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ORIGINAL PAPER

Newly detected haul-out of Atlantic walruses (*Odobenus rosmarus rosmarus*) on Yamal Peninsula has become the biggest in the Kara Sea

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Abstract

Atlantic walruses (*Odobenus rosmarus rosmarus*) are still poorly studied in the easternmost part of their range, especially in the Kara Sea. Therefore, any new data from this region on the biology and ecology of the subspecies are highly important. In autumn 2019, the largest coastal assemblage of walruses ever found in the Kara Sea was observed on the northwestern coast of the Yamal Peninsula. This assemblage was surveyed using a drone-mounted digital camera (from 5 m in altitude) on 17 October 2019. The herd comprised 1062 (±17 SE) walruses. Approximately one-sixth of the assemblage consisted of dependent calves (0–2 years old), one-sixth consisted of mature bulls, one-third consisted of independent immature animals, and one-third consisted of mature females and young (mature) males. A considerable but not estimated number of walruses was also observed in nearshore water. Satellite imagery and an opportunistic visit to the site revealed that walruses used this haul-out from mid-September until at least the end of October. Satellite tracking of two tagged walruses showed that animals stayed within 200 km of the coastline in shallow water (not deeper than 20–25 m) throughout their tracking periods (8 and 9 days). In addition to the main haul-out, three more sites on this part of the Yamal Peninsula coast were identified as areas where walruses came ashore. These new abundance and distribution data from the Kara Sea add significantly to our knowledge regarding Atlantic walruses in this region. Considering the rapid and large-scale industrial development in the region, proactive measures should be taken to protect key walrus habitats in the Yamal Peninsula area.

Keywords Atlantic walrus · Kara Sea · Satellite tracking · Satellite imagery · Tagging · Terrestrial haul-outs · Yamal Peninsula

Introduction

The Kara Sea is the easternmost part of the Atlantic walrus (*Odobenus rosmarus rosmarus* Linnaeus, 1758) range (Stewart et al. 2014). Although little is known about walruses in this area, it is very likely that they belong to the same population as walruses that occur in the Pechora Sea to the west (Andersen et al. 2017), which are genetically distinct from animals in the northern Barents Sea. Previous satellite tracking showed that approximately 17% of the walruses tagged in the Pechora Sea moved to the western coast of the Yamal Peninsula and subsequently moved northward to haul out on the northern part of the Novaya Zemlya Archipelago or on the Severnaya Zemlya Archipelago (Semenova et al. 2019). These animals also came ashore on islands in the southwestern, central, and northern parts of the Kara Sea.

The number of walruses occupying the Kara Sea is unknown. However, up to 200 walruses have been observed on Gemskerka Island near the northeastern coast of Novaya Zemlya (Vekhov and Khakhin 1999; Chernook et al. 2015), and groups of 110–120 individuals have been recorded on the Vize and Ushakova Islands in the northern Kara Sea (Gavrilo 2010). According to employees at the polar weather station on Troinoy Island (Izvestiy TsIK Archipelago), up to 30 walruses occasionally appear on the island's coasts. No substantial terrestrial haul-outs of walruses have ever been recorded on the Yamal Peninsula, although in the 1970s, small groups of animals were observed onshore near

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the mouths of the Mordiyakha and Kharasavey Rivers, on the northern part of the Sharapovy Koshki isles (near the western coast of the peninsula) and on Cape Kharasavey (Dobrinskiy 1995; Azarov 1996). In the mid-1990s, approximately 100 walruses were seen on Beliy Island north of the peninsula (Azarov 1996). Two groups (100 and 15) of walruses were encountered on this island again in 2004 (Svetochev and Svetocheva 2008). According to Chapski (1936), a few walruses have been found on ice floes in shallow water areas west of the Yamal Peninsula in late summer, and these animals are subjected to native harvests. Coastal assemblages of walruses were not mentioned by Chapski (1936). However, there is archaeological evidence that walruses did haul out on the northwestern coast of the peninsula in ancient times, at least in the sixth to fourteenth centuries. A seasonal camp from the Iron Age was discovered near the mouth of the Tivteyakha River (Chernetsov 1935; Fedorova et al. 1998). Reindeer hunters came to the area in July following the northward migrating reindeer (*Rangifer tarandus*) herds and left camp in October as the reindeer retreated southward. In these summer–fall camps, hunters harvested not only reindeer but also geese (*Anser* sp. and *Branta* sp.), polar bears (*Ursus maritimus*) and walruses. Walruses played an important role in providing skin, blubber, meat, and tusks; the tusks were used mainly for making arrowheads. People did not have boats; they hunted walruses onshore, which implies regular terrestrial haul-outs by the walruses. Although it is impossible to assess the number of animals using the region at that time, aggregations were mixed, including adult females and calves, with bones of the latter being found during excavations of the camp, and the local Nenets name for the area "Tivteyakha" means "walrus river," suggesting that the walruses were an important resource.

Intensive, unregulated commercial harvests that took place over hundreds of years resulted in the walruses in the Kara Sea being close to extirpation by the mid-twentieth century. Since 1957, Atlantic walruses have been protected in Russian waters. Bychkov (1976, 1978) proposed that the number of walruses in the Kara Sea did not exceed a few hundred animals 10–15 years after the ban on hunting was imposed. At present, the Atlantic walrus is listed in the Red Data Book of Russia as an endangered taxon. Although they are now protected from direct harvest, several new factors pose potential threats to walruses in the southern Kara Sea, including accelerating industrial development of coastal areas and ongoing climate warming with concomitant loss of sea ice. The Yamal Peninsula is one of the most rapidly growing centers for hydrocarbon extraction in Russia. Effects are likely to be particularly critical near key habitats of walruses, such as breeding and resting grounds (terrestrial haul-outs) and feeding areas. Thus, the goal of this research was to provide as much information as possible regarding key sites in the Kara Sea for walruses based on the first survey of the area and short-term satellite tracking.

Materials and methods

This work was carried out on the western coast of the Yamal Peninsula (Fig. 1) in the Kara Sea, Russia. A report of a vast group of walruses at the Tivteyakha River mouth was posted on social media networks by staff from the gas industry shift camp Kharasavey, which led to a visit to the site by scientists on 17 October 2019.

Filming, counting, and measuring

An assessment of age and sex categories was performed based on video footage taken using a DJI Mavic 2 Pro drone with a Hasselblad L1D-20C camera (20 Mp, lens FOV 77°). The weather during the survey day varied from clear skies to complete cloud cover (at an altitude of approximately 300–600 m), and the wind and temperature ranged from 2 to 3 m s^{-1} and from −3 °C to −5 °C, respectively. Filming was performed at an altitude of 5 m; the reactions of the walruses were observed, and measures were taken to prevent their disturbance. The footage was examined frame by frame (1920 × 1080 pixels). The number of walruses and their body length were assessed using the free software ImageJ 1.8.0 (https://imagej.nih.gov/ij/) as described by Lydersen et al. (2012). Walruses on the haul-out were crowded very tightly together, and some of them were only partially visible on the images. Therefore, all walruses were counted, while body length was taken only from individuals who were in a position suitable for measurement.

Triple counts of the walruses in the images were performed by three different persons. Body length measurements were estimated to obtain a general age composition assessment of the walruses at the haul-out. Two types of body length measurements were utilized: if an animal was lying on its dorsal or abdominal side, then the projected body length (PBL) was used; if an animal was lying on its side(s), then the curvilinear body length (CBL) was measured. This was approximated by drawing a line along the body's central line from the tip of the snout to the tail (see yellow lines in Fig. 2). Body lengths were also estimated using the number of pixels standardized to published dimensions for walrus bulls (BL_{ref}), which is approximately 340 cm for animals from the Canadian Arctic, Greenland, Svalbard, and Russia (Born et al. 1995). If bulls were present in each frame, the largest body length in pixels (BL_{px_max}) for a certain frame was considered to correspond to BL_{ref}. The ratio BL_{ref} to BL_{px_max} was then used to convert pixel counts to cm.

Walruses of all sex and age classes were confirmed at the haul-out, so the body length data were sorted into

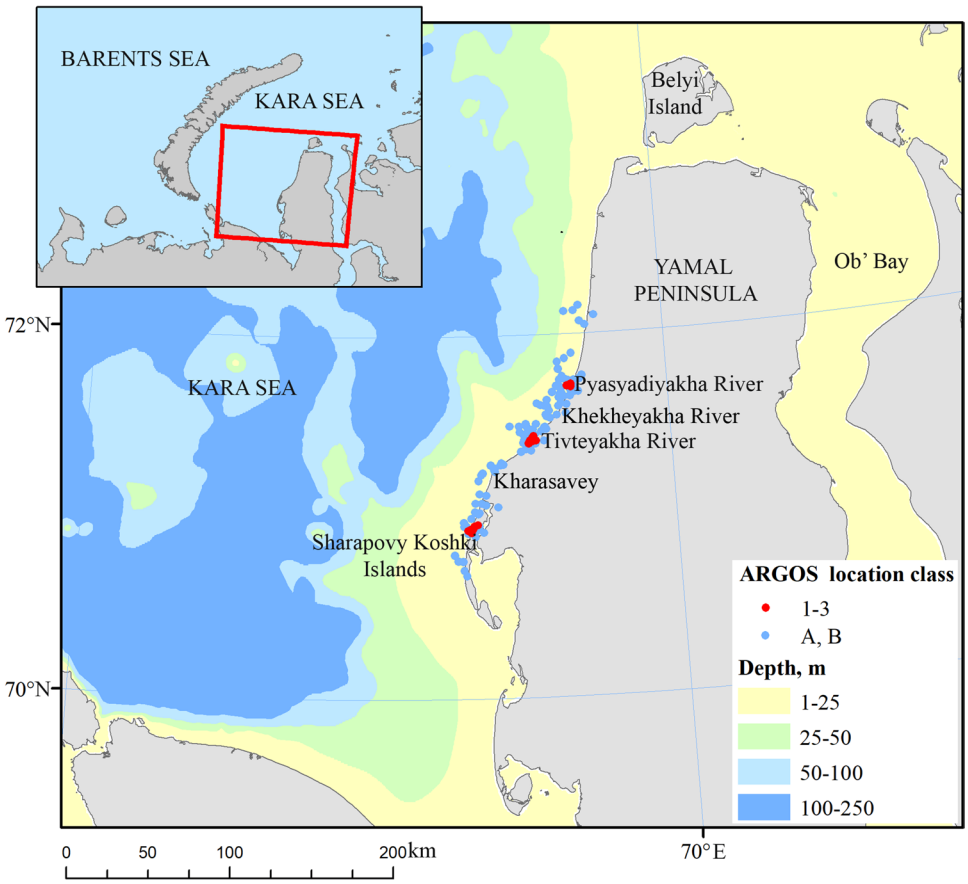

Fig. 1 Study area and the Advanced Research and Global Observation Satellite (ARGOS) locations for two walruses tagged with platform terminal transmitters in October 2019

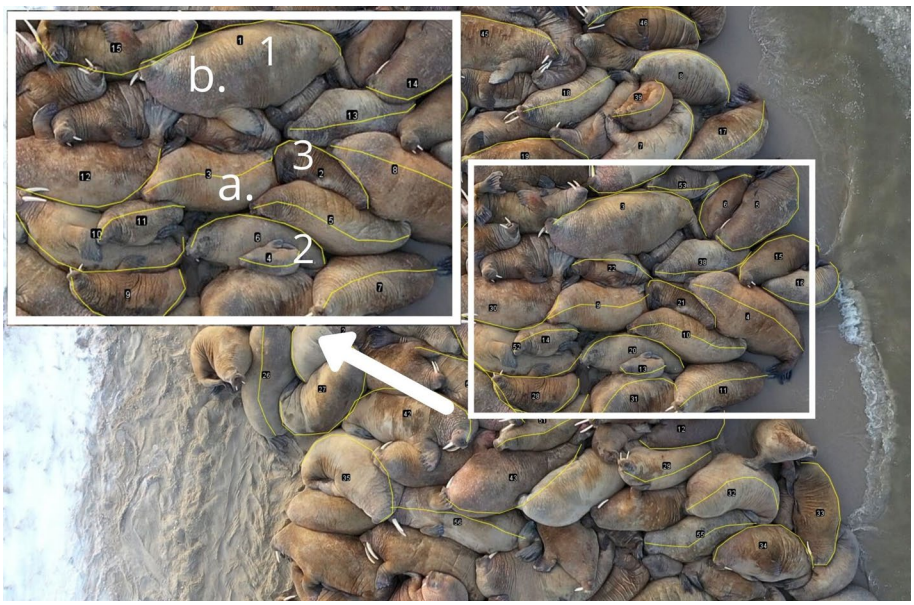

Fig. 2 Example of projected (**a**) and curve (**b**) body length measurements: 1—adult male; 2—calf; 3—juvenile

four age–sex classes: (1) the largest animals—bulls, (2) the smallest individuals—0–2-year-old dependent calves, (3) independent immature animals of both sexes, and (4) mature females and young mature males. *K*-means clustering (four clusters) was used to estimate the approximate proportions of each of these classes within the herd. PBL and CBL data were treated separately. The analyses were performed using PAleontological STatistics (PAST) version 3.19. Mean values are given with ± SE.

Tagging and satellite telemetry

Two adult walruses (sex not identified) were tagged with satellite-linked radio transmitters (platform terminal transmitters, PTTs) on a terrestrial haul-out on 17 October 2019. The tags were manufactured by Ltd. Es-Pas company (Moscow, Russia). The tag design was based on the "Pulsar" transmitter (Ltd. Es-Pas) operated by the CLS Group (https://www.cls.fr/en). The transmitters provided positional data that were received through the Advanced Research and Global Observation Satellite (ARGOS) system.

The tags were mounted on the walruses using a stainless-steel anchor with two rows of three petals (six petals total; see Online Resource 1) designed by the Marine Mammal Research and Expedition Center LLC (Russia) and manufactured by the Plant of Medical Tools (Tumbotino, Russia). The tags were mounted by thrusting the anchor through the skin of the walrus using an extension pole (3 m). The preferred target site was the medial dorsal thorax (shoulder) region that is above the water's surface when a walrus is breathing (see Semenova et al. 2019).

ARGOS locations were filtered using the algorithm described by Freitas et al. (2008, 2009). Locations with abnormal swimming speeds (> 10 km h^{-1}) and unlikely turning angles (> 165° or > 155°, depending on the length of path deviations) were removed. Based on comparisons with digital maps, all filtered locations were manually divided into two categories, "on terrestrial haul-out" and "in water." If two or more consecutive locations within 10-min minimum intervals were on land, then such positions were considered "on terrestrial haul-out." A haul-out bout terminated when the last "on-land" location was received prior to a location at sea. ARGOS location classes (ARGOS user's manual 2016) also supported the detection of walruses on land. Locations of classes 1–3 with defined accuracy were received from the coast, while in the water, the PTTs provided only locations of classes A and B without an accuracy estimation (Fig. 1).

Bathymetric data in the study area were accessed from the General Bathymetric Chart of the Oceans (GEBCO) (https://seabed2030.gebco.net/).

All field studies were conducted under permits issued by the Federal Supervisory Natural Resources Management Service (Moscow, Russia), which is responsible for the control and supervision of any invasive studies on endangered species in the wild.

Satellite imagery

Archived satellite images from LANDSAT-8 (USA) and SENTINEL-2A/B (EU) from September to October 2019 were examined to detect walruses onshore in the Yamal Peninsula region. These data are available at the websites of the USGS (https://www.usgs.gov/) and Copernicus (https://www.copernicus.eu/en). Processed images covered the coastline from the Tivteyakha River to the Pyasyadiyakha River (Fig. 1). Only images with no clouds or scattered clouds were used.

Results

A total of 1062 (± 17) walruses were counted on the 21 drone images of the surveyed group. The walruses occupied an area of approximately 2700 m^2 on the bank of the Tivteyakha River mouth, resulting in a density of approximately 0.4 walruses m^{-2}.

PBL varied from 71 to 340 cm ($n = 442$), and CBL varied from 86 to 340 cm ($n = 441$; Fig. 3a, b). *K*-means clustering resulted in four groups (Table 1). Approximately 20% of the animals were classified as calves, 30% were immature animals, 30% were adult females or young adult males, and 20% were large bull walruses (Fig. 3c).

Two PTTs mounted on two walruses worked for 8 and 9 days, respectively. During these days, the animals occupied waters with depths not exceeding 20–25 m along approximately 200 km of the coastline (Fig. 1). The tagged animals came ashore at two sites (Fig. 1).

Walruses were detected on two of the ten satellite images available in September–October (SENTINEL-2 on 4, 13, 15, 22, and 29 September and 17 October and LANDSAT on 4, 13, and 22 September and 31 October) (Online Resource 2); they were detected on 4 September at the Khekheyakha River mouth and on 31 October at the Tivteyakha River mouth.

Discussion

This study is the first to report distributional information on walruses from the Yamal Peninsula since the beginning of the twentieth century. Four haul-out sites were found through a combination of visual observations and short periods of satellite tracking. On the western coast of the Yamal Peninsula, terrestrial haul-outs of walruses were reliably registered in the mouths of the Tivteyakha and Khekheyakha Rivers. Additionally, sites were determined from satellite tracks on the Sharapovi Koshki Islands and at the mouth of the Pyasyadiyakha River.

The number of animals encountered at the mouth of the Tivteyakha River in 2019 is the largest haul-out group ever recorded on the Yamal Peninsula or, for that matter, anywhere in the entire Kara Sea. It was a "mixed" haul-out that contained animals of different ages and sexes. Most of the walruses (approximately 65%) on the haul-out were mid-sized individuals—independent immatures and mature males of younger ages with mature females. Walrus calves

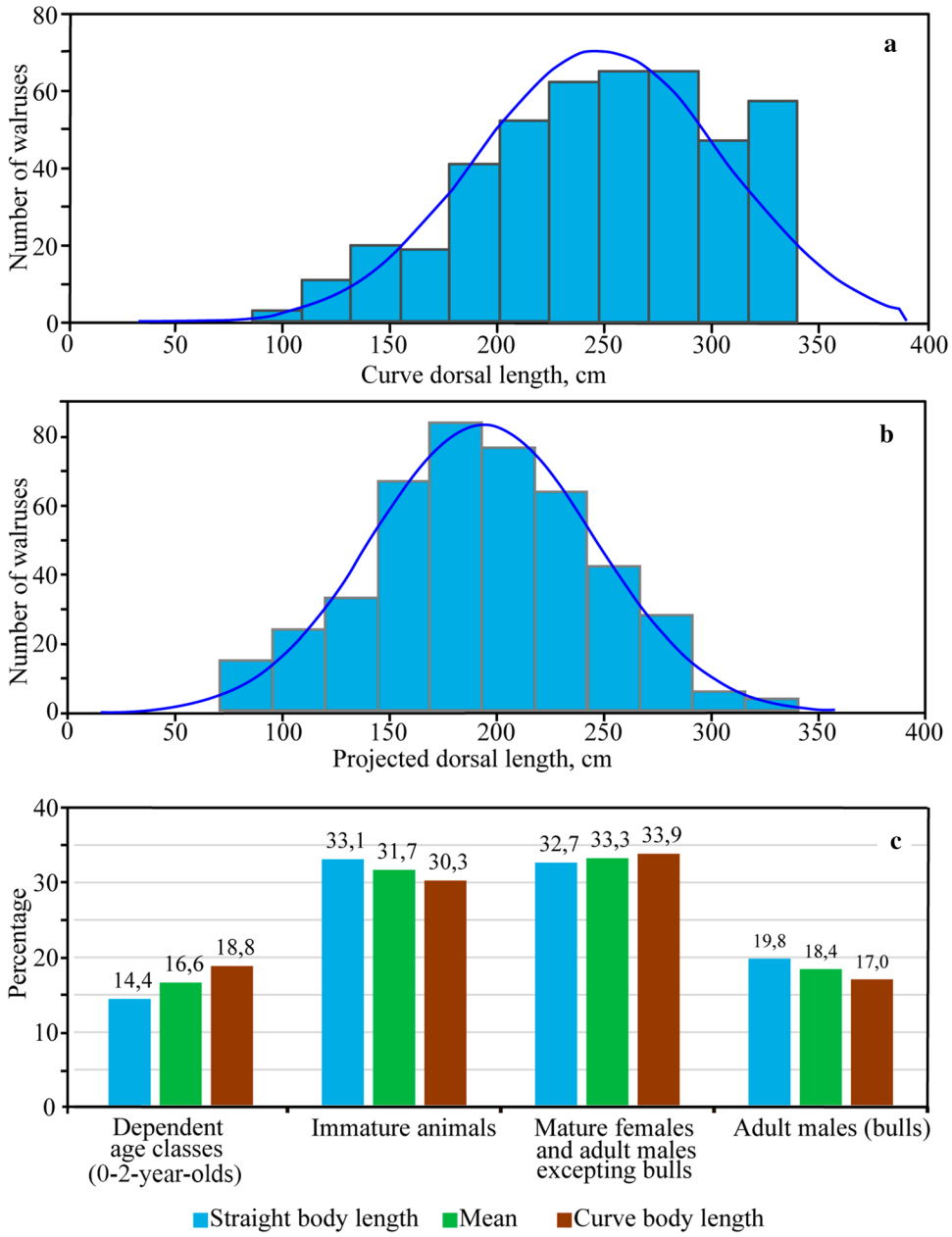

Fig. 3 Distribution of body length frequencies according to curve (**A**) and straight (**B**) measurements, and percentages of the four body length clusters (**C**) according to measurements derived from aerial (drone) walrus photos taken at terrestrial haul-out on 17 October 2019

Table 1 Results of *K*-means clustering (four clusters) based on body length measurements of walruses hauled out on western coast of Yamal Peninsula on 17 October 2019

Cluster	PBL (cm)			CBL (cm)		
	Min–max	*N*	Mean ± SE	Min–max	*N*	Mean ± SE
1	71–138	64	110.8 ± 2.38	86–193	83	159.3 ± 2.95
2	139–189	147	167 ± 1.19	195–254	147	227.5 ± 1.41
3	190–239	145	212.6 ± 1.17	255–304	134	280.2 ± 1.24
4	240–340	88	267.3 ± 2.29	305–340	75	327.8 ± 1.36

stay with their mother for at least 2 years (Fay 1981); hence, the number of mature females on the haul-out could not have been less than the number of dependent 0- to 2-year-old calves. Dependent calves and large mature bulls formed the two smallest clusters. Drones proved to be very useful in studying this haul-out group (also see Monson et al. 2013).

Walruses often demonstrate significant sexual segregation in haul-out groups outside the breeding season, when

males aggregate separately from females and young animals. Proportions of different age–sex classes on Atlantic walrus terrestrial haul-outs can vary from being exclusively mature males ("male aggregations") to groups dominated by mature females with calves in "mixed aggregations." For instance, the former is characteristic of Svalbard (Lydersen et al. 2012; Lydersen and Kovacs 2014) and Vaigach Island (Semenova et al. 2019), and the latter is characteristic of Franz Josef Land (Gavrilo 2010; Chernook et al. 2015). The presence of females with calves raises concerns regarding the vulnerability of the animals in the herd if a disturbance should take place. Stampedes of alarmed walruses into the water are associated with mortality due to trampling, particularly of calves, as well as abortion of fetuses and separation of cow–calf pairs (Born et al. 1995; Garlich-Miller et al. 2011).

Interviews with people visiting the Kharasavey industrial site suggest that small groups of walruses were seen on the shore as early as mid-September, with several hundred animals by the end of the month. The latest evidence of the walruses' presence on the haul-out was a satellite image taken on 31 October 2019. Consequently, one can propose that the walruses used the haul-out for at least 1.5 months—from mid-September to the end of October. Little was determined about the duration of use of the other sites identified in this study, although the examination of the satellite images suggests that they might be used only intermittently or for short seasonal periods.

All sites where walruses haul out on the northwestern coast of the Yamal Peninsula are on the banks of river mouths. In the Russian Arctic, this is the only known haul-out of the Atlantic walruses on the mainland shore, as opposed to being on islands.

The two satellite tags deployed in this study functioned for only very short periods. The most likely reason for this short duration was that the tag mounting systems were not ideal for walruses; they were designed for tagging cetaceans and were used in this case only as an "emergency" solution (see Semenova et al. 2019 for more suitable walrus solutions).

While the transmitters functioned, the tagged walruses remained close to shore in shallow waters. Studies of walrus ($n = 6$) diving behavior using dive recorders in Svalbard showed that walruses spend an average of 56 h in the water followed by 20 h hauled out onshore (Gjertz et al. 2001). Assuming similar diving and haul-out patterns are typical for walruses near the Yamal Peninsula, one can propose that during the tag deployment period (8–9 days), they had two to three "in water" phases. The small ranges covered during their aquatic phases suggest that they found sufficient food in the area. This assumption is supported by the benthic surveys performed in the area in 2007 and 2010 (Kozlovskiy 2012). At a depth of 12–20 m, the benthic community had a high average biomass of approximately 112.08 g m^{-2}, dominated by *Serripes groenlandicus* and *Ciliatocardium ciliatum*. In deeper areas (20–46 m), benthic assemblages had an average biomass of 106.26 g m^{-2}, with *Astarte borealis* dominating. These molluscs, especially *S. groenlandicus*, are primary prey species for Atlantic walruses (Sheffield et al. 2001). The structure of the benthic community near the western coast of the Yamal Peninsula is similar to that of the neighboring Pechora Sea, which is influenced by the same warm southern Barents Sea water masses. Although walruses have the physiological capacity to dive down to 450 m and the maximum duration of their dives can exceed 45 min, they normally feed in shallow coastal areas, performing only relatively shallow (≤ 50 m), short dives (≤ 10 min) (Lowther et al. 2015).

The large haul-out aggregation reported herein is a promising sign that preharvesting range restoration and an increasing trend in abundance are taking place. This result is similar to those in reports from other parts of the Kara Sea (Gavrilo 2010) and the Svalbard Archipelago (Kovacs et al. 2014). These results suggest that the Kara Sea is not a peripheral area but rather an important part of the subspecies range. Considering the rapid and large-scale industrial development taking place in the region, proactive measures should be taken to conserve key walrus habitats in the Kara Sea. Conservation management plans would benefit from more research on the seasonal distribution, abundance, and forage behaviors of Atlantic walruses in the easternmost part of their range.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00300-021-02942-0.

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Author contributions AB and VS conceived and designed the research and performed tagging of walruses and analysis of received data (video footage, satellite tracking). AS organized field expedition and performed drone-based filming of the walruses. AK analyzed satellite imagery. AB wrote the manuscript. All authors read and approved the manuscript.

Declarations

Conflict of interest The authors have no conflict of interest to declare.

References

Andersen LW, Jacobsen MW, Lydersen C, Semenova VS, Boltunov AN, Born EW, Wiig Ø, Kovacs KM (2017) Walruses (Odobenus rosmarus rosmarus) in the Pechora Sea in the context of contemporary population structureof Northeast Atlantic walruses. Biol J Linn Soc 122(4):897–915

Argos user's manual (2016). CLS. https://www.argos-system.org/wp-content/uploads/2016/08/r363_9_argos_users_manual-v1.6.6.pdf

Azarov VI (1996) Rare animals of the Tymenskaya Region and their conservation. Amphibia, reptiles, birds and mammals. In: Vector Book, pp 168–169 (**in Russian**)

Born EW, Gjertz I, Reeves RR (1995) Population assessment of Atlantic walrus (*Odobenus rosmarus rosmarus*). Nor Polarinst Medd 138:1–100

Bychkov VA (1976) Conservation and sustainable use of pinnipeds. VNIITEISKh, Moscow (in Russian)

Bychkov VA (1978) The Atlantic walrus. The red data book of USSR. USSR, Moscow, pp 22–23

Chapskiy KK (1936) The walrus of the Kara Sea. Proceedings of the Arctic Institute. Arctic Institute, Leningrad (**in Russian**)

Chernetsov VN (1935) Ancient seaside culture of Yamal Peninsula. Soviet Ethnogr 4–5:109–133 (**in Russian**)

Chernook VI, Solovyov BA, Vasilyev AN, Solodov AA, Zemlyanskaya YA (2015) Results of aerial surveys of marine mammals in the offshore strips of the Kara Sea in August 2013. Marine mammals of the Holarctic, collection of scientific paper. Saint-Petersburg, Russia, pp 292–298

Dobrinskiy LN (1995) Nature of Yamal. Nauka, Ekaterinburg (in Russian)

Fay FH (1981) Walrus *Odobenus rosmarus*. Handbook of marine mammals The walrus. Academic Press, London, pp 1–23

Fedorova NV, Kosintsev PA, Fitzhugh W (1998) Gone into the hills. Culture of the Northwestern Yamal coast population. Ekaterinburg publishers, Ekaterinburg (in Russian)

Freitas C, Lydersen C, Fedak MA, Kovacs KM (2008) A simple new algorithm to filter marine mammal Argos locations. Mar Mammal Sci 24:315–325

Freitas C, Kovacs KM, Ims RA, Fedak MA, Lydersen C (2009) Deep into the ice: over-wintering and habitat selection in male Atlantic walruses. Mar Ecol Prog Ser 375:247–261

Garlich-Miller JL, MacCracken J, Snyder J, Meehan R, Myers M, Wilder JM, Lance E, Matz A (2011) Status review of the Pacific walrus *(Odobenus rosmarus divergens*). U.S. Fish and Wildlife Service, Marine Mammals Management, Anchorage

Gavrilo M (2010) On the modern distribution of Atlantic walrus (*Odobenus rosmarus rosmarus*) in the northern Kara-Barents Sea region. In: Marine mammals of the Holarctic, collection of scientific papers, Kaliningrad, Russia, pp 125–129

Gjertz I, Griffiths D, Krafft BA, Lydersen C, Wiig Ø (2001) Diving and haul-out patterns of walruses *Odobenus rosmarus* on Svalbard. Polar Biol 24:314–319. https://doi.org/10.1111/j.1748-7692.2001.tb01273.x

Kovacs KM, Aars J, Lydersen C (2014) Walruses recovering after 60+ years of protection in Svalbard. Norway Polar Res 33:26034. https://doi.org/10.3402/polar.v33.26034

Kozlovskiy VV (2012) Macrozoobenthos of the upper shelf of the Southwestern part of the Kara Sea. Dissertation, The Shirshov Institute of Oceanology (in Russian)

Lowther AD, Kovacs KM, Griffiths D, Lydersen C (2015) Retrospective identification of motivational state in a free-ranging marine mammal inferred from changes in behaviour. Mar Mamm Sci 31:1291–1313

Lydersen C, Kovacs KM (2014) Walrus *Odobenus rosmarus* research in Svalbard, Norway, 2000–2010. NAMMCO Sci Publ 9:175–190

Lydersen C, Chernook VI, Glazov DM, Trukhanova IS, Kovacs KM (2012) Aerial survey of Atlantic walruses (*Odobenus rosmarus rosmarus*) in the Pechora Sea, August 2011. Polar Biol 35:1555–1562

Monson DH, Udevitz MS, Jay CV (2013) Estimating age ratios and size of Pacific walrus herds on coastal haulouts using video imaging. PLoS ONE 8(7):e69806. https://doi.org/10.1371/journal.pone.0069806

Semenova VS, Boltunov AN, Nikiforov VV (2019) Key habitats and movement patterns of Pechora Sea walruses studied using satellite telemetry. Polar Biol 42:1763–1774

Sheffield G, Fay FH, Feder H, Kelly BP (2001) Laboratory digestion of prey and interpretation of walrus stomach contents. Mar Mamm Sci 17:310–330. https://doi.org/10.1111/j.1748-7692.2001.tb01273.x

Stewart REA, Kovacs KM, Acquarone M (2014) Walrus of the North Atlantic. NAMMCO Sci Publ 9:7–12

Svetochev VN, Svetocheva ON (2008) Distribution of Atlantic walruses (*Odobenus rosmarus rosmarus* L.) in the White, Barents and Kara Seas in 2004–2007. In: Marine mammals of the Holarctic, collection of scientific papers, Odessa, Ukraine, pp 543–544

Vekhov N, Haknin G (1999) How many walruses on Novaya Zemlya. In: Hunting and hunting economy 4:14–15 (in Russian)