



NOTES

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THE ENIGMA OF HARBOR PORPOISE PRESENCE IN THE MEDITERRANEAN SEA

The harbor porpoise (*Phocoena phocoena*) is distributed throughout the temperate and subarctic continental shelf waters of the Northern Hemisphere (Rice 1998, Read 1999). Populations of this species in the North Pacific, North Atlantic, and Black Sea are geographically isolated (Gaskin 1984, Yurick and Gaskin 1987, Rosel 1997) and are generally considered separate subspecies, based on regional variation in morphology (Yurick and Gaskin 1987, Amano and Miyazaki 1992, Rice 1998) and genetics (Wang *et al.* 1996, Rosel *et al.* 1995). Although Rice (1998) did not recognize the Black Sea subspecies *P. p. relicta* Abel, 1905, there is strong genetic evidence to support this status (Rosel *et al.* 1995).

Harbor porpoises are assumed to have colonized the Black Sea from the Atlantic Ocean (Gaskin 1982, Rosel 1997). This hypothesized relationship is based on both geographical proximity and genetic evidence (Rosel *et al.* 1995), and it implies that a harbor porpoise population once existed in the Mediterranean Sea, when water temperature was considerably cooler than today (Gaskin 1982). From the northeastern part of the Mediterranean (*i.e.*, the northern Aegean Sea), they could have entered the Black Sea after it was transformed from a lake to a sea, some 7,000 yr ago (Ryan *et al.* 1997, Aksu *et al.* 1999). Though some historical records suggest that the species was present in the Mediterranean until the end of the 19th century, today all reliable evidence indicates that harbor porpoises are absent from the Mediterranean Sea (Viale 1985, Evans 1987, Donovan and Bjørge 1995, Notarbartolo di Sciara and Demma 1997, Rice 1998), with the possible exception of the northern Aegean Sea (this work). The purpose of this note is to clarify the historical distribution of *P. phocoena* in the Mediterranean Sea by: (1) reviewing the literature from the end of the 19th century to the present, (2) critically examining unpublished data, and (3) providing new information from three recent strandings in the northern Aegean Sea (Greece, northeastern Mediterranean).

In 350 b.c. the Greek philosopher and naturalist Aristotle (1994*a, b*) attributed the name *phocoena* (“φώκαινα”) to the species and described its morphology in detail, clearly distinguishing between porpoises and dolphins. Interestingly, although Aristotle was based in the northern Aegean Sea, he men-

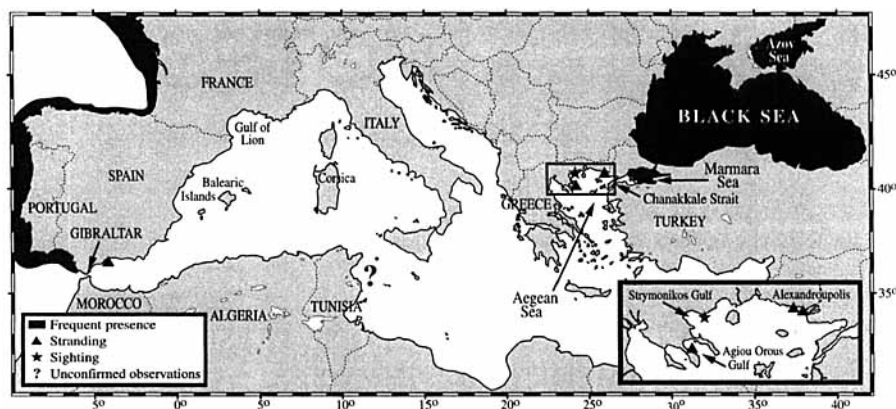


Figure 1. Distribution of harbor porpoises in Mediterranean Sea, Black Sea, and contiguous Atlantic area. All known records for 20th century regarding Mediterranean Sea are shown. Box at bottom right is closer view of northern Aegean Sea and locations of four recent harbor porpoise records. For further details concerning these records refer to text.

tioned the presence of harbor porpoises in the Black Sea but made no reference to observations in the Aegean (Fig. 1). More recently, some 19th century naturalists reported that harbor porpoises were abundant in the Mediterranean Sea. For instance, Companyo (1863) considered the species "excessively common" in the French Mediterranean; Barceló (1875) and Graells (1897) mentioned that it was very common off the Balearic Islands and the Spanish Mediterranean coasts respectively; while in his "Fauna der Cykladen" Erhard (1858) (cited by De Heildreich 1878) reported its presence in the central Aegean Sea. On the other hand, Trouessart (1884) stated that harbor porpoises inhabited the Channel and the Atlantic, but had not been captured in the French Mediterranean. Part of this confusion, no doubt, stems from the vernacular names used at that time to describe porpoises in Spanish ("marsopa") and French ("marsouin") which were also applied to dolphins in general. While some of the above-mentioned authors clearly distinguished between porpoises and dolphins (Companyo 1863, De Heildreich 1878, Trouessart 1884), others courted confusion by not describing the animals they named as porpoises (Barceló 1875).

The situation remained unresolved in the 20th century. Cabrera (1914) included the Mediterranean Sea in his description of the global distribution of harbor porpoises, but specifically mentioned only one specimen in the Straits of Gibraltar (without clarifying whether it was stranded or caught in fishing nets). Bourdelle and Grassé (1955) stated that the harbor porpoise occurred widely throughout the Mediterranean Sea. On the other hand, Richard (1938) (cited in Duguay and Cyrus 1973) noted that observations of harbor porpoises were doubtful due to the frequent confusion with dolphins, and added, ". . . I have never seen a harbor porpoise caught, but always dolphins." Tortonese (1962) claimed that the harbor porpoise was very rare in Italian waters, an

assertion that Toschi (1965), who noted that the species might be confused with dolphins, agreed with. Skeletal remains would confirm some of these earlier reports, however, searches of museum collections have been futile in locating any Mediterranean harbor porpoise material in Spain,¹ France (Duguy and Cyrus 1973, Casinos and Vericad, 1976), Italy (Notarbartolo di Sciara and Demma, 1997) or Greece (this work), neither are cetacean specialists from other Mediterranean countries aware of such material.

In recent times Duguy and Cyrus (1973) reported observations of harbor porpoises off the East Tunisian coasts (Fig. 1) and assumed that this confirmed their presence off the North African coast in general. Subsequent publications on Tunisian cetacean fauna at first refer to the observations reported by Duguy and Cyrus (Ktari-Chakroun 1980), but later considered harbor porpoise presence to be doubtful in Tunisian waters.² Duguy noted that the observations of harbor porpoises in Tunisia had been orally transmitted to him and were not supported by photographs. Duguy added that, at the time he received the information, he judged that his source was highly reliable.³ Regarding other North African countries with a Mediterranean coastline, it should be noted that harbor porpoises were not included in the inventories of the Algerian⁴ or the Mediterranean Moroccan (Bayed and Beaubrun 1987) cetacean faunas. Unfortunately, although no new data have been produced to confirm harbor porpoise observations in Tunisian waters, their possible occurrence there was interpreted by some as an indication of a presence in North Africa as a whole, and the assertion was widely cited in subsequent literature (Casinos and Vericad 1976, Marchessaux 1980, Duguy *et al.* 1983, Duguy 1990, Rice 1998).

Data concerning the occasional presence of harbor porpoises in other regions of the western Mediterranean (Balearic Islands, Corsica, and Gulf of Lion) also seem uncertain. In the French Mediterranean sightings have been proposed by some authors but denied by others (Viale 1985). Duguy and Cyrus (1973) concluded ". . . finally it is important to note that *Phocoena phocoena* has never been observed." Collet (1996) reviewed information on porpoise strandings and bycatch in French waters from 1970 to 1994 and found that there were no reports from the French Mediterranean coasts. In the past decade many regions of the Mediterranean Sea (but not the northern Aegean), have been surveyed repeatedly by various cetological projects, and stranding networks have been established in most Mediterranean countries, but no specimens or

¹ Personal communication from Juan Antonio Raga, Departamento de Biología Animal and Instituto Cavanilles de Biodiversidad y Biología Evolutiva, Universitat de Valencia, Dr. Moliner 50, E-46100 Burjassot, Valencia, Spain, December 1999.

² Personal communication from F. Chakroun, Institut National Agronomique de Tunis, Halieutique, 43, Avenue Charles Nicolle, 1082 Tunis, Tunisia, March 1994.

³ Personal communication from R. Duguy, Musee Oceanographique de la Rochelle, Port des Minimes, 17000 La Rochelle, France, December 1999.

⁴ Personal communication from Z. Boutiba, Director, Institut des Sciences de la Nature, Universite d'Oran Es-Senja, Laboratoire de Biologie et Pollution Marine, B. P. 16, 31000 Oran, Algeria, March 1994.

sightings have been recorded, with the exception of those we report in this paper.

Accidental incursions of porpoises into the western Mediterranean, such as the stranding in Malaga (Rey and Cendrero 1982), mentioned below, should not be surprising as harbor porpoises are reasonably common along the Atlantic coast of the Iberian Peninsula. Sightings and strandings are most common to the north, in Galicia in Spain (Lens 1997) and in northern and central Portugal, but strandings are not infrequent off Faro (Sequeira 1996) and farther south. In 1999 two strandings and one sighting took place close to Gibraltar in Cadiz, southwestern Spain.⁵ Porpoise populations are also found off the Atlantic coast of Morocco and Mauritania (Bayed and Beaubrun 1987, Smeenk *et al.* 1992). Casinos and Vericad (1976) proposed that surface currents entering from the Atlantic could explain the occasional occurrence of porpoises in the Mediterranean, an explanation that has also been put forward by others (Marchessaux 1980, Duguy *et al.* 1983, Viale 1985, Duguy 1990).

After a critical review, we conclude that only five observations of harbor porpoises are reliable indicators of the recent presence of this species in the Mediterranean Sea. All of them occurred close to known populations of the species in the Black Sea or the Atlantic. The first was a stranding of a female harbor porpoise in Playa de la Malagueta (Málaga, Spain, Fig. 1) in October 1981 (Rey and Cendrero 1982). A second case, a sighting in the northeast Strymonikos Gulf, northern Aegean (40°43'N–24°06'E, Fig. 1), occurred in January 1993⁶ when a group of six to ten harbor porpoises was spotted <100 m from the coast. This field observation was supported by three strandings (one of them live) in the same general area. On 26 June 1997 a female harbor porpoise (157 cm in length) stranded alive in Panagias Bay (40°13'45"N–23°44'00"E, Agiou Orous Gulf, northern Aegean Sea). Two more strandings occurred in Apalos Bay (40°50'35"N–25°56'00"E, sea area of Alexandroupolis, northeastern Aegean Sea) on 9 February and 19 March 2000, respectively. Both stranded porpoises were males (126 and 113 cm in length, respectively).

In his review of the global status of the species in 1984, Gaskin concluded that the available literature provided little clear guidance regarding the possible existence of harbor porpoises in the Mediterranean Sea during the past two centuries. We suggest that even if the species was present, a large population linking the Atlantic and Black Sea harbor porpoises is very unlikely: the absence of verified museum specimens (all other Mediterranean cetacean species are well represented), and the extremely low number of captures, strandings, or sightings of harbor porpoises, are all strong arguments against substantial harbor porpoise abundance in the Mediterranean in historical and modern times.

Genetic evidence also supports this suggestion. Rosel *et al.* (1995) compared

⁵ Personal communication from R. de Stefanis, Foundation for information and research on marine mammals, firmm Espana, Pedro Cortes 3, 11380 Tarifa, Spain, January 2000.

⁶ Personal communication from Triantaphyllos Akriotis and George Handrinis, University of the Aegean, Department of Environmental Studies, Old building Xenia, 81100 Mitilini, Greece, December 1999.

mtDNA haplotypes in porpoises from Pacific, North Atlantic, and Black Sea populations. They found that, although Black Sea and North Atlantic control region sequences were more similar to each other than those from the Pacific, none of the 40 unique haplotypes they identified were shared between any of the regions. Therefore, they concluded that Atlantic and Black Sea harbor porpoises are reproductively isolated, a state that would be hard to maintain if a substantial, widespread Mediterranean population had existed in historical times. Substitution rates in the mitochondria control region in porpoises were not sufficiently characterized to allow Rosel *et al.* (1995) to determine how long these populations had been isolated. However, they speculated that if substitution rates of the same order as are found in other cetacean are assumed for porpoises, then the North Atlantic and Black Sea populations may have diverged well before the last glacial maximum (Rosel *et al.* 1995).

The recent strandings in the northern Aegean demonstrate that harbor porpoises occur in this region of the Mediterranean. We do not know whether their presence in this area is sporadic or regular because the cetacean fauna of the northern Aegean has been poorly investigated. There are two feasible scenarios to explain the presence of harbor porpoises in the northern Aegean. The most likely one is that harbor porpoises from the Black and Marmara Seas disperse into the northern Aegean through the Chanakkale Strait (Fig. 1). The second possibility is that these animals belong to a local, isolated, and geographically discrete population. If this is the case, then the northern Aegean population could be a remnant of that formerly dispersed more widely through the Mediterranean Sea.

We conclude that it is unlikely that there was a substantial Mediterranean harbor porpoise population in the past centuries, or even the last few millennia. With the possible exception of the northern Aegean Sea, harbor porpoises are not a regular component of the Mediterranean cetacean fauna. The possible presence of a small breeding population in the Aegean is significant for this species. Clearly, if this represents a remnant of a distinct Mediterranean population it is of great conservation importance. If these animals are in fact part of the Black Sea population, then, bearing in mind the poor ecological health of the Black Sea and the recent history of directed hunting and bycatch (Berkes 1977), the subspecies *P. p. relicta* might be less vulnerable if it was established in two separate locations.

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EVIDENCE FOR SIGNATURE WHISTLE PRODUCTION BY A PACIFIC HUMPBAC DOLPHIN, *SOUSA CHINENSIS*

Delphinids are known for their impressive capacities to both produce and perceive sounds. They can produce a variety of tonal sounds, clicks, and combinations of the two (*e.g.*, Popper 1980). Whistles and burst pulses appear to play a role in social interactions, while broad band clicks are thought to be used mainly for echolocation (*e.g.*, Herman and Tavolga 1980), although clicks also occur in social contexts (*e.g.*, Herzing 1996). Bottlenose dolphins, *Tursiops* spp., have been shown to produce individually distinctive “signature” whistles (Caldwell and Caldwell 1965, Caldwell *et al.* 1990, Sayigh *et al.* 1990, Janik *et al.* 1994). Experiments with captive and restrained bottlenose dolphins have demonstrated that these whistles function as individual identifiers (Sayigh *et al.* 1999) and contact calls (Janik and Slater 1998).

The vocal repertoire of humpback dolphins (three species of *Sousa* are recognized currently, Rice 1998) comprises whistles, burst-pulsed sounds, low-frequency narrow-band sounds, and broad-band clicks (Zbinden *et al.* 1977; Schultz and Corkeron 1994; Van Parijs and Corkeron, in press). The repertoire of Pacific humpback dolphins, *Sousa chinensis*, is similar to that of bottlenose dolphins, although humpback dolphin whistles are generally of higher frequency and shorter duration than sympatric *T. aduncus* (Schultz and Corkeron 1994).

The biology and status of Pacific humpback dolphins are poorly known (Corkeron *et al.* 1997, Jefferson and Leatherwood 1997). They occur in relatively small groups of between one to over 20 individuals, generally in inshore waters (Corkeron 1990, Corkeron *et al.* 1997, Jefferson and Leatherwood 1997). Although recent studies have improved our knowledge concerning Pacific humpback dolphin vocalizations (Schultz and Corkeron 1994; Van Parijs and Corkeron, in press), many areas still remain unstudied. The purpose of this study was to document and describe the whistle repertoire of a Pacific humpback dolphin to further explore the function of humpback dolphin whistles.

On 27 February 2000 an adult female Pacific humpback dolphin was found stranded alive on the shore of Bowling Green Bay (19°15'S, 146°50'E), North