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Preliminary icebreaker-based survey of polar bears around Franz Josef Land, Russia

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Abstract: As a Vulnerable species, regular estimates of polar bear (*Ursus maritimus*) numbers are an important requirement for understanding population status. In the Russian part of the Barents Sea subpopulation, near the Franz Josef Land Archipelago, counts of polar bears have not been conducted since 2004. We observed polar bears from icebreakers in this area in 2015 and 2017 and obtained a preliminary estimate of density and abundance.

Key words: abundance, Barents Sea, Franz Josef Land, icebreaker, polar bear, surveys, Russia, *Ursus maritimus*

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The polar bear (*Ursus maritimus*) is one of the best-studied Arctic species (Amstrup 2003). Nevertheless, the polar bear is classified as Vulnerable (Wiig et al. 2015), so ongoing monitoring of population size and habitat status are necessary. Gaps in our knowledge remain for several areas within the polar bear range, especially for the islands of the Arctic Ocean in Russia. One such place is the Franz Josef Land Archipelago. Polar bears inhabiting these islands and the adjacent area are included in the Barents Sea subpopulation, which is 1 of 19 world-wide subpopulations (Wiig et al. 2015). These subpopulations are not genetically isolated, but are considered to be governed more by internal reproductive and survival rates than by immigration from adjacent areas (Paetkau et al. 1999). The Barents Sea subpopulation can be divided into 2 parts: the western portion is associated with the islands of the Svalbard Archipelago and is managed by Norway; the eastern portion is associated with Franz Josef Land and is managed by Russia. Information on the Norwegian part includes abundance estimates from 2004 and 2015 (Aars et al. 2009, 2017), but the Russian part has always been more poorly studied. The latest estimate of abundance of polar bears within the Russian portion was obtained in 2004 by aerial survey (Aars et al. 2009). That study estimated that 2,650 polar bears (95% CI = 1,900–3,600) occurred in the entire Barents Sea subpopulation, with numbers in the Russian part being 3 times greater than in the Norwegian part (Aars et al. 2009, Andersen and Aars 2016). This means that approximately 2,000 polar bears occurred in the Russian section at that time—approximately 1,500 adults and 500 juveniles (263 polar bears were counted during the aerial survey, including 189 adults [72%] and 74 juveniles). However, changes in abundance may have occurred since 2004 because of rapid changes in sea ice coverage, especially in the Barents Sea (Stern and Laidre 2016, Alexeev et al. 2017, Wang et al. 2019). Changes in ice coverage have influenced the distribution of polar bears near Svalbard and surrounding waters, though no change in abundance has yet occurred (Aars et al. 2017). Similar data are lacking for Franz Josef Land; therefore, in 2015 and 2017 we visited part of the Russian section of the Barents Sea aboard an icebreaker, recorded observations of polar bears, and obtained a preliminary estimate of abundance.

Study area

Franz Josef Land, with a total area of 16,134 km², is an archipelago of 192 islands located in the northern part of the Barents Sea. Most of the surface area is covered by glacial ice. Human presence was, and still is, limited to a few small scientific stations and military posts, some of which are now abandoned. Human activity is increasing only on Alexandra Island, which has a military post. Nevertheless, human-influenced areas are insignificant compared with the entire area available to polar bears. Therefore, polar bears in the region are little disturbed by human presence. In 2016, the islands of Franz Josef Land were added to the Russian Arctic National Park, which was originally created in 2009 (www.rus-arc.ru; accessed 11 Oct 2018). This should provide additional protection to wildlife habitat in the region.

Materials and methods

Voyages of icebreakers and other vessels support human activity on Franz Josef Land. In June 2015 and May 2017, we joined icebreaker voyages to the region and took

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advantage of the opportunity to observe polar bears. The observers surveyed the route from the wheelhouse of the ship looking forward along the path of the ship with a view 90° to port or starboard of the ship's heading. Our observations took place on a 24-hour basis, but in 2015 the polar bear habitat was crossed during a shorter time interval. We recorded routes of the icebreakers via hand-held Garmin Global Positioning System (Garmin Ltd, Olathe, Kansas, USA). We photographed all bears observed and subsequently classified them to age and sex categories. We collected similar information during a snowmobile survey of Alexandra Island in 2015.

Our observations took place in May–June. In April the ice coverage reaches the maximum in the Barents Sea; in May–June it breaks up, but still occupies large areas (Zabolotskikh and Myasoedov 2017). During this season the polar bears are actively feeding and moving across suitable areas. Therefore, they are highly visible and are distributed across the ice. Other seasons would be less suitable for such observations; pregnant females are in maternity dens and cannot be observed during winter, whereas the ice cover is reduced and polar bears concentrate in smaller areas during summer.

We considered the route of the icebreaker as a transect line crossing polar bear habitat. Based on the encounters of polar bears, we tried to estimate their density using distance sampling methods (Buckland et al. 2001), specifically the program Distance 7.3 (http://distancesampling.org; accessed 1 Oct 2019). However the number of encounters turned out to be too few to enable a rigorous analysis based on distance sampling. Therefore, we calculated a rough estimate based on total minimum counts. We used the number of the visible bears within the observation stripe along the transect line to calculate density; we considered 2 km as a maximum distance of effective observation from either side of the vessel (i.e., the estimated stripe width for the calculation was 4 km). We used only adult bears for calculation. We then extrapolated this density over the available habitat to obtain an estimate of abundance. To estimate the borders of polar bear habitat, we used the results of our observations of ice condition, as well as maps and satellite images provided by the Arctic and Antarctic Research Institute (Saint Petersburg, Russia). We assumed that the zone of multi-year ice was unsuitable for bears (Paetkau et al. 1999). Although they do occur there in small numbers, the main part of the population is located in the zone of annual ice. We also considered the land (i.e., the islands) as part of the habitat because the islands are small in relation to how far a bear can travel in a day (Laidre et al. 2012, Auger-Méthé et al. 2016). The archipelago is a network of islands, narrow bays, and peninsulas; however, even for the largest islands, the distance from inland areas to the nearest coastline is only a few kilometers, and the bears often cross them in different directions.

Results and discussion

According to aerial pictures and our observations, the southern boundary of ice cover began between the 77°N and 79°N in different years. Beyond 82°N a zone of multi-year thick ice begins, which is non-optimal for polar bears. The western and eastern boundaries of the territory under consideration are rather arbitrary; we defined the western boundary as the border between Norway and Russia, and the eastern boundary as the border of the Barents Sea and the Kara Sea. This means that the habitat of the Russian part of the Barents Sea unit in spring lies mainly in the trapezoid around the islands of the Franz Josef Land Archipelago, the area of which varies in different years depending on the state of the ice cover (Fig. 1). In May–June 2015 this area comprised 190,000 km^2, and in May–June 2017 it comprised 350,000 km^2.

We did not observe many polar bears (Table 1). The same is true for a snowmobile survey we conducted on Alexandra Land Island and adjacent ice fields in June 2015. During 5 days we covered a total distance of 200 km and observed sign of polar bears (recent footprints) only once. Of the 4 surveys, we observed the maximum density of adult polar bears on 17–18 May 2017. The area scanned during that period was 1,600 km^2 (400 km $\times$ 4 km) and the 8 adults observed resulted in a density of 5 adult bears/1,000 km^2. Taking into account the total area of suitable ice at that time, the number of adult polar bears in our study area can be roughly estimated as 1,750. Data from the return transect in 2017 yielded a similar estimate—1,432 adults (21–22 May 2017)—but transects from 2015 yielded much lower estimates—712 (7–8 Jun 2015) and 475 (1 Jun 2015). We acknowledge that our method was not rigorous enough to allow us to estimate uncertainty.

Our estimated numbers of adult polar bears around Franz Joseph Land were either considerably smaller (in 2015) or somewhat larger (in 2017) than the numbers estimated in 2004 (approx. 1,500 adults; Aars et al. 2017). Therefore it is problematic to estimate whether there have been recent changes in the number of polar bear in the study area. In addition, the amount of suitable ice and number of polar bears is continuously changing. In a situation like this, only rough numbers can be obtained.

Our estimates based on ice-breaker-based surveys do not provide estimates as rigorous as those of systematic

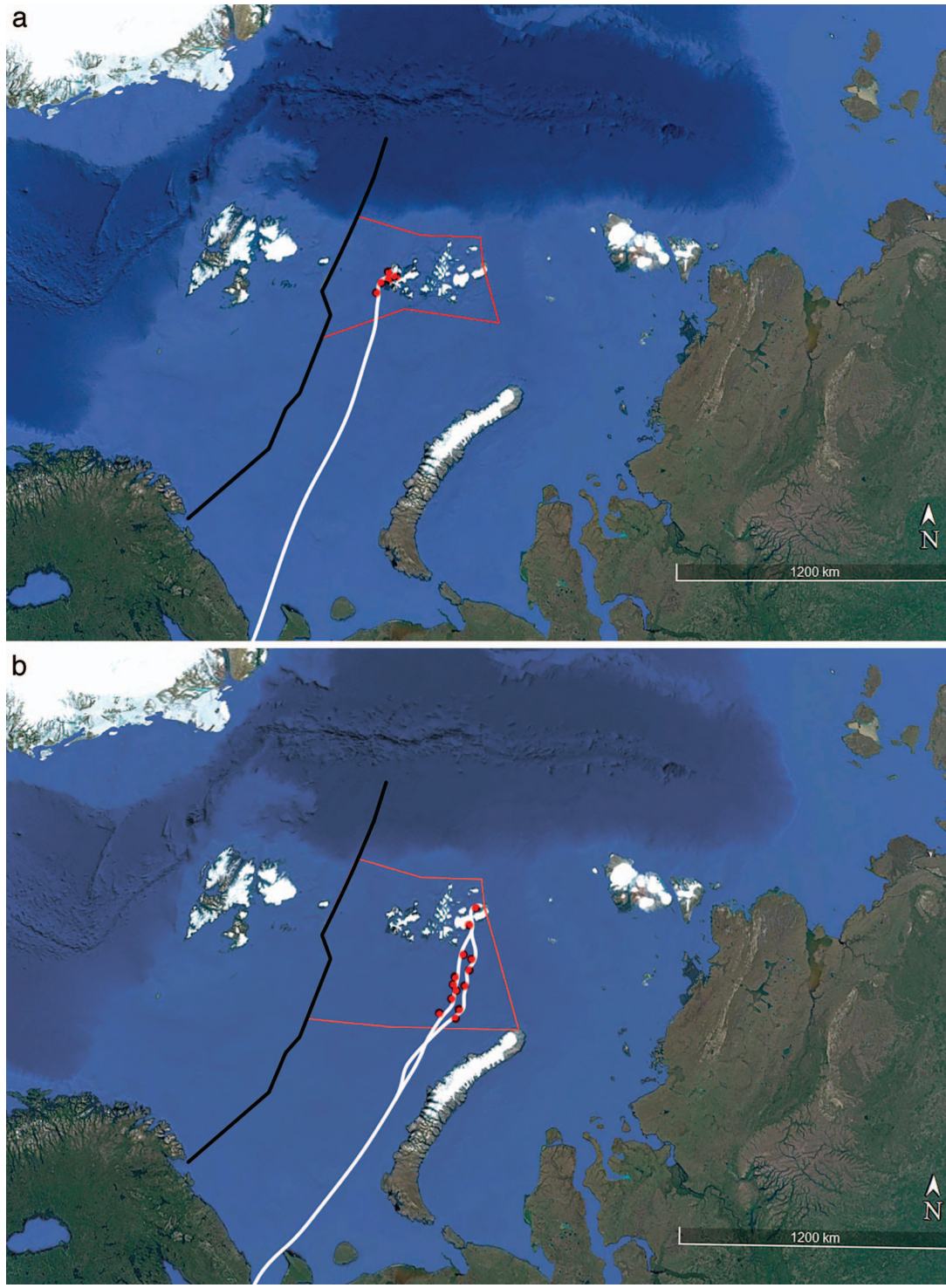

Fig. 1. Distribution of the Barents Sea subpopulation of polar bears (*Ursus maritimus*) in the Russian section: (a) June 2015, and (b) May 2017. White lines indicate the routes of icebreakers, black line indicates the national boundary of Russia, red lines indicate the borders of the study area, and red points indicate the locations of the encounters of the polar bears.

Table 1. Observations of polar bears (*Ursus maritimus*) from icebreakers in the Franz Josef Land archipelago, Russia, in June 2015 and May 2017.

Dates	Duration of observation (hr)	Distance of route (km)	No. of adult polar bears observed	Information on age, sex, and cubs
1 Jun 2015	17.5	200	2	1 female with 1 yearling 1 adult
7–8 Jun 2015	15.3	200	3	adults without cubs
17–18 May 2017	24	400	8	1 female with 2 cubs 2 pairs in heat 3 single adults
21–22 May 2017	24	550	9	2 females with 2 cubs either 1 pair in heat 5 single adults

aerial surveys, but the method we used may be especially useful in our study area, where use of other methods can be problematic. Since 2004 only one attempt was made to estimate polar bear numbers in the eastern part of the Barents Sea, but it was unsuccessful. In 2015, an aerial survey using the same methods as in 2004 was planned, but Russian authorities did not grant permission to conduct it (Aars et al. 2017). Meanwhile, icebreakers travel the area regularly as the development of the Arctic continuously progresses. Therefore, there is the possibility of obtaining increased data on encounters of polar bears and therefore estimates of their density. There was variability in estimates that we documented between the 2015 and 2017 surveys; therefore, we suggest that ice-breaker surveys be conducted regularly in order to hopefully detect population changes in a longer time series of surveys when aerial surveys are problematic. These observations are "non-invasive" because the polar bears show little, if any, reaction to icebreakers, usually resuming their previous activities, such as resting, feeding or foraging, within 5 minutes (Smultea et al. 2016). In some cases, observations at a short distance are possible (Fig. 2), and are safe both for bears and observers.

Fig. 2. Polar bears (*Ursus maritimus*) observed from an icebreaker surveying around Franz Josef Land, Russia (2017).

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