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Shore-Based Counts of Bowhead Whales along the Chukotka Peninsula in May and June 1999–2001

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ABSTRACT. This study presents the results of shore-based counts of bowhead whales (*Balaena mysticetus*) along the Chukotka Peninsula in 1999, 2000, and 2001. These counts confirmed that at least a small proportion of the Bering-Chukchi-Beaufort Seas stock migrates along the western Bering Strait in late spring. The results of the counts in the Bering Strait were somewhat consistent between years. Taking into account that the whales passed by rapidly at great distances, we believe the number of whales seen during these counts is an underestimate of the actual number of whales migrating through the area.

Our results indicate that the beginning of the spring migration of bowhead whales out of the Gulf of Anadyr varies by up to 30 days between cold and mild years, but in both cases, the area migration continues at least until 20 June. During the spring migration in the western Bering Strait, at the exit from the Gulf of Anadyr, whales moved over a broad front from near shore out to sea. When the directed migration began in May, the whales were not (or were seldom) observed to rest, feed, or engage in social behavior. Instead, we saw whales traversing long distances under water, swimming at speeds considerably faster than those of bowhead whales noted previously at Point Barrow.

Key words: shore-based count, bowhead whale, Bering Strait, Gulf of Anadyr

РЕЗЮМЕ. В предлагаемой работе представлены результаты берегового учета гренландских (полярных) китов (*Balaena mysticetus*) у побережья Чукотского полуострова в 1999, 2000 и 2001 гг. Результаты работ подтвердили, что, по меньшей мере, небольшая часть берингово-чукотско-бофортской популяции мигрирует вдоль западной части Берингова пролива поздней весной. Результаты учета относительно стабильны между годами. С учетом того, что киты мигрировали быстро и на большом расстоянии, мы предполагаем, что число учтенных китов было значительно ниже подлинного числа китов мигрировавших в районе работ.

Полученные результаты показывают, что начало весенней миграции из Анадырского залива варьирует до 30 дней между холодными и теплыми годами, однако в обоих случаях миграция продолжается, по меньшей мере, до 20 июня. Во время миграции в западной части Берингова пролива и на выходе из Анадырского залива киты идут широким фронтом, как вблизи побережья, так и вдали от него. В период миграции киты не проявляли признаков социального поведения, не отдыхали или очень редко отдыхали и кормились. Было видно, что киты проходили большие расстояния под водой, двигались с большой скоростью, которая была значительно выше скорости движения китов отмеченной ранее для мыса Барроу.

Ключевые слова: береговой учет, гренландский кит, Берингов пролив, Анадырский залив

RÉSUMÉ. Cette étude présente les résultats de dénombrements côtiers de baleines boréales (*Balaena mysticetus*) effectués le long de la presqu'île des Tchouktches en 1999, 2000 et 2001. Ces comptages ont confirmé qu'au moins une petite proportion du stock de la mer de Béring, de la mer des Tchouktches et de la mer de Beaufort migre à la fin du printemps le long du détroit de Béring occidental. Les résultats des dénombrements dans le détroit de Béring étaient relativement uniformes d'une année à l'autre. Si l'on tient compte du fait que les baleines passaient rapidement, et ce, à une grande distance, on pense que le nombre des baleines aperçues durant ces comptages représente une sous-estimation du nombre réel de ces cétacés qui traversent la région durant leur migration.

Nos résultats révèlent que le début de la migration printanière des baleines boréales quittant le golfe de l'Anadyr peut varier jusqu'à 30 jours entre les années froides et les années plus tempérées, mais que, dans chaque cas, la migration dans la région se poursuit au moins jusqu'au 20 juin. Durant la migration printanière dans le détroit de Béring occidental, à la sortie du golfe de l'Anadyr, les baleines formaient un large front qui s'étendait de la proximité de la côte jusqu'au large. Lorsque la migration dirigée

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commençait en mai, on n'a pas (ou rarement) observé de baleines qui se reposaient, s'alimentaient ou manifestaient un comportement social. Par contre, on les a vues qui traversaient de grandes distances sous l'eau, nageant à des vitesses bien supérieures à celles de leurs congénères observées précédemment à Point Barrow.

Mots clés: dénombrement côtier, baleine boréale, détroit de Béring, golfe de l'Anadyr

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INTRODUCTION

The shore-based counts of bowhead (polar) whales (*Balaena mysticetus* L.) on the Chukotka Peninsula in 1999 to 2001 (Fig. 1) were a continuation and development of a joint Russian-American project implemented in 1992–96 to study the bowhead whale in waters adjacent to the Chukotka Peninsula. Earlier work done under that project indicated that in spring, some whales linger in the Gulf of Anadyr, migrating from the western Bering Sea into the Chukchi Sea later than the whales that migrate up the eastern side of the Bering Strait (Melnikov and Bobkov, 1993a, b; Melnikov et al., 1997, 1998).

The objectives of the Chukotka Peninsula study were 1) to count bowhead whales migrating out of the Gulf of Anadyr and past Sireniki village during the spring and 2) to count whales migrating from the Bering Sea through the western Bering Strait into the Chukchi Sea from an observation post in the Cape Dezhnev area.

METHODS

Location and Elevation of the Observation Posts

The observation site for counting bowhead whales coming out of the Gulf of Anadyr was the village of Sireniki, situated at the extreme southeastern edge of the Chukotka Peninsula (Fig. 1). The northeastern entrance to the Gulf of Anadyr is clearly visible from the village and from the adjacent mountains. Sireniki was selected as a convenient vantage point for counting migrating whales not only because of its location, which eased logistics, but most importantly because of the high bowhead passage rate observed here during the spring migration in previous years (Melnikov et al., 1998). The observation perch lies at 55 m above sea level, atop an ancient moraine.

The other observation post was on Cape Pe'ek, 10 km south of Cape Dezhnev (Fig. 1). This was the most accessible and convenient site for a whale count in the western Bering Strait area, with a good view of the southeastern and southern approaches to the Strait. When visibility was excellent, we could clearly see Ratmanov Island (Big Diomede), 40 km to the southeast. Overall, we had a 20 km field of vision. However, observations from Cape Pe'ek were hampered by steep terrain, bad weather, and the strong local winds, which accelerate as they round the Cape.

The elevation of the post is a crucial factor in ensuring a wide enough field of vision. The relief of the Chukotka coastline, both at Sireniki and at Cape Dezhnev, makes it possible to conduct observations from heights of up to 300–400 m. Trial observations from various elevations showed that the best results were obtained at 50–70 m. Higher than that meant too broad a field of vision; this reduced the possibility of sighting a whale because the area seen, particularly through the binoculars, would be too small. With lower elevations, however, results were worse because the horizon was too close. But an elevation of 50–70 m, with good visibility, permits sighting whales at distances up to 20–25 km without having too broad a field of vision.

Observer Routines

Typically, two observers were on each watch and continuously scanned the entire viewing area with binoculars or the naked eye (or both) for four hours at a time and eight hours during a day. Three teams of observers, therefore, could count whales 24 hours a day. Personnel included 8–10 experienced hunters and a biologist for part of the season. When one observer sighted a whale or whales at the surface, the other would record data. Observers used the bino-compass to determine the bearing to the whale. The distance to the whale was determined with the aid of the vertical scale on the binoculars and by eye. If possible, observers would monitor the progress of the whale or whales, count the number of times the whale(s) surfaced, and verify the number of whales. Other factors noted during the count were the time (hours and minutes) when the whales were sighted, whether they were newly sighted or re-sighted, species, swim direction, and behavior. Observation conditions, including visibility, weather, wind direction and speed, temperature of the air, and percentage of ice cover, were also recorded. Weather and visibility were recorded every 30 minutes.

Determining the Species of a Whale

We experienced some difficulty identifying whale species during the count, especially differentiating between bowhead and gray whales. At 5 to 10 km, under good to excellent visibility, it was no particular problem. But if a whale was so far away that only its spout could be seen, then it was hard to tell a bowhead from a gray. The only clues were the duration of a dive and the number of surfacings. In the Chukotka area, gray whales do not usually stay submerged for more than three or four minutes (Bogoslovskaya et al., 1981), and they rarely blow

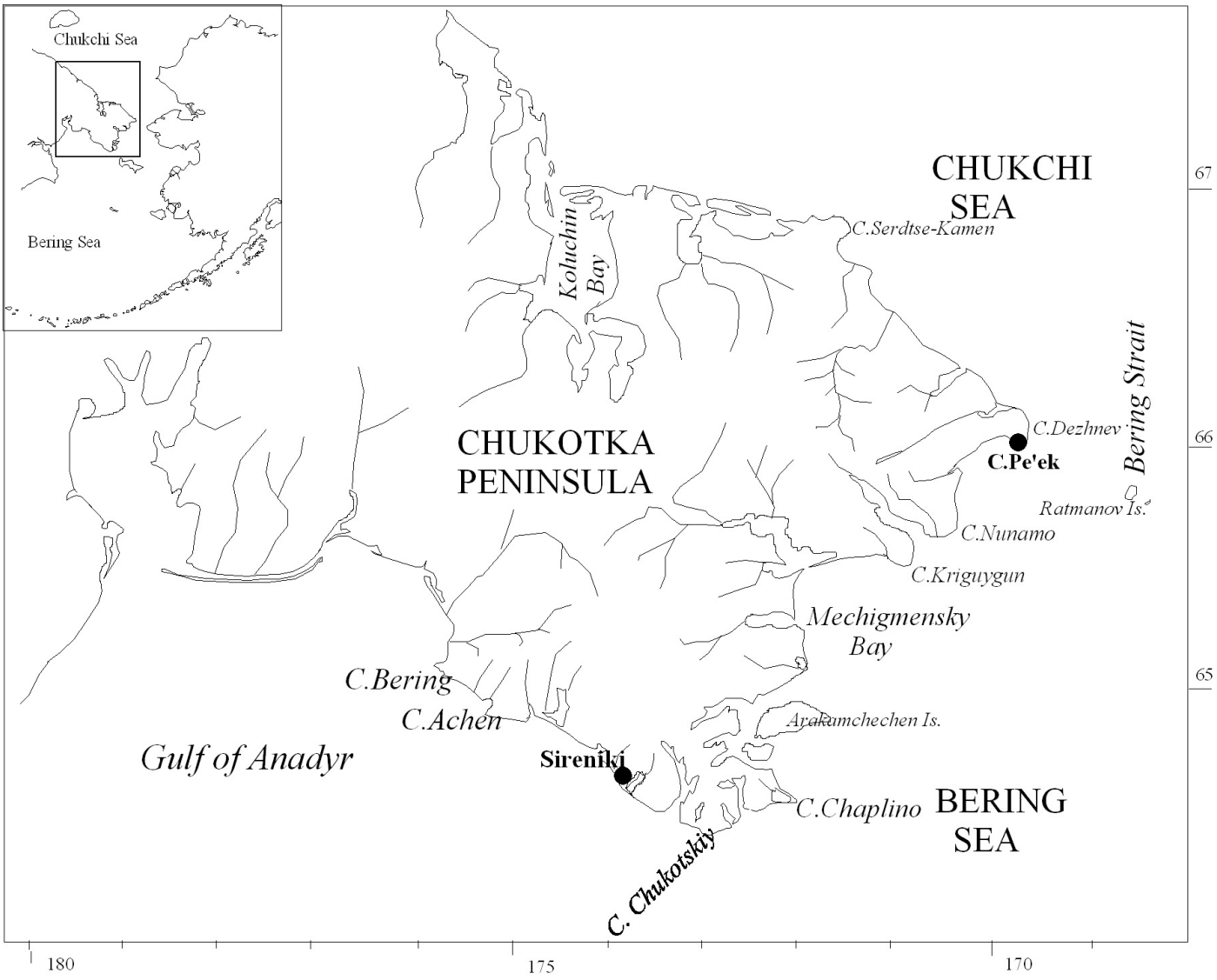

FIG. 1. Eastern Chukotka Peninsula showing all locations. Black dots indicate observation posts.

more than three or four times in a row. In addition, a gray whale when diving nearly always shows its tail flukes (fluke-up dive). A bowhead, in contrast, almost never up-flukes because it dives by lowering its entire body all at once, instead of consecutively exposing its head, then its back, and finally its tail (before actually submerging). When migrating at high speed, a bowhead generally remains under water for 15–30 minutes, blowing perhaps 4–10 times when it surfaces. Another difference is that most gray whales migrate either right along the ice edge or some 0.3–3 km from shore (Rugh, 1984), whereas bowhead whales usually pass by at a much greater distance away from the shoreline and the ice edge. Because auxiliary clues were used, not all species identifications were considered equally reliable. Large cetaceans that were not readily assignable to species, either by body characteristics or by the above-mentioned criteria, were listed as 'unidentified whales' and excluded from the present analyses.

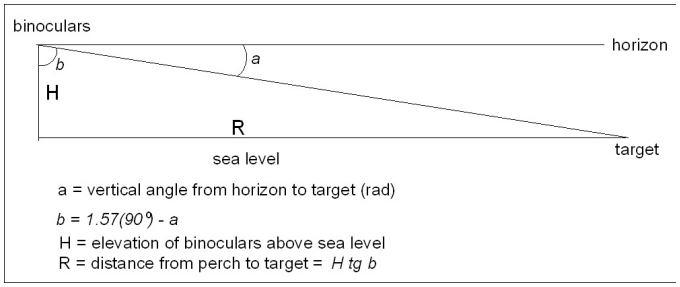

FIG. 2. The method of measuring distance from the observation perch to the whale.

Determining the Location of a Whale

Observers used seven-power binoculars (Commander III 7 × 50, Steiner of Germany) with a built-in compass and a vertical and horizontal scale. The compass provided the horizontal angle to the target, starting from zero at the

magnetic pole. The vertical scale provided the vertical angle of the whale's surfacing relative to the horizon. These measurements, plus the elevation of the instrument above sea level, made it possible to determine the distance between the observation perch and the whale (Fig. 2).

Determining Swim Speeds

Calculations of the bowhead whale's spring migration speed were based on measurement of distance and angles using the scales on the binoculars. This method made it possible to determine the distance covered by the whale between its first and last surfacings, according to the formula:

$$V = S/t\ 60$$

where V is the swim speed, t is the time in minutes between the first and last surfacings of the whale, and S is the distance covered by the whale between the first and last surfacings (Fig. 3).

Only whales migrating at 7 km or less from the observation post were used in the calculations. At a greater distance, it was difficult both to track a whale's surfacing and to distinguish "new" and duplicate sightings. Greater distances also increased the chance of instrument error. Questionable repeat sightings were not used.

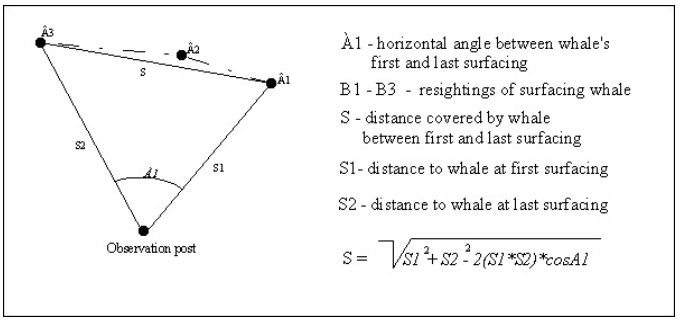

FIG. 3. The method of determining speed of migration.

RESULTS AND DISCUSSION

Overall Ice Conditions (Spring 1999–2001)

Ice conditions in the northeastern Gulf of Anadyr were very unstable. All winter long, ice drifted away from the shore, pushed out by the prevailing northerly winds, leaving the shore nearly always free of fast ice. During the time of the count, ice was constantly being carried out by a perceptible current from the western part of the Gulf of Anadyr. The area of open water that usually forms between the shore and the pack ice depends on the direction of the wind. When the wind comes from the north, the ice is carried away, sometimes as far as the horizon, but a south wind presses the ice up against the shore. In 1999–2000, the ice-free area varied in width from 2 km to 7 km. The location of open water determined the area that could be observed. A field of floating ice at a distance of 2–3 km can prevent observation, because against the background of ice, a spout is virtually invisible, and it is often impossible to see a whale's profile amid floating ice. The 2001 season was marked by a very early retreat of ice from the shore. Between 24 April and the end of June, there was almost no ice in the area of the count.

In most years, strong currents in the Bering Strait prevent the formation of landfast ice except in bays and inlets. By early spring the Strait is generally clear of ice. At the beginning of May, open pack ice in the strait forms a 20–30% cover. But sometimes, as in spring of 1999, the Bering Strait was blocked by ice because strong northerly winds were meeting currents from the south, forming an ice jam. During the count, the strait between Cape Pe'ek and Ratmanov Island (Big Diomede) usually had an ice cover of 10–30%. Only in a few cases, when disintegrating landfast ice was carried into the Strait, did ice cover increase to 80%.

Overall Visibility Conditions (Spring 1999–2001)

During every count, visibility varied from one period to another. The conditions that determine visibility are the most important factor affecting the results of the count (Krogman et al., 1989; Zeh et al., 1993).

In Sireniki, on the southern coast of Chukotka, visibility during the count was excellent or very good only 13% of the time. On Cape Pe'ek, visibility varied markedly during the count both in 2000 and in 2001 (Table 1). By contrast, Point Barrow observers, even in the worst years of their whale counts, had very good or excellent visibility 24% of the time (Krogman et al., 1989).

As in the shore-based count at Barrow, periods of poor or unacceptable visibility occurred under different conditions. Visibility is almost always poor in stormy weather, in fog, rain, or snow. "Visibility" (really the probability of detecting a whale) can be excellent even with a high wind, but as soon as whitecaps appear on the sea, the probability of sighting whales drops just as it would with fog. Ice too plays a crucial role, because spouts cannot be discerned against the background of ice, and floating ice will obscure the profile.

The weather also appears to affect migration patterns. We observed that migration seemed to stop when there were high winds or storms, both in the western Bering Strait area and at the exit from the Gulf of Anadyr. Whales were almost completely absent the day before a storm broke, and the numbers migrating slowly increased once it was over. If the weather was calm, even with fog, rain, or snow, migration did not stop, as was evidenced by the sounds of the whales blowing and also by occasional glimpses of a spout.

TABLE 1. Visibility during the shore counts (1999–2001).

Visibility	Sireniki						Cape Pe'ek					
	Duration of the count in 1999		Duration of the count in 2000		Duration of the count in 2001		Duration of the count in 1999		Duration of the count in 2000		Duration of the count in 2001	
	hours	%	hours	%	hours	%	hours	%	hours	%	hours	%
Excellent or very good	84	12.7	131	13.7	119	12.8	59	21.9	150	28.9	77	15.7
Good or fair	405	61.3	459	48.7	458	49.3	57	21.1	93	17.9	123	25.0
Poor or unacceptable	172	26.0	355	37.6	352	37.9	154	57.0	276	53.2	492	59.3

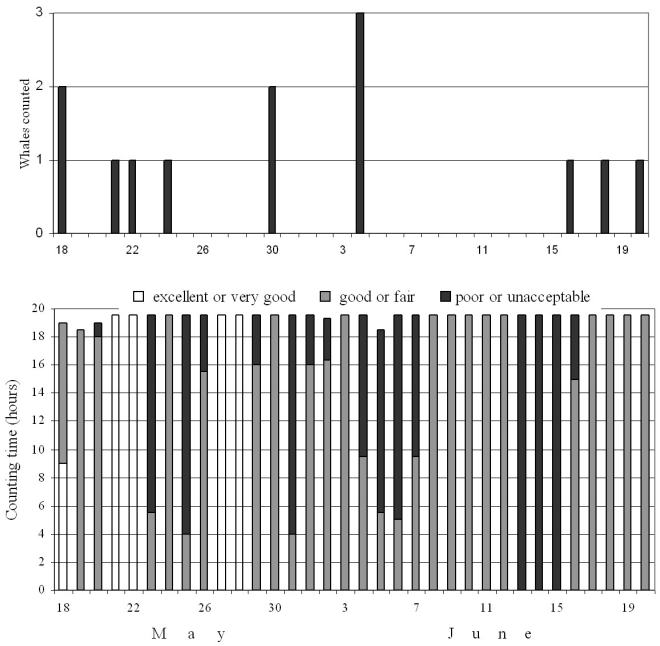

FIG. 4. Results of the 1999 bowhead whale count in the Sireniki area. Upper graph shows the number of whales counted. Lower graph indicates visibility conditions. "Excellent" or "Very good" refers to visibility 15 km or over. "Good" or "Fair" refers to visibility to 10 km. "Poor" or "Unacceptable" refers to visibility less than 5 km.

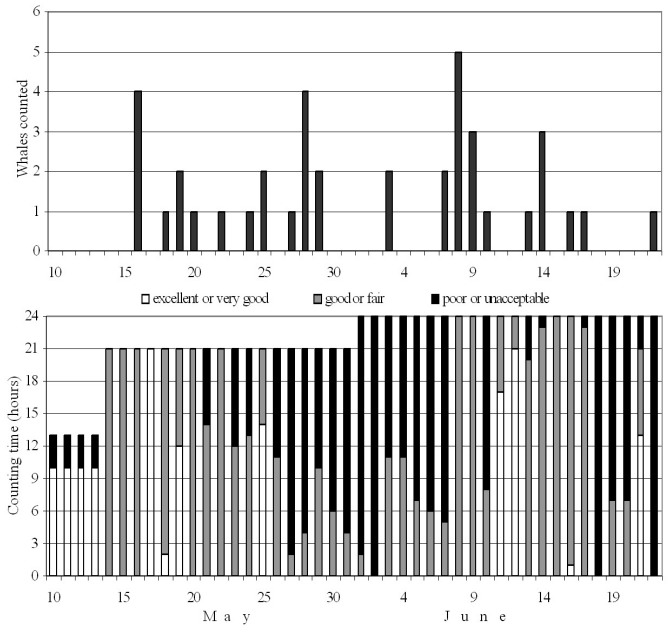

FIG. 5. Results of the 2000 bowhead whale count in the Sireniki area. (Visibility values as in Fig. 4.)

Sireniki Shore Count (Spring 1999)

The 1999 bowhead whale count at Sireniki was conducted from 16 May to 20 June, but observations by hunters began in April. The first two whales were seen in this area on 1 April, and thereafter, 1–5 whales were seen almost daily until the end of the month. The whales were 2–5 km from shore and moved slowly about in different directions parallel to the shoreline, sometimes lingering in place for long periods. Tail-slapping and breaching were observed. Hunters, who often approached very close to the whales, reported that they were feeding.

In the first 10 days of May, no bowheads were sighted in the observation area. The behavior of whales that began appearing singly on 18–20 May was very different from that of the whales observed in April. Whales moved rapidly eastward, without slowing down or stopping, to the exit from the Gulf of Anadyr, and for the duration of the count (34 days), whales were seen on only nine days (only 1–3 whales on each day) (Fig. 4). There were obviously a number of missed whales, because any that were swimming amid floating ice in the ice field, or along its proximal edge, could not be seen.

Sireniki Shore Count (Spring 2000)

In April 2000, in the count area at Sireniki, mostly single whales were sighted. Most of these single whales passed along the shore in different directions. A large group of 14 whales arrived on 23 April. The whales stayed so far from shore all day that only the spouts were visible. They remained more than 10 km offshore, so we suspect that there were many more. Judging from their behavior—slow movement in different directions, often lingering in place for long periods—in April 2000 migration had not yet started.

Whales sighted on 2 and 6 May were already swimming rapidly eastward, with no slowing or stopping, toward the exit from the Gulf of Anadyr. Throughout May of 2000, there were one or two whales daily exiting the Gulf of Anadyr, without any delays or stops (Fig. 5). Despite the bad weather, they maintained their rapid migration through about 10 June. During the next ten days (11–20 June), broken ice (20–50% concentration) was continuously carried out of the Gulf at a distance of about one kilometre

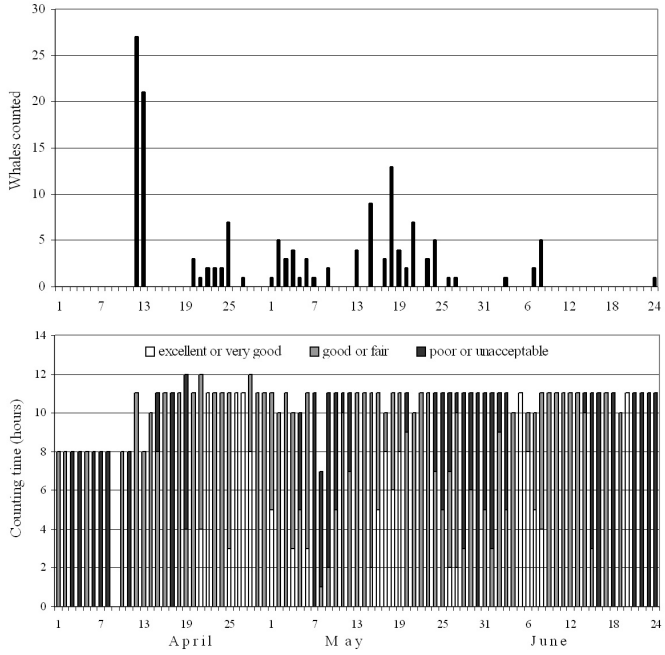

FIG. 6. Results of the 2001 bowhead whale count at Sireniki village. (Visibility values as in Fig. 4.)

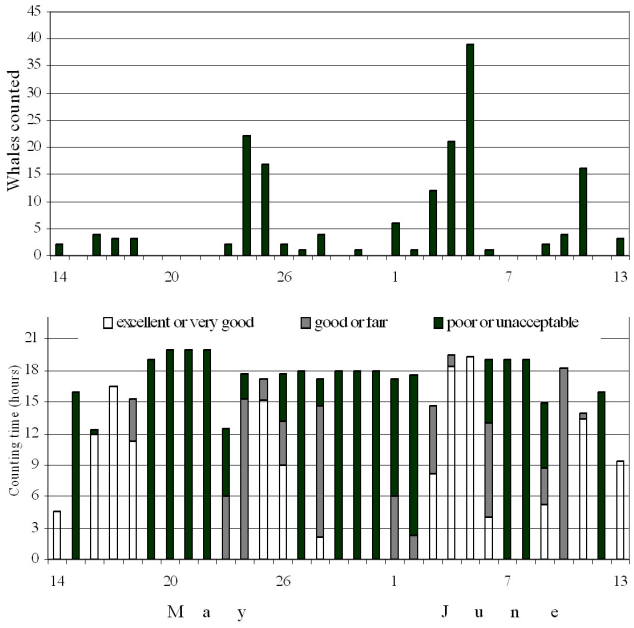

FIG. 7. Results of the May–June 2000 bowhead whale count in the Cape Dezhnev area. (Visibility values as in Fig. 4.)

offshore. Even so, there were days when whales were sighted migrating singly. Shortly after 20 June, the migration showed signs of waning, and on 22 June, the last whale seen passed the observation site. Because of bad weather, the observation period was prolonged until 30 June; however, no more whales were sighted.

Sireniki Shore Count (Spring 2001)

In 2001, experienced hunters began the count on 1 April. In the first ten days, no whales were sighted in the Sireniki area although weather and visibility were good. On 12 April, however, a large group (at least 27 whales) was sighted a very long distance from shore (Fig. 6). The group included individuals, pairs, and small groups of up to four whales amid floating ice. Owing to the great distance and the presence of ice, an accurate count could not be made, but it was clearly a large group, its numbers exceeding those previously recorded several times over. A similar situation was observed on 13 April, except that some of the group passed by only 4–5 km from shore. Most of the whales for which swim direction was determined were moving westward into the gulf. Signs that the 2001 migration was slackening off became evident in late May and early June. The spring bowhead migration out of the northern Gulf of Anadyr was virtually over by 8 June, although we saw a single bowhead migrating eastward on 24 June.

Beginning on 20 April, the whales were on a stable migration path eastward out of the Gulf of Anadyr. The major pulse of the spring bowhead migration out of the gulf passed by during 13–27 May, with three peaks on 15, 18, and 21 May, when 9, 13, and 7 whales, respectively, were sighted (Fig. 6). As before, the whales moved rapidly out of the gulf over a broad front, without slowing or stopping.

Cape Pe'ek Shore Count (Spring 1999)

The objective of the 1999 count in the Cape Dezhnev area was primarily to test the feasibility of counting in this area. Unfortunately, the bowhead whale count on Cape Dezhnev in the spring of 1999 was conducted sporadically from two sites with dissimilar conditions. Nevertheless, the first data received indicated the presence of a substantial number of bowhead whales in the viewing area. At the beginning of the count, the passage rate of whales migrating northward was not high, with groups of whales lingering in leads in the ice fields. Such behavior could have been due to the fact that the Bering Strait was jammed with ice, formed by strong northerly winds meeting currents from the south. No consistent whale movement was reported until June. A total of 115 bowhead whales were counted in June 1999.

Cape Pe'ek Shore Count (Spring 2000)

In 2000, fieldwork was conducted at Cape Pe'ek from 16 May to 15 June. During the count, when weather permitted, we saw three pulses migrate past the observation perch (Fig. 7). The first pulse was seen on 23–25 May, when 62 whales were sighted in three days. The second, with the highest passage rate, was on 3–5 June, when 70 new whales were sighted. The third pulse passed Pe'ek on 11 June, with 17 whales sighted. In the intervals between pulses, a steady rate of migration seemed to be maintained, with 3–5 whales a day sighted when weather permitted. In reality, however, our observations of the pulses of migratory activities may have been inaccurate because poor weather caused gaps in sighting records. All the whales

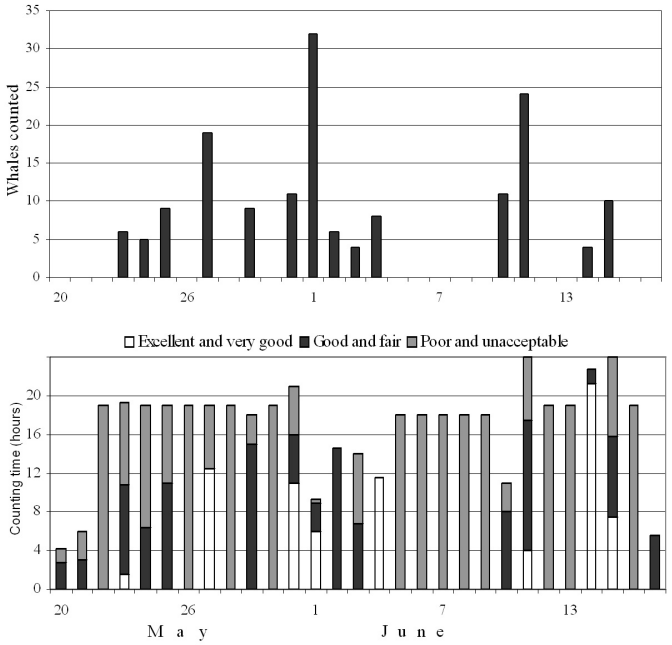

FIG. 8. Results of the May–June 2001 bowhead whale count off Cape Dezhnev. (Visibility values as in Fig. 4.)

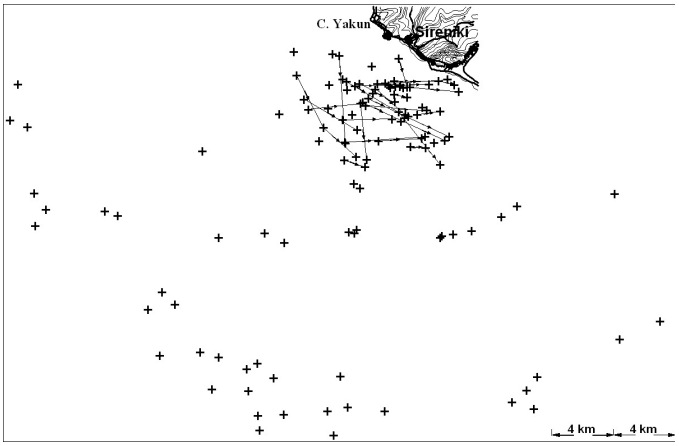

FIG. 9. Bowhead migration routes and surfacings based on data of the count at Sireniki in 2001.

moved rapidly into the western Bering Strait at a distance of 2–15 km from shore.

Cape Pe'ek Shore Count (Spring 2001)

In 2001, the bowhead whale count in the Cape Pe'ek area was conducted from 19 May to 19 June (Fig. 8). As far as weather permitted, we saw two pulses of migratory activities.

The first pulse was the longer one, from 23 May to 4 June. During that time, when visibility was good, 5–10 bowheads were sighted per day, with 19 sighted on 27 May and 32 on 1 June. A total of 100 whales were seen passing by in the first pulse.

The second pulse passed by during 10–15 June, except for 12 and 13 June, when the weather was stormy. The numbers seen in the second pulse totaled 49 whales. During this whole period, all the whales moved rapidly into the strait without slowing or stopping and spread out between Cape Pe'ek and Ratmanov Island. On 1 June, two neonates were sighted, each forming a part of a group of three whales moving into the strait. After 17 June, owing to continuous storms, the count was terminated.

Comparison of Whale Migration Dates (Spring 1999–2001)

Whale behavior, as was mentioned earlier, was markedly different before and during the count. In 1999 and 2000, the whales showed no signs of migration activity until the end of April. Migration from the Gulf of Anadyr in 1999 began in mid-May. In 2000, by 2 May and again on 6 May, whales were already migrating rapidly. In 2001, the stable movement of whales eastward towards the exit from the gulf was noted as early as 20 April, and in the western Bering Strait, it is entirely possible that the spring bowhead migration began before the count started. By 20 June, however, migration both in the western Bering Strait and at the exit from the Gulf of Anadyr showed signs of slackening. Our data indicate that migration starting dates can differ by up to 30 days, depending on whether the year is cold or mild. But in either case, the migration continues until about 20 June and then stops.

Comparison of Whale Migration Counts (Spring 1999–2001)

The early spring in 2001 (and thus the almost total absence of ice in the area of the count at Sireniki that year) made possible a better understanding of the numbers of bowhead whales migrating out of the Gulf of Anadyr. In 1999 we sighted only 13 whales and in 2000 we sighted 39, but in 2001, we counted 150. This included 51 whales that were counted by hunters in April, even before the official start of the 2001 count (the count proper was 99 whales) (Table 2). These figures should be viewed as a minimum, because most whales passed the observation station too far offshore to be counted, or they could have been underwater and not visible to observers.

The results of the counts in the western Bering Strait were similar for all three years. However, we feel that in all years we considerably underestimated the true number of whales migrating by. We could not calculate an abundance estimate because we did not estimate correction factors for missed whales. Detection probabilities estimated at Barrow probably cannot be used in Chukotka, as our observation site is much higher and whales migrate much farther offshore.

Comparison of Whale Migration Corridors (Spring 1999–2001)

As in other shore-based whale counts, the probability of detection in this study decreased with distance. We suggest that the great distances from the observers onshore at

TABLE 2. Results of the shore-based bowhead whale count from Chukotka.

	Sireniki			Cape Pe'ek		
	1999	2000	2001	1999	2000	2001
First sighting	13	39	150	115	162	149
Duration of count (in hours)	660	945	929	270	519	492

which the whales migrated produced a significant downward bias in detection (Krogman et al., 1989).

The geographical location of Sireniki suggests that the whales that migrate past this village come from the northwest Gulf of Anadyr (Fig. 1). In 1999–2000, the observation area for the count included a swath of open water 3–5 km wide. In 2001, there was no ice during the count period, and 76% of the whales counted were sighted at over 5 km from shore (Fig. 9).

Along the western shore of the Bering Strait, bowhead whales migrating northward spread somewhat evenly over the 40 km distance between Cape Pe'ek and Ratmanov Island. As 54% of the whales were sighted at distances over 10 km from shore, they apparently exhibited little preference for inshore movement, either along the coastline or along the edge of the fast ice (Fig. 10).

Thus it seems that during their spring migration northward, both from the Gulf of Anadyr and from the western Bering Strait, bowhead whales migrate over a broad front, and not mainly near shore as they apparently do at Barrow.

Comparison of Whale Behavioral Patterns (Spring 1999–2001)

Every April there are bowhead whales in the northern part of the Gulf of Anadyr whose behavior is very different from that of migrating whales. A large group of whales, and also individuals and small groups, approach the north shore of the gulf and remain far offshore for a day or two. They move about in various directions, exhibiting social and feeding behavior, with tail-slapping and breaching.

With the start of the migration, however, this type of behavior ceases. Both in the western Bering Strait and at the exit from the Gulf of Anadyr, the whales begin swimming rapidly, without stopping to rest and with no sign of feeding or social behavior. They surface only for blows before beginning another dive. We have the impression that they are highly motivated to travel as quickly as possible.

Comparison of Whale Swim Speeds (Spring 1999–2001)

The average speed of the migrating animals and the direction of their movement are important in estimating population numbers (Sonntag et al., 1988; Zeh et al., 1993). The swim speed of bowhead whales at Point Barrow during the spring migration is approximately 3–6 km per hour (Braham et al., 1979; George and Carroll, 1987).

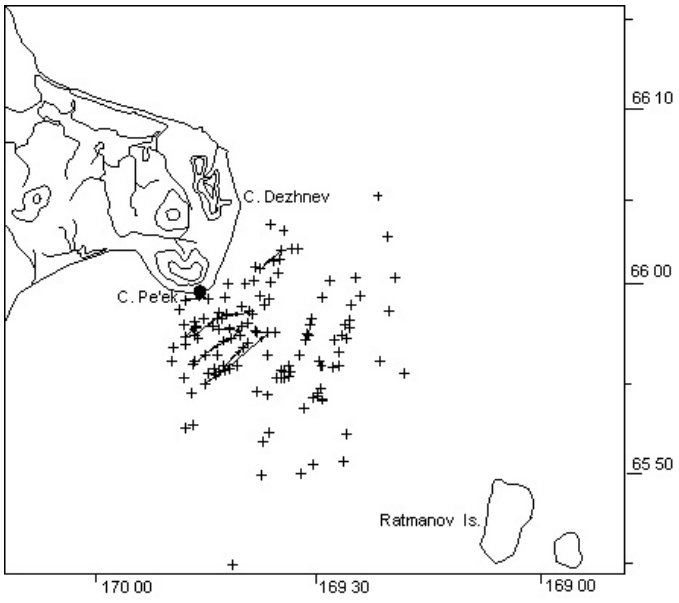

FIG. 10. Bowhead migration routes and surfacings in the Cape Dezhnev area in 2001.

Zeh et al. (1993), after a repeat analysis of the 1987 and 1988 data, reported that the average speed for all whales migrating past Point Barrow (including lingering whales) was 2.8 km an hour. The mean speed for north-traveling whales was 4.03 km/h in 1987 and 3.31 km/h in 1988. Reliable estimates for a few (2%) whales indicated they were traveling at about 7 km/h (Zeh et al., 1993).

Our measurements of bowhead swim speeds indicated that at the exit from the Gulf of Anadyr in spring 2000, whales were swimming at the rate of 9.8 ± 4.0 km/h (n = 13, range = 2.8–16.04 km/h). In 2001, the swim speed was 8.3 ± 2.3 km/h (n = 26, range = 3.4–14.8 km/h). At the entrance to the western Bering Strait in 2001, whales were migrating at a speed of 8.4 ± 3.1 km/h (n = 10, range = 3.1–12.5 km/h). The results were similar in all years. The speed was no doubt affected by a current flowing in the same direction, but we did not measure current speed separately from swim speed. However, Niebauer and Schell (1993) found that the speed of the current in the western part of the Bering Strait could be up to 50–60 cm/sec (1.8 km/h), while the speed of the Anadyr current between St. Lawrence Island and the continental coast was about 20 cm/sec (0.72 km/h). Subtracting the estimated speed of the current from our estimated speeds brings them into the upper range of the Barrow estimates. We did not use a theodolite to fix the position of the whales precisely, so the speed estimates have some inherent inaccuracy. Still, in our opinion, the swim speeds of whales on their spring migration in Chukotka coastal waters appear to be considerably higher than those of whales at Point Barrow.

CONCLUSIONS

The bowhead whale counts of 1999–2001, conducted under the joint Russian-American program studying bowhead whales in waters off the Chukotka Peninsula, confirmed that part of the Bering-Chukchi-Beaufort stock migrates along the western side of the Bering Sea in spring.

The results indicate that the beginning of the spring migration of bowhead whales out of the Gulf of Anadyr varies by up to 30 days between cold and mild years but, in both cases, it continues at least until 20 June.

During the spring migration along the western shore of the Bering Strait, and at the entrance to the Gulf of Anadyr, whales migrated over a broad front both close to shore and far out to sea. Migrating whales covered great distances under water and showed no indication of stopping to rest, feed, or engage in social behavior. Their estimated swim speeds were quite high, greater than those of migrating whales at Point Barrow.

Taking into account that the whales passed by at great distances from the observation posts, and at high speed besides, we believe the number of whales seen during these counts is an underestimate of the actual number of whales migrating through the area.

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