Ecological Atlas of the Bering, Chukchi, and Beaufort Seas, 2nd Edition: Metadata

Chapter 7: Human Uses

Shortcut to metadata for

Map 7.2 Transportation and Energy Infrastructure

MAPPING METHODS (MAP 7.2)

Map 7.2 shows three main types of infrastructure: terrestrial, marine, and aviation. Terrestrial data include roads and power plants. Power plant data for the US were compiled from a series of surveys conducted, collected, and aggregated by the US Energy Information Administration (2016): Annual Electric Generator Report (EIA-860), Monthly Update to the Annual Electric Generator Report (EIA-860M), and Power Plant Operations Report (EIA-923). Smaller power plants, with no capacity reported, were georeferenced from a report by Melendez and Fay (2012). For Russia, only the locations of power plants were used from the Carbon Monitoring for Action (CARMA) database (Ummel 2012, Carbon Monitoring for Action 2016) due to issues with accuracy. Canadian power plants were manually digitized from Canadian Electricity Association (2016).

Marine data—ports, harbors, ferry terminals, and ferry routes—were downloaded from the Alaska Department of Transportation and Public Facilities (2016a, b) and georeferenced from Alaska Marine Highway System (2016b).

Aviation data were based on information from the US Department of Transportation: US airports (with passenger and cargo/mail volume by year) and Russian and Canadian airport locations (US Department of Transportation 2016a, b). The Quintillion Subsea Cable System was manually digitized from maps showing the project's extent (National Oceanic and Atmospheric Administration 2016c).

Data Quality

Based on comparisons with US Energy Information Administration data, the CARMA estimates for power plant capacity were vastly different from actual output for power plants in the US. Because of this, only the locations of power plants in Russia were used from the CARMA dataset.

Many datasets were not available in a spatial format and were instead manually digitized from existing maps. We attempted to ensure that the estimated locations were as close as possible to the original data, but the locations of Canadian power plants, the Alaska Marine Highway System route, and the Quintillion Cable System should still be considered approximate rather than exact.

MAP DATA SOURCES

Power Plants: Canadian Electricity Association (2016); Carbon Monitoring for Action (2016); Melendez and Fay (2012); Ummel (2012); US Energy Information Administration (2016)

Airports: US Department of Transportation (2016a, b)

Ports, Harbors, and Ferry Terminals: Alaska Department of Transportation and Public Facilities (2016a, b)

Ferry Routes: Alaska Marine Highway System (2016b)

Quintillion Subsea Cable System: National Oceanic and Atmospheric Administration (2016c)

Reference list available here.

Map 7.3 Petroleum Exploration and Development

MAPPING METHODS (MAP 7.3)

Map 7.3 shows likely target areas for future offshore petroleum exploration and development (sedimentary basins), as well as offshore areas where exploration, leasing, and development have already occurred. Data are based on a synthesis of literature on the geology and petroleum potential of the region.

The offshore sedimentary basin data are mapped based on published figures and maps showing acoustic basement depth, highlighting sediments located 2–4 miles (3–6 km) below the seafloor, a region with the highest likelihood of maturation inside the oil window. Data are displayed with shaded contours to give a general impression of basin shape. This information was compiled from Drachev et al. (2010), Grantz et al. (2010), Grantz et al. (2011), Miller et al. (2002), and Worrall (1991).

In Alaska, OCS leasing information includes BOEM program areas and Presidential Withdrawals, as well as active and historical leases. The mapped program areas and Presidential Withdrawals are published in BOEM's 2017–2022 OCS Oil and Gas Leasing Proposed Final Program (Bureau of Ocean Energy Management 2016a); GIS data were downloaded from Bureau of Ocean Energy Management (2016b) and are current as of early April 2017. Since the withdrawal publication, President Trump issued an Executive Order that, among other actions, retracted the Chukchi and Beaufort Sea withdrawals. The President's authority to undo these withdrawals has been challenged in court, therefore these areas were left on the map and labeled as contested. Active and historical lease data for Alaska were downloaded from Bureau of Ocean Energy Management (2016b) and are current as of May 2017.

Leasing data for Canada were available from Indigenous and Northern Affairs Canada (2016), while leasing data for Russia were from Rosneft (2016).

Well data, shown for both exploration and production wells, were available for Alaska and Canada from Alaska Oil and Gas Conservation Commission (2016) and National Energy Board (2014), respectively.

Potential deep-water ports are shown based on the top two candidate locations identified in a US Army Corps of Engineers Deep-Draft Arctic Port Study (US Army Corps of Engineers and Alaska Department of Transportation and Public Facilities 2013).

Data Quality

Our current understanding of the region's offshore geology and its petroleum system remains surprisingly broad-brush and decidedly incomplete. First-order conceptual models concerning tectonic effects on hydrocarbon generation and migration are still being tested. While abundant source rocks occur throughout the circumpolar Arctic in rock formations young and old (Proterozoic to Paleogene age), uncertainty remains as to where the resource has been trapped by the folds, faults, and unconformities visible in seismic images (Spencer et al. 2011).

Seismic imagery, gravity data, limited shallow scientific well logs, and five industry well logs are the primary sources of subsurface geologic knowledge for offshore areas of the Chukchi and Beaufort Seas region. Two-dimensional and three-dimensional seismic data acquired by vessel-towed arrays are by far the most important. There is, however, no single seismic coverage for the map area. Likewise, there is no single sensor used to acquire seismic data, nor to process the raw signal into depth-converted, interpretable images. Dozens of companies have collected, processed, and interpreted their own data for use on specific, local projects without regard for non-industry users. Publications that result from these interpretations do not often conform to mapping standards. Basin boundaries and sediment thickness isopachs depicted here were compiled from publicly available sources, and sediment thickness contours on published maps routinely differed. The data are displayed using unlabeled, shaded contours to give a general impression of basin shape.

The leasing and well data are most complete for Alaska and Canada. These data are most detailed for Alaska, the portion of the project area where the majority of petroleum exploration and production has taken place to date. Little to no petroleum production has yet occurred in the Canadian and Russian portions of the project area. Leasing and well data in the Russian portion of the Bering Sea were unavailable.

MAP DATA SOURCES

Sedimentary Basins: Drachev et al. (2010); Grantz et al. (2010, 2011); Miller et al. (2002); Worrall (1991)

BOEM Program Areas and Presidential Withdrawals: Bureau of Ocean Energy Management (2016a, b)

Leases: Alaska – Bureau of Ocean Energy Management (2016b)
Canada – Indigenous and Northern Affairs Canada (2016)
Russia – Rosneft (2016)

Wells: Alaska – Alaska Oil and Gas Conservation Commission (2016)
Canada – National Energy Board (2014)

Potential Deepwater Ports: US Army Corps of Engineers and Alaska Department of Transportation and Public Facilities (2013)

Reference list available here.

Map 7.5.1 Vessel Density

MAPPING METHODS (MAPS 7.5.1–7.5.3)

Vessel traffic data were acquired in CSV format from exactEarth (2017) in the form of satellite-based Automatic Identification System (AIS) data. We built an R script to clean the data, remove spurious records, and build tracks. A separate track was built for each vessel for each day. Due to data volume (>100 GB in total; ~10,000,000 records for each month), data were first sorted by date and vessel ID, then parsed into sequences of 1 million points, and finally batch processed.

The output tracks were intersected with a 3-mile (5-km) buffer of Alaska, Canada, and Russia landmasses to remove tracks that ran on land, producing a cleaned track file.

After the cleaned track files were developed, all tracks for 2015 and 2016 were merged, and a pixelate function with cell size of 6 miles (10 km) was run to calculate how many total miles were traveled by all vessels in each cell. To generate finer-scale data suitable for representation in regional maps, these processes were re-run at a cell size of 0.6 mile (1 km) and 1.5 miles (2.5 km) for Unimak Pass and Bering Strait, respectively.

To calculate concentration areas, we filtered data by ship type. For each type, we used a 75% contour from the isopleth function from the Geospatial Modeling Environment in ArcMap. Resulting contours were manually smoothed.

Data Quality

AIS data accuracy and completeness is limited by the distribution of AIS receivers. We used data collected by a series of polar-orbiting satellites, which provide more extensive geographic coverage but more limited precision than a network of land-based receivers.

Due to AIS latency (periods of time when no satellite is in range) and potential errors in the data, some accuracy issues may exist for individual tracks. Approximately 0.001% of the date/time data were received incorrectly and omitted. Approximately 0.4% of the latitude/longitude data were invalid (either latitude = 91 or longitude = 181). Depending on the month, between 0.9% and 6% of generated tracks ran on land (and were therefore omitted from the analysis). Finally, a few individual AIS locations were transmitted incorrectly and represented significant divergence from previous and subsequent points. Although tracks were constructed using these incorrect locations, these were manually identified and removed in the finer-scale Unimak Pass and Bering Strait data analysis.

MAP DATA SOURCES

Vessel Traffic Data: Audubon Alaska (2017) based on exactEarth (2017)

Reference list available here.

Map 7.5.2 Vessel Traffic Patterns

MAPPING METHODS (MAPS 7.5.1–7.5.3)

Vessel traffic data were acquired in CSV format from exactEarth (2017) in the form of satellite-based Automatic Identification System (AIS) data. We built an R script to clean the data, remove spurious records, and build tracks. A separate track was built for each vessel for each day. Due to data volume (>100 GB in total; ~10,000,000 records for each month), data were first sorted by date and vessel ID, then parsed into sequences of 1 million points, and finally batch processed.

The output tracks were intersected with a 3-mile (5-km) buffer of Alaska, Canada, and Russia landmasses to remove tracks that ran on land, producing a cleaned track file.

After the cleaned track files were developed, all tracks for 2015 and 2016 were merged, and a pixelate function with cell size of 6 miles (10 km) was run to calculate how many total miles were traveled by all vessels in each cell. To generate finer-scale data suitable for representation in regional maps, these processes were re-run at a cell size of 0.6 mile (1 km) and 1.5 miles (2.5 km) for Unimak Pass and Bering Strait, respectively.

To calculate concentration areas, we filtered data by ship type. For each type, we used a 75% contour from the isopleth function from the Geospatial Modeling Environment in ArcMap. Resulting contours were manually smoothed.

To prepare the Vessel Traffic Patterns map, we began with the prepared 2016 vessel traffic rasters for each ship type: Tow/Tug, Cargo, Tanker, and Other (excluding Fishing). Focal Statistics were calculated on each in ArcMap, generating new rasters representing the maximum value within 31 miles (50 km) of each original pixel. Point samples of these new rasters were taken at hand-selected intervals along the visually-apparent main traffic routes. By taking the maximum value within 31 miles (50 km), our results were less sensitive to variations in the choice of point sample location. The approximate routes for each ship were then manually drawn, connecting the sampling points. For each ship type, the width of the line was fixed at each sample point to be proportional to the square root of the sample value; line widths were tapered smoothly between sample points.

Data Quality

AIS data accuracy and completeness is limited by the distribution of AIS receivers. We used data collected by a series of polar-orbiting satellites, which provide more extensive geographic coverage but more limited precision than a network of land-based receivers.

Due to AIS latency (periods of time when no satellite is in range) and potential errors in the data, some accuracy issues may exist for individual tracks. Approximately 0.001% of the date/time data were received incorrectly and omitted. Approximately 0.4% of the latitude/longitude data were invalid (either latitude = 91 or longitude = 181). Depending on the month, between 0.9% and 6% of generated tracks ran on land (and were therefore omitted from the analysis). Finally, a few individual AIS locations were transmitted incorrectly and represented significant divergence from previous and subsequent points. Although tracks were constructed using these incorrect locations, these were manually identified and removed in the finer-scale Unimak Pass and Bering Strait data analysis.

MAP DATA SOURCES

Vessel Traffic Data: Audubon Alaska (2017) based on exactEarth (2017)

Reference list available here.

Maps 7.5.3a–m Vessel Traffic by Month

MAPPING METHODS (MAPS 7.5.1–7.5.3)

Vessel traffic data were acquired in CSV format from exactEarth (2017) in the form of satellite-based Automatic Identification System (AIS) data. We built an R script to clean the data, remove spurious records, and build tracks. A separate track was built for each vessel for each day. Due to data volume (>100 GB in total; ~10,000,000 records for each month), data were first sorted by date and vessel ID, then parsed into sequences of 1 million points, and finally batch processed.

The output tracks were intersected with a 3-mile (5-km) buffer of Alaska, Canada, and Russia landmasses to remove tracks that ran on land, producing a cleaned track file.

After the cleaned track files were developed, all tracks for 2015 and 2016 were merged, and a pixelate function with cell size of 6 miles (10 km) was run to calculate how many total miles were traveled by all vessels in each cell. To generate finer-scale data suitable for representation in regional maps, these processes were re-run at a cell size of 0.6 mile (1 km) and 1.5 miles (2.5 km) for Unimak Pass and Bering Strait, respectively.

To calculate concentration areas, we filtered data by ship type. For each type, we used a 75% contour from the isopleth function from the Geospatial Modeling Environment in ArcMap. Resulting contours were manually smoothed.

Data Quality

AIS data accuracy and completeness is limited by the distribution of AIS receivers. We used data collected by a series of polar-orbiting satellites, which provide more extensive geographic coverage but more limited precision than a network of land-based receivers.

Due to AIS latency (periods of time when no satellite is in range) and potential errors in the data, some accuracy issues may exist for individual tracks. Approximately 0.001% of the date/time data were received incorrectly and omitted. Approximately 0.4% of the latitude/longitude data were invalid (either latitude = 91 or longitude = 181). Depending on the month, between 0.9% and 6% of generated tracks ran on land (and were therefore omitted from the analysis). Finally, a few individual AIS locations were transmitted incorrectly and represented significant divergence from previous and subsequent points. Although tracks were constructed using these incorrect locations, these were manually identified and removed in the finer-scale Unimak Pass and Bering Strait data analysis.

MAP DATA SOURCES

Vessel Traffic Data: Audubon Alaska (2017) based on exactEarth (2017)

Reference list available here.

Map 7.7 Fisheries Management Conservation Areas

MAPPING METHODS (MAP 7.7)

Fisheries management areas were obtained directly from the National Oceanic and Atmospheric Administration (NOAA) (National Oceanic and Atmospheric Administration 2016a, b), the managing entity for fisheries in the federal waters of Alaska. State fishery regulations were not depicted as these maps are not the appropriate scale for that information. Conservation areas in Russian waters and the Canadian Beaufort were obtained from the Marine Conservation Institute (2017) and Sasha Moiseev, WWF Russia (pers. comm.). The proposed Arctic High Seas Fisheries Moratorium was digitized based on descriptions of the interim measures in the Declaration Concerning The Prevention Of Unregulated High Seas Fishing in the Central Arctic Ocean (Regjeringen 2015).

This map also depicts the top fishing ports of Alaska, as identified by the National Marine Fisheries Service (2015).

Fish catch data are from the Alaska Fisheries Science Center (2016) Observer Groundfish Program. For this map, we selected all observed catch for all gear types from 2010–2015 and then calculated the average catch (in kilograms) for all years. Catch values were then converted to metric tons and then interpolated using the Inverse Distance Weighted (IDW) tool in ArcGIS version 10.5. A power of 2 was used and a search radius of 12 points was set as the maximum distance for interpolation.

The sea-ice data shown on this map approximate median monthly sea-ice extent. The monthly sea-ice lines are based on an Audubon Alaska (2016) analysis of 2006 to 2015 monthly sea-ice extent data from the National Snow and Ice Data Center (Fetterer et al. 2016). See Sea Ice Mapping Methods section for details.

Data Quality
Data quality and coverage through the US EEZ off Alaska is excellent. Fisheries management conservation areas are straightforward regulatory boundaries and information about management measures is readily available.

The federal groundfish fisheries catch and location are estimated and recorded by independent fisheries observers onboard vessels. The observed catch is summarized and accessible online (Alaska Fisheries Science Center 2016), however the location and amount of a small proportion of catch is deemed confidential and not released to the public.

MAP DATA SOURCES

Management Areas: Marine Conservation Institute (2017); National Oceanic and Atmospheric Administration (2016a, b); Regjeringen (2015); Russian Federation Ministry of Agriculture (2013)

Commercial Fish Landing Ports: National Marine Fisheries Service (2015); Russian Federation Ministry of Agriculture (2013)

Observed Catch: Alaska Fisheries Science Center (2016)

Sea Ice: Audubon Alaska (2016) based on Fetterer et al. (2016)

Reference list available here.

Maps 7.8.1a–g Subsistence Harvest Areas by Species

MAPPING METHODS MAPS

Subsistence information is mapped on two types of maps. Marine subsistence use areas are shown on seven maps, each pertaining to a species group (Maps 7.8.1a-g). A separate map shows relative proportions of marine resources harvested by coastal communities throughout Alaska (Map 7.8.2).

Harvest Areas (Maps 7.8.1a–7.8.1g)
Maps 7.8.1a–7.8.1g show marine areas where use by subsistence harvesters for marine birds and eggs, fish, marine invertebrates, polar bears, seals, walrus, and whales has been documented. Unmarked areas of the maps are areas where we could not obtain needed spatial data, where spatial data do not exist, or are areas not used for subsistence harvest; an unmarked area does not necessarily indicate non-use.

The mapped data were largely provided from two sources: Oceana and Kawerak's Bering Strait Marine Life and Subsistence Use Data Synthesis (Oceana and Kawerak 2014) and data compiled by Stephen R. Braund and Associates (2016).

Data in the Bering Strait region were compiled in Oceana and Kawerak (2014) based on subsistence data collected from TK experts from nine Bering Strait tribes during Kawerak's Ice Seal and Walrus Project in Kawerak (2013), as well as several other data sources. The data were updated based on a February 2017 workshop with Bering Strait region TK experts who reviewed Audubon Alaska's draft subsistence harvest areas maps (Audubon Alaska et al. 2017).

For North Slope communities, marine subsistence harvest areas were compiled by Stephen R. Braund and Associates based on numerous data sources published between 1979 and 2014, as listed in the Map Data Sources section.

The "Extent of Marine Subsistence Harvest Areas" line shown on these maps represents the farthest offshore extent of all marine subsistence harvest-area data obtained for our project. As previously indicated, lack of data beyond this line does not necessarily indicate non-use beyond this extent.

Data Quality

Marine subsistence data across the project area are incomplete. In a number of portions of the project area, there were limitations in the availability of spatial data. Data from some regions, though documented, sought but were unavailable for inclusion in this publication: Northwest Arctic Borough's Iñuuniaḷiqput Iḷiḷugu Nunaŋŋuanun: Documenting Our Way of Life through Maps (Satterthwaite-Phillips et al. 2016), data from community conservation plans for communities in the Inuvialuit Settlement Region of Canada (Joint Secretariat Environmental Impact Screening Committee 2008), the Bering Sea Elders Advisory Group's Northern Bering Sea: Our Way of Life (Bering Sea Elders Advisory Group 2011), data from the Bering Sea Sub-Network (available, but used different methods), and spatial harvest-area data from specific subsistence studies conducted by the Alaska Department of Fish and Game. Subsistence data collection focused exclusively on existing, previously published datasets. Of the two datasets we were able to use (for the North Slope and Bering Strait regions), both were collected using robust methods documenting subsistence use by communities. For the North Slope, these data were collected, prepared, and shared with us by Stephen R. Braund and Associates. For the Bering Strait region, our access to the data required a review workshop with their TK experts. See the Introduction Chapter sections on Use of Traditional Knowledge and Subsistence Use Datasets, and A Closer Look: Kawerak's Contribution of Traditional Knowledge. Data for the North Slope were not further reviewed by TK experts from that region.

Subsistence harvest-area data are shown only for portions of Alaska. For regions where marine subsistence data were available and are shown on our maps, polygons indicate that subsistence harvest activities occur in these areas. Unmarked areas are areas where spatial data were not available to us, where information has not been spatially documented, or are areas that are not used for subsistence harvest of a particular species. An unmarked area does not necessarily indicate non-use.

MAP DATA SOURCES

Birds and Eggs: Audubon Alaska et al. (2017); Oceana and Kawerak (2014) based on Bering Straits Coastal Resource Service Area (1984), National Oceanic and Atmospheric Administration (1988), and Sobelman (1985); Stephen R. Braund and Associates compiled based on Braund and Burnham (1984), Impact Assessment Inc. (1989), Nelson (1981), Pedersen (1979, 1986), Stephen R. Braund and Associates (2003, 2010, 2013c, 2014, 2017), and Stephen R. Braund and Associates and Institute of Social and Economic Research (1993a)

Fishes: Audubon Alaska et al. (2017); Oceana and Kawerak (2014) based on Bering Straits Coastal Resource Service Area (1984), Jorgenson (1984), Magdanz and Olanna (1986), National Oceanic and Atmospheric Administration (1988), and Raymond-Yakoubian (2013); Stephen R. Braund and Associates compiled based on Braund and Burnham (1984), Brown (1979), Impact Assessment Inc. (1989), Nelson (1981), Pedersen (1979, 1986), Pedersen and Linn (2005), Stephen R. Braund and Associates (2003, 2010, 2013b, 2013c, 2014, 2017), and Stephen R. Braund and Associates and Institute of Social and Economic Research (1993a)

Marine Invertebrates: Audubon Alaska et al. (2017); Oceana and Kawerak (2014) based on Bering Straits Coastal Resource Service Area (1984), Jorgenson (1984), Magdanz and Olanna (1986), and National Oceanic and Atmospheric Administration (1988); Stephen R. Braund and Associates compiled based on Pedersen (1979)

Polar Bears: Audubon Alaska et al. (2017); Oceana and Kawerak (2014) based on National Oceanic and Atmospheric Administration (1988) and Sobelman (1985); Stephen R. Braund and Associates compiled based on Braund and Burnham (1984), Impact Assessment Inc. (1989), Pedersen (1979, 1986), Stephen R. Braund and Associates (2014, 2017), and Stephen R. Braund and Associates and Institute of Social and Economic Research (1993a)

Seals: Audubon Alaska et al. (2017); Oceana and Kawerak (2014) based on Bering Straits Coastal Resource Service Area (1984), Jorgenson (1984), Kawerak (2013), Magdanz and Olanna (1986), National Oceanic and Atmospheric Administration (1988), C. Pungowiyi (pers. comm. 2008), and Sobelman (1985); Stephen R. Braund and Associates compiled based on Braund and Burnham (1984), Brown (1979), Impact Assessment Inc. (1989), Nelson (1981), Pedersen (1979, 1986), Stephen R. Braund and Associates (2003, 2010, 2013c, 2014, 2017), and Stephen R. Braund and Associates and Institute of Social and Economic Research (1993a)

Walrus: Audubon Alaska et al. (2017); Oceana and Kawerak (2014) based on Bering Straits Coastal Resource Service Area (1984), Jorgenson (1984), Kawerak (2013), National Oceanic and Atmospheric Administration (1988), and C. Pungowiyi (pers. comm. 2008); Stephen R. Braund and Associates compiled based on Braund and Burnham (1984), Impact Assessment Inc. (1989), Nelson (1981), Pedersen (1979, 1986), Stephen R. Braund and Associates (2010, 2013c, 2014, 2017), and Stephen R. Braund and Associates and Institute of Social and Economic Research (1993a)

Whales: Audubon Alaska et al. (2017); North Slope Borough Department of Planning and Community Services: Geographic Information Systems Division (2003); Oceana and Kawerak (2014) based on Bering Straits Coastal Resource Service Area (1984), Jorgenson (1984), and North Slope Borough Department of Planning and Community Services: Geographic Information Systems Division (2003); Stephen R. Braund and Associates compiled based on Braund and Burnham (1984), Impact Assessment Inc. (1989), Nelson (1981), Pedersen (1979, 1986), Stephen R. Braund and Associates (2003, 2010, 2011, 2013c, 2014, 2017), and Stephen R. Braund and Associates and Institute of Social and Economic Research (1993a)

Extent of Marine Subsistence Harvest Areas: Compiled data for all species based on all data sources listed above.

Reference list available here.

Map 7.8.2 Reported Subsistence Harvest

MAPPING METHODS MAPS (7.8.2)

Subsistence information is mapped on two types of maps. Marine subsistence use areas are shown on seven maps, each pertaining to a species group (Maps 7.8.1a-g). A separate map shows relative proportions of marine resources harvested by coastal communities throughout Alaska (Map 7.8.2).

Reported Subsistence Harvest

Map 7.8.2 shows the average per capita harvest of subsistence categories taken from coastal US federal subsistence regions within our project area. Data for these maps were downloaded from the Alaska Department of Fish and Game's Community Subsistence Harvest Information System (CSIS) (Alaska Department of Fish and Game 2017) for the Most Representative Year, as defined by CSIS, from each community in our project area for which a comprehensive survey has been conducted.

To get mean harvest for each subsistence category (marine invertebrates, fish, birds and eggs, land mammals, marine mammals, and vegetation), we averaged the harvested-pounds-per-capita data across each region, which were calculated by Alaska Department of Fish and Game (2017), across each federal subsistence region.

The marine mammal and fish categories are further split into subcategories: seals, whales, polar bears, walrus, and sea lions for marine mammals, and salmon and non-salmon for fish. Harvested-pounds-per-capita for these subcategories were calculated by Alaska Department of Fish and Game (2017) for each community, and we averaged each subcategory across each federal subsistence region. There are other marine mammal subcategories defined in CSIS (such as porpoises) that are not shown on our map. However harvest of these other species subcategories makes up less than 0.1% of total marine mammal pounds-per-capita harvest in the federal subsistence regions within our project area.

Data Quality
Alaska Department of Fish and Game (2017) subsistence harvest data are available only for the Alaska portion of our project area. These data give a sense of which types of subsistence resources are used by Alaskan communities. However, data for many communities are incomplete, many have never been surveyed, and some have not been surveyed for decades. Community harvest of specific resources fluctuates over time depending on a variety of factors. The average per capita harvest data map should be viewed with these issues in mind.

MAP DATA SOURCES
Reported Subsistence Harvest: Alaska Department of Fish and Game (2017)

Reference list available here.

Map 7.10 Conservation Areas

MAPPING METHODS (MAP 7.10)
Conservation areas were derived from the Arctic Council's Conservation of Arctic Flora and Fauna (CAFF) working group (2017a). CAFF classifies protections into multiple categories that translate measures across international borders. We mapped the following designations together: Ia—Strict Nature Reserves; Ib—Wilderness Areas; II, III, and V—National Park, National Monument, or Similar; IV—National Wildlife Refuge or Habitat/Species Management Area; VI and Other—Protected Area with Sustainable Use of Natural Resources or MPAs. Ramsar Sites and World Heritage Sites were also downloaded from CAFF (2017c). ATBAs were digitized from the Aleutian Islands Risk Assessment and the eastern Bering Sea PARS (Nuka Research and Planning Group 2015, US Coast Guard 2016). Oil and gas withdrawals were from Bureau of Ocean Energy Management (2016b). The mapped program areas were published in BOEM's 2017–2022 OCS Oil and Gas Leasing Proposed Final Program (Bureau of Ocean Energy Management 2016a). The GIS data were downloaded from Bureau of Ocean Energy Management (2016b) and were current as of April 2017. In May 2017, President Trump wrote an Executive Order retracting the Chukchi and Beaufort Sea withdrawals, among others. The legality of the president's action to reverse withdrawals is under review, therefore the areas under legal review were left on the map and labeled as contested.

MAP DATA SOURCES
Arctic Boundary: Conservation of Arctic Flora and Fauna (2017b)

Areas to be Avoided: Nuka Research and Planning Group (2015); US Coast Guard (2016)

Conservation Areas: Conservation of Arctic Flora and Fauna (2017a)

Oil and Gas Withdrawals: Bureau of Ocean Energy Management (2016a, b)

World Heritage and Ramsar Sites: Conservation of Arctic Flora and Fauna (2017c)

Reference list available here.