

DURATION OF SUMMER FEEDING PERIOD AND NUMBER OF CALVES FOR THE CALIFORNIA-CHUKOTKA STOCK OF GRAY WHALES (*ESCHRICHTIUS ROBUSTUS*)

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ABSTRACT

Duration of the summer feeding period of gray whales in the waters of the Chukotka Peninsula and its correlation with number of calves are considered in this work. Feeding duration of gray whales was defined by the period between their first observation in the spring period and the last observation in fall. Average feeding duration of gray whales in the Chukchi Sea was 167 ± 23 days. In coastal waters off the eastern Chukotka coast, feeding duration was on average 198 ± 26 days. In the northern part of the Gulf of Anadyr gray whales were present for the most extended period, 219 ± 26 days. The only significant correlation found between feeding duration and estimated number of calves the following spring was off the eastern Chukotka coast between Cape Dezhnev and Mechigmen Bay.

The key words: gray whale, Chukotka Peninsula, feeding period, calves.

INTRODUCTION

In 1999 and 2000 unusually large numbers of dead gray whales were found along the North American coast from Southern California to Alaska. There were from 21 to 54 dead stranded gray whales found in 1995 - 1998, then 273 in 1999 and 361 in 2000 (Norman et al., 2000; Moore et al., 2001). During the seasons of 1999 and 2000 predominantly physically mature animals died, more than 60%. (Moore et al., 2001). The debilitated state of many of the individuals pointed to the fact that the reason for death was starvation (Le Boeuf et al., 2000). The mass death of gray whales brought attention to the question of possible depletion of the environmental capacity (carrying capacity K) for this population (Moore et al., 2001).

In the same period there was a fivefold or more decrease in the estimated number of calves migrating north, which pointed to a decrease of the population reproductive ability (Perryman et al., 2002). There was the assumption that a low level of reproduction of the population is connected with the poor conditions of gray whales feeding in Arctic regions and, respectively, insufficient fatness of pregnant females (Le Boeuf et al., 2000; Perryman et al., 2002; Perryman, Lynn, 2002). Perryman et al., (2002; 2004) found significant positive correlation between the ice free days (or feeding season) in the Chirikov basin area (the most northeasterly part of the Bering Strait between Saint Lawrence Island and Cape Prince of Wales) and estimates of calf production for the following spring.

It is known that ice plays a very important role in the life of all sea mammals in the Arctic. Gray whales are adapted to the ice cover, and ice does not always have a direct influence on the feeding of gray whales. Ice barriers up to 80% cover are not an obstacle for gray whales either migrating or forming local aggregations in particular areas (Bobkov, 1994). Only pack ice is capable of limiting the dispersal of gray whales in the Arctic. Therefore we tried to compare reproductive ability of the population with the duration of gray whales' presence in the coastal waters of the Chukotka Peninsula, not with the duration of the ice free period. The necessity of such comparisons is due to the fact that the coastal waters of the Chukotka Peninsula are the main feeding areas for the gray whales of the California-Chukotka population (Blokhin, 1988).

MATERIALS AND METHODS

The observation of gray whales was conducted concurrently with that of other marine mammal species. In some years, up to 30 native Chukotkan observers were employed, some watching from observation posts in villages onshore, others from motorboats during hunting trips to obtain marine mammals as food and to fulfill other needs of the population (Fig. 1; Table 1). Observations were conducted mainly from April to November, but some were conducted year round. The data presented here reflect the period from the first observation of gray whales in spring up to the time of the last observation in fall.

Binoculars were used for observations. Data collected included: elevation of the observation perch; duration of observation; observation conditions (direction and force of wind, visibility, presence or absence of whitecaps); percentage ice cover; number of gray whales sighted; approximate distance from shore.

Owing to differences in conditions (habitat and hydrological), data for analysis were divided into three areas (Fig. 1): (1) the north coastal waters of the Chukotka Peninsula, including the southwestern Chukchi Sea; (2) the east coastal waters of the Chukotka Peninsula, including the north westernmost part of the Bering Sea adjacent to the Bering Strait; and (3) the south coastal waters of the Chukotka Peninsula, including the northern part of the Gulf of Anadyr.

Data were analyzed using the programmers *Excel*, *Access* and *GrafPad Prism 4*.

RESULTS

Observations off the north coast of the Chukotka Peninsula. The Chukchi Sea typically has a high inter-yearly variation in ice condition. The feeding season of gray whales was different in different years ranging from 116 up to 196 days (Table 2). The difference in feeding seasons between the most “cold” 1998 (late thaw and early ice forming) and the most “warm” (early thaw and late ice forming) 1996 was 80 days. The average feeding duration of gray whales in the Chukchi Sea was 167 ± 23 days. In the western part of the Chukchi Sea the shortest feeding season was in 1994 - 105 days, the most extended - 163 days in 1995 (Table 3). On the average, based on the years with data from both areas, the foraging season of gray whales in the western part of the Chukchi Sea turned out to be 32 days shorter than in the southern part of the Chukchi Sea (Table 3). The correlation between feeding periods of gray whales in the Chukchi Sea and estimated number of gray whale calves born the following spring was not significant ($r = 0.51$; P value = 0.16 two tailed).

Observations off the east coast of the Chukotka Peninsula. In the Bering Sea off the eastern coast of Chukotka the feeding season of gray whales lasted 148 to 239 days (Table 2). The difference between the shortest feeding period in 1998 and the longest feeding period in 1999 was 91 days. On the average, the feeding season of gray whales in the coastal waters of the eastern Chukotka lasts 198 ± 26 days, 31 days more than in the Chukchi Sea. The correlation between feeding periods of gray whales off the east coast of Chukotka and estimated number of gray whale calves born the following spring was not significant ($r = 0.22$, P value = 0.56 two tailed). Only for the north eastern coast of Chukotka Peninsula for area adjacent to Cape Dezhnev, Lavrentiya and Mechigmen Bays was there a significant correlation ($r = 0.69$; P value = 0.04 two tailed).

Observations off the south coast of the Chukotka Peninsula. In the northern part of the Gulf of Anadyr gray whale feeding was for the most extended period. The feeding season of gray whales here ranged from 174 days in 2002 to 249 days in 1998. On the average, gray whales in these waters were feeding 219 ± 27 days. This is 21 days more than in the eastern coast

of Chukotka and 52 days more than in the Chukchi Sea. An interesting point is the longest foraging period in the northern part of the Gulf of Anadyr was observed in a cold season of 1998, while that foraging period was the shortest in the Chukchi Sea and at the eastern coast of Chukotka. Correlation between the feeding duration of gray whales in the northern part of the Gulf of Anadyr and the estimated number of the calves in the following spring was negative but not significant ($r = -0.3$; P value = 0.51 two tailed).

DISCUSSION

The results from shore-based surveys of presence of gray whales on feeding grounds off the Chukotka Peninsula point to an average duration of gray whale stay in the Chukchi Sea of 5.5 months. In the Bering Sea off the eastern coast of the Chukotka Peninsula gray whales are foraging 6.5 months, one month longer than in the Chukchi Sea. The shortest period is 4 months for gray whales feeding in the western part of the Chukchi Sea. The longest feeding period, more than 7 months, is in the northern part of the Gulf of Anadyr.

The feeding duration of gray whales in the waters off the Chukotka Peninsula is substantially different in different years. In the Chukchi Sea the difference in time of gray whales stay between the shortest and the longest periods was more than 2 months. In the waters off the eastern coast of the Chukotka Peninsula, the difference in feeding duration between the years was the largest - 3 months. In the northern part of the Gulf of Anadyr this difference was 2.5 month.

The dates of the first gray whale appearance in spring and the last date seen in fall show that the latest date a whale was recorded in the Gulf of Anadyr (December 30, 1998) was in the worst season for the feeding areas. The earliest appearance of gray whales was recorded in the following spring (April 1, 1999). It appears that after the poor summer in 1998, gray whales from the northern feeding grounds proceed to south areas tried to live on as long as they could. After winter 1998/1999 they tried to get to the feeding grounds as early as possible.

If the population reproduction is connected by linear dependence with the feeding duration of gray whales in the previous season (Perryman et al., 2004), there should be a connection between the reproductive data and the feeding periods of gray whales in the Chukchi Sea, where 54.7% of gray whales feed (Blokhin, 1988). Their main feeding grounds are located there. However, there was no significant correlation between feeding duration of gray whales in the Chukchi Sea and the calculated number of the calves. Nor was there a significant correlation of the foraging duration of gray whales and reproduction for the eastern coast of the Chukotka Peninsula as a whole or the southern coast (Gulf of Anadyr). Only for the area directly adjoined to Chirikov Basin, the area considered by Perryman et al. (2002), was the correlation between the feeding period and number of calves significant.

It is interesting that low numbers of gray whale calves, in the California research, were recorded not only in spring 1999, but also in 2000 and 2001, and in last two years it was nearly twice as low as in 1999 (Wade, Perryman, 2002, Perryman et al., 2004). As our data show, feeding periods of gray whales in coastal waters of the Chukotka Peninsula in 1999 and 2000 were not extreme (Table 2). Apparently, adverse feeding conditions in summer 1998 affected the reproduction of gray whales throughout three years, consistent with gray whale calving intervals, which approached three years near the end of the last century (Blokhin, 1990). Possibly, poor feeding conditions influenced not only pregnant females, but also the females with nursing calves that summer and as well the females not participating in reproduction. This is suggested by the extremely low number of gray whale calves in spring 2000 and 2001. The increased number of the calves in 2002 and 2003 can be explained by female gray whales participating in these years' reproduction after recovering from the extremely hard winter of 1998 (Perryman et al., 2004 (Perryman et al., 2004)). The wave extremely

low number calves were born in 1999, 2000 and 2001 will affect the following generations of gray whales when female was born this year's will start reproduction.

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Table 1. Duration of the observation in the coastal waters of the Chukotka Peninsula

Years	Coast of Chukotka	Number of observers	The beginning of work	The end of work
1994	Northern	9	05.01	10.10
	Eastern	10	04.01	10.31
	Southern	7	04.01	12.27
1995	Northern	10	04.01	11.30
	Eastern	12	02.01	12.31
	Southern	6	02.01	12.31
1996	Northern	10	04.01	11.30
	Eastern	13	01.10	11.30
	Southern	7	01.10	09.30
1998	Northern	3	06.19	10.31
	Eastern	2	05.02	10.31
	Southern	4	04.01	12.30
1999	Northern	4	05.01	10.31
	Eastern	9	04.01	11.30
	Southern	6	04.01	11.30
2000	Northern	4	05.01	10.31
	Eastern	9	04.01	12.30
	Southern	7	04.01	12.30
2002	Northern	9	04.01	11.22
	Eastern	9	03.01	11.30
	Southern	11	03.01	10.31
2003	Northern	7	05.01	11.28
	Eastern	15	03.01	11.28
	Southern	7	03.01	11.28

Table 2. The dates of first and last sightings and the feeding durations of gray whales in the waters of the Chukotka Peninsula. The recorded dates, in brackets, of the first and the last gray whale sightings are in the columns titled coasts. The number of days between the recorded dates of the first and the last whales are under the brackets.

Years	Northern coast	Eastern coast	Southern coast	Cape Dezhnev – Lorino	<i>Number of calves in the following spring*</i>
1994	(06.20-11.23) 157	(05.14-11.09) 178	(05.05-11.14) 193	160	619
1995	(05.24-12.01) 191	(05.02-12.01) 213	(05.05-12.14) 223	198	1146
1996	(05.13-11.25) 196	(05.15-11.26) 195	(04.27-)**	195	1431
1998	(06.22-10.15) 116	(06.01-10.26) 148	(04.20-12.30) 249	148	1388
1999	(05.20-10.31)*** 163	(04.01-11.25) 239	(04.01-11.29) 243	188	427
2000	(05.28-10.21) 177	(04.16-10.31) 198	(05.05-12.22) 231	167	279
2002	(05.25-11.11) 169	(05.21-11.25) 188	(05.10-10.31) 174	188	256
2003	(06.01-11.14) 167	(04.17-11.26) 223	(04.23-11.28) 219	199	1527

* according to Wade, Perryman (2002), Perryman et al., (2004) data

** observations were discontinued in September

*** gray whale may stay off the north shore after this data

Table 3. Duration (days) of gray whale feeding in the waters of the north and northeastern coasts of the Chukotka Peninsula.

Years	Western part of the Chukchi Sea (Neshkan- Enurmino)	Southern part of the Chukchi Sea (Inchoun – Uelen)
1994	(06.22-10.17) 105	(06.20-11.23) 157
1995	(06.19-11.29) 163	(05.24-12.01) 191
1996	(06.14-10.03) 142	(05.13-11.25) 195
1998	No data	(06.22-10.15) 115
1999	No data	(05.20-10.31) 163
2000	No data	(05.28-10.21) 146
2002	(06.05-10.10) 117	(05.25-11.11) 169
2003	(06.19-10.25) 128	(06.01-11.14) 167

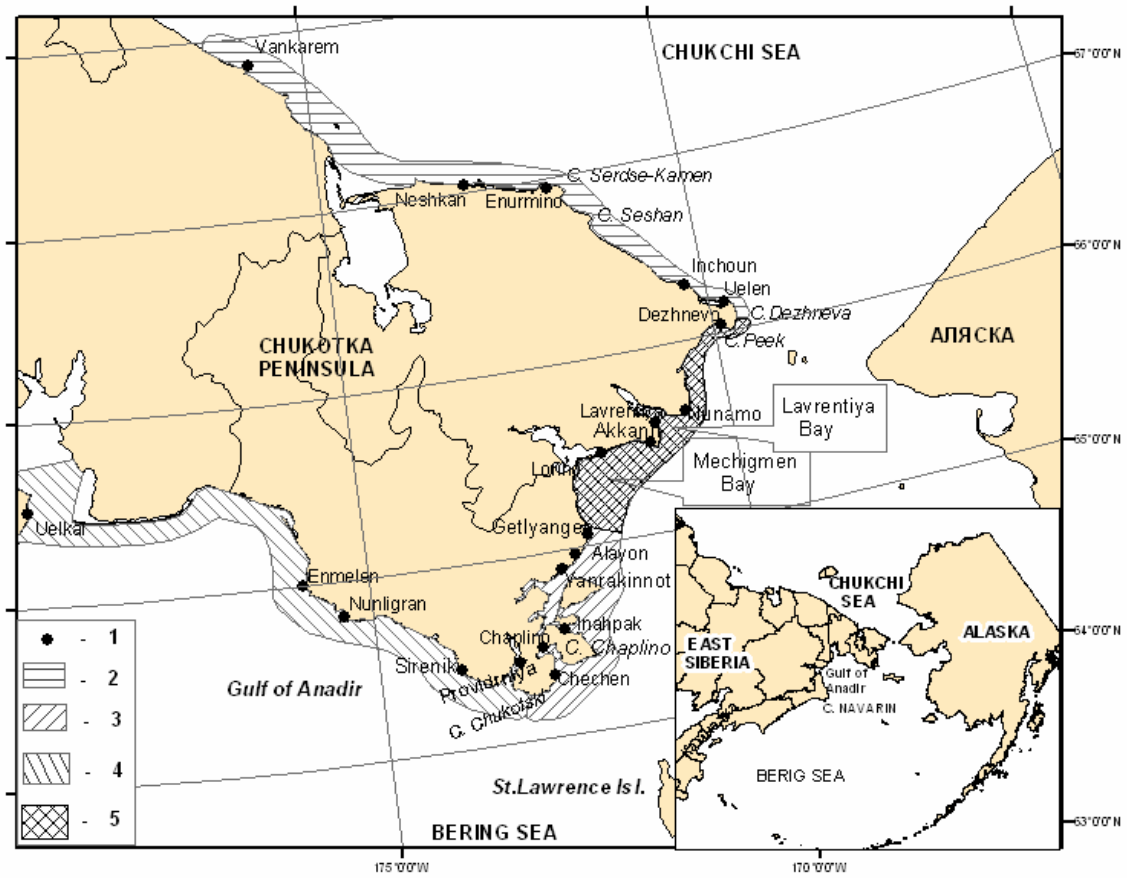


Fig 1. Map of the Chukotka Peninsula study area. 1 - main observation posts; 2- north coast of the Chukotka Peninsula; 3-east coast of the Chukotka Peninsula; 4-south coast of the Chukotka Peninsula and 5- north eastern coast of the Chukotka Peninsula

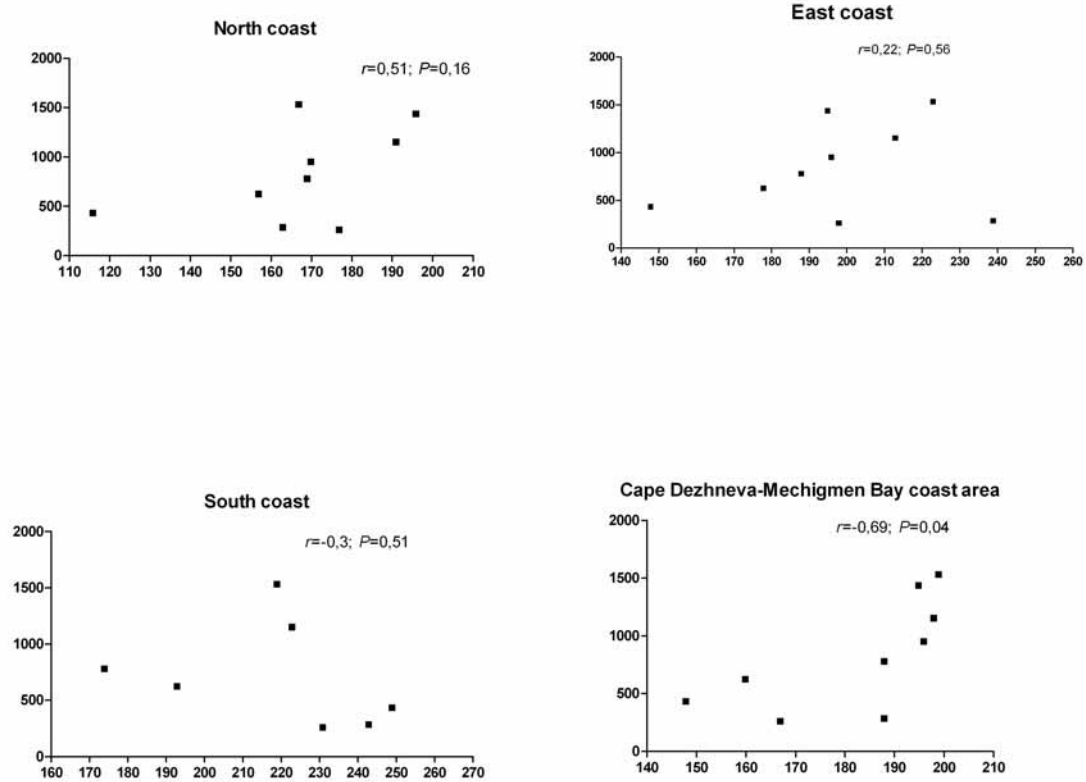


Fig. 2. Correlation of the estimated number of gray whale calves of the California- Chukotka population and the duration of summer feeding in the waters of the Chukotka Peninsula in 1993 – 2003. The abscissas give summer feeding periods (days). The ordinates give estimated numbers of calves in the following spring according to Perryman et al. (2002; 2004), Wade and Perryman (2002) data.