Research on Cetaceans in Italy

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1. Introduction

Zoology, like other branches of the natural sciences, has expanded greatly from the time of Aristotle, who may be regarded as its founder, to the present day. Zoology started from simple descriptions of animals, based in part on facts and in part on fantasy. Century after century, accounts became increasingly detailed, extending from representations of external features to anatomical descriptions of internal organs, while zoological collections were established to buttress such descriptions with reference material. Increasingly detailed knowledge of the different animal species afforded in the XVIII cent. the adoption of the Linnaean cataloguing system, still valid to this date. Two thousand years of zoological work also set the stage for Darwin's unifying theory of evolution, which provided an explanation for the mechanisms responsible for the diversity of all existing animal species, of the relationships among species, and between species and their environment.

Cetology (cetacean zoology) followed a similar development, although at a slower pace with respect to most branches of zoology. This was because cetaceans have never been easy to study. Compared to most species, and even to most mammals, cetaceans are relatively rare, and the body size of even the smallest species (let alone the largest) made it often problematic to bring specimens to a laboratory or to a collection for detailed investigation. Furthermore, their lifestyles have made cetaceans, until recently, barely accessible not only to studies of their ecology and behaviour, but even to more simple taxonomical, anatomical, and physiological descriptions. This situation has changed significantly only in the last few decades. Technological advances in scientific methods and improvements in our capabilities of working offshore, together with an increased interest and respect for these animals in many cultures, are finally narrowing the gap between zoology in general and cetology in particular.

What follows is a brief, and certainly incomplete, account of the main contributions to cetology by zoologists in Italy. The past works on cetaceans in our country have largely been ignored by the international scientific community, because they were published in Italian and mostly on hard-to-obtain journals; however, scientific production in this field is comparable to that of most other European countries. We are only considering here, for the purposes of this writing, studies involving cetaceans deriving from the Mediterranean seas surrounding Italy; studies of captive cetaceans, largely of an exotic origin, are not included in our review.

Early descriptions of cetaceans are found in the writings of natural historians across a wide temporal span, from the accounts of Pliny the Elder in the I cent. AD (Cagnolaro 1982) to the colourful descriptions of whales, sperm whales, killer whales, dolphins and porpoises by Ulisse Aldrovandi (1638). Further contributions were provided by Antonino Mongitore (1734), an erudite clergyman from Palermo, and by Constantine Samuel Rafinesque-Schmaltz (1810), a naturalist who spent a decade in Sicily in the early XIX cent. However, not unlike Pliny's descriptions 17 centuries before him, Rafinesque's cetaceans, such as *Epiodon urganantus* and *Oxypterus mongitori*, belong more to the realm of fantasy than to that of science.

To the best of our knowledge, the first attempt to catalogue all the cetacean species occurring in the whole of the seas surrounding Italy is that of naturalist Emilio Cornalia (1824-82), director of the Civic Museum of Natural History of Milan, who in his 1872 “Fauna d'Italia” listed 10 species of *Delphinus* (*D. delphis*, *D. tursio*, *D. phocoena*, *D. orca*, *D. rissoanus*, *D. mongitori*, *D. urganantus*, *D. globiceps*, *D. desmarestii*, *D. doumetii*), two of *Physeter* (*P. macrocephalus* and *P. tursio*), and *Balaenoptera musculus*. Many of these species did not withstand the scrutiny of time. Slightly less than a century later, in 1965, Augusto Toschi wrote a newer account which is vastly more accurate, thanks to the accumulation of knowledge that had occurred since Cornalia's time, and that is succinctly narrated in the next section of this paper. However, Toschi's account still contains clear incongruences as to the species composition of the cetacean fauna in Italy, because in spite of all efforts the state of knowledge of cetacean populations in those years was still very limited. Sensible improvements were contained in the guide of cetaceans in Italy by Luigi Cagnolaro et al. (1983), rehashed in Di Natale (1987). The latest comprehensive account of Mediterranean cetaceans, with a special attention for the Italian seas (already including knowledge of the ecology of these species which had become available since the 1980s), is provided by a field guide written by the senior author and illustrated by Massimo Demma (1997).
Another rather different, but extremely useful nation-wide review, which includes a list of all the cetacean specimens found in the Italian collections and museums, was compiled by Luigi Cagnolaro in 1996.

2. Accounts of sporadic findings of stranded or captured specimens: 1715-1985

Beginning mostly from the second half of the XIX cent. an increasing number of zoologists engaged in the reporting of occurrences of cetacean species in the seas surrounding Italy. Scientific activities were conducted from a limited number of centres of interest, mostly in correspondence of the country’s main zoological museums and scientific universities. These are here listed geographically, following the Italian coastline from Liguria in to north west to Friuli-Venezia Giulia in the north east.

Liguria. Significant contributions to the knowledge of the occurrence, strandings and captures of large cetaceans in Italy, notably fin, sperm, minke and right whales, where compiled in 1896 and 1908 by Corrado Parona, who directed the Institute of Zoology of the University of Genoa around the turn of the century. Decio Vinciguerra reported in 1926 on two hitherto little-known cetaceans from the area, the false killer whale and the Cuvier’s beaked whale. Enrico Tortonese, director of the City Museum of Natural History “Giacomo Doria” of Genoa, also contributed with a number of writings, including the description of two specimens of Ziphius stranded in Liguria (1957), a report of the multiple stranding of a minimum of 15 Ziphius along the Ligurian shore (1963b), the catalogue of cetacean specimens belonging to 9 species (striped dolphins being noticeably absent) conserved in the collections of Turin and Genoa (1963c), and a popular book with an account of cetaceans found in the Ligurian Sea (containing, however, a rather conspicuous misidentification of a striped dolphin, classified as common dolphin). In more recent years, Gianna Arbocco (1969) and Roberto Poggi (1982), the current director of the “Giacomo Doria” museum, provided an updated account of the recent cetological acquisitions by that institution. Other contributions from Liguria include that by Giovanni Podenzana (1888) from La Spezia, reporting on a long-finned pilot whale captured locally that year, and that from Niccolò Mezzana (1900) from Savona, who reports on the local capture of a specimen of Ziphius, which he unfortunately misidentified as Hyperoodon ampullatus; thus paving the way to a long and unfortunate series of similar misidentifications which, rather incredibly, persist to our days.

Not too far from Liguria, in nearby landlocked Lombardy, the Civic Museum of Natural History of Milan remains a centre of excellence on cetology thanks to the interest and activities of its former director and curator, Luigi Cagnolaro. Among Cagnolaro’s many contributions to this early phase of Italian cetology we here recall his description of a newborn Cuvier’s beaked whale stranded near Genoa (1964), the description of a pregnant female long-finned pilot whale, captured off Genoa in 1967, the description of the skeleton of a fin whale exposed in the Milan Museum (1977), and the account, description and morphometrics of 18 cetacean specimens belonging to six species (fin whale, sperm whale, Cuvier’s beaked whale, long-finned pilot whale, Risso’s dolphin and striped dolphin) stranded along the coasts of Italy from 1981 to 1985 (Cagnolaro et al. 1986).

Tuscany. In Florence, where the important ancient cetological collection of the zoological museum “La Specola” is headquartered, Enrico Hillyer Giglioli provided (1880) a brief but precise account of 12 species of cetaceans for which he could find records from the seas surrounding Italy. This account vastly improved the list which had been drafted by Cornalia only eight years before. Later (1882) Giglioli added the further account of a 13th species, the false killer whale, which he had identified in specimens conserved in the zoological museum of Palermo. Pisa, and the zoological museum of its university, remains a most substantial centre of interest for cetaceans in Tuscany. An important role was played by Sebastiano Richiardi, former director of the zoological museum of Bologna and afterwards director of the Pisa museum since 1871. Richiardi embarked on an ambitious project, having the target of establishing in that institution a collection representing all the world’s known genera of Cetacea. Although the target was not attained, Richiardi’s effort resulted in a major assemblage of cetacean specimens, which are conserved today in the Certosa di Calci, near Pisa. Richiardi published in 1874 a detailed analysis of the cranium of a young female fin whale stranded near Livorno in 1871, listing as well other cetacean specimens which were acquired by his collection, and in 1881 an analysis of Risso’s dolphin skeletal morphology. A later curator of the same museum, Eugenio Ficalbi, briefly reported in 1907 the local stranding of a fin whale, and in 1919 subsequent strandings of two fin and one sperm whale. Co-worker Umberto Repetti, who had published the catalogue of cetacean specimens in the collection, was charged by him to proceed to the specific determination of four crania in the collection, all of which turned out to belong to B. physalus. Alberto Razzauti, from the same institution, described a female specimen of Risso’s dolphin stranded in the vicinities in 1910, providing with the occasion morphometrics of that specimen and a summary of the occurrence of the species in Italy. In 1927 Celso Borri, from the same institution, described a young fin whale which had been captured in Portoferraio, Isola d’Elba. Some years before (1910) Giacomo Damiani gave an account of his attempts to salvage specimen material from a likely stranding of a minke whale on Isola d’Elba. In 1901 Eugenio Salle and Giuseppe
Becherucci endeavoured to salvage a specimen of fin whale for the city of Livorno, and provided measurements and some anatomical descriptions of that specimen. Finally, the cetological collection at the Museo dei Fisiocritici of Siena, mentioned later in this paper, must be recalled here for its importance.

**Rome.** The first sign of an interest for cetaceans here is represented by the account of a fin whale stranded on the nearby shore, published by Vincenzo Diorio in 1866. Leone De Sanctis, a fine anatomist as well as director of the Zoological Museum of the University "La Sapienza", left a remarkable morphological description of a large male sperm whale stranded on the Adriatic coast of Italy in 1874, including an extremely detailed representation of the circulatory system, heart and aorta, gastro-intestinal tract, spermaceti organ, respiratory tract, brain and dura mater, and genital organs. The paper is enriched by beautifully crafted drawings of internal anatomical features, and by anatomical comparisons between sperm whales and other dolphin species. Antonio Carruccio, who succeeded to De Sanctis in the direction of the museum, made quite a few contributions. These include accounts and descriptions of cetacean specimens acquired by his institution, such as a minke whale captured in a tuna trap in Tuscany (1899, 1900), a live-stranded long-finned pilot whale off Anzio (1903), a Risso’s dolphin captured in Tuscany (1906), with a review of the species’ occurrence in Italy, and finally (1911) a rather adventurous account with measurements of a small balaenopterid whale, by him supposed a minke whale, stranded at Castel Fusano, near Rome. In 1914 Giuseppe Lepri, of the Institute of Zoology of the University of Rome, rectified Carruccio’s 1911 report, demonstrating that the Castel Fusano specimen was, in fact, a very young fin whale. Gustavo Brunelli, from the Accademia Nazionale dei Lincei, attempted in 1928 (without success) to organise the collection of data on cetacean reproductive biology through the analysis of pregnant dolphin females which had become available through a culling programme. Brunelli also described in 1928, in cooperation with colleague G. Fasella, the stranding of a female *Mesoplodon*, which they differentiated from *Ziphius* as having two mandibular teeth in medial position; unfortunately, no specimen from this extremely rare event in the Mediterranean was secured to science. The greatest production in terms of cetological literature in Rome came in the 1950s, through the works of Giuseppe Tamino, curator at the Civic Zoological Museum of that city. Among his contributions we here recall a detailed account of a long-finned pilot whale stranded near Rome (1952), an account of the stranding of a young fin whale on the island of Ischia (1953), with morphometrics and comparisons with other known specimens, an account and measurements of the strandings of two sperm whales along the Tyrrenian coast of Italy, with a review of past occurrences (1953), an account and measurements of the stranding of a fin whale in the bay of Salerno (1953), an account of the stranding of a Risso’s dolphin near Rome (1953), a study on the osteomorphology of a long-finned pilot whale (1954), with speculations about the species’ functional anatomy and locomotion, a study of the muscular anatomy of Risso’s dolphins and on this species’ swimming capabilities (1953), a report on a stranded young fin whale in the Gulf of La Spezia (1956), with comments on fin whale morphometry and allometry, and finally an account of the stranding of a Cuvier’s beaked whale in 1957, with morphometrics and comparisons with other similar strandings in Italy.

**Naples.** The zoological museum of that city hosts what may be regarded as one of the rarest specimens of cetaceans from the Mediterranean, the mounted skeleton of a North Atlantic right whale, which stranded in Taranto in 1877 and was acquired by Paolo Panceri, professor of comparative anatomy at the University of Naples; the skeleton is described in detail by Gasco (1878), as well as by Giovanni Capellini (1877b) from Bologna (see below). Gesualdo Police, from the university of that city, provided in 1909 a detailed description of the cranial anatomy of a long-finned pilot whale, together with a review of the occurrence and captures of that species along the Italian coasts. Francesco Saverio Monticelli, director of the zoological museum of the University “Federico II” of Naples, discussed (1906) the collection of a large sperm whale stranded on Ischia in 1770, and reported in 1925 the entrapment of a minke whale in a fixed tuna net on the island of Ischia in 1925.

**Sicily.** Antonino Mongitore (1734) provided an interesting account of a very rare event in the Mediterranean, the mass stranding of 16 sperm whales near Mazzara del Vallo (western Sicily), allegedly during a violent storm on 30 November of that year. An interesting summary of the cetaceans found in the waters surrounding Sicily was compiled in 1868 by Sicilian naturalist Francesco Minà Palumbo. Few years later, Pietro Doderlein, director of the Museum of Zoology and Comparative Anatomy of the University of Palermo, published an account of the Sicilian vertebrate fauna, in which cetacean species are listed, although with little direct knowledge (1871). In 1883 Giuseppe Riggio, curator of that museum, described the anomalous skull of a common dolphin. The same author also provided in 1893, together with a discussion on the presence of large cetaceans in the area, yet another mass stranding account of seven sperm whales on the coast of western Sicily in 1892. In Messina, Concettina Scordìa from the local Istituto Sperimentale Talassografico reported rather mysterious occurrences, in 1933 and 1939, of “pilot whales” attacking giant bluefin tuna in the Strait of Messina (1939); these were, in fact, false killer whales, as is apparent from the published photograph of a skull (also pointed out by Orsi Relini and Cagnolaro 1996). In later years Arturo Bolognari, director of the Institute of Zoology of the University of Messina, was fascinated by sperm whales, and gave numerous accounts (1949, 1950, 1951, 1957) of specimens that were captured off eastern Sicily, together with morphometrics and a
wealth of other information. Later contributions from northeastern Sicily were provided by Di Natale and Giuffré (1976), and Di Natale and Mangano (1985).

**Puglia.** Pasquale Manni reported in 1827 a large whale stranded near the tip of the Apulian peninsula, on the Adriatic side, and provided sufficient information to identify the whale as *Balaenoptera physalus*. Pietro Parenzan, curator of the zoological collection in Porto Cesareo (Lecce), reported on the stranding of a fin whale on the island of Ponza (Tyrrenian Sea) in 1957, and on the capture of a Risso’s dolphin in the Gulf of Taranto in 1961. It is also worth mentioning here the compilation on cetacean reports for the seas adjacent to the Apulian coasts by Giambattista Bello (1990), from the Provincial Laboratory of Marine Biology of Bari, as this paper mostly refers to historical occurrences.

**Bologna.** Sebastiano Richardi, who directed the university museum of comparative anatomy before moving to Pisa, enriched the collection with several cetacean specimens, including the skeleton of 19 m-long Mediterranean sperm whale, the largest on record in Italy. Giovanni Capellini, professor of geology at the university of that city, published in 1877 two important cetological papers: a very detailed osteological description of another specimen caught near the mouth of the river Piave in 1882, and published in 1894 a list of cetaceans occurring in the Adriatic Sea. Venetian naturalist Alessandro Pericle Ninni reported two Risso’s dolphins which entered the Venice Lagoon in 1890; Emilio Ninni provided in 1901 an account of the cetacean species known to have been captured, stranded or occurred in the Adriatic (surprisingly failing to mention the Risso’s dolphins in Venice in 1890), and commented on the dolphins’ relative abundance at sea, based on accounts from fishermen. E. Ninni further speculated about the behaviour of dolphins, again based on reports from fishermen (1904). In more recent times naturalist Giampaolo Rallo reported on the sighting of a bottlenose dolphin inside the Venice lagoon (1976), and later compiled an account of cetaceans from the Adriatic Sea (1979).

**Venice.** In 1715 chemist Giovanni Girolamo Zannichelli published in Venice “Puro e distinto ragguaglio del gran pesce chiamato Balenotto bufalino, detto anche Capo d’olio, preso in vicinanza del porto di Pesaro il giorno 18 aprile 1715 da P. Domenico Cavaglieri” (not seen, cited by Tortone 1963a). Giovan Domenico Nardo (1855) listed all the species of marine mammals found in the Adriatic Sea known to him. Enrico Filippo Trois, curator of the natural history collections of the Istituto Veneto di Scienze, Lettere ed Arti of Venice, provided a first record of a Risso’s dolphin in the northern Adriatic Sea in 1874, gave a detailed anatomical description of another specimen caught near the mouth of the river Piave in 1882, and published in 1894 a list of cetaceans occurring in the Adriatic Sea. Venetian naturalist Alessandro Pericle Ninni reported two Risso’s dolphins which entered the Venice Lagoon in 1890; Emilio Ninni provided in 1901 an account of the cetacean species known to have been captured, stranded or occurred in the Adriatic (surprisingly failing to mention the Risso’s dolphins in Venice in 1890), and commented on the dolphins’ relative abundance at sea, based on accounts from fishermen. E. Ninni further speculated about the behaviour of dolphins, again based on reports from fishermen (1904). In more recent times naturalist Giampaolo Rallo reported on the sighting of a bottlenose dolphin inside the Venice lagoon (1976), and later compiled an account of cetaceans from the Adriatic Sea (1979).

**Trieste.** Antonio Valle provided in 1900 a summary of past occurrences of Risso’s dolphins in the northern Adriatic, comprising the waters adjacent to the Istran peninsula and Dalmatia, at that time part of Italy, including as well the original description of a recent capture with morphometrics and endoparasites. In 1932 Aristocle Vatova, from the Italian-German Institute of Marine Biology of Rovigno, listed *Delphinus delphis* and *Tursiops truncatus* among the marine animal species that are most frequently encountered in that area.

### 3. Beginning of a concerted and systematic scientific activity at the national level: the Centro Studi Cetacei.

The first advocates of the need for organised research on cetaceans in Italy, and for the collation of the existing information on this mammalian order, were Arturo Bolognari from the University of Messina (1951), and Enrico Tortone from the Genoa Museum (1963a). However, a real impulse in this direction had to wait until 1985, when the foundations were laid for the organisation of a nation-wide cetacean stranding network during a conference held in Riccione (Notarbartolo di Sciara et al. 1986). That meeting saw the creation of the Centro Studi Cetacei (CSC), consisting of a group of zoologists concerned with cetacean science, and hosted by the Italian Society for Natural Science in Milan. The CSC embarked immediately in the organisation and maintenance of a nation-wide stranding network, *Progetto Spiaaggiamenti*, still operant today. The most remarkable aspect about the CSC and its network is its strict volunteer status, and the scope of its achievements which were produced at zero cost for the Italian taxpayer. The activities of the CSC were most notably supported by the Natural History Museum of Milan, through the funding of the annual reports published on the proceedings of the Italian Society of Natural Sciences (Centro Studi Cetacei 1987, 1988, 1990, 1991, 1992, 1994, 1995, 1996a, 1996b, 1997a, 1997b, 1998, 2000, 2001, 2002, 2003, in press a, in press b), and through the coordination of *Progetto Spiaaggiamenti* by the Museum’s curator, Michela Podestà. During its first ten years of operations, a total of 1,463 cetacean specimens belonging to 11 species were recorded (Borri et al. 1997; Bortolotto and Podestà 1997), and listed in the yearly reports. The total number of specimens recorded by the CSC has meanwhile grown to 2,928 in 16 years (1986-2001).
Of all these, a total 377 specimens had been secured by a number of zoological collections around the country during the first decade of operations (Cagnolaro 1997), providing an unprecedented influx of study material into Italian research institutions. Collections benefiting from the output of CSC included, most notably, the museums of Florence, Genoa, Livorno, Milano, Pescara, Rome, and Siena, as well as that of the Fondazione Cetacea in Riccione. Updated catalogues of some such collections have been compiled since, to account for the large number of new entries. These include the catalogue of the collection in Rome (Carlini 1991), Siena (Pezzo et al. 1995), Pisa (Cagnolaro and Braschi 1993) and Naples (Maio et al. 2001b).

Through the results of its strandng network, the CSC has provided a remarkable flow of study material which is vigorously promoting the advance of knowledge in the fields of cetacean pathology, toxicology, mortality, and conservation, despite the limitations of research efforts dedicated to these mammals imposed by the lack of funding and consequent absence of university programs specifically dedicated to cetaceans throughout the 15 Italian faculties of veterinary medicine. Until 10-15 years ago, medical research on cetaceans was limited to few passionate scientists from the Institute of Parasitology of the University of Rome “La Sapienza” (now Section of Parasitology of the Department of Public Health Sciences), the Department of Public Health and Cell Biology of the University of Rome “Tor Vergata”, the Institute of General Veterinary Pathology (now Section of Parasitology of the Department of Veterinary Public Health) of the University of Milan, and the Department of Experimental Veterinary Science of the University of Padua, Bologna and Siena (e.g., Paggi et al. 1986). Studies on development, structure and function of dolphins have been promoted at the Institute of Anatomy of Domestic Animals of the University of Milan in the ‘80s and ‘90, and presently at the Department of Experimental Veterinary Science of the University of Padua, where Bruno Cozzi has managed in 2002 to establish a pioneering tissue bank of Mediterranean cetaceans. A specific, active interest in pathology was developed in the ‘90s by Giovanni Di Guardo, now at the University of Teramo, who studied morbillivirus infections in Mediterranean cetaceans. In fact, data from the CSC network provided the sole evidence that a morbillivirus epizootic of striped dolphins, originated in Spain, had extended to Italy (Bortolotto et al. 1992). Several “Istituti Zooprofilattici” (State Institutes for Animal Health), and Departments of Veterinary Pathology of some Universities (Bari, Bologna, Napoli, Padova, Palermo) now provide diagnosis for stranded cetaceans and are active with specific research projects (e.g., Di Guardo et al. 2001, Maio et al. 2001a).

Studies of the presence of contaminants in the tissues of cetaceans, stranded as well as free ranging, are undertaken most extensively at the Department of environmental sciences of the University of Siena. Toxicological analyses were performed on biopsy samples that were largely provided by the CSC (stranded animals) and by the Tethys Research Institute (free-ranging animals). In the early 1990s Silvano Focardi and co-workers started producing information on the levels of contaminants found in cetaceans stranded along the Italian coasts (e.g., Focardi et al. 1991, Marsili and Focardi 1997). This work was expanded by Maria Cristina Fossi, Letizia Marsili and their colleagues at the Laboratory of Biomarkers of that same university, who specialized in advanced methodologies applied to the investigation of cetacean toxicology. As a whole, the Senese research group produced a remarkable body of scientific information aimed at evaluating the toxicological risk of Mediterranean cetaceans (e.g., Fossi et al. 1992). Additional work was done by Claudio Leonzio (University of Siena) and Marco Nigro (University of Pisa) on levels of heavy metals found in cetacean tissues. Other laboratories investigating contaminants included the University of Genoa (e.g., Capelli et al. 2000), the zoological museum of Rome (e.g., Carlini and Fabbri 1989), and Taranto’s Istituto Sperimentale Talassografico (Cardellicchio 1996).

4. Ecology, behaviour and population studies

Knowledge of the distribution, abundance, and population ecology of cetaceans in the seas surrounding Italy, based on data collected at sea, was virtually absent until the 1980s. During the early decades of the 20th cent. such type of studies had made considerable progress in other fields of zoology, mostly on terrestrial environments but also including marine species such as fishes and invertebrates. However, cetaceans had remained largely impermeable to such advances due to the often recalled practical difficulties related to their lifestyle and large body sizes. Arturo Bolognari from the University of Messina was certainly, among the Italian zoologists of the first half of the 20th cent., one of the most intrigued by aspects related to cetacean ecology, and provided a wealth of observations of sperm whales, with speculations on their migration patterns within the Mediterranean (Bolognari 1949, 1950, 1951, 1957).

In 1979 the World Wildlife Fund Italy launched “Progetto Cetacei”, a programme consisting in the collection of information on sightings, strandings, and accidental captures of cetaceans in the seas surrounding Italy, in cooperation with the Institute of Zoology and Comparative Anatomy of the University of Messina and the Civic Natural History Museums of Milan and Venice. Several other research institutions, including the Museum of Natural History of Genoa,
the Museum of Zoology of Rome, and other laboratories involved in the collection and study of stranded cetaceans, were later involved in the programme (e.g., Di Natale 1979, Di Natale and Mangano 1981). Although the scientific merit of "Progetto Cetacei" was weakened by the impossibility of verifying the quality of the data, generally thought to be rather heterogeneous, this initiative represented the first attempt of a nation-wide organized, systematic description of the distribution of cetaceans in Italy, with the involvement of a large number of recognized research institutions, and promoting the awareness on cetaceans among the general public.

In the second half of the 1980s a small number of Italian researchers began to realise that the information that could be obtained through "traditional" investigation techniques such as the monitoring of stranded cetaceans and the analysis of museum collections (let alone studies on captive animals) could not provide a satisfactory understanding on the ecology and status of free-ranging populations. The first who pioneered the approach of collecting information at sea in Italy were Michela Podestà and Luca Magnaghi, who at that time were intern students of Luigi Cagnolaro. Podestà and Magnaghi were lucky enough to start their studies in the Ligurian Sea waters of today's Pelagos Cetacean Sanctuary, where cetacean densities are particularly high. Their work, conducted from various platforms of opportunity, represented the first truly modern approach to the study of free-ranging animals through direct and systematic observations at sea (Podestà 1986; Magnaghi and Podestà 1987; Podestà and Magnaghi 1988). In the wake of their example, and taking as a model studies conducted overseas, other enthusiastic students soon began to take the sea in search for dorsal fins, and started to import field research techniques that by that time were routinely adopted by several researchers in the U.S. and elsewhere. This work, partly incorporated in the scientific literature, was typically conducted in the context of Biological Sciences or Natural Sciences theses (e.g. Cavalloni 1988, Zanardelli 1988, Bearzi 1989).

Pioneer work conducted in the 1980s, together with a raising interest towards cetacean field research, stimulated a number of studies aimed to describe the distribution and species composition of the cetacean fauna off several portions of the Italian coast. Many of these studies were conducted with minimal funds, often by taking advantage of platforms of opportunity or privately-owned boats. One of the most comprehensive early scientific attempts to produce an overview of cetacean distribution and relative abundance in Italian waters was conducted by the Tethys Research Institute (Notarbartolo di Sciara et al. 1993), a non-profit organization funded by the senior author in 1986. Although preliminary, this early survey of the Italian cetacean fauna provided the first overview of cetacean distribution, relative abundance (weighed by effort) and habitat use of cetaceans off the national coasts, in which the extraordinary importance of the Ligurian Sea was for the first time emphasized by quantitative data.

During the first half of the 1990s, research on free-ranging cetaceans boomed. An increasing number of groups specialising in cetacean studies were founded. These included both institutional bodies (e.g. universities or governmental institutes) and NGOs, with a clear predominance of the latter. As a consequence of this growing interest in cetaceans, Italian scientists began to attend with increasing frequency national and international marine mammal conferences, such as those of the European Cetacean Society and the Society for Marine Mammalogy. It is undeniable that at the beginning of this process a lack of familiarity with the English language kept many Italian researchers away from such fora, or made it difficult for them to enter a scientific microcosm that was predominantly Anglophone. However, this gap was soon overcome, and by the mid 1990s international marine mammal conferences had a strong Italian component.

Providing a comprehensive review of the work done by Italian cetologists after 1980 goes beyond the scopes of this essay. A minimum of 556 "scientific contributions" (see list and working definition in Bearzi et al., this volume) were produced since 1980 and it would be difficult to consider all of them individually. An effort to mention some of the groups who have been particularly active in the realm of ecology, behaviour and population studies is attempted here, although we realize that our selection criteria will be inevitably biased by our personal experience and perception. While being aware that our effort may result in disappointment by those who do not appear here, we hope that such an imperfect exercise will provide impetus for a more comprehensive and balanced review of the recent history of cetacean science in Italy. Meanwhile, omissions must be exclusively blamed on the authors of this essay. We apologize with all those individuals and research groups whose work has been overlooked.

For the purposes of the brief overview provided below, the criterion for inclusion of a research group rests on the number and quality of published contributions in the field of ecology, behaviour and population studies. Contributions included in the proceedings of the European Cetacean Society conferences ("European Research on Cetaceans"), although not benefiting from a Science Citation Index, were considered here nevertheless, due to their great numbers and to their importance in documenting the status of cetacean research in Italy (see Bearzi et al., this volume). All other conference presentations and unpublished or "grey literature" contributions were excluded from this analysis.
As some of the authors changed affiliation over time, an attempt was made to relate their work to the institute for which they issued most of their published contributions. The research groups below are listed alphabetically.

**Centro Interdisciplinare di Bioacustica e Ricerche Ambientali (CIBRA).** The Interdisciplinary Centre for Bioacoustics and Environmental Research, founded in 1988 at the University of Pavia, is headed by Gianni Pavan who began in the early '80 to design detection and analysis equipment for investigating cetacean acoustics (Zanardelli 1988, Pavan 1992). Having considered the dearth of available bioacoustic instrumentation and data in those years in the Mediterranean Sea, CIBRA started organising cetacean surveys based on passive acoustic methods with towed hydrophones designed for the purpose, through funding from the Ministries of merchant marine and environment (Pavan 1995, Pavan and Borsani 1997, Priano et al. 1997). In 1995, within the framework of the European Nature Conservation Year launched by the Council of Europe, CIBRA organized and promoted a cooperative project with the Italian Navy for the protection of marine mammals and of the marine environment (Pavan 2002). One of the most representative research projects started within this context, and still ongoing, investigates the ecology and behaviour of sperm whales (Pavan et al. 1997a, 1997b, 1999, 2000; Teloni 1998; Priano et al. 2001; Fossati et al. 2003), with funding from the Italian Navy and the US Office of Naval Research. Different platforms and acoustic detection systems were used and tested for improving acoustic methods for the detection, monitoring and surveying of marine mammals (Pavan 1996; Pavan et al. 2001; Fossati et al. in press), including the development of ad hoc software to support Environmental Impact Reduction (Pavan et al. 2004). CIBRA was among the promoters of, and first participants to the SOLMaR Project organised by the Saclant Undersea Research Center. CIBRA currently maintains one of the most extensive digital library of underwater sounds in Europe, including both animal vocalizations and manmade signals, as well as a public consultation library with over 5,000 papers on acoustics and bioacoustics.

**Consiglio Nazionale delle Ricerche (CNR).** Since the mid-1990s, National Research Council researcher Massimo Azzali and colleagues at the Istituto di Ricerche sulla Pesca Marittima (IRPEM) of Ancona worked on a wide range of issues, mostly centred around acoustic research techniques. These included various studies in captivity, bioacoustic research on free-ranging cetaceans (e.g. Azzali et al. In press) and work on Adriatic dolphins (e.g. Azzali et al. 2000, Manoukian et al. In press). In addition, Claudio Lafortuna at the Istituto di Bioimmagini e Fisiologia Molecolare has done relevant work on the physiology and locomotion of free-ranging cetaceans (Jahoda et al. 2003, Lafortuna et al. 2003).

**Fondazione Cetacea.** Although dealing in large part with cetacean husbandry, public awareness and education, the Fondazione Cetacea produced information on free-ranging cetaceans living in the Adriatic Sea, that was included in the newsletter by the Fondazione (“Cetacea Informa”) or presented at national and international conferences. Refereed contributions on the occurrence or rare cetaceans in the Adriatic Sea were also published (e.g. Stanzani and Piermarocchi 1992; Affronte et al. 2003). The Fondazione has been active in the rescue and rehabilitation of live-stranded cetaceans throughout Italy (Bortolotto et al. 1992).

**Istituto Centrale per la Ricerca Applicata al Mare (ICRAM).** Within the framework of its general mandate to support national policy in matters concerning the protection of threatened marine species, ICRM launched in the late 1990s and early 2000s a series of activities to promote cetological knowledge. These included, among others, an investigation of bottlenose dolphins in the waters of the National Park of Asinara (north-western Sardinia), and of their conflicts with fishing operations (Lauriano et al. 1999, in press a, b), the acoustic monitoring of the Pelagos Sanctuary through the deployment of bottom-deployed “popup” hydrophones for a period of three years by J. Fabrizio Borsani (Borsani et al. 1999a, 1999b, 2000; Clark et al. 2002, an investigation of dolphin-fisheries interactions in the northern Adriatic Sea (Casale in press), and the collection of sightings data from the Italian Navy (Nascetti and Notarbartolo di Sciara 1997). ICRM is a “partner” of the Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS).

**Oceanomare.** In 1996 Daniela Silvia Pace, together with Francesca Triossi and Marina Pulcini, started a study on bottlenose dolphins around the island of Lampedusa (Pulcini et al. 1997; Pace et al. 1999, in press b; Pulcini and Pace 1999), including dolphin interactions with local fisheries (Pace et al. in press a), within the framework of an NGO named Oceanomare. Oceanomare is collaborating with two other Italian NGOs, Delphis and Ketos, for projects focusing on the behaviour and ecology of Mediterranean cetaceans. Francesca Triossi has recently started a study on Adriatic Sea bottlenose dolphins (Triossi and Tizzi in press). Marina Pulcini also produced work on cetaceans of the Ligurian Sea and adjacent waters, and in the Greek Ionian islands (Pulcini and Pace 1999).

**Saclantcen.** In the late 1990s, partly as a result of the increased interest by NATO in the relationship between mass cetacean strandings and military sonar exercises, the Saclant Undersea Research Centre of La Spezia began a series of studies coordinated by Angela D’Amico, within the framework of an international program named SOLMaR (Sound,
Oceanography and Living Marine Resources) was setup with the cooperation of several research institutions and the Italian Navy. SOLMaR focused initially on the correlation of cetacean presence and oceanographic and biological features in the Ligurian Sea (D’Amico et al. 2003), and included the tagging of sperm and Cuvier’s beaked whales with D-Tags in cooperation with the Woods Hole Oceanographic Institution. Furthermore, a Mediterranean-wide multidisciplinary database and GIS system was developed, including 15 years of stranding and sightings data collected by the CSC, as well as acoustic and visual records from CIBRA and other institutions (Fossati et al. 1999; Manghi et al. in press; Pavan et al. in press).

**Studiomare/Delphis.** Research in the waters surrounding the islands of Ischia and Ventotene was conducted by Studiomare (now Delphis - Mediterranean Dolphin Conservation) since 1991, thanks to the efforts of Barbara Mussi and Angelo Miragliuolo. Starting in 1997 Delphis focused its work on the submarine canyon of Cuma, off the island of Ischia, where a remarkable density and diversity of cetaceans was found. This resulted in a proposal for the creation of a Marine Protected Area that is attracting considerable interest. Research has also focused on a relict group of common dolphins (Mussi et al. in press), on a small pod of long-finned pilot whales (Mussi et al. 2000), on cetacean interactions with fisheries and other anthropogenic threats (Mussi et al. 1999 a; Miragliuolo et al. in press a, b), and on other cetacean species found in the area (Mussi et al. 1999 b, 2001).

**Tethys Research Institute.** Founded in 1986, the Tethys Research Institute is a NGO specialized in cetacean research. Exclusively based on autonomous fundraising, Tethys has generated one of the largest datasets on Mediterranean cetaceans and over 200 scientific contributions. Tethys first conceived and proposed the creation of the Ligurian Sea Pelagos Sanctuary (Notarbartolo di Sciara et al. 1991, 1992; Notarbartolo di Sciara 1997), based on extensive information collected in the field. Data collected by Tethys since 1990 contributed to show that fin whales are endemic in the Mediterranean (Notarbartolo di Sciara et al. 1996; Berubé et al. 1998). Tethys has conducted longitudinal studies of bottlenose dolphins in the northern Adriatic Sea since 1987 (Bearzi et al. 1997, 1999, 2000; Fortuna et al. 1997, 1999, 2000), and on both common and bottlenose dolphins in the eastern Ionian Sea (Politi et al. 1994; Bearzi 2003). Research methods used by Tethys included remote sensing and telemetry (Panigada et al. 1999; Jahoda et al. 2003; Airoldi et al. In press), relative abundance (Notarbartolo di Sciara et al. 1993) and line-transect population studies (Forcada et al. 1995), the combined use of laser range-finding binoculars and GPS to passively track and record the horizontal movements of whales (Notarbartolo di Sciara et al. 1997; Jahoda et al. 2003), bioacoustic research (e.g. Borsani et al. 1992, 1997), photo-identification and behavioural sampling, remote biopsy sampling for genetic and toxicological analyses, and historical research (Bearzi et al. 2004). Tethys owns photographic archives exceeding 50,000 cetacean images, that have resulted in the identification of over 1,200 individuals of seven Mediterranean species. This expertise has granted to Tethys a role as regional coordinator for the EC-funded Europhlukes project. Tethys manages one of the largest collections of scientific literature on cetaceans in Europe, currently including over 11,000 entries. Comprehensive reviews of Mediterranean fin whale and common dolphin populations were produced (Bearzi et al. 2003; Notarbartolo di Sciara et al. 2003). Following a proposal by the junior author in 2003, the Mediterranean common dolphin population was listed as “Endangered” in the IUCN Red List of Threatened Species. Tethys is a “partner” to the Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS).

**University of Durham, U.K.** In the late 1990s Ada Natoli, a researcher with the Tethys Research Institute, started investigating and comparing the population genetics of Mediterranean, Black Sea and North Atlantic cetaceans in the context of her PhD curriculum with Dr. Rus Hoelzel at Durham. Ada is applying genetic investigation methods to the study of philopatry in bottlenose dolphins and common dolphins (Natoli and Hoelzel 2000; Natoli et al. in press a, b). Stefania Gaspari - also a Tethys collaborator - is another Italian researcher who has worked with the University of Durham in the context of her PhD programme, focusing on the social and population structure of striped dolphins and Risso’s dolphins in the Mediterranean (Gaspari et al. 2000, in press).

**University of Genova.** Since the early 1990s, researchers from the University of Genova, particularly Lidia Orsi Relini, Giulio Relini and Maurizio Wurtz, have been focusing on the diets of cetaceans living in the Ligurian Sea, and on the ecology and distribution of their prey (Orsi Relini and Garibaldi 1992; Orsi Relini and Giordano 1992; Wurtz et al. 1992 a,b; Orsi Relini and Relini 1993; Wurtz and Marrale 1993; Orsi Relini et al. 1994 a, b; Relini et al. 1994). This work has produced significant scientific information that benefits our understanding of the ecological roles of Mediterranean cetaceans. The University of Genova was among the initial promoters of the idea of a pelagic reserve in the Ligurian Sea, where cetaceans would find protection from Italian driftnet operations (Orsi Relini et al. 1992).

**University of Rome and the Accademia del Leviatano.** Since the early 1990s, the University of Rome has been focusing on cetacean ecology and distribution, particularly in the central Tyrrhenian Sea, as well as on the behaviour and ecology of dolphins in Sardinia coastal waters, producing several contributions (e.g. Consiglio et al. 1999; Forcada et al. 1999; Orsi Relini and Wurtz 1999; Wurtz and Orsi Relini 1999).
The Agreement and its Scientific Committee, currently chaired by the senior author, have since become an integral component of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) that came into force in 1992, with the aim of ensuring the favourable conservation status of cetacean populations in this marine region, and as a consequence of this political will the UN Agreement on the Conservation of Mediterranean Cetaceans was established. The riparian nations in the Mediterranean and Black seas have decided to cooperate to ensure the favourable conservation status of cetacean populations. This agreement continues the work on bottlenose dolphin off the northern Sardinian coasts (Díaz López et al. 2001). Research was also conducted in other Mediterranean areas, including the Aegean Sea (Marini et al. 1996 a; Carpentieri et al. 1999). L. Marini and colleagues published a refereed account on fin whale aerial behaviour (Marini et al. 1996 c).

We finally wish to mention here a number of other organisations, which have contributed to the promotion of scientific knowledge on cetaceans in Italy through the implementation of specific activities. These include:

• Acadario di Genova, where a sighting programme was recently implemented targeting dolphins found in the coastal area of the city of Genoa, called “Delfini Metropolitani” ( Gnone et al. in press).
• Centro Turistico Studentesco (CTS), which has been monitoring bottlenose dolphin groups off the coasts of Sardinia and Lampedusa for several years, also promoting public awareness and conservation initiatives (Fozzi et al. in press; Zannetti and Di Marco in press; Zannetti et al. in press).
• Cetus, a research, educational and whale watching NGO established in 2000 and based in Viareggio, conducting cetacean surveys in the Tuscan Archipelago (Nutì and Chiericoni, in press).
• Ketos, and NGO established in 1997 and based in Catania, which has produced several contributions on the ecology and behaviour of cetaceans off the eastern coast of Sicily (Tringali et al. 1999, 2001, Catalano et al. in press; Puzzolo and Tringali in press a; Tringali and Puzzolo in press), as well as accounts of dolphin-fisheries interactions (Puzzolo and Tringali in press b; Tringali et al. in press). Ketos' researchers have also been involved previously in similar cruises promoted by the Museo del Mare of Cefalù (Giordano and Tringali 1992, Giordano et al. 1995).
• the Italian Navy contributed to knowledge on distribution of large cetaceans in the Italian Seas by reporting sightings to ICRAM (Nascetti and Notarbortolo di Sciara 1997), and investigating possible effects of military sonars on cetaceans (Nascetti et al. 1997). In addition, the Italian Custom’s Authority (Guardia di Finanza) contributed sighting reports and welcomed cetacean researchers on board its vessels in the Adriatic Sea.
• the World Wide Fund for Nature, Italy (WWF). The Ligurian section of the WWF, largely through the efforts of Roberta Trucchi, has been conducting research campaigns in the Ligurian Sea cetacean fauna since the late 1990s (Trucchi et al. 1999, in press). Researchers from the Miramare Marine Reserve affiliated with the World Wide Fund have been monitoring the cetacean fauna of the Gulf of Trieste since the mid 1990s (Francese et al. 1999, Picciulin et al. in press).
• Zoönomia, established in the late 1990s by Alessandro Bortolotto (formerly with the Fondazione Cetacea), is a non-profit association aimed at the conservation of biodiversity, with particular reference to cetaceans. Research activities include the reproductive behaviour of captive bottlenose dolphins, ecology of wild cetaceans (in Italy and Tanzania), strandings (Bortolotto et al. 1992) and microscopic anatomy of cetaceans (Bortolotto 1994, 2001).

5. Science for conservation

Until few decades ago, it was very uncommon for a zoologist to explicitly express concern for the conservation status or for the living conditions of his or her study subjects: a ‘real’ scientist had to remain detached from the contamination of emotions, and remain strictly confined within the limits of purported objectivity. More recently it has dawned on an increasing fraction of the scientific community that science – while still remaining outside of an emotional context - is the most powerful tool for the initial addressing of the widespread concern for the state of the world’s biodiversity, by providing decision makers and managers with much needed support for the adoption of remedial or mitigating measures. Thus conservation has become today a science in its own right. That such evolution of science has affected also cetacean research in Italy is demonstrated in many ways. Some of the strongest evidence to this date of the existence of serious conservation problems for cetaceans in Italy, caused by threats such as pollution (Focardi et al. 1991, Marsili and Focardi 1997); epizootics (Bortolotto et al. 1992); collisions with vessels, intentional kills (e.g., with firearms), and accidental captures in fishery operations (Notarbortolo di Sciara 1990, Cagnolaro and Notarbortolo di Sciara 1992), has derived from the stranding network managed by the CSC. At the same time, research cruises to investigate cetacean populations at sea (e.g., Notarbortolo di Sciara et al. 1993, Forcada et al. 1995), and long-term studies of resident dolphin communities (e.g., Bearzi 2003), were designed and conducted specifically to provide knowledge badly needed for conservation purposes. Recently, the riparian nations in the Mediterranean and Black seas have decided to cooperate to ensure the favourable conservation status of cetacean populations in this marine region, and as a consequence of this political will the UN Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) came into force in 2001. The Agreement and its Scientific Committee, currently chaired by the senior author, have since become an integral part of the scientific community.
important catalytic force for the promotion of cetacean knowledge and conservation in the region, and Italian professionals are becoming engaged in cetacean science in increasing numbers under the Agreement’s auspices.

We would like to conclude this review of our country’s contribution to cetacean knowledge by recalling that the first awakening of the scientific community in Italy to the problem of cetacean conservation was due, to the best of our knowledge, to Prof. Arturo Bolognari from the University of Messina. As a tribute to his foresight, we report here (English translation ours) the concluding paragraph of his last (1957) paper on sperm whales:

“Finally, we formulate the wish that the Sperm whale, instead of enduring the fate of having to disappear due to the relentless hunt that mankind has been conducting against it for centuries, may continue to plough the world’s oceans as its instinct dictates; to testify in this way, with its immense size in which force, agility and beauty coexist, a highly significant work of Nature. And perhaps we would render to the sperm whale justice by not considering it anymore a sea monster, but rather a being having the full right of living undisturbed on Earth.”

6. Acknowledgements

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