Aquatic Mammals 1993, **19.1**, 13–19

Information on the biology of Commerson's dolphins (*Cephalorhynchus commersonii*)

R. A. Kastelein[1], J. McBain[2] and B. Neurohr[3]

[1] *Harderwijk Marine Mammal Park, Strandboulevard-oost 1, 3841 AB Harderwijk, Holland*
[2] *Sea World of California, 1720 South Shores Road, San Diego, CA 92109–9980, USA*
[3] *Zoo Duisburg, Muelheimerstrasse 273, 4100 Duisburg, Germany*

Key words: *Cephalorhynchus commersonii*, food passage time, metabolism, reproduction, lactation, swimming bahaviour.

Introduction

Very little is known about the Commerson's dolphin (*Cephalorhynchus commersonii*) due to its remote distribution area around southern Chile, southern Argentina, the Falkland Islands and the Kerguelen Islands (Angot, 1954; Brownell, 1974; Aguayo, 1975). The small, black and white cetacean was first kept in human care in 1978 (Spotte *et al.*, 1979; Gewalt, 1990). This paper presents some anecdotal information on passage time of food through the digestive tract, metabolic rate, reproduction, suckling, weaning and swimming behaviour of Commerson's dolphins in zoological parks. Some of these anecdotes may stimulate researchers to conduct more elaborate scientific studies. Details on the biology of the Commerson's dolphins may provide information required for the management of this dolphin and other small toothed whales in human care and in the wild. We report here details of the care of Commerson's dolphins at Sea World, USA, Duisburg Zoo, Germany, and Matsushima Aquarium, Japan.

Methods, Results & Discussion

Passage time of food through gastrointestinal tract
To measure the passage time of food through the gastrointestinal tract, dyes were inserted into the food of some Commerson's dolphins. At Sea World of California, gelatine capsules containing carmine red dye were used in North Atlantic herring (*Clupea harengus*) and Columbia river smelt (*Thaleichthys pacificus*) and fed to the animals. In each test, the capsules were offered at a different time of day, but never at night. After feeding, the trainers watched the animals constantly, and recorded the time when the red dye was passed in the faeces. Tests were conducted on 3 male animals, twice in September and once in October 1991.

At Duisburg Zoo, 2 gelatine capsules with methylene blue dye were given to each of 2 male Commerson's dolphins with the fish fed during presentations (200 g Mackerel, *Scomber scombrus*, 250 g Herring, *Clupea harengus*, and 250 g Squid, *Illex spp.*). The 2 capsules were fed together but at a different time each test day, and never at night. A researcher watched the animal constantly on test days, and recorded the time when the faeces were blue. This study was done in November and December 1991.

The passage times of carmine red dye in 3 animals at Sea World are shown in Table 1. The average passage time was 143 min. The 2 results from S5M in September 1991 were excluded from this calculation. With this small sample size, no temporal variation in passage times could be detected during the 8 hour period in which the animals were observed. The passage times of methylene blue in 2 animals at Duisburg Zoo are also shown in Table 1. The average passage time in D1M (a slow swimming animal which often floated) was 87 min., and the average passage time in D4M (a very dynamic, erratic swimming animal) was 50 min.

The difference in passage times between the animals from Sea World and from Duisburg Zoo may be due to the squid in the diet of the animals at Duisburg Zoo. Squid is often fed as a laxative. The animals at Duisburg Zoo were also much older than those at Sea World, but whether this has an influence on passage times is not known. The passage time may vary according to the time of day. However, in the present study dyes were given at different times in the 8 hour working day, so the differences in passage times between the animals in different places probably do not represent different activity levels of the digestive tract due to different timing. Future studies of food passage times should

Table 1. The passage time of carmine red dye in 3 Commerson's dolphins at Sea World (S) and of methylene blue dye in 2 animals at Duisburg Zoo (D). M=male

Animal	Age (year)	Study period	Passage time (min)
S5M	4	Sept. 1991	86*
S5M	4	Sept. 1991	109*
S5M	4	Oct. 1991	131
S4M	6	Sept. 1991	155
S4M	6	Sept. 1991	149
S4M	6	Oct. 1991	131
S1M	13	Sept. 1991	150
S1M	13	Sept. 1991	148
S1M	13	Oct. 1991	134
D4M	>10	Nov. 1991	50
D4M	>10	Dec. 1991	40
D4M	>10	Dec. 1991	60
D4M	>10	Dec. 1991	50
D1M	>16	Dec. 1991	100
D1M	>16	Dec. 1991	105
D1M	>16	Dec. 1991	56

*Fast passage times associated with a temporary appetite depression.

involve both sexes and animals of different ages, and the dyes should be given at different times of the day and night.

In spite of its limitations, this brief study shows a fast passage time in the Commerson's dolphin. For comparison, the passage time in Bottlenose dolphins (*Tursiops truncatus*) is around 6 hours (Ridgway, 1972), indicating that in the wild Commerson's dolphins probably feed often and are opportunistic feeders. Whether or not they feed at night is not known.

Metabolic rate

Cetaceans generally have larger thyroid glands than terrestrial mammals of similar weights. Thyroid hormones regulate the metabolism. However, there is no simple correlation between the thyroid hormone plasma level and the activity level of a cetacean species (Ridgway and Patton, 1971). The only T3 and T4 measurements in Commerson's dolphins have been carried out on 2 male animals at Duisburg Zoo in 1990. They lived in the same pool system, but had completely different activity patterns. One animal designated D4M was very active, while another animal D1M had become slow in old age, and spent lots of time floating at the water surface. D1M was over 18 years old, and Commerson's dolphins are estimated to have a maximum life expectancy of about 18 years (Lockyer *et al.*, 1988). Both animals had similar body weights, and ate about the same proportion of their body weights each day. T3 and T4 levels in the dynamic, young D4M were lower than those of the older slower D1M (Table 2). The T4 values found in the present study are slightly lower than those found in Bottlenose dolphins (*Tursiops truncatus*), and slightly higher than those found in Pacific white-sided dolphins, *Lagenorhynchus obliquidens* (Ridgway and Patton, 1971). Sterling *et al.* (1975) showed that there is no correlation between body size and serum T3 concentration in cetaceans. However, 2 Dall's porpoises (*Phocoenoides dalli*) were found to have very high serum T3 concentrations. The authors speculate that this was attributed to an adaptation to the low water temperatures in the distribution area of this species. Although Commerson's dolphins seem to occupy a similar niche in the southern hemisphere, the few serum T3 values found in the present study are low compared to all other cetaceans described by Sterling *et al.* (1975). This difference may be due to the small sample sizes, or perhaps cetaceans maintain a large circulating pool of T4 for conversion to T3 when requirements are high, or because T3 has a fast turnover rate and a short half-life in these animals, making measurement difficult (Greenwood and Barlow, 1979). The conclusions possible from the present study are severely limited because of the small sample size and the lack of variation in samples (in relation to time of day, feeding, stress, sleep and wake cycles, etc.). In terrestrial mammals, high T4 levels are often found in neonates and lactating females. T4 levels can fluctuate rapidly and greatly in cetaceans and large decreases are often associated with illness (McBain, pers. obs.). The differences in the 2 dolphins at Duisburg Zoo are minimal. In future studies, baseline data about daily fluctuations in different aged animals should first be recorded, before different individuals and species are compared.

Reproduction

In Commerson's dolphins of both sexes, the point of sexual maturity has been expressed in terms of the dolphin's age or body length. Collet and Robineau (1988) estimate that male Commerson's dolphins from the Kerguelen Islands reach sexual maturity at an age of about 8 years and a body length of 165 cm. Lockyer *et al.* (1988) reported that the testis weight increased dramatically in Commerson's dolphins from Tierra del Fuego when they were between 5 and 6 years of age and 127 to 131 cm in length. Cornell *et al.* (1988) describe a 144 cm long male from Tierra del Fuego, which produced motile sperm. Collet and Robineau (1988) concluded that female Commerson's dolphins from the Kerguelen Islands reach sexual maturity at 5 years of age and at a body length of about 165 cm. Lockyer *et al.* (1988) estimated that

Table 2. The concentrations of T4 and T3 in the blood of 2 male Commerson's dolphins from the Duisburg Zoo

Animal	Age (yr)	Behaviour	T3 Free (pg/ml)	T3 Total (ng/dl)	T4 Free (ng/dl)	T4 Total (μg/dl)
D1M	>18	Slow	2.60	45.1	1.88	7.9
D4M	>11	Dynamic	—	41.2	—	5.3

females from South America reached sexual maturity between the age of 5 and 6 years, at a body length of 139 to 152 cm. Collet and Robineau (1988) stated that on the Kerguelen Islands, the number of ovulations a female has had is more closely correlated to length than to age, and that ovulation occurs in January. Whether females ovulate regularly is not known. December and January seem to be the peak months for mating. Commerson's dolphin births around Tierra del Fuego occur predominantly in the austral summer when the water is relatively warm and food abundant (from November to February; Gewalt, 1979 & 1981; Mermoz, 1980; Goodall *et al.*, 1988). Joseph *et al.* (1987) observed that during the first year after arrival at Sea World, a pregnant female's progesterone level increased dramatically between January and May to 6 ng/ml. The gestation period is 345 ± 20 days (n=8) (Asper *et al.*, 1992), so calving coincides with the mating season.

After the first few years that individual Commerson's dolphins were kept in the northern hemisphere, their reproductive months changed. At Sea World of California, sexual activity took place between January and March for the first 2 years after the dolphins arrived (Fig. 1). Later, mating occurred mainly in the second half of the year. While conception occurred in the northern hemisphere, the first 4 calves at Sea World of California were born in first half of the year (Table 3). Later, births occurred towards the end of the year. The change is probably due to the transport of the animals from the southern hemisphere to the northern hemisphere. The reproductive cycle did not change at once to the same season in the northern hemisphere, but took about 4 years to shift by 6 months. This suggests that other factors besides daylength influence sexual behaviour, which in turn influences the appetite. If daylength changes had been the only parameter influencing ovulation, a 6 month shift of the first mating season would have occurred. Possibly seasonal differences in other environmental parameters such as prey abundance, available prey species, water temperature and internal biological rhythms are also causal factors. In deer transported from the U.K. to New Zealand a similar gradual shift has been seen. It took about 2 years before the male rut and female oestrus in the transported animals became synchronized with those of the local deer (Marshall, 1942).

The first birth of a Commerson's dolphin at Matsushima Aquarium (animal M6F) occurred in the second half of the year. Conception occurred in the northern hemisphere, after the mother (M4F) had been at the park for 16 months. For this female, 16 months was sufficient to shift her reproductive cycle by 6 months, perhaps because her oestrous cycle had not yet started at transportation. Her ovulation cycles may have started under northern hemisphere light cycles.

Suckling and weaning

A full-term calf (S15M) which died shortly after birth at Sea World on 08–12–92 was 91 cm long, and weighed 8.8 kg. During the first 4 days of its life, calf S4M suckled about every 40 minutes. Each suckling session consisted of an average 8 attachments, each lasting on average 5.5 seconds. The periods during which the 6 Commerson's calves at the three locations were completely dependant on milk varied from 73 to 236 days (Table 3). The increase in solid food intake was gradual in all cases, and the calves continued to suckle frequently for some months. One calf (S11F) died shortly after her suckling period, which may have been too short. The suckling period in Commerson's dolphins of the present study was variable. This could be attributed to opportunism on behalf of the calves. Depending on the mother's social ranking in a group, food fish that she drops may be taken by other adults, or remain available for the calf to play with or perhaps eat. At Theater of the Sea, Florida, trainers feed Bottlenose dolphin calves with live shrimp from which the tail has been removed while the adults are occupied in the shows. This opportunity to play with slow-moving prey allows the calves to wean early at 3–4 months after birth (Beverley Abbitt, pers. comm.). Usually *Tursiops* weans at 12–18 months of age (Kastelein, pers. obs.).

In the Baltic Sea, Harbour porpoises, which are also small cold-water odontocetes, begin to take solid food when they are about 5 months old, and weigh around 25 kg (Møhl-Hansen, 1954). This is

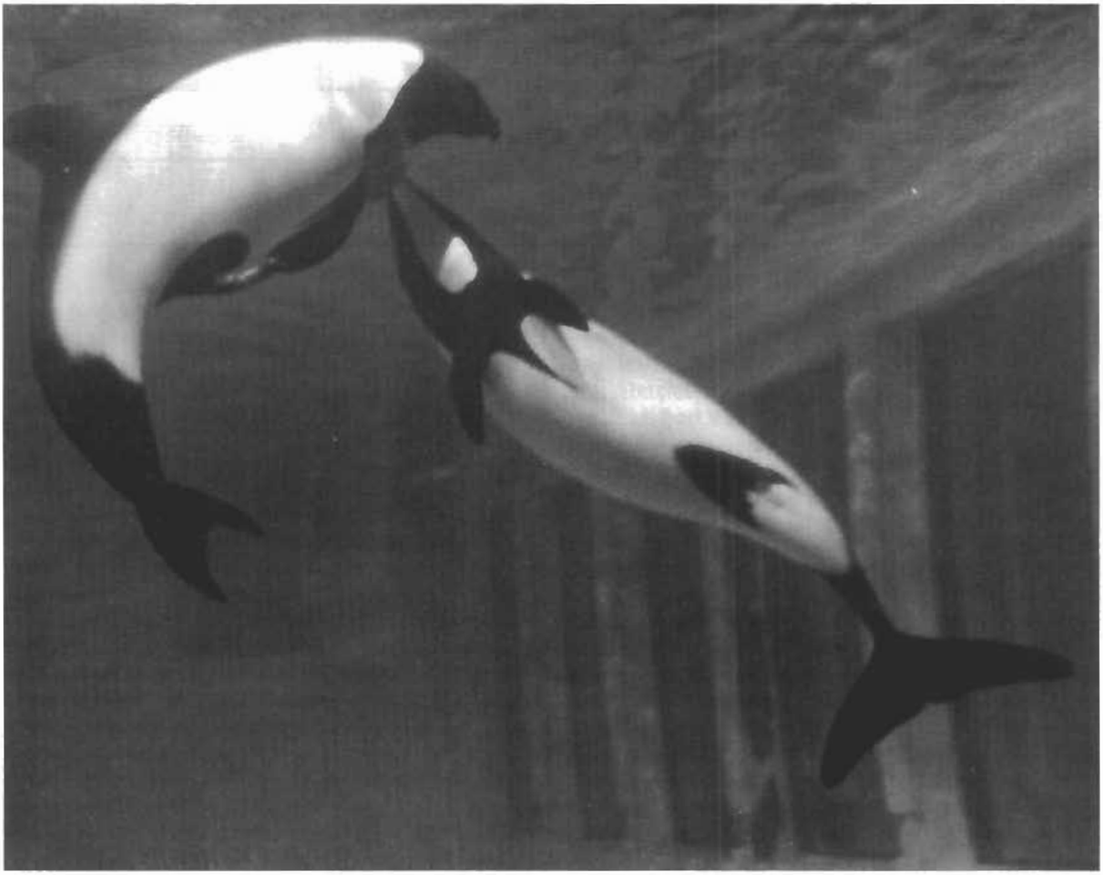

Figure 1. Sexual interaction between a male (left) and female Commerson's dolphin. Note the sexual dimorphism in the genital patch, the female having a boomerang-shaped patch, and the male an oval patch (Photo: Sea World of California photo department).

comparable to the age of when the Commerson's dolphin calves in the present study start to accept fish. Although the moment of weaning was not accurately determined in the Commerson's dolphin calves in the present study, it was probably soon after the animals started to accept fish (as was judged by the calves' sudden large increase in food intake).

The Commerson's dolphin's rapid development can only be achieved if many calories are transferred from mother to her calf in the suckling period. The fat content of Commerson's dolphin milk is unknown but probably high. Milk from the Harbour porpoise has a fat content of 46%. This is high compared to the 10–17% fat found in the milk of the larger Bottlenose dolphin (Ridgway, 1972; Peddemors *et al.*, 1989). Milk of a medium sized odontocete, the Common dolphin (*Delphinus delphis*) contains between 30–37% fat (Peddemors *et al.*, 1989). However, the fat content of milk is not

Table 3. Birth dates, and ages at which Commerson's dolphin calves at Sea World of California (S) and Matsushima Aquarium (M) started to eat fish. They continued to suckle for some months after dependence on milk ceased. M=male, F=female. An * indicates a calf which died soon after birth

Animal	Date of birth	Time of full dependence on milk (days)
S4M	21/02/1985	133
S12F	05/01/1986	0*
S11F	19/04/1986	73
S13M	25/05/1987	0*
S5M	10/07/1987	163
S9F	10/09/1988	236
S10F	28/09/1988	198
M6F	01/07/1989	112
S14M	05/08/1990	0*

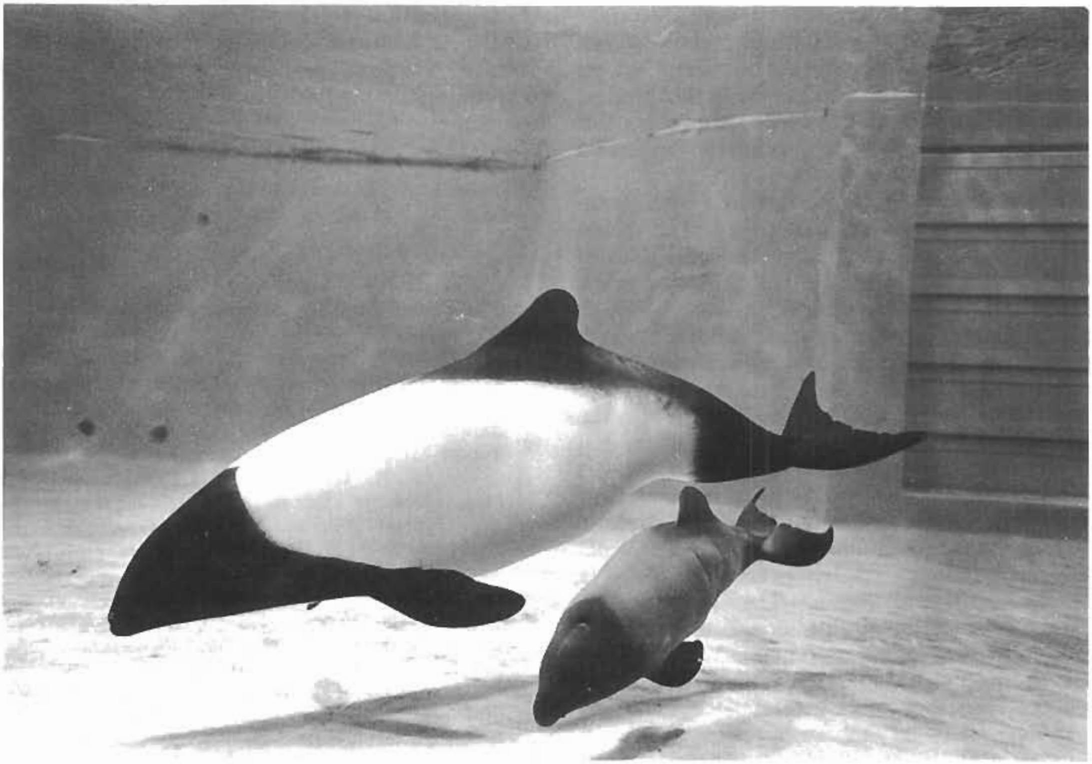

Figure 2. A new-born calf with its mother. The calf has grey skin and birth folds. The latter disappear about a week after birth (Photo: Sunshine Aquarium).

always negatively correlated to the adult body size of a species; 6 weeks into lactation Killer whale milk has a fat content of between 40 to 45%. The fat content of milk in many terrestrial mammals shows large day to day fluctuations. This may also be the case in cetaceans. Because of small sample sizes in milk fat content studies in cetaceans, the above mentioned percentages should be interpreted carefully. The milk fat may have also provided the calf with a source of metabolic water.

A high milk fat content in small cetaceans is needed because of the calves' unfavourable body mass to surface ratio (Fig. 2), which causes them to lose a lot of energy to their aquatic environment (Kanwisher and Sundnes, 1965). Energy loss is minimized if the calves' body mass to surface ratio is improved by a quick increase in volume. In addition, calves develop an insulatory blubber layer. Also, blubber lipid content is an important factor in the insulation quality (Worthy, 1991). In adult Harbour porpoises, the blubber layer and the fat found in the melon constitutes around 40% of the body weight (Slijper, 1958). Perhaps as a mechanism to enhance survival, Commerson's dolphin calves are heavy at birth in relation to their mother. The new-born calf constitutes around 22% of the mother's body weight, and 61% of her length. In the Harbour porpoise, a similarly sized cetacean, new-born calves also make up between 20 and 25% of the mother's body weight (Kanwisher and Sundness, 1965). For comparison, new-born Bottlenose dolphins constitute about 10% of their mother's weight and around 46% of their mother's length (Kastelein, per. obs.).

Swimming behaviour

In oceanaria, Commerson's dolphins usually swim fast, and are very erratic. However, they do have periods of rest which are characterized by surface bobbing. Mermoz (1980) observed Commerson's dolphins' swimming behaviour in the wild. They usually swim at moderate speed of 11–13 km/hr, and remain submerged for 15 to 20 seconds, at a depth of 1 to 1.5 m. They rarely swim in a straight line. The erratic swimming behaviour may be a specific foraging technique, used in the wild to optimize food intake, and the erratic swimming behaviour observed in Commerson's dolphins in pools may be derived from this strategy. If this is true, an increase in this behaviour would be expected before a feeding session, and a decrease after feeding. Some anecdotal information seemed to support this idea; surface bobbing occurs particularly after feeding and at the hottest time of the day (Cornell *et al.*, 1988). However, this decrease in activity after feeding is a general phenomenon in mammals.

Commerson's dolphins in oceanaria often swim upside down (Kastelein, pers. obs.). This could have 3 possible reasons. Firstly, the visual fields of the eyes of many cetaceans probably overlap in the rostro-ventral direction (Kastelein *et al.*, 1990), so that the animal has binocular vision and possibly stereoscopic vision in this direction. For fish, the water-air interface is a real barrier. If fish are chased from below, they are in contrast with the sky, and can be trapped between the dolphin and the water surface. By swimming upside down, the Commerson's dolphin would have a better view of the fish during the last approach before capture. Secondly, the sonar beam pattern (see Au *et al.*, 1988) in Commerson's dolphins may be directed in the dorso-rostal direction. The Commerson's dolphin may swim upside down in order to echolocate prey on the ocean floor. Thirdly, by rotating around their body axis, Commerson's dolphins direct their black genital patches in many directions, showing to conspecifics their sex (Goodall *et al.*, 1988) and, in case of females, their age (Kastelein, 1984).

None of the information above is derived from elaborate scientific research, so care should be taken when interpreting the data. However, the information shows that many of the biological parameters of this species are different from those of other toothed whales. This is probably because the Commerson's dolphin is one of the smallest odontocetes. Therefore studies on Commerson's dolphins not only serve to gain knowledge of this species, but are also valuable for comparison with other odontocetes.

Acknowledgements

We thank the following for their help with this project: of Duisburg Zoo, Germany: Wolfgang Gewalt, director, Reinhold Reimann, head trainer and Angelika Hutter, student. Of Sea World of California, U.S.A.: Jim Antrim, curator of mammals, Tom Goff, assistant curator of mammals and Dee Dee Dilworth, administrative assistant. Karen Novak, student of the School of Veterinary Medicine, University of Wisconsin, recorded the food passage times. Part of the data used in this paper come from Sea World of California Technical Contribution No. 9202-C. We also thank M. Mohri of Sunshine International Aquarium, Japan, and S. Saijo of Matsushima Aquarium, Matsushima, Japan. We thank Dan Odell, research biologist at Sea World of Florida, Piet Wiepkema of the Agricultural University of Wageningen and Nancy Vaughan for their comments on the manuscript.

References

Aguayo, L. A. (1975) Progress report on small cetacean research in Chile. *J. Fish. Res. Board Can.* **32,** 1123–1143.

Angot, M. (1954) Observations sur les mammifères marins de l'archipel de Kerguelen, avec une étude détailée de l'Elephant de mer *Mirounga leonina* (L.) *Mammalia* **18,** 1–111.

Asper, E. D., B. F. Andrews, J. E. Antrim & W. G. Young (1992) Establishing and maintaining successful breeding programmes for whales and dolphins in a zoological environment. *Intern. Mar. Biol. Res. Inst.* Report No. 3. Kamogawa, Japan, 71–84.

Au, W. L., R. H. Penner & C. W. Trul (1988) Propagation of beluga echolocation signals. In *Animal Sonar, Processes and Performance* (eds P. E. Nachtigall & P. W. B. Moore). Plenum Press. New York. 47–51.

Brownell, R. L. (1974) Small odontocetes of the Antarctic. In *Antarctic mammals, Antarctic Map Folio series, Am. Geogr. Soc. New York*, **18,** 13–19.

Collet, A. & D. Robineau (1988) Data on the genital tract and reproduction in Commerson's dolphin, *Cephalorhynchus commersonii* (Lacépède, 1804), from the Kerguelen Islands. In *Biology of the Genus* Cephalorhynchus (eds R. L. Brownell Jr & G. P. Donovan) Rep. of the I.W.C. Special Issue 9, 119–141.

Cornell, L. H., J. E. Antrim, E. D. Asper & B. J. Pincheira (1988) Commerson's dolphins (*Cephalorhynchus commersonii*) live-captured from the Strait of Magellan, Chile (SC/36/SM5) In *Biology of the Genus* Cephalorhynchus (eds R. L. Brownell, Jr & G. P. Donovan) Rep. of the I.W.C. Special Issue 9, 183–196.

Gewalt, W. (1979) The Commerson's dolphin (*Cephalorhynchus commersoni*)—capture and first experiences. *Aquatic Mammals* **7**(2), 37–40.

Gewalt, W. (1981) Ein "neues" Zootier, Der Jacobita oder Commerson's dolphin (*Cephalorhynchus commersoni*, La Cepède, 1804) in Walarium des Zoo Duisburg. Zoologische Beiträge **27**(23), 199–204.

Gewalt, W. (1990) The Jabobita, or Commerson's Dolphin (*Cephalorhynchus commersoni*), *Aquatic Mammals* **16**(2), 53–64.

Goodall, R. N. P., A. R. Galeazzi, S. Leatherwood, K. W. Miller, I. S. Cameron, R. A. Kastelein & A. P. Sobral (1988) Studies of Commerson's dolphins, *Cephalorhynchus commersonii*, of Tierra del Fuego, 1976–1984, with a review of information on the species in the South Atlantic (SC/36/SM8). In *Biology of the Genus* Cephalorhynchus (eds R. L. Brownell Jr & G. P. Donovan) Rep. of the I.W.C. Special Issue 9, 3–70.

Greenwood, A. G. & C. E. Barlow (1979) Thyroid function in dolphins: radioimmunoassay measurements of thyroid hormones. *Br. vet. J.* **135,** 96–102.

Joseph, B. E., J. E. Antrim & L. H. Cornell (1987) Commerson's dolphin (*Cephalorhynchus commersonii*): a discussion of the first live birth within a marine zoological park. *Zoo Biol.* **6,** 69–77.

Kanwisher, J. & G. Sundnes (1965) Physiology of a small cetacean. *Hvalradets Skrift.* **48,** 45–53.

Kastelein, R. A. (1984) Commerson's dolphin, *Cephalorhynchus commersonii* (Lacépède, 1804). Review of published information and report on field research in the Strait of Magellan, Chile, January-February 1984. MSc. Thesis, Agricultural University Wageningen, NL.

Kastelein, R. A., R. C. V. J. Zweypfenning & H. Spekreijse (1990) Anatomical and histological characteristics of the eyes of a month-old and adult harbor porpoise (*Phocoena phocoena*). In *Sensory Abilities of Cetaceans* (eds J. Thomas & R. Kastelein). Plenum Press, New York, 463–480.

Lockyer, C., R. N. P. Goodall & A. R. Galeazzi (1988) Age and Body-length characteristics of *Cephalorhynchus commersonii* from incidentally-caught specimens off Tierra del Fuego (SC/36/SM4). In *Biology of the Genus* Cephalorhynchus (eds R. L. Brownell Jr & G. P. Donovan) Rep. of the I.W.C. Special Issue 9, 103–118.

Marshall, F. H. A. (1942) Exteroceptive factors in sexual periodicity. *Biol. Rev.* **17,** 68–90.

Mermoz, J. F. (1980) A brief report on the behaviour of Commerson's dolphin, *Cephalorhynchus commersonii*, in Patagonian shores. *Sci. Rep. Whales Res. Inst.* **32,** 149–153.

Møhl-Hansen, U. (1954) Investigations on reproduction and growth of the porpoise (*Phocoena phocoena* (L)) from the Baltic. *Vidensk. Medd. fra. Dansk naturh. Foren. Bd.* **166,** 369–396.

Peddemors, V. M., H. J. H. de Muelenaere & K. Devchand (1989) Comparative milk composition of the Bottlenose dolphin (*Tursiops truncatus*), Humpback dolphin (*Sousa plumbea*) and Common dolphin (*Delphinus delphis*) from southern African waters. *Comp. Biochem. Physiol* Vol. 94A(4), 639–641.

Ridgway, S. H. (1972) Homeostasis in the aquatic environment. In *Mammals of the sea: Biology and Medicine* (ed. S. H. Ridgway). Thomas publisher, Springfield, Illinois.

Ridgway, S. H. & G. S. Patton (1971) Dolphin thyroid: some anatomical and physiological findings. *Z. vergl. Physiologie*, **71,** 129–141.

Slijper, E. J. (1958) Organ weights and symmetry problems in porpoises and seals. *Archs. neerl. zool.* **13,** 97–113.

Spotte, S., C. W. Radcliffe & J. L. Dunn (1979) Notes on Commerson's dolphin (*Cephalorhynchus commersonii*) in captivity. *Cetology* **35,** 1–9.

Sterling, K., P. Milch & S. Ridgway (1975) The day of the dolphin: thyroid hormone metabolism in marine mammals. In *Thyroid hormone metabolism* (eds W. A. Harland & J. S. Orr). Academic Press, New York. 241–248.

Worthy, G. A. J. (1991) Thermoregulatory implications of the interspecific variations in blubber composition of odontocete cetaceans, (Abstract) 9th Biennial Conf. on the Biol. of Mar. Mammals, Chicago. pg 74.