

The Icelandic live-capture fishery for killer whales, 1976–1988

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ABSTRACT

The history of the Icelandic live-capture fishery for killer whales (*Orcinus orca*) is reviewed. In 1974, herring fishermen caught a live killer whale in a purse-seine but released it when it was judged too large to collect for sale to an oceanarium. In 1975, the government instituted a system of regulation in which permits can be issued to individuals or organizations. From 1975 through 1988 21 permits issued to six permit holders authorized taking of 84 animals. From 1976 through 1988, 59 whales were actually collected; 8 were released, 3 died in holding facilities prior to export and 48 (average 3.7 per year) were exported. The sex ratio of animals removed was 61:39 (males:females), the average size 3.4 m for both sexes.

INTRODUCTION

Killer whales (*Orcinus orca*) were caught in and near Icelandic waters by Norwegian small-type whalers between 1955 and 1972 (Jonsgård and Lyshoel 1970; Christensen 1975; Øien 1988 – this volume). They have not, however, been the object of an organized fishery based in Iceland, apart from a live-capture fishery that started in the mid 1970's and continues today. Statistics on this fishery through 1983 have been reported (e.g. IWC 1983; Hoyt 1984), but some details of the various accounts have been contradictory. The purpose of this paper is to review and update information on the history and extent of the live-capture operation in Iceland, based on original sources (government records and files of the participants in various phases of the operation) within the country and in doing so to clarify published discrepancies.

THE BEGINNING OF THE FISHERY

For many years, fishermen in Iceland have encountered killer whales on the fishing

grounds. Encounters have been especially common in fall and winter when the Icelandic summer spawning herring (*Clupea harengus*) aggregate before overwintering along the south and east coasts of Iceland. They also occur at the southwest and west coasts where the long-line fishery for halibut (*Hippoglossus hippoglossus*) is conducted (Sigurjónsson in press).

In 1974, some Icelandic herring fishermen accidentally caught a live 6 m killer whale in their purse-seine net. Hoping to sell the whale to a marine zoological park for display, they collected it. However, the animal was subsequently released after the staff of the *Sædýrasafnið* (Hafnarfjord marine zoo) examined it and judged it too large to be offered for sale. It is likely that killer whales had been accidentally entrapped in purse-seine nets prior to 1974, but this particular incident sparked interest in deliberately capturing live killer whales for export and gave rise to the live-capture industry that continues today.

REGULATION OF THE FISHERY,
1975-1988

From its beginning, the live-capture fishery has been regulated by the Icelandic Ministry of Fisheries in cooperation with the Marine Research Institute (MRI), Reykjavík and the State Veterinarian. The Ministry issues permits to qualified individuals and organizations. Permit holders are responsible for not exceeding set catch limits and for following specific procedures for catching and handling of animals. All phases of the operation are inspected by a government employed veterinarian. Every effort is made to ensure the safety of the animals and since two animals died in holding pools in 1979, procedures for collecting, holding and exporting the animals have been greatly improved and become all but routine. This can be accounted for by refinement of capture regulations, the continuing

TABLE 1
Number of permits issued to live-capture killer whales off Iceland, 1975-1988, by organization.

Year	Individual/organization	No. animals
1975	Roger de la Grandière	2
1976	Jón Kr. Gunnarsson	4
	Roger de la Grandière	2
1977	Konráð Júlíusson	4
	Sædýrasafnið	6
1978	Anna h.f.	4
	Sædýrasafnið	6
	Sædýrasafnið	2
	Sædýrasafnið	2
1979	Sædýrasafnið	6
	Sædýrasafnið	2
1980	Sædýrasafnið	8
1981	Jón Kr. Gunnarsson	4
	Sædýrasafnið	4
1982	Sædýrasafnið	6
1983	FAUNA	4
1984	Sædýrasafnið	5
	Sædýrasafnið	1
1985	- No permit issued -	
1986	FAUNA	4
1987	FAUNA	4
1988	FAUNA	4
	Total	84

improvements by collectors of all their procedures and higher standards for treatment of animals, both at sea and in holding pools in Iceland.

Number of permits

Since 1975, 21 permits authorizing the take of a total of 84 killer whales have been issued to six permit holders (Table 1). With the exception of permits issued to a French national for 2 animals in 1975 and 2 in 1976, all permit holders have been Icelandic. The *Sædýrasafnið* or its director, Mr Jón Kr. Gunnarsson, received permits for 56 animals, and the more recently established company Fauna of Hafnarfjörður, permits for 16 animals. Prior to 1985, authorization was given for the take of 14 animals in one year (1978) and 10 or fewer in all other years. Since 1985, permits have authorized takes of no more than four whales per year.

The whales have been captured exclusively for export to marine zoological parks in Europe (France, the Fed. Rep. Germany, the Netherlands, Spain, and the UK), South and North America (Brazil, Canada and USA) and Japan. A few animals have later been resold to parks in other countries (e.g. Switzerland, Mexico and Hong Kong).

Basis for issuing permits

Permits were issued on the basis of the best available information on size and status of the Icelandic killer whale stock(s) and in accordance with recent suggestions by the International Whaling Commission (IWC) for management of this species.

Sigurjónsson (1984) gave a minimum estimate of 284 killer whales on the nearshore herring grounds, based on coordinated census onboard herring fishing vessels in October 1982. As that census covered only a small portion of eastern Icelandic waters and as some animals were reported from outside the main survey area, it was concluded that (a) the population of killer whales in the nearshore waters of Iceland was in excess of 300 animals and that (b) additional animals probably occurred in coastal waters to the north, west

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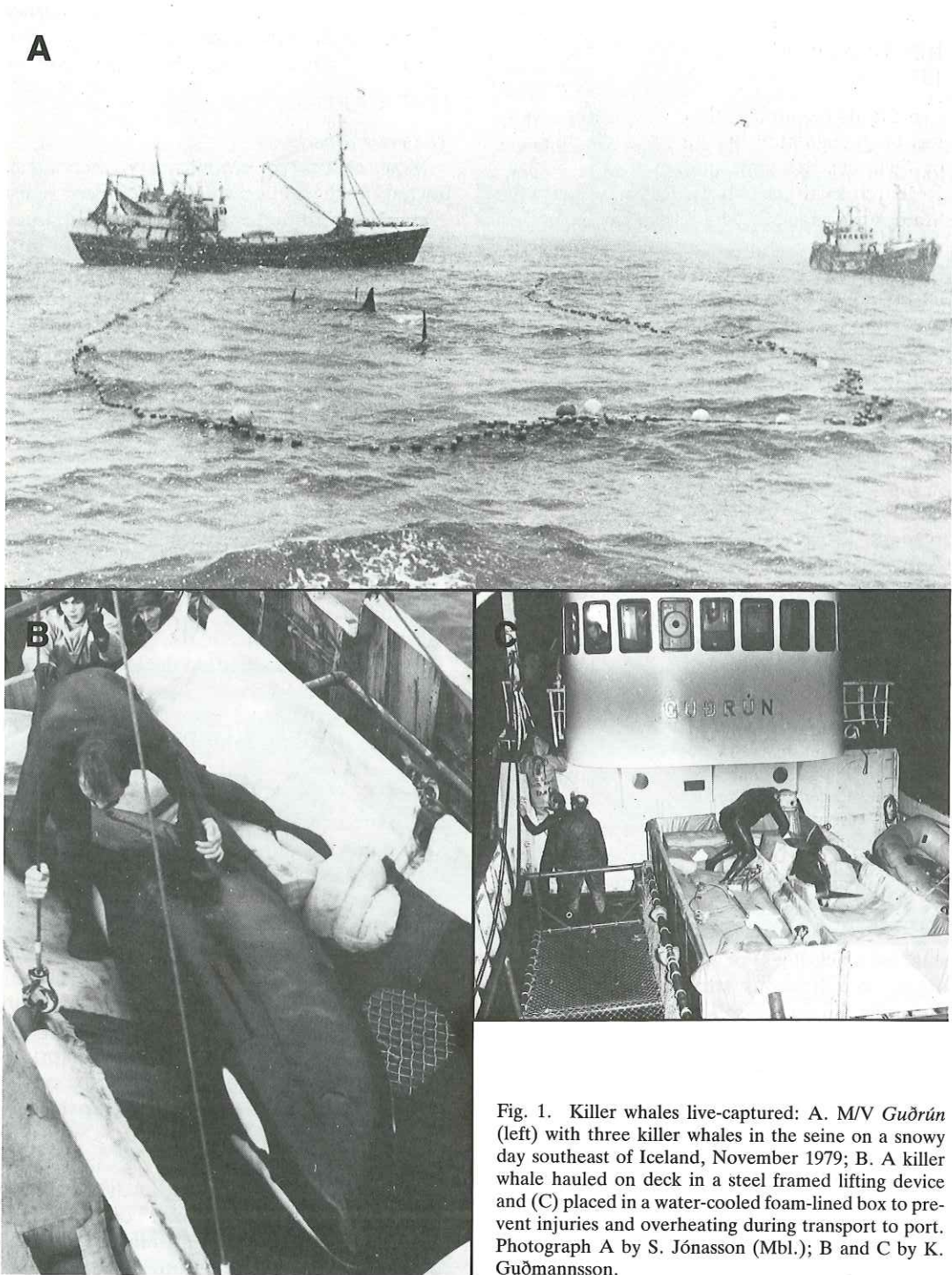


Fig. 1. Killer whales live-captured: A. M/V *Guðrún* (left) with three killer whales in the seine on a snowy day southeast of Iceland, November 1979; B. A killer whale hauled on deck in a steel framed lifting device and (C) placed in a water-cooled foam-lined box to prevent injuries and overheating during transport to port. Photograph A by S. Jónasson (Mbl.); B and C by K. Guðmannsson.

and south of Iceland and in offshore waters all around the country. The 143 killer whales photoidentified (134 identified in a small area off eastern Iceland) by the end of the 1986 field season (Sigurjónsson *et al.* 1988 – this volume) were also believed to be only a fraction of a larger local population and an even larger total Icelandic stock(s). The sample of identified animals was expected to increase significantly by continued efforts in the following seasons.

In 1985, no killer whales were live-captured in the waters for which population information was available. In 1986, authorities issued permits for 4 animals, a level which was regarded safely within 1% of the total stock size. This was considered a conservative management strategy in light of available information on reproduction, mortality and recruitment of killer whales in stocks elsewhere (Best 1980; Balcomb *et al.* 1982; Bigg 1982; Christensen 1982, 1984; IWC 1982). The Scientific Committee of the IWC had advised in 1983 (IWC 1984), that annual removals be less than 2% of the population. Permits have been issued for only one year at a time, pending continued research and additional information on the stock size.

The sightings surveys conducted in and adjacent to Icelandic waters during the summer of 1987 confirmed (Sigurjónsson *et al.* in press, 1988 – this volume) that there were larger numbers of killer whales around Iceland than had been indicated by the previous, limited and localized research efforts. The 21 primary sightings (i.e. seen from randomly selected track-lines) of 155 killer whales made during simultaneous surveys onboard three Icelandic survey vessels, resulted in an estimate of 6,487 killer whales with a 95% lower limit of around 4,000 whales (Gunnlaugsson and Sigurjónsson in press). The animals were widely distributed around Iceland (Sigurjónsson *et al.* 1988 – this volume: p. 113, Fig. 7). Furthermore, the ongoing efforts to photo-identify individual killer whales in 1987 and 1988 (still under analysis), have increased considerably the number of known individuals, both off the east coast during fall and in

other areas around Iceland during the warmer season (MRI, unpubl. data).

LIVE-CAPTURES 1976–88

The catch operation

Most capture operations have been conducted from the herring purse-seiner (Fig. 1A), M/V *Guðrún* (182 Btn), with a modified cod seine net, 230 fathom long and 50 fathom deep (Gunnarsson 1986). Catches have usually been made in close conjunction with herring fishing operations, where killer whales are frequently found eating fish released when the remains are pumped out of the purse-seine. At such times, the animals do not respond when the purse-seine is released and the large ring of net is closed around them. Often, the release of the left-overs is timed to help to capture the animals; on some occasions, a load of several hundred kilogrammes of herring has been dumped in front of a group of whales to make them easier to catch.

After netting, the desired animals are selected and the rest of the group released. The animals are hauled on deck in a specially designed steel framed lifting device and placed in foam-lined boxes containing seawater to prevent injuries and overheating (Fig. 1B and C). During the first years, the animals were kept in a floating pen in Grindavík harbour, SW Iceland and shipped abroad after a few days or weeks. Since 1979, all animals have been transferred to a holding pool at the *Sædyrasafnið*, to adjust to captivity and to be carefully monitored by veterinarians, usually for at least several weeks before being shipped by air to the buyer's facilities (Fig. 2). The early capture techniques and handling procedures of this fishery are described in Dudok van Heel (1986). These have in principle been used ever since, although the collectors involved have steadily improved the methods (Gunnarsson 1986; B. Sandholt, pers. comm.).

Statistics

Table 2 gives details of all killer whales captured (some of which were exported, re-

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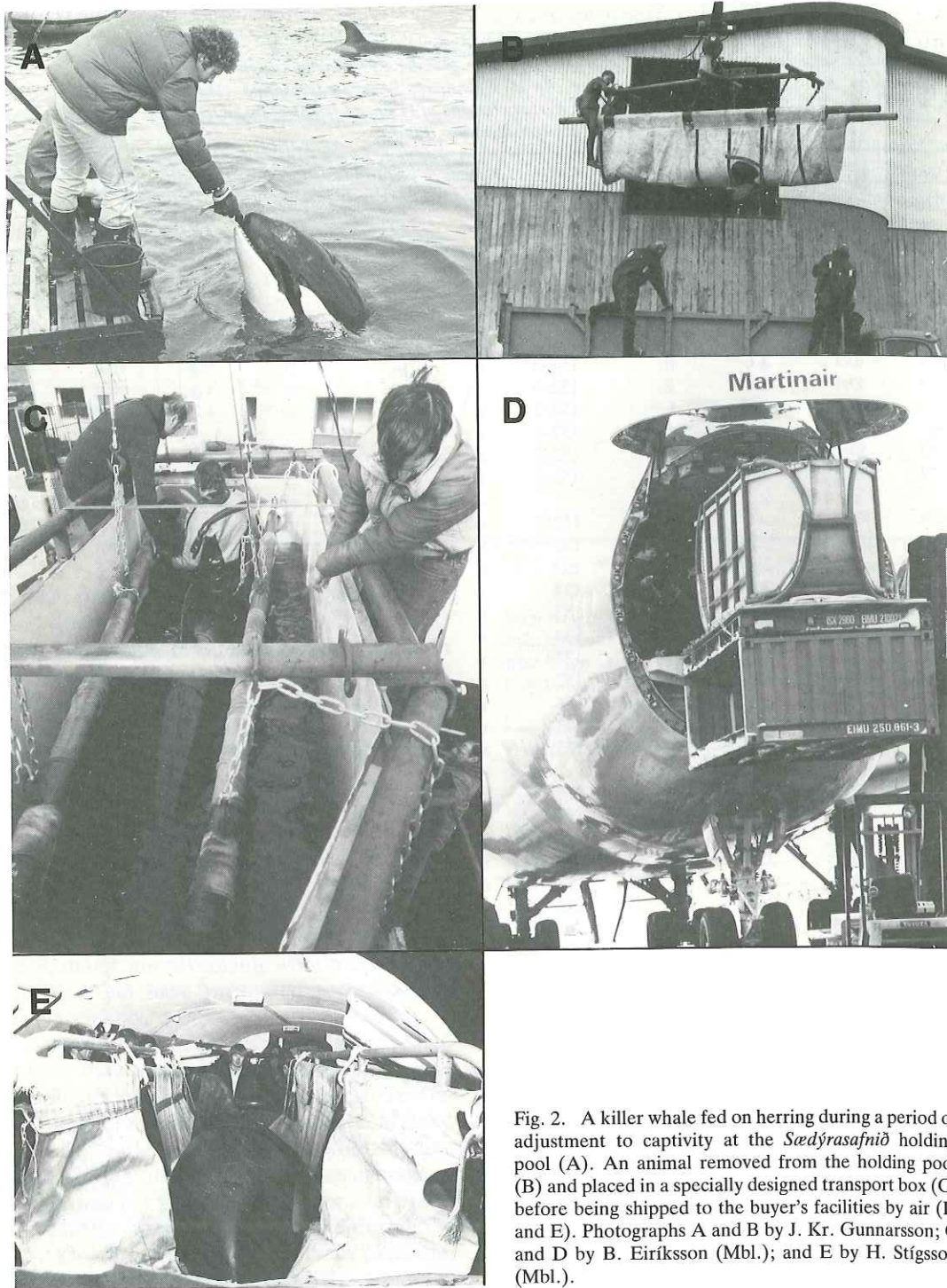


Fig. 2. A killer whale fed on herring during a period of adjustment to captivity at the *Sædýrasafnið* holding pool (A). An animal removed from the holding pool (B) and placed in a specially designed transport box (C) before being shipped to the buyer's facilities by air (D and E). Photographs A and B by J. Kr. Gunnarsson; C and D by B. Eiríksson (Mbl.); and E by H. Stígsson (Mbl.).

TABLE 2

Killer whales captured in Icelandic waters 1976-1988. f = female; m = male; length in m; squares (see Fig. 3); JKG = Jón Kr. Gunnarsson; RG = Roger de la Grandière; S = Sædýrasafnið (Hafnarfjörð marine zoo); A = Anna hf; F = FAUNA; in calculations of average lengths of removed females, the two animals of 3+ m in 1977 are considered as 3.0 m.

Year	Month	Length	Sex	Square	Captured	Released	Died	Exported	Collectors
1976	Oct	5+	f	152	x	x			JKG
1976	Oct	3.6	-	171	x	x			JKG
1976	Oct	4.4	-	171	x	x			JKG
1976	Oct	3.0	f	152	x			x	JKG
1976	Oct	2.7	f	152	x			x	JKG
1976	Oct	4.5	f	152	x			x	RG
1977	Oct	2.6	m	152-3	x			x	S
1977	Oct	3+	f	152-3	x			x	S
1977	Oct	3+	f	152-3	x			x	S
1977	Oct	2.7	f	152-3	x			x	S
1977	Oct	2.8	f	152-3	x			x	S
1977	Oct	3.3	m	152-3	x			x	S
1978	Oct	-	f	152-3	x			x	A
1978	Oct	2.8	m	152	x			x	S
1978	Oct	2.9	f	153	x			x	S
1978	Oct	2.9	f	134	x			x	S
1978	Oct	3.2	f	153	x			x	S
1978	Oct	3.6	f	134	x			x	S
1978	Oct	3.1	m	134	x		x		S
1978	Nov	3.2	f	152	x		x		S
1978	Nov	3.6	-	153	x	x			S
1978	Nov	3.3	m	153	x	x			S
1978	Nov	3.2	-	153	x	x			S
1979	Jul	3.07	m	106	x			x	S
1979	Oct	3.7	f	153	x			x	S
1979	Nov	2.7	m	153	x			x	S
1979	Nov	2.8	m	153	x			x	S
1979	Nov	3.7	f	152	x			x	S
1979	Nov	3.6	f	152	x			x	S
1980	Oct	-	-	171	x	x			S
1980	Oct	2.9	f	171	x			x	S
1980	Nov	3.9	m	116	x			x	S
1980	Nov	3.5	f	116	x			x	S
1980	Nov	3.95	f	116	x			x	S
1980	Nov	4.0	f	116	x			x	S
1981	Oct	-	-	148	x	x			S/JKG
1981	Oct	4.15	f	148	x			x	S/JKG
1981	Oct	3.4	f	148	x			x	S/JKG
1981	Oct	2.6	m	148	x			x	S/JKG
1981	Oct	2.8	m	148	x			x	S/JKG
1981	Oct	3.5	f	171	x			x	S/JKG
1981	Oct	4.1	m	171	x			x	S/JKG

Table 2 (continued)

Year	Month	Length	Sex	Square	Captured	Released	Died	Exported	Collectors
1982	Oct	2.9	f	75	x			x	S
1982	Oct	3.0	f	75	x			x	S
1982	Oct	3.8	f	75	x			x	S
1982	Oct	4.4	f	149	x			x	S
1982	Oct	3.9	m	149	x			x	S
1983	Nov	4.3	m	115	x			x	F
1983	Nov	3.5	m	115	x			x	F
1983	Nov	4.0	f	115	x			x	F
1984	Nov	3.4	m	115	x			x	S
1984	Nov	4.1	f	115	x			x	S
1984	Nov	4.9	m	116	x			x	S
1984	Nov	4.1	m	116	x		x		S
1984	Nov	3.4	m	116	x			x	S
1987	Oct	4.01	f	96	x			x	F
1987	Oct	2.74	f	96	x			x	F
1987	Oct	3.99	m	96	x			x	F
1987	Oct	3.20	m	96	x			x	F

leased, or they died in holding pools in Iceland before shipment) 1976–1987. Table 3 gives a summary of catch statistics by year. In all, 59 whales were captured during the period 1976–1987; there were no animals captured in the 1985, 1986 and 1988 seasons. Three animals died in the holding pool at the *Sædýrasafnið*. Two died in February 1979 after a period of severe weather that caused damages in water circulation in the pool and subsequent illness of two animals. The third animal, caught in November 1984, died in January 1985 of neck damages (B. Sandholt, pers. comm.). After the incident in February 1979, major improvements were made on the facilities that have prevented recurrence of such accidents.

A total of eight animals was released, three before they were transported to port, two after being kept in the floating pen at Grindavík and three after being kept for at least several months at the *Sædýrasafnið* holding pool. Thus, a total of 51 whales, an average of 3.9 animals per year, has been removed by the live-capture operations off Iceland during the past 13 years. Forty-eight of them (average: 3.7 per year) have been exported.

TABLE 3

Summary of live-captures of Iceland killer whales: * 1 animal released shortly after being captured; x 2 released after being kept in floating pen; ** released after being kept in holding pool; + animals died in holding pool before shipment from Iceland.

Year of capture	Number of animals			
	Captured	Released	Died+	Exported
1976	6	*x 3	0	3
1977	6	0	0	6
1978	11	**3	2	6
1979	6	0	0	6
1980	6	*1	0	5
1981	7	*1	0	6
1982	5	0	0	5
1983	3	0	0	3
1984	5	0	1	4
1985	0	0	0	0
1986	0	0	0	0
1987	4	0	0	4
1988	0	0	0	0
Total	59	8	3	48

Sex and size composition of captured animals

According to available information, the sex composition of all removed animals consisted of 31 females (61%) and 20 males (39%). Of the eight animals released, six were of un-

known sex, one was 5+ m female and one a 3.3 m male. It should be pointed out, however, that a few of the earlier sex determinations may have been incorrect due to the difficulties in sexing the animals during normal handling and observations (ventral side not visible). The sexes of animals captured during the last eight years or so (i.e. since cytological tests have been applied routinely for sex determination; see karyotypes in Árnason *et al.* 1980) have been reliably determined. The preponderance of females in the captive sample probably reflects the actual proportion of the sexes in wild populations (Bigg 1982; Sigurjónsson *et al.* 1988 – this volume). In addition, the owners of marine zoological parks have preferred known females or other animals in the lower size range (less than 4 m) and there are more females than males in this subset because males reach greater maximum size and have higher rate of growth than females (Christensen 1982, 1984; Duffield and Miller 1988 – this volume).

Length measurements were usually made and recorded onboard *Guðrún* or shortly after arrival at the holding pool. In the last few seasons, animals have been measured from the tip of snout in parallel to the notch of the tail

fluke. However, in earlier years some whales may have been measured along the body curvature. This may have caused some upward bias in measurements of the total sample.

The measurements of 56 of the 59 animals captured are given in Table 2. The average size of all animals removed is 3.44 (n = 50; SD 0.58), that of males and females 3.42 (n = 20; SD 0.65) and 3.43 m (n = 30; SD 0.54), respectively. Generally, the animals were two years old or less (see age/length key in Christensen 1984). The whales released in 1976 were all above the overall average size; those captured in 1978 (released in 1979) were 3.3 (male), 3.2 and 3.6 m (sex unknown for the last two). The lengths of the animals captured and released in 1980 and 1981 are not available.

The largest animals captured and exported were a 4.9 m male and a 4.5 m female. Therefore, it appears that all exported animals were sexually immature at the time of capture (Christensen 1984; Duffield and Miller 1988 – this volume). Of the exported whales, 13 (27%) were less than 3 m long; the smallest male and female measured 2.6 and 2.7 m, respectively. According to Duffield and Miller (1988 – this volume) three calves born to

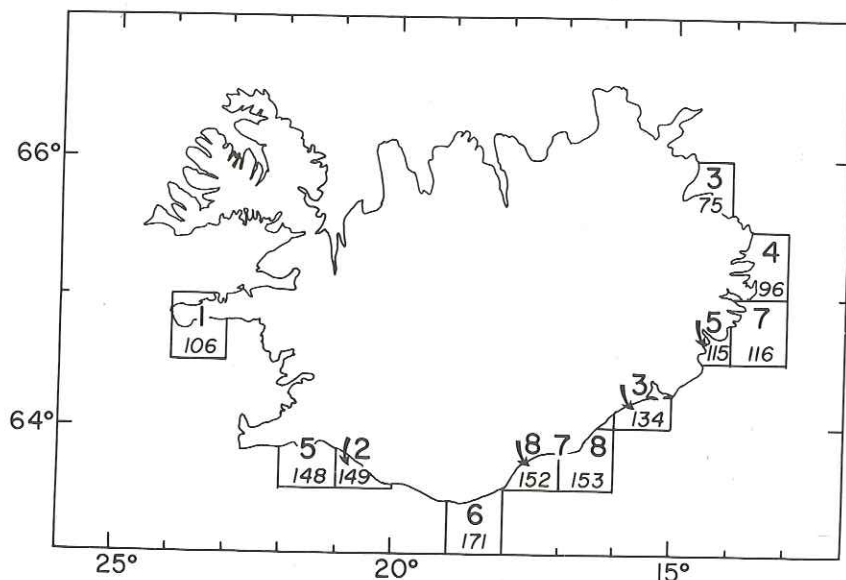


Fig. 3. Distribution (indicated by large numbers) of killer whales live-captured off Iceland, 1976–1987, by statistical squares (small numbers).

females captured off Iceland measured 206, 213 and 238 cm, respectively; four calves born alive to a Pacific breeding pair ranged from 231 cm to 241 cm. Some of the animals captured off Iceland may therefore have been young of the year. The longevity of 19 of the whales caught off Iceland and kept in US and Canadian zoos has been studied by Duffield and Miller (1988 – this volume).

Geographical and temporal distribution of catches

All catches were made in October and November in conjunction with the ongoing herring fishery, except one animal that was caught off Malarriif, W Iceland, in July 1979. The geographical distribution of the catches is given, by statistical squares, in Table 2 and shown in Figure 3. Prior to 1980, all animals (except the one off Malarriif) were captured off the south and southeastern coasts (squares 134, 152, 153 and 171), where the Icelandic summer spawning herring aggregated for overwintering. Two animals were captured in the same area in each of the seasons 1980 and 1981, raising to 32 the total number of animals captured in this area; seven were released. In 1981, four whales (one later released) were captured on the southwest coast (squares 148 and 149); two more whales were taken in this area in 1982.

The first catches off the east coast of Iceland (squares 75, 96, 115 and 116) were made in 1980 (four animals). Since 1983 all removals have been from this area (a total of 16 whales). The shift in catch grounds corresponds with the shift in the autumn aggregations of herring in the recent eight years, where the bulk of the herring catches have also been taken (see Anon. 1981 and subsequent annual reports of MRI on the state of the marine stocks; J. Jakobsson, pers. comm.).

CONCLUSION

The live-capture fishery of killer whales off Iceland has now been conducted and regulated over a period of thirteen years. Given

the available information on killer whales in Icelandic coastal and other territorial waters, the catch rate appears to be within the reproductive capacity of the overall Icelandic stock(s). However, additional information from ongoing photoidentification efforts, sightings surveys and other studies should cast further light on the biology and abundance of killer whales in the area.

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