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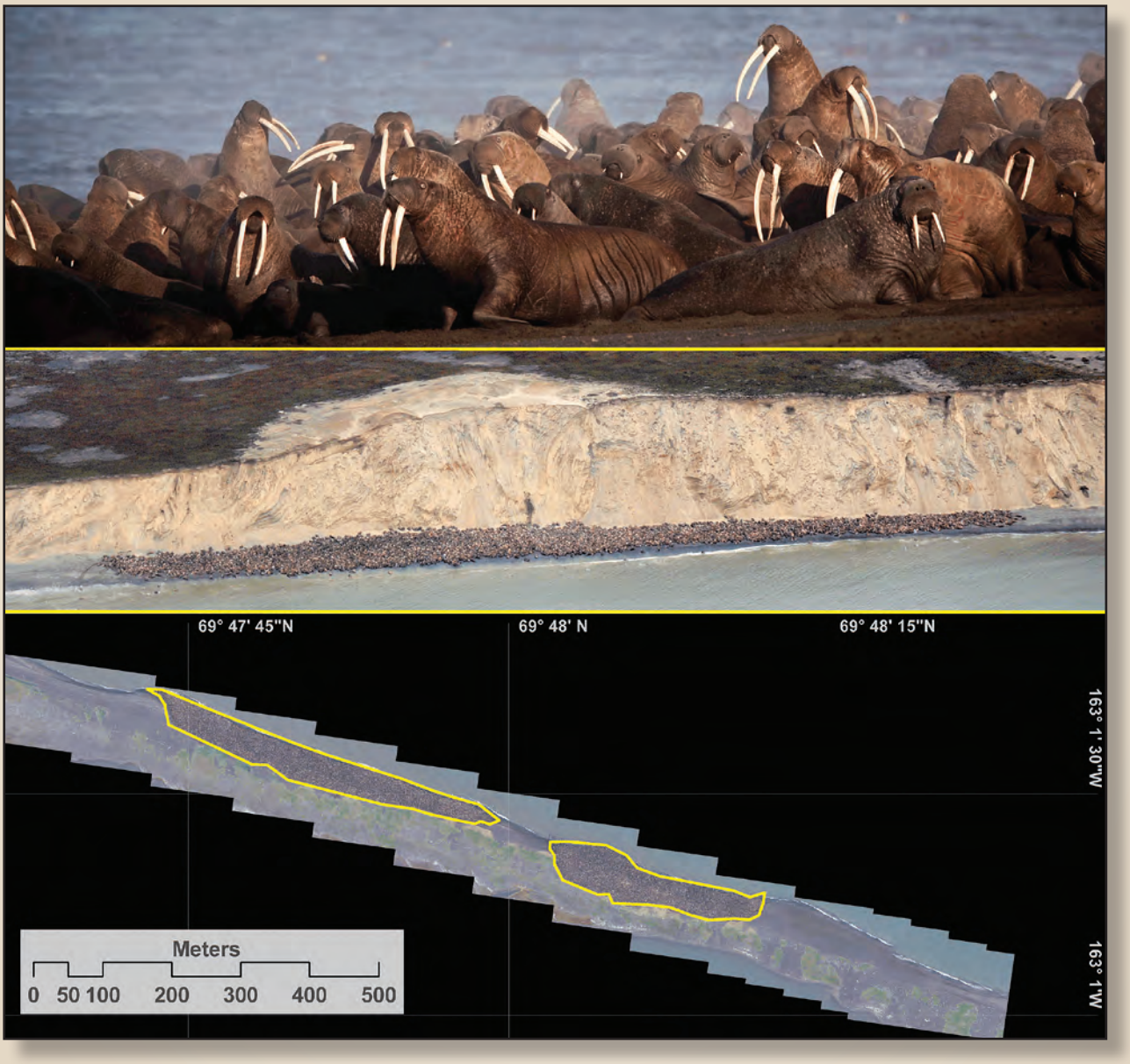
Pacific Walrus Coastal Haulout Database, 1852–2016—Background Report



Open-File Report 2016–1108

U.S. Department of the Interior
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Cover: Images of walrus haulouts. A ground level view of an autumn haulout with adult females and young (Point Lay, Alaska, September, 25, 2013) is shown in the top panel. An aerial composite image of a large haulout with more than 1,000 male walruses is shown in the middle panel (Cape Greig, Alaska, May 3, 2016). A composite image of a very large haulout with tens of thousands of adult female walruses and their young is shown in the bottom panel in which the outlines of the haulout is highlighted in yellow (Point Lay, Alaska, August 26, 2011). Photo credits (top panel: Ryan Kingsbery, USGS; middle panel: Sarah Schoen, USGS; bottom panel: USGS).

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Conversion Factors

Inch/Pound to International System of Units

Multiply	By	To obtain
	Length	
foot (ft)	3.281	meter (m)
mile (mi)	1.609	kilometer (km)
mile, nautical (mm)	1.852	kilometer (km)
yard (yd)	1.094	meter (m)

Pacific Walrus Coastal Haulout Database, 1852–2016—Background Report

By Anthony S. Fischbach[1], Anatoly A. Kochnev[2], Joel L. Garlich-Miller[3], and Chadwick V. Jay[1]

Abstract

Walruses are large benthic predators that rest out of water between foraging bouts. Coastal "haulouts" (places where walruses rest) are formed by adult males in summer and sometimes by females and young when sea ice is absent, and are often used repeatedly across seasons and years. Understanding the geography and historical use of haulouts provides a context for conservation efforts. We summarize information on Pacific walrus haulouts from available reports (n =151), interviews with coastal residents and aviators, and personal observations of the authors. We provide this in the form of a georeferenced database that can be queried and displayed with standard geographic information system and database management software. The database contains 150 records of Pacific walrus haulouts, with a summary of basic characteristics on maximum haulout aggregation size, age-sex composition, season of use, and decade of most recent use. Citations to reports are provided in the appendix and as a bibliographic database. Haulouts were distributed across the coasts of the Pacific walrus range; however, the largest (maximum >10,000 walruses) of the haulouts reported in the recent 4 decades (n=19) were concentrated on the Russian shores in regions near the Bering Strait and northward into the western Chukchi Sea (n=17). Haulouts of adult female and young walruses primarily occurred in the Bering Strait region and areas northward, with others occurring in the central Bering Sea, Gulf of Anadyr, and Saint Lawrence Island regions. The Gulf of Anadyr was the only region to contain female and young walrus haulouts, which formed after the northward spring migration and prior to autumn ice formation.

Introduction

The Pacific walrus (*Odobenus rosmarus divergens*) is one of two subspecies and represents about 90 percent of the worldwide number of walruses (Fay, 1985). The Pacific walrus ranges across the broad and shallow continental shelves of the Bering and Chukchi Seas that extend between the United States and the Russian Federation. Walruses are benthic predators that spend most of their time at sea where they forage primarily on organisms that live in and on marine sediments. Between foraging bouts, walruses rest out of the water. Coastal

[1]U.S. Geological Survey.

[2]ChukotTINRO [Pacific Research Fisheries Center, Chukotka Branch], Anadyr, Chukotka. Chukotka 689000, Russian Federation. Present address: Institute of Biological Problems of the North, Far East Branch of Russian Academy of Sciences, 18 Portovaya St., Magadan 685000.

[3]U.S. Fish and Wildlife Service.

haulouts are locations where walruses aggregate on shore and rest. Haulouts may be used by adult males throughout the year, but are most commonly used during summer and autumn; but may also be used by females and young, especially during periods lacking sea ice. Pacific walruses are highly gregarious with a very clumped distribution and, when resting on land, they often gather in large numbers. Many coastal haulouts are used repeatedly across seasons and years, such that understanding their previous distribution and use can provide insight on current distribution and use.

Management agencies recognize a need to protect Pacific walruses when they are aggregated in large numbers at coastal haulouts and adjacent waters, because of the potential for trampling deaths and exposure to marine pollution (Garlich-Miller and others, 2011). When coastal haulouts are used by large numbers of walruses and the haulout is disturbed, walruses may be trampled if the herd moves in a panic toward the water. For example, when sea ice retreats from large regions of the Chukchi Sea, as in 1990 and 1991, or from the entire Chukchi Sea, as in more recent years beginning in 2007, large numbers of adult females and young walruses formed coastal haulouts, and trampling injuries resulted in the disproportionate death of young walruses by the hundreds and thousands (Ovsyanikov and others, 1994; Kochnev, 2001, 2002, 2008, 2012; Ovsyanikov and others, 2008; Fischbach and others, 2009; Semenova and others, 2010). Such large losses of young walruses could affect overall population growth (Kochnev, 2004b; Udevitz and others, 2013). Additionally, large aggregations of walruses in the water near coastal haulouts may be more vulnerable to localized marine pollution events than walruses using offshore sea ice (Kochnev, 2004b; Garlich-Miller and others, 2011). Localized marine pollution events are hazards inherent to marine shipping and offshore hydrocarbon resource development. Marine shipping is expected to increase substantially in the coming decades because the open water season that enables shipping through the Bering Strait is expected to expand in the coming decades (Smith and Stephenson, 2013; Reeves and others, 2014). Proposed offshore hydrocarbon resource development within the Pacific walrus range also poses a risk of localized marine pollution (Reeves and others, 2014; Kochnev, 2015).

The geography and characteristics of coastal Pacific walrus haulouts have been previously summarized on Asian shores (Arsenyev, 1927; Gol'tsev, 1968; Semenov and others, 1988; Figure 2B in Garlich-Miller and Jay, 2000; Kochnev, 2001, 2004a; Testin, 2004), on North American shores (Frost and others, 1983a, 1983b), and in general across the Pacific walrus range (Fay, 1982; Robards and others, 2007). Since these published summaries, substantial changes in the seasonal availability of sea ice have resulted in substantial shifts in coastal haulout use and the formation of new haulouts. Thus, there is a need to update the previous documentation of Pacific walrus coastal haulouts. None of the previous efforts to document Pacific walrus coastal haulouts provided a comprehensive database that could be queried based on geography and based on summary characteristics of the haulouts, and none provided bibliographic records that could be directly traced back to the original reports from across the Pacific walrus range. This report provides background information on the compilation of a georeferenced database of Pacific walrus haulouts across their range and provides a bibliography of available reports cited in the database.

Methods

Data Sources

We documented Pacific walrus coastal haulout locations reported in published papers, reports, personal communications, and personal observations from 1852 to 2016 across the range of the Pacific walrus, and provide a georeferenced database of these haulout locations. The monitoring of the occurrence and locations of Pacific walrus coastal haulouts has not been the subject of range-wide systematic study, and the reports of Pacific walrus coastal haulouts have generally not been published in the peer-reviewed scientific literature. As such, much of the information on haulouts is found only in management agency reports and in accounts from marine explorers, and little information is available in scholarly bibliographic databases. We discovered most of the reports and accounts cited in the database by following citations in previous efforts to summarize Pacific walrus coastal haulouts (Arsenyev, 1927; Gol'tsev, 1968; Fay, 1982; Frost and others, 1983a, 1983b; Semenov and others, 1988; Kochnev, 2001, 2004a; Testin, 2004) and reviewing references listed in the Walrus International Technical and Scientific Committee's compilation of a bibliography of walrus reports (Stewart, 1993). We expanded this search effort based on the authors' knowledge of management agencies and local history. We obtained copies of most reports through the interlibrary loan services of the Alaska Resource Library and Information Services (http://www.arlis.org) or through the website "Haulout Keepers" (http://www.pacificwalrus.ru, available through the Internet archive hosted on the website http://web.archive.org/). However, many reports were available only through the archives of the Chukotka Branch of the Pacific Research Institute of Fisheries and Oceanography (ChukotTINRO, Чукотский филиал Тихоокеанского научно исследовательского рыбохозяйственного центра) and from files from the U.S. Fish and Wildlife Service's Marine Mammals Management office. Residents of remote communities living near some haulouts, as well as coastal aviators, have made substantial observations of Pacific walrus coastal haulouts, and many have generously offered their observations. We included these observations as personal communications in the database. The authors have made personal observations of haulouts incidental to on-going walrus management and research efforts, and we included these in the database.

Haulout Locations

We assigned a geographic location to each haulout based on available data sources indicated above and adjusted the location based on publically available georeferenced imagery (Digital Globe, Longmont, Colorado, viewed through the virtual digital globe geographical information system Google Earth™). For each haulout location, we provided a brief geographic description indicating the country (Russian Federation or United States), waters (Bering, Chukchi, or East Siberian Seas; or North Pacific or Arctic Oceans), geographic region (table 1), and prominent local landmarks. When hauled out on land, walruses are generally restricted to a strip of coastline from which they may readily return to the water. As such, haulouts are essentially linear coastal geographic features. Due to the scale at which exact locations are known, the scale that haulout locations may shift among bouts of use, and the scale at which we expect this database to be used, we indicated each haulout as a single geographic point.

Table 1. Number and composition of Pacific walrus coastal haulouts reported in the Pacific Walrus Coastal Haulout Database, 1852–2016, by region.

Region	Description	Aggregation Composition			
		Predominantly male	Mix of age and sex classes	Predominantly females and dependent young	Not reported
Alaska Peninsula	Coast extending from the mouth of Naknek River to Cape Sarichef in the southeastern Bering Sea	7			4
Beaufort Sea	Coast extending east of Point Barrow		2		
Bering Strait and Chirikov Basin	The region north of Saint Lawrence Island bounded by Cape Chaplino, the Bering Strait, and Sledge Island in the northern Bering Sea	3	3		14
Bristol Bay	Coast between Cape Newenham and the Naknek River in the southeastern Bering Sea	9			
Central Bering Sea	Islands of the central Bering Sea, including the Pribilof Islands, Saint Matthew and Hall Island	4	2		
East Siberian Sea	Coast west of Long Strait in the eastern East Siberian Sea				5
Eastern Chukchi Sea	Eastern coast of the Chukchi Sea north of Kotzebue Sound	1	8	4	2
Gulf of Anadyr	Coast between Cape Chukotskiy and Cape Navarin in the northwestern Bering Sea	2	6		1
Kamchatka and Commander Islands	Western coast of the Kamchatka Peninsula south of Cape Anana in the southwestern Bering Sea and north Pacific Ocean, and the Commander Islands	8		1	8
Koryak Coast	Coast of the Koryak mountains between Cape Anana and Cape Navarin in the western Bering Sea	8			3
Kotzebue Sound	Coast between Cape Krusenstern and Cape Espenberg in the southeastern Chukchi Sea				2
Kuskokwim Bay Etolin Strait	Coast at the mouth of the Kuskokwim River between Cape Newenham and northern Etolin Strait				3
Norton Sound	Coast between the mouth of the Yukon River and the town of Nome in the northeastern Bering Sea	3			2
Saint Lawrence Island	Saint Lawrence and Punuk Islands in the northern Bering Sea	1	5		1
Western Chukchi Coast	Russian coast west of the Bering Strait and east of Long Strait in the western Chukchi Sea		7	3	7
Wrangel Island	Coast of Wrangel Island and adjacent islands in the western Chukchi and eastern East Siberian Seas			3	8

However, for some larger haulouts and for some haulouts that have repeatedly formed along an extended stretch of coastline, we also indicated a linear geographic feature in addition to a point. For haulouts that formed at various features within an enclosed bay, on a distinct promontory, or on a small island of less than 5 km diameter, we indicated the haulout location with a single point.

Haulout Aggregation Size

Reported haulout aggregation sizes ranged from less than 10 to more than 100,000 walruses. The degree, consistency, and method of effort to characterize haulout aggregation size varied greatly among reported haulout locations and years. Reports from haulouts that had consistent monitoring efforts spanning seasons and years indicated that aggregation size can vary greatly within and between seasons. As such, we indicated aggregation sizes among the haulouts, but only as a general index, by indicating the order of magnitude of the maximum number of walruses reported. For the index, we used a log 10 scale ranging from 0 to 5, representing from less than 10 to greater than or equal to 100,000 walruses. We coded haulouts without a reported aggregation size as -1.

Haulout Temporal Context

Coastal haulout use is generally seasonal, occurring during ice-free or sparse ice conditions. The onset and duration of ice-free conditions vary greatly among regions occupied by Pacific walruses. The dates of ice-free seasons have varied across the period of reported haulout use and are expected to shift substantially with continued sea ice loss through this century (Wang and Overland, 2015). The precision of the reported dates of haulout use varied greatly among haulouts and among reports. With these general constraints on our knowledge of seasonal use, we provided a general index of seasonal use during four 3-month periods (January–March, April–June, July–September, October–December). The temporal extent of haulout use varied across years and decades. Some haulouts were used throughout the decades of available reports while others were used consistently before falling into disuse, and others were used only recently. To provide a general temporal context of haulout use with respect to contemporary management issues, we indicated the decade of the most recent reported use.

Aggregation Composition

When composition was reported for individual haulouts, we indicated whether the composition was either predominantly male, predominantly adult female and dependent young, or a mix of age and sex classes. Determination of haulout composition requires expert knowledge on the aging and sexing of free-ranging walruses and requires a clear view of walruses throughout the haulout (Fay, 1982; Monson and others, 2013). Within the notes field of each haulout record, we note citations to reports indicating the haulout composition, as well as any caveats about the certainty of the haulout composition determination.

Results

Database Components

The database consists of a set of interrelated digital files (table 2). The georeferenced component of the database is provided in two digitally accessible forms—one intended for display and query in a geographic information system (GIS), and another for display and query in a virtual globe. The form of the database intended for display and query in a GIS is provided in two file formats: a tabular comma separated value (CSV) file and a shape file. The CSV file is encoded using the UTF-8 character encoding and can include all fields of the database, including the Cyrillic script field containing Russian language names of the haulouts. The shape file contains a geographic representation of spatial lines representing haulouts that are depicted as linear features. Linear features contained in the shapefile may be linked back to the full record of the haulout contained within the CSV file based on a key field.

Table 2. Components of the Pacific Walrus Coastal Haulout Database, 1852–2016.

File	Contents	Software required	Use if you are interested in:
Comma Separated Value tabulation (CSV)	All fields of the database in tabular format, including both the Latin script and the Cyrillic script fields of the database.	The file is optimally viewed with data management software, but may be viewed using spreadsheet management software or a text editor.	Querying of the database based on tabulated haulout characteristics, or manipulation of the database within a geographic information system.
Shape file	Linear features depicting extended coastal haulouts. These features are linked to records in the comma separated value tabulation based on a key field.	This file may be manipulated by geographic information system software.	Manipulation of the database within a geographic information system.
Keyhole Markup Language	A georeferenced copy of the database, including both linear and point features and all Latin script fields of the database.	The file may be viewed with a virtual globe such as Google Earth™ (http://www.google.com/earth/), Marble (http://marble.kde.org/), or World Wind (http://worldwind.arc.nasa.gov/java/).	Geographic query of the database and review of individual haulout records.
Machine readable bibliography	References to reports cited in the database, and listed in appendix B of this report.	This file may be read and manipulated by bibliography management software.	Management of the bibliographic entries cited in the database.
Metadata record	A full description of the database files.	This file may be read by metadata management software or standard text editors.	Technical description of the files and the fields contained therein.

The form of the database intended for display and query in a virtual globe is provided as a single keyhole markup language (KML) file that contains all points and linear features. The KML file can be viewed in a virtual globe such as Google Earth™ (http://www.google.com/earth/), Marble (http://marble.kde.org/), or World Wind (http://worldwind.arc.nasa.gov/java/).

In addition to the haulout database files, we provided a machine-readable bibliographic file that is a full copy of the references cited in the database (n=151). Bibliographic data management software is required to display and manipulate the citations in the machine readable bibliographic file. However, a full listing of these references is provided in a standard bibliographic listing format in appendix A of this report. A full description of these files is provided as a metadata file. The metadata file is written in an Extensible Markup Language (XML) format file encoded in UTF-8 following the biological metadata format of the United States Federal Geographic Data Committee (FGDC; http://www.fgdc.gov/).

Summary of Haulouts Reported in the Database

We documented 150 coastal haulouts reported across the range of Pacific walruses (fig. 1). These haulouts occurred primarily in the Bering (n=93) or Chukchi Seas (n=46); 5 occurred on the eastern shores of the East Siberian Sea, 4 on the western shores of the North Pacific Ocean, and 2 along the southern shores of the southern Beaufort Sea. Haulouts in the database occurred on shores of both the Russian Federation (n=86) and the United States (n=64) and were distributed across 16 distinct regions (table 1, fig. 1).

Of the 150 haulouts, 77 percent had their most recent reported use within the past 4 decades (2010s n=58; 2000s n=24; 1990s n=18; 1980s n=15). At least one report of an aggregation size was reported for 136 haulouts. Maximum reported aggregation size for most haulouts was of hundreds (n=32) to thousands (n=49) of walruses; however, maximum reported aggregation size for many (n=21) haulouts was in excess of 10,000 walruses; one of which was reported to have had more than 100,000 walruses (Cape Serdtse-Kamen' in the western Chukchi Sea region).

Although the database contains records of haulouts from 16 regions across the range of the Pacific walrus, haulout aggregation sizes were in excess of 10,000 walruses in 7 regions, all of which had a report within the past 4 decades (fig. 2): the Bering Strait and Chirikov Basin (n=4), Bristol Bay (n=2), the eastern Chukchi Sea (n=1), the Gulf of Anadyr (n=2), Saint Lawrence Island (n=1), the western Chukchi Sea (n=7), and the Wrangel Island area (n=2). Of haulouts reported within the past 4 decades (1980s– 2010s) with a maximum reported aggregation size greater than 10,000 walruses (n=19, fig. 2), all occurred within the same seven regions. Three regions had no haulouts with a maximum aggregation size in excess of 1,000 walruses. The Beaufort Sea had no reports of haulouts with a maximum aggregation size in excess of 10 walruses; East Siberian Sea coast had no haulouts with a maximum haulout aggregation size exceeding 100 walruses; and the Kuskokwim Bay-Etolin Strait region has no haulouts with a maximum haulout aggregation size exceeding 1,000 walruses.

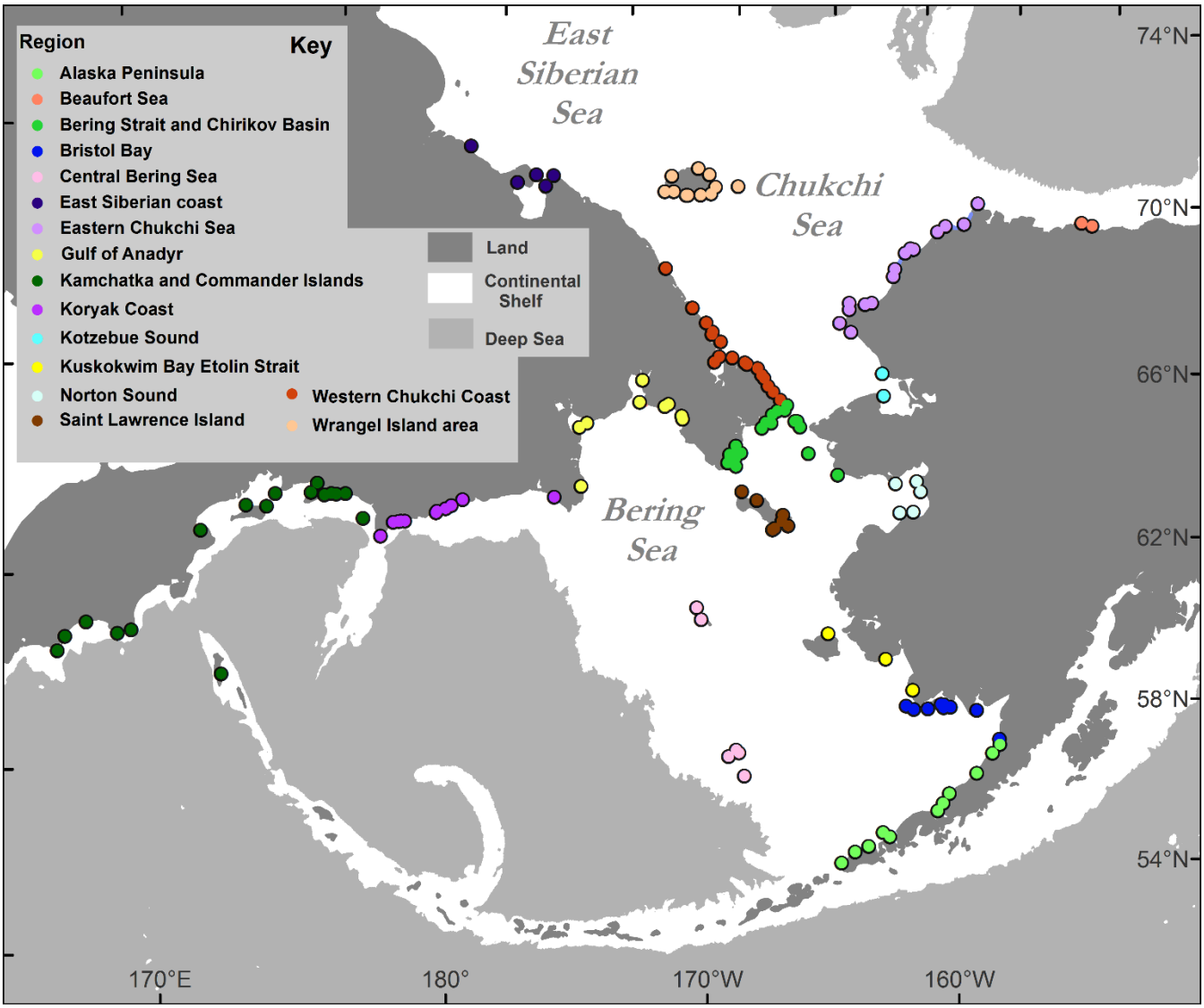

Figure 1. Map showing Pacific walrus coastal haulout locations reported in the Pacific Walrus Coastal Haulout Database, 1852–2016.

Of the 90 haulouts with reported herd compositions, most (n=46) had predominantly male walruses, many (n=33) had a mix of age and sex classes, while only a minority (n=11) had predominantly females and dependent young. Haulouts reported to have mixed age and sex classes or predominantly females and dependent young were primarily in the region of the Bering Strait and Chirikov Basin and north thereof (table 1), with the exception of the Central Bering Sea, Gulf of Anadyr, and Saint Lawrence Island. Only the Gulf of Anadyr had females and dependent young reported south of the Bering Straits during summer (July–September).

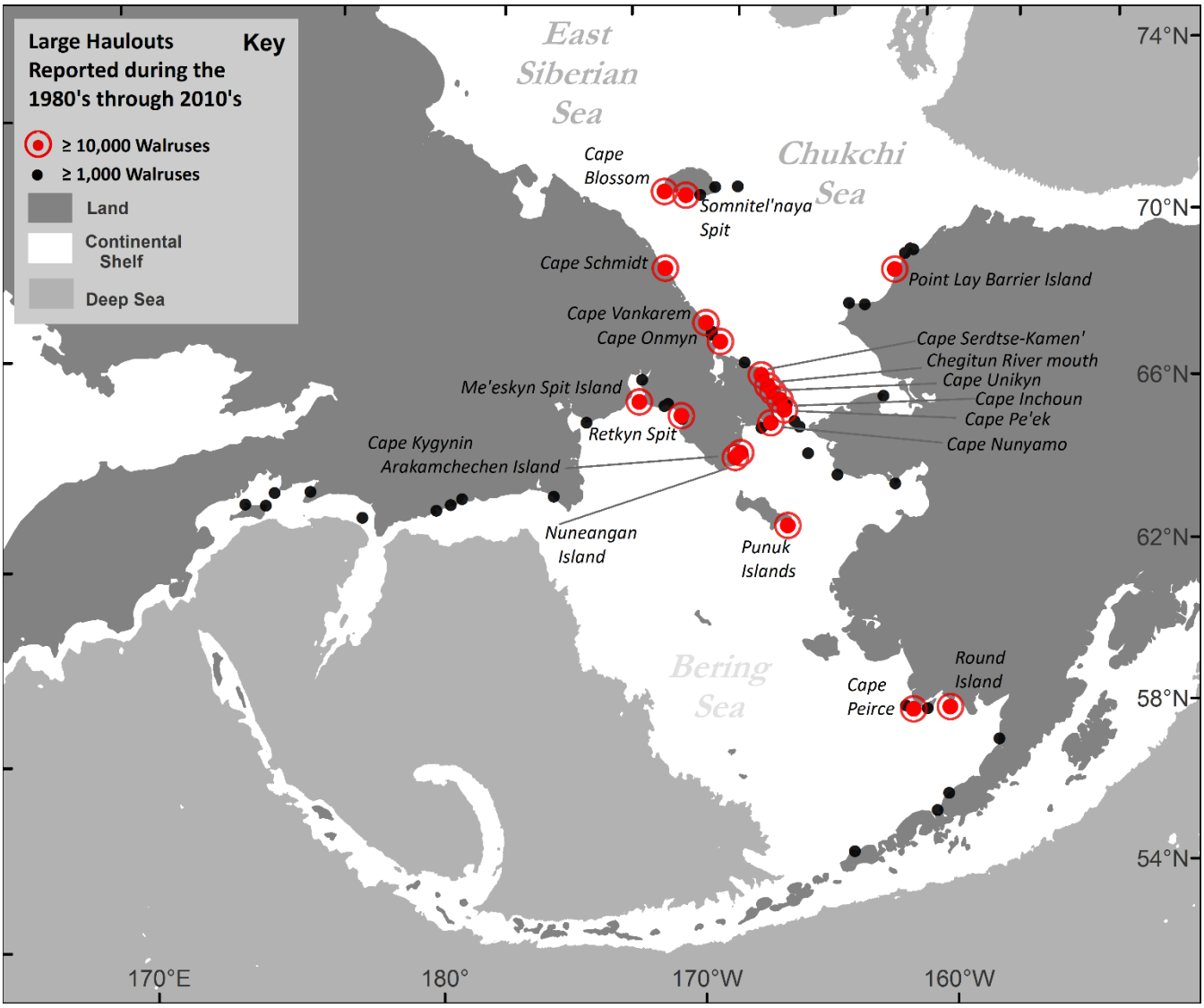

Figure 2. Map showing Pacific walrus coastal haulout locations reported in the past four decades (1980s–2010s), with a maximum aggregation size of greater than or equal to 1,000 walruses.

Discussion

The haulout records provided in the database provided a concise summary of reported haulout geography and characteristics, which may be suitable for the planning of walrus conservation. However, interpretation of trends among the reported haulouts must be tempered by the highly variable level of efforts made to observe walruses among areas and across years. Pacific walrus coastal haulouts are distributed across vast and generally remote regions. Efforts to systematically monitor coastal haulouts were made for only a small number of haulouts, and even fewer haulouts have received consistent monitoring efforts over decades. Systematic efforts have surveyed extended coastlines within the range of the Pacific walrus, such as the autumn aerial surveys of much of the Russian coasts conducted every 5 years between 1975 and 1990, and autumn aerial surveys of much of the United States coasts conducted in 1980, 1985, and 1990, as well as the surveys of the United States Chukchi Sea coast conducted annually during summer and autumn of 2007 through 2015 (see citations for eastern Chukchi Sea haulouts listed in the database). However, these systematic surveys have only documented any given haulout for a single point in time and have been unable to survey much of the coastline due to weather and logistics challenges.

Many haulouts were reported only from incidental accounts from mariners, aviators, or coastal fishery patrols that noted the haulout during transit of an extended coastline. Where dedicated observers have monitored individual haulouts, neighboring haulout sites and intervening coasts were typically not systematically monitored. Similar to the efforts of the dedicated surveys, observation efforts of local observers are constrained by many factors that limit access to the coast where walruses may haulout. Our collection of local observations for the database was from interviews conducted during the course of ongoing walrus management and research activities, and not from a comprehensive survey of communities across the Pacific walrus range.

The database enables a comprehensive geographic view of the reported Pacific walrus haulout distribution that may be readily accessed for conservation planning. For example, the database may be queried to provide a map of reported haulouts that meet specific criteria, such as the distribution of large haulouts observed within the past four decades represented in figure 2. Taken together, the information sources referenced in the database provide insight into where, when, and how Pacific walruses have come ashore to rest, and enable ready access to a summary of reports for each individual haulout. Because these information sources were not designed to collect systematic information on haulout characteristics across the range of the Pacific walrus, evaluation of trends should be done cautiously.

Records in the haulout database are consistent with the previously reported understanding that, after the time of northward migration, haulouts in the regions south of the Bering Strait contain almost exclusively independent male walruses (Fay, 1982). Fay (1982) noted that, after the late winter breeding season (January–March), Pacific walruses generally segregate by sex and age classes, and that during spring through the autumn onset of ice formation females and dependent young, as well as some independent males, move north through the Bering Strait into the Chukchi Sea. Reports in the haulout database indicating that hundreds to thousands of adult female walruses and dependent young use haulouts in the Gulf of Anadyr during the ice-free season are the exception to this general pattern.

The distribution of Pacific walrus haulout use has fluctuated over decades and shifted substantially in response to the expansion of the open water season in the Chukchi Sea. An understanding of these fluctuating and shifting distributions requires monitoring efforts. Because comprehensive monitoring of haulouts across the range of the Pacific walrus would be a challenge, contributions of haulout observations from local observers will continue to be an important information source. Individuals wishing to report coastal haulouts of Pacific walruses are requested to send their observations to the following e-mail address: *fw7_walrus_group@fws.gov*.

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Glossary

ChukotTINRO The Chukotka Branch of the Pacific Research Institute of Fisheries and Oceanography (Чукотский филиал Тихоокеанского научно исследовательского рыбохозяйственного центра) is the Federal agency with management authority for the scientific support of fisheries, including the management of the Pacific walrus, in the autonomous region of Chukotka.

GIS Geographical Information System.

Haulout A location where walruses haul themselves out of the water to rest.

VNIRO All-Russian Research Institute of Fisheries and Oceanography (Всероссийский научно-исследовательский институт рыбного хозяйства и океанографии) is the federal agency for the scientific support of management of fisheries in the Russian Federation.

TINRO The Pacific Research Fishery Center (Тихоокеанский научно-исследовательский рыбохозяйственный центр) is the federal agency with authority for the scientific support of management of marine fisheries, including the management of the Pacific walrus, in the Russian Federation.

USFWS United States Fish and Wildlife Service is the federal agency with authority for the management of Pacific walrus in the United States.

UTF-8 Universal Character Set Transformation Format 8-bit is a character encoding system capable of encoding characters in both English and Russian that is in common use worldwide.

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Director, Alaska Science Center
U.S. Geological Survey
4210 University Dr
Anchorage, Alaska 99508-4560
http://alaska.usgs.gov