Title

Environmental Analysis of Submerged Cultural Resource Survey Areas of the Kiska Island National Historic Landmark Maritime Battlefield

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Environmental Analysis of Submerged Cultural Resource Survey Areas of the Kiska Island National Historic Landmark Maritime Battlefield

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Commonly Used Acronyms

AAA	Anti-Aircraft Artillery
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
AHTWG	
AI	Aleutian Islands
CDA	Coastal Defense Area
CORDC	Coastal Observation Research & Development Center
DOD	Department of Defense
ESI	Environmental Sensitivity Index
GIS	Geographic Information Services
HCA	Habitat Conservation Area
KOCOA	Key terrain, Observation and fields of fire, Cover and concealment, Obstacles, and Avenues of Approach
MEC	Munitions and Explosives of Concern
MPA	Marine Protected Area
MMPA	Marine Mammal Protection Act
NOAA	National Oceanic and Atmospheric Administration
NDSA	Naval Defensive Sea Area
NPS	National Park Service
OER	Ocean Exploration and Research
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
POL	Petroleum, Oil, & Lubricants
PR	Project Recover
SIO	Scripps Institution of Oceanography
SPR	Spill Prevention and Response
SSLPA	Steller Sea Lion Protected Area
STEM	Science, Technology, Engineering, & Mathematics
UAF	University of Alaska Fairbanks
UASE	University of Alaska Southeast
UCSC	University of California Santa Cruz
UCSD	University of California San Diego
USFS	United States Forestry Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

Abstract

Project Recover, formally established in 2016, fuses historical data with the latest technology to research and locate submerged WWII wreckage and the associated servicemen that have been missing in action (Project Recover, 2018). In July 2018, Project Recover will conduct remote-sensing surveys in four locations off Kiska Island, Alaska. The terrestrial component of the Kiska battlefield has been well researched; the maritime component remains largely unknown. Little research has been done in the area regarding the submerged WWII cultural sites, as well as environmental assessments and analysis. Historical analysis of the Battle of Kiska, applying KOCOA (key terrain, observation and fields of fire, cover and concealment, obstacles, and avenues of approach) analysis to submerged maritime sites in the area, assessments of active contaminant sites, and analysis of environmental and habitat data of the area will aid in the creation of one composite geodatabase. The implementation of the geodatabase and other environmental support information is important in the planning stages of the survey and will serve to be a timely reference during the field data collection phase. Furthermore, analysis done in this Capstone project will help ensure another efficient and successful Project Recover survey and will contribute to the overall goal of Project Recover, which is to document and honor the final resting place of 167 U.S. and Japanese service members who lost their lives in the waters surrounding Kiska Island, thus ensuring the preservation of maritime cultural history.

INTRODUCTION

Background

Kiska is a volcanic island in the Rat Island group of the Aleutian Chain located approximately 1,450 miles west of Anchorage, Alaska and is approximately 30 miles long and 7 miles wide (Spennemann, 2012). Prior to about 1728, the Aleutian Islands, including Kiska, were occupied by about 12,000 Aleut people, a native, warrior race (Cloe, 1990). With Russian advancement in a quest to hunt and trap fur-bearing animals moving eastward through the Aleutians during much of the eighteenth century, the population of the Aleuts was decimated to a mere 2,000, mostly due to the degradation of Aleut culture and the subjection of disease (Cloe, 1990). By 1867, the fur trade had become an unprofitable business for the Russians, so they sold the nearly uninhabited Aleutian territory to the United States (Cloe, 1990). Except for the occasional visits by fur trappers, Kiska was uninhabited from about the 1830s to 1941 when the U.S. Navy installed a small weather station on the island, which was occupied by about ten personnel. However, on June 6, 1942, as part of the overall strategy for the Battle of Midway, Japanese forces invaded and occupied Kiska, constructing a seaplane and submarine base, a runway, a main camp comprised of various buildings for soldiers and weapons, and an array of coastal defense utilities such as anti-aircraft gun positions (Spennemann, 2012). Over the next year and several months, the U.S. Navy and Army Air Corps, through air assault and bombing raids, attempted to drive out the thousands of Japanese Army and Navy troops by destroying their weapons, planes, and ships. These raids were often hampered by intense weather conditions: dense fog made for low ceilings and almost zero visibility; snow, ice, and sub-zero temperatures made it almost impossible to operate aircraft; and "williwaws," a word often used to describe the intense winds in the Aleutians, added to the already unfavorable conditions. After the U.S. captured Attu Island from the Japanese on May 30, 1943, the focus shifted to recapturing Kiska. Over the next few months, intense bombing raids pressed on, and approximately 34,000 U.S. and Canadian forces planned to invade Kiska via sea-going assets; however, in July 1943, 5,100 Japanese troops used the fog to their advantage and in less than one hour, escaped without being detected by both the American and Canadian forces (Spennemann, 2012). Kiska was taken back by the United States and August 15, 1943, marked the end of the Aleutian campaign (Cloe, 1990).

From the end of WWII to present day, there has been no permanent human occupancy on Kiska Island, which has enabled the Kiska battlefield to remain in a state of excellent preservation and one of only two battlefields world-wide where neither previous nor later settlement obscure military developments (Spennemann, 2012). On land, weapons used by the Japanese remain in position, although somewhat weathered and deteriorated. Remnants of a Japanese midget sub, seaplane parts, and anti-aircraft artillery (AAA) litter the once occupied Japanese military installations around Kiska Harbor and a partially sunken Japanese ship, the *Borneo Maru*, crests above the waters of Gertrude Cove (Figure 1). What are not visible, are the countless ships and planes, now dismembered and most likely the residences of various species of marine flora and fauna, submerged beneath the waters surrounding Kiska Island. This tundra-like and untouched environment is a land that time seems to have forgot but serves as the haunting reminder of what was once a significant and active battleground.

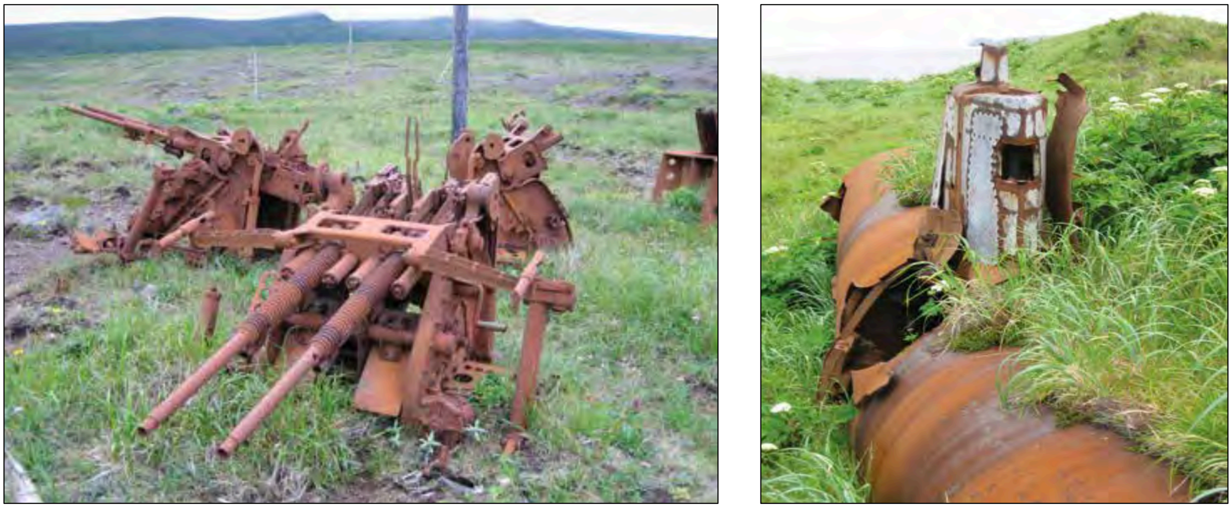

Figure 1: Remnants of Japanese anti-aircraft gun (left) and midget submarine (right); (Rudis, USFWS)

The remoteness of Kiska, along with the fact that it remains uninhabited, and therefore undisturbed, enhances maritime preservation efforts for the terrestrial and submerged battlegrounds. Kiska lies within the Aleutian Islands (AI) Habitat Conservation Area (HCA) and is also a National Oceanic and Atmospheric Administration (NOAA) fisheries Marine Protected Area (MPA). (Figure 2).

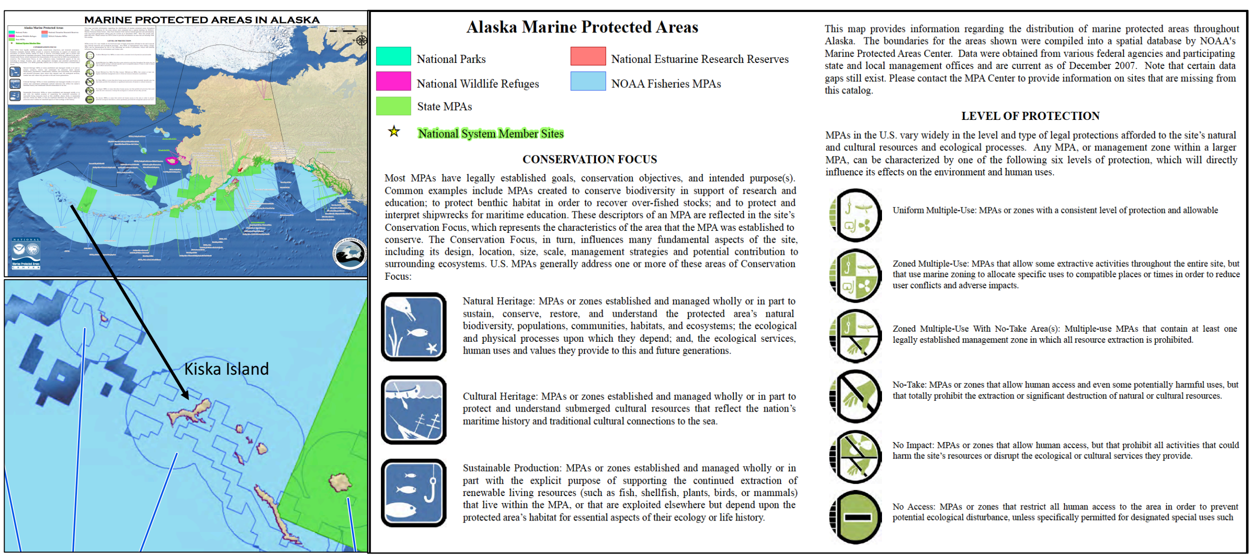

Figure 2: Kiska Island within the Alaska Marine Protected Areas (NOAA)

Kiska Island is encompassed by a Stellar Sea Lion Protected Area (SSLPA), which restricts commercial fishing and has a primary conservation focus in natural heritage meaning that "MPAs or zones established and managed wholly or in part to sustain, conserve, restore, and understand the protected area's natural biodiversity, populations, communities, habitats, and ecosystems; the ecological and physical processes upon which they depend; and, the ecological services, human uses and values they provide to this and future generations" (NOAA, 2018). Such human uses include enhancing the education and knowledge of the value of submerged maritime archaeological sites. "Maritime heritage preserves and protects valuable historical, cultural, and archaeological resources within our coastal, marine, and Great Lakes environments and includes not only physical resources such as historic shipwrecks and prehistoric archaeological sites, but also archival documents and oral histories," (NOAA, 2018). Assessing the Battle of Kiska, through historic documentation like photos, personal accounts, and archival resources allows us to feel a connection to our country's history and a duty to preserve it. "Maritime heritage resources, when properly studied and interpreted, add an important dimension to our understanding and appreciation of our nation's rich maritime legacy, and make us more aware of the critical need for us to be wise stewards of our ocean planet" (NOAA, 2018). As a nation that relies on its vast coastline as a source of economic stability and growth, U.S. citizens are obligated to understand and protect the legacy of our maritime culture and heritage.

Project Origin

Project Recover was established in 2012 with sponsorship from private and public entities. It was formalized in 2016 as a partnership among researchers at the University of Delaware's College of Earth, Ocean and Environment, the Scripps Institution of Oceanography (SIO) at the University of California San Diego (UCSD), and the BentProp Project (Project Recover, 2018). Project Recover merges the latest science and technology with in-depth archival and historical research to locate submerged cultural sites associated with WWII aircraft in an effort to successfully locate American servicemen still unaccounted for and provide closure to family members (Project Recover, 2018).

The footprint for Project Recover is expanding around the globe. In July 2018, Project Recover will conduct an exploratory remote-sensing survey to locate and document WWII-era submerged cultural resources in the waters off Kiska Island, Alaska, an area of cultural significance that has been largely unexplored (Terrill et al., 2018). This archaeological survey is sponsored by NOAA's Office of Ocean Exploration and Research (OER) (Terrill et al., 2018).

Project Recover's goals for the Kiska survey are to: provide an inventory of submerged cultural resources associated with the Kiska Island National Historic Landmark and baseline environmental/benthic data for site management and preservation; interpret documented sites though the lens of battlefield archaeology and contextualized within the greater maritime landscape to elucidate our understanding of the Aleutian Campaign; research, develop, and refine new maritime search capabilities, concepts of operations, and data exploitation for maritime archaeology to increase efficiency, accuracy, and cost effectiveness; promote an increased awareness of maritime cultural heritage and the NOAA mission through technology, such as 3D photogrammetric models, that allow a distant public access to one of our country's most remote battlefield sites; foster a meaningful integration of education and outreach opportunities through this project that bridges both Science, Technology, Engineering and Mathematics (STEM) related fields and the social sciences by active participation in the field efforts and generation of learning products from the results by way of print media, video/web/social media production, teaching modules, displays, presentations, models, and professional publications; and document and honor the final resting place of 167 U.S. and Japanese service members who lost their lives in the waters surrounding Kiska Island (Terrill et al., 2018).

Purpose

In alignment with the goals of Project Recover, the purpose of this Capstone Project is set forth by the following goals:

- Create a database for Kiska Island including historic and environmental data. Since little is known about the maritime component of the Battle of Kiska in terms of the analysis of submerged wreckage and environmental conditions in the area, including critical habitat and environmental sensitivity data, one composite data source – a geodatabase created via the ArcGIS suite – would serve as an inventory of all said resources. This geodatabase would be of value, especially since the geodatabase and respective metadata can be edited at the convenience of the Project Recover team.
- Use KOCOA analysis for the terrestrial environment to derive assessments about the surrounding maritime environment and cultural resources. Although KOCOA analysis is primarily used for the terrestrial battlefield, it can be applied to the maritime environment (Spennemann, 2011). By interpreting the landscape of the terrestrial battlefield and how it is contextualized within the surrounding maritime landscape, along with understanding each of the elements of KOCOA as they apply to land, similar analysis of why certain events occurred in the maritime environment can be conducted, thus enabling a more comprehensive understanding of the submerged maritime archaeology in the waters surrounding Kiska Island.
- Use analysis to provide recommendations for areas of concern regarding any environmental hazards to ensure a successful and efficient survey. Active sites of munitions and explosives of concern (MECs) have been documented on Kiska Island and in Kiska Harbor and are the remnants of weapons used during the Battle of Kiska over 70 years ago. The geodatabase will be used to conduct analysis of their potential effects on the surrounding biological environment, as well as their location in proximity to the remote-sensing survey sites could prove to be critical information to the Project Recover team, to include divers and survey equipment.
- Implement the geodatabase and environmental support data as a baseline of environmental analysis for future surveys and to promote increased awareness of maritime cultural heritage through Geographic Information System (GIS) technology and capabilities. The utilization of user-friendly products, like the geodatabase, along with key environmental information regarding Kiska Island, will aid in providing insight and recommendations to the Project Recover team, thus contributing to a successful and efficient remote-sensing survey. This may also

increase awareness and education of maritime cultural heritage and the importance of its preservation.

- To have the analysis done in this Capstone project contribute not only to the remote-sensing surveys but to Project Recover's "big picture," overall goal, which is to document and honor the final resting place of 167 U.S. and Japanese service members who lost their lives in the waters surrounding Kiska Island (Terrill et al., 2018). The analysis conducted in this project is just a small contribution to help Project Recover locate and repatriate service members that were lost over 70 years ago, however, said analysis will help contribute to the education and preservation of yet another piece of America's maritime cultural heritage.

METHODOLOGY

The Data

GIS serves to store, display, and analyze spatial data (ESRI, 2018). The ESRI ArcGIS suite was used to create one composite file geodatabase that stores and displays important historical and environmental data and was also used to perform analyses regarding survey sites and their proximity to habitats and contaminated areas. To begin the creation of the file geodatabase, a basemap of Kiska Island, provided by the Coastal Observation Research and Development Center (CORDC) at SIO, was added in ArcMap in order to add existing shapefiles and digitize those that were created as feature classes in ArcMap.

After adding the basemap and bathymetric data, a file geodatabase containing 21 feature classes (not including the seven feature classes created via geoprocessing tools) was created by compiling existing shapefiles (.zip files) and by creating new feature classes by either deriving references from specific sources or converting .csv files to shapefiles (Table 1). Existing .zip files were downloaded from their source(s), imported into ArcCatalog as a new feature class, then added as a "layer" to the Table of Contents in ArcMap. Shapefiles not already existing or available for download, were created by "creating a new feature class" within the file geodatabase in ArcCatalog. The new feature classes were then added as a "layer" to the Table of Contents in ArcMap and then digitized according to their locations, which were referenced using their respective sources. Data in the form of .csv files were converted to shapefiles by "Adding XY Data" in ArcMap, done by importing the .csv file. The .csv file was then added as XY data to the map and then converted to an actual shapefile, which was then added as a "layer" to ArcMap's "Table of Contents." See Table 1 for information regarding the 21 shapefiles.

Shapefile (Feature Class) Name	Digitized (Y/N)	Source
AWC_Kiska	No	ADF&G (.zip file)
Bird_Nesting_Colonies*	Yes	USFWS
Coastline*	Yes	USFWS
Contaminated_Sites	Yes	Alaska DEC
Critical_Habitat	No	USFWS (.zip file)
Fish_Species*	Yes	USFWS
Habitat_Shoreline*	Yes	USFWS
Historic_Japanese_Military	Yes	USNPS, PR Team
Intertidal	No	USFS, UASE
MPAI_v2017	No	NOAA
Pier	Yes	USNPS, Google Maps
Pinniped*	Yes	USFWS
Place_Names	Yes	USNPS, Google Maps
Sea_Otter*	Yes	USFWS
Sediments_Kiska	No	NOAA (.zip file)
SideScanTracks_1989	No	PR
Streams	No	USFS, UASE, ADF&G, AHTWG, USGS (.zip file)
SurveyAreas	Yes	PR Team
Unconfirmed_Side_Scan_Locations1989	No	PR Team (.csv file)
Volcano*	Yes	USFWS
Wrecks_Confirmed	No	PR Team (.csv file)

Table 1: Feature classes downloaded or created in ArcGIS; *denotes data derived from ESI data from the USFWS (Appendix D)

Attribute tables for each feature class contain information pertaining to the individual feature class. For example, the attribute tables for the shapefiles derived from the United States Fish and Wildlife Service's (USFWS) Environmental Sensitivity Index (ESI) data contain information from the ESI catalog specific to that digitized shapefile. Downloaded shapefiles (.zip files) already contain attributes created by their original source and .csv files contain coordinate data (XY) that was used to create the shapefile. Other attributes can vary and are typically up to the creator of the feature class in ArcCatalog. Information can be edited. Metadata for all feature classes was added and/or edited in ArcCatalog and can be edited at any time. Metadata can be referenced in Appendix E.

Marine Mammals

Data pertaining to marine mammals was not included in the file geodatabase but compiled in Microsoft Office Power Point format (Appendix B) to be used as a reference or guide by the Project Recover team serving as environmental support information for the Kiska Island maritime environment. Since Kiska Island is within a designated MPA, marine mammals and their resources are protected, therefore they are highly likely to forage and/or rest in the relative area. Marine mammal information was gathered from NOAA's Alaska Fisheries website and includes marine mammals that could be found in the vicinity of Kiska Island and are either species listed under the Endangered Species Act (ESA) or the Marine Mammal Protection Act (MMPA) (Table 2).

Marine Mammals Protected by the ESA	**Marine Mammals Protected by the MMPA**
Steller Sea Lion	Ribbon Seal
Blue Whale	Harbor Seal
Fin Whale	Baird's Beaked Whale
Humpback Whale	Harbor Porpoise
North Pacific Right Whale	Killer Whale
Western North Pacific Right Whale	Pacific White-Sided Dolphin
Sperm Whale	Northern Fur Seal
	Dall's Porpoise
	Minke Whale
	Stejneger's Beaked Whale

Table 2: Marine mammals that could be found in the vicinity of Kiska Island that are either protected by the Endangered Species Act (ESA) or the Marine Mammal Protection Act (MMPA); Source, NOAA.

<u>Kelp</u>

Kelp species data were not included in the file geodatabase but compiled in Microsoft Office Power Point format (Appendix A) to be used as a reference or guide by the Project Recover team serving as environmental support information for the Kiska Island maritime environment. General kelp data for all possible kelp found in the area of Kiska Island was gathered (photos and statistics) via the Seaweeds of Alaska website (Appendix A). More specific data for kelp in 24 survey locations around the eastern side of Kiska Island and Little Kiska Island were provided by Dr. Brenda Konar from the University of Alaska Fairbanks (UAF) and Mike Kenner from the University of California Santa Cruz (UCSC). UAF and UCSC conducted the kelp surveys and collected the data, which was gathered in the years 1993, 2008, 2009, 2014, 2015, 2016, and 2017 in one-quarter meter transects at 20-25 feet depth. Of note, not all survey sites were sampled all of the time (in each year). Table 3 contains a list of the kelp species found in the Aleutian Islands based on this research.

Eualaria fistulosa	Dragon Kelp
Laminaria yezoensis	Suction-Cup Kelp
Laminaria longpipes	Northern Rhizome Kelp
Agarum clathratum	Sieve Kelp
Agarum turneri	Smooth Sieve Kelp
Thalassiophyllum clathrus	Spiral Sieve Kelp
Cymathaere triplicate	Three-Ribbed Kelp
Desmarestia viridis	Stringy Acid Kelp
**Alaria marginata*	Ribbon Kelp
**Chorda filum*	Spaghetti Kelp
**Saccharina groenlandica*	Split Kelp
**Saccharina latissimi*	Sugar Kelp
**Saccharina dentigera*	Northern Stiff-Stiped Kelp
**Petalonia fascia*	False Kelp
**Porphyra gardneri*	Laver Kelp
**Coilodesme fucicola*	Fringe Kelp

Table 3; *Denotes kelp not found in the survey data but could potentially be found in the vicinity of Kiska Island (Seaweeds of Alaska, 2018; Konar and Kenner, 2018).

Survey data for the kelp found in the vicinity of Kiska Island will be extremely useful in terms of knowing where certain species are most likely to be found and will aid in determining what species are more prevalent than others based on patterns found in the survey data. Higher densities of kelp can interfere with Project Recover's remote-sensing surveys by impeding with the survey equipment (side-scan sonars, multi-beam echo-sounders, remotely operated vehicles) and can also prevent divers from conducting efficient dive operations.

<u>Tides and Tidal Currents</u>

Tide predictions for Kiska Harbor and Gertrude Cove, for the month of July 2018, were gathered via the NOAA website (Figures 3 and 4). Current predictions for Sea Lion Pass, on the eastern side of Kiska Island, for the month of July, were gathered via the NOAA website (Figure 5). This is the only location closest to Kiska Island in which NOAA had predictive current data.

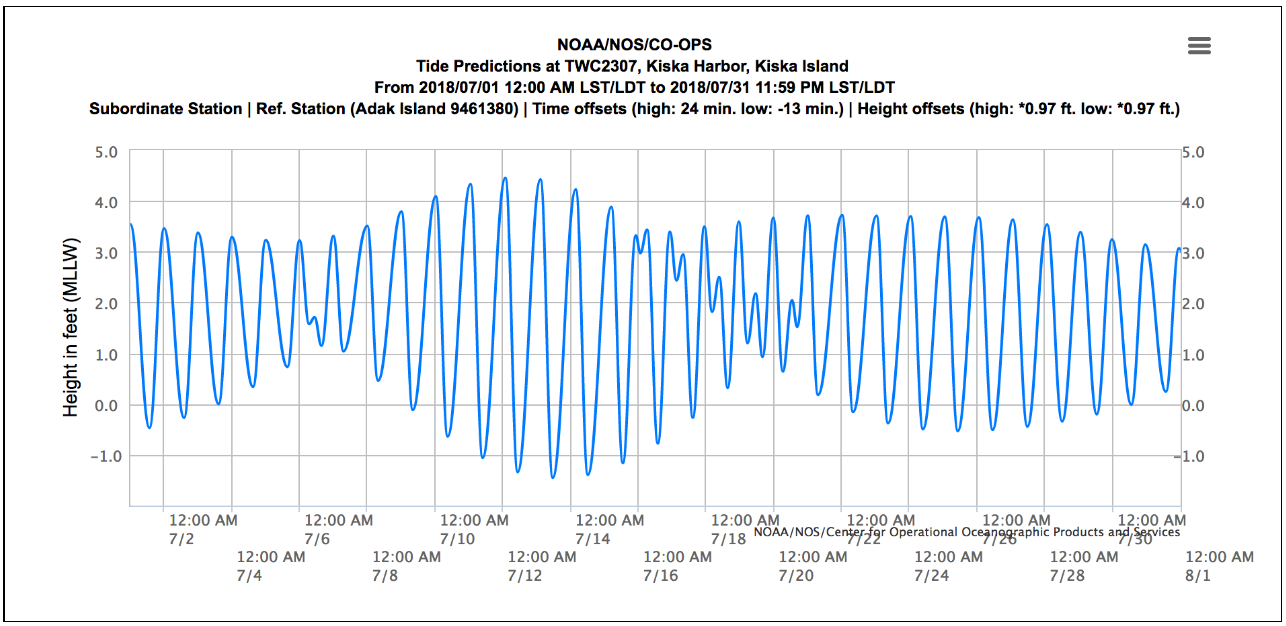

Figure 3: Tide predictions for Kiska Harbor, July 2018 (NOAA)

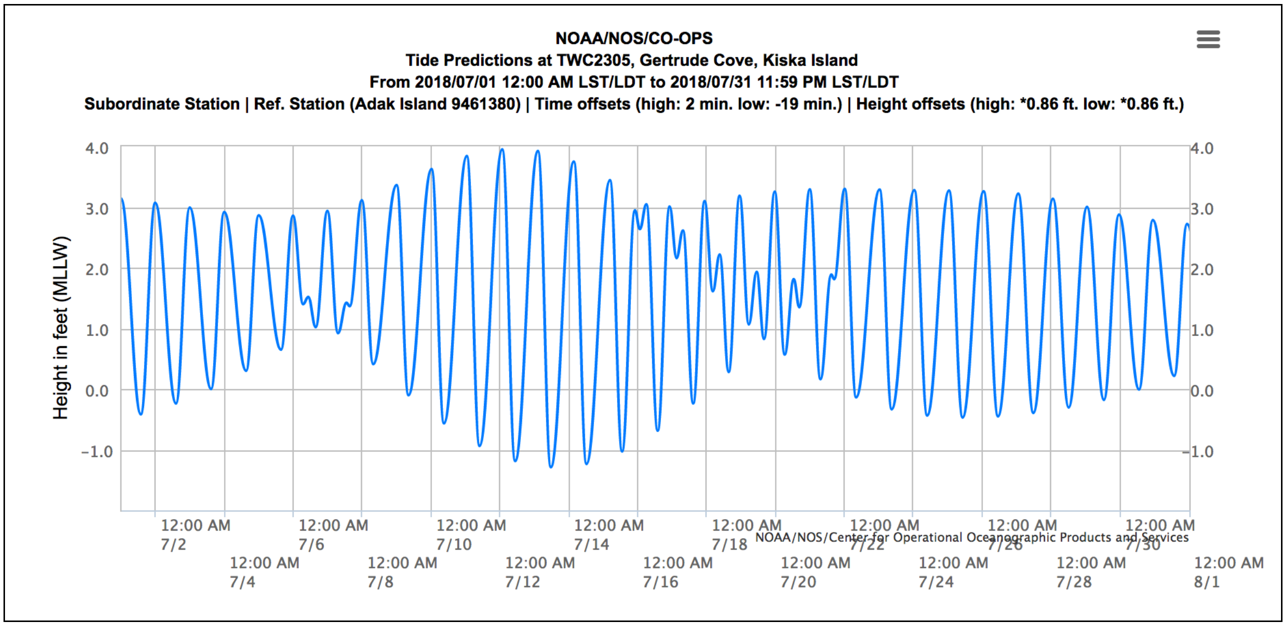

Figure 4: Tide predictions for Gertrude Cove, July 2018 (NOAA)

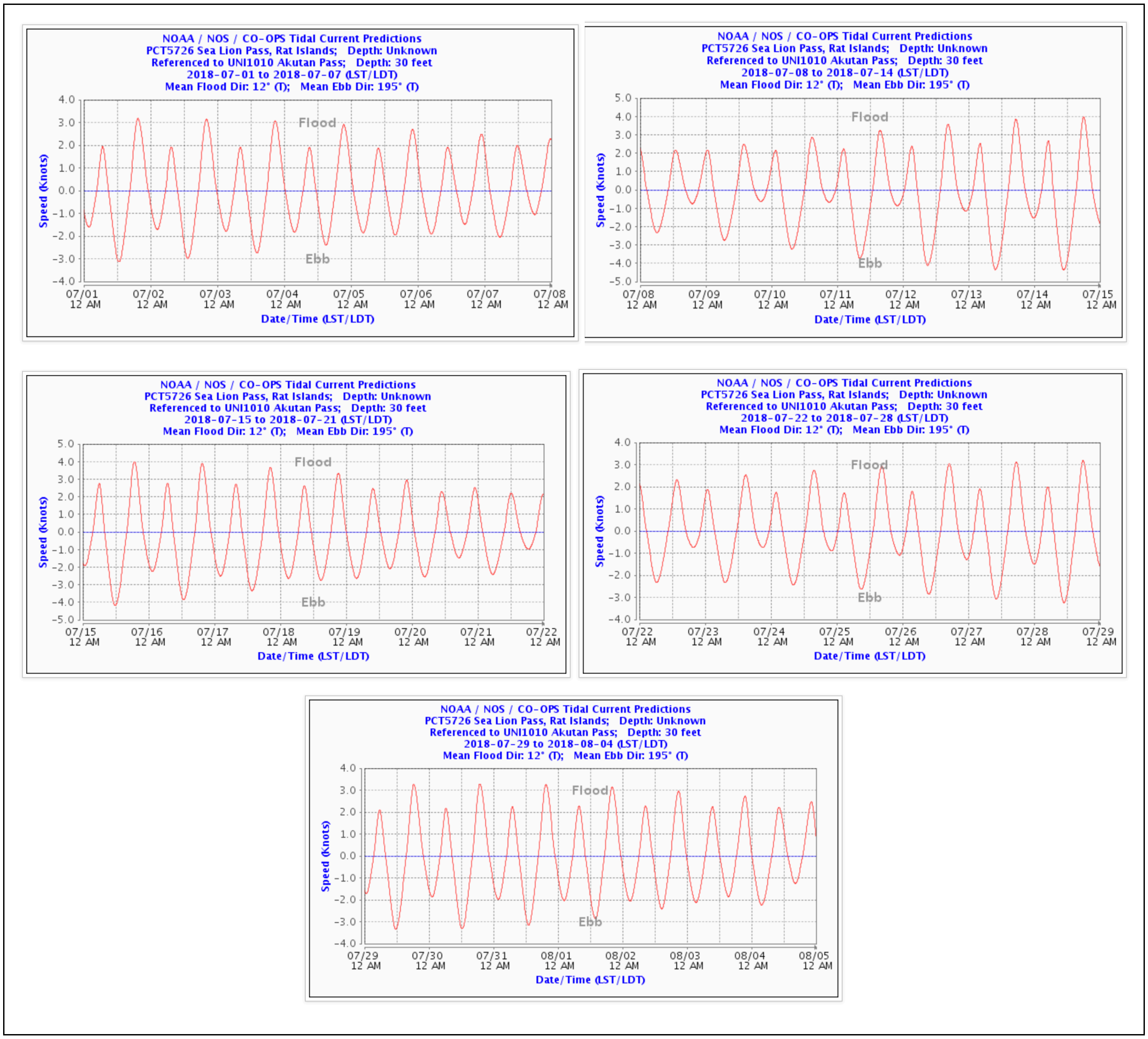

Figure 5: Tidal current predictions, Sea Lion Pass, July 2018 (NOAA)

Although subject to change based on the fluctuation of local weather patterns, the predictive tide and tidal current data allows the Project Recover team to gain insight as to what to expect in terms of specific tide and current patterns for the month of July, and if necessary, can allow them to adapt to varying tidal and current conditions.

ANALYSIS AND DISCUSSION

Environmental Analysis and Geoprocessing Tools

Habitat Analysis

Geoprocessing is a framework and set of tools for processing geographic and related data and can be used to perform spatial analysis or manage GIS data in an automated way (ESRI, 2018). To determine the habitats residing within the four survey areas, the geoprocessing tool “Intersect” was used in ArcMap. “Intersect” computes a geometric calculation of the input features and features or portions of features which overlap all layers and/or feature classes will be written to the output feature class (ESRI, 2018). The “SurveyAreas” feature class (an input feature) was intersected with the following feature classes (also input features), each individually:

1) Bird_Nesting_Colonies
2) AWC_Streams (Anadromous Waters Catalog)
3) Sea_Otter
4) Pinniped
5) Fish_Species
6) Shoreline_Habitat
7) Streams

Upon completion of running the intersect tool seven separate times, each new feature class (output feature) was added as a layer to the Table of Contents in ArcMap for a total of seven new feature classes: NestingColonies_int; StreamsAWC_int; SeaOtter_int; Pinniped_int; Fish_int; Shoreline_int; and Streams_int. Only two of the four survey areas displayed habitats after running the intersect tool: the Gertrude Cove Survey Area and the Kiska Harbor Survey Area. See Figure 6 and Figure 7.

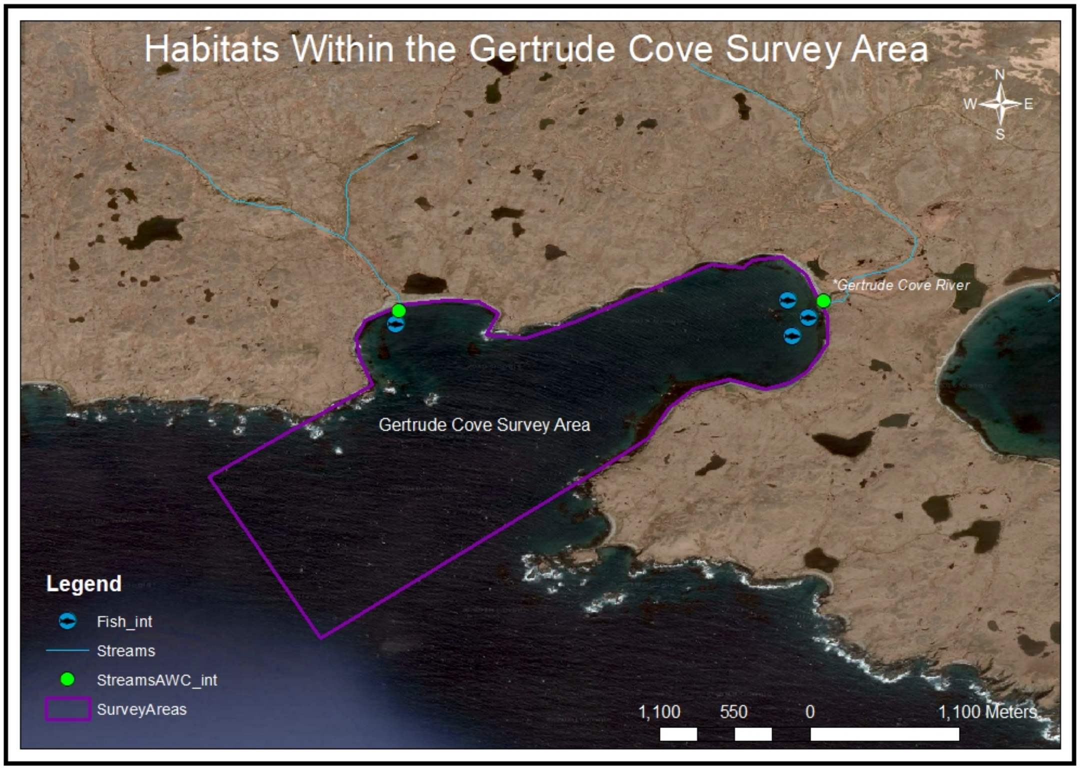

Figure 6: Gertrude Cove Survey Area and habitats

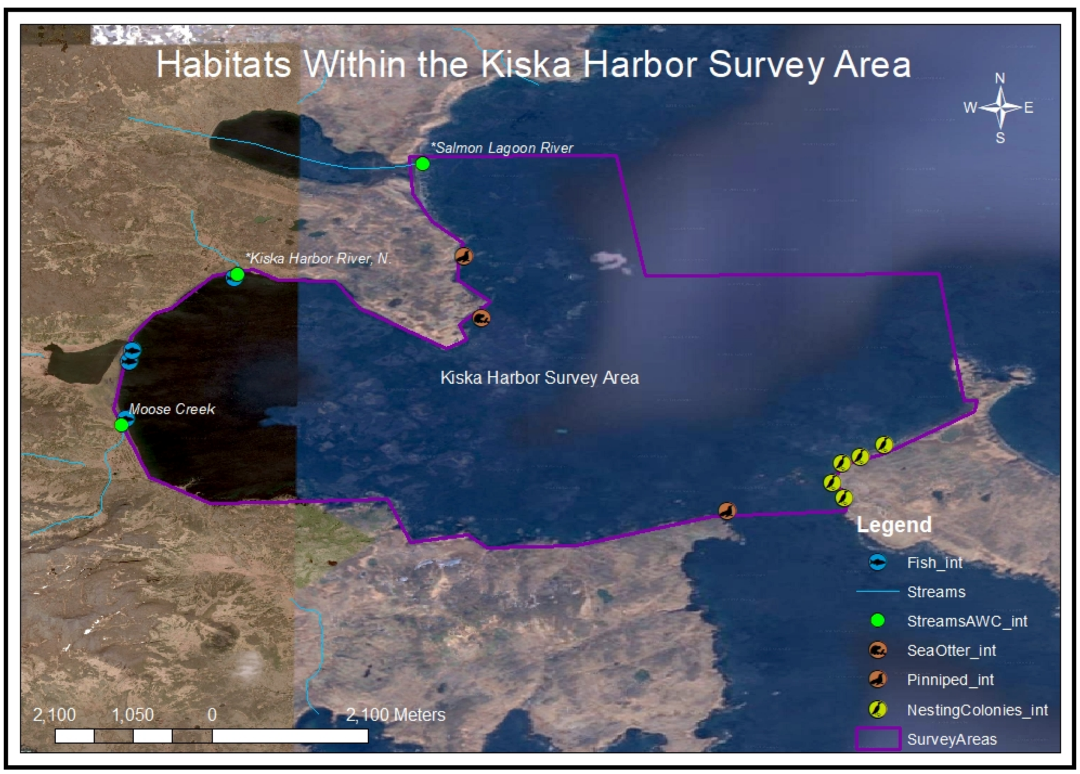

Figure 7: Kiska Harbor survey area and habitats.

Further analysis of the two survey areas was completed in a Microsoft Excel spreadsheet to produce charts that displayed more detailed information about the number of habitats found in each survey area and furthermore, names of species found among fish, nesting birds, and marine mammals (Figures 8 and 9). Images of species in Figure 9 can be found in Appendix C.

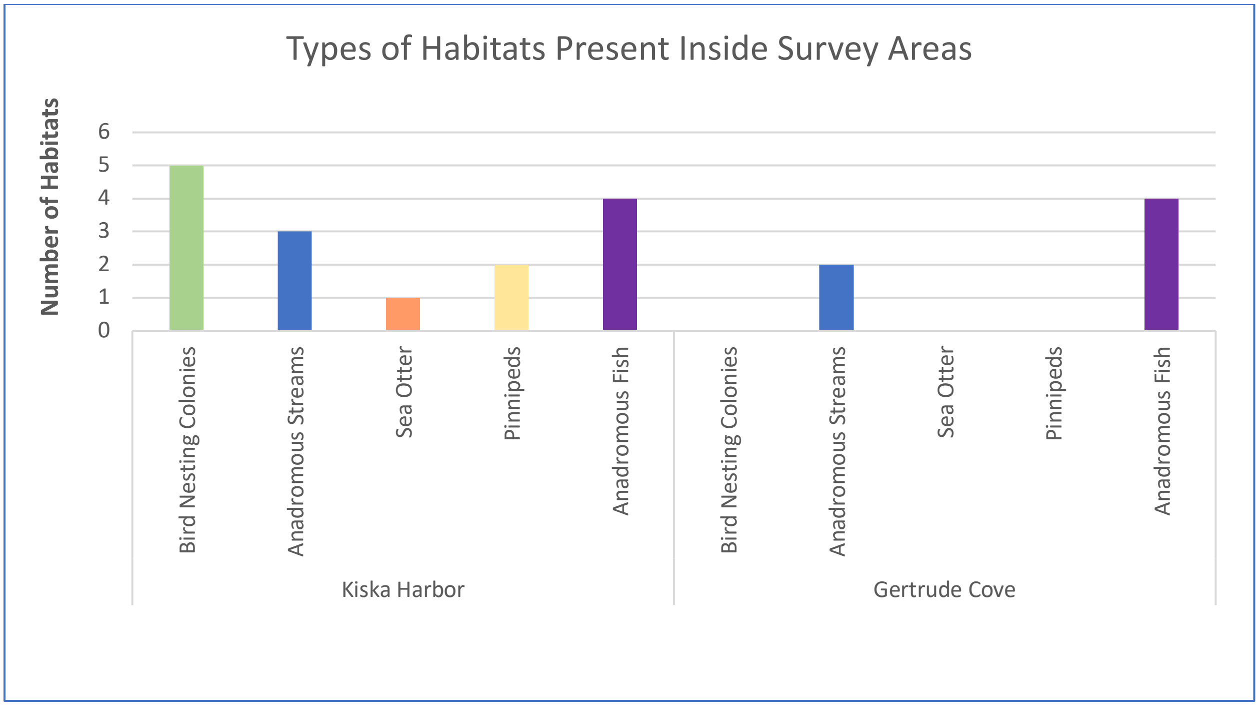

Figure 8: Habitats within Kiska Harbor and Gertrude Cove

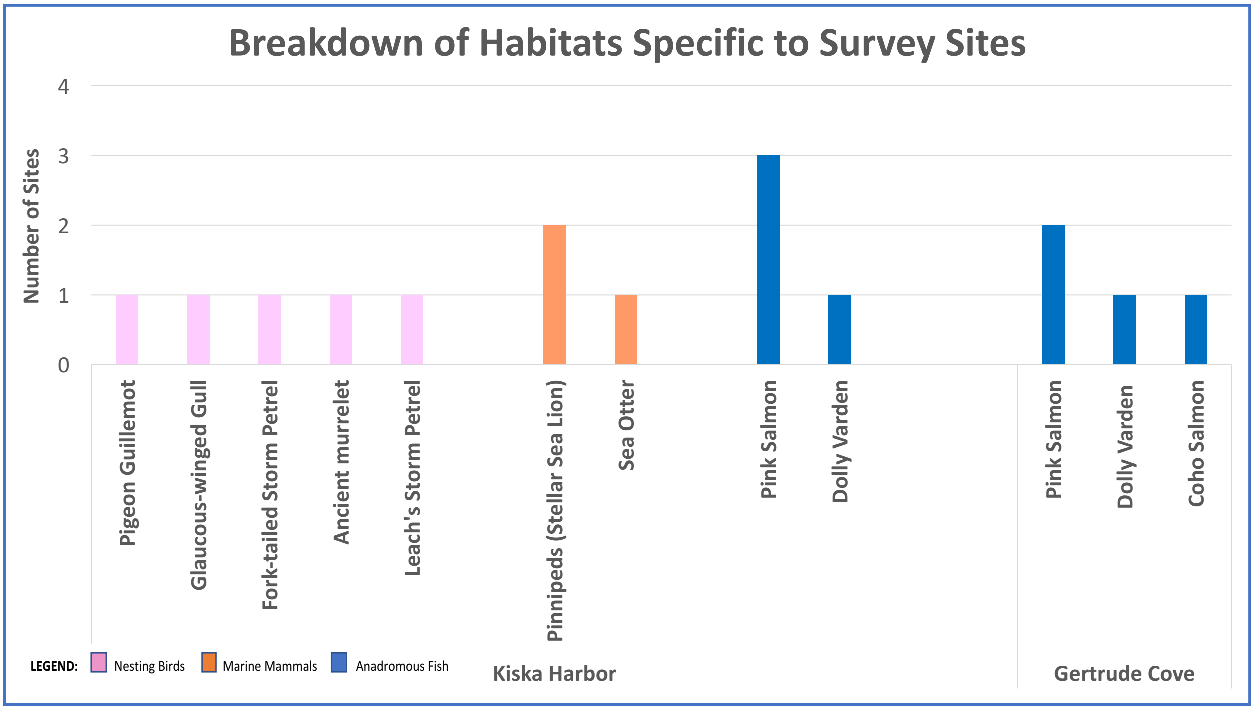

Figure 9: Species of nesting birds, marine mammals, and anadromous fish within survey areas.

All species of nesting birds found within the Kiska Harbor survey area are nesting during the months of April through September (USFWS, 2018). Pink Salmon in both the Kiska Harbor and Gertrude Cove survey areas spawn during the months of July through September, therefore the adults of these species will be found within these locations from July through September, more specifically at the anadromous waterways and streams found within the survey areas (USFWS, 2018). The Dolly Varden can be found at both survey areas throughout the year, both as juveniles and adults (USFWS, 2018). Adult Coho Salmon are only present during their spawning season, which is from October through December (USFWS, 2018). Steller Sea Lions are federally endangered and can be found around the coastline of Kiska Island throughout the year (USFWS, 2018). Since their haul out location is primarily in the Kiska Harbor survey area, based on the analysis, it is important to note that their pupping season is from May through July and their molting season is from July through December (USFWS, 2018). The Northern Sea Otter pupping season is the month of May (USWFS).

Through analysis done via the "Intersect" geoprocessing tool, in conjunction with the USFWS habitat information, it can be concluded that during the month of July, which is when the Project Recover remote-sensing surveys will take place around Kiska Island, that the team be aware of the presence of nesting birds, the presence of Pink Salmon and Dolly Varden and the fact that it is the spawning season for both, the Steller Sea Lion pupping and molting season, and also the presence of the Northern Sea Otter.

Shoreline Analysis

The "Intersect" geoprocessing tool was also used to determine the type of shoreline habitats within the survey areas. The "SurveyAreas" feature class was intersected with the “Shoreline_Habitats” feature class; the output feature class was named “Shoreline_int.” Only two of the four survey areas displayed shoreline habitats within their bounds: Gertrude Cove and Kiska Harbor (Figure 10 and Figure 11).

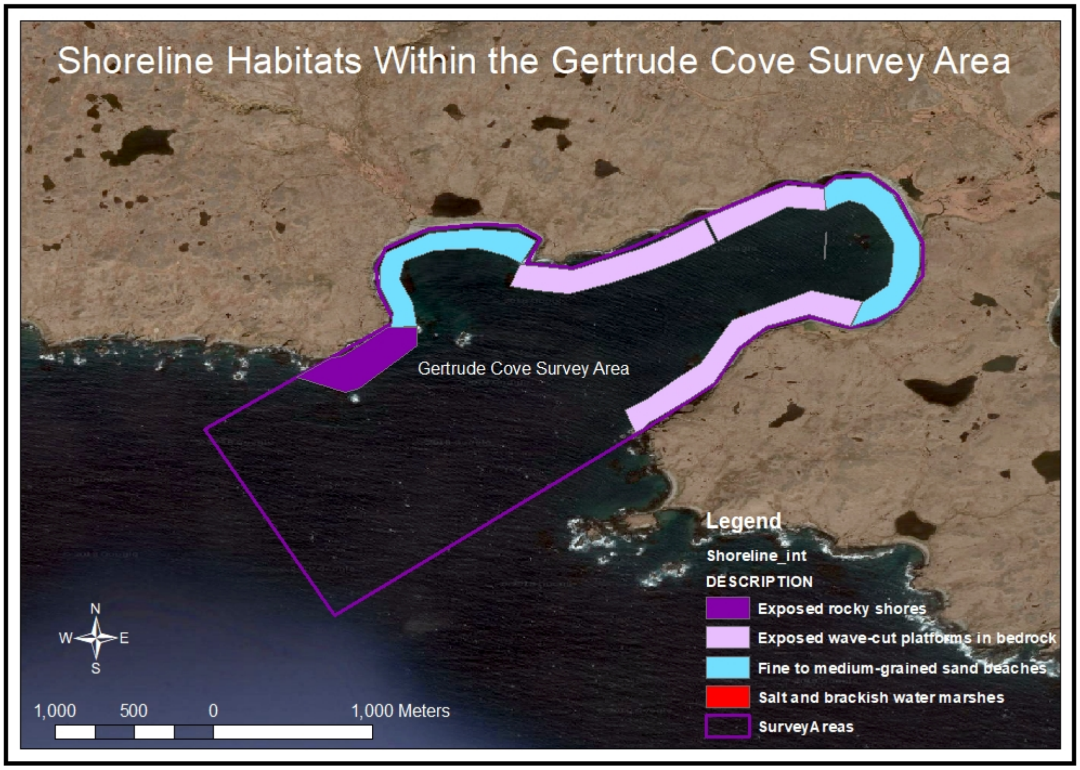

Figure 10: Gertrude Cove Survey Area and shoreline types.

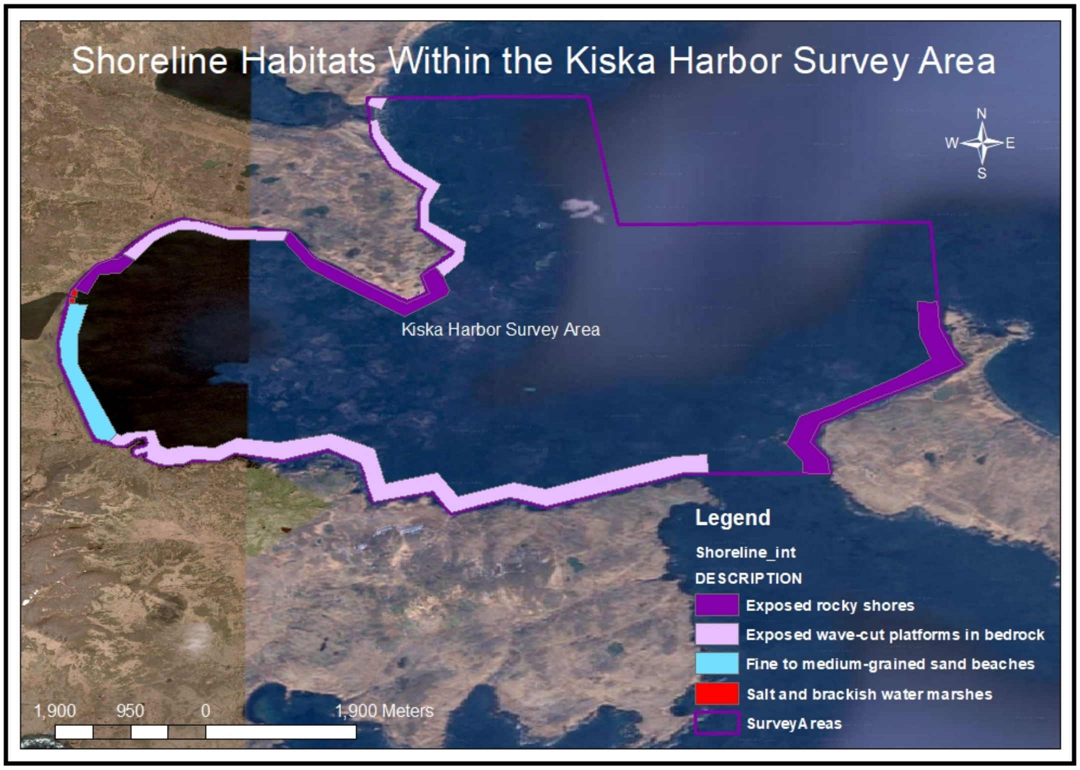

Figure 11: Kiska Harbor survey area and shoreline type

The purpose of running the intersect tool for the shoreline habitats was to display the types of coastline within the survey area. “Assessment of the environmental sensitivity of a particular intertidal habitat is based on an understanding of the dynamics of the coastal environments, not just the substrate type” (USFWS, 2018).

- Exposed rocky shores are where “the intertidal zone is composed of bedrock, steep (greater than 30° slope), and thus very narrow; sediment accumulations are uncommon because waves remove the debris that has slumped from the eroding cliffs; they are regularly exposed to wave action and strong currents; attached organisms are accustomed to the impacts of the waves and the associated hydraulic pressure; there is strong vertical zonation of intertidal biological communities; species density and diversity vary greatly, but barnacles, snails, mussels, and macroalgae dominate; they are common throughout the area along headlands and offshore islands wherever there is open fetch facing the direction of storm-generated winds” (USFWS, 2018).
- Exposed wave-cut platforms in bedrock are where “the shores consist of a bedrock shelf or platform of variable width (up to hundreds of meters wide) and very gentle slope; the surface of the platform is irregular and the presence of tidal pools is common; the shoreline may be backed by a steep rock scarp or low bluffs; there may be a narrow gravel beach at the base of the scarp; species density and diversity varies greatly, but barnacles, snails, mussels, and macroalgae are often very abundant; attached organisms are accustomed to the impacts of the waves and the associated hydraulic pressure” (USFWS, 2018).

- Fine to medium-grained sand beaches are where “the beaches are flat to moderately sloping and relatively hard packed; they are composed of predominantly quartz sand; they are utilized by birds for resting and foraging; backshore habitats include dunes and wetlands which are important seasonally as nesting areas for birds” (USFWS, 2018).
- Salt and brackish water marshes can vary in width, “from a narrow fringe along lagoons to extensive areas at stream mouths, though most marshes are small in area; sediments are composed of mixtures of mud, sand, and gravel; resident flora and fauna are abundant with numerous species and high utilization by birds, fish, and shellfish” (USFWS, 2018).

Rocky shorelines and shorelines with wave-cut platforms in bedrock may experience more wave action, so close proximity to that type of shoreline habitat may be hazardous to survey vessels and divers. Fine to medium-grained sand beaches may be conducive to beach landings. All three shoreline habitat classifications are critical habitat areas of pinnipeds and are also conducive to inhabiting nesting birds. These shoreline types may also serve as the transition zone of salt water habitats and the salt and brackish water marsh habitats, in which a variety of diverse marine flora and fauna may reside.

<u>Contaminated Areas</u>
Analysis of the contaminated areas was conducted without the use of geoprocessing tools because there were only two specified areas, one of which is terrestrial based. The second site is located at the center of Kiska Harbor. Both areas are important to consider when assessing contamination in the Kiska Harbor survey area.

“Terrestrial research and historical data have shown that due to the high amount of activity at Kiska Island during WWII, there remains a high amount of MECs scattered across Kiska Island, as well as in its coastal waters, which was noted in an underwater survey conducted in 1989” (Rudis, 2013). “MECs do pose potential physical hazards to divers but present a low ecological risk under expected scenarios in the marine environment because any chemical releases would only directly affect sediments” (Rudis, 2013).

Contaminants derived from WWII activity on Kiska Island were observed by the USFWS during a series of investigations during 1987-1990, in which “visual observations were made of waste, debris, and oil contaminants, as well as potential runoff of these contaminants into adjacent harbors and coastlines, which have been determined to pose ecological and human risks” (Rudis, 2013). “At some sites, fuel products have been leaking since WWII, including submerged wreckage” (Rudis, 2013). The terrestrially situated site is elevated and several streams, including an anadromous waterway, reside in its vicinity, flowing downslope and emptying into Trout Lagoon and potentially Kiska Harbor. This contaminated area, known as the Kiska Island Garrison, has been assessed by the Alaska Department of Environmental Conservation (ADEC) Spill Prevention and Response (SPR) to have “petroleum and lubricant contamination” (ADEC SPR, 2017).

Due to the Japanese invasion in 1942, and the fact that the Japanese established military installations on Kiska and ran their operations here for over a year, petroleum, oil and lubricants (POL) tanks and POL contaminated soil are still present here (ADEC SPR, 2017). "Numerous contaminants have been identified at this site ranging from polycyclic aromatic hydrocarbons (PAH's) to polychlorinated biphenyls (PCB's) to POL's" (ADEC SPR, 2017). The contaminated area in Kiska Harbor, the Kiska Island Naval Defensive Sea Area (NDSA), is "composed of the underwater areas surrounding Kiska Island where Munitions and Explosives of Concern (MEC) were historically deposited/disposed as a result of DoD activities" (ADEC SPR, 2017). This area has also been assessed by the ADEC SPR and MEC may be present in the near-shore environment of Kiska Harbor, as well as submerged across the harbor (ADEC SPR, 2017). Japanese occupation of Kiska Island from June 1942 to July 1943, and their use of Kiska Harbor to transport munitions from ship to land and vice versa, as well as establishing AAA and Coastal Defense Artillery (CDA) that fired munitions over-water, deposition of MECs at the bottom of Kiska Harbor was quite frequent, whether it was accidental or intentional, in terms of military operations against the U.S. (ADEC SPR, 2017) (Figure 12).

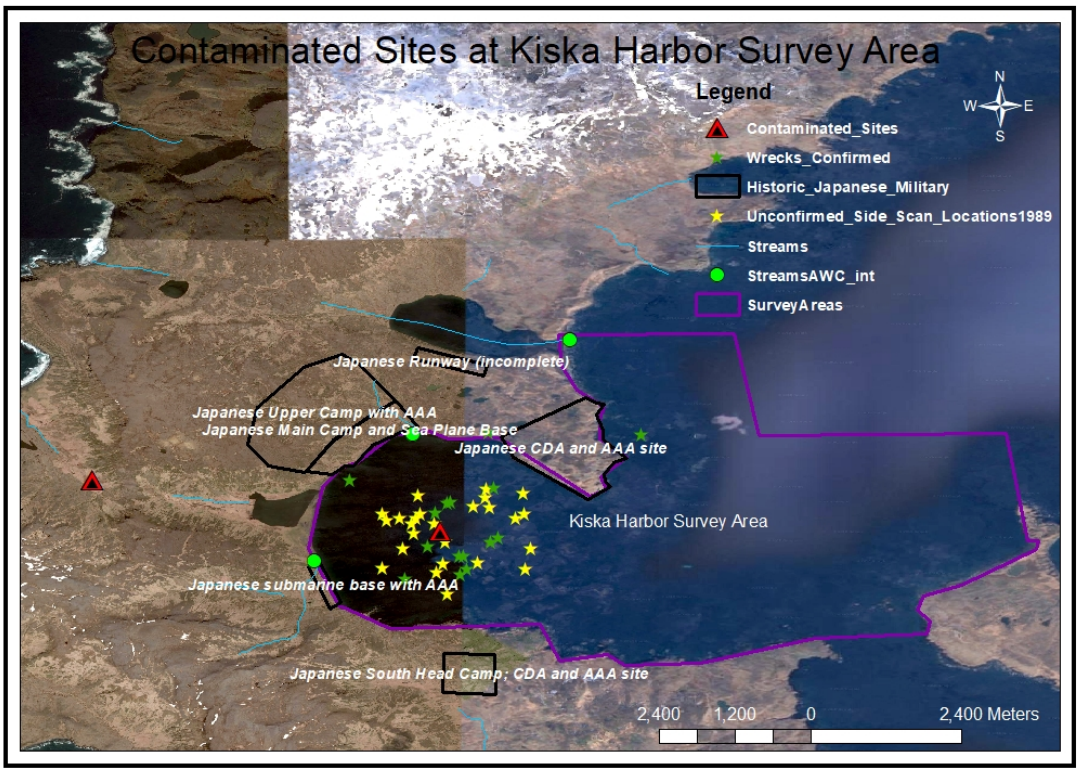

Figure 12: Kiska Harbor survey area and contaminated sites and submerged wrecks.

KOCOA Analysis

KOCOA analysis is "primarily used for land-based combat between two opposing forces" and is "inherently unsuited for open sea Naval Warfare or for aerial warfare" (Spennemann, 2011). "KOCOA is also of limited use in a situation where an opposing force holds an environmentally circumscribed terrain, such as an island, but where no ground-to-ground combat occurred" (Spennemann, 2011) (Figure 13). Despite the fact that Kiska Island is not a traditional battlefield in the sense that no ground-to-ground combat took place, KOCOA can still be loosely applied to the maritime environment surrounding the terrestrial battlefield (Spennemann, 2011).

Battlefield Element	Definition	Examples
Key Terrain	A portion of the battlefield, possession of which gives an advantage to the possessor.	Road junctions, bridges, high ground.
Observation and Fields of Fire	Any point on the landscape that allows observation of the movements, deployments, and activity of the enemy that is not necessarily key terrain, offers opportunity to see over an area and acquire targets, and allows flat-trajectory weapons to be brought to bear on the enemy.	High ground, sloping approaches to entrenched positions.
Cover and Concealment	Landforms or landscape elements that provide protection from fire and hide troop positions from observation.	Walls, structures, forests, ravines, riverbanks, entrenchments, ditches.
Obstacles	Landscape elements that hinder movement and affect the ultimate course of the battle.	Rivers, walls, dense vegetation, fortifications, ravines, ditches.
Avenues of Approach	Corridors used to transfer troops between the core battle area and outer logistical areas.	Roads, paths, creek beds, railroads

Figure 13: Definitions of KOCOA Battlefield Evaluation System used by the NPS (Spennemann, 2011).

Key Terrain: Spennemann (2011) states that "all of Kiska that was occupied and defended by the Japanese was key terrain." From historical data added as the feature class "Japanese_Historical_Data" in the file geodatabase for this project, Japan had an advantage to overtaking and occupying Kiska. They utilized the island to establish a seaplane base and submarine base, as well as several areas of concentrated AAA and CDA – all of which enabled them to carry out their operations against the U.S. Japanese occupation was established on the eastern side of Kiska Island (Kiska Harbor area) suggesting that this side of the island was key terrain more so than the western side; the shelter of the harbor along with the beach slope composed of fine-grained sand made this area conducive for a submarine and seaplane base and for cargo ships to offload supplies (Figure 14).

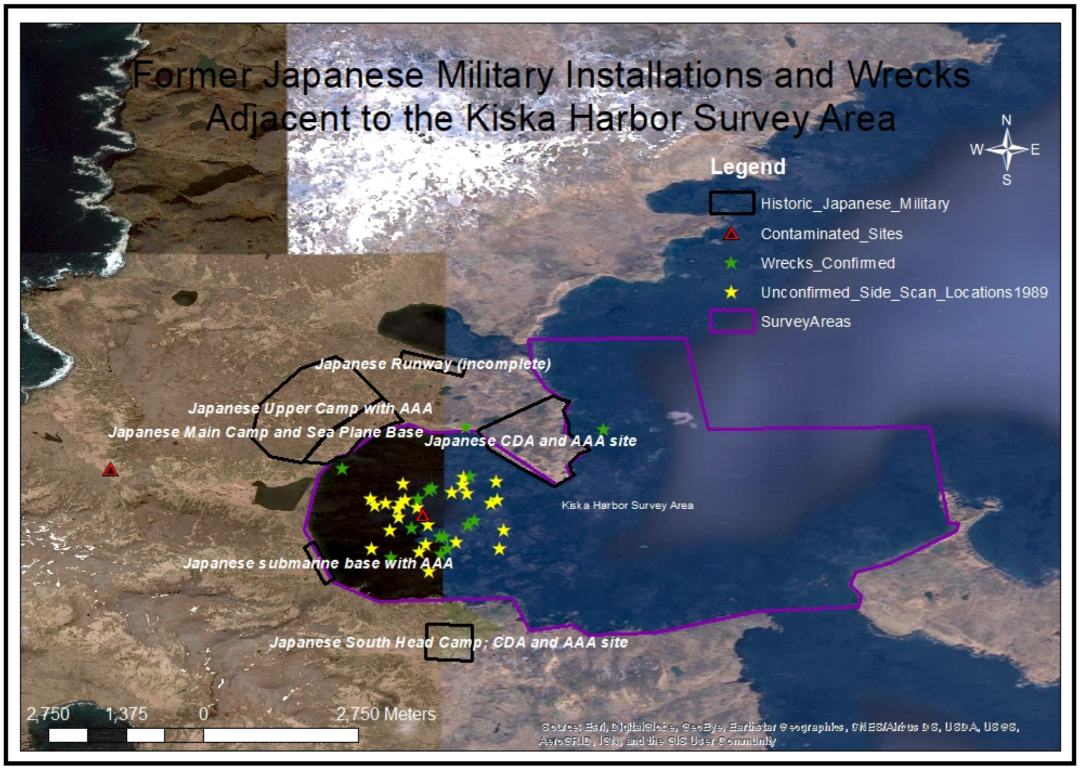

Figure 14: Former Japanese military installations

Observation and Fields of Fire: Japan established AAA and CDA sites on both sides of Kiska Harbor that were also on elevated ground giving them an advantage to detect incoming U.S. bombing raids. "The first Japanese medium Anti-Aircraft (AA) position was set up on the rise just inland from what was to become known as the main camp area" (Spennemann, 2011). There were also AA establishments on elevated ground both south of Kiska Harbor (South Head area) and the North Head area (Figure 14). These AA positions would "provide an effective coverage of Kiska Harbor above 500 feet, which would cover all but low-flying strafing aircraft for most of the approaches (and) any aircraft that flew above 1,000 feet was at risk from AA fire" (Spennemann, 2011). Japan also used its ships for AA fire, almost all of which resided in Kiska Harbor. On the other hand, during the Battle of Kiska, the U.S. used all of the island as their "fields of fire," since their raids were all airborne.

Cover and Concealment: "Concealment could play a vital role in how ships were deployed during the course of a battle. Islands could be used to conceal vessels or even entire fleets" (Sabick and Dennis, 2011). Spennemann (2011) documents that landings by the Japanese were "shielded by the elevation of North Head (the northern area of Kiska Harbor) and that the approach was shielded until less than 1,000 yards away." The weather itself, particularly cloud cover and fog, served as a form of "cover and concealment" for both the U.S. and Japanese during the Battle of Kiska. The weather hampered the air attacks conducted by the U.S. on Kiska from both the east and the west. The west approach provided more concealment than the east approach due to the elevated terrain.

Obstacles: Pertaining to the maritime environment, like that of Kiska Island, obstacles can take on a number of forms, such as islands, reefs, shoals, shallow water, strong currents, high winds, and fog – all of which are natural obstacles (Sabick and Dennis, 2011). The weather in Kiska is notoriously hazardous and was the main cause of many of the shipwrecks and air collisions during the Battle of Kiska, which, in turn resulted in both Japanese and American casualties. "Regarded as one of the cloudiest regions of the Northern Hemisphere, the Aleutian Chain experiences broken to overcast conditions for more than 90% of the time, with only two to four clear days a month" (Spennemann, 2011). Kiska Island is composed of extremely soft, soot-like sediment due to volcanic ash so it's underfoot is more consistent with that of tundra-like conditions making it difficult for the Japanese to navigate the island by foot or vehicle. However, during the Battle of Kiska, the Japanese experienced little to no obstacles except for the weather. The U.S. had to overcome the obstacles of both the weather and the terrain, flying around the Kiska Volcano (1,220 meters elevation) either on a west or east approach.

Avenues of Approach and Withdrawal: "In principle, the U.S. aircraft had a limited number of options for attacking the harbor. Unless they flew very low, using the landforms for concealment, their approaches would have been noted, giving the Japanese sufficient time to man the AA positions" (Spennemann, 2011). The U.S. approached Kiska Harbor from the east or the west: the eastern approach was "through the mouth of the Harbor and gave the U.S. pilots time to choose and line up their targets as the approached;" the western approach was "flying through the pass just to the west of Trout Lagoon but depending on the height of the approach, some or much of the approach would have been concealed, thus possible catching the Japanese off-guard" (Spennemann, 2011). Approaches by the U.S. from the east (Figure 15) "gave the Japanese AA gunners time to spot and aim at incoming aircraft" and the western approach (Figure 16), with the surrounding hillsides, "offered the pilots no escape route, and as a result, the Japanese AA gunners could follow a plane in or out, without having to readjust their aim" (Spennemann, 2011). Whether from the east or the west, the U.S. approaches to Kiska Island were aimed at bombing Kiska Harbor in order to destroy Japanese cargo ships filled with military supplies, thus potentially crippling the Japanese Army and Navy. The Japanese would respond to the U.S. approaches by aiming and firing their AA guns and as seen in Figure 13, the majority of wrecks and other submerged military assets, both U.S. and Japanese, are found in Kiska Harbor.

On July 28, 1943, the Japanese withdrew from Kiska Island by successfully embarking over 5,000 Imperial Japanese Army and Navy personnel on eleven ships in under an hour, then slipping through the cover of the fog (Spennemann, 2011). The U.S. continued to conduct bombing raids over Kiska Harbor, for the next month, unbeknownst to them that all Japanese forces had quietly disappeared and that they were conducting operations against an abandoned landscape.

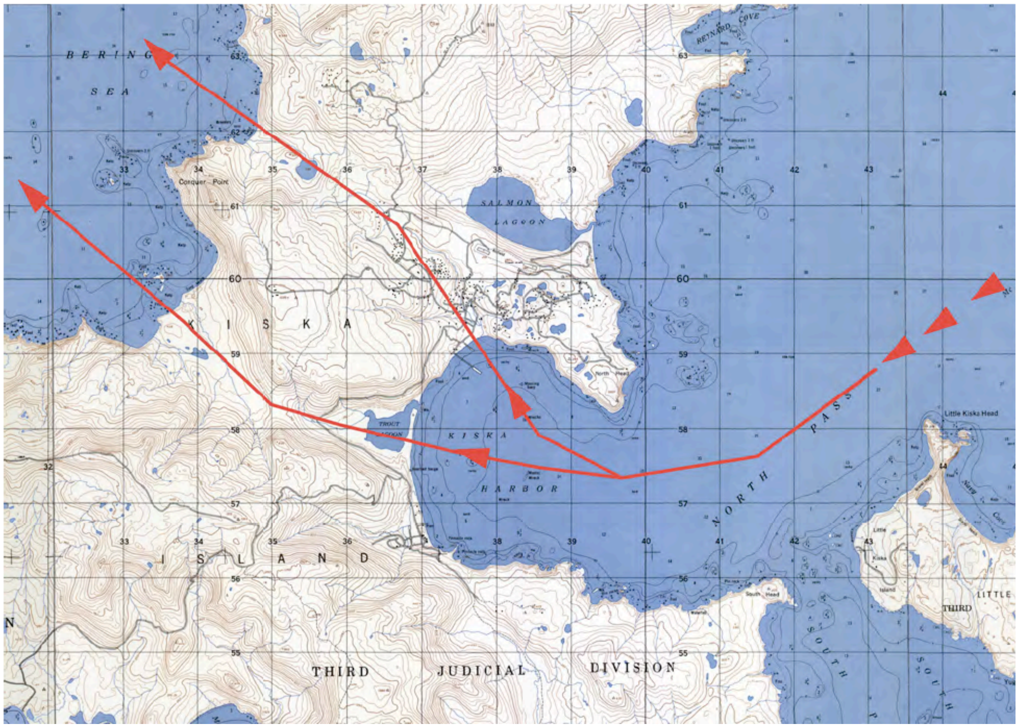

Figure 15: Approach from the east by U.S. aircraft over Kiska Harbor (Spennemann, 2011).

Figure 16: Approach from the west by U.S. aircraft over Kiska Harbor (Spennemann, 2011).

KOCOA analysis for Kiska can aid in understanding what remains today, both on land and what is submerged in the surrounding waters. By considering all elements of KOCOA and how they apply to both the U.S. and Japanese operations, more insight is gained as to why the eastern side of the island was heavily occupied by the Japanese. The key terrain of Kiska Harbor was conducive to the establishment of the Japanese military installations. By knowing this, it is evident as to why the U.S. approached Kiska Harbor, be it from either the east or west, when conducting their bombing raids. It can then be deduced that the majority of wreckage from airplanes, submarines, and ships rest at the bottom of Kiska Harbor and that the remote-sensing surveys would most likely find the majority of the submerged archaeology from the Battle of Kiska in this location.

KOCOA analysis also enhances the understanding of why the contaminated area in Kiska Harbor is present: the main camp area, the submarine base, and the seaplane base are all adjacent to the harbor and from those areas the majority of AA fire and MECs originated, most of which were lost at the bottom of the harbor. The majority of wreckage of planes, ships, and submarines carrying POLs and MECs also rest at the bottom of Kiska Harbor, further contributing to the contamination found at this site.

The use of KOCOA analysis, specified by the United State National Park Service (NPS), represents a means of understanding the geographical realities of combat, and combat decisions and capabilities, therefore rendering the importance of preservation of history, culture, and heritage.

CONCLUSION

The overall research of Kiska Island's military history, the collection of data pertinent to the surrounding biological and physical environments, and the analysis of said data, all aided in meeting the goals set forth for this Capstone project.

One composite geodatabase was created via the ArcGIS suite and contains 28 feature classes, along with their respective metadata. This geodatabase represents an inventory of baseline historical and environmental data that can be used in the planning stages of the survey, as well as in the field and can be edited at the convenience of the Project Recover team. The geodatabase aided in the application of KOCOA analysis, as it helped contextualize the maritime landscape with the surrounding terrestrial landscape of Kiska Island. By using KOCOA analysis of the terrestrial environment surrounding Kiska Harbor, assessments about the surrounding maritime environment were derived, thus enhancing the understanding of why the Kiska Harbor area contained the majority of submerged wreckage, as well as active MEC sites. The geodatabase was used to enhance further analysis of the active MEC sites, and it was also used to further analyze the habitats and environmental sensitivity surrounding the remote-sensing survey areas, via geoprocessing tools. These analyses will provide the Project Recover team with critical information regarding these areas of concern and their locations in reference to the survey sites, potentially aiding in decision-making and recommendations, which will help to ensure another successful and efficient survey. The implementation of the geodatabase, along with environmental support data, will serve as a baseline of environmental and historical analysis for future surveys and will promote increased awareness of maritime cultural heritage through GIS technology and capabilities.

The aforementioned goals of this project, successfully achieved through the utilization of research, various methods of analysis, and GIS technology, will inevitably contribute to the ultimate goal of Project Recover, which is also the overall goal of this Capstone Project: to document and honor the final resting place of the U.S. and Japanese service members whose lives were lost over 70 years ago in the water surrounding the Kiska Island National Historic Landmark Maritime Battlefield. Furthermore, outreach and education of such success could be paramount in ensuring that future generations will be inclined to continue the preservation of maritime cultural heritage and that history will forever continue to be repatriated and honored.

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APPENDIX

A: Kelp Information

Types of Kelp Found in the Vicinity of Kiska Island

Source for all photos and text: seaweedsofalaska.com

Agarum clathratum (aka Sieve Kelp)

Description: Thallus of this medium brown kelp has a branched holdfast (haptera), a stipe up to 30 cm (12 in) long, a stiff blade riddled with small, distinctive holes, and a wide midrib. The blade grows to 90 cm (35 in) long and 50 cm (20 in) wide. When present, fertile patches (sori) are found toward the edges of the blade. **Habitat:** This perennial kelp is found on rock in the very low intertidal to subtidal (to a depth of at least 15 m or 50') and prefers a semi-protected habitat. **Similar taxa:** *Agarum fimbriatum*, *A. turneri*, *Thalassiophyllum.*

Eualaria fistulosa (aka Dragon Kelp)

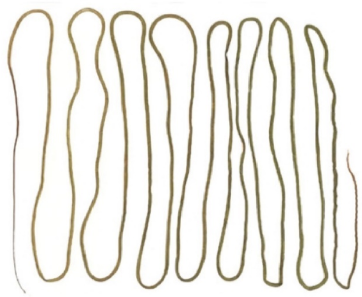
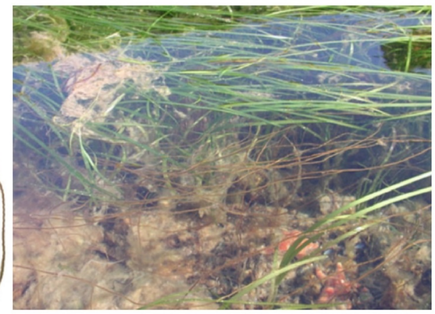
Description : Thallus of this canopy-forming kelp is brown with a large branching holdfast (haptera), a stipe 25 cm (10 in) long, and a blade with midrib up to 25 m (82 ft) long and 1 m (3.2 ft) wide. The midrib is 2-3 cm (0.8-1.2 in) wide with gas-filled chambers (fistulae) that hold the blade in the water column. Reproductive sporophylls develop on the upper portion of the stipe. **Habitat:** This fast growing annual occurs on rock from the low intertidal to subtidal and forms offshore kelp beds in cold, semi-protected to exposed habitats.

Alaria marginata (aka Ribbon Kelp)

Description: Thallus of this common intertidal kelp is brown with a branched holdfast (haptera), a stipe, cylindrical near the base but flattened near the blade, that can reach 30 cm (12 in) or more in length, and a thin, lanceolate blade up to 3 m (10 ft) long with solid midrib. Twenty to forty elliptical sporophylls form in spring on the upper portion of the stipe and grow up to 25 cm (10 in) long, thickening with maturity. **Habitat:** This kelp is an annual found on rock in the mid to low intertidal from semi-protected (if there is sufficient current) to exposed habitats.

Chorda filum (aka Spaghetti Kelp)

Description: This light brown kelp has a long, firm, smooth, cylindrical, whip-like thallus 0.5 cm (0.2 in) in diameter and up to 1 m (3.3 ft) or more tall, which tapers to a tiny discoidal holdfast. Air pockets are visible inside the thallus, causing the thallus to float toward the surface. There are no constrictions along the thallus. **Habitat:** This uncommon kelp is an annual and may be found growing on rock (often pebble or cobble) in the very low intertidal to upper subtidal in protected habitats with slight current. **Similar taxa:** *Scytosiphon lomentaria*, *Halosiphon tomentosus.*

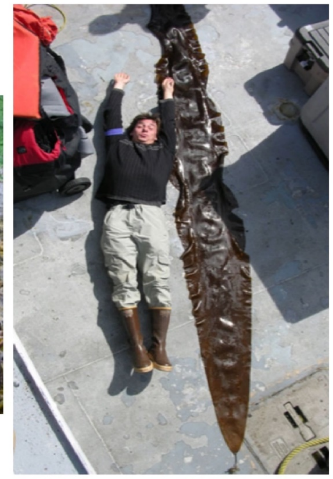
Cymathaere triplicate (aka Three-Ribbed Kelp)

Description: Thallus of this light to sometimes reddish-brown kelp has a discoidal holdfast, a stipe up to 25 cm (10 in) long, a linear blade up to 4 m (13 ft) long and 18 cm (7 in) wide, and three riblike folds. No other kelp has this configuration. This species has a distinctive cucumber-like aroma that can often be smelled before the kelp is seen, but the species is not palatable. **Habitat:** This annual kelp grows on rock (often cobble) in the low intertidal to upper subtidal from semi-protected to semi-exposed habitats.



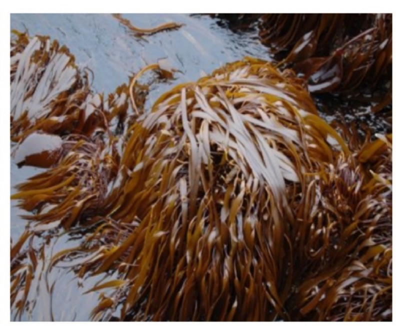
Saccharina groenlandica (aka Split Kelp)

Description: Thallus of this common kelp is medium to dark brown with a branched holdfast (haptera), a stipe up to 60 cm (24 in) long with microscopic mucilage ducts, and a blade up to 2 m (6 ft) long. The blade is often bullate when young but becomes thicker and smoother with age; it often splits into 2-3 segments. The stipe is cylindrical at the holdfast but is often flattened at the base of the blade. **Habitat:** This perennial kelp is found on rock in the low intertidal to shallow subtidal zones and occurs in semi-protected to semi-exposed habitats.



Laminaria longpipes (aka Northern Rhizome Kelp)

Description: Thallus of this brown kelp has a branched, rhizomatous holdfast, with numerous stipes arising from the extensive holdfast structure. A long, narrow blade, less than 5 cm (2 in) wide and up to 50 cm (20 in) long, extends from each stipe. *Coilodesme fucicola* and *Porphyra gardneri* are common epiphytes along old blade margins. **Habitat:** This perennial kelp grows on rock in the low intertidal of semi-exposed to exposed habitats. **Similar taxa:** *Lessoniopsis* also has narrow blades but a different holdfast.



Saccharina latissima (aka Sugar Kelp)

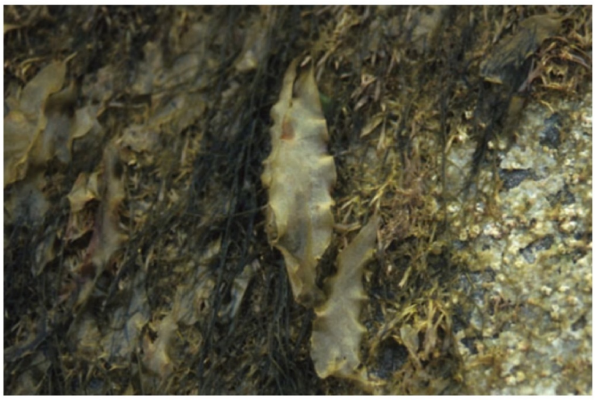
Description: Thallus of this very common kelp is light to medium brown with a finely branched holdfast (haptera), a cylindrical stipe up to 50 cm (20 in) long without mucilage ducts, and a blade up to 3.5 m (10 ft) long. The blade is moderately thin and undulate and frequently has rows of blister-like swellings or puckers (bullations) near the base. **Habitat:** Although this kelp is considered a perennial, the blade dies back in the fall/winter and re-grows in the spring. It attaches to rock in the low intertidal to subtidal and prefers protected to semi-protected habitats. **Similar taxa:** *Saccharina subsimplex.*

Laminaria yezoensis (aka Suction-cup Kelp)

Description: Thallus is medium to dark brown with a large disc- or suction-cup-like holdfast, a somewhat rigid stipe up to nearly 1 m (37 in) long although it is often shorter, and a thick blade that can be nearly as wide as long. The blade is usually split and has mucilage ducts, which are visible microscopically. **Habitat:** This perennial kelp is found on rock in the extreme low intertidal to subtidal zones from semi-protected to exposed habitats. **Similar taxa:** *Laminaria solidungula, Saccharina* spp.

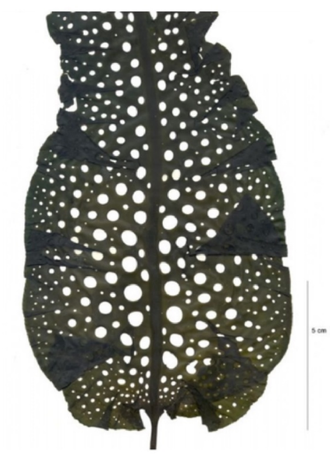
Petalonia fascia (aka False Kelp)

Description: The thallus is a light to medium brown blade that tapers below to a tiny discoidal holdfast but lacks the complex cell differentiation of true kelps. The blade is thinner than kelps, and the margins are smooth. The thallus can grow up to 35 cm (14 in) tall. **Habitat:** This annual is found growing on rock in the mid intertidal to shallow subtidal from protected to semi-exposed habitats. **Similar taxa:** young *Laminaria*, young *Saccharina, Punctaria.*



Agarum turneri (aka Smooth Sieve Kelp)

Description: Thallus is a smooth, ovate brown blade to 90 cm (35 in) long and 30 cm (14 in) wide with a flattened midrib, large circular holes, and a branched holdfast. **Habitat**: The species occurs subtidally to at least 20 m depth in semi-exposed habitats. It is currently not considered a separate species from *A. clathratum* but is morphologically distinct.



Thelassiophyllum clathrus (aka Spiral Seive Kelp)

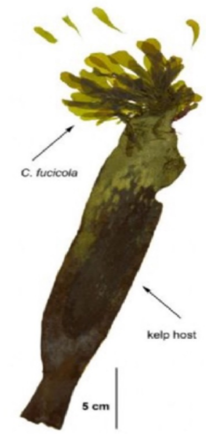
Description: Thallus of this unique kelp is brown with a branched holdfast (haptera) and a woody stipe that is spirally twisted due to meristematic growth from which new blades unfurl. The blade can grow up to at least 50 cm (20 in) long and has somewhat regular perforations. Reproductive patches (sori) develop on the older portions of the blade. **Habitat:** This perennial kelp is found on rock in the very low intertidal and shallow subtidal and prefers semi-exposed habitats. It is also found in tidepools. **Similar taxa:** *Agarum.*


Porphyra gardneri (aka Laver Kelp)

Description: Thallus is somewhat oval, to 12 cm (5 in) long, reddish pink, one cell layer thick, with the margin slightly ruffled to somewhat ragged. Sexes are intermixed. **Habitat:** This species grows in large numbers along the edges of blades of *Laminaria* and sometimes other kelps in the low intertidal and subtidal of semi-exposed and exposted habitats. **Similar taxa:** *Porphyra variegata*, another common epiphyte on kelps, is larger and has a blade sectored into separate male and female "halves".

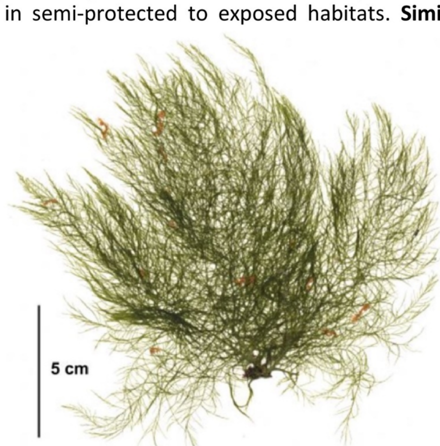

Coilodesme fucicola (aka Fringe Kelp)

Description: Thallus is a flattened, obovate to elongate, light brown sac, with a narrow stipe, to 13 cm (5 in) tall and 0.8 cm (0.3 in) wide, attached by an inconspicuous discoidal holdfast. **Habitat:** This species grows in abundance along the margin of kelps, particularly *Laminaria longipes*, in the low intertidal of semi-exposed habitats.



Desmarestia viridis (aka Stringy Acid Kelp)

Description: The light brown thallus has a cylindrical central axis, opposite branching, and a discoidal holdfast. The thallus is often delicate. It grows up to 120 cm (48 in) tall and is considered the most acidic of all the acid kelps, destroying itself and other seaweeds when damaged by releasing sulfuric acid. **Habitat:** This perennial is found on rock in the very low intertidal to subtidal zones in semi-protected to exposed habitats. **Similar taxa:** *Chordaria, Dictyosiphon.*



Saccharina dentigera
(aka Northern Stiff-Stiped Kelp)

Description: Thallus is dark brown, thick, reaching 1.5 m (5 ft) tall. The holdfast is branched, the stipe somewhat rigid, and the blade often split down to 10 cm above its base. Mucilage ducts occur near the surface of stipe. **Habitat** : This perennial is found on rock in the very low intertidal to shallow subtidal. **Similar taxa**: *Saccharina subsimplex*

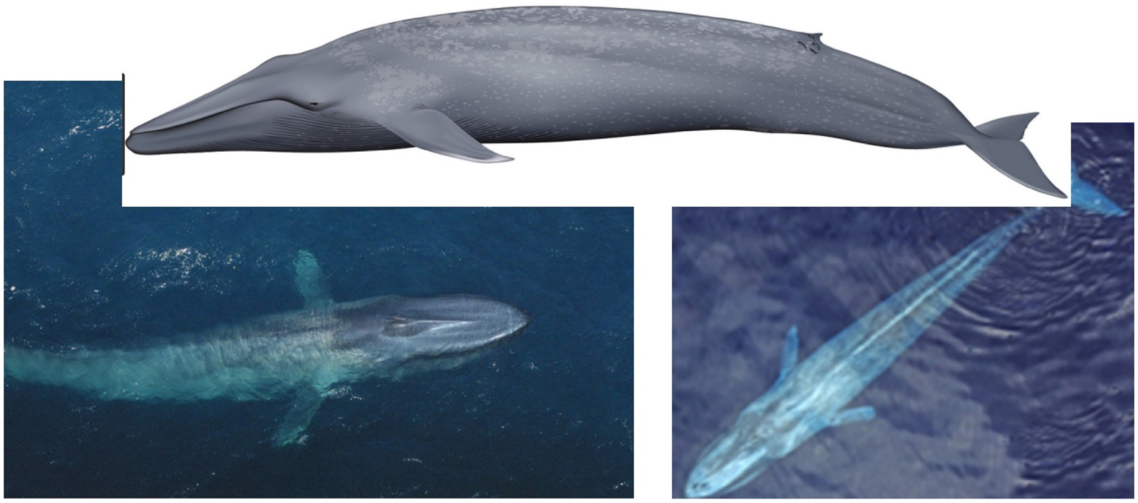
Marine Mammals Found in the Vicinity of Kiska Island, Aleutian Chain, Alaska

(Marine mammals are listed under either the Endangered Species Act (ESA) or the Marine Mammal Protection Act (MMPA))

Source for all photos: NOAA

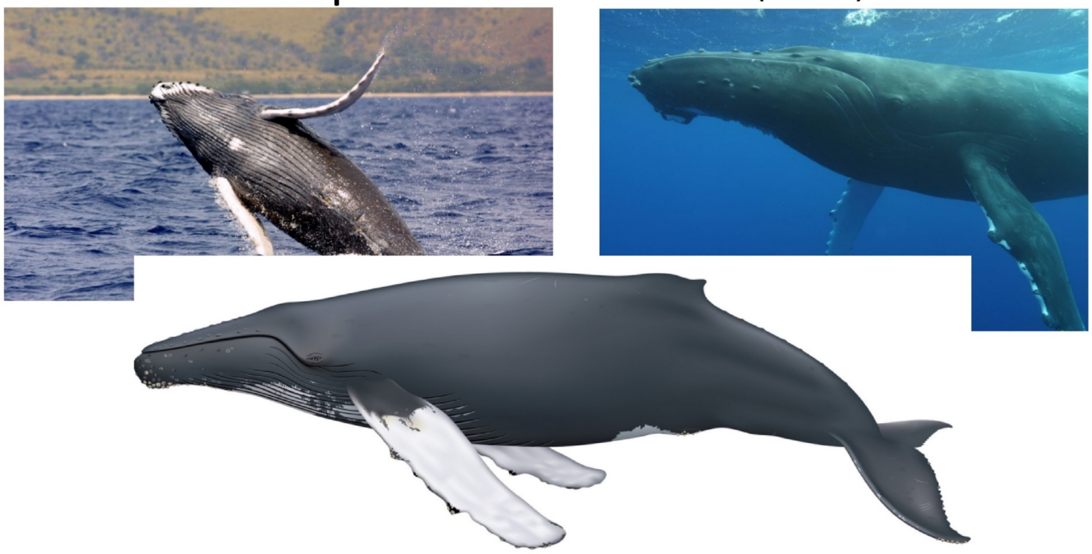
Steller Sea Lion (critical habitat)

Blue Whale (ESA)



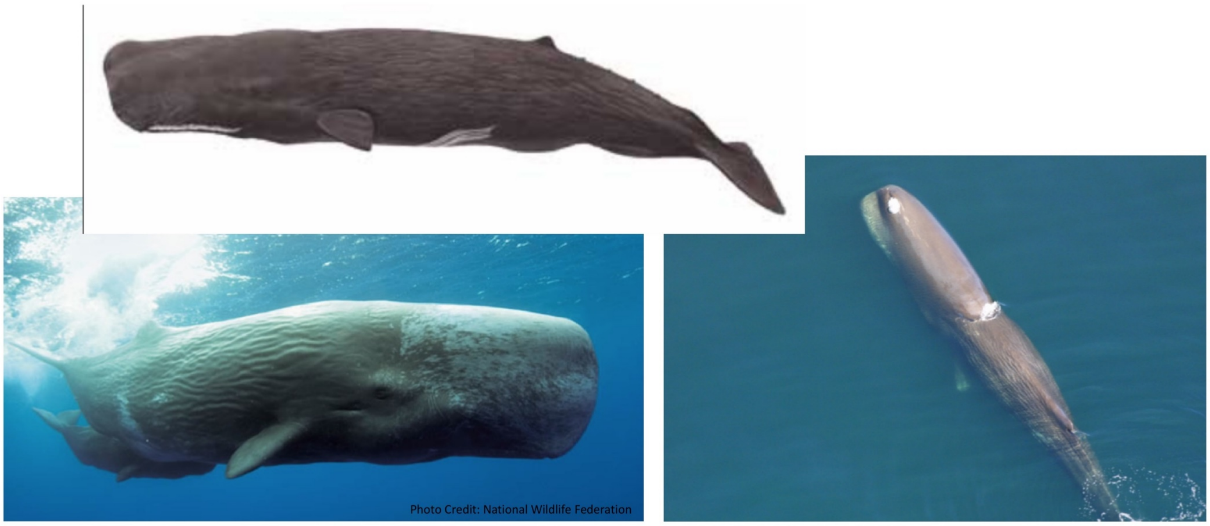
Fin Whale (ESA)

Humpback Whale (ESA)

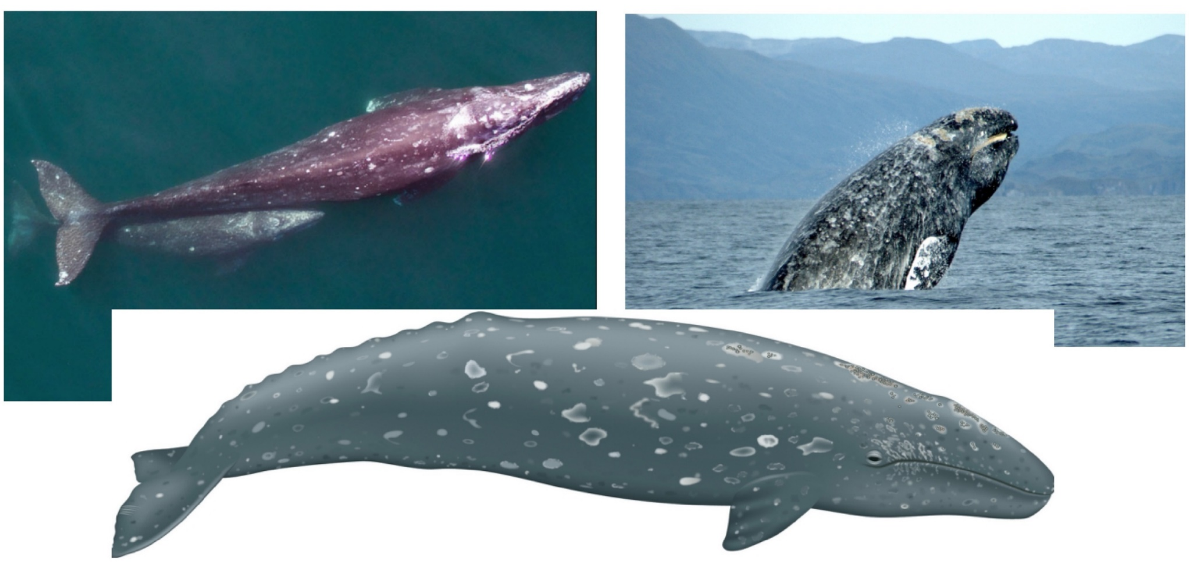


N. Pacific Right Whale (ESA)

Sperm Whale (ESA)



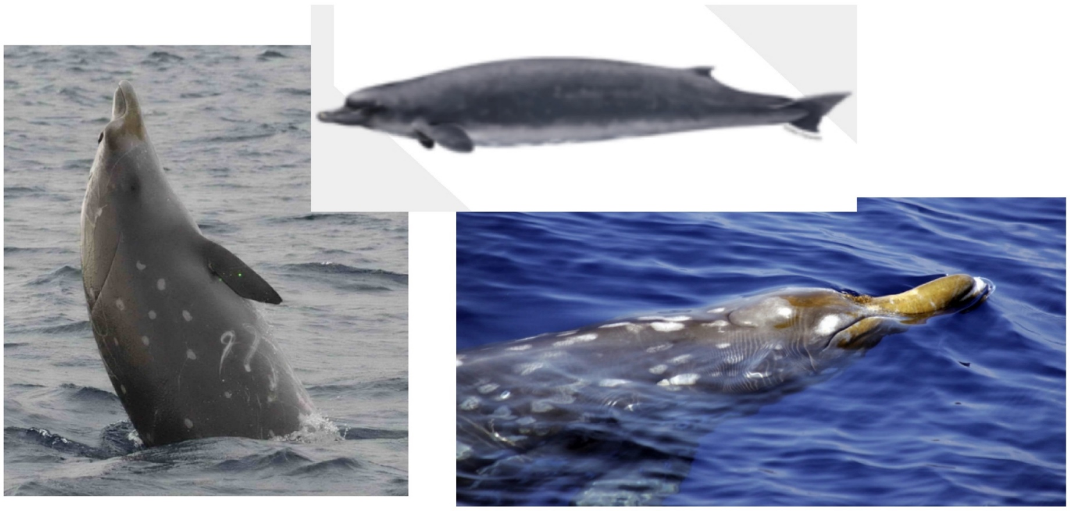
Western N. Pacific Gray Whale (ESA)



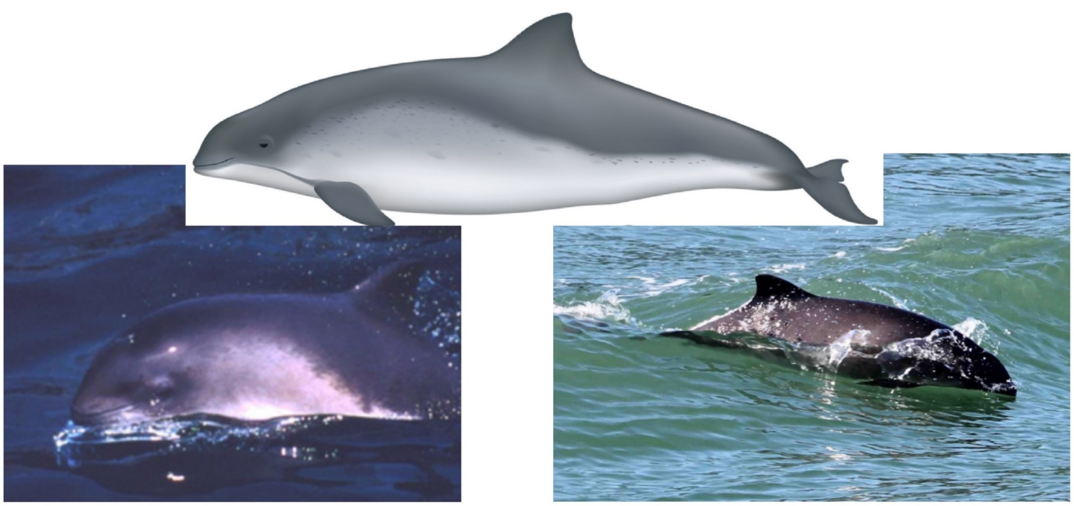
Ribbon Seal (MMPA)

Harbor Seal (MMPA)

Baird's Beaked Whale (MMPA)

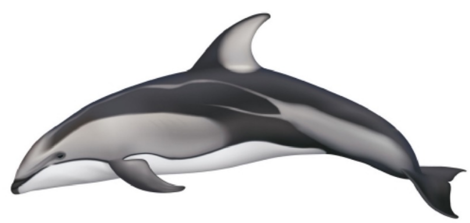
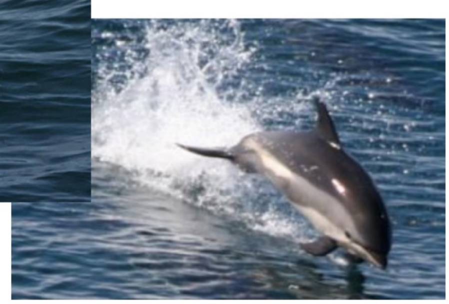


Harbor Porpoise (MMPA)



Killer Whale (MMPA)

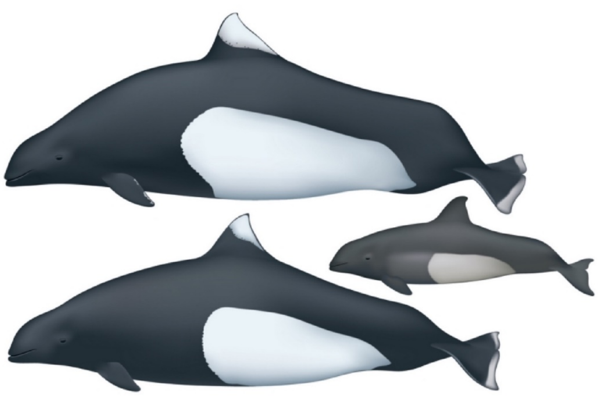

Pacific White-Sided Dolphin (MMPA)

Northern Fur Seal (MMPA)

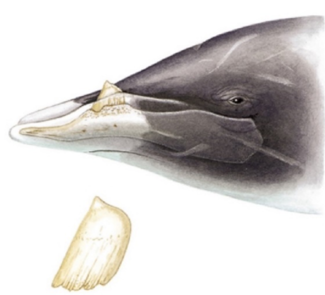



Dall's Porpoise (MMPA)



Minke Whale (MMPA)

Stejneger’s Beaked Whale (MMPA)



C: Images for Species Found During Habitat Analysis

Species From the Kiska Harbor and Gertrude Cove Survey Areas

(Nesting Birds, Anadromous Fish, Marine Mammals)

Nesting Birds

Pigeon Guillemot

Glaucous-winged Gull

Nesting Birds

Fork-tailed Storm Petrel

Ancient Murrelet

Nesting Birds

Leach's Storm Petrel

Anadromous Fish

Pink Salmon

Dolly Varden

Anadromous Fish

Coho Salmon

Marine Mammals

Steller Sea Lion

Northern Sea Otter

D: ESI Data Provided by the USFWS

COASTAL RESOURCES INVENTORY AND ENVIRONMENTAL SENSITIVITY MAPS: ALEUTIANS WEST COASTAL RESOURCE SERVICE AREA

INTRODUCTION

Environmental Sensitivity Index (ESI) maps have been developed for the coastal zone of the Aleutians West Coastal Resource Service Area (CRSA). The ESI mapping project was expanded to provide the basis for updating of the Coastal Management Program for this area. The ESI maps include information for three main components: shoreline habitats; sensitive biological resources; and human-use resources. In addition to the three traditional ESI components, general geothermal and mining resource information have been included on the maps, as well as locations of volcanic activity and faults. Background information, methods of data collection, and data presentation are summarized in the following sections.

SHORELINE HABITAT MAPPING

The intertidal habitats of the Aleutians West CRSA were mapped using two systems: the ESI shoreline ranking scheme and the Coastal Habitats shoreline ranking scheme. The two approaches are outlined below.

The shoreline of Unalaska Island was classified using the ESI ranking system during overflights conducted by an experienced coastal geologist on 30 June-3 July 2000. In the course of a typical ESI survey a combination of observational scales is employed. Prior to overflights, existing aerial photos and 1:63,360 topographic maps are examined and parameters such as tidal regime, wave energy, and long-shore sediment transport are assessed through interpretation of coastal landforms by a coastal geologist. If possible, modifications to the digital shoreline to be used in the project are made at this time. Overflights are then conducted, flying at altitudes ranging from 300 to 600 ft. and speeds of 80 knots. The timing of any ESI overflight is solely dependant upon the timing of the spring low tides. During a five hour interval of time centered on the peak low tide, a portion of the coast is flown and categorized in the terms of the ESI scale. Mapping only during this interval of time ensures the proper delineation of tidal flats and allows the maximum amount of the intertidal zone to be exposed and evaluated. ESI classifications are denoted directly onto 1:63,360 U.S. Geological Survey (USGS) maps. Additionally, small changes in the shoreline, such as inlet positions or new man-made structures, are drawn onto the basemaps. The final component of an ESI survey is the ground verification of the classifications made during overflights. Depending on logistics, representative examples of each ESI category are surveyed on the ground. In the case of Unalaska ground-truthing locations were: the north shore of Beaver Inlet near Ugadaga bay; Summer Bay; Iliuliuk Bay; Dutch Harbor; the northern and eastern shores of Amaknak Island, and Captains Bay. The maps used in the field are then digitized by teams of geographers and the digital shoreline is updated to reflect the observations made during the survey.

The shorelines of all other islands in the Aleutians West CRSA, from Attu to Umnak, were mapped at a scale of 1:250,000 by the same coastal geologist using the more general Coastal Habitat classification system. Overflights of these islands were not conducted, hence the separate mapping scheme. While interest remains high in conducting traditional field-oriented ESI surveys for these islands, budget considerations and logistical factors such as fuel staging, a short field season, habitation, and helicopter availability must be addressed. The mapping done in the Coastal Habitat classification scheme is based on field experience gained in the Unalaska mapping effort, National Imaging and Mapping Agency (NIMA) 1:25,000 topographic maps, USGS bulletin series 1028 (1951-1971) and local expertise. These classifications are not field checked. The categories in the Coastal Habitat scheme are similar to those included in the previous Aleutians West CRSA Resource Inventory atlas. However, the Coastal Habitat scheme improves on the previous work in that individual beaches are mapped as distinct coastal habitats.

SENSITIVITY INDEX (ESI) RANKING

Assessment of the environmental sensitivity of a particular intertidal habitat is based on an understanding of the dynamics of the coastal environments, not just the substrate type. The sensitivity ranking of a particular intertidal habitat is an integration of the following factors:

1) Shoreline type (substrate, grain size, tidal elevation, origin)
2) Exposure to wave and tidal energy
3) Biological productivity and sensitivity
4) Ease of cleanup (trafficability, permeability)

These concepts have been used in the development of the ESI, which ranks shoreline environments in terms of their relative sensitivity to oil spills. The original concept of ranking coastal environments on a scale of relative sensitivity was developed at Lower Cook Inlet in 1976 (Michel et al. 1978). Generally speaking, areas exposed to high levels of physical energy, such as wave action and tidal currents, rank low on the scale, whereas sheltered areas with associated high biological activity have the highest ranking. The key to the sensitivity ranking is an understanding of the relationships between: shoreline type; substrate; physical processes, sediment transport patterns; product type; and fate and effect of oil.

Since 1976, the ESI mapping scheme has been refined and expanded through repeated mapping and spill response experiences on most of the U.S. shorelines, including the Great Lakes. The result of these experiences is a standardized ESI shoreline habitat ranking system, consisting of 25 categories that encompass the general coastal habitats for the entire United States. This ranking system has been adopted by the National Oceanic and Atmospheric Administration and is a primary pollution response tool used by the United States Coast Guard (NOAA, 1997). In addition to the adoption of the ESI scheme by NOAA, the definitions of Environmentally Sensitive Areas (ESAs) as recorded in the Federal Register directly parallel the categories and concepts outlined in the ESI scheme (NOAA, 1994). These guidelines are commonly used for coastal zone management including: permitting, port development and management, and environmental assessment.

The ESI shoreline habitats delineated in this atlas are listed below in order of increasing sensitivity.

1A) Exposed Rocky Shores
2A) Exposed Wave-Cut Platforms in Bedrock
3A) Fine- to Medium-Grained Sand Beaches
4) Coarse-Grained Sand Beaches
5) Mixed Sand and Gravel Beaches
6A) Gravel Beaches
6B) Riprap
7) Exposed Tidal Flats
8A) Sheltered Rocky Shores
9A) Sheltered Tidal Flats
10A) Salt-and Brackish-Water Marshes

Each of the shoreline habitats are described on pages 9-12 in terms of their physical characteristics, predicted oil behavior, and response considerations.

COASTAL HABITAT MAPPING

The Coastal Habitat mapping scheme is based on the same factors and principles as the ESI mapping system but, because it is not a field survey based mapping scheme, provides less resolution. The Coastal Habitat categories and the corresponding ESI shorelines or shoreline combinations included within them are as follows:

1) Exposed Rocky Shores With or Without Wave Cut Platforms
   ESI = 1A, 1A/2A
2) Exposed High Energy Shoreline (unidentified cliffs, platforms, and beaches)
   ESI = 1A, 1A/2A, 1A/5, 1A/6A, 2A, 5, 6A
3) Beaches (fine and medium sand, coarse sand, sand and gravel, gravel)
   ESI = 3A, 4, 5, 6A
4) Exposed Tidal Flats
   ESI = 7
5) Estuarine Vegetation and Sheltered Coast
   ESI = 8A, 9A, 10A, 10A/9A, 8A/9A, 8A/10A, 8A/10A/9A

It should be noted that Coastal Habitat #2, Exposed High Energy Shoreline, being the least specific of the five, was used only when data available would not permit identification of specific habitats.

The descriptions, response considerations, and photos of the ESI types on pages 9-12 should be consulted when using the Coastal Habitat maps.

SENSITIVE BIOLOGICAL RESOURCES

Biological information presented in this atlas was collected and compiled with the assistance of biologists primarily from the U.S. Fish and Wildlife Service, Alaska Department of Fish and Game, and National

Marine Fisheries Service, as well as other state and federal agencies and individuals. Information collected and depicted on the maps denotes the key biological resources that are most likely at risk in the event of an oil spill. Five major categories of biological resources are included in this atlas: marine mammals, birds, fish, submersed aquatic vegetation, and invertebrates.

Spatial distribution of the species on the maps is represented by polygons and points, as appropriate. Associated with each of these representations is an icon depicting the types of species or habitat types that are present. Species have been divided into groups and subgroups, based on their behavior, morphology, taxonomic classification, and vulnerability and sensitivity to impacts. The icons reflect this grouping scheme. The groups are color coded, and the subgroups are represented by different icons:

The polygon or point color and pattern are generally the same for all the species in each major group (e.g., birds are green), and match the icon colors. Species with a red box outlining the icon are listed as threatened or endangered at either the state or federal level. Also associated with each biological polygon or point feature on the map is a resources at risk identification number (RAR#), located under each icon or group of icons. The RAR# is the link to a table on the reverse side of the map with a complete list of species found in the polygon or at the point, as well as the state and federal protected status (T&E), concentration or abundance, seasonality, and life-history information for each species.

There are some species that are found throughout specific geographical areas or habitat types. Displaying the polygons for these species would cover large areas, making the maps very difficult to read. Thus, species which occur over the majority of certain geographic areas or habitats are often identified in a small box on the maps that states that they are "Present in ..." (e.g., "Present in Izembeck Lagoon"). This approach informs the user of the presence of these species, while maintaining readability of the map. In all instances, data for species listed as "Present in ...." exist as polygons in the digital coverages. The use of this strategy is implemented on a map per map basis, depending on the location, size, and number of polygons present on each map.

For many biological resources, information and expert knowledge may not be available for all geographic locations. For this reason, absence of a resource on a map does not necessarily mean it is not present. Under the descriptions of the various biological resource groups, the geographical limits of available knowledge or the survey boundaries of particular studies are given when known.

MARINE MAMMALS

Marine mammals depicted in the Aleutians West atlas include seals, sea lions, fur seals, walruses, and sea otters. Major haul-out sites for harbor seals, Steller sea lions, and northern fur seals, are depicted. Though only haul-out sites are mapped, seals can occur throughout the nearshore waters. For sea otters, concentration areas are shown where surveys have been conducted. Sea otters are present all year along the Aleutian Islands. Though not depicted on the maps, whales are highly mobile species, and they can occur throughout most of the waters. Gray whales are most commonly found in the migration corridor through Unimak Pass.

Many of the whales are listed as threatened or endangered species, and all marine mammals are protected under the Marine Mammal Protection Act of 1972. Sea Otters in the Aleutians are a candidate species for listing under the Endangered Species Act. Northern fur seals are currently listed as depleted under the Marine Mammal Protection Act.

Expert contacts for marine mammals in the Aleutians are the NMFS National Marine Mammal Lab, Seattle Washington; Brad Smith, NMFS, Anchorage, Alask; and USFWS Marine Mammals Management, Anchorage, Alaska.

Marine mammal concentration areas are displayed on the maps as polygons with a brown hatch pattern. If multiple resource types (marine mammals and birds) occupy the same polygon, a black-hatched multi-group pattern is used. A brown icon with a pinniped or whale silhouette is used to indicate the presence of marine mammals. The RAR# under the icon links to a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been designated as being endangered (E) or threatened (T) on either the state (S) and/or federal (F) lists. The next column provides an estimate of the concentration of the species at the site. Concentration is indicated as "HIGH", "MODERATE", or "LOW", or numeric values are used for seal and sea lion haul-out sites. The species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at that location in a particular month, an "X" is placed in the month column. The final columns list the time periods for sensitive life-history stages or activities, such as pupping and molting for seals.

BIRDS

Birds are divided into several species subgroups based on taxonomy, morphology, behavior, and oil spill vulnerability and sensitivity. The species table lists all the birds included on the maps, sorted by subgroup. The major types of bird areas depicted in this atlas include: resident, migratory, nesting, and overwintering waterfowl concentration areas; migratory shorebird concentration areas; seabird concentration areas; and colonial waterbird nesting sites (for seabirds and wading birds).

Although birds are a major resource shown on the Aleutians West ESI maps, seabirds concentration areas are shown only where surveys have been conducted. Seabird nesting site information was obtained from the Beringian Seabird Colony Catalog database. The points representing the location of the nesting colonies are usually located near the geographic center of the colony. In some cases the point is located in the middle of an island, even though birds nest along the shorelines all around the island, not necessarily in the middle of the island. Waterfowl concentration areas shown on the map are derived from survey data provided by Alaska Department of Fish and Game, U. S. Fish and Wildlife Service, and local experts. Present but not shown are scattered distributions of emperor geese and Steller's eider around the islands of the Western Aleutians. Data were also incorporated from Audubon Society Christmas bird counts. Eagle nest sites are found throughout the coastal zone of the Aleutians, however, because a comprehensive nest survey has not be conducted nesting sites are not shown. Eagles are present all year, but their most critical time is from March to August when they are nesting.

Expert contacts for birds are in the U.S. Fish and Wildlife Service, Refuge and Migratory Bird Management Divisions and ADF&G Habitat and Restoration Division.

Bird concentrations, including nesting areas for some species, are shown on the maps as polygons with a green hatch pattern. If multiple resource types (marine mammals and birds) occupy the same polygon, a black-hatched multi-group pattern is used. A green icon with the appropriate bird silhouettes (wading bird, raptor, etc.) is associated with the polygons. Seabird nesting sites from the U.S. Fish and Wildlife Service are shown with a green dot scaled to reflect the colony size. The RAR# under the icon links to a table on the reverse side of the map. In this table, the first column gives the species name. The second column indicates whether the species is listed as threatened (T) or endangered (E) on either the state (S) and/or federal (F) lists.

The next column in the tables provides an estimate of the concentration of each species at the site. Concentration is indicated as a numerical value representing the number of breeding pairs occurring at a nesting site, or as HIGH, MEDIUM, and LOW to represent relative concentrations. "Unknown" is used where the birds have been surveyed but an accurate count was not available. A blank field in concentration indicates no concentration information was provided. Nesting concentrations at any particular site may fluctuate seasonally and annually based on local or regional conditions, or other factors.

The species seasonality is shown in the next twelve columns representing the months of the year. If the species is present at that location in a particular month, an "X" is placed in the month column. The last columns denote the nesting period for each species, if nesting occurs in the particular area or site. Nesting refers to the entire nesting period, including laying, hatching, and fledging. For many species, there is a temporal shift in seasonality and reproduction along with spatial changes in location. Temporal information included in the tables is specific to the one polygon or point that it references.

Fish

The fish depicted in the Aleutians West ESI atlas include commercially important benthic and pelagic fish, herring spawning grounds, and streams important to anadromous fish. Not all species of environmental, recreational, or commercial interest are depicted.

The anadromous streams shown on the map are from Alaska Department of Fish and Game database, Waters Important to Anadromous Fish. Species included in these streams are coho, chinook, chum, pink, and sockeye salmon, dolly varden, and cutthroat trout.

While all of the anadromous streams in the database are shown, some of them are represented as a straight line, connecting the beginning point and endpoint of the stream, because the actual stream was not digitized. It is also cautioned that although this dataset is the best current representation of anadromous streams, it should not be considered definitive in determining the presence or absence of fish runs. Absence of anadromous streams on the maps for any particular location does not necessarily suggest that anadromous runs do not occur there.

Expert contacts for anadromous fish are in the ADF&G Habitat and Restoration Division.

Fish concentrations are shown on the maps as polygons with a blue hatch pattern. If multiple resource types (birds and fish) occupy the same polygon, a black-hatched multi-group pattern is used. A blue icon with a appropriate fish silhouette is associated with the polygons containing fish.

For the anadromous fish streams, a blue line is used to mark the fish runs (in the mouth of the stream). A blue icon with a fish silhouette is associated with the line using a leader line.

The RAR# positioned under the fish icon links to a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been designated as being endangered (E) or threatened (T) on either the state (S) and/or federal (F) lists. Concentration information was not available and was left blank. Seasonality is listed by month with an "X" indicating the species presence in any particular month. The last columns indicate time periods for various life-history stages or activities (spawning, eggs, larvae, juveniles, and adults). For many species there is a temporal shift in seasonality and life-history along with spatial changes in location. Temporal information included in the tables is specific to the one polygon or site that it references.

Invertebrates

King crab, tanner crab, and dungeness crab can be found throughout the island chain. Depicted on the maps are the concentration areas for these species. These data were obtained from the National Marine Fisheries Service Essential Fish Habitat (1999) report.

Bivalve concentrations are also shown on the maps in some of the sheltered bays. While not depicted everywhere, it can be expected to find clam concentrations in the areas that have high waterfowl concentrations, since the clams are a principle food of the waterfowl.

Crab and bivalve concentrations are shown on the maps as polygons with an orange hatch pattern. If multiple resource types (crabs and fish) occupy the same polygon, a black-hatched multi-group pattern is used. A orange icon with a crab silhouette is associated with the polygons representing the distribution of crab.

The RAR# positioned under the crab icon links to a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been designated as being endangered (E) or threatened (T) on either the state (S) and/or federal (F) lists. Concentration information is given as "Minor", "General", or "Significant". Seasonality is listed by month with an "X" indicating the species presence in any particular month. The last columns indicate time periods for various life-history stages or activities (spawning, eggs, larvae, juveniles, and adults). For many species there is a temporal shift in seasonality and life-history along with spatial changes in location. Temporal information included in the tables is specific to the one polygon or site that it references.

Seagrasses

Eelgrass beds can be found throughout much of the island chain. The highest densities of beds are in the sheltered bays, however eelgrass is also found in the open coastal waters around the islands. Eelgrasses are only mapped in the areas where they have been reported as being present, but they likely exist through out the chain, scattered along the shorelines of all of the islands.

Eelgrass concentrations are shown on the maps as polygons with a purple hatch pattern. If multiple resource types (eelgrass and birds) occupy the same polygon, a black-hatched multi-group pattern is used. A purple icon with a eelgrass silhouette is associated with the polygons representing eelgrass.

The RAR# positioned under the eelgrass icon links to a table on the reverse side of the map. In this table, the first column gives the species name. No seagrasses are designated as Threatened or Endangered. The second column is blank. Concentration information is given as "High", "Abundant", "Present" and "Scattered".

HUMAN-USE FEATURES

The human-use features depicted on the maps are listed below. All the features are represented by icons indicating the type of human-use resource.

Airports	Marinas / Docks
Boat Ramps	Mining Resources
Geothermal Features (V = Vapor; W = Water; S = Subsurface)	Volcanoes (See Table 1)

Airport—Location of airports, airfields, landing strips, etc., whether they are manned or unmanned. These sites were mapped during the overflights, and obtained from a state database of airports.

Boat Ramps—Location of boat ramps. This information was gathered via overflight observations, and from expert sources.

Geothermal Features—Geothermal resources categorized by dominate type (water, vapor, subsurface) as listed in Motyka et al. 1993.

Marina—Location of marinas and anchorages. This information was gathered via overflight observations, digital data, and expert sources.

Mining Resources—Location of known mineral resources, from the USGS Alaska Resource Data File.

Volcanoes—Locations of Quaternary volcanic activity. Main calderas and satellite vents as tabulated in Motyka et al. 1993.

GEOTHERMAL RESOURCES

The Aleutian Islands Arc, being the product of long-term and on-going volcanism, is rich in geothermal resources. The most recent compilation of the geothermal resources of the Aleutians was produced by Motyka et al. (1993) and was the primary source of geothermal information included in this atlas.

The geothermal resources of the Aleutians are all ultimately hydrothermal, that is, heat is transported by convective circulation of fluids within the subsurface as opposed to conduction through rock (Motyka et al. 1993). The primary styles in which geothermal activity is expressed at the surface can be grouped into three general categories: vapor-dominated sites, exposed geothermal waters, and subtle subsurface indicators. Vapor-dominated sites include fumaroles, superheated fumaroles, and gas vents. These are shallow vapor-dominated systems linked to deeper hot-water systems. True vapor-dominated sites are rare (Motyka et al., 1993). Exposed geothermal water sites include hot springs (T>50°C), warm springs (T<50°C), mud pots, geysers, and crater lakes. The last category, subtle subsurface indicators, consists of zones of steaming ground and geothermal wells. Steaming ground is included in this category because it is an expression of geothermal activity that is more dependent on surface saturation and vaporization of meteoric waters than on outgasing directly from deeper hydrothermal sources. Geothermal wells are simply artificial test wells drilled for the assessment of hydrothermal water temperatures and chemical composition.

Each geothermal site has been mapped according to the dominant style of geothermal activity. It is important to note that at any given site a combination of vapor, water, and subtle indicators of subsurface geothermal activity is most likely present. Geothermal sites appear on the maps as a yellow triangle containing a V, if vapor dominated; W, if water dominated; or S if the site is marked by only subtle indications of subsurface geothermal activity.

MINING RESOURCES

Exploited and unexploited mineral resources of the Aleutians include gold, silver, copper, iron, and titanium ores. Concentrations of sulfur and

molybdenum are also present at some localities. The mineral commodities of the Aleutians are mapped using data from the USGS Alaskan Resource Data File (ARDF). Both potential and confirmed resource sites are included as points on the maps. Each point is labeled with a traditional pick and shovel accompanied by a number. The number below the pick and shovel symbol corresponds with a unique assemblage of resource elements found in the ore at that location. If no number exisits, the presence of a mining claim is known, but the resources or commodities being mined are not. The names of the individual minerals present at each site are not provided; only the significant economic elements of the ore are listed. A table on the back of each map lists the element assemblages present in the area. The elements are listed in the table on the back of the maps using their standard periodic table abbreviation as shown below:

Element	Description
Ag	Silver Ore Present
Au	Gold Ore Present
Cu	Copper Ore Present
Fe	Iron Ore Present
Hg	Mercury
Mo	Molybdenum
Pb	Lead Ore Present
S	Sulfur
Sb	Antimony
Ti	Titanium Ore Present
Zn	Zinc Ore Present

VOLCANOES OF THE ALEUTIANS ARC

Volcanism in the Aleutian Islands Arc is brought about by the ongoing subduction of the Pacific plate beneath the North American plate. As the oceanic crust of the Pacific plate migrates northwestward, it is overridden or subducted by the less dense crust of the North American plate. As the Pacific plate compresses, bends, and sinks beneath the North American plate, the pressure and temperatures increase greatly, converting solid rock into liquid magma. The magma, superheated and less dense than the material surrounding it, seeks a density equilibrium and rises towards the surface. These continuous tectonic processes have created the current assemblage of 89 Quaternary volcanoes distributed throughout the Aleutian chain. The natural and human development of each island in the chain has been and will continue to be affected by the eruptive capacity of these volcanoes.

Evaluation of the risk posed by individual volcanoes must take into account complex relationships between the size of an eruptive event and probability. These relationships are beyond the scope of this atlas. Suffice to say that a highly improbable large scale eruption will obviously have greater numbers of potentially destructive processes associated with it but, by nature of its improbability, pose a lower over- all risk than more probable smaller scale eruptive events. In the event of a small or large eruption, the following processes or volcanic hazards identified in Waythomas et al. (1998) and Beget et al. (2000), may exist; they are listed in relative order of importance:

Volcanic Ash Clouds. The primary hazard in eruptions of any size, these clouds of fine ash can reach heights of up to 20 kilometers or more above the volcano and can drift for thousands of kilometers down wind from their source. Presence of an ash cloud poses significant risk to cargo and passenger air transport and can cause total failure of jet engines. Prevailing winds tend to carry these clouds eastward.

Ash and Bomb Fallout. Ash fallout may occur within hundreds of kilometers down wind from the source. Bomb fallout occurs only within tens of kilometers of the volcano. Light ash fallout (millimeters of accumulation) can greatly reduce visibility (down to 100 meters) and cause respiratory complications in both humans and animals. Heavier accumulations (centimeters of accumulation) can interfere with electrical equipment and power generation and can cause roof collapse, in addition to intensifying complications associated with light volumes of fallout.

Lahars, Lahar Runout Flows, and Floods. Hot volcanic debris interacting with snow and ice at the summit or on the flanks of the volcano may form slurries of varying composition. Those dominated by mud and rock are classified as lahars. Those dominated by water are floods, and those with an intermediate mix are called lahar runout flows. Lahars and related flows are typically restricted to valleys and drainages and are a hazard to only those in their direct path. Lahars can travel upwards of 20 kilometers within a valley and move at speeds approaching 30 km per hour.

Pyroclastic Flows and Surges. Consisting of extremely hot material traveling down the flanks of the volcano, pyroclastic flows are a risk only to those in their path. Like all gravity driven flow. They will seek the lowest ground, and hence, tend to concentrate in valleys. Typically they travel no further than 10-15 km from the source

Debris Avalanche. These are rapidly moving (tens to hundreds of meters per second) masses of rock debris produced by large-scale landslides typically within a 10-15 km radius of the summit region. The direct hazard of a debris avalanche is typically limited to a volcano's flanks and valleys.

Directed Blasts. These are laterally directed explosions caused by the release of extremely high internal pressure during slope failure. While extremely rare, they are highly destructive with damage occurring up to 30 km away from the volcano.

Phreatomagmatic Explosions. Characterized by repeated explosions, ejection of bombs, and possible pyroclastic surges, these types of explosions occur near the volcano summit or near any satellite vents. They are caused by the rapid transition of water to steam which occurs when magma contacts surficial snow and ice.

Volcanic Gases. Dangerous odorless gases such as carbon monoxide and carbon dioxide may collect in and displace oxygen from low-lying areas near the summit or near any fumaroles. As such, the risk posed by gases is a localized one. In addition, highly detectable gases such as hydrogen sulfide and sulfur dioxide may be present. Aerosols or droplets of sulfuric acid may also be present in the air during eruptive events, causing corrosion of metals.

Lava Flows. Typical lava flows in the Aleutians arc are of andesitic or basaltic composition. As such they are not rapid moving flows (tens of meters per hour) and pose little risk to human life. Immobile structures in their path will be destroyed. Commonly the shedding of material down slope off the front of a flow or frontal lahars poses a large hazard than the flow itself. Lava flows tend to follow existing drainages and valleys.

The volcanoes of the Alaskan Peninsula and Aleutians Arc are monitored by the Alaskan Volcano Observatory (AVO). Weekly reports produced by the AVO update the "Level of Concern Code" status for each of the volcanoes under observation. The reports, available free at the AVO web site http://www.avo.alaska.edu/, are distributed to the Federal Aviation Administration, the National Weather Service, and the Alaska Department of Emergency Services.

Table 1 is a compilation of the volcanoes included on the maps of this atlas. Volcanoes are portrayed by a black triangle centered on the latitude and longitude of the primary peak. Each volcano is also labeled with a number corresponding to those shown in Table 1, which includes specific volcano names, volcano morphology or type, eruptive history, and general geothermal resource potential.

TABLE 1. VOLCANOES OF THE ALEUTIANS WEST CRSA.

No.	Volcano Name	Current Morphology[a]	Elev. (m)	Events Since 1760	Geothermal Potential	Map Number
1	Buldir	Strato-P	656	0	Poor	8
2	East Cape	Strato-P	610	0	Poor	8
3	Kiska	Strato	1,220	6	Fair	8
4	Segula	Strato	1,160	0	Fair	8
5	Little Sitkin	Strato-S	1,174	3	Good	7
6	Semisopochnoi	Shield-S,P	850	7	Fair	7
7	Gareloi	Strato-P	1,573	14	Fair	6
8	Sajaka	Strato	1,304	0	Fair	6
9	Tanaga	Strato	1,768	4	Fair	6
10	Takawangha	Strato	1,449	0	Fair	6
11	Bobrof	Strato	738	0	Poor	6
12	Kanaga	Strato	1,313	12	Fair	6
13	Moffett	Strato-P	1,196	0	Fair	6
14	Adagdak	Strato-P	610	0	Poor	6
15	Great Sitkin	Strato-P	1,750	11	Good	5
16	Kasatochi	Strato	314	3	Fair	5
17	Koniuji	Strato	273	0	Poor	5
18	Korovin	Strato-P	1,533	7	Fair	5
19	Kluichef	Strato-P	1,451	1	Good	5
20	Konia	Strato	1,125	0	Poor	5
21	Sarichef	Strato	610	1	Fair	5
22	Seguam (Pyre Peak)	Strato-P	1,054	9	Fair	4
23	Seguam East	Strato-P	854	0	Fair	4
24	Amukta	Strato	1,067	5	Fair	4
25	Chagulak	Strato	1,142	0	Poor	4
26	Yunaska	Strato-P	610	5	Fair	4
27	Herbert	Strato	1,280	0	Poor	3
28	Carlisle	Strato	1,620	4	Poor	3
29	Cleveland	Strato	1,730	12	Fair	3
30	Uliaga	Strato	888	0	Poor	3
31	Chuginadak East	Strato	1,170	0	Poor	3
32	Kagamil	Strato	893	12	Fair	3
33	Vsevidof	Strato-P	2,134	4	Fair	3
34	Recheshnoi	Strato-P	1,984	0	Good	3
35	Okmok	Shield-S,P	1,072	18	Fair/Good	3
36	Bogoslof	Dome Complex	44	12	Poor	3
37	Pakushin Cone	Strato	1,035	0	Poor	1
38	Makushin	Shield-S	2,036	20	Confirmed	1
39	Table Top Mountain	Strato	792	0	Poor	1
40	Wide Bay Cone	Strato	610	0	Poor	1

[a] The primary terms used in the description of volcanic morphology are defined as follows:

Strato: Stratovolcanoes are composed of both volcanic flows and ejected tephra and pyroclastics. The majority of the Aleutian volcanoes are of this type.

Shield: Shield Volcanoes are typically gently sloping, broad volcanoes composed solely of basaltic lava flows.

Dome: In some cases synonomous with shield, this term can also pertain to steeper sided protrusions of viscous lava on the flanks of larger shield volcanoes

Maar: A low relief, broad volcanic crater formed by multiple shallow explosive eruptions.

P: Indicates the presence of smaller cones or vents on the flanks of the volcano.

S: Indicates that larger satellite volcanoes occur on the flanks of the volcano

[b] The elevations listed here are the highest recorded points on each volcano. When a large caldera rim is present the actual eruptive center of the volcano may be at a lower elevation

(after Motyka et al., 1993)

There are forty volcanoes in or just adjacent to the Aleutians West Coastal Resource Service Area. Nine of these are found in the Islands of Four Mountains, including one of the more recently active volcanoes, Mt. Cleveland. In its twelfth historically recorded event Mt. Cleveland erupted on February 19th, 2001. The blast was preceded by just over two weeks of calm lava flows near the summit. The first eruptive phase was followed by two others on March 11 and 19. An ash cloud from the initial eruption extended 35,000 feet into the air, spreading over the next two days as far east as Anchorage. The island of Nikolski to the east of Mt. Cleveland experienced significant ash fallout. Since 1760 the volcanoes of the western Aleutians have produced a total of 170 recorded eruptive events. Over this period, the most active volcanoes in the area have been Gareloi, Okmok, and Makushin.

FAULTING AND SEISMIC HAZARDS IN THE ALEUTIANS ARC

Another geophysical hazard caused by the subduction of the Pacific plate beneath the North American plate is earthquakes. To accommodate the tremendous stress and strain associated with the collision of the two plates, each will deform. This deformation is expressed in several ways. Some of the deformation is ductile, during which rocks are heated and compressed at rates that allow the minerals within them to re-organize their crystal structures or metamorphose. Ductile deformation usually occurs at great depths and may result in intensification of mineralization. Another way deformation associated with the collision is expressed is through brittle deformation or fracturing of the rock. This usually occurs at shallower depths than ductile deformation and may be expressed on the surface as faulting. Each type of deformation is continuously driven by subduction. The interface between tectonic plates is an extremely complex area. Stresses can build in one location while motion continues in another. Eventually, stresses reach a critical threshold and the stored energy is released resulting in an earthquake. The seismic energy released by these earthquakes can create new brittle deformation in the rocks above and/or trigger localized motion on existing fault planes. The Aleutian Islands, which owe their existence to the subduction of the Pacific plate, are also one of the most active seismic zones on the planet because of it.

The subduction and subsequent bending of the Pacific plate has created a bathymetric depression offshore that runs roughly parallel to the southern coastline of the Aleutian Islands. This area is called the Aleutian Trench and most of the earthquakes of the region have their origins (epicenters) near it.

Since 1963 there have been as many as 2403 Richter scale magnitude 5 or higher earthquakes along the Aleutian Island Arc and Alaskan Peninsula. Only 101 have been magnitude 6 or higher (Haberman, 2000). While seismic activity at magnitudes 5 and higher generally cause damage, it is impossible to generalize a relationship between earthquake magnitude and the risk or hazard the event poses to humans. Many local factors must be taken into account. Soil type, hydrology, and local slope, all differ from site to site and all effect the amount of damage an earthquake may cause. In a seismically active area risk is perhaps best assessed in terms of the amount of human infrastructure there is to lose. For example, despite the fact that both California and the Aleutians are seismically active areas, it could be said that earthquakes are a bigger hazard in California simply by virtue of a greater population density.

In the Aleutians West CRSA, 62 of the 101 magnitude 6 or higher earthquake epicenters (Haberman, 2000). Many were located south of the area shown on the maps in this atlas. These 62 events occurred between 1965 and 1999. Of note due to their epicentral proximity to land are the following earthquakes:

A. 9 km west of Kashega village, Unalaska, magnitude 6, 1987

B. 12 km west of Cape Star, Umnak, magnitude 6.3, 1999

C. Seven quakes, just west of Ulak Pass in Delarof Islands, magnitude 6-6.4, 1969-1997

D. Six quakes, on and southeast of Amchitka Island, magnitude 6-6.8, 1965-1997

Faults on which movement may be triggered are portrayed on the maps by a bold red line.

TSUNAMIS

The term Tsunami applies to impulsively (as opposed to meteorologically) generated gravity waves in water. They can be produced in three ways: 1) uplift or drop of a large area of the ocean floor during earthquakes; 2) subaerial or submarine landslides or, 3) events linked to volcanism (Lander, 1996). Volcanically induced tsunamis are controversial in that it is difficult to definitively link a tsunami to a volcanic event.

It is a common misconception that tsunamis are always towering waves breaking and plunging landward. While some rare tsunamis do reach those proportions, most are perceived as a rapid rise and fall of the "tide", hence the commonly used and incorrect term "tidal-wave". The character of a tsunami event will vary with the source type, but all tsunamis move at extremely rapid rates (speeds up to and above 500 miles per hour) and ultimately the generation of almost all tsunamis can be linked to zones of subduction such as the Aleutian Trench.

It is both important and interesting to note the directional nature of tsunamis and their hazard. Areas perpendicular to the source of the tsunami suffer the greatest effects, while those to the sides may feel no disturbance at all. When looking at a map, however, it is necessary to realize that a straight line on a sphere is a great circle route, hence the arcing appearance of published tsunami tracks. The directional nature of tsunamis is illustrated to some degree by the fact that tsunamis generated at the Aleutians Arc have caused 175 fatalities in Hawaii in addition to 19 on the mainland coast of the western U.S. This total is higher than all the tsunami related deaths in Alaska (122) (Lander, 1996). Low numbers of fatalities in on the Aleutian Islands and southern Alasakan Peninsula can be related to low population density and the tendency toward construction on the northern, sheltered coastlines.

Tsunamis, no matter what their source type, can be classified as either teletsunamis or local tsunamis. A teletsunami is simply one observed at distances greater than or equal to 1000 kilometers from its source. The source for a teletsunami must be an earthquake of significant size (typically above magnitude 6). In the case of any seismically generated tsunami, the source area can be quite large (on the order of 500 to 800 kilometers in length) despite the tendency to portray an earthquake epicenter as a point. The period of warning for a teletsunami may be on the order of hours to days, depending on source location. Teletsunamis are not a primary risk on the Aleutian Arc. Risk increases slightly to the west due to the proximity of the subduction zone off shore of Kamchatka and the indo-china trench. Local tsunamis, defined as a tsunamis generated adjacent to the shoreline, are a much greater risk to all of the Aleutians and Alaskan Peninsula, particularly along the southern shorelines. Local tsunamis are usually generated by lower energy sources such as landslides or volcanism. Warning periods for these events can be as small as a matter of minutes. The safest policy is that higher ground should be sought after any indication of earthquake activity.

Recorded instances of teletsunamis in the Aleutians are rare. In 1960, a 4.5 foot surge caused minor flooding in Massacre Bay and on the southern shores of Attu. This surge was caused by earthquake activity in Chile. Tsunami events of extremely small amplitude are regularly observed in Massacre Bay and are attributed to seismic events near Kamchatka and the Kuril Islands of Russia.

Instances of local tsunamis are more frequently recorded than teletsunamis, but events of significant size still remain relatively rare. Still, it should be noted that roughly 98 percent of all tsunami-related fatalities can be attributed to local events (Lander, 1996). The most significant seismically generated local tsunami occurred in 1946 when a magnitude 7.8 earthquake occurred roughly 144 kilometers off shore of Unimak Island. Reports indicate that roughly 45 minutes after the initial earthquake was felt a 100 ft. tsunami impacted the southern Unimak coast at Scotch Cap destroying a new lighthouse and resulting in five fatalities. Forty meters of run up (distance inland affected by the water) were recorded. Additionally, several homes on the eastern shore of Akutan were washed off their foundations (Waythomas, 1998). Since the 1946 event, ten seismically induced waves have been recorded along the Aleutians Arc. The lowest magnitude seismicity associated with these events was 6.5, and the only areas with minor flooding were the islands of Shemya and Amchitka.

Landslide generated tsunamis are most common in heavily glaciated regions such as southeastern Alaska. Large amounts of till and pro-glacial sediment loading deltas creates a greater chance for slope failure. There are no reports of tsunamis associated with landslides in the regions covered in this atlas. This is not to say these events are impossible in the region. In fact, for the more sheltered northern shorelines, these types of events most likely account for most of what little tsunami risk there may be.

Overall, the hazard posed by tsunamis in the study area is relatively low. On average 2 significant tsunami events per decade are recorded in all of Alaska (Lander, 1996). The southern shorelines have a much higher risk than northern shores due to their exposure to the Aleutians trench, a local seismic source, and their exposure to teletsunamis originating at the boundaries of the Pacific plate.

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SPECIES LIST*

Common Name	Species Name
MARINE MAMMALS	
PINNIPEDS	
Harbor seal	*Phoca vitulina*
Steller (Northern) sea lion	*Eumetopias jubatus*
Northern fur seal	*Callorhinus ursinus*
SEA OTTERS	
Sea otter	*Enhydra lutris*
BIRDS	
ALCIDS	
Ancient murrelet	*Synthliboramphus antiquus*
Black guillemot	*Cepphus grylle*
Cassin's auklet	*Ptychoramphus aleuticus*
Common murre	*Uria aalge*
Crested auklet	*Aethia cristatella*
Horned puffin	*Fratercula corniculata*
Least auklet	*Aethia pusilla*
Murre	*Uria sp.*
Murrelets	-
Parakeet auklet	*Aethia psittacula*
Pigeon guillemot	*Cepphus columba*
Rhinoceros auklet	*Cerorhinca monocerata*
Thick-billed murre	*Uria lomvia*
Tufted puffin	*Fratercula cirrhata*
Whiskered auklet	*Aethia pygmaea*
DIVING BIRDS	
Common loon	*Gavia immer*
Cormorant	*Phalacrocorax sp.*
Double-crested cormorant	*Phalacrocorax auritus*
Pelagic cormorant	*Phalacrocorax pelagicus*
Red-faced cormorant	*Phalacrocorax urile*
GULLS AND TERNS	
Aleutian tern	*Sterna aleutica*
Arctic tern	*Sterna paradisaea*
Glaucous-winged gull	*Larus glaucescens*
Mew gull	*Larus canus*
Terns	-
PELAGIC	
Black-legged kittiwake	*Rissa tridactyla*
Fork-tailed storm-petrel	*Oceanodroma furcata*

Common Name	Species Name
BIRDS	
PELAGIC (cont.)	
Leach's storm-petrel	*Oceanodroma leucorhoa*
Northern fulmar	*Fulmarus glacialis*
Red-legged kittiwake	*Rissa brevirostris*
Shearwaters	-
Storm-petrels	*Oceanodroma spp.*
SHOREBIRDS	
Black oystercatcher	*Haematopus bachmani*
Rock sandpiper	*Calidris ptilocnemis*
Shorebirds	-
WATERFOWL	
American wigeon	*Anas americana*
Black (common) scoter	*Melanitta nigra*
Brant	*Branta bernicla*
Bufflehead	*Bucephala albeola*
Canada goose	*Branta canadensis*
Common eider	*Somateria mollissima*
Common goldeneye	*Bucephala clangula*
Common merganser	*Mergus merganser*
Emperor goose	*Chen canagica*
Gadwall	*Anas strepera*
Greater scaup	*Aythya marila*
Green-winged teal	*Anas crecca*
Harlequin duck	*Histrionicus histrionicus*
King eider	*Somateria spectabilis*
Mallard	*Anas platyrhynchos*
Northern pintail	*Anas acuta*
Northern shoveler	*Anas clypeata*
Oldsquaw	*Clangula hyemalis*
Red-breasted merganser	*Mergus serrator*
Scoters	*Melanitta spp.*
Steller's eider	*Polysticta stelleri*
Surf scoter	*Melanitta perspicillata*
Tundra (whistling) swan	*Cygnus columbianus*
Waterfowl	-
White-winged scoter	*Melanitta fusca*
FISH	
DIADROMOUS	
Chinook salmon	*Oncorhynchus tshawytscha*
Chum salmon (dog)	*Oncorhynchus keta*
Coho salmon (silver)	*Oncorhynchus kisutch*

Common Name	Species Name
FISH	
DIADROMOUS (cont.)	
Dolly varden	*Salvelinus malma*
Pink salmon (humpy)	*Oncorhynchus gorbuscha*
Rainbow trout (steelhead)	*Oncorhynchus mykiss*
Sockeye salmon (red)	*Oncorhynchus nerka*
ESTUARINE NURSERY	
Pacific herring	*Clupea pallasi*
MARINE BENTHIC	
Alaska plaice	*Pleuronectes quadrituberculatus*
Arrowtooth flounder	*Atheresthes stomias*
Flathead sole	*Hippoglossoides elassodon*
Greenland halibut (turbot)	*Reinhardtius hippoglossoides*
Pacific cod	*Gadus macrocephalus*
Pacific halibut	*Hippoglossus stenolepis*
Rock sole	*Lepidopsetta bilineata*
Sablefish (blackcod)	*Anoplopoma fimbria*
Walleye pollock	*Theragra chalcogramma*
Yellowfin sole	*Pleuronectes asper*
MARINE PELAGIC	
Atka mackerel	*Pleurogrammus* monopterygius
INVERTEBRATES	
BIVALVES	
Blue mussel	*Mytilus edulis*
Macoma spp.	*Macoma spp.*
Pacific razor clam	*Siliqua patula*
Washington butter clam	*Saxidomus giganteus*
Weathervane scallop	*Patinopectin caurinus*
CRABS	
Red king crab	*Paralithodes camtschaticus*
Tanner crab	*Chionoecetes bairdi*
PLANTS	
SAV	
Eelgrass	*Zostera marina*

*** Threatened and endangered species are designated by underlining.**

SHORELINE DESCRIPTIONS

EXPOSED ROCKY SHORES **ESI = 1A**

DESCRIPTION

- The intertidal zone is composed of bedrock, steep (greater than 30° slope), and thus very narrow
- Sediment accumulations are uncommon because waves remove the debris that has slumped from the eroding cliffs
- They are regularly exposed to wave action and strong currents
- Attached organisms are accustomed to the impacts of the waves and the associated hydraulic pressure
- There is strong vertical zonation of intertidal biological communities; Species density and diversity vary greatly, but barnacles, snails, mussels, and macroalgae dominate
- They are common throughout the area along headlands and offshore islands wherever there is open fetch facing the direction of storm-generated winds

PREDICTED OIL BEHAVIOR

- Oil is held offshore by waves reflecting off the steep, hard surfaces
- During calm conditions, the oil can form a band at the high-tide line; oil will not adhere to wet, algae-covered surfaces
- Oil that is deposited is rapidly removed from exposed faces
- The most persistent oil would remain as a patchy band at or above the high-tide line
- Impacts to intertidal communities are expected to be short-term in duration.

RESPONSE CONSIDERATIONS

- Cleanup is usually not required
- Access can be difficult and dangerous

EXPOSED WAVE-CUT PLATFORMS IN BEDROCK **ESI = 2A**

DESCRIPTION

- These shores consist of a bedrock shelf or platform of variable width (up to hundreds of meters wide) and very gentle slope
- The surface of the platform is irregular and the presence of tidal pools is common
- The shoreline may be backed by a steep rock scarp or low bluffs
- There may be a narrow gravel beach at the base of the scarp
- Species density and diversity varies greatly, but barnacles, snails, mussels, and macroalgae are often very abundant
- Attached organisms are accustomed to the impacts of the waves and the associated hydraulic pressure
- They are common along the southern Alaska Peninsula and Sanak Island area

PREDICTED OIL BEHAVIOR

- Oil will not adhere to the wet rock surface, but could penetrate crevices or sediment accumulations if present
- Persistence of oil on the platform itself is usually short-term, except in wave shadows or where the oil was deposited high above normal wave activity

RESPONSE CONSIDERATIONS

- Cleanup is usually not required
- Where the high-tide area is accessible, it may be feasible to manually remove heavy oil accumulations and oiled debris
- Consider potential impacts to rich biological communities on the platforms when cleaning adjacent gravel beaches

FINE- TO MEDIUM-GRAINED SAND BEACHES **ESI = 3A**

DESCRIPTION

- These beaches are flat to moderately sloping and relatively hard packed
- They are composed of predominantly quartz sand
- They are utilized by birds for resting and foraging
- Backshore habitats include dunes and wetlands which are important seasonally as nesting areas for birds
- They are very uncommon, occurring at the heads of coastal bays along the southern Alaska Peninsula

PREDICTED OIL BEHAVIOR

- Light oil accumulations will be deposited as oily swashes or bands along the upper intertidal zone
- Heavy oil accumulations will cover the entire beach surface; oil will be lifted off the lower beach with the rising tide
- Maximum penetration of oil is about 10-15 cm
- Burial of oiled layers by clean sand within the first week after a spill typically will be less than 30 cm at the upper beach face
- Biological impacts include temporary declines in infauna, which can affect important shorebird foraging areas

RESPONSE CONSIDERATIONS

- These beaches are among the easiest shoreline types to clean
- Cleanup should concentrate on removing oil and oily debris from the upper swash zone once oil has come ashore
- Traffic through both oiled and dune areas should be limited, to prevent contamination of clean areas
- Manual cleanup is advised to minimize the volume of sand removed from the shore and requiring disposal
- All efforts should focus on preventing the mixture of oil deeper into the sediments by vehicular and foot traffic
- Mechanical reworking of lightly oiled sediments from the high-tide line to the lower intertidal zone can be effective in speeding natural recovery without having to remove sediment

COARSE-GRAINED SAND BEACHES **ESI =4**

DESCRIPTION

- These beaches are wide and have relatively steep beach faces and soft substrates
- They can undergo rapid erosion/deposition cycles, even within one tidal cycle
- They are utilized by birds and mammals for resting and foraging
- Backshore habitats include dunes and wetlands, which are important seasonally as nesting areas for birds
- They are very common along Bristol Bay; in other areas they occur at the heads of coastal bays and at stream mouths

PREDICTED OIL BEHAVIOR

- Light oil accumulations will be deposited as oily swashes or bands along the upper intertidal zone
- Heavy oil accumulations will cover the entire beach surface; oil will be lifted off the lower beach with the rising tide
- Maximum penetration of oil is about 20 cm
- Burial of oiled layers by clean sand within the first week after a spill can be up to 50 cm at the upper beach face
- Biological impacts include temporary declines in infauna, which can affect important shorebird foraging areas

RESPONSE CONSIDERATIONS

- Coarse sand sediments are less trafficable, increasing the risk of moving oil into the substrate by foot and vehicular traffic
- Cleanup should concentrate on removing oil and oily debris from the upper swash zone once oil has come ashore
- Traffic through both oiled and dune areas should be limited, to prevent contamination of clean areas
- Manual cleanup is advised to minimize the volume of sand removed from the shore and requiring disposal
- All efforts should focus on preventing the mixture of oil deeper into the sediments by vehicular and foot traffic
- Mechanical reworking of lightly oiled sediments from the high-tide line to the lower intertidal zone can be effective in speeding natural recovery without having to remove sediment

MIXED SAND AND GRAVEL BEACHES **ESI = 5**

DESCRIPTION

- Moderately sloping beach composed of a mixture of sand and gravel on the surface
- Because of the mixed sediment sizes, there may be zones of pure sand, pebbles, or cobbles
- There can be large-scale changes in the sediment distribution patterns depending upon season, because of the transport of the sand fraction offshore during storms
- Because of sediment desiccation and mobility on exposed beaches, they have relatively low densities of animals and plants; densities are higher for sheltered beaches
- They are the common shoreline type along the mapped Aleutian Islands and southern Alaska Peninsula, occurring as extensive beaches at the base of rocky cliffs, as perched beaches on rocky platforms, and along bays

PREDICTED OIL BEHAVIOR

- Oil penetration into the sediments may be up to 50 cm; however, the sand fraction can be quite mobile, and oil behavior is much like on a sand beach if the sand fraction exceeds 40 percent
- Burial of oil may be deep at and above the high-tide line, where oil tends to persist, particularly where beaches are only intermittently exposed to waves
- In sheltered pockets, pavements of asphalted sediments can form if there is no removal of heavy oil accumulations, because most of the oil remains on the surface
- Once formed, these asphalt pavements can persist for years
- Oil can be stranded in the coarse sediments on the lower part of the beach, particularly if the oil is weathered or emulsified

RESPONSE CONSIDERATIONS

- Heavy accumulations of pooled oil should be removed quickly from the upper beachface
- Sediment removal should be limited as much as possible
- Even low-pressure flushing should be avoided because of the potential for transporting contaminated sand to the lower intertidal or subtidal zones
- In-place tilling may be used to reach deeply buried oil layers in the middle zone on exposed beaches
- Mechanical reworking of oiled sediments from high tide to the upper intertidal zone (not below the mid-tide zone) can be effective in areas regularly exposed to wave activity (as evidenced by storm berms).

GRAVEL BEACHES ESI = 6A

DESCRIPTION

- Gravel beaches can be very steep, with multiple wave-built berms forming the upper beach
- The grain size of the gravel can vary widely, from small pebbles to large boulders
- Exposure to wave energy is highly variable. Degree of exposure can be inferred partly by the roundness/angularity of the gravel: well rounded gravel indicates regular re-working of the surface sediments by waves; angular gravel indicates infrequent exposure to waves big enough to re-work the sediments
- Density of animals and plants in the upper intertidal zone is low along exposed beaches, but can be very high on sheltered beaches and on the lower intertidal zone of all beaches
- Gravel beaches are a common shoreline type in the study area

PREDICTED OIL BEHAVIOR

- Deep penetration of stranded oil is likely on gravel beaches because of their high permeability
- Long-term persistence will be controlled by the depth of routine reworking by the waves; oil can persist for longer than 10 years
- Chronic sheening and the formation of asphalt pavements is likely where accumulations are heavy

RESPONSE CONSIDERATIONS

- Heavy accumulations of pooled oil should be removed quickly from the upper beachface
- Oiled debris should be removed
- Sediment removal should be limited as much as possible
- Low-pressure flushing can be used to float oil away from the sediments for recovery by skimmers or sorbents. High-pressure spraying should be avoided because of the potential for transporting contaminated finer sediments (sand) to the lower intertidal or subtidal zones
- Mechanical reworking of oiled sediments from high tide to the upper intertidal zone (not below the mid-tide zone) can be effective in areas regularly exposed to wave activity (as evidenced by storm berms).
- In-place tilling may be used to reach deeply buried oil layers in the middle zone on exposed beaches

RIPRAP ESI = 6B

DESCRIPTION

- Riprap structures are composed of boulder-sized blocks
- Riprap structures are used for shoreline protection and as breakwaters in marinas
- Attached biota are highly variable, depending on the elevation of the riprap
- They are present only in developed areas around shipping ports

PREDICTED OIL BEHAVIOR

- Deep penetration of oil between the blocks is likely
- Oil adheres readily to the rough surfaces of the blocks
- Uncleaned oil can cause chronic leaching until the oil hardens

RESPONSE CONSIDERATIONS

- When the oil is fresh and liquid, high-pressure spraying and/or water flooding may be effective, making sure to recover all liberated oil
- Heavy and weathered oils are more difficult to remove, requiring scrapping and/or hot-water spraying

EXPOSED TIDAL FLATS ESI = 7

DESCRIPTION

- Exposed tidal flats are broad intertidal areas composed primarily of sand and gravel
- The presence of sand indicates that tidal currents and waves are strong enough to mobilize the sediments
- Biological utilization can be very high, with large numbers of infauna, heavy use by birds for roosting and foraging, by mammals as haulouts, and use by foraging fish
- They are usually located inside of bays and lagoons, near the mouths of inlets where the currents are strongest

PREDICTED OIL BEHAVIOR

- Oil does not usually adhere to the tidal flat surface, but rather moves across the flat and accumulates at the high-tide line
- Deposition of oil on the flat may occur on a falling tide if concentrations are heavy
- Oil does not penetrate water-saturated sediments
- Biological damage may be severe, primarily to infauna, thereby reducing food sources for birds and other predators

RESPONSE CONSIDERATIONS

- Currents and waves can be very effective in natural removal of the oil
- Cleanup is very difficult (and possible only during low tides)
- The use of heavy machinery should be restricted to prevent mixing of oil into the sediments

SHELTERED ROCKY SHORES ESI = 8A

DESCRIPTION

- The substrate is solid and composed of bedrock, although cracks and crevices can be common
- This shoreline type is sheltered from significant wave activity and strong currents
- Sheltered rocky shores often co-occur with gravel beaches at the lower half of the intertidal zone
- They are usually heavily encrusted with algae, barnacles, mussels, snails, limpets, and other attached animals and plants
- Intertidal habitats can be rich and diverse, supporting many different users (birds, fish, shellfish, mammals)
- They are uncommon, occurring only inside of bays and coves

PREDICTED OIL BEHAVIOR

- Oil tends to adhere to the upper intertidal zone where the rock surface dries out during low tide, and the algal cover is sparse
- On solid bedrock surfaces, the oil will occur as a surface coating
- Oil will penetrate and persist in crevices and sediment accumulations
- Stranded oil will persist because of low energy setting, particularly on the undersides of rock outcrops and in sediment accumulations

RESPONSE CONSIDERATIONS

- Thick accumulations of pooled oil should be of high priority for removal, to prevent re-mobilization and/or penetration
- Manual removal of heavy oil is likely to leave significant residues, but may be useful for oil in crevices or sediment pockets
- Flushing techniques will be most effective when oil is still fresh and liquid; restrict operations to tidal levels that will prevent oily effluents from impacting lower tidal elevations with rich intertidal communities
- Expect to increase temperature and pressure over time as the oil weathers; Evaluate trade-offs between oil removal and pressure/temperature impacts on intertidal communities
- Consider potential impacts to rich biological communities on the rocky shores when conducting cleanup of associated gravel beaches

SHELTERED TIDAL FLATS ESI = 9A

DESCRIPTION

- Sheltered tidal flats are composed primarily of mud with minor amounts of sand and gravel
- They are present in low-energy habitats, sheltered from waves and currents
- The sediments are very soft and cannot support even light foot traffic in many areas
- There can be large concentrations of shellfish, polychaetes, and snails on and in the sediments
- They are heavily utilized by birds and mammals for feeding and resting
- They occur at the heads of bays and lagoons, away from the influence of strong currents and wave action

PREDICTED OIL BEHAVIOR

- Oil does not usually adhere to the surface of sheltered tidal flats, but rather moves across the flat and accumulates at the high-tide line
- Deposition of oil on the flat may occur on a falling tide if concentrations are heavy
- Oil will not penetrate the water-saturated sediments, but could penetrate burrows and desiccation cracks or other crevices in muddy sediments
- In areas of high suspended sediments, sorption of oil can result in deposition of contaminated sediments on the flats
- Biological damage may be severe

RESPONSE CONSIDERATIONS

- These are high-priority areas necessitating the use of spill protection devices to limit oil-spill impact; deflection or sorbent booms and open water skimmers should be used
- Cleanup of the flat surface is very difficult because of the soft substrate; many methods may be restricted
- Low-pressure flushing and deployment of sorbents from shallow-draft boats may be attempted

SALT- AND BRACKISH-WATER MARSHES ESI = 10A

DESCRIPTION

- Width of the marsh varies, from a narrow fringe along lagoons toexten-sive areas at stream mouths, though most marshes are small in area
- Sediments are composed of mixtures of mud, sand, and gravel
- Resident flora and fauna are abundant with numerous species and high utilization by birds, fish, and shellfish
- They are generally widely scattered; extensive marshes are associated with Izembek Lagoon, Nelson Lagoon, and Mud Bay

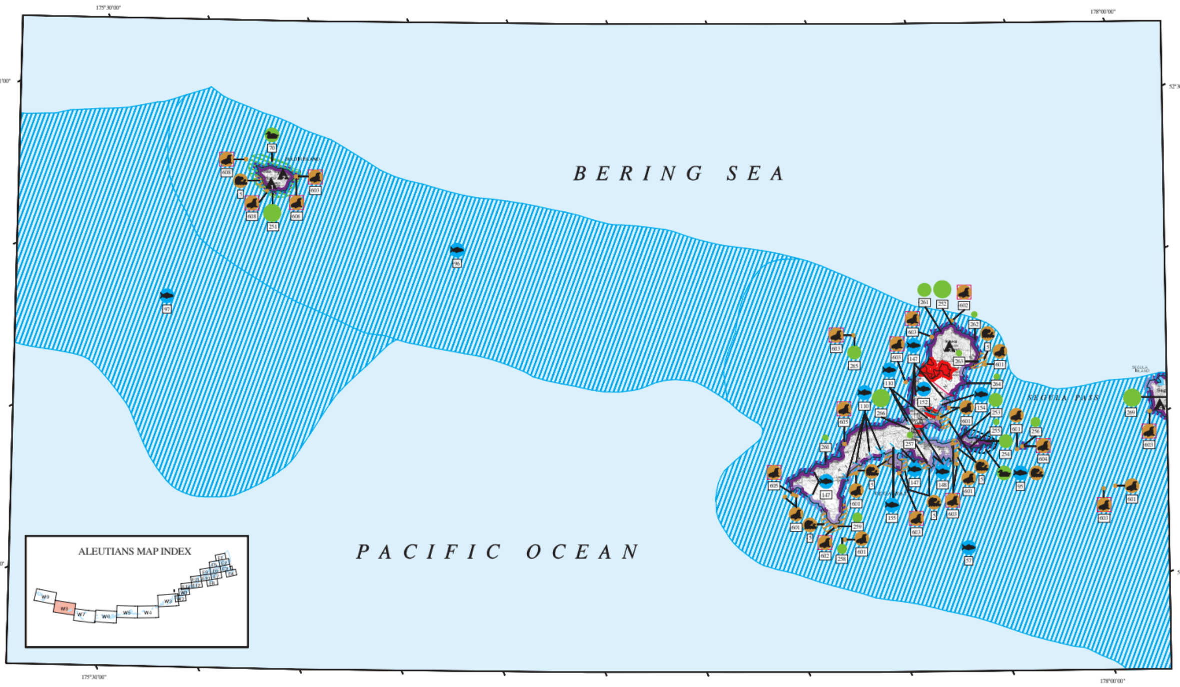
PREDICTED OIL BEHAVIOR

- Oil adheres readily to intertidal vegetation
- The band of coating will vary widely, depending upon the water level at the time oil slicks are in the vegetation. There may be multiple bands
- If the vegetation is thick, heavy oil coating will be restricted to the outer fringe, although lighter oils can penetrate deeper
- Medium to heavy oils do not readily adhere to or penetrate the fine sediments, but can pool on the surface or in burrows
- Light oils can penetrate the top few centimeters of sediment and deeply into burrows and cracks (up to one meter)

RESPONSE CONSIDERATIONS

- Natural removal processes and rates should be evaluated prior to conducting cleanup
- Heavy accumulations of pooled oil can be removed by vacuum, sorbents, or low-pressure flushing. During flushing, care must be taken to prevent transporting oil to sensitive areas down slope or along shore
- Cleanup activities should be carefully supervised to avoid damage
- Any cleanup activity must not mix the oil deeper into the sediments. Trampling of the roots must be minimized
- Cutting of oiled vegetation should only be considered when other resources present are at great risk from leaving the oiled vegetation in place

COASTAL RESOURCE INVENTORY MAP



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RAT ISLAND, AK (1983)
KISKA, AK (1983)

ALEUTIAN WEST -8

ALEUTIANS WEST - ESIMAP 8

BIOLOGICAL RESOURCES:

BIRD:

RAR#	Species	S/F	T/E	Concen	J	F	M	A	M	J	J	A	S	O	N	D	Nesting	Laying	Hatching	Fledging
70	Waterfowl			HIGH	X	X	X	X	X			X	X	X	X	X	-	-	-	-
95	Common eider			HIGH				X	X	X	X	X	X				APR-SEP	-	-	-
	Waterfowl			HIGH	X	X	X	X	X	X	X				X	X	JUN-JUL	-	-	-
251	Ancient murrelet			10000				X	X	X	X	X	X				APR-SEP	-	-	-
	Black-legged kittiwake			29600				X	X	X	X	X	X				APR-SEP	-	-	-
	Cassin's auklet			400				X	X	X	X	X	X				APR-SEP	-	-	-
	Common murre			1100						X	X						-	-	-	-
	Crested auklet			280000				X	X	X	X	X	X				APR-SEP	-	-	-
	Fork-tailed storm-petrel			1300000				X	X	X	X	X	X				APR-SEP	-	-	-
	Glaucous-winged gull			5000				X	X	X	X	X	X				APR-SEP	-	-	-
	Horned puffin			20000				X	X	X	X	X	X				APR-SEP	-	-	-
	Leach's storm-petrel			1700000				X	X	X	X	X	X				APR-SEP	-	-	-
	Least auklet			140000				X	X	X	X	X	X				APR-SEP	-	-	-
	Northern fulmar			1240				X	X	X	X	X	X				APR-SEP	-	-	-
	Parakeet auklet			12000				X	X	X	X	X	X				APR-SEP	-	-	-
	Pelagic cormorant			200				X	X	X	X	X	X				APR-SEP	-	-	-
	Pigeon guillemot			300				X	X	X	X	X	X				APR-SEP	-	-	-
	Red-faced cormorant			280				X	X	X	X	X	X				APR-SEP	-	-	-
	Red-legged kittiwake			12680				X	X	X	X	X	X				APR-SEP	-	-	-
	Rhinoceros auklet			30				X	X	X	X	X	X				APR-SEP	-	-	-
	Thick-billed murre			12300				X	X	X	X	X	X				APR-SEP	-	-	-
	Tufted puffin			20000				X	X	X	X	X	X				APR-SEP	-	-	-
	Whiskered auklet			3000				X	X	X	X	X	X				-	-	-	-
252	Cormorant			16				X	X	X	X	X	X				APR-SEP	-	-	-
	Crested auklet			332000				X	X	X	X	X	X				APR-SEP	-	-	-
	Least auklet			1160000				X	X	X	X	X	X				APR-SEP	-	-	-
	Parakeet auklet			4000				X	X	X	X	X	X				APR-SEP	-	-	-
	Pelagic cormorant			30				X	X	X	X	X	X				APR-SEP	-	-	-
	Red-faced cormorant			80				X	X	X	X	X	X				APR-SEP	-	-	-
253	Ancient murrelet			unknown				X	X	X	X	X	X				APR-SEP	-	-	-
	Fork-tailed storm-petrel			unknown				X	X	X	X	X	X				APR-SEP	-	-	-
	Glaucous-winged gull			400				X	X	X	X	X	X				APR-SEP	-	-	-
	Horned puffin			200				X	X	X	X	X	X				APR-SEP	-	-	-
	Leach's storm-petrel			unknown				X	X	X	X	X	X				APR-SEP	-	-	-
	Pigeon guillemot			350				X	X	X	X	X	X				APR-SEP	-	-	-
	Tufted puffin			6600				X	X	X	X	X	X				APR-SEP	-	-	-
254	Horned puffin			2800				X	X	X	X	X	X				APR-SEP	-	-	-
255	Cormorant			26				X	X	X	X	X	X				APR-SEP	-	-	-
	Red-faced cormorant			2				X	X	X	X	X	X				APR-SEP	-	-	-
256	Cormorant			18				X	X	X	X	X	X				APR-SEP	-	-	-
	Glaucous-winged gull			60				X	X	X	X	X	X				APR-SEP	-	-	-
	Horned puffin			50				X	X	X	X	X	X				APR-SEP	-	-	-
	Pigeon guillemot			24				X	X	X	X	X	X				APR-SEP	-	-	-
	Tufted puffin			30				X	X	X	X	X	X				APR-SEP	-	-	-
257	Cormorant			10				X	X	X	X	X	X				APR-SEP	-	-	-
258	Tufted puffin			150				X	X	X	X	X	X				APR-SEP	-	-	-
259	Tufted puffin			700				X	X	X	X	X	X				APR-SEP	-	-	-
260	Cormorant			16				X	X	X	X	X	X				APR-SEP	-	-	-
261	Black-legged kittiwake			1126				X	X	X	X	X	X				APR-SEP	-	-	-
	Pelagic cormorant			8				X	X	X	X	X	X				APR-SEP	-	-	-
	Red-faced cormorant			8				X	X	X	X	X	X				APR-SEP	-	-	-
262	Cormorant			14				X	X	X	X	X	X				APR-SEP	-	-	-
	Pelagic cormorant			12				X	X	X	X	X	X				APR-SEP	-	-	-
	Red-faced cormorant			18				X	X	X	X	X	X				APR-SEP	-	-	-
263	Red-faced cormorant			16				X	X	X	X	X	X				APR-SEP	-	-	-
264	Cormorant			30				X	X	X	X	X	X				APR-SEP	-	-	-
	Pelagic cormorant			6				X	X	X	X	X	X				APR-SEP	-	-	-
	Red-faced cormorant			42				X	X	X	X	X	X				APR-SEP	-	-	-
265	Common murre			250						X	X						-	-	-	-
	Thick-billed murre			1370				X	X	X	X	X	X				APR-SEP	-	-	-
266	Glaucous-winged gull			900				X	X	X	X	X	X				APR-SEP	-	-	-
	Horned puffin			5500				X	X	X	X	X	X				APR-SEP	-	-	-
	Pigeon guillemot			560				X	X	X	X	X	X				APR-SEP	-	-	-
	Tufted puffin			9150				X	X	X	X	X	X				APR-SEP	-	-	-
269	Cormorant			140				X	X	X	X	X	X				APR-SEP	-	-	-
	Crested auklet			46975				X	X	X	X	X	X				APR-SEP	-	-	-
	Glaucous-winged gull			210				X	X	X	X	X	X				APR-SEP	-	-	-
	Horned puffin			550				X	X	X	X	X	X				APR-SEP	-	-	-
	Least auklet			474150				X	X	X	X	X	X				APR-SEP	-	-	-
	Parakeet auklet			1620				X	X	X	X	X	X				APR-SEP	-	-	-
	Pigeon guillemot			144				X	X	X	X	X	X				APR-SEP	-	-	-
	Tufted puffin			550				X	X	X	X	X	X				APR-SEP	-	-	-

FISH:

RAR#	Species	S/F	T/E	Concen	J	F	M	A	M	J	J	A	S	O	N	D	Spawning	Eggs	Larvae	Juveniles	Adults
57	Atka mackerel			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	JUN-SEP	-	-	JAN-DEC	JAN-DEC
	Pacific cod			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	JAN-MAY	JAN-MAY	-	JAN-DEC	JAN-DEC
	Pacific halibut			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	-	JAN-DEC
95	Greenland halibut (turbot)			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	JAN-DEC	-
96	Atka mackerel			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	JUN-SEP	-	-	JAN-DEC	JAN-DEC
	Pacific cod			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	JAN-MAY	JAN-MAY	-	JAN-DEC	JAN-DEC
97	Pacific cod			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	JAN-MAY	JAN-MAY	-	JAN-DEC	JAN-DEC
110	Pink salmon (humpy)										X	X	X				JUL-SEP	-	-	-	JUL-SEP
147	Dolly varden				X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	JAN-DEC	JAN-DEC
148	Dolly varden				X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	JAN-DEC	JAN-DEC
	Pink salmon (humpy)										X	X	X				JUL-SEP	-	-	-	JUL-SEP
152	Dolly varden				X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	JAN-DEC	JAN-DEC
	Sockeye salmon (red)										X	X	X	X	X	X	JUL-DEC	-	-	-	JUL-DEC
154	Coho salmon (silver)													X	X	X	OCT-DEC	-	-	-	OCT-DEC
155	Coho salmon (silver)													X	X	X	OCT-DEC	-	-	-	OCT-DEC
	Dolly varden				X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	JAN-DEC	JAN-DEC
	Pink salmon (humpy)										X	X	X				JUL-SEP	-	-	-	JUL-SEP

MARINE MAMMAL:

RAR#	Species	S/F	T/E	Concen	J	F	M	A	M	J	J	A	S	O	N	D	Mating	Calving	Pupping	Molting
5	Sea otter			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-	-	MAY-MAY	-
95	Sea otter			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-	-	MAY-MAY	-
601	Harbor seal			0-49	X	X	X	X	X	X	X	X	X	X	X	X	-	-	MAY-JUL	MAY-OCT
602	Steller (Northern) sea lion	F	E	100-199	X	X	X	X	X	X	X	X	X	X	X	X	-	-	MAY-JUL	JUL-DEC
603	Steller (Northern) sea lion	F	E	0-49	X	X	X	X	X	X	X	X	X	X	X	X	-	-	MAY-JUL	JUL-DEC
604	Steller (Northern) sea lion	F	E	50-99	X	X	X	X	X	X	X	X	X	X	X	X	-	-	MAY-JUL	JUL-DEC
605	Steller (Northern) sea lion	F	E	>= 300	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	JUL-DEC
606	Steller (Northern) sea lion	F	E	>= 300	X	X	X	X	X	X	X	X	X	X	X	X	-	-	MAY-JUL	JUL-DEC
608	Steller (Northern) sea lion	F	E	0-49	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	JUL-DEC

Biological information shown on the maps represents known concentration areas or occurrences, but does not necessarily represent the full distribution or range of each species. This is particularly important to recognize when considering potential impacts to protected species.

ALEUTIANS WEST COASTAL RESOURCES SERVICE AREA, ALASKA

SHORELINE HABITAT RANKINGS

- 1A) EXPOSED ROCKY SHORES
- 2A) EXPOSED WAVE-CUT PLATFORMS IN BEDROCK
- 3A) FINE-TO MEDIUM-GRAINED SAND BEACHES
- 4) COARSE-GRAINED SAND BEACHES (NOT PRESENT IN ALEUTIANS WEST)
- 5) MIXED SAND AND GRAVEL BEACHES
- 6A) GRAVEL BEACHES
- 6B) RIPRAP
- 7) EXPOSED TIDAL FLATS
- 8A) SHELTERED ROCKY SHORES
- 9A) SHELTERED TIDAL FLATS
- 10A) SALT-AND BRACKISH-WATER MARSHES

COASTAL HABITAT RANKINGS

- 1) EXPOSED ROCKY SHORES WITH OR WITH-OUT WAVECUT PLATFORMS
- 2) EXPOSED HIGH ENERGY SHORELINE (UNIDENTIFIED CLIFFS, PLATFORMS, AND BEACHES)
- 3) BEACHES (FINE AND MEDIUM SAND, COARSE SAND,SAND AND GRAVEL, GRAVEL)
- 4) EXPOSED TIDAL FLATS
- 5) ESTUARINE VEGETATION AND SHELTERED COAST

OTHER FEATURES

- GEOTHERMAL FEATURES (V=VAPOR;W=WATER;S=SUBSURFACE)
- VOLCANOS (SEE INTRODUCTION FOR NAMES)
- FAULTLINES
- REFUGE BOUNDARY
- BOROUGH/CRSA BOUNDARY

HUMAN-USE FEATURES

- AIRPORTS
- MARINA/ DOCKS
- BOAT RAMPS
- MINING RESOURCES

SENSITIVE BIOLOGICAL RESOURCES

BIRD

- ALCID AND PELAGIC BIRD
- DIVING BIRD
- GULL AND TERN
- SHOREBIRD
- WATERFOWL

NESTING COLONIES

- 0- 100
- 1,001- 10,000
- 101- 1,000
- >10,000

FISH

- FISH
- ANADROMOUS STREAM

INVERTEBRATE

- BIVALVE
- CRAB

PLANT

- EELGRASS

MARINE MAMMAL

- PINNIPED
- SEA OTTER
- HAULOUT SITE

MULTI-GROUP

- THREATENED/ ENDANGERED
- 123 RAR NUMBER

AK Hydro modified AWC Points

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Arctic cisco - AW, fish, lamprey - LP, sturgeon ST, Arctic lamprey - AL, salmon, western brook lamprey - LB, spawning - s, Pacific lamprey - PC, anadromous fishes, broad whitefish - BC, green sturgeon - GS, white sturgeon - WS, Dolly Varden- DV, Steelhead trout - SH, sockeye salmon - S, anadromous, rivers, least cisco - LC, present - p, AWC, longfin smelt - OL, rearing - r, coho salmon - CO, sheefish - SF, inland waters, rainbow smelt - OM, pink salmon - P, chum salmon - CH, river lamprey - LV, char, Arctic char - AC, Bering cisco - BW, whitefish - W, Alaska, eulachon - OU, trout, hydrography, humpback whitefish - HW, smelt - SM, inconnu - SF, cutthroat trout - CT, migration - m, Chinook salmon - K, AWC_PT, AK Hydro

Summary

These points are AN ABSTRACT of the Anadromous Waters Catalog (AWC) data which are used to specify the water bodies referred to in AS 16.05.871 for the protection of waters important for the spawning, rearing or migration of anadromous fishes. They are NOT authoritative AWC content and, in some instances, have been moved from their original position that they integrate with the AK Hydro stream and networked features.

Description

These features are NOT AUTHORITATIVE CONTENT from the state's Anadroumous Waters Catalog. In in some instances, these points have been moved (via snapping) from their original position so they can integrate with the AK Hydro geometric network - specifically, points within 10m of existing AK Hydro stream features have been snapped to the stream features so they participate in the geometric network. The points are provided in this revised format so that they can be used for network analysis and cartographic apllications - they have no direct relationship to the AWC once published in this revised AK Hydro format.

The Alaska Department of Fish and Game's (ADFG) Anadromous water bodies data is derived from the ADFG's GIS shape files for the "Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes" (referred to as the "Catalog") and the "Atlas to the Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes" (referred to as the "Atlas"). It is produced for general visual reference and to aid users in generating various natural resource analyses and products. The shape files depict the known anadromous fish bearing lakes and streams within Alaska (from the mouth to the known upper extent of species usage). It incorporates data from a variety of sources including: USGS Digital Line Graph (DLG) and National Hydrography Dataset (NHD) hydrography data; Alaska Department of Natural Resources hydrography layer; and ADF shape files for the "Atlas" and "Catalog". ADF updates the Anadromous Streams data regularly. Note that stream numbers, locations, extent of cataloged habitat or species utilization of a given stream may change from year to year. Data for the shape files are current as of the 2014 revision of the "Atlas to the Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes" and the "Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes" effective July 1, 2015.

Credits

There are no credits for this item.

Use limitations

The State of Alaska makes no express or implied warranties (including warranties of merchantability and fitness) with respect to the character, function, or capabilities of the electronic services or products or their appropriateness for any users purposes. In no event will the State of Alaska be liable for any incidental, indirect, special, consequential or other damages suffered by the user or any other person or entity whether from the use of the electronic services or products, any failure thereof or otherwise, and in no event will the State of Alaska's liability to the requestor or anyone else exceed the fee paid for the electronic service or product. Users shall not re-distribute this data. To ensure distribution of the most current public information, please refer requests for data or products to ADF Division of Sport Fish (see distribution contact above).

Extent

West	-154.854764	**East**	-139.909160
North	63.795215	**South**	58.045813

Scale Range

Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:500,000

Bird_Nesting_Colonies

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Aleutian Islands, Alaska, Birds, Nesting, Colonies, Concentration

Summary

This feature class (point) was created by referencing location and species data from the U.S. Fish and Wildlife Service. The feature class created in ArcCatalog was then added as a layer to ArcMap and digitized by referencing location data via a U.S. Fish and Wildlife Service for the Western Aleutian Islands (Kiska Island). Species data and other nomenclature, for each individual point, was added as text in the attribute table.

Description

Birds are divided into several species subgroups based on taxonomy, morphology, behavior, and oil spill vulnerability and sensitivity. The species table lists all the birds included on the maps, sorted by subgroup. The major types of bird areas depicted in this atlas include: resident, migratory, nesting, and overwintering waterfowl concentration areas; migratory shorebird concentration areas; seabird concentration areas; and colonial waterbird nesting sites (for seabirds and wading birds). Although birds are a major resource shown on the Aleutians West ESI maps, seabirds concentration areas are shown only where surveys have been conducted. Seabird nesting site information was obtained from the Beringian Seabird Colony Catalog database. The points representing the location of the nesting colonies are usually located near the geographic center of the colony. In some cases the point is located in the middle of an island, even though birds nest along the shorelines all around the island, not necessarily in the middle of the island. Waterfowl concentration areas shown on the map are derived from survey data provided by Alaska Department of Fish and Game, U. S. Fish and Wildlife Service, and local experts. Present but not shown are scattered distributions of emperor geese and Steller’s eider around the islands of the Western Aleutians. Data were also incorporated from Audubon Society

Christmas bird counts. Eagle nest sites are found throughout the coastal zone of the Aleutians, however, because a comprehensive nest survey has not be conducted nesting sites are not shown. Eagles are present all year, but their most critical time is from March to August when they are nesting. Expert contacts for birds are in the U.S. Fish and Wildlife Service, Refuge and Migratory Bird Management Divisions and ADF&G Habitat and Restoration Division. Bird concentrations, including nesting areas for some species, are shown on the maps as polygons with a green hatch pattern. If multiple resource types (marine mammals and birds) occupy the same polygon, a black-hatched multi-group pattern is used. A green icon with the appropriate bird silhouettes (wading bird, raptor, etc.) is associated with the polygons. Seabird nesting sites from the U.S. Fish and Wildlife Service are shown with a green dot scaled to reflect the colony size. The RAR# under the icon links to a table on the reverse side of the map. In this table, the first column gives the species name. The second column indicates whether the species is listed as threatened (T) or endangered (E) on either the state (S) and/or federal (F) lists. The next column in the tables provides an estimate of the concentration of each species at the site. Concentration is indicated as a numerical value representing the number of breeding pairs occurring at a nesting site, or as HIGH, MEDIUM, and LOW to represent relative concentrations. "Unknown" is used where the birds have been surveyed but an accurate count was not available. A blank field in concentration indicates no concentration information was provided. Nesting concentrations at any particular site may fluctuate seasonally and annually based on local or regional conditions, or other factors. The species seasonality is shown in the next twelve columns representing the months of the year. If the species is present at that location in a particular month, an "X" is placed in the month column. The last columns denote the nesting period for each species, if nesting occurs in the particular area or site. Nesting refers to the entire nesting period, including laying, hatching, and fledging. For many species, there is a temporal shift in seasonality and reproduction along with spatial changes in location. Temporal information included in the tables is specific to the one polygon or point that it references.

Credits

Source: United States Fish and Wildlife Service

Use limitations

There are no access and use limitations for this item.

Extent

West	177.289314	**East**	177.781142
North	52.138624	**South**	51.818550

Scale Range

Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:150,000,000

Coastline

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Aleutian Island Chain, Alaska, Coastline

Summary

This feature class (contour line) was created by referencing coastline location data from the U.S. Fish and Wildlife Service. The feature class created in ArcCatalog was then added as a layer to ArcMap and digitized by referencing coastline location data via a U.S. Fish and Wildlife Service for the Western Aleutian Islands (Kiska Island). Species data and other nomenclature, for each individual line, was added as text in the attribute table.

Description

This coverage depicts the entire boundary of Kiska Island, which is coastline.

Credits

Source: United States Fish and Wildlife Service

Use limitations

There are no access and use limitations for this item.

Extent

West	177.198077	**East**	177.705647
North	52.135974	**South**	51.824860

Scale Range

Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

Contaminated_Sites

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Aleutian Island Chain, Alaska, Contaminated, Sites, Active, Contained

Summary

This feature class (point) was created by referencing contamination data from the U.S. Fish and Wildlife Service. The feature class created in ArcCatalog was then added as a layer to ArcMap and digitized by referencing coordinate data for contamination points at Kiska Island via the Alaska Department of Environmental Conservation, Spill Prevention and Response. Contamination and other nomenclature, for each individual point, was added as text in the attribute table.

Description

The site report for the Kiska Island Garrison - Oil (Hazard ID 2619; Active Status), is as follows: Petroleum/lubricant contamination may be present. POL tanks and POL contaminated soils. Islands were invaded by Japanese task force in 1942. Left behind barracks, power plants, hospitals, defense fortifications, and ordnance. Three cargo ships lie on beaches. U.S. Army left structures, seaplane ramp, Japanese runway and numerous craters. Site entered by Shannon and Wilson. Numerous contaminants have been identified at this site ranging from PAH's, PCB's to POL's. Site is still in preliminary investigation stage. The USACE is attempting to use the CERCLA "Act of War" exclusion to limit DoD responsibility for remediating this site. Action information history: 12/30/1991 - Update or Other Action (Old R:Base Action Code = SI - Site Investigation). Based on FUDS Site Summary dated 2/21/96, SI for POL contaminated soils completed 12/30/91; 8/11/1993 - Preliminary Assessment Approved, based on FUDS Site Summary dated 2/21/96; 3/1/1996 - Update or Other Action, (Old R: Base Action Code = RIFS - Remedial Investigation / Feasibility Study). Final RI/FS report received. Seven operable units identified. Operable units A, B, and C have potential surface water and sediment impacts and additional investigation is recommended; 11/20/1996 - Site Added to Database, Site added by Shannon and Wilson; 3/1/1997 - Update or Other Action, (Old R:Base Action Code = RIFS - Remedial Investigation / Feasibility Study). Final Phase II RI/FS and risk assessment workplans received. Project on hold due to funding constraints; 4/2/2001 - Update or Other Action, ADEC received a copy of a letter from the U.S. EPA to the U.S. Army Corps of Engineers and U.S. Fish and Wildlife requesting the following work be done in coordination with ADEC and EPA: 1) develop and post warning signs on unexploded ordnance (UXO) during 2001, 2) Develop and distribute brochures on UXO safety to all permit holders for on-island activities, 3) Conduct SI and removals in 2006 to address ordnance, drums, and metals contaminated soil, 4) Conduct tribal consultation, and 5) notify all parties in writing if there is a schedule change; 6/14/2005 - Update or Other Action, File number update 2570.38.001; 6/26/2008 - Exposure Tracking Model Ranking, Initial ranking with ETM completed; 10/24/2014 - Update or Other Action, Current USACE FUDS schedule is to perform additional investigation/remediation during 2029. This schedule is subject to change; 12/1/2016 - Meeting or Teleconference Held, CS managers participate in the annual FUDS site management action plan meeting. The purpose of the is to collaborate with FUDS management on site progress and prioritization for all of the formerly used defense sites. FUDS prioritization is based on risk, congressional interest, state input and proximity to other sites on the prioritization list. FUDS has increased environmental restoration funding in Alaska for the 2017 and 2018 field seasons to meet National goals for site progress.

The site report for the Kiska Island NDSA (Hazard ID 26049, Active Status) is as follows:The Naval Defensive Sea Area (NDSA) site is composed of the underwater areas surrounding Kiska Island where Munitions and Explosives of Concern (MEC) were historically deposited/disposed as a result of DoD activities. Kiska Island was occupied by the Japanese from June 7, 1942 through early July 1943. The US began offensive operations against the Japanese on the island on or around June 7, 1942. Over 3,000 tons of bombs and over 15,000 naval projectiles were directed at Japanese positions on the island, between June 1942 and August 1943. While much of the ordnance was directed at positions on the island, several ships were sunk in Kiska Harbor and weather did not always allow for accurate delivery. The Japanese abandonded their defensive positions sometime in July 1943 prior to the Allied reoccupation on August 15, 1943. Allied forced occupied the island for several months. Anti-Aircraft Artillery (AAA) and Coastal Defense Artillery (CDA) gun positions were established. Practice firing was conducted over-water, depositing MEC into the marine environment. In addition MEC may be present in the near-shore environment associated with off-shore ordnance transfer and sunken naval vessels. Following the war areas of Kiska Harbor were used for rocket and bomb strikes against abandonded ships. MEC is present in the marine environment from sevel sources. The Navy will implement an IC program to inform potential visitors to the island of the potential hazards from MEC. Action information history: 12/18/2012 - CERCLA PA, Submit comments to NAVAC NW on the Draft Preliminary Assessment for Naval Defensive Sea Area - Kiska Island. Comments focused on the Navy's authority to address the NDSA as opposed to the USACE FUDS program, appropriate terminology, and adequate institutional controls; 5/3/2013 - Site Added to Database, A new site has been added to the database; 6/13/2013 - CERCLA PA, Submit approval letter to NAVFAC NW on the Final Preliminary Assessment for NDSA Kiska Island. Executive Order 8680 provides the basis of the Navy's authority/responsibility to address MEC at the NDSA. The report recomends implemting an IC program to include "notice to mariners" and an information advisory to increase awareness of the presence of MEC in the area. The Navy will work with NOAA to include a "notice to mariners" on navigation charts of the island. The Navy intends to submit a Decision Document to finalize this decision with ADEC; 7/9/2014 - Submit comments to NAVFAC NW on the Draft Engineering Evaluation/Cost Assessment (EE/CA) for the Kiska Naval Defensive Sea Area (NDSA). The document evaluates two options for interim Institutional Controls for the site; 12/21/2015 - Report or Workplan Review-Other, Submit approval letter for the EE/CA for the Kiska Naval Defensive Sea Area. The EE/CA evaluates two different options for implementing Land Use Controls (LUCs) at the island to address underwater UXO.

Credits
Source: Alaska Department of Environmental Conservation, Spill Prevention and Response
http://dec.alaska.gov/Applications/SPAR/PublicMVC/CSP/SiteReport/2619
http://dec.alaska.gov/Applications/SPAR/PublicMVC/CSP/SiteReport/26049

Use limitations
There are no access and use limitations for this item.

Extent

West	177.502010	**East**	177.551729
North	51.976034	**South**	51.968765

Scale Range

Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

CRITHAB_POLY

Shapefile

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Critical Habitat, Steller Sea Lion, Northern Sea Otter

Summary
This feature class (polygon) was dowloaded as a .zip file via the United States Fish and Wildlife Service website, then added to ArcMap as a feature class in order to display critical habitats near and around Kiska Island, Western Aleutian Islands, Alaska. Species data and other nomenclature, for polygons, are denoted in the attribute table.

Description
The .zip file was downloaded from https://ecos.fws.gov/ecp/report/table/critical-habitat.html, then added to the geodatabase as a feature class and then as a layer in ArcMap. Locations of Steller Sea Lion and Northern Sea Otter critical habitats were displayed over a basemap.

Credits
United States Fish and Wildlife Service, https://ecos.fws.gov/ecp/report/table/critical-habitat.html

Use limitations
There are no access and use limitations for this item.

Extent

West	-180.000000	**East**	180.000000
North	70.333363	**South**	13.639711

Scale Range
Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

Fish_int

File Geodatabase Feature Class

Thumbnail Not Available

Tags
Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Survey Areas, Sites, Kiska Harbor, Twin Rocks, Gertrude Cove, North Head, anadromous fish species

Summary
This feature class (point) was created by using the geoprocessing tool "intersect." The input feature class "Fish_Species" was intersected with the input feature class "SurveyAreas" to create the output feature class, "Fish_int" to show what fish species are within the survey areas.

Description
This feature class shows what species of anadromous fish are within the Project Recover survey areas.

Credits
Source: Power Point presentation created by both Project Recover and the BentProp Project, 2018; United States Fish and Wildlife Service

Use limitations
There are no access and use limitations for this item.

Extent

West	177.431095	**East**	177.547479
North	51.982152	**South**	51.933425

Scale Range
Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

Fish_Species

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Anadromous, Fish, Species

Summary

This feature class (point) was created by referencing location and species data from the U.S. Fish and Wildlife Service. The feature class created in ArcCatalog was then added as a layer to ArcMap and digitized by referencing location data via a U.S. Fish and Wildlife Service for the Western Aleutian Islands (Kiska Island). Species data and other nomenclature, for each individual point, was added as text in the attribute table.

Description

The fish depicted in the Aleutians West ESI atlas include commercially important benthic and pelagic fish, herring spawning grounds, and streams important to anadromous fish. Not all species of environmental, recreational, or commercial interest are depicted. The anadromous streams shown on the map are from Alaska Department of Fish and Game database, Waters Important to Anadromous Fish. Species included in these streams are coho, chinook, chum, pink, and sockeye salmon, dolly varden, and cutthroat trout. While all of the anadromous streams in the database are shown, some of them are represented as a straight line, connecting the beginning point and endpoint of the stream, because the actual stream was not digitized. It is also cautioned that although this dataset is the best current representation of anadromous streams, it should not be considered definitive in determining the presence or absence of fish runs. Absence of anadromous streams on the maps for any particular location does not necessarily suggest that anadromous runs do not occur there. Expert contacts for anadromous fish are in the ADF&G Habitat and Restoration Division. Fish concentrations are shown on the maps as polygons with a blue hatch pattern. If multiple resource types (birds and fish) occupy the same polygon, a black-hatched multi-group pattern is used. A blue icon with an appropriate fish silhouette is associated with the polygons containing fish. For the anadromous fish streams, a blue line is used to mark the fish runs (in the mouth of the stream). A blue icon with a fish silhouette is associated with the line using a leader line. The RAR# positioned under the fish icon links to a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been designated as being endangered (E) or threatened (T) on either the state (S) and/or federal (F) lists. Concentration information was not available and was left blank. Seasonality is listed by month with an “X” indicating the species presence in any particular month. The last columns indicate time periods for various life-history stages or activities (spawning, eggs, larvae, juveniles, and adults). For many species there is a temporal shift in seasonality and life history along with spatial changes in location. Temporal information included in the tables is specific to the one polygon or site that it references.

Credits

Source: United States Fish and Wildlife Service

Use limitations

There are no access and use limitations for this item.

Extent

West	177.245640	**East**	177.714691
North	52.027390	**South**	51.816540

Scale Range

Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:150,000,000

Habitat_Shoreline

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Shoreline, Habitats, Rocky, Wave, Beach, Sand

Summary

This feature class (polygon) was created by referencing shoreline habitat location data from the U.S. Fish and Wildlife Service. The feature class created in ArcCatalog was then added as a layer to ArcMap and digitized by referencing shoreline habitat data via a U.S. Fish and Wildlife Service for the Western Aleutian Islands (Kiska Island). Delineation and description data, for each individual polygon, was added as text in the attribute table.

Description

Assessment of the environmental sensitivity of a particular intertidal habitat is based on an understanding of the dynamics of the coastal environments, not just the substrate type. The sensitivity ranking of a particular intertidal habitat is an integration of the following factors: 1) Shoreline type (substrate, grain size, tidal elevation, origin); 2) Exposure to wave and tidal energy; 3) Biological productivity and sensitivity; 4) Ease of cleanup (trafficability, permeability). These concepts have been used in the development of the ESI, which ranks shoreline environments in terms of their relative sensitivity to oil spills. The original concept of ranking coastal environments on a scale of relative sensitivity was developed at Lower Cook Inlet in 1976 (Michel et al.1978). Generally speaking, areas exposed to high levels of physical energy, such as wave action and tidal currents, rank low on the scale, whereas sheltered areas with associated high biological activity have the highest ranking. The key to the sensitivity ranking is an understanding of the relationships between: shoreline type; substrate; physical processes, sediment transport patterns; product type; and fate and effect of oil. Since 1976, the ESI mapping scheme has been refined and expanded through repeated mapping and spill response experiences on most of the U.S. shorelines, including the Great Lakes. The result of these experiences is a standardized ESI shoreline habitat ranking system, consisting of 25 categories that encompass the general coastal habitats for the entire United States. This ranking system has been adopted by the National Oceanic and Atmospheric Administration and is a primary pollution response tool used by the United States Coast Guard (NOAA, 1997). In addition to the adoption of the ESI scheme by NOAA, the definitions of Environmentally Sensitive Areas (ESAs) as recorded in the Federal Register directly parallel the categories and concepts outlined in the ESI scheme (NOAA, 1994). These guidelines are commonly used for coastal zone management including: permitting, port development and management, and environmental assessment. The ESI shoreline habitats delineated in this atlas are listed below in order of increasing sensitivity: 1A) Exposed Rocky Shores; 2A) Exposed Wave-Cut Platforms in Bedrock; 3A) Fine- to Medium-Grained Sand Beaches; 4) Coarse-Grained Sand Beaches; 5) Mixed Sand and Gravel Beaches;

6A) Gravel Beaches; 6B) Riprap; 7) Exposed Tidal Flats; 8A) Sheltered Rocky Shores; 9A) Sheltered Tidal Flats; 10A) Salt-and Brackish-Water Marshes.

Credits
Source: United States Fish and Wildlife Service

Use limitations
There are no access and use limitations for this item.

Extent

West	177.196187	**East**	177.706867
North	52.137344	**South**	51.822841

Scale Range

Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

Historic_Japanese_Military

File Geodatabase Feature Class

Thumbnail Not Available

Tags
Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Battle of Kiska, Historic, Japanese, Military, Installations, Artillery, Guns, Bases

Summary
This feature class (polygon) was created by referencing location data from historical records from sources documenting the Battle of Kiska. The feature class created in ArcCatalog was then added as a layer to ArcMap and digitized by referencing historical maps from two different sources regarding areas of Japanese occupation on Kiska Island. Site information and descriptions, for each individual polygon, was added as text in the attribute table.

Description
Historical maps from two sources, one of which was provided by the U.S. National Park Service, were referenced to create the areas occupied by Japanese forces (Army and Navy) on Kiska Island. These areas may not be one hundred percent accurate, in terms of coordinates, but is approximate enough to denote the general area of the Japanese military installations. However, anti-aircraft depicted on the historical maps, which are also incorporated into the description of each site (in the attribute table) is accurate as these anti-aircraft sites are within the range of the military installations, per reference to the historical maps of Kiska Island.

Credits
Sources; The Aleutian Warriors: A History of the 11th Air Force & Fleet Air Wing 4, John Haile Cloe, 1990; The Cultural Landscape of the World War II Battlefield of

Kiska, Aleutian Islands, Dirk HR Spennemann, 2011; United States National Park Service

Use limitations

There are no access and use limitations for this item.

Extent

West	177.524149	**East**	177.578269
North	51.994872	**South**	51.945414

Scale Range

Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

AK Hydro Saltwater Inundation Areas

File Geodatabase Feature Class

Thumbnail Not Available

Tags

tideline, coast, Alaska, shoreline, tide, coastline, intertidal, high tide, shore_hl, mean high tide, high, shore, mean high water, foreshore, inundation, Intertidal_PL, AK Hydro

Summary

The dataset was developed for submission to the USGS National Hydrography Dataset (NHD). It contains polygons describing high and low tide shorelines with delineated intertidal areas.

Description

This dataset contains polygons describing high and low tide shorelines with delineated intertidal areas for Southcentral Alaska.

Credits

Jim Schramek and Emil Tucker - USFS Tongass National Forest; Mike Plivelich - University of Alaska Southeast

Use limitations

There are no access and use limitations for this item.

Extent

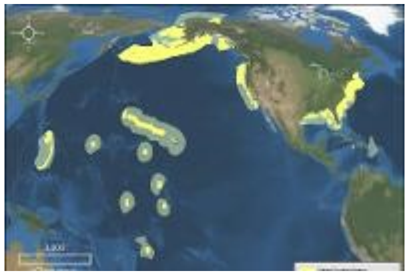
West	-180.000000	**East**	180.000000
North	71.476276	**South**	48.769019

Scale Range

Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

MPAI_v2017

File Geodatabase Feature Class



Tags

Ocean Conservation, North America, Marine Boundaries, Water - Oceans and Coasts, boundaries, United States, Marine Protected Areas, ngda, Marine Conservation Areas, location, oceans

Summary

NOAA's Marine Protected Areas Inventory (v2017) represents a collection of data compiled from various federal, state, tribal and territorial entities to provide a publicly available source of comprehensive information on place-based marine conservation efforts under U.S. federal, state, territorial, local, and tribal jurisdiction.

Description

The MPA Inventory is a comprehensive catalog that provides detailed information for existing marine protected areas in the United States. The inventory provides geospatial boundary information (in polygon format) and classification attributes that seek to define the conservation objectives, protection level, governance and related management criteria for all sites in the database. The comprehensive inventory of federal, state and territorial MPA sites provides governments and stakeholders with access to information to make better decisions about the current and future use of place-based conservation. The information also will be used to inform the development of the national system of marine protected areas as required by Executive Order 13158.

Credits

NOAA Marine Protected Areas Center in joint effort with the US Department of the Interior

Use limitations

These data are in the Public domain. The data are not to be used for navigation. For more information, see the accuracy section.

Extent

West	-180.000000	**East**	180.000000
North	74.709769	**South**	-15.386142

Scale Range

Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

NestingColonies_int

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Survey Areas, Sites, Kiska Harbor, Twin Rocks, Gertrude Cove, North Head, bird nesting colonies

Summary

This feature class (point) was created by using the geoprocessing tool "intersect." The input feature class "Bird_Nesting_Colonies" was intersected with the input class "SurveyAreas" to create the output feature class, "NestingColonies_int" to show what bird nesting colonies are within the survey areas.

Description

This feature class shows what bird nesting colonies are within the Project Recover survey areas.

Credits

Source: Power Point presentation created by both Project Recover and the BentProp Project, 2018; United States Fish and Wildlife Service

Use limitations

There are no access and use limitations for this item.

Extent

West	177.619666	**East**	177.626043
North	51.961983	**South**	51.955588

Scale Range

Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

Pier

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Pier, Kiska Harbor

Summary

This feature class (point) was created by referencing high resolution imagery of Kiska Harbor via GoogleEarth. The feature class created in ArcCatalog was then added as a layer to ArcMap and digitized by referencing Kiska Island via GoogleEarth. Description and measurements were added in the attribute table.

Description

The pier feature class was added to ArcCatalog, then as a layer to ArcMap, and was digitized by referencing GoogleEarth in order to serve as a reference point for the Kiska Harbor area of Kiska Island, Alaska. Measurements of the pier (length and width) are approximate.

Credits

GoogleEarth

Use limitations

There are no access and use limitations for this item.

Extent

West	177.541764	**East**	177.544819
North	51.981442	**South**	51.979529

Scale Range

Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:150,000,000

Pinniped

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Pinniped, Concentration, Seals, Sea Lions

Summary

This feature class (point) was created by referencing location and species data from the U.S. Fish and Wildlife Service. The feature class, created in ArcCatalog was then added as a layer to ArcMap and digitized by referencing location data via a U.S. Fish and Wildlife Service for the Western Aleutian Islands (Kiska Island). Species data and other nomenclature, for each individual point, was added as text in the attribute table.

Description

Marine mammals depicted in the Aleutians West atlas include seals, sea lions, fur seals, walruses, and sea otters. Major haul-out sites for harbor seals, Steller sea lions, and northern fur seals, are depicted. Though only haul-out sites are mapped, seals can occur throughout the nearshore waters. Northern fur seals are currently listed as depleted under the Marine Mammal Protection Act. Expert contacts for marine mammals in the Aleutians are the NMFS National Marine Mammal Lab, Seattle Washington; Brad Smith, NMFS, Anchorage, Alaska; and USFWS Marine Mammals Management, Anchorage, Alaska. Marine mammal concentration areas are displayed on the maps as polygons with a brown hatch pattern. If multiple resource types (marine mammals and birds) occupy the same polygon, a black-hatched multi-group pattern is used. A brown icon with a pinniped or whale silhouette is used to indicate the presence of marine mammals. The RAR# under the icon links to a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been designated as being endangered (E) or threatened (T) on either the state (S) and/or federal (F) lists. The next column provides an estimate of the concentration of the species at the site. Concentration is indicated as "HIGH", "MODERATE", or "LOW", or numeric values are used for seal and sea lion haul-out sites. The species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at that location in a particular month, an "X" is placed in the month column. The final columns list the time periods for sensitive life history stages or activities, such as pupping and molting for seals.

Credits

Source: United States Fish and Wildlife Service

Use limitations

There are no access and use limitations for this item.

Extent

West	177.211058	**East**	177.668748
North	52.135239	**South**	51.820198

Scale Range

Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

Pinniped_int

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Survey Areas, Sites, Kiska Harbor, Twin Rocks, Gertrude Cove, North Head, pinnipeds, steller sea lion

Summary

This feature class (point) was created by using the geoprocessing tool "intersect." The input feature class "Pinniped" was intersected with the input feature class "SurveyAreas" to create the output feature class, "Pinniped_int" to show pinnipeds within the survey areas.

Description

This feature class shows what pinnipeds and species of pinnipeds are within the Project Recover survey areas.

Credits
Source: Power Point presentation created by both Project Recover and the BentProp Project, 2018; United States Fish and Wildlife Service

Use limitations
There are no access and use limitations for this item.

Extent

West	177.575216	**East**	177.606939
North	51.984800	**South**	51.953953

Scale Range

Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

Place_Names

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Place, Name, Harbor, Lagoon

Summary
This feature class (point) was created by referencing locations and place names from historical and current maps. The feature class created in ArcCatalog was then added as a layer to ArcMap and digitized by referencing historical maps of the Battle of Kiska, as well as Google Earth, in order to accurately depict important locations with historical names and/or present day nomenclature. The name of the location, for each individual point, was added as text in the attribute table.

Description
Place names are annotated for various reference points that may be of historic value to the Battle of Kiska and/or of value in present day. These place names also aid in giving reference to locations of importance during the Battle of Kiska.

Credits
Sources: GoogleMaps; The Aleutian Warriors, A History of the 11th Air Force & Fleet Air Wing 4, John Haile Cloe, 1990.

Use limitations
There are no access and use limitations for this item.

Extent

West	177.397378	**East**	177.605065
North	51.998671	**South**	51.913105

Scale Range

Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

Sea_Otter

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Sea Otter, Concentration

Summary

This feature class (point) was created by referencing location and species data from the U.S. Fish and Wildlife Service. The feature class, created in ArcCatalog was then added as a layer to ArcMap and digitized by referencing location data via a U.S. Fish and Wildlife Service for the Western Aleutian Islands (Kiska Island). Species data and other nomenclature, for each individual point, was added as text in the attribute table.

Description

Marine mammals depicted in the Aleutians West atlas include seals, sea lions, fur seals, walruses, and sea otters. For sea otters, concentration areas are shown where surveys have been conducted. Sea otters are present all year along the Aleutian Islands. Though not depicted on the maps, whales are highly mobile species, and they can occur throughout most of the waters. Many of the whales are listed as threatened or endangered species, and all marine mammals are protected under the Marine Mammal Protection Act of 1972. Sea Otters in the Aleutians are a candidate species for listing under the Endangered Species Act. Expert contacts for marine mammals in the Aleutians are the NMFS National Marine Mammal Lab, Seattle Washington; Brad Smith, NMFS, Anchorage, Alaska; and USFWS Marine Mammals Management, Anchorage, Alaska. Marine mammal concentration areas are displayed on the maps as polygons with a brown hatch pattern. If multiple resource types (marine mammals and birds) occupy the same polygon, a black-hatched multigroup pattern is used. A brown icon with a pinniped or whale silhouette is used to indicate the presence of marine mammals. The RAR# under the icon links to a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been designated as being endangered (E) or threatened (T) on either the state (S) and/or federal (F) lists. The next column provides an estimate of the concentration of the species at the site. Concentration is indicated as “HIGH”, “MODERATE”, or “LOW”, or numeric values are used for seal and sea lion haul-out sites. The species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at that location in a particular month, an “X” is placed in the month column. The final columns list the time periods for sensitive life history stages or activities, such as pupping and molting for seals.

Credits

Source: United States Fish and Wildlife Service

Use limitations
There are no access and use limitations for this item.

Extent

West	177.292079	**East**	177.671365
North	52.084319	**South**	51.836617

Scale Range
Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:150,000,000

SeaOtter_int

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Survey Areas, Sites, Kiska Harbor, Twin Rocks, Gertrude Cove, North Head, northern sea otter

Summary
This feature class (point) was created by using the geoprocessing tool "intersect." The input feature class "Sea_Otter" was intersected with the input feature class "SurveyAreas" to create the output feature class, "SeaOtter_int" to show sea otters within the survey areas.

Description
This feature class shows sea otter areas within the Project Recover survey areas.

Credits
Source: Power Point presentation created by both Project Recover and the BentProp Project, 2018; United States Fish and Wildlife Service

Use limitations
There are no access and use limitations for this item.

Extent

West	177.577243	**East**	177.577243
North	51.977319	**South**	51.977319

Scale Range
Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:150,000,000

Sediments_Kiska

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Sediment

Summary

The purpose for creating this data set was to provide the best available sediment information of the Aleutian Islands for predictive, geospatial modeling of sponge and coral abundance and diversity.

Description

We assembled 2.1 million National Ocean Service (NOS) bathymetric soundings extending 1,900 km along the Aleutian Islands from Unimak Island in the east to the Russian border in the west, and ranging approximately 500 km north of the central Aleutians to Petrel and Bowers Banks, and also the surrounding deep waters of the southeastern Bering Sea. These bathymetry data are available from the National Geophysical Data Center (NGDC: http://www.ngdc.noaa.gov), which archives and distributes data that were originally collected by the NOS and others. While various bathymetry data have been downloaded previously from NGDC, compiled, and used for a variety of projects, our effort differed in that we compared and corrected the digital bathymetry by studying the original analog source documents - digital versions of the original survey maps, called smooth sheets. Our editing included deleting erroneous and superseded values, digitizing missing values, and properly aligning all data sets to a common, modern datum. We also digitized 25,000 verbal surficial sediment descriptions from the smooth sheets, providing the largest single source of sediment information for the Aleutians.

Credits

Source: https://www.afsc.noaa.gov/RACE/groundfish/bathymetry/Aleutians.htm

https://www.afsc.noaa.gov/RACE/metadata/Zimmermann_AI_seds.xml#Abstract

https://service.ncddc.noaa.gov/rdn/www/metadata-standards/documents/ncddcmdprofile_v2.pdf

Use limitations

Extent

West	177.216583	**East**	177.768365
North	52.089598	**South**	51.808438

Scale Range

Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

Shoreline_int

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Survey Areas, Sites, Kiska Harbor, Twin Rocks, Gertrude Cove, North Head, shoreline, habitats, rocky, fine to medium grain sand, beaches, salt and brackish water marshes

Summary

This feature class (polygon) was created by using the geoprocessing tool "intersect." The input feature class "Habitat_Shoreline" was intersected with the input feature class "SurveyAreas" to create the output feature class, "Shoreline_int" to show what types of shoreline habitats are within the survey areas.

Description

This feature class shows what types of shoreline habitats are within the Project Recover survey areas.

Credits

Source: Power Point presentation created by both Project Recover and the BentProp Project, 2018; United States Fish and Wildlife Service

Use limitations

There are no access and use limitations for this item.

Extent

West	177.423974	**East**	177.637120
North	51.996832	**South**	51.923119

Scale Range

Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

SideScanTracks_1989

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Side scan sonar, tracks, survey area, Kiska Harbor

Summary

This feature class (contour line) was downloaded via a .zipfile, imported into ArcCatalog as a new feature class, then added as a new layer into ArcMap's Table of Contents.

Description
This feature class displays the side scan sonar tracks in Kiska Harbor done in a 1989 survey and was provided by the Project Recover team.

Credits
Project Recover team

Use limitations
There are no access and use limitations for this item.

Extent

West	177.539598	**East**	177.581051
North	51.980568	**South**	51.957693

Scale Range
Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

Streams

File Geodatabase Feature Class

Thumbnail Not Available

Tags
Kiska Island, Rat Islands, Aleutian Island chain, Alaska, river, channel, water, hydrology, stream, creek, rivers, watercourse, creeks, Alaska, salmon, fish, streams, hydrography, habitat, hydrographic, AWC, Anadromous Waters Catalog, NHD, National Hydrography Dataset, Stream_LN, AK Hydro

Summary
The streams dataset provides channel type classification and stream-class information for forest resource planners, fisheries biologists, hydrologists, and ecologists. Channel types provide information on fish habitat utilization, fish habitat capability, and fisheries enhancement options. They also provide information on suitable stream crossing locations and design criteria for road drainage structures and are useful to evaluate potential sediment delivery and retention for cumulative watershed effects analysis. This particular version of the dataset was developed to submit to the National Hydrography Dataset (NHD). Specifically, stream arcs were extended to the low tide shoreline to ensure inclusion of thousands of feet of the most productive intertidal stream habitats for salmon. Without extending the stream arcs, all or nearly all of the "estuarine" streams channel types would be dropped from the USDA-FS WATER Module under development.

Description
This dataset portrays the linear water features across Alaska. The layer also provides channel type information, stream class information and classifications particular to the State Anadromous Waters Catalog.

Credits
Jim Schramek and Emil Tucker - USFS Tongass National Forest; Mike Plivelich - University of Alaska Southeast; Alaska Department of Fish & Game, Sport Fish Division; Alaska Hydrography Technical Working Group; USGS National Geospatial Technical Operations Center

Use limitations
There are no access and use limitations for this item.

Extent

West	-180.000000	**East**	180.000000
North	71.237459	**South**	49.230804

Scale Range
Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:150,000,000

Streams_int

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Survey Areas, Sites, Kiska Harbor, Twin Rocks, Gertrude Cove, North Head, streams

Summary
This feature class (contour line) was created by using the geoprocessing tool "intersect." The input feature class "Streams" was intersected with the input feature class "SurveyAreas" to create the output feature class, "Streams_int" to show what streams/waterways are within the survey areas.

Description
This feature class shows what streams are within the Project Recover survey areas.

Credits
Source: Power Point presentation created by both Project Recover and the BentProp Project, 2018; Jim Schramek and Emil Tucker - USFS Tongass National Forest; Mike Plivelich - University of Alaska Southeast; Alaska Department of Fish & Game, Sport Fish Division; Alaska Hydrography Technical Working Group; USGS National Geospatial Technical Operations Center

Use limitations
There are no access and use limitations for this item.

Extent

West	177.418539	**East**	177.637120
North	52.038392	**South**	51.913360

Scale Range

Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:150,000,000

StreamsAWC_int

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Survey Areas, Sites, Kiska Harbor, Twin Rocks, Gertrude Cove, North Head, AWC, anadromous waterway, streams

Summary

This feature class (point) was created by using the geoprocessing tool "intersect." The input feature class "AWC_Kiska" was intersected with the input feature class "SurveyAreas" to create the output feature class, "StreamsAWC_int" to show anadromous waterways within the survey areas.

Description

This feature class shows what anadromous waterways are within the Project Recover survey areas.

Credits

Source: Power Point presentation created by both Project Recover and the BentProp Project, 2018; Alaska Department of Fish and Game

Use limitations

There are no access and use limitations for this item.

Extent

West	177.431311	**East**	177.570175
North	51.995948	**South**	51.935052

Scale Range

Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:150,000,000

SurveyAreas

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Survey Areas, Sites, Kiska Harbor, Twin Rocks, Gertrude Cove, North Head

Summary

This feature class (polygon) was created by referencing survey area locations drawn out by the Project Recover team. The feature class created in ArcCatalog was then added as a layer to ArcMap and digitized by referencing survey locations around Kiska Harbor from a power point file created by the Project Recover team leads. The survey area name, for each individual area, were added as text in the attribute table.

Description

The four survey sites around Kiska Island were referenced by a power point file created by Project Recover. Exact coordinates for the survey area are not known. Locations for the survey areas are approximate but encompass the entire area expected to be surveyed by the Project Recover team.

Credits

Source: Power Point presentation created by both Project Recover and the BentProp Project, 2018.

Use limitations

There are no access and use limitations for this item.

Extent

West	177.418539	**East**	177.637120
North	52.038392	**South**	51.913360

Scale Range

Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

Unconfirmed_Side_Scan_Locations1989

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island chain, Alaska, Kiska Harbor, unconfirmed side scan locations, 1989

Summary

This feature class (point) was created by referencing historical data from a prior side scan sonar survey in Kiska Harbor in 1989. The feature class was created in ArcCatalog was then added as a layer to ArcMap and digitized by referencing the 1989 side scan survey data. Descriptions and other data for each individual point, were added as text in the attribute table.

Description

These locations from a 1989 side scan sonar survey of Kiska Harbor are unconfirmed targets. Coordinates are approximate.

Credits

Project Recover team

Use limitations
There are no access and use limitations for this item.

Extent

West	177.543491	**East**	177.564756
North	51.974780	**South**	51.959785

Scale Range

Maximum (zoomed in)	1:5,000
Minimum (zoomed out)	1:150,000,000

Volcano

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island Chain, Alaska, Volcano, Morphology, Geothermal

Summary
This feature class (point) was created by referencing location data from the U.S. Fish and Wildlife Service. The feature class created in ArcCatalog was then added as a layer to ArcMap and digitized by referencing volcano location data via a U.S. Fish and Wildlife Service for the Western Aleutian Islands (Kiska Island). Data and information pertinent to the volcano was added as text in the attribute table.

Description
Volcanism in the Aleutian Islands Arc is brought about by the ongoing subduction of the Pacific plate beneath the North American plate. As the oceanic crust of the Pacific plate migrates northwestward, it is overridden or subducted by the less dense crust of the North American plate. As the Pacific plate compresses, bends, and sinks beneath the North American plate, the pressure and temperatures increase greatly, converting solid rock into liquid magma. The magma, superheated and less dense than the material surrounding it, seeks a density equilibrium and rises towards the surface. These continuous tectonic processes have created the current assemblage of 89 Quaternary volcanoes distributed throughout the Aleutian chain. The natural and human development of each island in the chain has been and will continue to be affected by the eruptive capacity of these volcanoes. Evaluation of the risk posed by individual volcanoes must take into account complex relationships between the size of an eruptive event and probability. These relationships are beyond the scope of this atlas. Suffice to say that a highly improbable large scale eruption will obviously have greater numbers of potentially destructive processes associated with it but, by nature of its improbability, pose a lower over- all risk than more probable smaller scale eruptive events.

Current morphology for the Kiska Volcano is "Strato," meaning that it is composed of both volcanic flows and ejected tephra and pyroclastics. Pyroclastic flows and surges consist of extremely hot material traveling down the flanks of the volcano, pyroclastic flows are a risk only to those in their path. Like all gravity driven flow. They will seek the lowest ground, and hence, tend to concentrate in valleys. Typically, they travel no further than 10-15 km from the source The majority of the Aleutian volcanoes are of this type. The Kiska Volcano is at an elevation of 1,220 meters, has had 6 events since 1760, and the geothermal potential is "fair."

Credits
Source: The United States Fish and Wildlife Service

Use limitations
There are no access and use limitations for this item.

Extent

West	177.602376	**East**	177.602376
North	52.098273	**South**	52.098273

Scale Range
Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:150,000,000

Wrecks_Confirmed

File Geodatabase Feature Class

Thumbnail Not Available

Tags

Kiska Island, Rat Islands, Aleutian Island chain, Alaska, Kiska Harbor, confirmed targets, wrecks, 1989

Summary
This feature class (point) was created by referencing historical data from a prior side scan sonar survey in Kiska Harbor in 1989. The feature class was created in ArcCatalog was then added as a layer to ArcMap and digitized by referencing the 1989 side scan survey data. Descriptions and other data for each individual point, were added as text in the attribute table.

Description
These locations from a 1989 side scan sonar survey of Kiska Harbor are unconfirmed targets. Coordinates are approximate.

Credits
Project Recover team

Use limitations
There are no access and use limitations for this item.

Extent

West	177.538900	**East**	178.133300
North	52.283330	**South**	51.961940

Scale Range
Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:150,000,000