

香港海域におけるスナメリの生態学に関する予備報告

トーマス A. ジェファーソン^{1,2}・ギル T. ブラウリック³

PRELIMINARY REPORT ON THE ECOLOGY OF THE FINLESS PORPOISE IN HONG KONG WATERS

THOMAS A. JEFFERSON^{1,2} AND GILL T. BRAULIK³

ABSTRACT

Two species of small cetaceans, the Indo-Pacific hump-backed dolphin and the finless porpoise, occur year-round in waters of the Hong Kong Special Administrative Region. Research conducted from September 1995 to March 1998 has allowed for a preliminary assessment of the status of the finless porpoise population that occurs in Hong Kong. Line transect vessel surveys have been used to examine distribution and abundance, and a stranding recovery program provides information on mortality and life history.

Finless porpoises only occur in the southern and eastern waters of Hong Kong, away from the influence of the Pearl River. The area of southwest Lamma Island appears to be a "hot spot" in winter and spring months. There are seasonal shifts in abundance, with minimum estimates of numbers in the southern waters of Hong Kong ranging from a low of 27 in autumn to a high of 154 in spring. There are currently insufficient data to reliably estimate numbers in Hong Kong's northeastern waters. It is likely that individuals move between Hong Kong and the surrounding waters of China's Guangdong Province. Although aggregations of up to 17 porpoises have been seen, most groups are of less than four porpoises. Calving takes place between November and April, with a large peak in mid-winter. Several natural and human-related mortality factors have been identified. Trends in abundance are not yet known, but the high number of strandings signal cause for concern over the

1 オーシャンパーク保護財団

Ocean Park Conservation Foundation, Ocean Park, Aberdeen, Hong Kong

2 現住所：南西漁業科学センター

Present address: Southwest Fisheries Science Center, NMFS, NOAA, P.O. Box 271, La Jolla, CA 92038, U.S.A.

3 ERM香港

ERM Hong Kong, Tsim Sha Tsui, Kowloon, Hong Kong

future status of the population. Further research over the next few years should clarify many remaining questions about the status of finless porpoises, and aid in the development and enactment of a conservation plan for this species in Hong Kong.

INTRODUCTION

Among the most poorly-known of the world's small cetaceans is the finless porpoise (*Neophocaena phocaenoides*). In 1995, the International Whaling Commission published a special issue on the biology of the true porpoises (family Phocoenidae) (Bjørge and Donovan, 1995). Each of the other six species in the family was represented by anywhere from 2-18 papers, but there were no papers on the finless porpoise. This fact emphasizes the poor state of knowledge on this species and the scarcity of dedicated studies currently focussing on it. Partly, this results from the fact the species occurs only in waters of east Asia and the northern Indian Ocean (Kasuya, 1999; Reeves *et al.*, 1997), a region not well populated with marine mammal biologists.

Although reported from Hong Kong in the 1950s (Romer, 1958), essentially nothing was learned of the finless porpoise in Hong Kong until the last few years (Parsons *et al.*, 1995; Reeves *et al.*, 1997). In 1995, we began a long-term study of small cetacean populations in Hong Kong waters of southern China (see Jefferson, 1998; Jefferson and Leatherwood, 1997). Although the main focus of the work so far has been the Indo-Pacific hump-backed dolphin (*Sousa chinensis*), much data have been collected on the biology of the local population of finless porpoises as well. In mid-1998, we began a further 2.5 year study aimed at learning more about the finless porpoise population. The main goal will be to provide information for the long-term management and conservation of the finless porpoise in Hong Kong. The present report is offered as a summary of the state of our knowledge on these animals at the start of this detailed study. We hope to be able to examine many more aspects and to update our analyses in future publications.

STUDY AREA AND METHODS

Since July 1997, Hong Kong has been governed as a Special Administrative Region of the People's Republic of China (PRC). The marine waters of the territory comprise about 1,800km² (about 63% of the total area of Hong Kong). Although the western waters of Hong Kong are influenced by the Pearl River (and waters to the north and west of Lantau Island are thus estuarine in nature), Hong Kong's eastern waters are more marine, with very little or no influence from the River. The climate is not strictly tropical, and there are distinct seasons. Summers are hot and wet, and

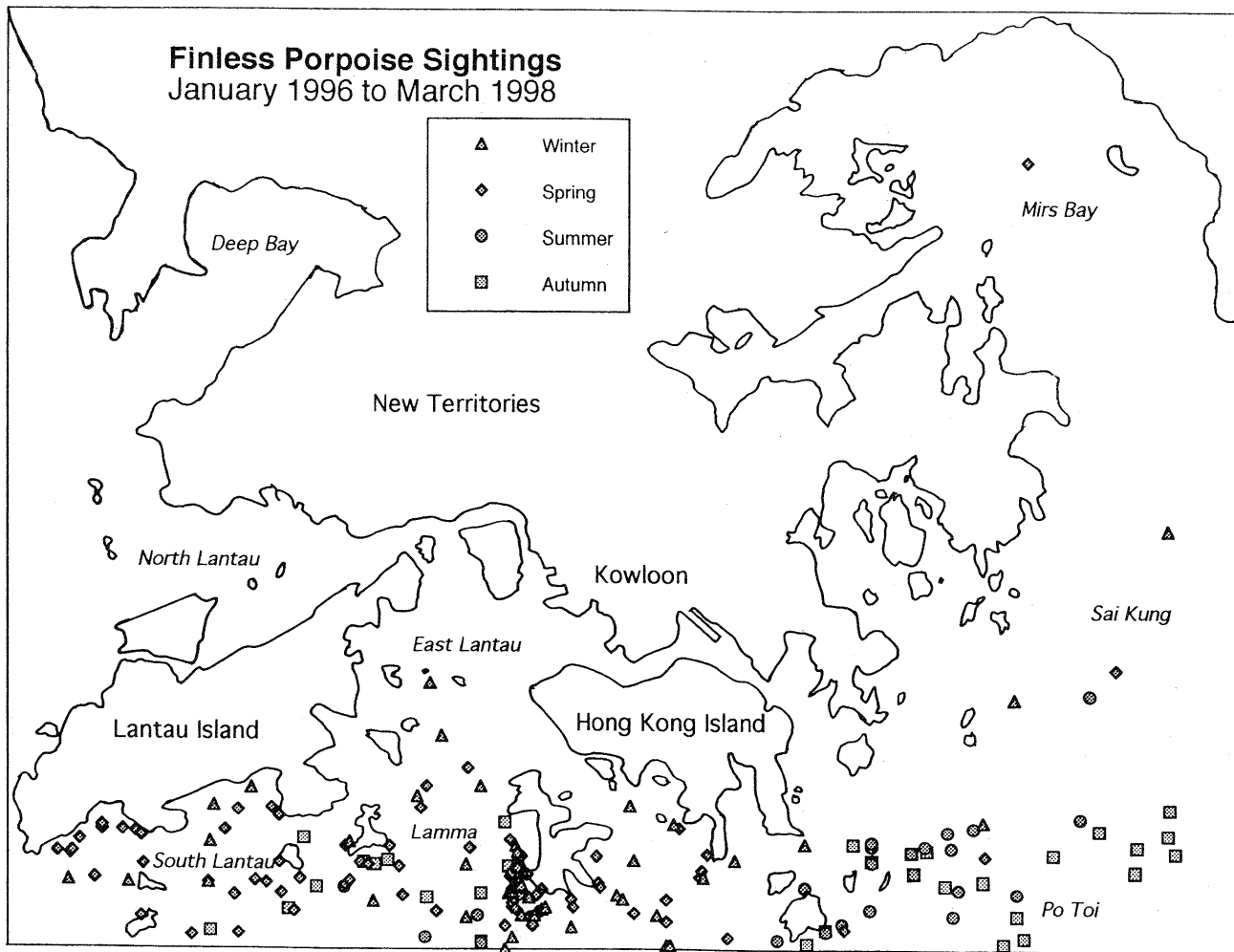


Fig. 1. Map of Hong Kong, showing the distribution of sightings of finless porpoises in different survey areas of the territory.

winters are relatively cool and dry.

The territory was divided into eight survey areas (Fig. 1). Surveys were conducted from medium-sized vessels (12-15m length), using a 2-person survey team. Line transect data were collected during surveys, and photographs were often taken of groups of porpoises, when seen. Occasional helicopter surveys have been used to assess distribution in relatively remote parts of the territory. Porpoise stranding reports were investigated, and necropsies were conducted to determine cause of death and to collect samples for various biological studies. For more detail on the study area and on research methods, see Jefferson (1998) and Jefferson and Leatherwood (1997).

DISTRIBUTION AND ABUNDANCE

The finless porpoise is distributed all along the coast of mainland China and in the Yangtze River, as well as along the west coast of Taiwan (Zhou *et al.*, 1995). Within Hong Kong, finless porpoises only occur in the southern and eastern waters (Fig. 1). Hump-backed dolphins are commonly found in the northwestern waters of Hong Kong (North Lantau and, to a lesser extent, Deep Bay), which are influenced by the Pearl River and are estuarine in nature (see Jefferson, 1998). We have never seen finless porpoises in these waters. The entire southern area of Hong Kong (South Lantau, Lamma, and Po Toi survey areas) is used by finless porpoises. In particular, the area along the southwestern coast of Lamma Island appears to be an area of concentration in winter and spring months (Fig. 1). Sightings have been made in the eastern areas of Sai Kung and Mirs Bay as well, but there has been very little survey effort there to date, so patterns of use can not be accurately evaluated at present. Based on the apparent preference for waters of relatively high salinity that we see in Hong Kong, we would expect that the finless porpoise's range extends south and east of Hong Kong into adjacent waters of China's Guangdong Province. However, we would not expect to find them in Pearl River estuary waters west of Hong Kong, and in fact preliminary dolphin surveys there have resulted in no sightings of finless porpoises.

Line transect analysis of vessel survey data has previously been used to estimate abundance of several species of phocoenoids (Barlow, 1988; Palka, 1995; Turnock *et al.*, 1995; Barlow *et al.*, 1997). Preliminary seasonal estimates of abundance have been made for some survey areas, based on line transect analysis of survey data (Table 1; Fig. 2). It appears that there are seasonal shifts in abundance of finless porpoises in Hong Kong (Parsons, 1997). The peak season appears to be spring, when there are significant numbers of porpoises in all of the areas for which

Table 1
Abundance estimates and associated parameters for finless porpoises
in different areas of Hong Kong.

Area	Season	No.Stgs	Stg.Rate (/100km)	Density (/km ²)	Abundance	95% CI	%CV
South Lantau	Winter	6	2.12	0.08	10	3-31	56
	Spring	10	3.73	0.21	25	10-62	47
	Summer	0	0	0	0	-	-
	Autumn	1	0.15	0	0	0-3	158
Lamma	Winter	16	1.56	0.15	28	13-61	40
	Spring	26	2.23	0.26	47	22-99	39
	Summer	4	0.45	0.01	2	1-8	60
	Autumn	7	0.80	0.02	4	2-9	38
Po Toi	Winter	2	0.79	0.04	7	1-80	123
	Spring	3	0.41	0.27	52	4-632	93
	Summer	12	1.60	0.10	18	7-45	47
	Autumn	15	2.39	0.12	23	10-53	41
Sai Kung	Winter ¹	0	-	-	-	-	-
	Spring	1	1.35	0.07	30	-	100
	Summer	5	5.16	0.19	77	8-762	83
	Autumn ¹	0	-	-	-	-	-

¹ Currently, there are not enough data to estimate the abundance of finless porpoises in Sai Kung in winter and autumn. The lack of sightings should not be taken to indicate that these animals do not occur there in these seasons-strandings and other evidence indicate that they do.

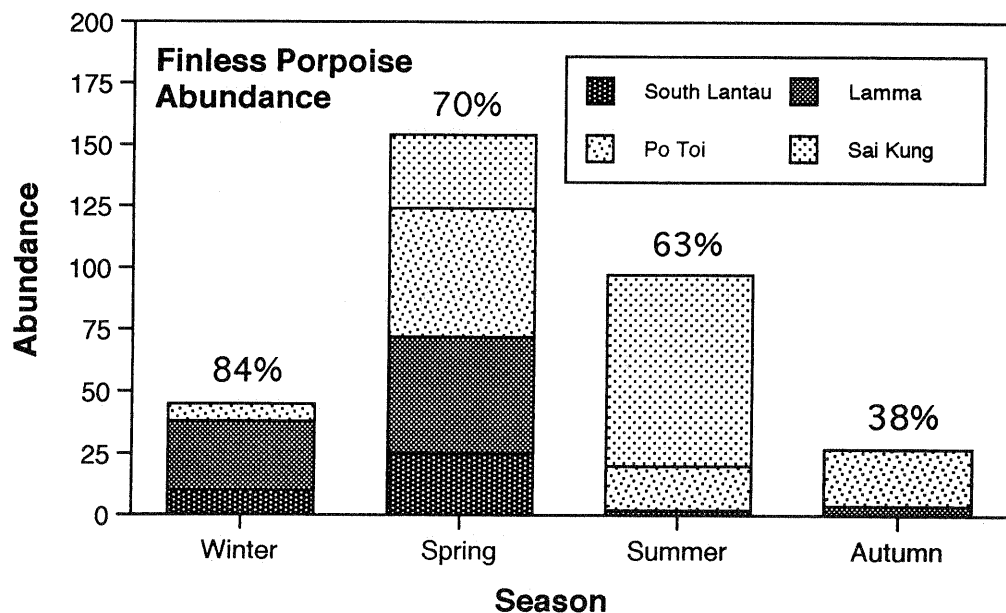


Fig. 2. Estimated abundance of finless porpoises in different areas of Hong Kong, by season. The darkly-shaded areas are the western waters of South Lantau and Lamma, and the lightly- shaded areas are the eastern areas of Po Toi and Sai Kung.

we have adequate data. In summer months, the western areas of South Lantau and Lamma appear to be largely vacated by finless porpoises, and in this season hump-backed dolphins move in to South Lantau (and occasionally Lamma) from the west. The same general trend probably exists in autumn (although we have essentially no survey data from Sai Kung for this time of year). At least in southern waters of Hong Kong, finless porpoise abundance appears to reach a low point in autumn, probably resulting from offshore movement of animals south of the border with Guangdong Province. In winter, again porpoises move into the western waters of South Lantau and Lamma, as hump-backed dolphins sightings become more rare in these waters at this time (Jefferson, 1998).

Taken together, these preliminary estimates of finless porpoise abundance in different parts of Hong Kong indicate that over 150 porpoises occur in the population. This is probably an underestimate of the total population size for the following reasons:

- 1) Finless porpoises are very difficult to spot on surveys, and it is likely that some animals on and near the transect line are missed (i.e., the detection function, $g(0), < 1$).
- 2) No estimates have yet been possible for the northwestern area of Mirs Bay and only partial estimates are available for Sai Kung (because of a lack of survey data from those areas).
- 3) There is an unknown, but potentially large, number of porpoises that occur in Chinese waters adjacent to Hong Kong, and there is every reason to believe that these animals form part of the same breeding population.

Our work on these animals over the next several years will attempt to address these issues and to develop an estimate of the size of the total population, as well as to monitor its long-term trend.

SOCIAL ORGANIZATION AND BEHAVIOR

Finless porpoises in Hong Kong occur in small groups, generally of 3 animals or less (Fig. 3). Aggregations of up to 17 porpoises have been seen, but these are always very loose groupings of animals that appear to be in the same area to feed on a common resource - i.e., these large groups are not cohesive schools. The average group size is $2.4 \pm \text{s.d. } 2.43$ (median = 2, $n = 183$). Group size does not vary greatly throughout the year, but slightly larger groups are found in spring and smaller groups in autumn (Fig. 4). This mirrors the patterns of abundance described above, and the increase in group size in spring may be related to seasonality in breeding (see below).

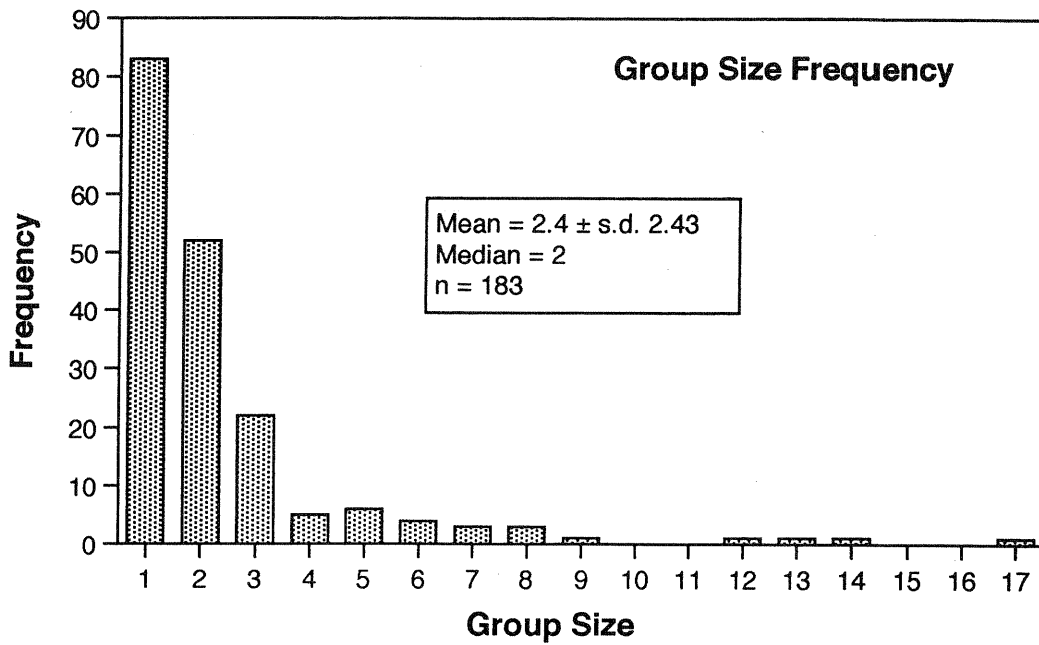


Fig. 3. Group size distribution for sightings of finless porpoises in Hong Kong waters.

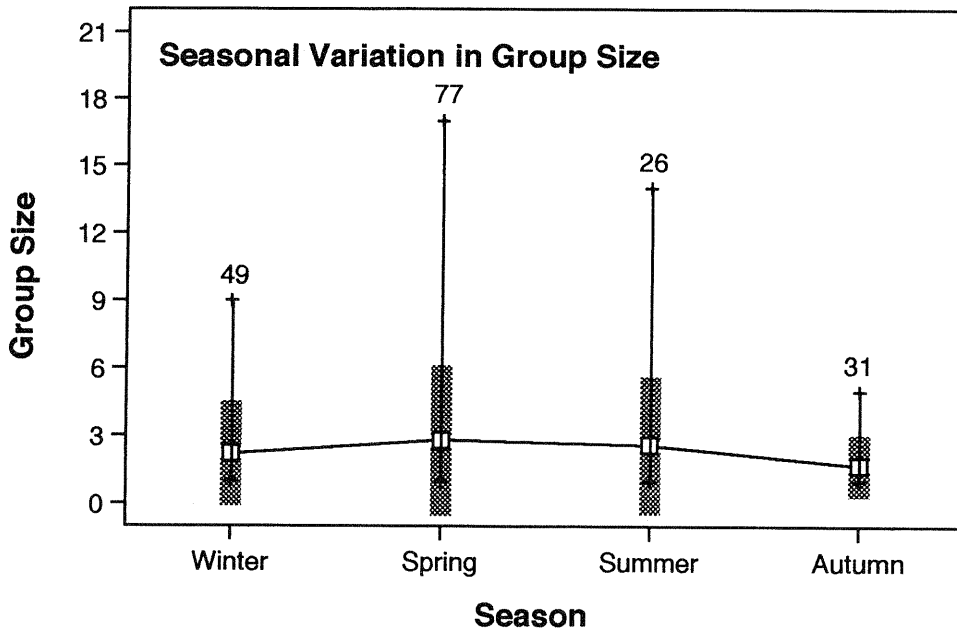


Fig. 4. Seasonal changes in group size. The white squares are the means, the shaded bars are the standard deviations, the narrow bars are the ranges, and the numbers are the sample sizes.

We have taken many photos of finless porpoises but, not surprisingly, we have had no success in identifying individual porpoises from photographs. This is probably due to the following factors:

- 1) The animals are small and dark in color, making them difficult to detect during surveys, and are hard to keep track of during photo sessions.
- 2) The behavior of the animals is not conducive to getting good photos - e.g., they do not generally approach vessels, often appear to dive when approached, and usually surface inconspicuously, rarely exhibiting aerial behavior.
- 3) They have no dorsal fin, the main appendage used for photo-identification of most small cetaceans.
- 4) The teeth of finless porpoises are blunt (unlike the sharp teeth of most dolphins) and therefore they are unlikely to leave "rake marks" on the bodies of conspecifics.

Because of the inability to identify individuals and a lack of tagging studies, nothing is yet known about the stability of finless porpoise groups or of individual movement patterns. However, based on what we know of other phocoenids we would expect to see very low levels of association between individuals (other than mother/calf pairs) (Miller, 1990). We hope to examine these aspects of the biology of the animals through a tagging and tracking study in the future.

LIFE HISTORY AND MORTALITY

There are at least three geographic forms of finless porpoise with different external characteristics that occur in Chinese waters, and these have been classified as separate subspecies (Gao, 1991; Wang, 1992a,b; Zhou *et al.*, 1993; Gao and Zhou, 1995). The forms that occur in northern China, in the Yellow, Bohai, and northern East China seas (*N. p. sunameri*), and in the Yangtze River (*N. p. asiaorientalis*), both have a narrow and deep dorsal ridge. However, the South China Sea form (*N. p. phocaenoides*) has a ridge that is much wider. The ridge is only slightly raised above the surrounding back and tail stock, and is covered with a series of small bumps, which are arranged in lines. As mentioned by Parsons and Wang (1998), newborns in Hong Kong and southern China are light gray to cream in color, and they appear to darken as they age, eventually becoming a dark charcoal gray as adults (Fig. 5). The jet black color of many stranded specimens presumably results from post-mortem darkening. The progression of color changes, from light calves to dark adults in *N. p. phocaenoides*, is different from that of *N. p. sunameri*, in which the opposite occurs (Kasuya, 1999).

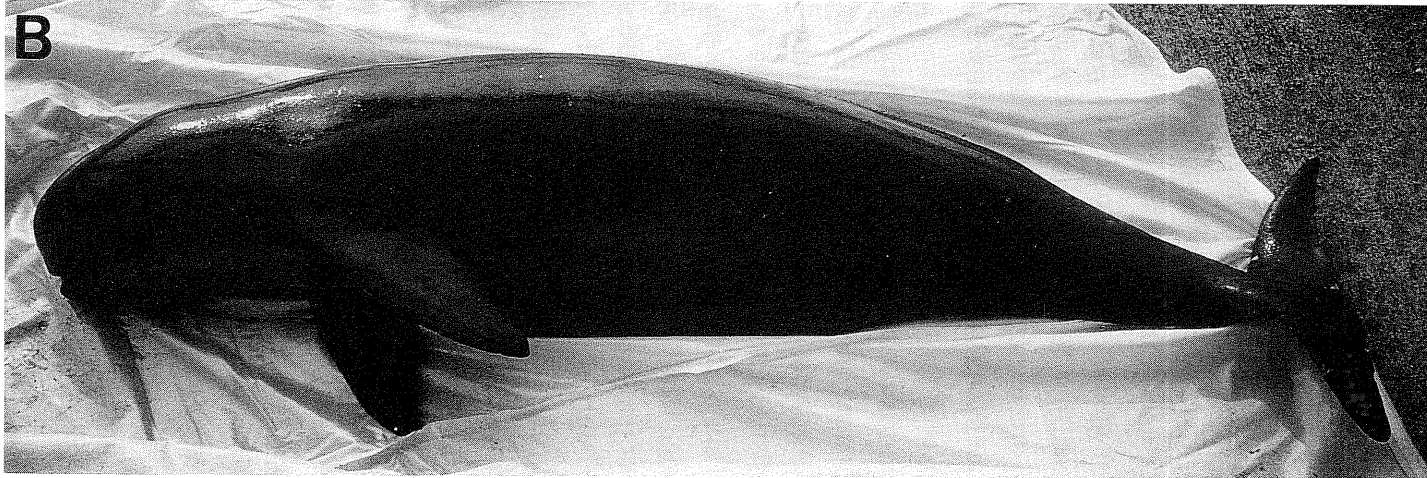
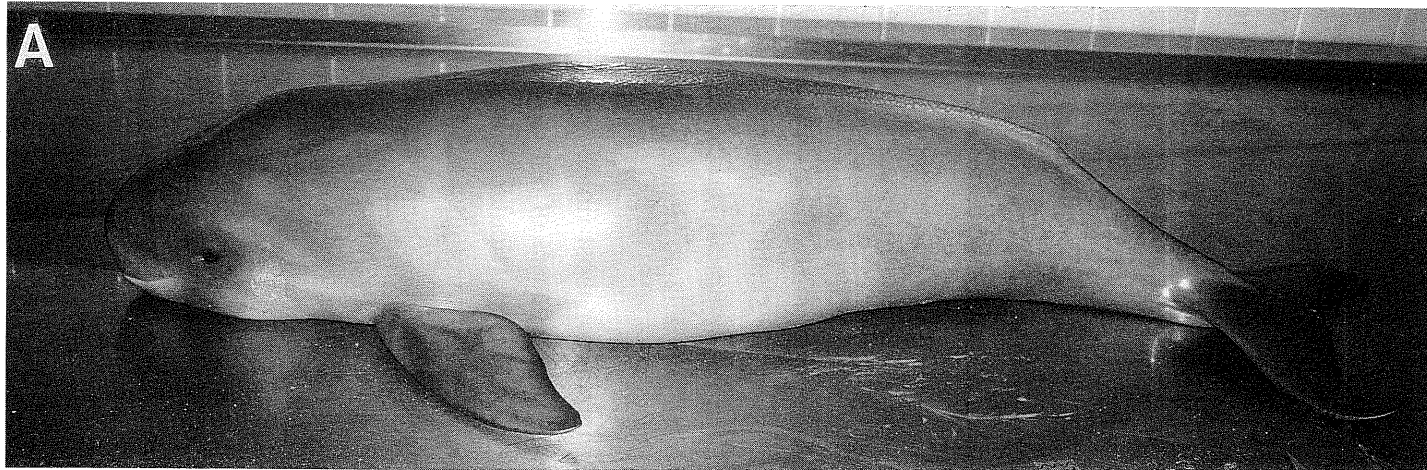


Fig. 5. External appearance of finless porpoises from Hong Kong, showing developmental variation in coloration: 84cm neonate male (A) and 137cm young adult male (B).

Calving appears to take place in winter months, as indicated by the frequency of strandings of neonates (Parsons and Wang, 1998). A total of seven neonates stranded in Hong Kong between January 1996 and February 1998, ranging in length from 67-94cm. Using information on growth for the South China Sea population from Gao and Zhou (1993) (length at birth = 84cm, length at age 1 = 117cm), we can calculate an approximate first year linear growth rate of 2.75 cm/month. Using this growth rate, along with length on the date of stranding, we have back-calculated the probable month of birth for each of these newborns. Of the seven, five appeared to have been born in January, and one each was born in November and April. This suggests that the calving season extends from late autumn to spring, with a large peak in mid-winter. However, it should be remembered that this is a preliminary result, based on only a small sample. Very little data are currently available to assess growth and the attainment of sexual maturity for Hong Kong porpoises, but we are building up a database to examine these aspects in the future.

Preliminary data on feeding habits of finless porpoises in Hong Kong are available, based on stomach contents of 12 individuals (Parsons, 1997; Barros *et al.*, in prep.). Analysis of food remains showed that finless porpoises feed on a variety of small fishes and squids. Most of the fish species are shallow-water, pelagic species. This is somewhat in contrast to prey taken by hump-backed dolphins in Hong Kong, which are almost exclusively demersal and pelagic fishes, with little evidence of predation on cephalopods (Jefferson, 1998).

Although mortality factors can not be determined for most finless porpoises stranded in Hong Kong, several natural and human-related causes of mortality have been identified (Fig. 6). Vessel collisions appear to be a particular problem for finless porpoises, as several high speed ferry routes travel through a main habitat area south of Lantau Island. Among natural causes of mortality, heavy infestations of the lungworm *Halocercus cf. pingi* (Wu, 1929) have been found in many animals, especially young calves. In some animals, the parasites have been so numerous as to cause apparent blockage of respiratory passages.

Preliminary analysis by S. Tanabe and colleagues (Ehime University, Japan), of heavy metals in the liver and kidney of 11 finless porpoises and organochlorines in the blubber of 9 porpoise specimens stranded in Hong Kong revealed high levels of some compounds. In particular, concentrations of some toxic heavy metals (e.g., Hg, Pb, and Tl) and organochlorines (e.g., DDT and PCBs) showed elevated levels. It is possible that several of the supposed natural deaths may in fact be related to immunosuppression, caused by high levels of these environmental contaminants in Hong Kong porpoises. High concentrations of the pesticide DDT have previously

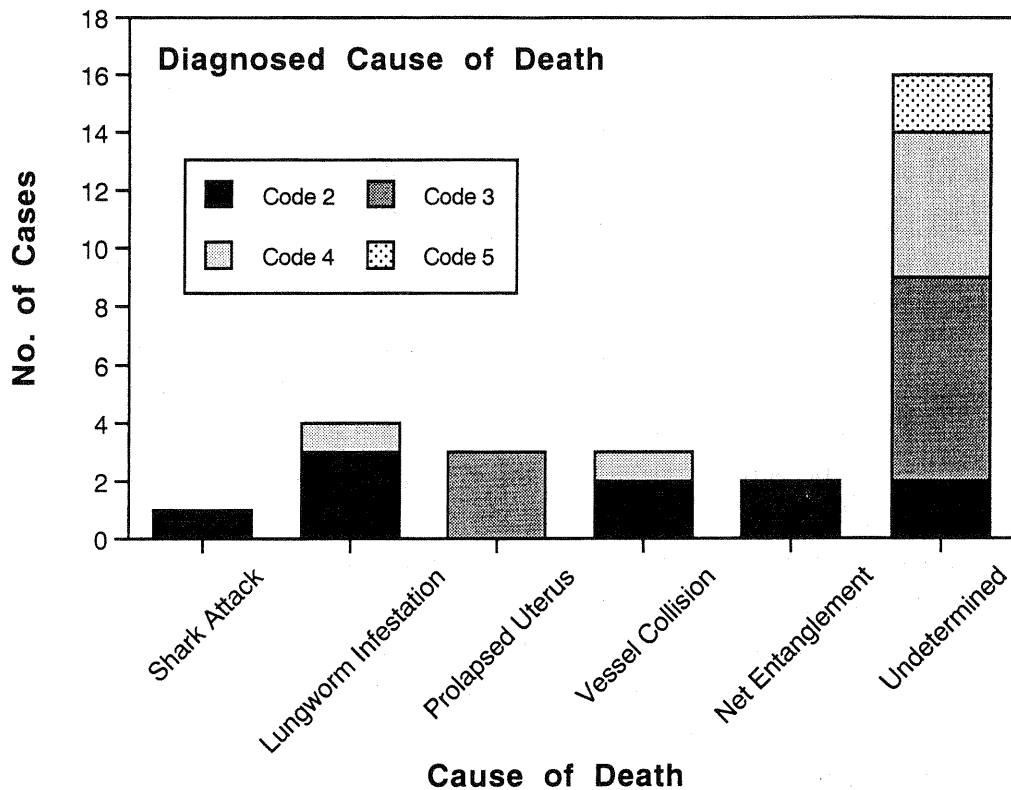


Fig. 6. Diagnosed cause of death for finless porpoises stranded in Hong Kong between September 1995 and February 1998.

been found in the blubber of many porpoises examined from Hong Kong waters (Parsons, 1997; Parsons and Wang, 1998). In addition, over one-third (10 of 26, or 38% since September 1995) of all finless porpoises stranded recently have been young-of-the-year. These facts suggest that organochlorines may be having a significant effect on the health of the population, and may even be causing the direct poisoning of many newborns (see Parsons and Wang, 1998). The effects of environmental contaminants will be examined in further detail over the next several years.

CONCLUSIONS

Preliminary information indicates that finless porpoises are distributed widely in Hong Kong's marine waters, only avoiding the western estuarine waters. The

population numbers over 150 animals, and the extent of its range in Chinese waters remains unknown. The number of strandings over the past few years signals cause for concern over the future status of the population (see Parsons and Wang, 1998), but we currently have no information on trends in abundance.

Over the next 2.5 years, with government funding, we will examine many aspects of the biology of Hong Kong finless porpoises in more detail. Specifically, our objectives will be to:

- 1) Study the distribution, abundance, and population trends of the population using line transect analysis of vessel and helicopter surveys, as well as acoustic survey techniques.
- 2) Study the acoustic behavior of the porpoises and the effects of human-caused noise.
- 3) Examine mortality rates, and identify threats to the population through detailed necropsy of stranded porpoises.
- 4) Study aspects of the feeding, growth and reproduction, and ecotoxicology of the population using samples from stranded animals.
- 5) Examine stock structure using morphometric and molecular genetic techniques.
- 6) Obtain information on individual movement patterns and surface/dive cycles from a tagging and tracking study.

Sound management of a wildlife population is generally not possible without good information on the biology of the animals. Hong Kong is a very busy and crowded place, and the marine habitat has been badly degraded by decades of intensive development. We are working closely with the Hong Kong Government (Agriculture and Fisheries Department) to obtain reliable, unbiased information on the population status of finless porpoises in Hong Kong and surrounding waters. It is our hope that a realistic, workable conservation and management strategy can be developed and implemented for this population, and that this will result in its long-term preservation.

ACKNOWLEDGEMENTS

Primary funding for this research was provided by the Agriculture and Fisheries Department of the Hong Kong Government, with additional funding from the Hong Kong Airport Authority and Hong Kong Electric Corporation. ERM-Hong Kong conducted many of the surveys and we would especially like to thank Peter Marsden for his assistance. The Ocean Park Conservation Foundation and Ocean Park Corporation provided administrative support. China Light and Power

provided use of several vessels. Many people assisted in this work. In particular, we would like to thank Chris Parsons, Isabel Beasley, Mientje Torey, Gloria Yang, Hiedi Chan, Dick Choi, C. C. Lay, and the many assistants who have helped with the surveys and strandings over the years. The comments of Chris Parsons were helpful in improving an earlier draft of the manuscript.

REFERENCES

- Barlow, J. 1988. Harbor porpoise, *Phocoena phocoena*, abundance estimation for California, Oregon, and Washington: I. Ship surveys. Fish. Bull. 86:417-431.
- Barlow, J., Gerrodette, T. and Silber, G. 1997. First estimates of vaquita abundance. Mar. Mammal Sci. 13:44-58.
- Barros, N.B., Parsons, E.C.M. and Jefferson, T.A. In prep. Feeding habits of coastal small cetaceans in Hong Kong. To be submitted to Journal of Zoology.
- Bjørge, A. and Donovan, G.P. (eds.). 1995. Rep. int. Whal. Commn (special issue 16). Biology of the Phocoenids: A Collection of Papers. International Whaling Commission, Cambridge. 552pp.
- Gao, A. 1991. Morphological differences and genetic variations among the populations of *Neophocaena phocaenoides*. Ph.D. Thesis, Nanjing Normal University, PRC. 116pp. (In Chinese).
- Gao, A. and Zhou, K. 1993. Growth and reproduction of three populations of finless porpoise, *Neophocaena phocaenoides*, in Chinese waters. Aquatic Mammals 19:3-12.
- Gao, A. and Zhou, K. 1995. Geographical variation of external measurements and three subspecies of *Neophocaena phocaenoides* in Chinese waters. Acta Theriologica Sinica 15:81-92 (In Chinese).
- Jefferson, T.A. 1998. Population biology of the Indo-Pacific hump-backed dolphin (*Sousa chinensis* Osbeck, 1765) in Hong Kong waters. Unpublished report to the Hong Kong SAR Agriculture and Fisheries Department. 232pp.
- Jefferson, T.A. and Leatherwood, S. 1997. Distribution and abundance of Indo-Pacific hump-backed dolphins (*Sousa chinensis* Osbeck, 1765) in Hong Kong waters. Asian Marine Biology 14:93-110.
- Kasuya, T. 1999. Finless porpoise *Neophocaena phocaenoides* (G. Cuvier, 1829). In: S.H. Ridgway and R.J. Harrison (eds.) Handbook of Marine Mammals Vol. 6: The Second Book of Dolphins and the Porpoises. Academic Press, London (in press).
- Miller, E.J. 1990. Photo-identification techniques applied to Dall's porpoise (*Phocoenoides dalli*) in Puget Sound, Washington. Rep. int. Whal. Commn (special issue 12):429-437.
- Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. int. Whal. Commn (special issue 16):27-50.
- Parsons, E.C.M. 1997. Hong Kong's cetaceans: the biology, ecology and behaviour of *Sousa chinensis* and *Neophocaena phocaenoides*. Ph.D. Thesis, University of Hong Kong, Hong Kong SAR. 257pp.
- Parsons, E.C.M., Felley, M.L. and Porter, L.J. 1995. An annotated checklist of cetaceans recorded

- from Hong Kong's territorial waters. *Asian Marine Biology* 12:79-100.
- Parsons, E.C.M. and Wang, J.Y. 1998. A review of finless porpoises (*Neophocaena phocaenoides*) from the South China Sea. pp. 287-306. *In*: B. Morton (ed.) *The Marine Biology of the South China Sea III*. Hong Kong University Press, Hong Kong SAR. 578pp.
- Reeves, R.R., Wang, J.Y. and Leatherwood, S. 1997. The finless porpoise, *Neophocaena phocaenoides* (G. Cuvier 1829): A summary of current knowledge and recommendations for conservation action. *Asian Marine Biology* 14:111-143.
- Romer, J.D. 1958. Cetaceans recorded from within or near Hong Kong territorial waters. *Hong Kong Univ. Fish. J.* 2:127-129.
- Turnock, J., Buckland, S.T. and Boucher, G.C. 1995. Population abundance of Dall's porpoise (*Phocoenoides dalli*) in the western North Pacific Ocean. *Rep. int. Whal. Commn* (special issue 16):381-398.
- Wang, P. 1992a. On the taxonomy of the finless porpoise in China. *Fisheries Science* 11:10-14 (In Chinese).
- Wang, P. 1992b. The morphological characters and the problem of subspecies identifications of the finless porpoise. *Fisheries Science* 11:4-9 (In Chinese).
- Wu, H.W. 1929. On *Halocercus pingi*, n. sp. a lung-worm from the porpoise, *Neomeris phocaenoides*. *J. Parasitol.* 15:276-279.
- Zhou, K., Leatherwood, S. and Jefferson, T.A. 1995. Records of small cetaceans in Chinese waters: a review. *Asian Marine Biology* 12:119-139.
- Zhou, K., Gao, A. and Sun, J. 1993. Notes on the biology of the finless porpoise in Chinese waters. *IBI Reports* 4:69-74.