Is it sensible to move the killer whale Keiko to a non-enclosed bay in Breidafjördur?

A Report to the Ocean Futures Society

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Introduction

The aim of this report is to explore some fundamental aspects regarding the possibility of relocating the famous killer whale Keiko from Klettsvík Bay in the Westmann Islands to an open environment in Breidafjördur Bay, W-Iceland.

The attempt to reintroduce a killer whale to the wild is unique, which makes it difficult to find examples to learn from. For that reason, we have to use common sense and our knowledge and experience to make sensible predictions about what is best for the animal, taking practical things for the caretakers into consideration.

1. Should Keiko be kept in an open environment?

This is the fundamental question about the next steps regarding Keiko. It seems that we have two choices:

A. To keep Keiko more or less enclosed in a pen. It would mean that the area he had for his daily activities would be considerably reduced from what he has now in Klettsvík Bay (Charles Vinick, pers. comm.). He would be taken for "walks" now and then.
B. To keep Keiko in an open environment. He would be fed at a chosen site, since he hasn't fully gained the ability to hunt prey on his own, and his movements would be monitored. He would be free to go wherever and whenever he wanted, but would still be taken good care of.

In both cases, Keiko would get appropriate stimulation and training and his health would be monitored. These two choices have very different consequences for Keiko. Some might say that since he has spent most of his life in an enclosed environment, he would have no difficulties in adapting to a new and smaller pen. Although that may be true, and without going into definitions of intelligence at this stage, we believe that we have to take into account that killer whales are relatively intelligent animals. Consequently, we feel it is highly likely that restriction of movements due to a reduction in available space would have a negative impact on Keiko's well being. If we only look at Keiko's interests, the freedom that he would have living in an open environment such as Breidafjördur Bay while still enjoying the security of regular feeding and human companionship to a degree, we must assume this to be a better choice for his well being than living in a closed and small pen. Also, we have to remember the original goal of the project, which is to reintroduce Keiko to the wild. If he will be kept in a non-enclosed environment, the likelihood of meeting other whales and learning to survive on his own, would probably be far greater than if he was kept in a pen.

2. Is Breidafjördur a good choice?

Breidafjördur Bay (Figure 1) is a very interesting area from the point of view of natural history. In this summary, we will try to outline some of the characteristics of the area.

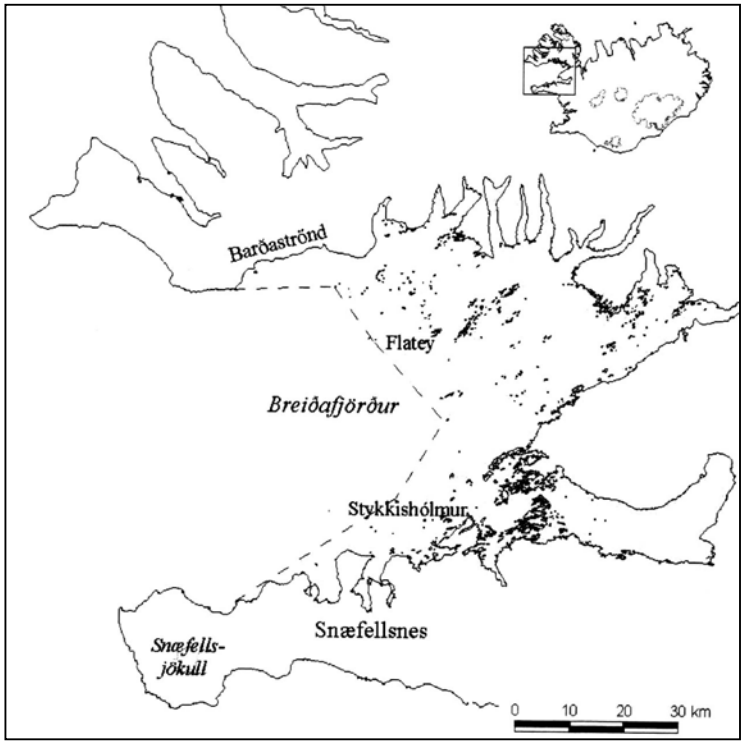

Figure 1. *A map of Breidafjördur bay. The nature reserve is east of the dotted line. (Map: The Icelandic Institute of Natural History).*

2.1. Biological diversity

Breidafjördur Bay is one of, if not the most diverse, part of Iceland's coastal waters. It supports benthic and planktonic animals and plants in great numbers and density. A few indicators of the richness in life in the area are:

A. Breidafjördur Bay supports 15-20% of the total Icelandic population of harbour seals (*Phoca vitulina*) and 50% of the gray seal (*Halichoerus gryphus*) population (Petersen 1989).
B. It supports the majority of the Icelandic white-tailed sea eagle (*Haliaeetus albicilla*) population, which preys mostly on seabirds and fish (Skarphédinsson 1994).
C. The majority of the Icelandic populations of cormorant (*Phalacrocorax carbo*) and shag (*P. aristotelis*) breed on the islands of Breidafjördur (Gardarsson 1979, 1996).
D. The islands support high numbers of puffins (*Fratercula arctica*), which is the most frequent bird in Breidafjördur Bay, eiders (*Somateria mollissima*), seagulls (*Larus* spp.), kittiwakes (*Rissa tridactyla*) and fulmars (*Fulmarus glacialis*) along with many other species (Petersen 1989).

E. People have always harvested the rich nature of Breidafjördur Bay. Before the time of the automobile, people living on the islands of Breidafjördur Bay were among the richest in Iceland, mostly because of their exploitation of the sea (Petersen 1989).
F. The shores of Breidafjördur are internationally important areas for birdlife (Einarsson 2000), since thousands of migrating birds heading from Europe to the breeding grounds in Greenland and Canada stop in Breidafjördur to accumulate fat to complete their migration in spring and autumn. The most prominent of these species are knot (*Calidris canutus*), turnstone (*Arenaria interpres*) and Brent goose (*Branta bernicla*).

Whales are common in Breidafjördur Bay, with more frequent sightings in the outer (western) part. Small whales are most common, but bigger ones like minke whale (*Balaenoptera acutorostrata*) are frequent in the outer parts. Porpoises (*Phocaena phocaena*) and white-beaked dolphins (*Lagenorhynchus albirostris*) are probably the most common cetaceans in Breidafjördur, but killer whales (*Orcinus orca*) and white-sided dolphins (*L. acustus*) are also common. Of 20 species of whales and dolphins living in Icelandic waters, 9 have been seen in Breidafjördur Bay (Ævar Petersen 1989).

The inner part of Breidafjördur Bay is a nature reserve and has been protected by law since 1978, because of the high international value of the nature in the area.

2.2. Depth

The depth of Breidafjördur Bay is very variable. It is greatest in the southwestern part, up to 300 m. The northern part is shallower, mostly between 50 and 60 m. East of a line between Bjarnarhöfn on the south coast and Hjardarnes on the north coast, the average depth declines. It is still extremely variable, ranging from 3-80 m, with a depth between 20 and 30 m being most common.

2.3. Tides and tidal currents

The tidal difference is greater in the inner part of Breidafjördur than anywhere else in Iceland, about 4-5 m on a spring tide, but can exceed 6 m in extreme cases. This has two major consequences: A. The coastal area is very extensive on low tide. B. The tidal currents can be very powerful in some areas.

2.4. Number of islands

The inner part of Breidafjördur is very unusual in that it has many islands. They are difficult to count but it has been estimated that they number about 2,500. Along with the high number of islands, the extensive tide difference and diversity of life make Breidafjördur a special and varied marine environment. Because of the tide difference and all the islands, the tidal currents in the inner part of Breidafjördur, especially in the mouth of Hvammsfjördur (~12 km east of Stykkishólmur), are very strong.

The islands provide shelter to the numerous inlets and bays in the area, thus waves rarely reach considerable height.

2.5. Sea temperature

The only site in Breidafjördur, which has available data on sea temperature is Stykkishólmur. Sea temperature was measured in Stykkishólmur from 1981-85, 1992 and 1995-98. Data for 1981-85 were obtained from the branch of the Marine Research Institute in Ólafsvík, Snæfellsnes, but data for the years 1992 and 1995-98 were obtained from the homepage of the Oceanographic Group of the Marine Research Institute in Reykjavík (*http://www.hafro.is/Sjora/index.htm*). In the period 1981-85, the average temperature was lowest in January 0,2°C, but highest in August 9,8°C (Figure 2). The data from 1992-98 are fragmentary but can be seen in the Appendix. Although the two periods are difficult to compare from these pictures, it appears that the temperature has been higher during the last decade than in 1981-85, which is in concordance with air temperature in the area.

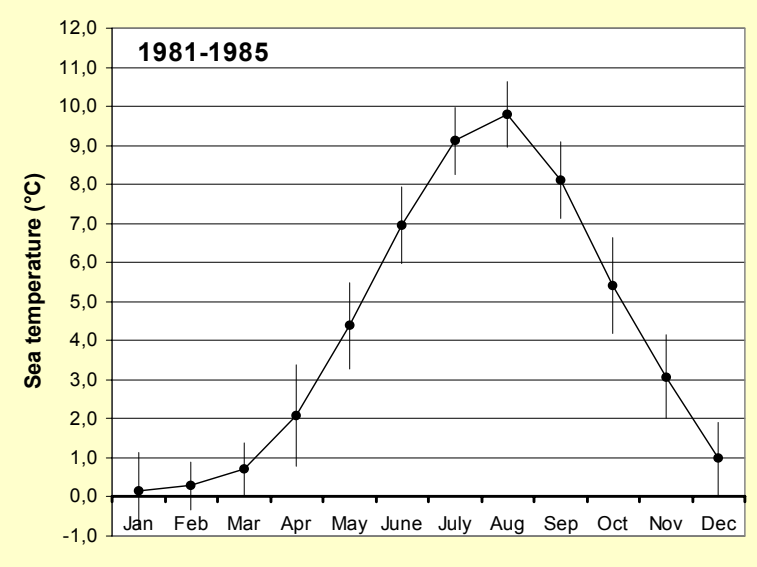

Figure 2. *Sea temperature in the harbour of Stykkishólmur in the period 1981-85. Dots show the mean for each month but the vertical lines show the standard deviation of the mean.*

2.6. Pack ice

Hvammsfjördur, which is the innermost part of Breidafjördur, is almost closed by a number of islands. Because of rather low salinity, the fjörd gets at least partially covered with pack ice in cold years, but other parts of Breidafjördur do not. Exceptions are to be found in small sheltered bays, which may get covered with ice in calm and cold periods.

When the ice in Hvammsfjördur melts, small ice floes drift west with the tidal currents.

3. Is Stykkishólmur a good choice?

Some of the most important characteristics of the area around Stykkishólmur, regarding the possible translocation of Keiko, are:

A. Shipping traffic in Stykkishólmur harbour is low, compared to many other places. It is characterised by 70-80 small fishing and leisure boats. Eleven bigger boats come to the harbour regularly. Five, ranging in size from 18–300 tons, are involved in Iceland scallop (*Chlamys islandica*) fishing, three (180-250 tons) in net fishing, two in nature and bird watching tours, barely 200 tons each, but the biggest ship that frequents the harbour is the ferry Baldur, which weighs around 350 tons.
B. Fishing in the vicinity of Stykkishólmur is not extensive. The only netting close to the town is for lumpfish (*Cyclopterus lumpus*) during the summer months. Hardly any fishing takes place east of Stykkishólmur.
C. Stykkishólmur is about 175 km (2 hours) drive from Reykjavík on a paved road. The town offers all the necessary services, in addition to a well-equipped hospital, the county magistrate, the county veterinarian and the W-Iceland Institute of Natural History. Two biologists (the authors of this report), both mammalogists with specialities in ecology, animal behaviour and genetic analysis, are currently employed at the institute and are willing to devote some of their time to the Keiko re-introduction project.
D. Stykkishólmur municipality is positive towards a participation in the Keiko project.

4. Possible dangers and interference

Wild animals are exposed to many threats in nature. Although the killer whale is at the top of the food chain, it also has a few dangers to avoid. It could also possibly interfere with its surroundings.

A. Ships and nets. As explained earlier, shipping traffic and netting is not extensive around Stykkishólmur and almost none east of the town. In our opinion, Keiko would not be negatively influenced by shipping traffic. Lumpfishing involves netting in the summer time close to the shore. Keiko could possibly be netted. Since almost no lumpfishing takes place east of Stykkishólmur, perhaps that area is more practical. Keiko has shown that he is attracted to people and boats (Charles Vinick & Hallur Hallsson, pers. comm.), and therefore might possibly interfere with fishing and fishermen. It is difficult to predict whether this will happen.
B. Pack or drift ice should not be a threat to Keiko, particularly not if he was kept in a non-enclosed environment.
C. Because of the extensive tidal fluctuations, there is a possibility that Keiko would get stranded. If he were equipped with a radio or a satellite transmitter, he would quickly be positioned and necessary help could be provided. It is not certain that this is an actual danger for killer whales, since wild orcas have been seen flopping well up onto the land to catch pinnipeds and then moving back to deep water (Novak 1999), which may imply that if he got stranded, he would generally be able to free himself.
D. Shelter is probably more important for Keiko than wild killer whales, since he seems to spend more time near the surface (Charles Vinick & Hallur Hallsson, pers. comm.). The inner part of Breidafjördur is sheltered from big waves because of all the islands. It is our opinion that it would be better for Keiko to be in a non-enclosure in cases of stormy weather, because he would always be able to find shelter between some of the islands.
E. Eider colonies. Eider farming is an important perquisite for many people in the region. It is difficult to predict the actual influence of Keiko upon eiders, though it is doubtful that he would kill eiders. The negative influence of Keiko on eider farming would probably be insignificant.

5. Possible sites near Stykkishólmur

The area around Stykkishólmur has been examined, looking for suitable locations for Keiko. After the first observations, three possible locations were identified: Ögur, Thingvellir and Móvík. On November 11th a local fisherman, Símon Sturluson, was kind enough to take us to measure the depth at these three sites (Figure 3 and 4). From that data it is clear that Ögur is too shallow and will not be considered further. Móvík and Thingvellir are still under consideration

and seem to be equally practical, but since Móvík is closer to Stykkishólmur and is owned by the town, it seemed to be more convenient.

Móvík is a shallow bay a few hundred meters east of Stykkishólmur. The bay is sheltered from west wind and whatever the wind direction, hardly any waves will build up because of shelter from land and the islands. On the other hand, Móvík is open for the wind from northeast, east and south. The wind direction frequency (Figure 5) shows that eastern directions are prevailing. Nevertheless, most storms come from the south and occasionally from northeast. The depth on low spring tide (Figure 4) implies that if facilities for Keiko would be built up there, it would have to be close to the cape Baulutangi on the western side of the bay (indicated by a green arrow in Figure 6).

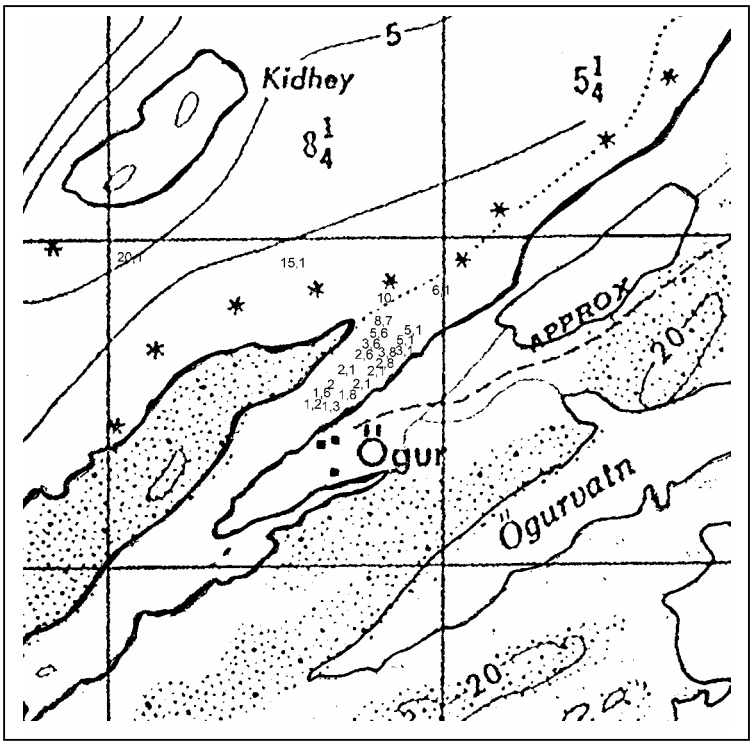

Figure 3. *A map, showing one of the identified sites, Ögur. Depth of the bay at low spring tide is shown where building up facilities was considered desirable. Each square is 1x1 kilometer.*

Following consideration and walks around Móvík, another possible site was identified (indicated by a red arrow in Figure 6). It is west of Móvík in the easternmost part of Borgarklettar, about 100 m west of the tip of Baulutangi. This site is better suitable than Móvík, particularly in respects to shelter, depth and probably also cost, since it needs little construction other than a road. Water and electricity can be taken from the town, a few hundred metres away.

Access from land is easy to the middle of a tiny bay, which has small (~5 m) cliffs on both sides. This creates a very good shelter from wind coming from southeast, south and southwest. The bay is open for wind blowing from north and northwest, but wind from northwest is rare in Stykkishólmur (Figure 5). It is also partly open for other north winds, but islands nearby provide a shelter. Even in heavy wind from north, islands provide shelter so big waves will not build up.

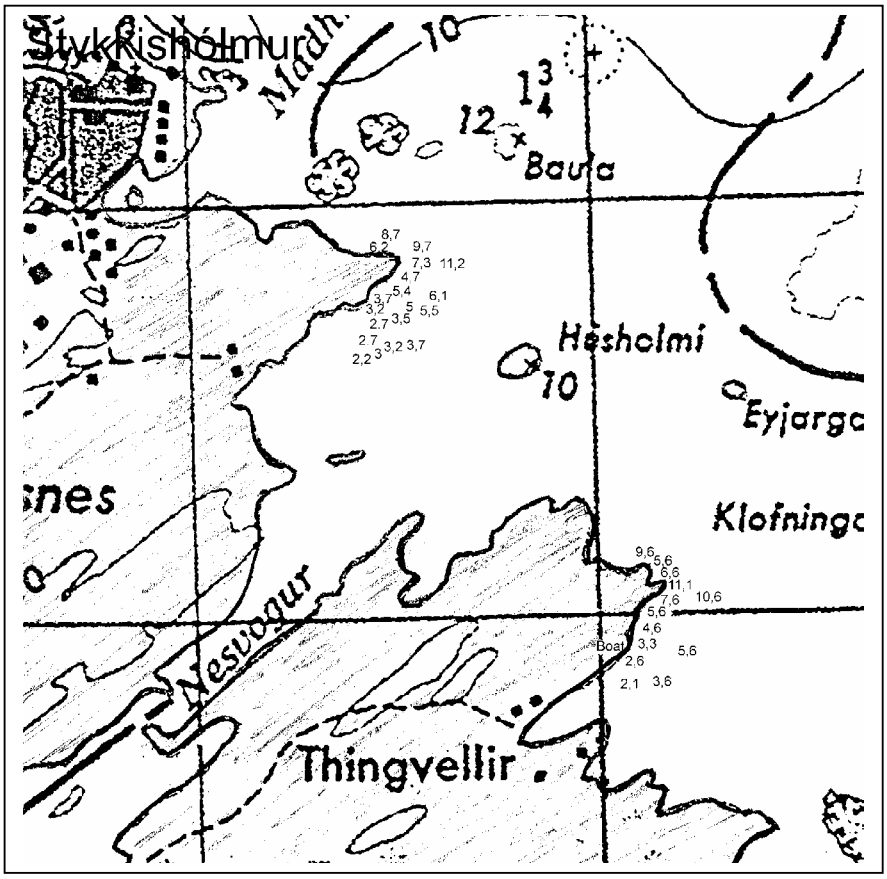

Figure 4. *A map, showing two of the identified sites, Móvík and Thingvellir. Depth at low spring tide is shown where building up facilities was considered desirable. Each square is 1x1 kilometer.*

Sewage outlet from about 40 homes in the easternmost part of Stykkishólmur, is positioned east of Madkavík, about 400 m west of the proposed site. A study on germ pollution in the ocean surrounding Stykkishólmur (Róbert A. Stefánsson & Helgi Helgason, unpubl. data), was conducted earlier this year. It showed that about 100 m away from this outlet, no coliform bacterias were found in the sea water. Dilution and tidal currents see to that all pollution that is carried to the sea in this area is rapidly diluted and carried away. This outlet should therefore hardly pose a threat to Keiko. Of course, if Keiko is to be kept close to a human society, he will always be in a possible danger of infections from sewage.

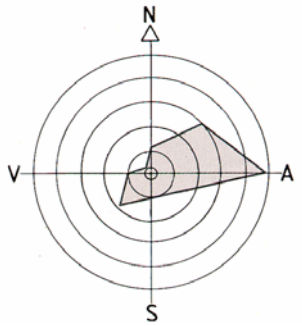

Figure 5. *The frequency of wind directions in the period 1950-71 in Stykkishólmur.*

The location west of Baulutangi (red arrow in Figure 6) seems to fulfil the most important needs, both for Keiko and for the people taking care of him. Therefore, we recommend that it will be used if Keiko comes to Stykkishólmur.

Figure 6. *An aerial photograph, showing cape Baulutangi and two of the possible facility locations for Keiko. The green arrow indicates the location in the west part of Móvík and the red arrow indicates the proposed location in Borgarklettar, west of cape Baulutangi.*

6. Conclusion

Trans-locating Keiko to a non-enclosed bay in Breidafjördur is certainly a very interesting idea. Of course practical matters have to be addressed, that is e.g. finding a suitable site for a base for the people attending to Keiko.

Breidafjördur is a nature reserve with a high level of diversity and biological richness. There don't seem to be any strong arguments against locating Keiko there. A location of particular interest is east of Stykkishólmur, in the east part of Borgarklettar, west of Baulutangi. That location seems to fulfil the most important needs, both for Keiko and for the people taking care of him. It is sheltered from many wind directions, has sufficient depth close to the shore and may easily be accessible without extensive road construction.

We recommend that Keiko will be located in an open environment, either in Breidafjördur Bay or some other location offering a similar environment and facilities for the staff taking care of him. It is our opinion that it would be a big step towards guaranteeing the well being of Keiko for the future.

7. Acknowledgements

We would like to thank Hallur Hallsson and Charles Vinick for very interesting conversations during the last few weeks. We are also grateful for the assistance of Símon Sturluson, a local fisherman who measured the depth of the possible sites. Konrád Ragnarsson provided information about Stykkishólmur harbour. Óli Jón Gunnarsson, Grétar Pálsson and Rúnar Gíslason were involved with us in the selection of the best possible location for facilities for Keiko. Grétar Pálsson and Ásgeir Gunnar Jónsson provided the aerial photograph of the proposed location. Professor Páll Hersteinsson commented on an earlier version of the manuscript.

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Appendix