original scientific paper

UDK 599.5(262.3-17)
574.9:5995(262.3-17)

A COMPARISON OF THE PRESENT OCCURRENCE OF BOTTLENOSE DOLPHINS, *TURSIOPS TRUNCATUS*, AND COMMON DOLPHINS, *DELPHINUS DELPHIS*, IN THE KVARNERIĆ (NORTHERN ADRIATIC SEA)

Giovanni BEARZI
BSc, marine biologist, Tethys Research Institute, 20121 Milano, viale G.B. Gadio 2, IT
dipl. biol., morski biolog, Tethys Research Institute, 20121 Milano, viale G.B. Gadio 2, IT

Giuseppe NOTARBARTOLO di SCIARA
PhD, marine biologist, Tethys Research Institute, 20121 Milano, viale G.B. Gadio 2, IT
dr., morski biolog, Tethys Research Institute, 20121 Milano, viale G.B. Gadio 2, IT

ABSTRACT

In the course of a long-term study focusing on bottlenose dolphin social ecology and behaviour, conducted in the Kvarnerić since 1987, bottlenose dolphins (Tursiops truncatus) and common dolphins (Delphinus delphis) were the only cetacean species observed. A total of 879 bottlenose dolphin groups were encountered, compared to three sightings of common dolphins. The sighting frequency for bottlenose dolphins was about 87 times higher than for common dolphins. The first of the common dolphin sightings, in August 1991, involved four adults, while the following two (August 1994 and July 1995) were of a single specimen, found both times in association with bottlenose dolphins. Photoidentification data showed that the same individual common dolphin was present in all three encounters. These observations reflect the almost complete disappearance of common dolphins from the Northern Adriatic Sea, a region in which both dolphin species were historically abundant.

Key words: common dolphin, *Delphinus delphis*, bottlenose dolphin, *Tursiops truncatus*, Mediterranean Sea, Adriatic Sea, sighting frequency, occurrence, interspecies association
Ključne besede: navadni delfin, *Delphinus delphis*, velika pliskavka, *Tursiops truncatus*, Sredozemsko morje, Jadransko morje, frekvenca opazovanj, pojavljanje, medvrstna združevanja

INTRODUCTION

The degradation of any ecosystem is first indicated by the disappearing of the most vulnerable, less adaptable species, and by a progressive impoverishment of its biological diversity. The general lack of attention given to the marine environment often makes such processes difficult to detect, and the scarce availability of circumstantial historical information in the scientific literature may prevent the understanding of the ongoing trends. Consequently, the feeling that something is wrong in a given marine environment often rests upon fishermen's stories and memories of the "good old times", value whose cannot be objectively assessed. Dolphins, as predators at the top of the marine food chain, represent excellent biological indicators of the status of the environment they inhabit. Their long lifespan (30 years or more) make them important bioaccumulators of man-made polluting substances such as organochlorine compounds and heavy metals, whose toxic potential is well known. Therefore, the decrease of a dolphin population represents a signal that should be carefully evaluated, and the assessment of the status of the dolphin populations is of foremost importance to determine trends and to suggest measures to prevent a possible decline. In the shallow and largely degraded Northern Adriatic Sea, little methodical effort has been made in the past to document the density and distribution of free-ranging

cetaceans, with most of the information deriving from stranded specimens, second-hand reports, or occasional sightings. Only since the late 1980s have Adriatic cetaceans attracted some scientific interest, and preliminary data were collected through surveys at sea (Notarbartolo di Sciara *et al.*, 1993). This study represents a further contribution to the understanding of the present occurrence of two cetacean species in the Kvarnerić, a small but representative portion of the Northern Adriatic Sea.

MATERIALS AND METHODS

The study area, measuring roughly 900 km2, is situated in the southern portion of the Croatian Kvarnerić (Fig. 1). Its sheltered and clear coastal waters, east of the islands of Lošinj and Cres, encompass a variety of different marine habitats, including rocky coastline and bottom, submerged reefs, seagrass flats, and a mud sea bed with a mean depth of about 70 m. The maximum depth is 96 m.

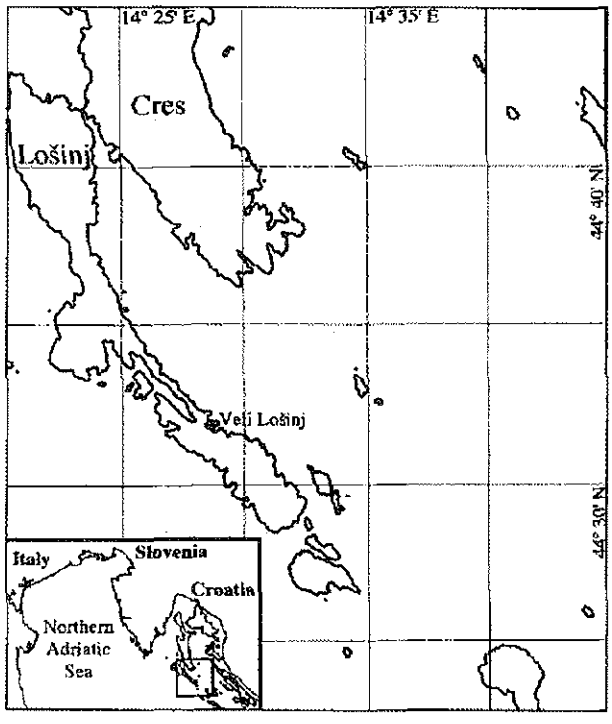

Figure 1: The study area.
Slika 1: Območje raziskave.

Data presented here are part of a larger effort focusing on the social ecology and behaviour of the bottlenose dolphin community frequenting the area (Bearzi *et al.* 1992, 1994, in press). Observations were carried out from September 1987 to July 1995, with a total of 41 months spent in the field (September 1987; April 1988; July - October 1988; July - September 1990; July - September 1991; without interruption from March 1992 - October 1993; April - September 1994; April - July 1995). A total of 453 days were spent at sea during the study: 14 in 1987-88, and 439 from 1990 to 1995, totalling more than 2,000 h.

Surveys were conducted from inflatable boats with fiberglass keels, equipped with 25 to 50 HP outboard engines. Over 18,700 photographs were taken with a reflex camera Minolta 8000i AF equipped with a zoom Minolta AF 80-200 APO f 2.8 lens, using Ektachrome EPR 64 ISO color transparency film. A chronological catalogue for the identification of individual dolphins was built using 14,300 of these slides.

Sighting frequencies were computed based on searching bouts. Each bout consisted of the sum of all periods spent searching for dolphins at a mean speed of 30 km/h under "adequate" sighting conditions, from the beginning of a survey to the time of sighting. A bout could include survey fragments on consecutive days. Sighting conditions were considered "adequate" only when: 1) at least one experienced observer continuously scanned the sea surface, searching for dolphins; 2) the sea state was 0 or 1 (flat, with capillary waves, or with wavelets prior to breaking). The time spent with either dolphin species and the time spent at sea following the first sighting of the day were not considered as searching time and were therefore excluded from the calculation of the sighting frequencies. Due to the unequal survey procedure in 1987-88, only data from 1990-95 were considered in the computation.

RESULTS

Bottlenose dolphins

A total of 843 h 50 min were spent observing and photographing 879 dolphin schools of different size and composition, averaging 6.6 individuals (SD=5.78, SE=0.195, range=1-65, mode=2). Bottlenose dolphins were the only species consistently sighted throughout this study, and the only one found in 1987-88. The mean time spent searching for bottlenose dolphins from the beginning of a survey with "adequate" conditions was 145 minutes (SD=152.35, SE=9.45, N=260, range 1-1139 min). The shortest seasonal mean search time occurred in spring 1994 (76 min), the longest in fall 1993 (313 min); however, despite such wide variation, the difference in search time among years was insignificant ($F=1.66$, $df=5$, $p<0.14$), indicating that the bottlenose dolphin density in the area shows little temporal patterns. Until the end of 1994 a total of 106 individuals were photoidentified by means of permanent natural marks on their dorsal fin (Würsig & Würsig 1977, Würsig & Jefferson 1990). The rate at which individual dolphins were identified during the study is presented in Fig. 2. Individual frequency of re-sighting ranged from 1 to 59 different days (mean=13.2, SD=11.48, SE=1.11,

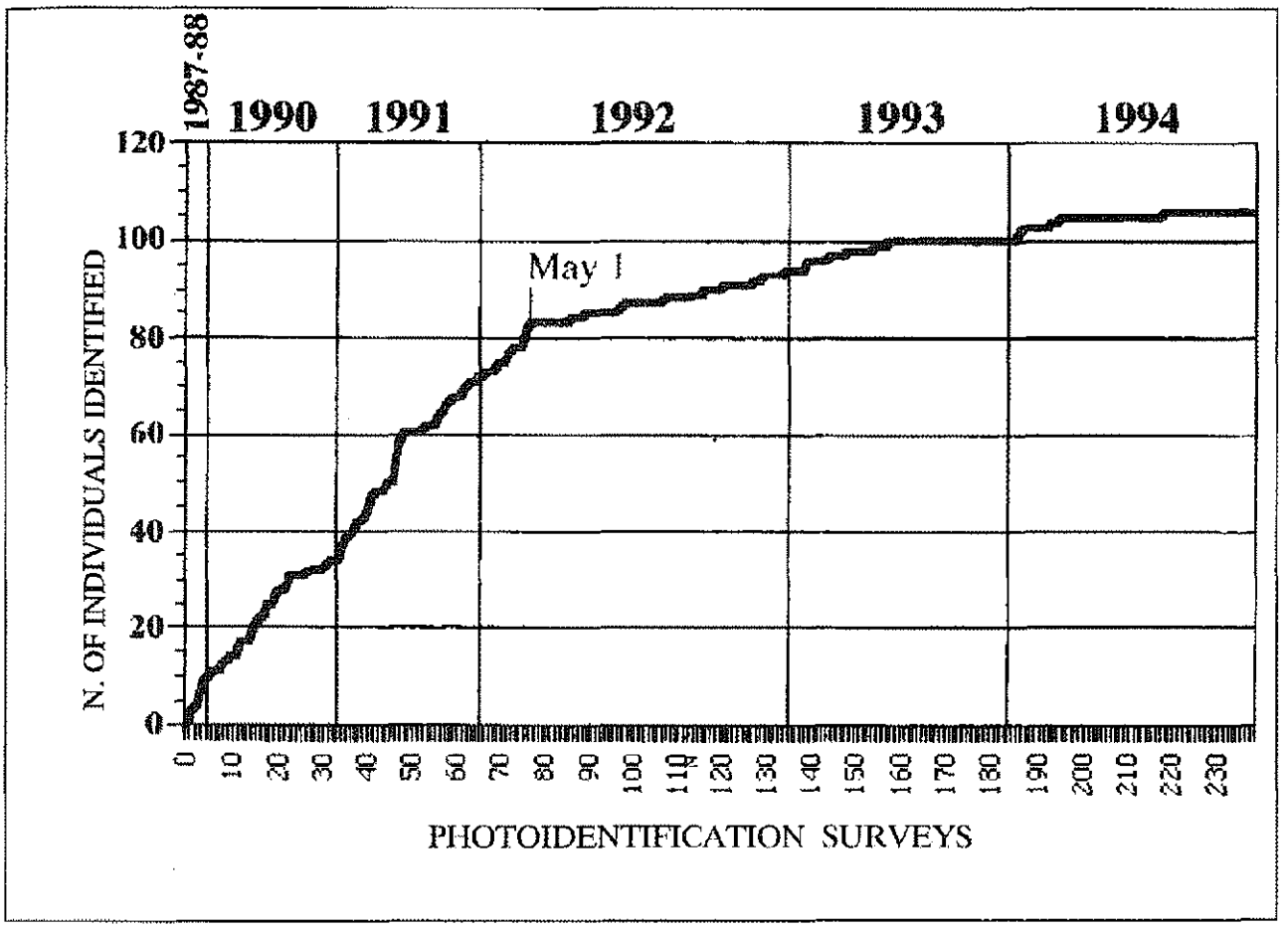

Figure 2: Cumulative rate of identification of new individual bottlenose dolphins over time ("rate of discovery").
Slika 2: Kumulativno število identificiranih osebkov velike pliskavke z metodo fotoidentifikacije v terenskih pregledih od 1987 do 1994.

mode=6); only four identified individuals (3.8%) were sighted once. Most animals were encountered frequently, although there were remarkable differences in site fidelity among individuals, and even the most "resident" animals ranged in an area that was larger than the one selected for this study (Bearzi *et al.*, in press).

Common dolphins

Common dolphins were observed three times. A group of 4 adult individuals was sighted on 2 August 1991 and followed for 96 min (12:03 - 13:39). No bottlenose dolphins were seen in the area on that day. On 4 August 1994 a single adult individual was seen in a group of 11 bottlenose dolphins including 5 calves and was observed for 27 min (13:03 - 13:30). The following year, on 11 July, a single individual was again found in a bottlenose dolphin group composed by 6 adults and 4 calves. During this observation, totalling 102 min (18:51 - 20:33), four more adult bottlenose dolphins joined the group. All observations were photographically documented; in addition, the 1995 sighting was partly videotaped. The analysis of the photographs showed that the dolphin seen in 1995, recognizable by its dorsal fin's shape, permanent marks, and pigmentation pattern, was the same as the one seen in 1994, and was also present in the group of four individuals sighted in 1991 (Fig. 3). The cumulative time spent before finding common dolphins in 1990-91, 1991-94, and 1994-95, was 6934, 22646, and 8163 min respectively, averaging 12581 min (SD=8738.2, SE=5045.0).

DISCUSSION

Many cetacean species have been reported to occur in the Northern and Central Adriatic Sea, including the fin whale, *Balaenoptera physalus*, the sperm whale, *Physeter catodon*, Cuvier's beaked whale, *Ziphius cavirostris*, the false killer whale, *Pseudorca crassidens*, the long-finned pilot whale, *Globicephala melas*, Risso's dolphin, *Grampus griseus*, and the stripped dolphin, *Stenella coeruleoalba*. However, these species were rep-

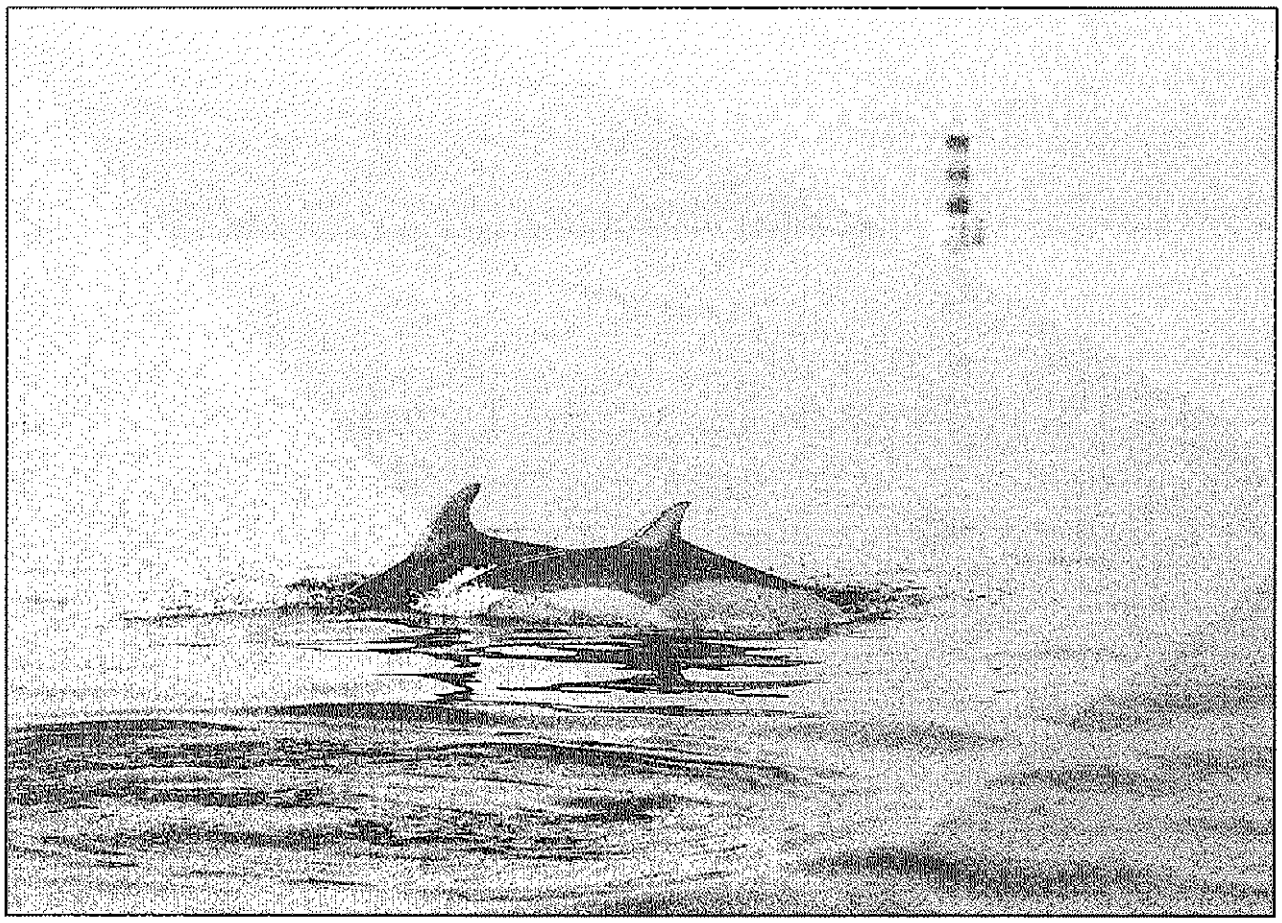

Figure 3: The common dolphin sighted on 11 July 1995, associated with a bottlenose dolphin. This same individual was encountered in 1991 and 1994 (Photo: G. Bearzi).
Slika 3: Navadni delfin, opažen 11. julija 1995 v družbi z veliko pliskavko. Isti osebek je bil opazovan v letih 1991 in 1994 (Foto: G. Bearzi).

resented by rare occurrences of erratic individuals (Kryštufek & Lipej, 1985; Notarbartolo di Sciara & Bearzi, 1992; Kryštufek & Lipej, 1993; Notarbartolo di Sciara *et al.*, 1994). Of all cetacean species, only bottlenose dolphins and common dolphins are regularly encountered in the region (Giglioli, 1880; Nardo, 1853; Kolombatović, 1882, 1894, 1896; Brusina, 1889; Trois, 1894; Ninni, 1901, 1904, 1917; Peksider-Srica, 1931; Vatova, 1932; Pilleri & Gihr, 1969, 1977; Pilleri, 1970; Rallo, 1976; Di Natale, 1979; Di Natale & Mangano, 1981; Pilleri & Pilleri, 1982, 1983; Di Natale, 1983; Canestri *et al.*, 1986; Giovannetti, 1986; Kovačić, 1986; Centro Studi Cetacei, 1987, 1988, 1989, 1990, 1991; Bearzi, 1989; Notarbartolo di Sciara *et al.*, 1993). Abundance ratios of common to bottlenose dolphins in the past are unclear. According to Brusina (1889), *D. delphis* was the most common cetacean species in the Adriatic, and Ninni (1904) considered that species very common there in contrast to *Delphinus tursio* (= *T. truncatus*), which he thought rare in the Adriatic. By contrast, Vatova (1932) listed *D. delphis* and *Tursiops tursio (= T. truncatus)* among the most common marine animals near Rovinj. Pilleri and Gihr (1977) noted a decrease of common dolphins in the Northern Adriatic with respect to the previous 40 years. In recent times, only the bottlenose dolphin is considered a regular inhabitant of the Northern Adriatic Sea (Notarbartolo di Sciara & Bearzi, 1992; Kryštufek & Lipej, 1993; Notarbartolo di Sciara *et al.*, 1994).

Based on an extensive effort in the field, this study documents the regular presence of bottlenose dolphins in the Kvarneric. The flattening of the discovery curve strongly indicates that at the end of 1994 most of the naturally marked individuals frequenting the study area were likely to have been identified (Fig. 2). The overall bottlenose dolphin density - as indicated by the mean time spent to find them and by the number of individuals identified - is low compared to other areas where

bottlenose dolphin communities have been studied (Shane *et al.* 1986, Scott *et al.* 1990, Richard C. Connor, personal communication). However, bottlenose dolphin sighting frequency was remarkably higher in the Kvarneric than in any other Northern Adriatic area surveyed by Bearzi (1989). Instead, the presence of common dolphins was limited to the rare occurrence of stray individuals. Only 4 different animals were sighted from 1987 to 1995, one of them being encountered in all of the sightings. The mean time spent before finding common dolphins was two orders of magnitude greater than the mean time needed to spot bottlenose dolphins. Moreover, the long time spent observing bottlenose dolphins (about 844 hours) was not considered in computing the mean search time for common dolphins, although this species could have been sighted while following the former.

It is apparent that both dolphin species faced a substantial population decrease in the Northern Adriatic Sea during the recent past. The numerical decline of bottlenose dolphins is indicated by their low present density throughout the area (Bearzi, 1989; Notarbartolo di Sciara *et al.*, 1993). Nevertheless, bottlenose dolphins, whose ability to adapt behaviourally and ecologically even to habitats heavily impacted by humans is well known (Shane *et al.*, 1986; Leatherwood & Reeves, 1990; Henningsen & Würsig, 1991), seem capable of surviving in the less degraded portions of the Northern Adriatic, despite the worsening environmental conditions. By contrast the common dolphin, a species whose adaptability and flexible behaviour and ecology was never investigated, might have been unable to deal with the same environmental degradation. The disappearing of the once "common" common dolphin from the Northern Adriatic Sea dramatically reflects its generalized decrease throughout its former Mediterranean range (Cagnolaro & Notarbartolo di Sciara, 1992; Notarbartolo di Sciara & Demma, 1994; Notarbartolo di Sciara & Gordon, in press). The reasons underlying such a decline possibly include environmental pollution and organochlorine contamination (Cummins, 1988; Tanabe *et al.*, 1988; Cockroft *et al.*, 1989; Tanabe & Tatsukawa, 1992; Tanabe, 1993; Notarbartolo di Sciara, 1994), the impoverishment of food resources (Anonymous 1989), high levels of ambient noise and boat disturbance (Kruse, 1991; Evans *et al.*, 1992; Dos Santos *et al.* in press), by-catches (Di Natale & Notarbartolo di Sciara, 1994), and the heavy impact of deliberate killings occurring in the Adriatic up until the early 1960s (Holcer, 1994). These threats deserve further investigation.

ACKNOWLEDGEMENTS

Special thanks are due to Draško Holcer for providing additional references and relevant information. Our thanks also go to the numerous friends and field assistants who have been working with us, including Laura Bonomi, Luca Bucchini, Benedetta Cavalloni, Caterina Maria Fortuna, Giancarlo Lauriano, Daniela Maldini-Feinholz, Mario Matešić, Sylvan Oehen, Melita Peharda, Marta Picciulin, Elena Politi, Sandra Pribanić, Luca Riva, Brigitte Sifaoui, Michele van der Schoot, and many "ecovolunteers" provided by Europe Conservation. We are grateful to Arlen Abramić, Dubravko Balenović, Vlado Balenović, Hrvoje Gomerčić, Gordana Lacković, Nena and Damir Nosalj-Peršić, Draško Šerman, Goran Sušić, Zoran Tomić, and all people of Lošinj and Cres for providing support and local assistance. This research was largely funded by Europe Conservation. Additional funds were given by the Centro Interdisciplinare di Bioacustica, University of Pavia. The Whale & Dolphin Conservation Society provided financial help in 1995. The main inflatable boat used for this research was sponsored by Novamarine.

POVZETEK

Med neko široko zastavljeno študijo na temo socio-ekologije in obnašanja velike pliskavke, ki so jo leta 1987 izvedli v Kvarnerskem zalivu, so opazili samo dve vrsti kitov: veliko pliskavko (Tursiops truncatus) in navadnega delfina (Delphinus delphis). Registrirali so 879 skupin velike pliskavke in le tri skupine navadnih delfinov. Pogostost opažanj velike pliskavke je bila kar 87-krat večja od frekvence navadnega delfina. Ko so avgusta 1991 prvič opazili navadne delfine, je šlo za štiri odrasle primerke, medtem ko so ob sledečih dveh priložnostih (avgusta 1994 in julija 1995) opazili samo enega predstavnika vrste, ki se je pridružil velikim pliskavkam. S tehniko fotoidentifikacije je bilo mogoče ugotoviti, da je bil ob vseh treh srečanjih prisoten isti primerek navadnega delfina. Iz teh primerov je razvidno, da je navadni delfin skoraj povsem izginil iz severnega Jadrana, iz območja, na katerem je bilo predstavnikov obeh vrst v preteklosti v izobilju.

LITERATURE

Anonymous. 1989. State of the Mediterranean Marine Environment. MAP Technical Report Series No. 28. UNEP, Athens.

Bearzi, G. 1989. Contributo alle conoscenze sulla biologia di *Tursiops truncatus* (Montagu, 1821) nel mare Adriatico settentrionale. Tesi di laurea in Scienze Biologiche. Università degli Studi di Padova. 172 pp.

Bearzi, G., G. Notarbartolo di Sciara & L. Bonomi. 1992. Bottlenose dolphins off Croatia: a socio-ecologic study. European Research on Cetaceans 6:130-133.

Bearzi, G., G. Notarbartolo di Sciara, E. Politi & G. Lauriano. 1994. Ecology and behaviour of bottlenose dolphins *(Tursiops truncatus)* near the island of Lošinj and Cres (Croatia). Abstract, 5th Congress of Croatian Biologists. Pula, October 3-7, 1994.

Bearzi, G., E. Politi & G. Notarbartolo di Sciara. In press. Photo-identification based short-term tracking of bottlenose dolphins resident in the Kvarnerić (Northern Adriatic Sea). European Research on Cetaceans 9.

Brusina, S. 1889. Sisavci Jadranskoga mora. Gradja za faunu hrvatsku uz obzir na ostale sisavce Sredozemnoga mora. Rad JAZU 95(10):79-177.

Cagnolaro, L. & G. Notarbartolo di Sciara. 1992. Research activities and conservation status of cetaceans in Italy. Boll. Mus. Ist. Biol. Genova, 56-57:53-85.

Canestri Trotti, G. & L. Corradini. 1986. Reperti parassitologici in un tursiope *(Tursiops truncatus)* spiaggiato lungo la costa dell'Emilia Romagna. Pages 53-60 in **S. Corazza,** ed. Gli spiaggiamenti dei cetacei sulle coste italiane. Maggioli Editore, Rimini.

Centro Studi Cetacei. 1987. Cetacei spiaggiati lungo le coste italiane. I. Rendiconto 1986. Atti Soc. ital. Sci. nat. Museo civ. Stor. nat. Milano 128(3-4):305-313.

Centro Studi Cetacei. 1988. Cetacei spiaggiati lungo le coste italiane. II. Rendiconto 1987. Atti Soc. ital. Sci. nat. Museo civ. Stor. nat. Milano 129(4):411-432.

Centro Studi Cetacei. 1989. Cetacei spiaggiati lungo le coste italiane. III. Rendiconto 1988. Atti Soc. ital. Sci. nat. Museo civ. Stor. nat. Milano 130(21):269-287.

Centro Studi Cetacei. 1990. Cetacei spiaggiati lungo le coste italiane. IV. Rendiconto 1989. Atti Soc. ital. Sci. nat. Museo civ. Stor. nat. Milano 131(27):413-432.

Centro Studi Cetacei. 1991. Cetacei spiaggiati lungo le coste italiane. V. Rendiconto 1990. Atti Soc. ital. Sci. nat. Museo civ. Stor. nat. Milano 132(25):337-355.

Cockroft, V.G., A.C. de Kock, D.A. Lord & G.J.B. Ross. 1989. Organo-chlorines in bottlenose dolphins *(Tursiops truncatus)* from the east coast of South Africa. South African Journal of Marine Sciences 8:207-217.

Cummins, J.E. 1988. Extinction: the PCB threat to marine mammals. The Ecologist 18(6):193-195.

Di Natale, A. 1979. Progress of research relating to Mediterranean Cetacea. Mem. Biol. Mar. Ocean. N.S. 9(1-2):1-50.

Di Natale, A. 1983. Distribution, frequence and biology of the common dolphin, *Delphinus delphis* Linnaeus, in the Central Mediterranean Sea. Rapp. Comm. int. Mer Medit. 28(5):199-200.

Di Natale, A. 1983. Distribution of the bottlenosed dolphin, *Tursiops truncatus* (Montagu), in the Italian seas. Rapp. Comm. int. Mer Medit. 28(5):193-194.

Di Natale, A. & A. Mangano. 1981. Report on the progress of Project Cetacea. VI.) July 1978 - October 1981. Mem. Biol. Mar. Ocean. N.S., Special Issue 9:1-49.

Di Natale, A. & G. Notarbartolo di Sciara. 1994. A review of the passive fishing nets and trap fisheries in the Mediterranean Sea and of the cetacean bycatch. Pages 189-202 in **W.F. Perrin, G.P. Donovan and J. Barlow (eds.).** Gillnets and cetaceans. Rep. Int. Whaling Comm Special Issue 15.

Dos Santos, M.E., A.J. Ferreira, J. Ramos, J.F. Ferreira & J.L. Bento-Coelho. In press. The acoustic world of the bottlenose dolphin in the Sado estuary. European Research on Cetaceans 9.

Evans, P.G.H., P.J. Canwell, E.J. Lewis, 1992. An experimental study of the effects of pleasure craft noise upon bottle-nosed dolphins in Cardigan Bay, West Wales. European Research on Cetaceans 6:43-46.

Giglioli, E.H. 1880. Elenco dei mammiferi, degli uccelli e dei rettili ittiofagi appartenenti alla fauna italiana. Firenze. 55 pp.

Giovannetti, L. 1986. Esami necroscopici eseguiti su delfini *(Tursiops truncatus)* inviati alla sezione provinciale di Forlì dell'Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia dall'anno 1981 all'anno 1985. Page 89 in **S. Corazza,** ed. Gli spiaggiamenti dei cetacei sulle coste italiane. Maggioli Editore, Rimini.

Henningsen, T. & B. Würsig. 1991. Bottle-nosed dolphins in Galveston Bay, Texas: numbers and activities. European Research on Cetaceans 5:36-38.

Holcer, D. 1994. Prospective of cetology in Croatia. European Research on Cetaceans 8:120-121.

Kolombatović, G. 1882. Mammiferi, anfibi e rettili della Dalmazia e pesci rari e nuovi per l'Adriatico che furono catturati nelle acque di Spalato. Split. Pages 18-19.

Kolombatović, G. 1894. O navodima vrsti mrhkužca (Cephalopoda) i Kralješnjaka (Vertebrata) Jadranskoga mora. Split. Pages 49-54.

Kolombatović, G. 1896. Zoologijske vijesti iz Dalmacije. Split. Pages 3-6.

Kovačić, D. 1986. Kitovi Jadranskog mora. Priroda 9-10:281-283.

Kruse, S. 1991. The interaction between killer whales and boats in Johnstone Strait, B.C. Pages 149-159 in **K. Pryor and K.S. Norris, eds.** Dolphin societies: discoveries and puzzles. University of California Press.

Kryštufek, B. & L. Lipej. 1985. Kiti v severnem Jadranu. Proteus 9-10(47):349-352.

Kryštufek, B. & L. Lipej. 1993. Kiti (Cetacea) v severnem Jadranu. Annales 3:9-20.

Leatherwood, S. & R.R. Reeves. 1990. The bottlenose dolphin. Academic Press, San Diego. 653 pp.

Nardo, G.D. 1853. Notizie sui mammali viventi nel mare Adriatico specialmente sui fisetteri presi in esso nello secolo scorso e nel presente. Atti R. Ist. Veneto Sc. Lett. Arti 4(2). 7 pp.

Ninni, E. 1901. Sulle catture di alcuni Cetacei nel Mare Adriatico ed in particolare sul *Delphinus tursio,* (Fabr.). Neptunia, Venezia 8:3-9.

Ninni, E. 1904. L'origine e l'intelligenza dei delfini secondo i nostri pescatori. Neptunia, Venezia 8:1-2.

Ninni, E. 1917. La pesca nel Mare Adriatico (con carta dell'Adriatico). Ispettorato Generale dell'Industria, Sezione Pesca: Estratto dal Bollettino Serie B, Fascicoli I, II, III dei mesi di gennaio, febbraio e marzo 1917. Roma. 26 pp. + map.

Notarbartolo di Sciara, G. 1994. Organochlorine contaminants and marine mammals in the Mediterranean Sea. Workshop on Industrial Pollution in the Mediterranean. Trieste, October 10-15, 1994. 3 pp.

Notarbartolo di Sciara, & G., Bearzi, G. 1992. Cetaceans in the Northern Adriatic Sea: past, present and future. Rapp. Comm. Int. Mer Médit. 33:303.

Notarbartolo di Sciara G., & M. Demma, 1994. Guida dei mammiferi marini del Mediterraneo. Franco Muzzio Editore, Padova. 262 pp.

Notarbartolo di Sciara, G., Venturino, M.C., Zanardelli, M., Bearzi, G., Borsani, F.J., & Cavalloni, B. 1993. Cetaceans in the central Mediterranean Sea: distribution and sighting frequencies. Boll. Zool. 60:131-138

Notarbartolo di Sciara, G., & Gordon, in press. Bioacoustics: a tool for the conservation of cetaceans in the Mediterranean Sea. Marine and Freshwater Behaviour and Physiology.

Notarbartolo di Sciara, G., D. Holcer, G. Bearzi, 1994. Past and present status of cetaceans in the Northern and Central Adriatic Sea. Abstract, 5th Congress of Croatian Biologists. Pula, October 3-7, 1994.

Peksider-Srica, V. 1931. O dupinu i lovu na njega. Lovačko-ribarski vjesnik 40(10):409-415.

Pilleri, G. 1970. Records of cetaceans off the Italian and Dalmatian coasts. Investigations on Cetacea 2:21-24.

Pilleri, G. & M. Gihr. 1969. Über adriatische *Tursiops truncatus* (Montagu, 1821) und vergleichende Untersuchungen über mediterrane und atlantische Tümmler. Investigations on Cetacea 1:66-73.

Pilleri, G. & M. Gihr. 1977. Some records of cetaceans in the Northern Adriatic Sea. Investigations on Cetacea 8:85-88.

Pilleri, G. & O. Pilleri. 1982. Cetacean records in the Mediterranean Sea. Investigations on Cetacea 9:4-63.

Pilleri, G. & O. Pilleri. 1983. Sight records of cetaceans in the Mediterranean Sea during 1981-1982. Investigations on Cetacea 16:189-197.

Rallo, G. 1976. Avvistamento di un *Tursiops truncatus* (Montagu) nella laguna di Venezia. Lavori Soc. Ven. Sc. Nat. 1:50-51.

Scott, M.D., R.S. Wells, & A.B. Irvine. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. Pages 235-244 in **S. Leatherwood and R.R. Reeves,** eds. The bottlenose dolphin. Academic Press, San Diego.

Shane, S.H., R.S. Wells, B. Würsig. 1986. Ecology, behavior and social organisation of the bottlenose dolphin: a review. Marine Mammal Science 2(1):34-63.

Tanabe, S. 1993. Specific accumulation and toxic impact of PCBs in marine mammals. 10th Biennial Conference on the Biology of Marine Mammals. Galveston, TX, November 12-15, 1993.

Tanabe, S. & R. Tatsukawa. 1992. Chemical modernization and vulnerability of cetaceans: increasing toxic threat of organochlorine contaminants. Pages 161-177 in **C.H. Walker and D.R. Livingstone, eds.** Persistent pollutants in marine ecosystems. Pergamon Press, Oxford.

Tanabe, S., S. Watanabe, H. Kan & R. Tatsukawa. 1988. Capacity and mode of PCB metabolism in small cetaceans. Marine Mammal Science 4(1):103-124.

Trois, E.F. 1894. Elenco dei Cetacei dell'Adriatico. Atti R. Ist. Veneto Sc. Lett. Arti 5(7). 6 pp.

Vatova, A. 1932. Elenco degli animali marini che più spesso s'incontrano nel mare Adriatico presso Rovigno. Not. Ist. Biolog. Rovigno 4. 12 p.

Würsig, B. & M. Würsig. 1977. The photographic determination of group size, composition, and stability of coastal porpoises *(Tursiops truncatus).* Science 198:755-756.

Würsig, B. & T.A. Jefferson. 1990. Methods of photo-identification for small cetaceans. Pages 43-52 in **P.S. Hammond, S.A. Mizroch and G.P. Donovan.** Individual recognition of cetaceans: use of photo-identification and other techniques to estimate population parameters. Rep. Int. Whal. Comm., Special Issue 12.