

The European studbook of bottlenose dolphins (*Tursiops truncatus*): 1998 survey results

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Abstract

In 1998, the first complete census of bottlenose dolphins (*Tursiops truncatus*) in human care in Europe was achieved with the cooperation of all European dolphinarium in the regional studbook of this species. As of 1 January 1998, a total of 181 dolphins were kept in European facilities. The average age of founder animals was around 20 years for both sexes and 35.4% of the population was born in captivity. Successful breeding most probably started at the end of the nineteen eighties, but breeding success and population developments could not be evaluated fully until now. Further data collection is needed to establish basic parameters for the European population of bottlenose dolphins in human care, such as birth rate, calf survival, death rate, average and maximum age, and ultimately population sustainability.

Key words: European Studbook, *Tursiops truncatus*, captivity, bottlenose dolphin, breeding.

Introduction

The keeping of non-domesticated mammals in human care has a tradition going back many centuries in Europe. The first modern zoological garden in Europe, primarily created for scientific research, opened to the public in Paris in 1793, followed by zoological gardens in London (1828), Amsterdam (1838), and many others (Gensch, 1986; Pies-Schulz-Hofen, 1996).

In contrast to many other mammalian species, the successful keeping of toothed whales was only achieved recently. The particular requirements of dolphins in terms of husbandry, feeding, water quality, and veterinary care need to be established: The husbandry of dolphins became well established in the United States in the nineteen fifties and sixties, which led to numerous publications on virtually unknown aspects of life history and health of toothed whales (see for instance Norris, 1966a; Ridgway, 1972; Sweeney & Ridgway, 1975). The

presence of echolocation in dolphins and whales was among the most important discoveries (McBride, 1956).

In Europe, the keeping of dolphins dates back to the early nineteen sixties, e.g. only about 3 decades (Gewalt, 1993). Inspired by the successes obtained in dolphin keeping and breeding in USA dolphinarium (Essapian, 1953), the first permanent dolphinarium in Europe opened at Riccione in 1963, at Rimini in 1964, at Duisburg in 1965, at Harderwijk in 1965, and at Lipperswil in 1965. Many more soon followed.

The husbandry and veterinary care of the animals benefited profoundly from information exchange and discussions among biologists, veterinarians, and husbandry personnel (see for instance Norris, 1966b). The exchange of knowledge on dolphins in general and their keeping in particular became a primary aim at conferences such as the annual symposia of the European Association for Aquatic Mammals, established in 1972, with the aim: 'to promote the free exchange of knowledge and further scientific progress pertaining to research, medical care, training, education, conservation, management, and other aspects of aquatic mammals' (Anonymous, 1972).

Initially, such information exchange was mainly informal. Since the nineteen eighties several scientists have undertaken more comprehensive surveys to analyse the situation of the European dolphin populations in human care. The aim of these surveys was to identify potential husbandry and veterinary problems and to predict trends for the European population of captive dolphins.

The first detailed survey focused on British dolphinarium and among many other factors listed 6 male and 10 female living dolphins at 6 facilities by the end of 1985 in the UK (Klinowska & Brown, 1986). In 1988, the Committee for Marine Mammals of the European Zoos established husbandry guidelines and strongly recommended the creation of a studbook for bottlenose dolphins and cooperation among European dolphinarium for breeding purposes (Anonymous, 1988). In 1991, de

Bois from Antwerp Zoo undertook a survey of dolphinariums in Europe on behalf of the Scientific Working Group of the European Economic Community (De Bois, 1991). Her effort marked the starting point of the European studbook of bottlenose dolphins, establishing the presence of 119 (43 males, 76 females) animals in 25 dolphinariums in 8 countries by 1 January 1991. The initial studbook was continued by Amundin at Kolmården Zoo and reported 137 dolphins held in 26 institutions by 13 November 1993 (Amundin, 1994). In 1997, the studbook was delegated to the author of this paper.

The aim of any studbook is to provide information on an entire population of animals in human care. Such a 'big-picture' is essential for sound management and effective decision-making at each facility housing this species. With the increasing attention paid to dolphins and whales by the general public, the media, and political communities, baseline data need to be collected to provide scientific data on the bottlenose dolphin population in human care in Europe. The tools for collection and analysis of such information are available through the instruments developed for small population management by the international zoo community (Anonymous, 1989).

The aims of the European dolphin studbook are defined clearly and are identical to those of other European studbooks:

'Assembly and distribution of a comprehensive, scientific, unbiased historical data set for a single taxon, which records at least all wild captures, transfers between facilities, reproductive events, and deaths; ideally permitting tracing of the ancestry of any specimen back to the places of capture of all of its wild ancestors' (Anonymous, 1989).

Materials and Methods

As a first step, a data set of the most basic information on all bottlenose dolphins kept in Europe as of 1 January 1998 was established. Information was collected by means of a questionnaire sent to all European dolphinariums. Additionally, all dolphinariums were approached personally, at meetings, by telephone, or both, to explain the aims and characteristics of the studbook. The information requested included name, gender, and age of all bottlenose dolphins present in each facility on 1 January 1998. Answers were introduced into the database program SPARKS (Single Population Analysis Record Keeping System, ISIS), a standard studbook keeping program used by the *European Association of Zoo and Aquaria* (Anonymous, 1989), as well as a commercial PC spreadsheet program (PlanPerfect[®]) for double-checking. Data collected in the 1998 survey are presented in this paper.

Results

Number and distribution of dolphins

The questionnaire was answered by 30 facilities in 11 European countries, representing 100% of European facilities keeping bottlenose dolphins on 1 January 1988. The population of bottlenose dolphins in Europe consisted of 181 individuals (70 males, 111 females). The distribution by gender, numbers of founder, and captive born animals is given in Figure 1.

A total of 48.6% of males and 74.8% of females were wild caught (founders). In total, 35.4% of the population was captive born (F1); 51.4% of all males and 25.8% of all females. Of all founders, 29.1% were males; of the captive born, 56.3% were males.

Age distribution

The distribution of age is displayed by means of age groups in five years increments, and separated by gender (Figure 2). Captive born animals were mainly ≤ 10 years of age; the oldest captive born female was 14 years, the oldest male was 16 years old. The average age of captive born females was 4.3 and of captive born males was 6.4 years. In founder dolphins, the oldest female was 37 years, the oldest male was 41 years old. The average age of founder females was 19.2, and of founder males was 20.2 years.

Breeding

Unfortunately, data collected did not allow for a direct evaluation of birth rate, calf survival, or population sustainability. However, 'breeding success' was estimated indirectly by the number of surviving captive born dolphins as of 1 January 1998. The number of captive born dolphins was established for each country and serves to evaluate the breeding success by country (Figure 3). However, since the large variety of factors affecting breeding can not be evaluated from these data, the names of countries have been omitted to avoid premature conclusions.

Discussion

Data collected in the 1998 survey of the European Studbook of bottlenose dolphins contains number of dolphins, gender and age for the entire captive population in Europe as of 1 January 1998. This is the first time a European data set has been complete, largely due to the willing collaboration of all European dolphinariums.

The European studbook of bottlenose dolphins is a first step towards a scientifically based population management. Small populations, both in the wild and in human care, can suffer from stochastic

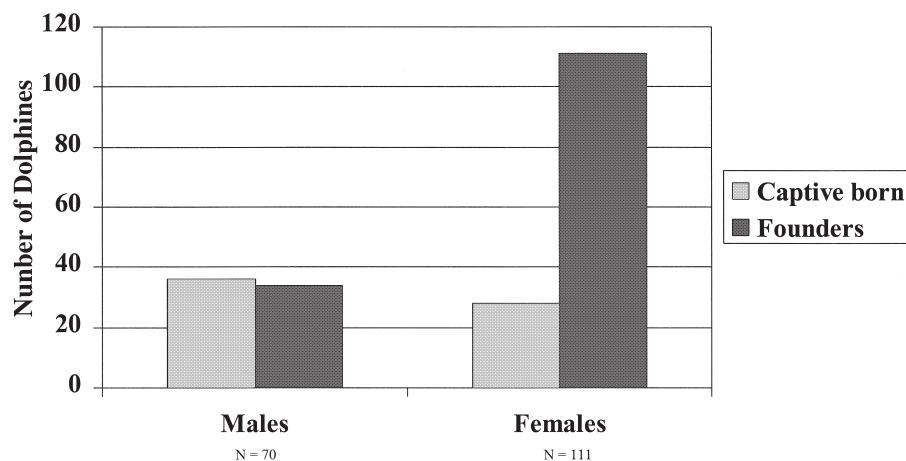


Figure 1. Total number of captive bottlenose dolphins present in European facilities as of 1 January 1998, by sex and origin.

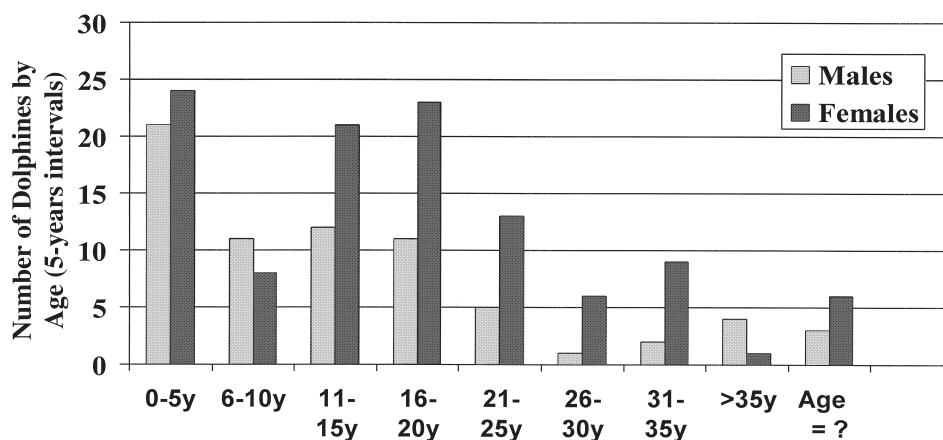


Figure 2. Age distribution of all captive bottlenose dolphins present in European facilities as of 1 January 1998.

problems e.g., environmental and demographic problems (Foose & Ballou, 1988). Such environmental problems, such as serious disease outbreaks (Gaukler, 1995; Garcia Hartmann, 1997), catastrophic events like fire (Vollmacher, 1988), and loss of financial support (García Hartmann, 1993) take place in dolphinariums around the world and profoundly affect the survival of this species in human care. The potential of demographic problems, like reproductive failure or survival decline and distortion in age and gender distribution, can only be established by keeping an overview of the entire population by means of continuous, scientifically sound studbook.

European studbook surveys from the past are available from the work by Amundin (1994) and De

Bois (1991). The number of institutions holding dolphins which participated in the respective surveys of 1991, 1993 and 1998 were similar (Figure 4), despite the fact that all British dolphinariums closed by 1998. Therefore, it is possible that in the 1991 and 1993 surveys some facilities were excluded. Additionally, the 1991 survey focused only on the then E.E.C. countries, not considering, for instance, the Swiss dolphinariums which were included in 1998. For these reasons, the total number of animals (Figure 4) in the surveys previous to 1998 might be underestimated. Therewith, the number of then recorded captive bred dolphins might be an underestimation too, yet the observed increase from 1991 to 1998 seems to be real and consistent with the increasing birth rate observed in Europe for years

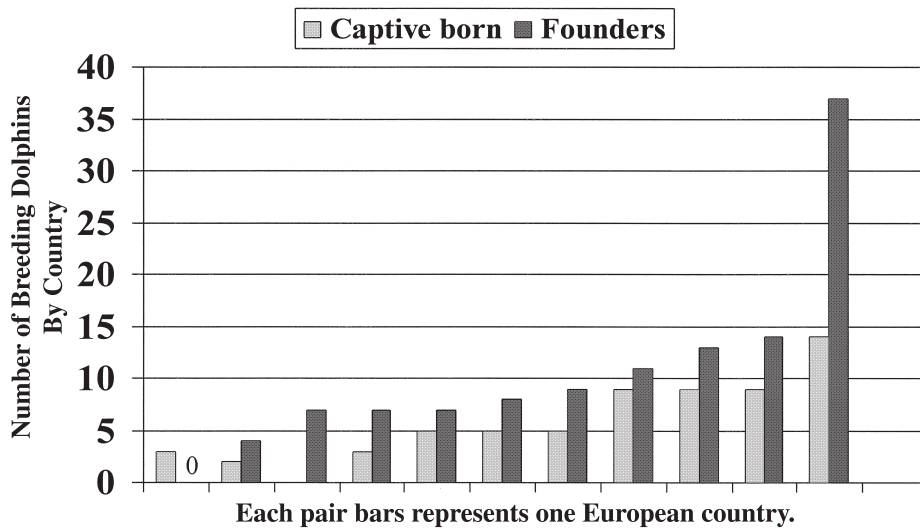


Figure 3. Number of founder and captive born dolphins by European countries as of 1 January 1998.

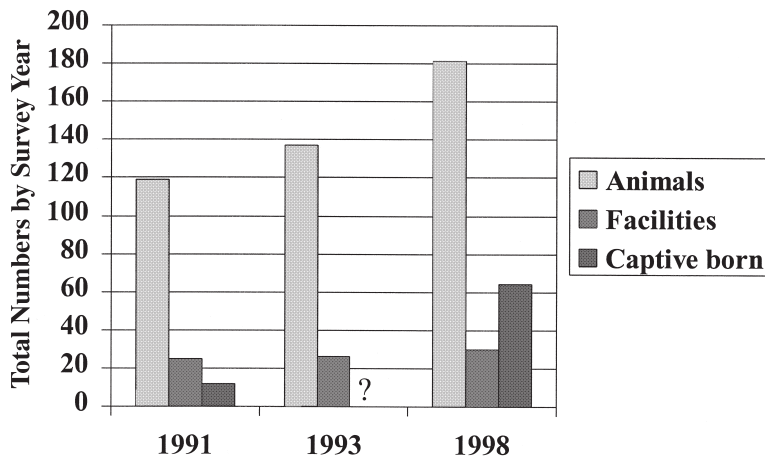


Figure 4. Comparison of the European survey results of 1991, 1993, and 1998, giving total number of animals, number of facilities and number of captive born dolphins.

previous to 1991 by De Bois (1991). A similar increasing birth rate is well documented in US dolphinarium from 1976 to 1990 (Cornell & Asper, 1979; Cornell *et al.*, 1982; Asper *et al.*, 1988; Asper *et al.*, 1990).

In 1998, the percentage of captive born dolphins in the European population was high (35.4%). For both males and females, the number of dolphins ≤ 5 years of age was greater than for any other age class (Figure 2). This age group consisted exclusively of captive born animals.

This coincides with the findings for the captive populations of bottlenose dolphins in the USA and Canada in a 1990 census and with the findings

in a wild population of bottlenose dolphins in Sarasota, Florida, before 1987 (Duffield & Wells, 1990).

From the information gathered in 1998, captive breeding became more successful at the end of the nineteen eighties in Europe. No conclusions can be drawn from the present study about birth rate, the overall breeding success, or whether the reproduction rate is sufficient to establish a permanent, self-sustaining captive population. To obtain such data, the studbook would require yearly surveys on the whole population for a number of consecutive years, plus additional information on all transfers and deaths.

From the basic 1998 survey, the sex and age distribution of bottlenose dolphins in Europe was healthy and potentially capable of similar breeding success as in USA and Japan, where third generation breeding has already taken place (McBain, 1999; Fujimoto & Hori, 1998). By 1990, eight percent of the bottlenose dolphin population in the USA and Canada was second generation born (Asper *et al.*, 1990).

In Europe, only one animal was second generation (father: F1, mother: founder) at the date of the survey and no dolphins were F3. There seems to be a delay which can be estimated at 10 to 15 years. The delay between otherwise apparently similar birth rates might originate from the time difference in first successful keeping of bottlenose dolphins in human care, which started several decades earlier in the USA.

The number of founder dolphins, especially in males, might become a critical factor for the growth of the European population in the future. Considering that not all founder dolphins in this survey will be 'effective founders' (N_e) (see Foose & Ballou, 1998) or successful in breeding, the number of males can become critical if the captive born male dolphins do not become successful breeders in coming years. Nonetheless, the example of the above-mentioned F2 animal fathered by an F1 male suggests that such replacement can be expected. In females, the number of founder dolphins might seem sufficient, although the number of effective founder females is unclear.

The age structure of the population (Figure 2) seems promising considering the dolphin's single offspring, long gestation, long lactation, and long interbreeding interval.

The sex ratio of the European bottlenose dolphin population was skewed with a clear dominance of females at >10 years of age. Most dolphins >10 years were imported from the wild, thus explaining the clear surplus. Dolphins <10 years of age all were captive born and the sex ratio was almost equally distributed (43.8% females). Such distortion slightly favouring captive born males has been found in the USA captive population too (Asper *et al.*, 1990).

Though tempting, conclusions on the reproductive success of the European captive population can not be deduced from the age distribution because no data are available on either parents or neonates which died before 1 January 1998. The maximum longevities reached within the European population were similar to those described by Duffield & Wells (1990) for both wild and captive *Tursiops*, but methodical problems exist in the comparisons (e.g., animals are not dead at the time of comparison and will reach an older age with each census). It is noteworthy that in the European captive

population (contrary to the situation in both the captive and Sarasota wild population in the US) the oldest animals are males, exceeding the oldest known ages of the males in the wild Sarasota population by 3 years (Duffield & Wells, 1990).

The aims of the European studbook were clearly defined above, but not met fully with the results of the 1998 survey. More complete data would enable analysis for reproductive rate, survival rate of neonates, age of sexual maturity in males and females, interbreeding intervals, average life span, maximum life span, and generation time (see Foose & Ballou, 1988) as examined in other captive populations of marine mammals (Small & DeMaster, 1995; Asper *et al.*, 1988; Asper *et al.*, 1990, Duffield & Wells, 1990). To establish these parameters for the proper management of the European dolphin population in human care, the studbook needs to continue monitoring the species for several years with full cooperation of all dolphinaria. As a result, the studbook would enable us to ascertain whether the population in human care is self-sustaining e.g., can sustain its number constant without the need to import animals from the wild.

*The evaluation of the current status of the captive population of bottlenose dolphins in Europe by up-to-date summaries, like the 1998 studbook survey, is of utmost importance to draw conclusions and make decisions relevant for management of *Tursiops* based on scientific grounds, rather than emotions and opinions.* Furthermore, sound scientific analysis and knowledge provides a superior basis for objective discussion and evaluation of the well being of this species under our care.

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Literature Cited

- Amundin, M. (1994) Report on the EEP captive dolphin monitoring survey. Abstract. In: *Proceedings of the 22nd Annual Symposium of the European Association for Aquatic Mammals*. Kolmården, Sweden.
- Anonymous (1972) Constitution and bylaws of the European Association for Aquatic Mammals, Article 2, section 1.
- Anonymous (1988) Guidelines for the keeping of the Bottlenose Dolphin (*Tursiops truncatus*) and marine dolphins of the same size in member countries of the

- E.E.C. Report of the Scientific Working Group of the European Economic Community.
- Anonymous (1989) User manual for SPARKS version 1.0, the Single Population Analysis Record Keeping System. International Species Information System, Apple Valley, USA.
- Asper, E. D., Cornell, L. H., Duffield, D. A. & Dimeo-Ediger, N. (1988) Marine mammals in zoos, aquaria and marine zoological parks in North America: 1983 census report. *Int. Zoo Yb.* **27**, 287–294.
- Asper, E. D., Duffield, D. A., Dimeo-Ediger, N. & Shell, D. (1990) Marine mammals in zoos, aquaria and marine zoological parks in North America: 1990 census report. *Int. Zoo Yb.* **29**, 179–187.
- Cornell, L. H. & Asper, E. D. (1979) A census of captive marine mammals in North America. *Int. Zoo Yb.* **18**, 221–224.
- Cornell, L. H., Asper, E. D. & Duffield, D. A. (1982) Census up-date: captive marine mammals in North America. *Int. Zoo Yb.* **22**, 227–232.
- De Bois, H. (1991) Preliminary report on the demographic status of the bottlenosed dolphin, *Tursiops truncatus*, in the EEC. Report of the Scientific Working Group of the European Economic Community.
- Duffield, D. A. & Wells, R. S. (1990) A discussion on comparative data of wild and oceanarium *Tursiops* populations. In: *Proceedings of the 18th International Marine Trainers Association Conference*. 4–9 November 1990, Chicago. I.M.A.T.A. Publication.
- Essapian, F. S. (1953) The birth and growth of a porpoise. *Nat. Hist.* **62**(9), 392–399.
- Foose, T. J. & Ballou, J. D. (1988) Management of small populations. *Int. Zoo Yb.* **27**, 26–41.
- Fujimoto, A. & Hori, Y. (1998) The birth of the third generation in the bottlenose dolphin, *Tursiops truncatus*. *Proceedings of the 53rd IUDZG-WZO Technical Session*, 15 October 1998, Yokohama, Japan (in press).
- García Hartmann, M. (1997) Pathology of marine mammals. *Bull. Soc. Roy. des Sciences de Liege.* **66**(1), 117–149.
- García Hartmann, M. (1993) Veterinary report on the health status of the marine mammals resident in the dolphinarium of Tel Aviv, Israel, December 1993. Unpublished report of the SRRC Pieterburen, 1993.
- Gaukler, A. (1995) Lethal pneumococcus-septicaemia in bottlenosed dolphins. Abstract. In: *Proceedings of the 23rd Annual Symposium of the European Association for Aquatic Mammals*. Nuremberg, Germany.
- Gensch, W. (1986) Entwicklung der Wildtierhaltung und Aufgaben der zoologischen Gärten. In: *Zootierhaltung*. Puschmann, W., S. Seifert, K. G. Witstruk & F. Zwirner (eds.); Verlag Harri Deutsch, 6th edition. [in German]
- Gewalt, W. (1993) Wale und Delphine: Spitzenköner der Meere. P. 153. Springer Verlag, Berlin. [in German]
- Klinowska, M. & Brown, S. (1986) A review of dolphinarium. Report of the UK Department of the Environment.
- McBain, J. (1999) Captive breeding of marine mammals: feasibility and success. Report of the Workshop Marine Mammal Reproduction: Morphology & Physiology. P. 417. In: *European Research on Cetaceans Vol. 12*. P. G. H. Evans & E. C. M. Parsons (eds.).
- McBride, A. F. (1956) Evidence for echolocation by cetaceans. *Deep-Sea Research* **3**, 153–154.
- Norris, K. (1966a) *Whales, Dolphins and Porpoises*. University of California Press.
- Norris, K. (1966b) Round table: Practical problems. Pp. 649–673. In: *Whales, Dolphins and Porpoises*. K. Norris (ed.). University of California Press.
- Pies-Schulz-Hofen, R. (1996) *Die Tierpflegerausbildung*. Paul Parey Berlin, 2nd edition. [in German].
- Ridgway, S.H. (1972) *Mammals of the Sea: Biology and Medicine*. Charles C. Thomas, Springfield, Illinois, USA.
- Small, R. J. & DeMaster, D. P. (1995) Survival of five species of captive marine mammals. *Mar. Mamm. Sci.* **11**(2), 209–226.
- Sweeney, J. C. & Ridgway, S. H. (1975) Common diseases of small cetaceans. *J. Am. Vet. Med. Assoc.* **167**, 533–540.
- Vollmacher, A. (1988) Dolfijnen stikken onder brandend puin. *Laaste nieuws*, 9 May 1988. [Dolphins suffocate underneath burning building. In Flaams Belgian].