covered with the incoming tides were suddenly raised far above the highest tide killing the exposed seaweeds and marine invertebrates within days[13]. Uplift caused extensive mortality of clam beds which were lifted above their normal upper limits. Conversely, in areas of subsidence, terrestrial zones became intertidal zones and areas which were once intertidal became subtidal.

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 and formerly productive intertidal zones became permanently covered with water. After the earthquake, mobile midintertidal animals, such as bidarkis, survived the vertical downward displacement of their habitat by moving upwards to reestablish their proper vertical ranges[13]. Although their main food of attached ribbon kelp (*Alaria marginata*) could not make that same journey upwards, they could graze on similar species of algal prey that existed in the midintertidal, such as sea lettuce (*Ulva* spp.) and sea cellophane (*Porphyra* spp.), that also exist in the high intertidal. Furthermore, bidarkis may have found new temporary food sources. On down thrust rock,

some littorine snails were found grazing on terrestrial moss! Preearthquake populations of mussels, barnacles and rockweed (*Fucus gardneri*) were found alive in their new, lower intidal home, apparently inhibiting the establishment of critters usually found at that level (i.e the split kelp, *Laminaria bongardiana*). Land subsidence also caused a direct loss of intertidal salmon-spawning areas in streams which was particularly damaging to pink and chum salmon.

In addition to land displacement, tidal waves surged into bays and inlets sweeping away square miles of soft sediment, scouring out clam beds and redepositing layers of mud and debris in deep and shallow waters elsewhere thereby suffocating the marine life below. This caused the total mortality of clam beds in some areas of Prince William Sound[13]. Some intertidal spawning habitat of the Port Graham River was lost due to land subsidence but tsunami action did not alter the salmon spawning habitat substantially[14].

"The earthquake destroyed 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)

Although this pulse perturbation in 1964 had dramatic immediate effects on seashore life, recovery was quick for most species. Intertidal observations made in 1968, 5 summers after the earthquake, confirmed that intertidal communities around the corner in Prince William Sound had essentially returned to their preearthquake condition with few exceptions[13]. Snails and limpets which were scarce in 1965 were abundant in 1968, and mussel beds were back at their preearthquake intertidal level. Nonetheless, Alaska sustained heavy economic loss 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 the immediate hardships of this natural pulse disturbance but things quickly returned to normal. Unfortunately, the human-caused press perturbations to come were likely of greater significance to our ocean home ecosystem.

High tides in Port Graham, November 1966. Courtesy of Dorothy Moonin.

Electricity and Sewer Lines Come to the Villages

"We would eat them within 2 days. We had to." (Vera Meganack, Port Graham)

"In the past, Bidarkis were like our popcorn, we would eat them fresh like snacks. Now I keep them in my freezer." (Anesha Metcalf, Elder, Port Graham)

"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)

"*Now, we clean them, freeze them, and put them away for the smaller tides*."
(Peter Anahonak Sr., Elder, Port Graham)

In 1970, Port Graham got electricity. 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 and affected the taste of the meat. Freezing was relatively fast and easy. Before freezers, people typically ate bidarkis right away. They would take only what they could eat soon. Any extras would be shared with others. With freezers, however, people could harvest many more on a single trip to stock up for later.

"*Our ability to freeze things – that has increased our impact*."
(Walter Meganack Jr., President Port Graham Corporation)

"Everything that goes down the kitchen sink ends up in the bay"
(Walter Meganack Jr., Port Graham Corporation)

After electricity came the local sewer line, putting 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 is another factor altogether.

The Commercial Crustacean Crash

“We used to be able to get all the Dungeness we wanted.”
(Walter Meganack, Jr., President Port Graham Corporation)

“*Dungeness were whipped because of commercial crab fisheries and dragging. They came right into this bay. Now they (the Dungeness crab) haven’t been able to come back because of the sea otters*.” (Jeffery McMullen, Port Graham)

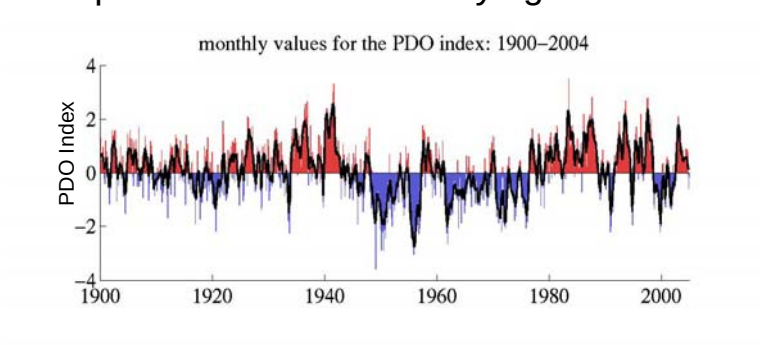
Commercial shrimp and crab fisheries in Cook Inlet began in the early 1940s close to shore in sheltered bays and inlets[3]. The fleet expanded in size during the late 1950s and began fishing further offshore. In Cook Inlet, crab and shrimp landings peeked in the early 60s. In fact, Port Graham Bay was heavily harvested for Dungeness crab in the late 1960s[3]. As years went on, both fisheries required increased effort to maintain harvest levels. Fishing effort on crab and shrimp stocks peeked between 1977 and 1981. As king crab declined, followed by tanner crab, Dungeness crab were targeted more aggressively. By the mid 1980s, crab and shrimp fisheries in the Gulf of Alaska had collapsed[15].

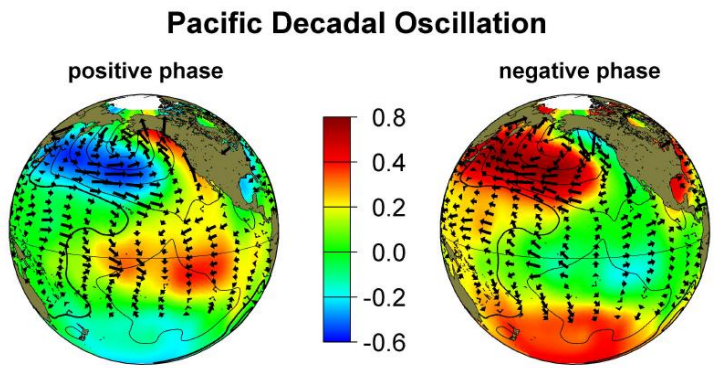
The Dungeness fishery in Kachemak Bay closed in 1986 and there was no catch in Cook Inlet between 1989 -1990. We observed this dramatic decline, here in Port Graham Bay, and suffered the consequences. Some scientists suggest serial depletion as a likely mechanism for these regional crustacean declines; historical fisheries were first developed to target the most lucrative and plentiful species, they then switched to other, less significant species after the former showed signs of depletion. This process happened one species after the next, after the next.

Changing Ocean Temperatures

"*The climate seems to be warming and with climate warming, water temperatures change*."
(Nick Tanape, Elder, Nanwalek)

Temperatures in the Pacific Ocean cycle between warm and cold regimes on a multi-decadal time scale[16]. This large-scale oscillation in ocean temperatures, known as the Pacific Decadal Oscillation (or PDO), affects the Gulf of Alaska and the waters in front of Port Graham and Nawalek. In the mid-1970s, the Aleutian low-pressure system shifted south and intensified, causing stronger westerly winds and warmer surface waters. With that shift, the Gulf of Alaska swung from a cold phase (1946 to 1976) to a warm phase (1977 to present)[17]. This shift in ocean temperatures during the late 1970s may have triggered an alteration in the Gulf of Alaska marine ecosystem[18]. The recruitment of 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 sea birds such as puffins and kittiwakes that rely on capelin and other fatty forage fish. At the same time as ocean temperatures were changing in the Gulf of Alaska, possibly favoring ground fish over crab and shrimp, harvest on shrimp and crab was intensifying.





The warm (positive) and cool (negative) phases of the Pacific Decadal Oscillation (PDO). Courtesy of the Joint Institute for the Study of the Atmosphere and Ocean. University of Washington.

People often debate weather fisheries or changing water temperatures are responsible for declining fish stocks. Yet the respective roles and relationship between these drivers of marine ecosystem change are difficult to sort out. 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 responsible for the ecosystem-wide shift. Furthermore, there is a strong association between shrimp catches and water temperatures[16]. On the other hand, large-scale fisheries can cause unfished species to decline or increase by removing their predators or competitors[19]. Plus, an increase in predators (cod, halibut) and decline in their prey (shrimp and crab) suggests that pressure from top predators, rather than ocean temperatures, may structure the marine ecosystem of the Gulf of Alaska and our ocean home of Port Graham and Nanwalek.

Fishing can also lead to simplified food webs. When food webs are diverse, predators can switch between prey as their numbers fluctuate. This ability to switch prey, allows predators to compensate for changes in their prey abundance that may be triggered by changes in ocean temperature. However, simplified food webs render predators more dependent on the annual recruitment and population growth of fewer prey species. This in turn may decrease the predictability in predator population sizes and catches. The net effect, no pun intended, is that as a fishery removes more fish it will increasingly appear as though changes in ocean temperatures have a strong influence on the fishery when originally it did not[20].

So is it harvest or is it changing ocean temperatures? There is no discrete answer. Successful management requires eliminating this dichotomy and focusing on holistic approaches which consider social systems and ecological interactions in the context of changing ocean temperatures.

Fishing boats in the harbor of Homer, Alaska. June 2003.

Clams and Cockles, the Next to Go

"*The clams were so big, you only needed 6 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)

After the urchin, sea cucumber, ladyslippers, crab and shrimp, came the clams and cockles. They were the next to go.

When the Water Died

"*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)

"*The oil spill impacted nature's cycles, the seasonal clock work 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)

On the twenty-fifth anniversary of the '64 earthquake came another regional disaster: the *Exxon Valdez* oil spill in 1989. The tanker ran aground on Bligh Reef in Prince William Sound spilling an estimated 11 million gallons of oil that spread across the Sound through lower Cook Inlet to Kodiak Island and beyond. Although relatively little oil came to Port Graham and Nanwalek, the spill and its aftermath had an extreme affect on our communities, ecologically and socially. People avoided subsistence foods for fear of oil contamination.

"*Clams, cockles & 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)

Interestingly, while bidarkis and other marine invertebrates along the shores of Port Graham and Nanwalek were affected by the oil, the declines in shellfish began prior to the spill.

"*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 Meganck Sr. Elder and Past Chief, Port Graham)

Hundreds of millions of dollars have been spent to assess the environmental impacts of the spill. In Prince William Sound, changes to the food web may have had long-lasting indirect effects. Ironically, the spill, although around the corner from our ocean home, had several important indirect effects on our culture and our beaches.

"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."

(Anesha Metcalf, Elder, Port Graham)

"*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)

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

(Walter Meganack Jr., President Port Graham Corporation)

With the flood of oil came a flood of money as many coastal communities were hired to help with the oil spill clean up. With the new income that was generated, people in our village bought new skiffs and motors. More and faster boats led to changes in the way we hunted, fished and collected from the shoreline. Before the oil spill, not many people had boats, so people either relied on resources near the community or traveled to camps to stay for long periods. With faster and larger boats, we were able to go out further. With better boats we could go out in rough weather that may have prevented us from going out before. These boats also allowed us to collect from more beaches in one tide.

"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 lead to more money. People have more money because of more jobs so they buy skiffs."
(Quentin McMullen, Port Graham)

Marvin Norman captaining a skiff on a calm day in our ocean home. Summer 2002.

Richard Mooning trolling for reds in his motor boat. Both his depth sounder and his local knowledge helps him find the fish. Summer 2004

Bidarkis Go Global

"My kids ask me; 'mom, are you bringing some bidarkis?" (Vera Meganack, Port Graham)

"We ship Bidarkis to friends and family. Most go to Anchorage in ziplock bags."
(Gerry Robart, Port Graham)

"Every time someone goes to Anchorage, I send some bidarkis up to my daughter."
(Vivian Malchoff, Port Graham)

Although the number of people in Port Graham and Nanwalek has not changed much over the past 100 years, more people are leaving the village. Friends and family from the village now live elsewhere but still enjoy their native foods from home. Luckily, 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 is greater than the number of people who actually live here.

Nearshore Marine Invertebrates Decline One After the Next

"*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*."
(Anonymous, Port Graham)

"*Urchins went first, then the crab and cockles, now the bidarkis are going*."
(Nina Kvasnikoff, Nanwalek)

"*Urchins were the first to go, crabs were next with the cockles*."
(Ephim Moonin, Elder, Nanwalek)

After the sea urchin and sea cucumbers declined in the late 1950s and early 1960s with the ladyslippers, the crab and shrimp followed in the 1980s. Clams and cockles began to disappear quickly soon after. The decline of these invertebrates happened serially, one after the next, after the next…

"*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., President, Port Graham Corporation)

Putting it All Together; Why have Bidarkis recently declined?

"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, & 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)

Nick Tanape Sr. monitoring Bidarkis. June 2003.

Historical subsistence harvest differed in several ways from today's practices: collection was less spatially concentrated because humans shifted among seasonal camps to subsist. Diets included a wider range of marine invertebrates, such as sea urchins, sea cucumbers, ladyslippers, crab, octopus, cockles and clams. These resources are now scarce, because sea otters (predators) and human fisheries (commercial and subsistence) have increased in magnitude and spatial extent. In living memory, these marine invertebrate resources declined serially, one after the next, with chitons among the most recent to disappear.

Sequential prey switching by both humans and sea otters from most accessible preferred prey, to least accessible and less preferred prey, likely resulted in a restriction in prey species breadth thereby leading to intensified harvest of bidarkis. Large-scale phenomena such as the earthquake of '64, changing ocean temperatures and the oil spill would have had large-scale regional effects, meaning sites close to the villages and sites further away would have been equally affected. However, the bidarki declines we have observed are localized; fewer and smaller bidarkis exist on the beaches closer to the villages compared to those beaches far way. Therefore, the recent localized depletion of bidarkis and its subsequent ecosystem-level effects may reflect a concentration in the spatial distribution of human harvest pressure, an increase in harvest efficiency and the serial depletion of various nearshore benthic invertebrates.

"People always used to have native food. People eat less native food now, but people still eat bidarkis." *(Vera Meganack, Port Graham)*

Other Changes to Our Ocean Home

Steller sea lion on Flat Island, Cook Inlet, Alaska
Summer 2004

Marine invertebrates weren't the only things to have declined in numbers in our living memory. Sea lions and seals are much less common now then 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? Ground fish fisheries in these same areas target some of the same fish species that form a large part of the sea lion's diet. At the same time, large changes in the North Pacific Ocean may have altered the distribution and abundance of fish too. But maybe Killer whales, their main predator, have increased in numbers or shifted their behavior.

"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. 6 years ago (1997) 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)

A killer whale comes up for a breath in front of Flat Island, Cook Inlet, Alaska summer 2004.

There are other signs of change in our ocean home. Killer whales have always been known to eat salmon, while some groups of killer whales eat sea lions and seals. Yet recently, killer whales have been seen eating sea otters in front of Nanwalek by Coal Mine beach. Some villages have observed that killer whales seem to spend more time closer to shore now than they did in the past. Interestingly, the record number of 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[21]. Why might Killer whales have shifted their diet to these less appetizing animals? For similar reasons that we harvest bidarkis more now then we did in the past relative to other marine invertebrates which are now scare. The number and abundance of prey species available to killer whales has decreased over time. Small baleen whales were drastically reduced in numbers due to historical whaling[22]. Of course, pollutants and disease may also be contributing problems to increased sea otter mortality in the Aleutians. Much like the declining bidarkis in Port Graham, this is yet another case of multiple causation.

"Now you can dipnet for halibut!" (Walter Meganack Jr., President, Port Graham Corporation)

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 are affecting everything in the ecosystem, not just one or two species, and not just in one or two habitats.

*"**All the clams are gone, but the starfish are in my way. I caught one with clams in its mouth."***
(Vera Meganack, Port Graham)

In the intertidal zone, many changes are taking place. Starfish, 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 and sea birds have increased in numbers. So why have all of these changes occurred? Are they natural? Will our ocean home support a productive ecosystem in the future?

Identifying the Problems to Create the Solutions

One of the first steps in developing solutions to maintain a productive and healthy ocean ecosystem is to pin point the major drivers of change. In the last chapter we identified some of the historic drivers of change in our ocean home. In this chapter we focus on the issues and current threats facing our oceans. In the chapter that follows we discuss possible solutions to these problems.

Jim Miller recording biodiversity data from a bidarki monitoring site. July 2002

Lydia McMullen counting and measuring bidarkis. July 2002

Matt McMullen estimating the abundance of ribbon kelp (*Alaria marginata*), prime bidarki food. July 2002

Our People and Sea otters;

Predators and Competitors

"I don't pick Bidarkis anymore. Now they appear in my sink"
(John Moonin, Elder, Port Graham)

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, that they would give away the first animals they harvested. Providing for oneself came afterwards. These practices persist, connecting people to their surroundings and to one another.

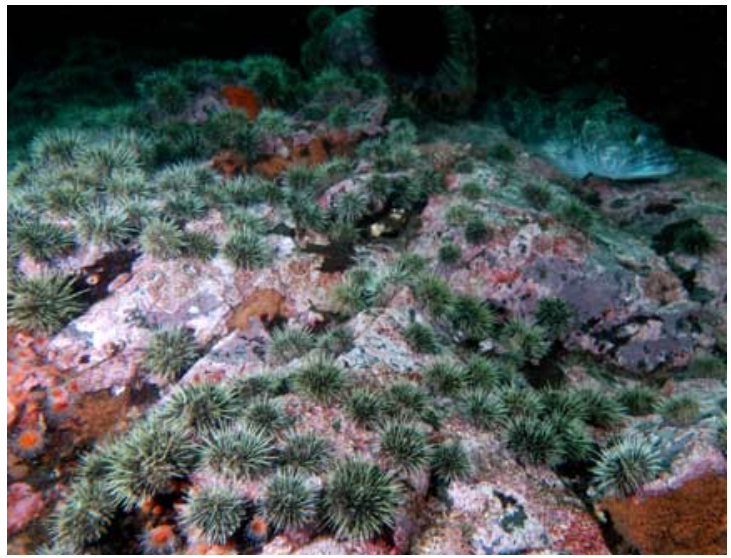
"I curse at sea otters sometimes. I'm being selfish with bidarkis."
(Vera Meganack, Port Graham)

Sharing may, however, have limits. There is a strong sense of connection to the environment. People recognize that all creatures in the food web have a place and need to eat. Nonetheless, the plants and animals in a food web are in a constant balancing act. When top predators, such as sea otters, build up in numbers, they can cause a dramatic decline in their prey, in this case sea urchin, clams, cockles, crab, octopus, even bidarkis. As a consequence, we often perceive the sea otter as one of our main competitors feasting in our refrigerator. Yet interestingly, when predators are in abundance, multiple changes may cascade across the entire food web. Their prey may decline, while their prey's prey may increase.

A sea otter paddles towards the reef west of Passage Island in Port Graham Bay. Dangerous Cape and Bird Reef are in the distance. August 2003

Kelp bed of dragon kelp (*Alaria fistulosa*). Courtesy of Brenda Konar, University of Alaska, Fairbanks.

In the case of the sea otter, those food web connections go far and there is a important consequence to keep in mind. Ironically, as sea otters feed on benthic grazers, the lawnmowers of the sea floor, more kelp can grown and survive. And so the balancing act begins. Systems with sea otters are known to become very productive because the kelp that grows in the absence of grazers fuels the ecosystem from the bottom-up providing food for the smaller bidarkis and urchins that evade the hungry paws of the sea otters. As the waves toss the growing kelp around bits of the blade shed off and become food for filter feeders[9] like clams, cockles and mussels. As a result, small clams and cockles which are not eaten benefit from this kelp in the form of detritus, bits of disintegrated organic material. This kelp also provides habitat and shelter for Tom cod, greenling, even young salmon on their way out to the ocean. Certainly, a seascape without sea otters or subsistence harvesters may indeed look very different. Wall to wall benthic grazers like bidarkis and urchins would mow the sea floor clean of kelp until their populations too would suffer from a lack of food.



High densities of green sea urchins can graze a garden of kelp into a pavement of pink crustose coralline algae. Urchins have a tremendous influence on the diversity and abundance of seaweeds.

And yet despite some of their ecological benefits, as sea otter numbers have increased, people feel an increasing sense of competition. Although we are allowed to hunt sea otters for subsistence purposes, the otters are not regarded as good to eat and only a few of us in the villages use their pelts for handcrafts. So the 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.

"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)

The sea otter increase touches on another aspect of recent times. People 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, 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.

"There are fewer bidarkis now and they are smaller." (Feona Sawden, Elder, Port Graham)

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

Of course, sea otters are not the only predators of bidarkis. Along with humans, sea gulls also feast on these chitons. Here, seagulls on Flat island give away their secret near their nesting colony where you can easily see the remnants of this week's lunch. Bidarki plates, of which each individual has eight, can be found scattered about. Summer 2004

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"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. This is not to say that sea otters are blameless. To the contrary, the increase in sea otter populations has inevitably caused changes in the ecosystem. Nonetheless, sea otters are unlikely to be the only factor. We humans have a role, too.

Both sea otters and humans are what are known as keystone species; a species whose impact on its community or ecosystem is large, and disproportionately large relative to its abundance[23]. Both humans and sea otters can have dramatic effects on our environment, even when there are just a few of us.

"*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., President, Port Graham Corporation)

Here, the six rayed sea star (*Leptasterias*) eats a young bidarki. Even large bidarkis are known to bulldoze small bidarkis!

Current Day Threats to Our Ocean

"*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., Nanwalek**)**

Humans, perhaps one of the most notorious keystone species, are exerting unparalleled pressure on marine systems around the world. Even here in our ocean home, the impacts are great. Pollution from the oil industry and our own sinks and out board engines introduce toxins to our waters. Charter boats from Homer and our own skiffs are loud and may scare breeding seals and sea lions away from rookeries. Overharvest locally and regionally, outside of our community, has more than likely led to the decline of many marine species.

Oil Platform Discharge

"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)

In 1998 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 16 platforms in Cook Inlet. While these platforms create jobs for people on the Kenai Peninsula and extract crude oil and natural gas we use to run our cars, and heat our homes, together, the platforms generate an estimated 2 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 found in clams, snails, chitons, and salmon sampled from the shores where we traditionally harvest[24]. 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[25]. Furthermore, some of the measured contaminants are global contaminants. Despite the uncertainty in determining the source of these contaminants, their consequences have been shown to be 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, press disturbance that likely has regional effects. Sadly, the burden of proof lays on the shoulders of citizens rather than the oil and gas industry itself.

Our Own ‘Nuclear Waste’

“*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., Port Graham)

“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)

And yet there are other sources of pollution that we can do something about. And that is our own. There has been a big change in the number and use of skiffs in our own village and with that comes the increasing use of oil and gas. Furthermore our own dumps are growing at a faster rate as we import more items to our village.

Nancy Yeaton from Nanwalke examines a Bidarki’s gut. Summer 2004

Charter Boats and our Own Skiffs

"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., President, Port Graham Corporation)

As with other changes to the area, the increase in fishing charters has had direct and indirect impacts to the ecosystem and the food web. Fishing charters are also a symbol of change beyond the control of the community. Charter boats start in Homer, 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, but their impacts to the ecosystem receive little or no attention.

Overharvest

Bidarki picking on Nanwalek Reef by Nancy Radtke, Nanwalek, 2004.

"*There are more people out harvesting bidarkis these days. Overharvesting is the biggest factor.*" (Anonymous, Nanwalek**)**

"*The decline is because so many people pick them. That is the main reason*."
(Sam Moonin, Port Graham)

"Nanwalek reef is picked out so we go there less often, only in the winter."
(Jonny Moonin, Nanwlaek)

Bidarkis, like other marine species, are likely being overharvested locally. As the demand for the resource increases, harvest increases. This is not only a problem in our ocean home, it's a problem world wide. According to the Food and Agriculture Organization, in 2003, 52% of the world's fish stocks were fully exploited and therefore producing catches that were close to their maximum sustainable limits. However, 16% of the world's fish stocks were overexploited, while 7% were depleted and 1% were recovering[26]. There is an increasing trend in the worldwide proportion of overexploited and depleted stocks from about 10% in the mid 1970s to close to 25% in the early 2000s.

"*The road increased access, now people can access these sites, more people can get to these sites so there are less refuges [for the bidarkis]*." (Nick Tanape Sr., Elder, Nanwalek)

As with many fisheries, increased access, either through better fishing technologies, bigger and speedier boats, or roads providing new beach access allows us to fish in places we would not have been previously able to. Therefore, natural refuges, which may have in the past sheltered spawners from our hooks, nets or knives, get found out. Those natural refuges may have been the source of young that replenish our traditional harvest beaches. Increased access thus facilitates more harvest and usually, overharvest. There are two main ways that overharvest can affect animal populations. Take Bidarkis for example.

"*It's harder to find the big ones now*." (Demetri Tanape, Port Graham)

"They are getting whipped out and are having trouble reproducing."
(Emerson Kavasnikoff, Nanwalek)

Large bidarkis have a disproportionately large amount of eggs or sperm. When many of the larger individuals that make up the spawning component of the population are picked, fewer young are produced. As a consequence, less young will be around to grow and become part of the population that is harvested in the following years. This is called recruitment overfishing because fewer young (also known as recruits or young of the year) are produced due to a lack of moms and dads around. The result is that the population simply can not replace its self. This poses a serious threat to the continued existence of any biological resource.

"Some people pick them even though they are small, people just pick and pick."
(Jennie Tanape, Nanwalek)

"It's harder to find the bigger ones so I'm getting the smaller ones."
(Jolene Kavasnikoff, Nanwalek)

With many of the large bidarkis gone, people resort to picking the little ones. However, this can actually lead to a lower overall amount of bidarki meat to eat. This type of overfishing is called growth overfishing and it occurs when small individuals are collected before they have a chance to grow and reach their maximum size. In other words, growth overfishing occurs when individuals are harvested at a size that is smaller than the size that would produce the maximum yield per individual. Reducing the amount of juveniles harvested, or their outright protection, would actually lead to an increase in yield from bidarki picking in the future. In a nut shell, growth overfishing reduces the potential yield from a fishery such that less fishing would actually produce a greater catch.

Sliding Baselines

The range of bidarki sizes people pick in our villages vary. Older folks generally are choosy and pick the larger bidarkis greater than 80 cm. They are aware how big bidarkis can get in areas that are rarely harvested. Younger folks, who don't have skiffs and generally pick locally may have never seen how large bidarkis can get. They pick smaller sized bidarkis.

"*You are cradle robbing*!" (Nina Kvasnikoff, Nanwalek, 48 yrs old)

"*Well, if you want them bad enough!"* (Jolene Kvasnikoff, Nanwalek, 22 yrs old)

This is an example of the 'sliding baseline syndrome'[27,28]. Many people suffer from this syndrome including scientists, politicians, fishermen and today's young subsistence gatherers. Essentially, each new generation accepts as a baseline the size and species composition that occurred at the beginning of their careers as harvesters or scientists. They then use that baseline to evaluate change. When the next generation begins harvesting (or researching), the resource (in this case, bidarkis) has declined and individual animals have gotten smaller, but it is this new abundance and size that becomes the new baseline. The result is a gradual shift in baselines from one generation to the next. Overtime, a slow acceptance of the disappearance of a resource occurs.

"*Maybe people's range of acceptable harvest sizes has now increased*."
(Ephim Moonin, Elder, Nanwalek)

One way to reconcile 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 earlier, historical data is vital for revealing the 'ghosts' of ecosystems past and evaluating change in ecosystems present. This is often difficult to do because there isn't always documentation on hand. Yet, large changes in our marine ecosystem happened many years ago, before scientist were here to record them. This is where the immense value of our elders knowledge is revealed. Many elders carry knowledge and observations from the past that can be used to prevent the sliding baselines syndrome for both young susbsitence harvesters and scientists alike. For this reason, their observations and this knowledge of the past is extremely valuable in allowing us to evaluate the true social and ecological changes in our ocean home today.

"*Now that I've started going around the corner, bidarki sizes have increased*."
(Anthony Brewster, Nanwalek)

Another way of curing the sliding 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 you reflect upon the severity of change in the places where you usually collect (or hunt or research). However, the danger of becoming aware of this new baseline, is the temptation to simply shift your fishing effort in space and carry on as usual. These once pristine areas then become heavily harvested, and again you move on to greener pastures with no recognition that a species is declining. This is a very common occurrence among fisheries. Like the crustacean crash described earlier, fisheries tend to deplete the most accessible resources and then move further away as resources dwindle locally.

Changing Life Ways

"*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)

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

(John Moonin, Elder, Port Graham)

One 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, in Port Graham and Nanwalek, 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. This may be for several reasons. Certainly, there has been a change in life ways. With modern conveniences, people today are several steps removed from their environment. But another tragic historical event may have played a role in the gradual erosion of traditional knowledge transfer from Elder to youth, and that was the establishment of English-only schoolsback in the 1950s. This was a contributing factor to the loss of our Sugcestun language.

Dorothy and John Moonin with grandson Colby Norman Fall 2003

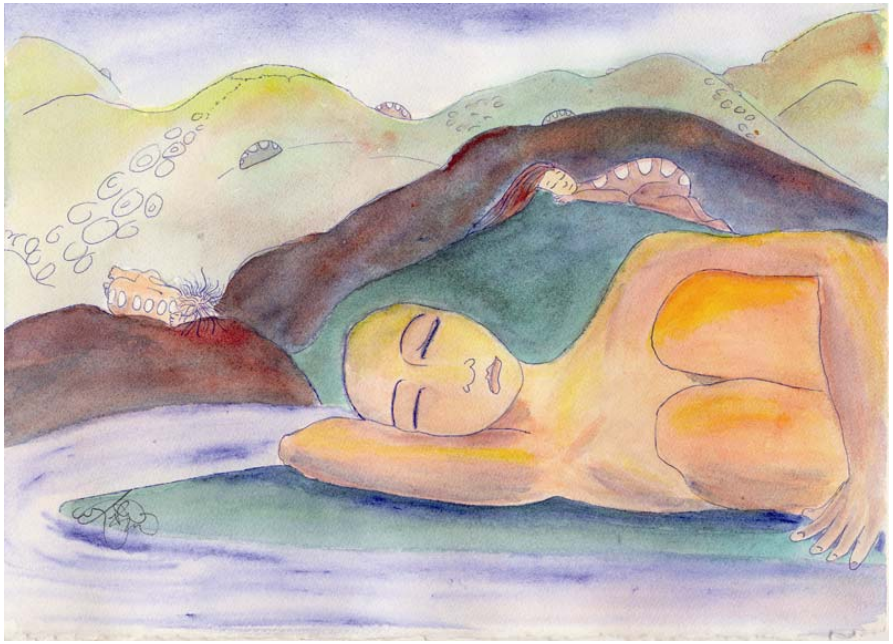
School children in Port Graham. Courtesy of the Paluwik Local Display Facility, Port Graham.

"*We couldn't speak Sugestun in school, we weren't allowed. We had to speak English. We had to listen to 3 languages. We're not fluent in English. We were real fluent in Sugcestun*."
(Irene Tanape, Elder, Nanwalek)

Today's Elders still speak Sugcestun but much of our language is being lost. With that loss comes the loss of stories about traditional practices, traditional life ways. The knowledge that has been lost, for what ever reason, is specific: it is the understanding, the wisdom, of how to look after one's self and one's surroundings.

Enjoying Our Marine Resources in the Future

Naomi McMullen fishes for humpies. Fall 2004.



Sleeping Bidarki Lady by Nancy Radtke, Nanwalek, 2004.

Quyaanaa- naa-naa-ruq, culiaret 2x
Aulukllutа, nayurluta, piturcesluta
Una urriitaq tuluku, lliiluku qutmen, amlercesluki neqpet
Piturcesluki kukupet, ellitaa kukuit piturcesluki, cali
Quyanaa-naa-naa-ruq, culiaret 2x

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

Song by Lydia Robart, Port Graham Elder 193?- 1999

"There are limits, limits of what you can harvest. Some people go beyond it."
(James Kvasnikoff, Second Chief, Nanwalek)

"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., President, Port Graham Corporation)

Where does this leave us? 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 the human communities have changed. But these changes have also forced people to think about the future, to think about the consequences of their own actions. People are asking what they can do to make things better.

"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)

There are many ideas for how to better manage the actions of people from the villages. 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. One starting point is within our villages themselves.

Traditional Management of Marine Resources

"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 use to tell us 'you'll get sick if you eat them during the springtime.' I think that that was their way to scare us out of eating them during the time that they were hatching."

(John Moonin, Elder, Port Graham)

Traditional management practices were designed to sustain populations which 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.

"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 what ever they want when ever they want."

(Simeon Kvasnikoff, Elder, Port Graham)

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 the resource locally has less of an immediate consequence on us now then it did in the past. In the old days, failure to take care of the resource meant that it would be depleted, and people would have to go without.

Simeon Kvasnikoff, Elder, Port Graham. Winter 2005

"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., President Port Graham Corporation)

But the situation is not beyond hope. Much knowledge remains with our Elders today. If they 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 ecosystem that nourishes us.

Luba Meganack, Richard Moonin, Debbie McMullen, and Bobbie Sue McMullen at the top of the 11 mile hike. Summer 2004

Teaching the Next Generation

"The resource is depleted due to a lack of teaching by the elders and a lack of management"
(Walter Meganack Jr., President, Port Graham Corporation)

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

"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)

"Now I pick larger Bidarkis because in the past I didn't know any better."
(Vivian Ukatish, Nanwalek)

Felicia Yeaton, Jess, Michelle, and Josh learning about Bidarkis at Rominoff Beach Fall 2003.

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.

"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)

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 take heed of the lessons of their Elders. Traditional foods and practices are a source of strength, both nutritionally and spiritually. This foundation is irreplaceable

"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)

Quentin, Larissa, Sam, and Jacob McMullen enjoying a sunny day in Port Graham. Summer 2004

Qaillumi Kipucesnaiyarrtaa; How Can We Bring It Back?

"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., President, Port Graham Corporation)

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 and 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 formal management plan for bidarkis may include steps such as imposing 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.

"*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)

"*Don't pick the little ones, they want to grow like you, you know*."

(Peter Anahonak Sr., Elder, Port Graham)

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.

"*We need to leave them alone in the spring otherwise we are probably harvesting the spawning ones*." (Pat Norman, Chief, Port Graham)

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.

"Maybe if we left them alone, maybe they would come back." (Jennie Tanape, Nanwlaek)

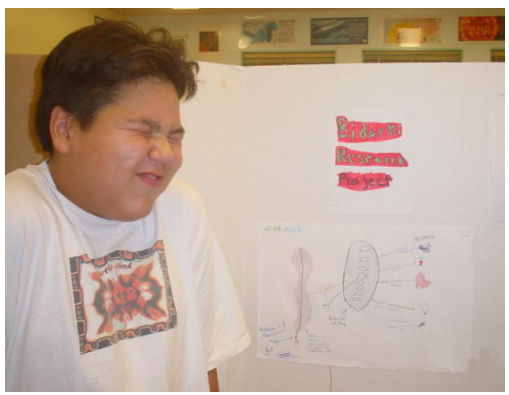
"Our harvest areas need to be protected. We need to protect rearing habitats."
(Walter Meganack Jr., President, Port Graham Corporation)

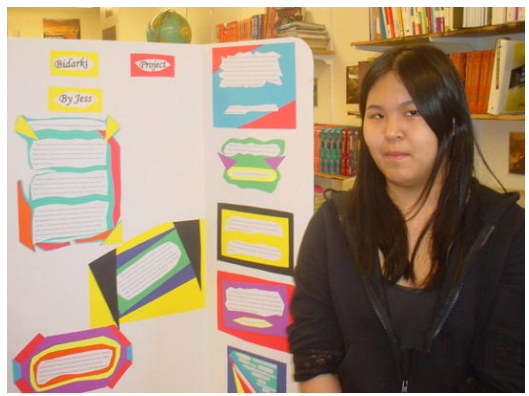
One of the most promising tools to help in Bidarki recovery would be the full protection of some shorelines. These untouched areas would act like natural refuges of the past. Individual bidarkis would grow, and overtime there would be a greater abundance of large individuals with disproportionately high quantities of eggs and sperm to release into the water column. Because they are broadcast spawners, when bidarkis are in close proximity of each other, the likelihood of sperm meeting egg and fertilization occurring is much greater. After fertilization occurs, bidarki larvae, tiny early forms of the chiton, then travel in the water column for about eight days before they are able to settle on to rock and start their life as a bottom dwelling animal. During those 8 days, larvae can travel great distances depending on ocean currents, waves, local eddies and thus the degree of local retention. The idea is that some of those larvae from the protected area could then replenish harvested sites with new young bidarkis. The process of larvae produced within a protected area and dispersing into adjacent fished areas is called 'spillover' and has been documented in numerous places in reserves around the world.

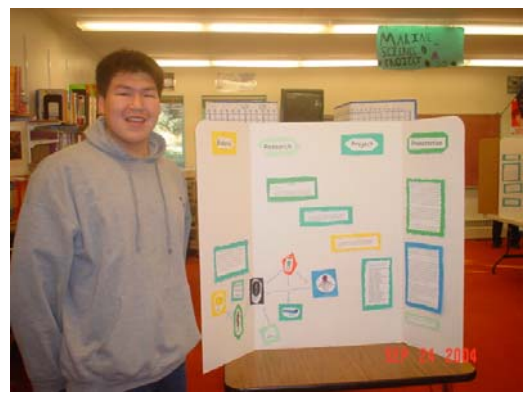
Young bidarkis, several weeks old, have recently ended their planktonic life as larvae and have now settled in the intertidal to begin their benthic life stage.

"*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)

And yet, the social realities of setting aside protected areas need to be carefully considered. It is true that protected areas will only work to replenish adjacent fished areas if everyone in the village abided by them. This may be difficult because some people may find themselves drawn to the opportunity to collect large bidarkis, even if they are protected. So, it is true that these protected areas would have to be enforced in some way and that may be a very difficult thing to do socially. As with many things, short-term social loses often outweigh long term gains, even if those gains are great. To overcome this hurdle, education on the possible benefits of protected areas would help our community recognize the value of investing in them. The community might be convinced, once people started seeing the positive consequences of 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 areas.







Travis, Jess and Josh present their Bidarki food web posters and marine science projects at the Port Graham School. September 2004

Although protected areas may be an important component in the recovery of bidarkis and other marine species, alone they would not be sufficient. This is simply because displacing fishing pressure from one area will result in its concentration in another. If fishing effort stays the same and say half of the harvest areas are protected, then twice as much harvest will occur in half the area. The implication is that protected areas must be coupled with an overall reduction in fishing pressure outside of their boundaries. Ultimately, it may take a combination of tools; education, size guidelines, seasonal closures, protected beaches and a reduction in collection in general to promote the recovery of bidarkis and other subsistence shellfish resources. This indeed is a lot to ask.

"We need to figure out how to protect the resources, not only from ourselves but from others too." (Walter Meganack Jr., President, Port Graham Corporation)

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.

"There are still changes that will happen that we haven't foreseen"
(Walter Meganack Jr., President, Port Graham Corporation)

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 experimenting with some management policies, careful monitoring to detect what changes do occur, communication to let people know what has happened, and support for the management program so that people will respond as needed. In other words, it requires people to be involved.

The Future of Our Ocean Home

"I want to go back to the old ways." **(Anesha Metcalf, Elder, Port Graham)**

Not everyone may wish 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 contingent on everything that came before. Any change in any step in the sequence of the past alters our present. Here in the Gulf of Alaska, in lower Cook Inlet, in our ocean home, a sequence of removing top predators, the rapid development of competing fisheries, the return of sea otters and a major change in ocean temperatures, have together caused a tipping point, a major reorganization of our coastal ecosystem.

Ironically, humans now have the power to influence the future more than ever before. As a consequence, the results of our own activities are becoming more severe. This coupled with a decline in knowledge transfer from Elders to youth and from scientists to local ocean observers has hindered our ability to determine the causes of change and develop solutions. Luckily, a transformation in our attitudes has begun. This book is one example.

You have listened to a story told through the voice of many storytellers; Elders, village residents, an anthropologist and a marine biologist. Collectively, we have pieced together bits of our history and our combined knowledge to more holistically understand the complex drivers of change in our ocean home. By sharing this knowledge, we hope to inspire solutions for the future. By integrating knowledge systems and delving into our ecological and social past we hope to foster a culture of sustainability, one that acknowledges both ecological and human systems and the need to shift our time frame of thinking into the deep past and far into the future.

Mnt. Augustine and our ocean home of at sunset. September, 2003.

Quyanásinaq

This story was truly a combined effort inspired by many. It sprung through the partnerships and friendships that grew over several summers of field work, many visits and cups of coffee, and the openness and good humor of everyone involved. We would like to thank the elders, residents, school students and tribal councils of Port Graham and Nanwalek. This story could not have been told with out you. Friends and colleagues at the Center for Alaskan Coastal Studies, the Kachemak Bay National Estuarine Research Reserve, and the University of Washington have also played a pivotal role in the creation of this book.

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