SATELLITE RADIO-TRACKING OF POLAR BEARS BETWEEN SVALBARD AND GREENLAND

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Abstract: An aerial survey program in 1977 and 1979 revealed that tracks of polar bears (*Ursus maritimus*) were abundant from Svalbard to Northeast Greenland south of 81° north latitude. In order to obtain evidence on possible exchange of polar bears between Svalbard and Greenland, 4 bears were instrumented with satellite radio collars from the ice drift station FRAM I in the northern Greenland Sea. After 1 month, 2 bears had moved eastwards to Svalbard and Frans Josef Land, and 2, which were instrumented further south, had moved southwards with the East Greenland Current. At times, some of the instrumented bears must have moved more than 40 km per day. Polar bears are able to compensate for the ice drift current, and can move against it. Helicopter observations revealed that there is an influx of bears, and particularly females with cubs, from the pack ice area off Northeast Greenland to Svalbard and the Barents Sea in early spring.

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Some scientists have regarded the Greenland Sea as a barrier that prevents a significant migration of polar bears between Svalbard and Greenland (Larsen 1971). Of 103 bears marked in Svalbard between 1966 and 1969, only 1 of 32 recoveries are from Greenland (Larsen 1972). Polar bears in East Greenland showed similar fidelity to their home areas. Of 45 bears marked in East Greenland between 1973 and 1975, 27 were recaptured in the same general area, while 2 travelled south to Scoresbysund where they were killed (Vibe 1982).

Manning (1971) studied cranial variation in polar bears, but could not detect significant differences between bears from Svalbard and East Greenland. Additional craniometric studies by Thor Larsen (unpublished) have confirmed Manning's findings. However, the evidence from limited recoveries of marked animals and the craniometric studies are not conclusive with regard to the extent of exchange between the two populations. An annual influx of bears and arctic foxes (*Alopex lagopus*) to Southeast Greenland, and no known maternity denning to account for the constant annual kill of about 70 bears by hunters, provided conflicting evidence. Mark-recapture data from East Greenland suggest a total bear population of not more than 60 to 100 bears on the central East Greenland coast, and a total number of not more than 200 to 300 along the entire east coast north of Scoresbysund (Vibe 1982). Such small populations cannot sustain an annual harvest of 70 bears in Southeast Greenland.

Vibe (1976) hypothesized that bears arrived in Southeast Greenland by drifting passively on the ice with the East Greenland Current from the Eurasian Basin. The bears that reach settlements in the south are harvested instead of lost. The sustained annual kill is possible through constantly draining bears from Svalbard to Southeast Greenland.

Our objective was to study migration of polar bears in the Greenland Sea in relation to ice drift, and to obtain evidence on the possible exchange of bears between Svalbard and Greenland.

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DESCRIPTION OF THE AREA

Approximately 75 to 80% of ice in the Polar Basin flows to the Greenland Sea through the Fram Strait between Svalbard and Greenland. Some 0.75 to 1.32 million km^2 of ice flows into the Greenland Sea each year (Vinje 1982). The

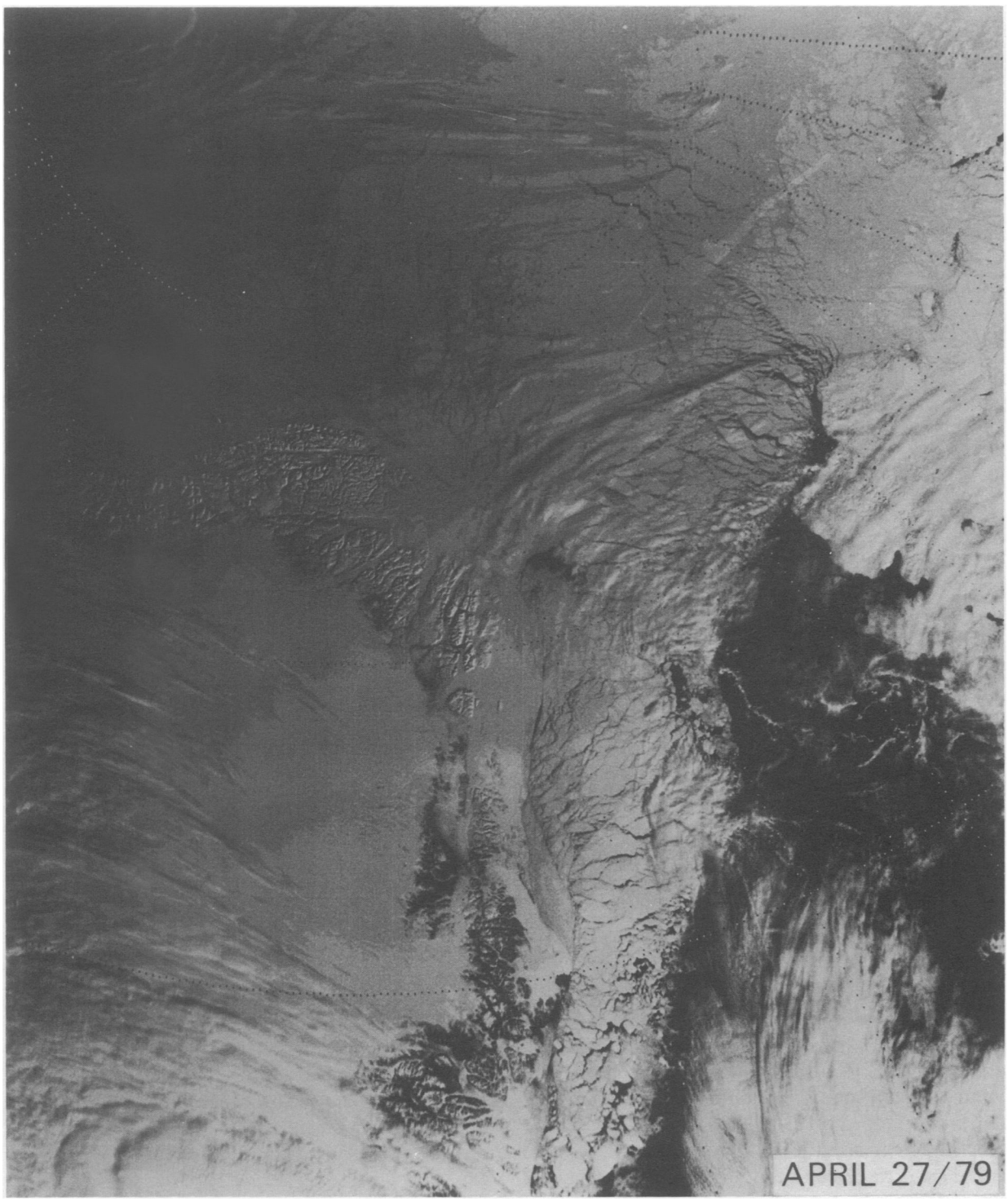

Fig. 1. TIROS N satellite photo, 27 April 1979, showing ice distribution and occurence of major leads in the Greenland Sea between Svalbard (right) and Greenland (left).

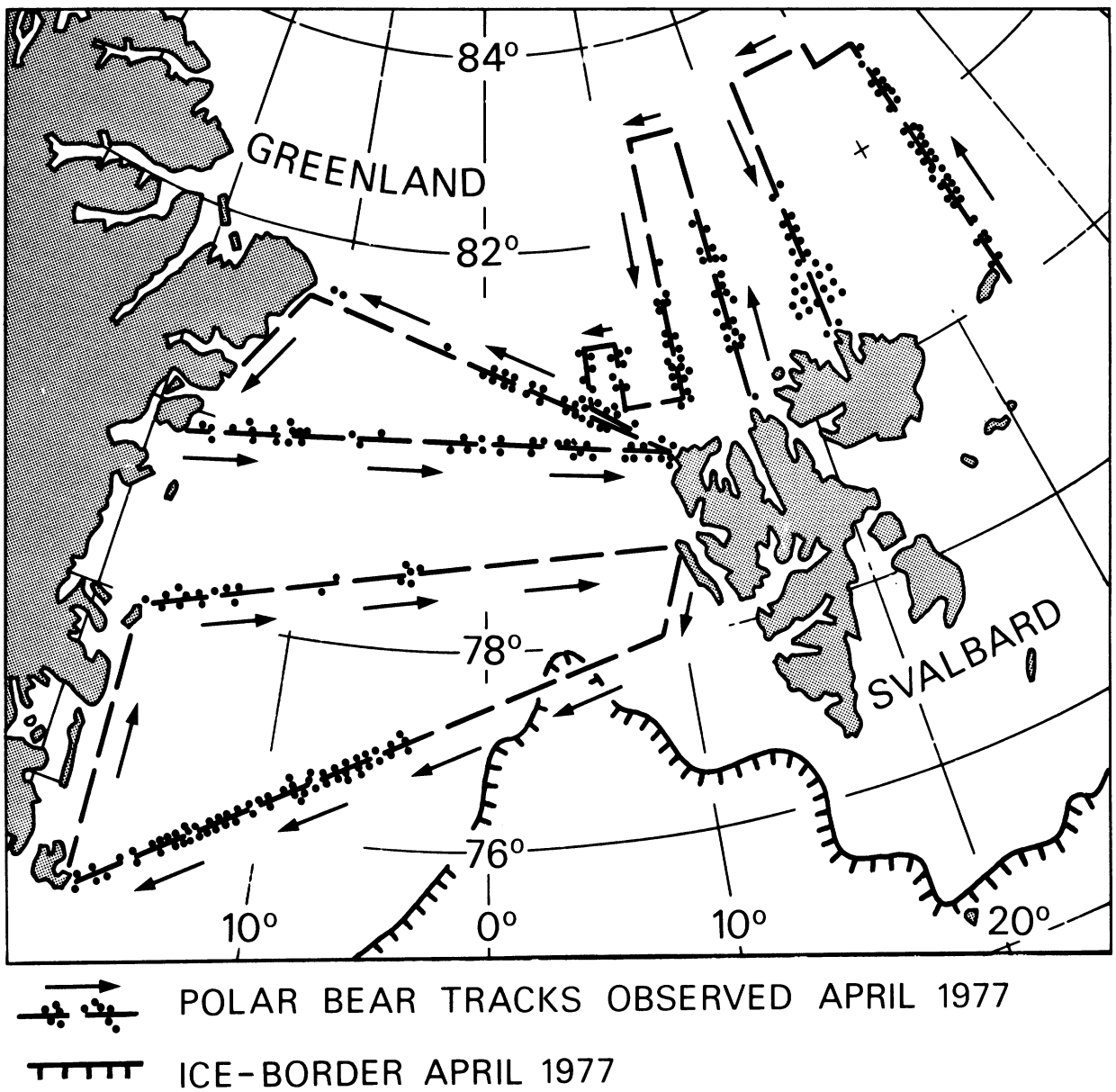

Fig. 2. Polar bear tracks observed from fixed-wing aircraft at Svalbard and Greenland, April 1977.

ice consists of pans 50 m to 5 km across, pressure ridges, and leads that open and close with wind and currents. The multi-year ice may have a thickness of 3 to 6 m. When drift begins the pans are large and the ice is consolidated, with 80 to 100% surface coverage. The large floes break up and the ice cover is reduced to 40 to 70% as the ice moves southwards. The speed of the current is 5 to 15 cm/s (Vinje and Loeng 1979). A seasonal pulsation of the ice cover occurs throughout the year. Maximum distribution is in March and minimum in August. Along the East Greenland coast shorefast ice remains for long periods of the year. Between the shorefast ice and the drift ice there are often open leads and ice-free water (Fig. 1).

METHODS

In 1977, ice north of Svalbard and between Svalbard and East Greenland was surveyed from a twin-engine Piper Navaho. The aircraft travelled at an average speed of 160 km per hour and

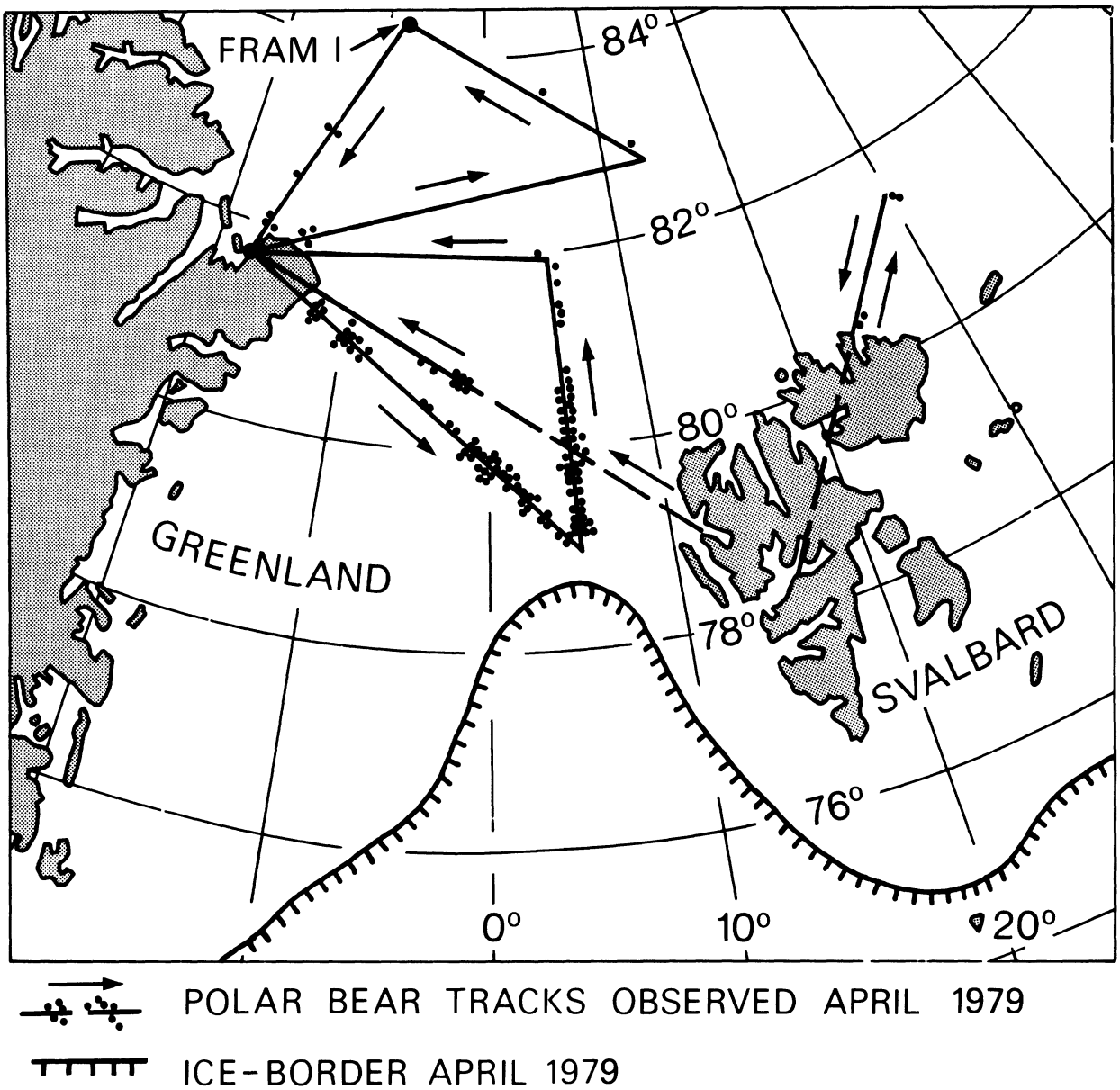

Fig. 3. Polar bear tracks observed from fixed-wing aircraft at Svalbard and Greenland, April 1979.

an average altitude of 100 m. Three observers were usually on board in addition to pilot and navigator. Two observers were on duty at any time. Observations of polar bear tracks were related to time, using synchronized watches, and plotted on maps. Four flights were made between 34° east and 20° west and between 82° and 75° north between 16 and 21 April (Fig. 2). Similar flights occurred in 1979 using a Twin Otter. This aircraft had an Omega navigation system which was used to confirm flight positions and observations. The 1979 surveys were made between 30° east and 17° west and between 84° and 79° north between 19 and 23 April (Fig. 3).

In April and May 1979, 4 polar bears were instrumented in the Greenland Sea with satellite telemetry equipment. The transmitters communicated with the NIMBUS 6 satellite on 402.2 MHz. A radiofrequency (rf) beacon in a self-contained circuit operated at 164 MHz. The instruments were powered by lithium batteries that gave them an expected life of 1 year and 18

Table 1. Migration characteristics of 4 polar bears instrumented with satellite radio collars in the Greenland Sea, spring 1979.

Bear No.	Sex	Date and position (Lat., Long.)	No. days tracked	General direction of travel	Avg travel speed (km/day)	Remarks
466	F	26 Apr 79 81°55'N, 0°	22	West and east	14–24	Lost collar. Was immobilized again after 3 hrs; harness tightened. In oestrus. Reported shot in Scoresbysund, SE Greenland, winter 1979–80.
430	M	2 May 79 82°01'N, 0°50'W	44	South	3–39	Avg travel speed down to 3 km/day at ice edge in June.
452	F	3 May 79 83°40'N, 3°W	63	East and southeast	3–32	With 2 cubs of the year. Avg travel speed down to 3 km/day in late June–early July.
477	F	4 May 79 83°55'N, 7°50'W	18	East and southeast	43	

months, respectively. A timing control operated the satellite transmitter for a continous 8-hour period every 4th day (Kolz et al. 1978). The instruments were packed in a 5-kg plastic collar which was fastened with a harness consisting of steel cables covered by plastic and rubber tubes. The cables were fastened by a magnesium bolt under the chest to allow release. The bolt deteriorates in salt water and, if not removed manually, it will break so that the harness comes off after about 1 year. Position fixes were accurate between 0.3 and 6.7 km for the 4 collars.

The search for bears was concentrated in the areas south of FRAM I in an attempt to capture bears most likely to be utilizing the East Greenland current for travel, and where bears were most likely to be found according to the previous surveys. After reconnaissance flights were made with the Twin Otter, a Bell 204 helicopter was used to track and locate bears. Selected bears were captured by means of immobilizing drugs (Sernylan) delivered by syringe guns by techniques described by Lentfer (1968) and Larsen (1972). Low bear density and limited helicopter range required support by the Twin Otter, which carried extra fuel. When necessary, a rendezvous was made on the ice to refuel the helicopter.

Automatic satellite buoys were placed on the ice in late April to monitor ice drift. One was placed at 82°50′ north and 14°07′ east and 1 on FRAM I at 84°13′ north and 7°57′ west.

RESULTS AND DISCUSSION

During the 1977 air surveys, a concentration of bear tracks occurred to 82° north. From there north they decreased markedly. Bears were concentrated off the northwest coast of Spitsbergen and off the east coast of Greenland. Few tracks were found in the central Greenland Sea (Fig 2). The north/south surveys confirmed that the Svalbard polar bear population has a normal northern distribution limit, a subpopulation boundary, at 82° north. This coincides well with our assumption that the shelf area north of Svalbard is also a border area between different water masses and ice types (and thus marks differences in biological productivity). The 1979 surveys revealed that polar bear tracks were distributed in the same general pattern as in 1977. But fewer tracks were observed north of Svalbard (Fig. 3), probably because of differences in ice and feeding conditions in the northern Svalbard area.

Track observations did not confirm migration of bears from Svalbard to Greenland. The few tracks observed in the central Greenland Sea indicated the existence of 2 different populations east and west of 0° longitude.

The 4 bears in this study (3 females and 1 male) were captured and instrumented between 26 April and 4 may 1979. Data on their movements are given in Table 1 and Fig. 4.

Ice drift data from the automatic buoys showed that average drift speed varied from 3.2–19.8 cm/s (5–31 km/day) for the buoy on FRAM I and from 5.1–13.3 cm/s (8–21 km/day) for the buoy in the east (T. Vinje pers. commun.). Drift was not constantly southwards. Southern winds sometimes forced the ice northwards against the current. As an example, FRAM I drifted 162 km

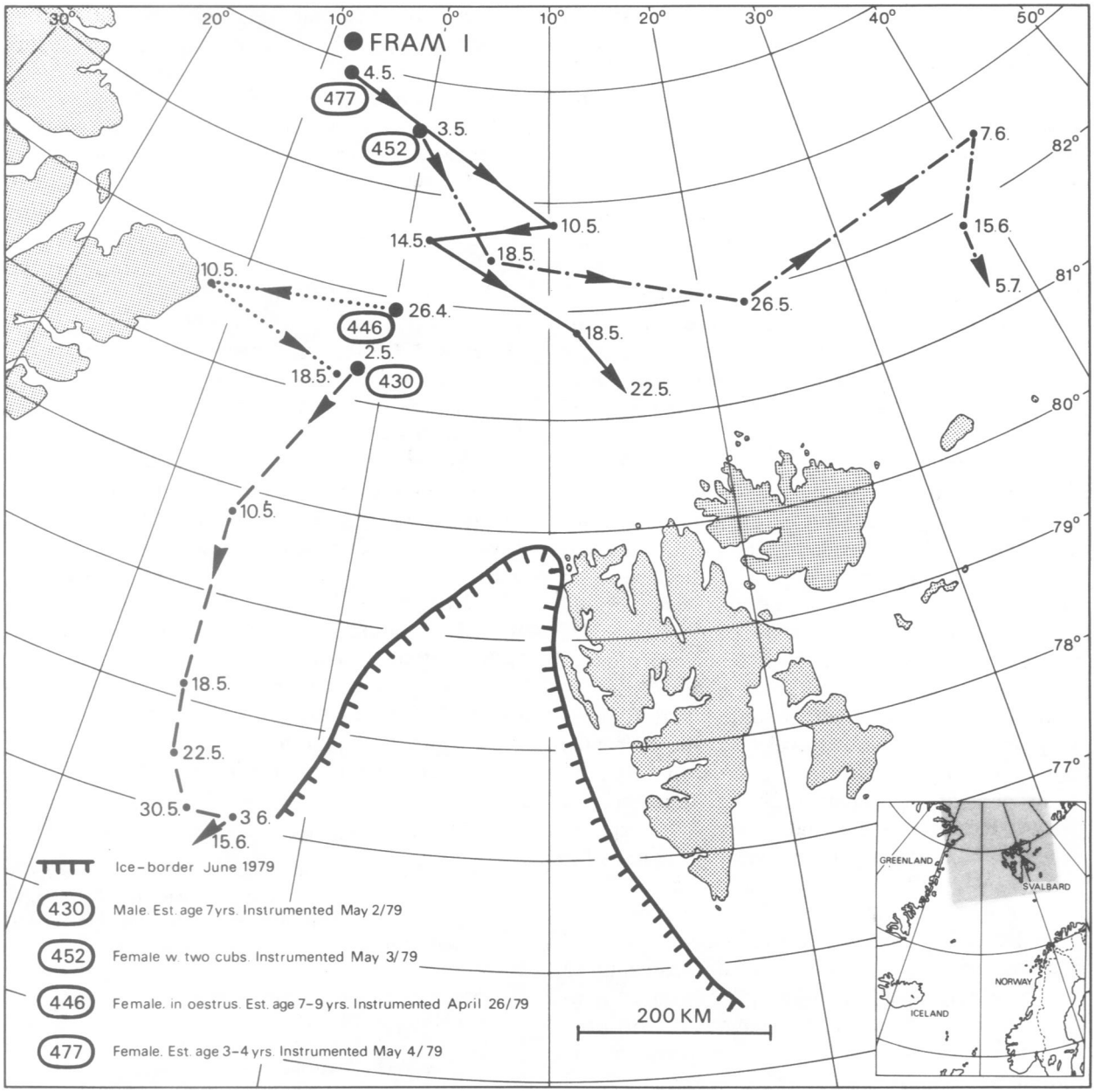

Fig. 4. Migratory routes of polar bears instrumented with satellite radio collars in the Greenland Sea, April and May 1979.

northwards between 11 and 20 March (Y. Kristoffersen 1979).

Data from the 4 bears instrumented in the Greenland Sea showed that they do not drift passively with the ice. Average travelling speeds of more than 40 km per day perpendicular to or even against the current compensated for ice drifts up to 31 km per day in this study. Polar bears may travel even faster, as demonstrated off the Alaskan coast. There, an instrumented bear migrated an average of 56 km per day with a maximum 1-day movement of 82 km (Kolz et al. 1978). Medium walking speed for polar bears is 1.5 m/s (N. Øritsland, pers. commun.); 40 km travel distance will then require between 7 and 8 hours walking each day as an average. The marking and recapture of polar bears in the Barents Sea east of Svalbard confirms that bears are able

to compensate for ice drifts there with speeds comparable to that of the East Greenland current. The southward ice drift in the Barents Sea has a speed of 8–14 cm/s (12.6–22 km/day, Vinje and Loeng 1979). Bears marked in the Barents Sea were recaptured there up to 3 years later (Larsen 1971).

Two of the instrumented bears travelled southwards (Fig. 4). No. 430 migrated 450 km south to the ice edge in 44 days. No. 446 ceased to give information after 22 days, but has later been reported shot in Scoresbysund the winter of 1979–80, 1500 km south of where it was instrumented. This bear was a female in oestrus. It is not known if it was in a den or in a denning area when it was shot.

The migrations of bears No. 452 and 477 (Fig. 4) demonstrated a connection between bears in Northeast Greenland, Svalbard, and Frans Josef Land areas. Both travelled perpendicular to and even against the general ice drift. Both went to areas south of 82° north latitude. Apparently they were heading towards the semi-open water and mingling currents of high biological productivity around Svalbard and in the Barents Sea.

It has previously been assumed that females with small cubs cannot travel fast, and that cubs observed far from the shore must have come from dens in the polar pack ice (Lentfer and Hensel 1980). Our data indicate travelling speeds of more than 30 km per day over long periods for female No. 452, which was accompanied by 2 cubs of 4 months age. The distance between potential denning areas in Northeast Greenland and the position where the family group was captured was between 300 and 350 km. They could therefore have travelled from a den in Northeast Greenland in less than 2 weeks. Previous observations from different high Arctic areas indicate that most polar bear females with cubs leave dens before the first week of April (Larsen 1975, Celincev 1977, Hansson and Thomassen 1983). Female No. 452 and her 2 cubs may have had more than 1 month to reach the position where they were captured. Furthermore, ice conditions in the Greenland Sea are not favorable for denning. There is more movement and breakup in the ice there than off the Alaskan coast, where polar bear maternity dens occasionally have been found in the pack ice.

The helicopter searches, which permitted closer inspection of the ice and polar bear tracks, revealed that almost 90% of all tracks observed around FRAM I were of females with small cubs. All of the family groups but 1 were heading southeast, the same general direction female No. 452 followed after she had been instrumented. The observations indicate that there is an influx of bears and particularly females with small cubs from the pack ice areas off Northeast Greenland to Svalbard and the Barents Sea in early spring. Bears south of 82° north latitude follow the East Greenland Current southwards. Whether these bears come from Svalbard or other areas is not known. But only 4 instrumented bears do not offer conclusive evidence. Further studies are therefore required.

The satellite radio collars ceased to give information after an average of 37 days (range 18–63 days). The most probable reasons are instrument deficiency, or battery failure, or that bears got rid of harnesses and collars. Studies under controlled conditions have shown that the magnesium bolt deteriorates faster than assumed, and that the steel cables break from metal fatigue (M. Taylor, pers. commun.). One of these factors or a combination of both is the most probable reason for instrument deficiency.

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