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A CONTRIBUTION TO THE KNOWLEDGE ON
THE BIOLOGY OF THE KILLER
WHALE (ORCINUS ORCA).

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I n t r o d u c t i o n .

Modern whaling for small whales in Norway has lasted for about 40 years. In addition to minke whales (Balaenoptera acutirostrata) which have been the main prey, bottlenose whales (Hyperoodon ampullatus), killer whales (Orcinus orca) and pilot whales (Globicephala melaena) have also been caught. The meat of the minke whale is used both for human and animal consumption, while all meat from toothed whales is used for animal consumption only. As the price offered for animal food has changed rather considerably from time to time, a corresponding change has taken place regarding the whaler's interest in catching such whales.

From 1938, the whalers were compelled to apply for a licence. The licensees have to fill in a form for each whale taken, containing both biological and technical information. Jonsgård and Øynes (1952) briefly analyzed the data concerning killer whales caught up to and including the season 1950. Since then, several hundred forms concerning killer whales have been received. In the following 1413 forms concerning biological data on killer whales received in the period 1938-1967 have been examined, the aim of which has been to see if they might give any further information on the biology of this species of whale.

M a t e r i a l .

In the forms mentioned above the whalers are asked for the following biological data on each whale caught: Date of catch, locality, species, sex, body length, and for females also information on presence of milk, pregnancy, and length of fetuses. In addition quite a lot of information on the weight of blubber and meat is available.

As the forms have been filled in by many different persons it may be supposed that some of the data are not quite correct. However, date of catch and locality are no doubt correct or almost correct. On the other hand, the sex determination may probably be incorrect in some cases, especially with regard to small animals. Contrary to large animals, small animals of both sexes possess a dorsal fin which is similar in size and appearance. If the penis of a male is not visible, it is possible that a mistake may be made.

With regard to the body length of the animals, which is given in English feet, there is no doubt that in several cases it is not quite correct, as the length has rather often been estimated instead of being exactly measured. However, the estimation is made just after the animal has been taken onboard lying across the deck. The width of the deck, which is known, forms the basis for the estimation. During our field work in 1967 and 1968 we measured the body length of several whales the length of which had been estimated by the whalers beforehand. We found that the deviation was up to ± 2 feet, but in most cases the estimated length was correct or almost correct.

Concerning the information on the presence of milk we are aware of the fact that the terminology used has in some cases obviously been misunderstood by the whalers, as they have not distinguished between those which had milk in the glands and those which had milk in the stomach. For this reason we have excluded this material from further discussion in this paper.

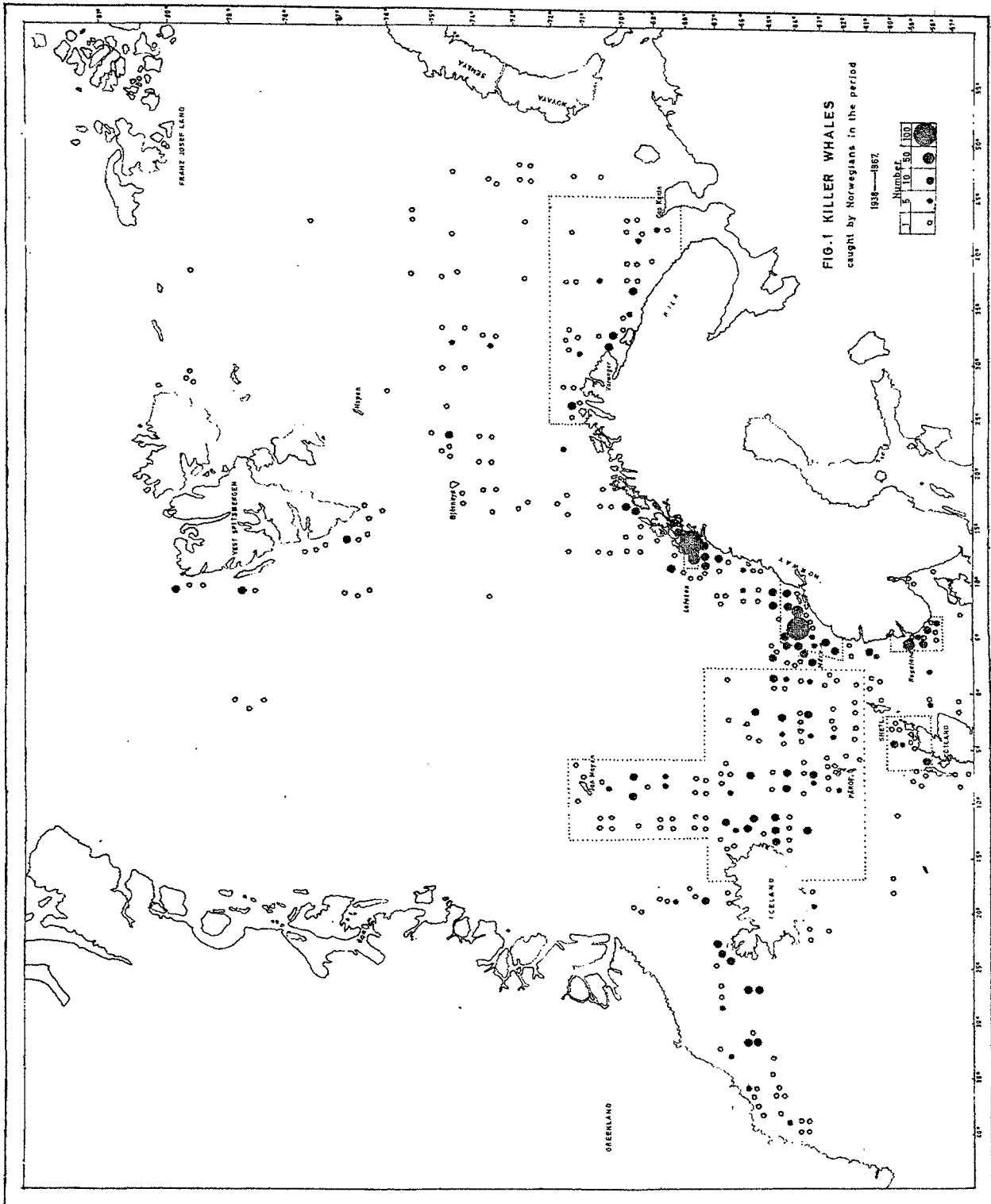
It is to be expected that small foetuses may be overlooked, and no doubt this is the case. Only 3 foetuses less than one foot in length have been reported found.

In addition to the forms mentioned, data from 4 killer whales examined by Dr. Åge Jonsgård and Mr. Ivar Christensen during our field work in 1967 have been included in this paper.

Occurrence and migration.

As stated by Fraser and Parker (1953), the killer whale is world-wide in its distribution. Apart from this fact, our knowledge on its occurrence and migration is very limited. It may be mentioned, however, that Collett (1912) points out that killer whales are abundant during the herring fisheries off western Norway.

Fig. 1 shows the approximate localities of killer whales caught by Norwegian whalers during the period 1938-1967. As will be seen they have been caught in almost all areas of the Norwegian Sea and the northern part of the North Sea, from the Scottish Islands and the Skagerak in the south to Spitsbergen in the north and from East Greenland in the west to Novaya Zemlya in the east. Although killer whales seem to occur all over this area, the catches are more or less concentrated in certain waters.



Concerning Norway this is true for the waters off Rogaland, Møre, Lofoten and Varanger. Another centre is situated off North Scotland. Many whales have also been taken off East Iceland and in adjacent waters of the Norwegian Sea. It is not possible to draw exact lines showing the borders of each of the six areas mentioned above, however in fig. 1 they are indicated with broken lines. In fig. 2 the number of killer whales caught in each of the areas has been split into six intervals of time. As is to be expected, there is a close connection between the whaling activity in the different waters and the number of killer whales caught. The remarkable increase in the number of the killer whales caught off Iceland, for example, in the periods 1959-1963 and 1964-1967 is due to the fact that the whaling activity increased considerably in these waters at that time.

The monthly catches of killer whales in the different areas are shown in fig. 3. In each area most whales have been caught within a very limited interval of time. The catches off Rogaland have mainly been made in the winter months with a distinct maximum in February. Most of the animals were caught as early as in the period 1938-1943 (fig.2). At this time winter herring was still plentiful in this area (Devold, 1963). It has been known for a long time that killer whales are following the Atlanto-Scandian herring during its migration towards the coasts of western Norway (Collett, 1912). In the 1930- ties a particular whaling for killer whales took place during the herring fishery on the spawning grounds off Rogaland (Jonsgård, 1955).

In all the three other areas off the coast of Norway (Møre, Lofoten, Varanger), the number of killer whales caught shows a distinct maximum in May. As most of the animals have been taken during the last two decades, some of the catch regulations put into force have to be taken into consideration when discussing the catches made in different months. Since 1952 a six months season lasting from 15th March until 15th September has been put into practice, no whaling at all however being allowed from 1st July until 21st July (introduced in 1950). Although whaling is allowed from 15th March, most whalers start whaling in the second half of April or even later on, because minke whales, which are the main prey, are not found in sufficient numbers on the whaling grounds prior to that time. For this reason, the maximum number of killer whales

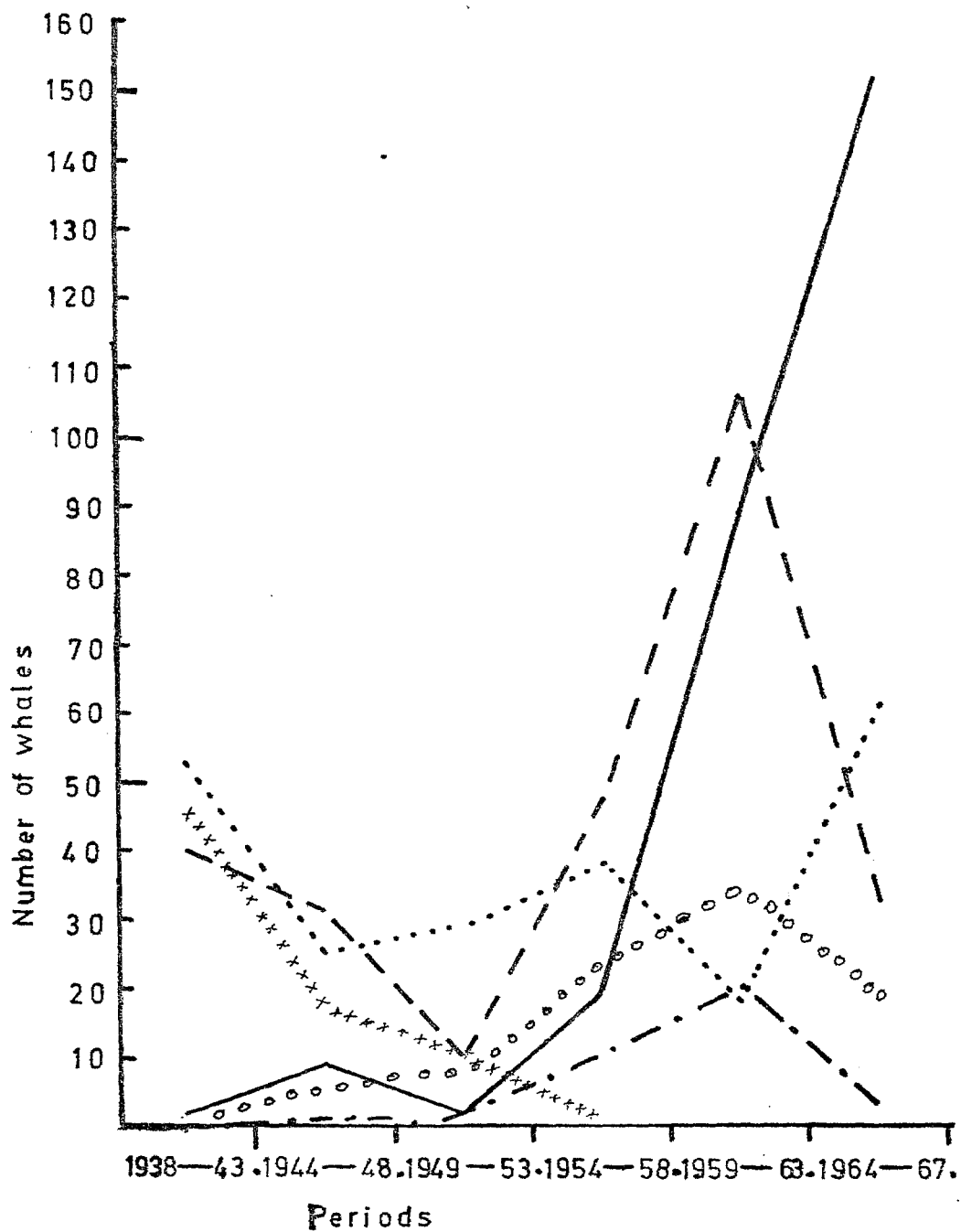


Fig. 2 Number of killer whales caught in six succeeding periods covering the seasons 1938—1967.

Iceland ————— Möre - - - - - Vestfjord
 Rogaland xxxxx Varanger ooo Scotland - . - .

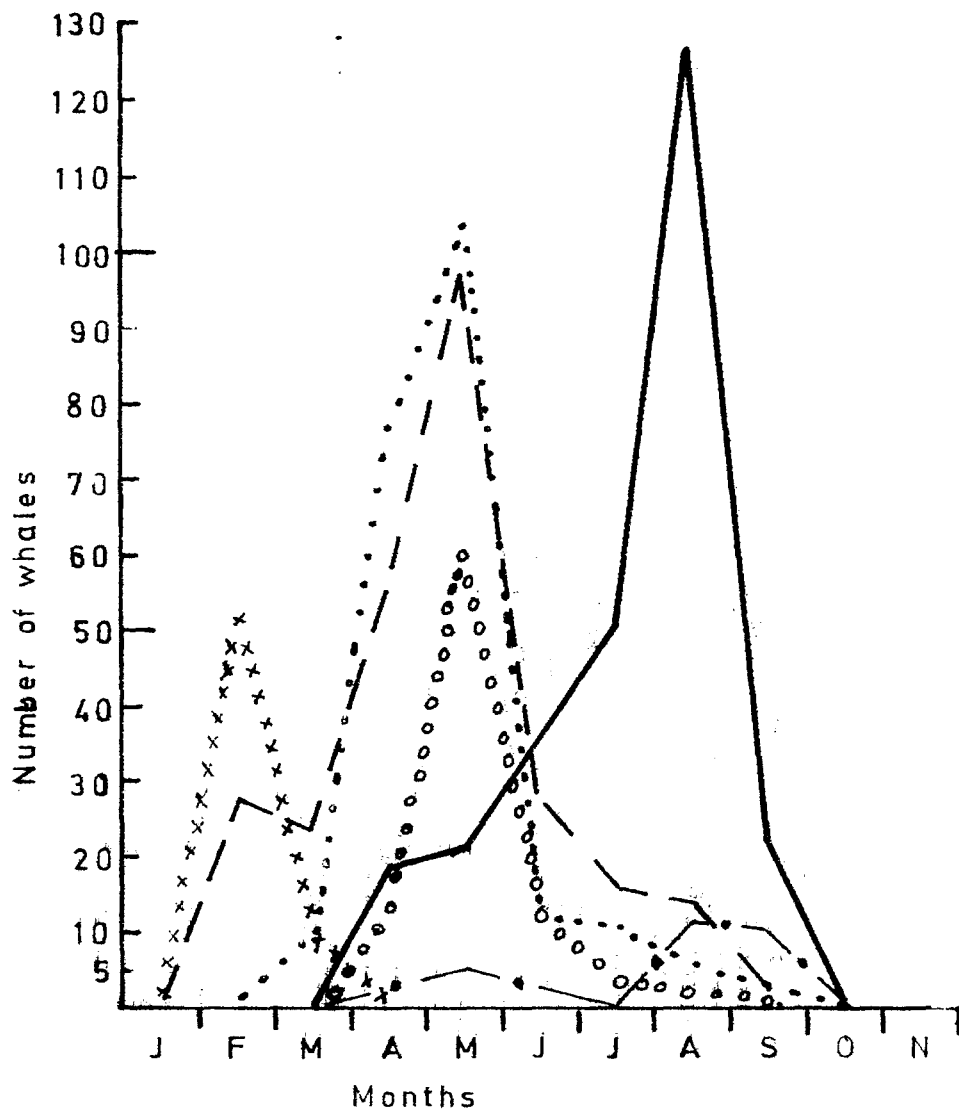


Fig. 3 Number of killer whales caught during different months in the seasons 1938—1967.

Iceland—— Möre———Vestfjord.....
 RogalandxxxxVarangeroooScotland—•—•

recorded in May, may not necessarily indicate that killer whales are most plentiful off the coast of Norway in this month; it may possibly be somewhat prior to May. However, it can hardly be doubted that killer whales are more plentiful off the coast of Norway during the first part of the whaling season than later on. Concerning the Møre area this may be explained by the immigration of herring during the winter. In most postwar years the immigration of herring in this area has taken place in late winter. It may very well be suggested that killer whales following the herring accumulate in the area during late winter and spring. This may also be the case for the Lofoten area, since herring also migrate into these waters in late winter. Concerning the Varanger area there seems to be a relation between the immigration of capelin in the late winter and spring and the maximum catches of killer whales, suggesting that killer whales also feed on capelin.

The distinct maximum in August recorded for killer whales caught off East Iceland and in adjacent waters of the Norwegian Sea corresponds with the occurrence of herring, since in late summer and autumn the Atlanto-Scandian stock of herring is feeding in these waters. Relatively few killer whales have been caught in July and September, this mainly being due to the whaling regulations (full stop for 3 weeks in July, and no whaling after 15th September).

The two less distinct maxima in May and in August - September for killer whales caught off Scotland also correspond with the occurrence of herring in these waters. An oceanic group of herring is spawning in the North Minch and to the north of the Hebrides between February and May, and a shelf group of herring is spawning in North and South Minch in July - September (Parrish and Saville, 1965).

The discussion above has demonstrated that the number of the killer whales caught in the Norwegian Sea seems to bear a particular relation to the occurrence of herring. From this evidence it may be concluded that the distribution and migration of killer whales in these waters are dependent upon the distribution and migration of the herring. The correlation concerning the occurrence of killer whales and herring off East Iceland and off western Norway respectively, and also the fact that killer whales have been caught along

all the main part of the migration route of the Atlanto-Scandian herring between those two areas (See fig. 1), indicate, that killer whales may migrate from Icelandic waters to the coast of western Norway.

F o o d.

It is a well-known fact that killer whales feed on fish, cephalopods and marine mammals. Collett (1912) states that during the great herring fisheries off western Norway the killer whale mainly eats herring. Grieg (1906) examined killer whales trapped in Bildøstrømmen (western Norway) in 1904, the stomachs of several containing remains of herring. Nishiwaki and Handa (1958) reported that 364 killer whales caught in Japanese and adjacent waters had mainly fed on fish, several species of which were recorded (sardines, salmon, mackerel, Atka mackerel, cod, rock cod, flat fishes, tunas, bonitos and others). Rice (1968) however, only found fish or fish remains in the stomachs of two out of ten killer whales caught in the eastern North Pacific, one having a partially digested Pacific halibut, the other one having remains of two moonfish and two sharks (Carcharinidae).

According to Nishiwaki and Handa (1958) a considerable number of killer whales had fed on squids, while Rice (1968) only found remains of one single squid.

Killer whales also feed on small cetaceans and seals. According to Nishiwaki and Handa (1958) and Rice (1968) a surprisingly high number of killer whales had eaten marine mammals. The latter reported remains of some species of seals and porpoises, and in one case remains of minke whale, in altogether six out of ten stomachs examined. In Japanese and adjacent waters dolphins seem to be the main mammalian prey for killer whales, but remains of some few other species of cetaceans including sei whales are reported by Nishiwaki and Handa as being found in their stomachs. Jonsgård (1968 a), however, points out that there is still no proof that larger whales in good health and under normal conditions are attacked by killer whales. Larger whales may possibly succeed in escaping from killer whales by diving so deep that the killer whales are not able to follow them (Jonsgård 1968 b).

Nishiwaki and Handa (1958) point out that larger food such as whales and dolphins had only been eaten by older killer whales, a statement being supported by Rice (1968), who concludes that in the offshore coastal waters of the eastern North Pacific, adult male killer whales feed preponderantly on mammals.

As previously mentioned 4 killer whales caught in the Norwegian Sea in 1967 were examined by Norwegian biologists. Their data are given in table 1.

Table 1. Data for 4 killer whales examined in 1967.

Data of catch	Locality	Length	Sex	
7. April	64°05'N, 01°00'W	22' 10"	♂	Squid and a few remains of small mammalian bones, probably seal.
7. "	" " " "	18' 4"	♂	None
8. "	65°05'N, 01°10'W	21' 8"	♂	Full of large herring
9. May	69°45'N, 12°30'W	24' 5"	♀	Remains of bones and skin from seal.

The table shows that the killer whales examined had fed upon squid, large herring and mammals. The two largest animals, which were a 22' 10" male and a 24' 5" female had eaten mammals. This fact supports the findings of Nishiwaki and Handa (1958), and Rice (1968), that mammals are eaten by the larger killer whales, large females, however, also included.

Propagation.

There is rather little information on the propagation of the killer whale. Grieg (1889) examined killer whales which at his time were trapped on the coast of western Norway. The two largest foetuses measured were 6' 2" and 6' 10" and in Grieg's opinion they were almost fully developed. In a later paper Grieg (1906) writes, that the smallest animals recorded on the coast of western Norway were about 8' 2" in length, the age of which was considered by him to be not more than a couple of months. Fraser (1934, 1937) reports on a specimen 7' 9" long which stranded on the Yorkshire coast in November, 1927, and he believed that the young are about 7 feet long at birth. Scheffer and Slipp (1948) mention that a suckling female killer whale stranded on the east coast of Vancouver Island in 1944, the length of which was 8' 1". These authors also refer

to fishermen's story of a 7-foot whale which drowned in a net near Camano Island in 1940 or 1941, the colouration of which was like that of an adult killer whale. The ^{above} information, however, is not in good agreement with Nishiwaki and Handa (1958) who examined records received from Japanese whalers and concluded that the body length at birth might be about 9 feet.

From the scanty evidence available both Grieg (1889) and Fraser (1937) believed that the gestation period is about 12 months, and that pairing takes place about the end of the year Fraser (1937), or in late autumn or midwinter Grieg (1889). Nishiwaki and Handa (1958) also suggest that the pregnancy may last for about 12 months, although they intimate that it may even last for as much as 16 months. The breeding time could not be clearly defined from their material, however, "principally the peak might be in May- July". Collett (1912) states that the body length of fetuses may vary considerably at about the same point in time, showing that the mating may cover several months.

Fig. 4 shows the length distribution of the 59 pregnant killer whales reported by the Norwegian whalers. The smallest one was 15 feet in length, but as many as eight were 16 feet long. In the total material, however, only a slightly higher number of females are 16 feet as compared to those being 15 feet (see fig. 6). The distinct increase in pregnant females from 15 feet to 16 feet tends to show that sexual maturity occurs when the females are about 16 feet long. With regard to the males we have no data from the whalers' reports which may give an idea of their length at attainment of sexual maturity. However, microscopic examination of the testes from the three males examined in 1967 showed that two of them with body length 22' 10" and 21' 8" were sexually mature, and many spermatids but very few spermatozoa were present. The third one which was 18' 4" in length had smaller testis tubules, most of which had no distinct lumen, and the wall consisted of a layer of small cells characteristic for immature males. Some other tubules, however, had lumen and spermiogenesis could be seen. This animal was classified as "maturing". Although we know that the length at attainment of sexual maturity in whales may differ somewhat from one individual to another, this may indicate that the male killer whale attains sexual maturity when it has grown to about 19 feet in length.

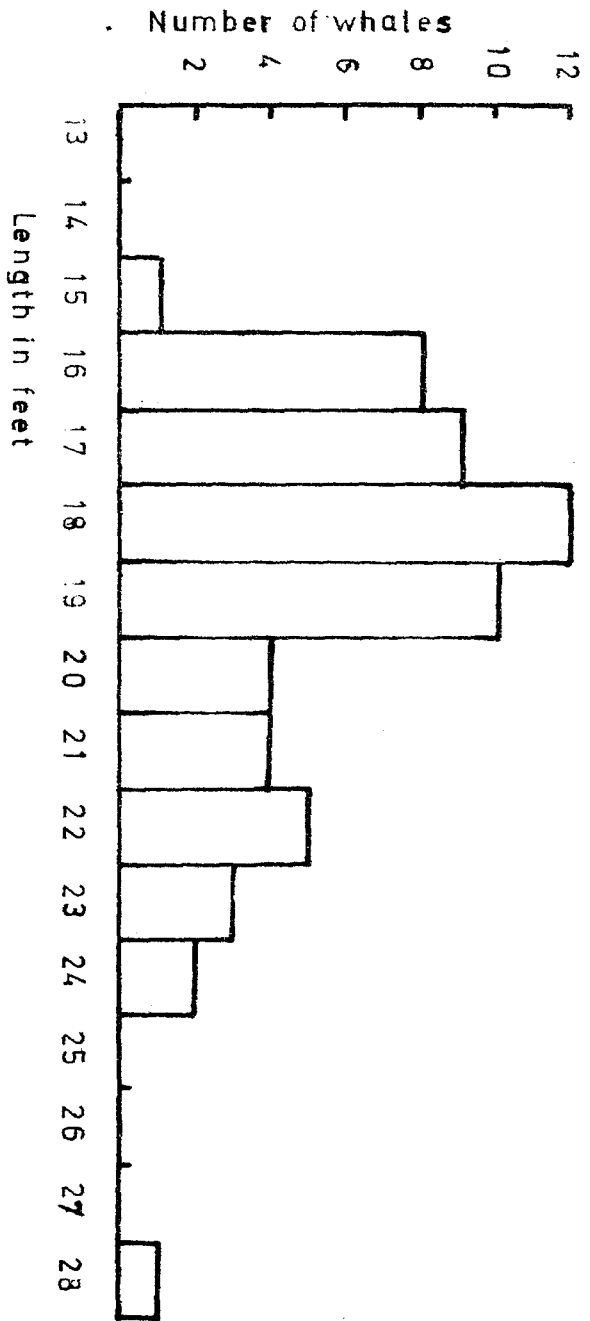


Fig. 4 Length frequencies of all pregnant females reported caught in the period 1938—1967.

Fig. 5 shows the length of fetuses recorded in different months. One fetus reported to be as large as 10 feet has been omitted in the figure, as there can be no doubt that in one way or other a mistake has been made.

The figure shows that within the separate months the length of the fetuses varies very considerably. For this reason it is impossible to make a growth curve for the fetuses. It seems likely, however, that in this species mating may take place at all seasons of the year.

It is not likely that the largest fetuses have been overlooked, and as the material covers as much as 8 months, the very largest fetuses are probably close to being fully developed. The three largest fetuses were reported to be 5' 9", 5' 11" and 6' 7" long. The smallest calf reported was 6' long, none was 7', one was 8', two were 9' and so on (see fig. 6). Most likely the lengths of these calves have been estimated, which means that they might have been some few inches shorter or longer, as it is improbable that any greater errors have been made. Although the 6' long calf reported might have been somewhat longer, the weight of its meat and blubber was only 125 kg. and 75 kg. which shows beyond doubt that the calf must have been very young indeed. Based upon the above data it may be concluded that the killer whale at birth is very close to 7 feet in length. This conclusion agrees very well with the information by Grieg (1889), Fraser (1937), and Scheffer and Slipp (1948). Nishiwaki and Handa (1958), however, concluded that the length at birth might be about 9 feet, this length even being longer than the length of the smallest animals reported (Grieg 1906, Fraser 1937, Scheffer and Slipp 1948). As will be seen from the next section, it is not likely that killer whales in Japanese and adjacent waters attain a greater length than those occurring in the Norwegian Sea, since the largest animals are of about equal length in both areas.

Although the present material, in accordance with the information by Collett (1912), shows that birth may take place at almost anytime of the year, there is some evidence that relatively more calves are born in late autumn and midwinter, as the two smallest calves were taken in February and the two next in size in April and May.

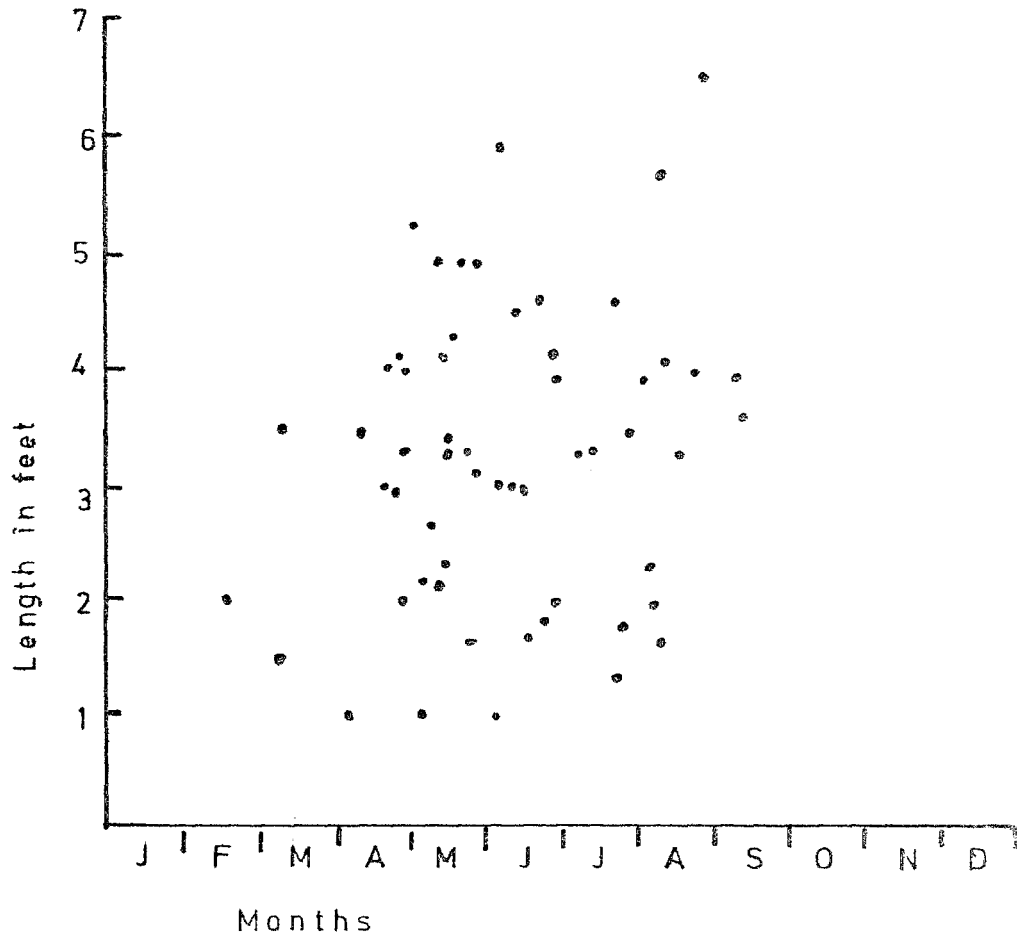


Fig.5 Length of killer whale fetuses recorded in different months by Norwegian whalers.

Body length of adult males and females.

It has been known for long that male killer whales may grow to about 30 feet in length, but until rather recently it was assumed that females only attained about half that length (Fraser and Parker 1953). Nishiwaki and Handa (1958) who examined 567 catch records received by the Fisheries Agency from Japanese whalers, state that the largest males and females were 31 feet and 27 feet respectively. However, they point out that it seems that some mistakes are involved in discerning the sex.

Fig. 6 shows the length frequency for killer whales reported caught by Norwegian whalers. The material includes 891 males and 494 females with complete information on their body length. The largest males and females are 32' and 28' respectively. However, as previously pointed out (See section on material), it is possible that their length may have been estimated too high. Only 4 males and 2 females have been reported to be more than 30' and 26' respectively, which points to the fact, that even if their lengths are correct, male and female killer whales very seldom exceed 30' and 26' respectively. This conclusion is in good agreement with the finding of Nishiwaki and Handa (1958) regarding killer whales from Japanese and adjacent waters. It should also be mentioned that in 1967 an adult female was examined by Norwegian biologists, the body length of which was as much as 24' 5".

S u m m a r y .

Biological data from 1413 killer whales caught by Norwegian whalers in northeastern North Atlantic waters in the period 1938-1967 have been examined. In addition to this material, four killer whales were examined by two Norwegian biologists in 1967.

The distribution and migration of killer whales in these waters seem to be dependent upon the distribution and migration of the herring.

The food of the killer whale has been discussed. It was confirmed that mammals are eaten by larger killer whales, both males and females.

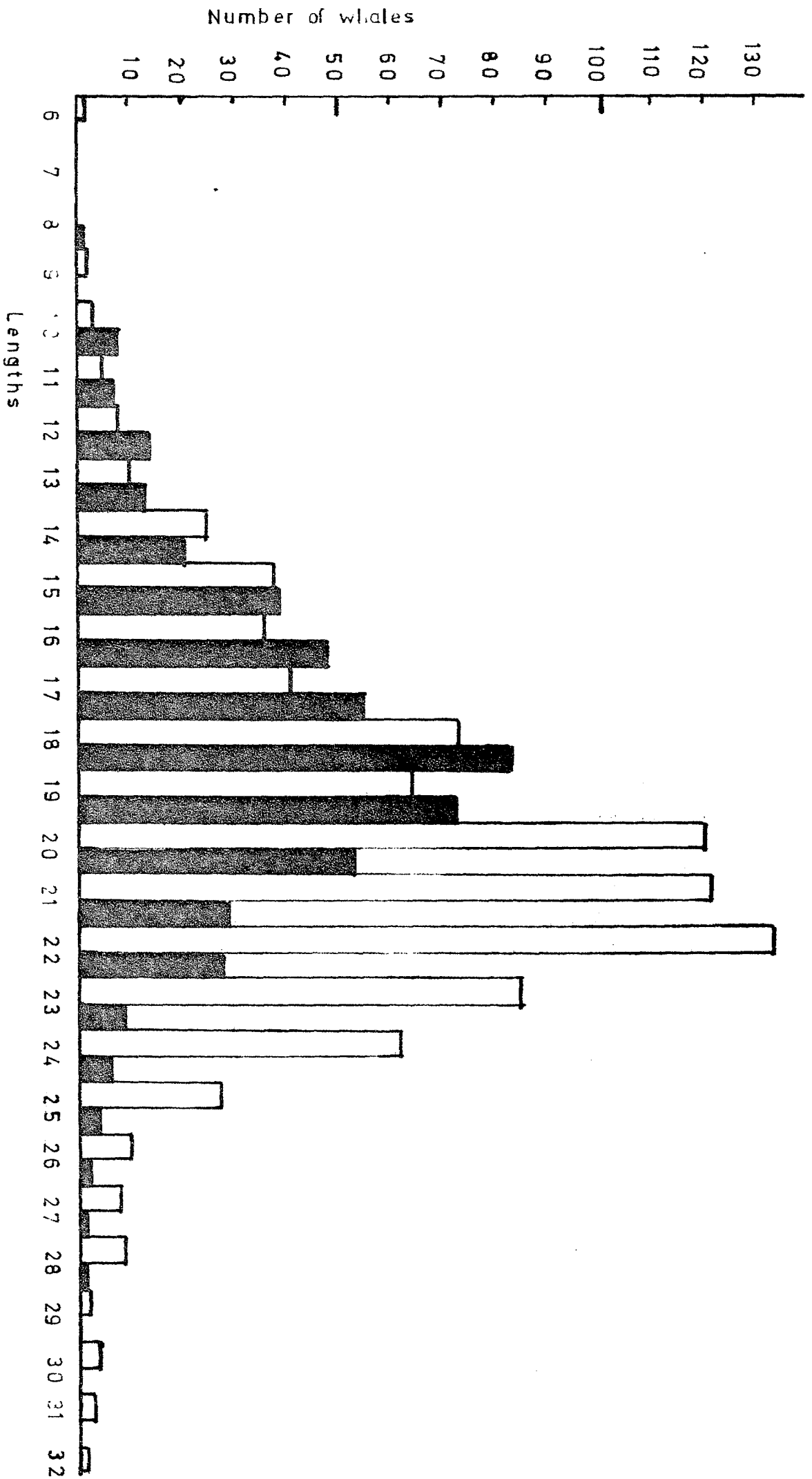


Fig. 6 Length frequensis of all male killer whales and females caught by Norwegians in the seasons 1938—1967.

Females and males respectively seem to attain sexual maturity when about 16 feet and about 19 feet long. The young are very close to 7 feet in length at birth. Although there is some evidence that relatively more calves are born in late autumn and midwinter, birth may take place at almost anytime of the year.

Adult females and males respectively very seldom exceed 30 feet and 26 feet in length.

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