Cetaceans of the Mediterranean and Black Seas: State of Knowledge and Conservation Strategies

SECTION 10

Interactions between Cetaceans and Fisheries in the Black Sea

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Introduction

The direct killing and intentional live capture of dolphins and porpoises (see Report Section 6) do not exhaust a pool of problems which are focused on mutual impact of fisheries and Black Sea cetaceans. Both parties – humans and marine mammals – continue to be in the state of peculiar confrontation because they have similar (but rival) vital interests in fish consumption and usually catch their prey in the same areas during the same time. Anecdotal indications of beneficial co-operation between Black Sea fishermen and dolphins have been called in question very long ago (Silantyev 1903), whereas conflicts, causing reciprocal harm to cetaceans and fisheries, are still indicated in all Black Sea countries (Vasiliu and Dima 1990, Birkun *et al.* 1992 1999a, Pavlov *et al.* 1996, Öztürk 1999 a).

Impact of cetaceans on fisheries

Very little reliable information exists concerning the influence of cetaceans on commercial fisheries in the Black Sea and contiguous waters. No special research was carried out except for biassed estimations of yearly amounts of fish allegedly consumed by hypothetical whole populations of dolphins and porpoises (see examples in: Morozova 1981, Zaitsev 1998, Bushuyev 2000). In all estimates, related to the 1940s-1960s, the use of incorrect basic data on daily ration and population size of Black Sea cetaceans resulted in a doubtful conclusion that cetaceans represent the principal threat to fisheries because they are guilty of the depletion of fish resources. Bushuyev (2000) revised those estimates using more realistic figures on cetacean nutrition rates. He came to a view that in the 1980s the annual consumption of fish by cetaceans was considerably less than the annual total harvest of Black Sea fisheries. In spite of the lack of any dependable proof, cetaceans are persistently blamed for damage to fisheries in Turkey (Klinowska 1991, Öztürk 1999 a).

More than 30 fish species have been recorded in stomach contents of cetaceans inhabiting the Black and Azov Seas off the Crimean and Caucasian coasts (waters of present Ukraine, Russia and Georgia). Those studies were conducted on thousands of individuals, deliberately killed in the 1930s-1950s (Zalkin 1940a, b, Kleinenberg 1956, Tomilin 1957), and on over 120 animals, incidentally caught or stranded in the 1990s (Krivokhizhin *et al.* 2000). Certain prey species, recognized as the most important for cetaceans, also appear to be of high priority for the fisheries (Table 10.1). In particular, small benthic (whiting, *Merlangius merlangus euxinus*, and gobies, Gobiidae *gen. spp.*) and pelagic schooling fishes (anchovy, *Engraulis encrasicolus ponticus*, and sprat, *Sprattus sprattus phalaericus*) make up a basic diet of harbour porpoises (*Phocoena phocoena*), but only the latter two species could be considered as the objects of perceived competition between porpoises and fishermen. The same fishes – anchovy and sprat – may cause a conflict of interests between pelagic trawling and common dolphins (*Delphinus delphis*). The feeding needs of bottlenose dolphins (*Tursiops truncatus*) are interacting mainly with the turbot (*Psetta maeotica*) and mullet (*Lisa spp.*, *Mugil cephalus* and *M. so-iuy*) coastal fisheries. No true data are available on the adverse effects of such competitive interactions on fisheries. It is believed that marine mammals do not have essential influence on the abundance of Black Sea anchovy in comparison with the anthropogenic threats affecting its fodder plankton resource (Andrianov and Bulgakova 1996).

Most leaders of fishing cooperatives and ordinary fishermen, interviewed in Ukraine, Russia (A. Birkun, unpubl. data), Bulgaria (T. Stanev, pers. comm.) and Georgia (A. Komakhidze, pers. comm.), do not denounce militant dislike for cetaceans, nor consider them as their serious rivals. Coastal fishermen have no claims against common dolphins, but usually express their discontent with incidental catches of harbour porpoises. Besides, they mention episodes in which bottlenose dolphins raise trouble by damaging their nets or catch, or stealing caught fish from the nets. The same problem is known to be occurring on the Turkish coast (Öztürk 1999 a). No statistics are available on such conflicts and ensuing financial losses, and no appropriate compensation is stipulated for fishermen from their governments. There is no evidence that Black Sea fishermen use acoustic deterrent devices or any other special means to reduce undesirable interactions with cetaceans.

Impact of fisheries on cetaceans

Fisheries could provoke a number of effects on Black Sea cetaceans, including:

- changes (diminution or increase) of foraging possibilities;
- modification of behaviour;
- deterioration of habitats;
- mortality and non-mortal injuries in fishing gear; and
- alteration of distribution, migrations and reproductive ability.

Most direct and indirect effects are still poorly studied and understood, therefore their consideration below must rest largely on particular cases and speculations.

Fisheries-related changes of forage resources. Pelagic and coastal fisheries can affect Black Sea cetacean populations through excessive exploitation of fish species which represent the basic prey of harbour porpoises, common and bottlenose dolphins (Table 10.1). Overfishing, combined with eutrophication and the outburst of a raptorial invader, *Mnemiopsis leidyi* (see Section 8), has already led to the rapid decline of anchovy and sprat abundance. As a result, the total commercial catch of anchovy experienced a 12-fold drop (from an absolute maximum of 468,800 tonnes in the 1987-1988 fishing season to 39,100 tonnes in 1990-1991), while landings of sprat fell nearly by a factor of eight (from 105,200 tonnes in 1989 to 13,800 tonnes in 1993) (Prodanov *et al.* 1997). Negative trends in abundance are also observed in indigenous mullet (*Lisa spp.*, *Mugil cephalus*) and turbot, especially in the northern part of the Black Sea (Zaitsev and Mamaev 1997), where pressure from legal and illegal fisheries is clearly pronounced. Since the late 1980s the Turkish fishing effort in the Black Sea is the most important (Marine Aquaculture 1996, Prodanov *et al.* 1997, Keresteciogluet *al.* 1998).

Supposedly, the decline of forage resources, resulting in reduced prey availability, has a strong influence mainly on common dolphins and harbour porpoises (Bushuyev 2000). Nevertheless, distinct signs of malnutrition have been observed only in stranded individuals found with locomotor problems caused by severe trauma or infection (Birkun *et al.* 1992, 1999 b).

Deliberately introduced far-east mullet, *Mugil so-iuy*, is an example of the influence of fisheries or, rather, aquaculture on Black Sea cetacean forage resources. The introduction of this species, originated from the Sea of Japan, was carried out during 1972-1984 in the lagoons and coastal waters of the northwestern Black Sea and the Sea of Azov (Zaitsev and Mamaev 1997). Since the late 1980s this fish became abundant and widespread throughout the region, and at present it is caught in all Black Sea countries. Bottlenose dolphins and, to a lesser extent, harbour porpoises have included this new species in their diet (Krivokhizhin *et al.* 2000, Birkun and Krivokhizhin 2001).

Modification of feeding strategy and behaviour. It is known from Ukrainian and Georgian fishermen that marine fishing activities could be attractive for bottlenose and common dolphins, but, perhaps, not for harbour porpoises. Both dolphin species may use fisheries as additional food source and include their visits to fishing boats and stationary nets into their foraging strategy. Common dolphins reportedly interact predominantly with pelagic trawling of schooling fish; very often they hunt just in the immediate proximity to a hauling trawl. Bottlenose dolphins, by contrast, are interested in both active and passive fishing types operating inshore. Solitary individuals of this species were seen more than once foraging within trap nets in the Kerch Strait, and sometimes attempts to chase them away from traps were made by means of noise and oars (V.S. Dikiy, pers. comm.). In spring 1999 one dolphin came every day during several days to a trammel net set near Cape Meganom, southeast Crimea; during each visit, the animal fed on red mullet caught in the net, leaving behind in the mesh only the fish heads (Yu. N. Ivannikov, pers. comm.). Bottlenose dolphins tend to gather around trawling boats, probably attracted by occasional discards (*e.g.*, whiting); thus, cetaceans have an opportunity to take advantage of this non-used resource (S.V. Krivokhizhin, pers. comm.).

A supposed interspecific competition between Black Sea cetaceans caused by a reduction of common forage resources (Morozova 1982, 1986) has not been confirmed until now.

Fisheries-related deterioration of cetacean habitats The impact of fisheries on Black Sea cetacean habitats comprises all negative influences which are peculiar to small- and medium-scale shipping (*e.g.*, sewage, oil and noise pollution; see Sections 8 and 14), but it also includes some specific extra threats. Actually, the widespread distribution of various types of fishing gear can be considered a peculiar kind of marine pollution by solid objects. That is true indeed regarding countless illegal nets and nets which were dis-

carded or abandoned. High concentrations of fixed and floating fishing gear in some coastal areas result in the reduction of habitat space for harbour porpoises and bottlenose dolphins and represents a potential risk of entrapment.

One more problem relates to seafloor trawling. Bottom trawling in the proper sense has been prohibited in the Black Sea at the beginning of the 20th century when its harmful effect on benthic biocoenoses was recognized (Zaitsev *et al.* 1992). In the 1970s the riparian countries virtually recommenced this kind of fisheries under the new name of near-bottom trawling, allegedly specialized in the catching of sprat. However, both near-bottom and pelagic trawls could be easily transformed into bottom trawls (Konsulov 1998), and their modified use in the shelf area seems to be practically uncontrolled today. In other words, at present pelagic trawling obviously plays a role of legal "umbrella" for illegal bottom trawling aimed to the most valuable Black Sea fish – sturgeons and turbot. Pelagic trawls are non-selective fishing gear due to their very small mesh (about 8-10 mm). Thus, their use along the bottom results in the elimination of not only adult, but also young fish of the mentioned long-living species. Besides, the detrimental effect of seafloor trawling also consists in direct mechanical damage inflicted on benthic communities and in the stirring up of sedimented pelitic matter, which causes a decrease of water transparency and buries bottom biocoenoses in neighbouring areas. Zaitsev and Mamaev (1997) have calculated that a 50 m-wide trawl dragged at a speed of three knots will in one hour plough up the top layer of soil over an area of 30 hectares. The magnitude of bottom-trawling impact on cetaceans (including the decrease of forage grounds and prey accessibility) has not been estimated, although *a priori* both inshore species – the harbour porpoise and bottlenose dolphin – should be much more influenced by this kind of fisheries than the common dolphin.

Accidental mortality in fishing gear. The earliest mention of incidental catch (by-catch) of Black Sea cetaceans in fishing operations dates back to the 19th century. Danilevsky (1871) reported such cases in connection with seine-net fishery of shad in the Sea of Azov. Silantyev (1903) considered the entrapment in fixed nets (especially, in bottom nets for turbot) and drag seines as a cause of cetacean accidental mortality along the Caucasian coast. However, no statistics on dolphin and porpoise by-catches were recorded in the Black Sea countries up to the late 1950s (Salnikov 1967).

The regular recording of by-catches began in the former Soviet Union in 1968 and lasted till 1993 (included). During 26 years that was a function of the Fish Protection Service attached to the Ministry of Fisheries of the USSR (until 1991) and to analogous national ministries/committees of Ukraine, Russia and Georgia (since 1991). For a long time the information on cetacean by-catches was available only to narrow ministerial use. Even now a large portion of this data, accumulated in the internal annual reports, is not published; the only brief publications available (Zhuravleva *et al.* 1982, Artov *et al.* 1996, Pavlov *et al.* 1996) are limited to the Black Sea waters off the Crimea and Russian Caucasus, including the Strait of Kerch. During 1984-1990 the incidental capture of cetaceans was also monitored in Romania by the Museum of Natural Sciences in Constantza (Vasiliu and Dima 1990). In 1993-1997 by-catches were recorded along the European coast of Turkey by researchers from the Istanbul University (Öztürk *et al.* 1999 b). The most comprehensive study was carried out for two years (February 1997 – January 1999) simultaneously in Bulgaria, Georgia and Ukraine (BLASDOL 1999, Birkun *et al.* 1999a 2000). It is difficult to compare the results of all these works (Table 10.2) because of different, sometimes unknown research methodology and efforts; however, some preliminary conclusions are possible.

Geographical distribution. Cetacean by-catches occur throughout the Black Sea waters of all six riparian countries. In Russia and Ukraine by-catches take place also in the Azov Sea and Kerch Strait. No direct evidence is available from the Sea of Marmara and Turkish straits, although incidental catches of dolphins and porpoises seem to be very possible in that area of intensive coastal fisheries, and several cetacean strandings, recorded in the Marmara Sea, were suspected as a result of by-catch (Öztürk *et al.* 1999 a).

Most cases of incidental entanglement in fishing nets occur not far from the shore and in the shallow waters of the continental shelf. For instance, by-caught individuals examined in Crimea were found at a depth from few metres to 94 metres (Birkun and Krivokhizhin, unpubl. data). Traditional areas of bottom-set gillnet fishery

and, to a lesser extent, pelagic trawling could be considered as the hot spots of cetacean mortality in fishing gear. Some (but obviously not all) fishing sites in which by-catch occurences are frequent were revealed in Russia (coastal area from Anapa to Sochi) and Ukraine (waters off the Crimea near Sevastopol and Feodosia, between Chernomorskoye and Evpatoria) (Pavlov *et al.* 1996, BLASDOL 1999). According to the latter report, in Bulgaria the majority of definite and suspected by-catches were recorded in two areas: from Shabla to Balchik and from Bjala to Cape Emine. In Georgia most cases were concentrated between the mouth of Chorokhi river and the Turkish border.

Species composition. Harbour porpoises almost always represented the major part of cetacean by-catches recorded in different places around the Black Sea (Table 10.2). On the contrary, bottlenose dolphins never predominated in by-catch scores; as far as common dolphins are concerned, only two exceptions are known in 1968 and 1976 when yearly number of common dolphins, by-caught in the Crimean and Caucasian area, was higher than the number of by-caught porpoises. Quite often the annual share of incidentally captured *P. phocoena* mounted to 90-100%, while the shares of *D. delphis* and *T. truncatus* tended to zero.

According to the results of regular studies (Vasiliu and Dima 1990, Pavlov *et al.* 1996, BLASDOL 1999, Öztürk *et al.* 1999 b), during the past decade (1990-1999) a total of 448 accidentally entrapped cetaceans were recorded in the Black Sea, including 425 harbour porpoises (95%), 10 common dolphins (2%) and 13 bottlenose dolphins (3%). In other words, every two tens of by-caught cetaceans consisted of 19 porpoises and one common or bottlenose dolphin. This estimation strongly suggests that the direct impact of Black Sea fisheries is focused mainly on *P. phocoena*, and the intensity of this impact is probably 30-40 times higher compared to the adverse influence of fisheries on the other two species.

The absolute numbers of population losses due to by-catch were not estimated in most Black Sea countries. Supposedly, every year at least 2,000-3,000 harbour porpoises and 200-300 bottlenose dolphins are accidentally caught in Turkey (Öztürk 1999 a, b).

Hazardous gear and seasons. Between the late 1960s and the early 1990s bottom gillnets for turbot (*P. maeotica*) and dogfish (*Squalus acanthias*) caused 98% of known cetacean by-catches in the waters off Crimea and Russian Caucasus; the remaining 2% belonged to bottom gillnets for sturgeons (*Acipenser spp.*, *Huso huso*) and labyrinth trap nets (Artov *et al.* 1994). Notably, official statistics in this area is quite incomplete because some legal and numerous illegal nets are not accounted for, moreover, the trawling fleet was almost entirely uncontrolled as far as by-catches are concerned. Thus, "net danger index" (CPUE) values have been calculated for turbot and dogfish fishery only: they averaged, respectively, nine and twelve by-caught cetacean individuals per 100 kilometres of net per year (Pavlov *et al.* 1996).

Vasiliu and Dima (1990) reported that in Romania most incidental catches of harbour porpoises occurred in passive fishing gear (not specified in detail) predominantly in March-May when small schooling fishes, mostly sprat (*S. s. phalaericus*) and anchovy (*E. e. ponticus*), aggregate in the northwestern Black Sea area. The capture of common dolphins coincided with a scad (*Trachurus spp.*) fishery in July-September.

In Turkey all published cases of cetacean by-catch (62 harbour porpoises and one bottlenose dolphin) have occurred in turbot bottom gill nets from April to June (Öztürk *et al.* 1999b). However, there are cursory mentions that harbour porpoises and bottlenose dolphins die in Turkish waters also due to the sturgeon and sole (*Solea spp.*) bottom fisheries, and "frequent instances of accidental capture by gill or trammel nets" are known for common dolphins (Öztürk 1999a). Unfortunately, no evidence has been supplied by the author to illustrate his conviction.

According to BLASDOL (1999), by-catches are most frequent during the year's second quarter (108 cases, or 68% of the reported total) off the Black Sea west, east and north coasts, with peaks of the accidents in April (Bulgaria), May (Georgia) and June (Ukraine). By-catches, recorded within these risky months, occurred in bottom gill nets for turbot (99 harbour porpoises and five bottlenose dolphins) and trap nets (two bottlenose dolphins). During the other months one bottlenose dolphin and about 40 harbour porpoises were found in turbot nets, and few porpoises (no less than four individuals) in the bottom gill nets for dogfish. All three cases of common dolphin by-catch were caused by pe-

lagic trawling for anchovy in December in the Georgian wintering area of this fish species.

Two additional common dolphin by-catch incidents occurred in November 1995 in Ukraine near Evpatoria during pelagic trawling operations for sprat (Birkun and Krivokhizhin, unpubl. data). A single case of cetacean (harbour porpoise) entrapment in trammel (triple-wall) net was registered in January 1994 in Laspi Bay, south Crimea. In addition, local fishermen reported that bottlenose dolphins and, perhaps, other Black Sea cetaceans were sometimes incidentally caught in purse seines used to catch far-east mullet (*M. so-iuy*) in the Kerch Strait and for the winter fishery for anchovy off the coast of Crimea (A. Chashchin, pers. comm. to S. Krivokhizhin).

Thus, bottom-set gill nets and turbot fishing period between April and June appear the principal fishing gear[1] and season which are hazardous for Black Sea bottlenose dolphins and, especially, for harbour porpoises. Common dolphins are threatened mainly by trawl nets catching schooling pelagic fishes in late Autumn and Winter. Other fishing techniques, including purse seines, trammel and trap nets, seem to be of secondary importance.

Non-mortal injuries and mortality rate. No direct data are available concerning Black Sea cetaceans which after the entrapment manage to break loose from fishing nets without human assistance. Certainly, this kind of unrecorded by-catch should take place, and sudden appearance of ragged holes in nets suggests this idea to fishermen. On the other hand, some free ranging cetaceans, namely bottlenose dolphins, show evident signs of past by-catching. For instance, individuals bearing net marks were sighted repeatedly between Foros and Balaklava, south Crimea, in 1997 and 1998 (Birkun and Krivokhizhin 2000). One dolphin had a loop of rope tightened around the tail stock, while another individual missed the left pectoral fin (S.A. Popov, pers. comm.), probably as a result of traumatic amputation.

Almost all recorded by-catches are lethal. There is no published evidence of any dolphin or porpoise survived in fishing nets in Bulgaria, Georgia, Romania and Turkey. Out of more than 2,000 entrapped cetaceans on record, 99.9% of have died in the nets in Russia and Ukraine in 1968-1993 (Pavlov *et al.* 1996). Only two bottlenose dolphins, entangled with their teeth and tail flukes in trap nets, were released alive in Ukraine in 1997-1999 (BLASDOL 1999). One more successful rescue operation related to the above mentioned harbour porpoise accidentally caught in a trammel net placed in shallow water.

Alteration of cetaceans distribution, migrations and reproduction. As shown above, fisheries degrade and confine living space and feeding resources of Black Sea cetaceans; some fishing operations/installations attract bottlenose and common dolphins providing them with an additional source of food; however, many individuals, especially harbour porpoises, perish from year to year in fishing nets. All these factors are likely to influence cetaceans distribution and migrations, which mainly depend on the distribution, migrations and abundance of prey stocks (Malm 1933, Zalkin 1940a, Kleinenberg 1956, Tomilin 1957). Certainly, solid data are needed to provide a better understanding of the mechanisms involved.

Turbot fishing operations in May – June could be defined not only as a significant anthropogenic factor of Black Sea harbour porpoises mortality, but also as a factor limiting their reproduction output (BLASDOL 1999, Birkun *et al.* 2000). The presence of ner-term pregnant, postpartum and lactating females (respectively, 15, 19 and 50% of the total number of mature by-caught females examined) indicated that the turbot fishing season coincides with porpoise gestation and nursing period. Furthermore, the state of mature male and female gonads (except pregnant individuals) indicated that the breeding period occurs in spring and early summer.

[1] Bottom gill nets are dangerous for Black Sea cetaceans, in particular, because of their very large mesh size: from 8-11 cm (dogfish nets) to 12-15 cm (sturgeon nets) and 18-22 cm (turbot nets). The height of these nets varies between 1.5 and three metres, and their length may reach 70-100 metres. Fishermen usually tie together some tens to 200 nets making a single line.

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Table 10.1. Target fish species of Black Sea cetaceans and commercial fisheries and their relative importance for the consumers: P – primary, S – secondary and U – undefined (non-target species)

Fish species	Consumers			
	Common dolphins	Bottlenose dolphins	Harbour porpoises	Fisheries [f]
Anchovy, *Engraulis encrasicolus ponticus*	P [a, c, d, e]	S [a, c, d]	P [c, d, e], S [b]	P
Sprat, *Sprattus sprattus phalaericus*	P [a, c, d, e]	U	P [e]	P
Whiting, *Merlangius merlangus euxinus*	S [a, c, e]	P [c], S [a]	P [e], S [b]	S
Pelagic pipefishes, Syngnathidae *gen. spp.*	P [c], S [a]	U	U	U
Black Sea turbot, *Psetta maeotica*	U	P [a, c]	U	P
Thornback ray, *Raja clavata*	U	P [a], S [c]	U	S
Mullets, *Lisa spp.*	S [c]	P [d], S [a, c]	S [b]	P
Grey mullet, *Mugil cephalus*	U	P [d], S [a, c]	U	P
Far-east mullet, *Mugil so-iuy*	U	P [e]	S [e]	P
Gobies, Gobiidae *gen. spp.*	U	U	P [a, b, e]	S
Red mullet, *Mullus barbatus ponticus*	S [a, c]	S [a, c]	S [a]	P
Bonito, *Sarda sarda*	S [a]	S [a, c]	U	P
Shad, *Alosa spp.*	S [c]	U	S [b, e]	P
Zander, *Lucioperca lucioperca*	U	S [a]	S [b]	U
Bream, *Abramis brama*	U	S [a]	S [b]	U
Bluefish, *Pomatomus saltator*	S [a, c]	U	U	P
Horse mackerel, *Trachurus spp.*	S [a, c, e]	U	U	P
Garfish, *Belone belone euxini*	S [e]	U	U	S
Mackerel, *Scomber scombrus*	S [c]	U	U	P
Wrasses, Labridae *gen. sp.*	S [c]	U	U	U
Blennies, Blenniidae *gen. sp.*	S [c]	U	U	U
Sea scorpion, *Scorpaena porcus*	U	S [a, c]	U	U
Corb, *Umbrina cirrhosa*	U	S [c]	U	U
Silverside, *Atherina sp.*	U	U	S [b]	U
Flounder, *Platichthys flesus luscus*	U	U	S [b]	S
Snouted sole, *Solea nasuta*	U	U	S [b]	U
Pickarel, *Spicara smaris*	U	U	S [e]	U

[a] – Zalkin (1940 a)
[b] – Zalkin (1940 b)
[c] – Kleinenberg (1956)
[d] – Tomilin (1957)
[e] – Krivokhizhin *et al.* (2000) and S.V. Krivokhizhin (pers. comm.)
[f] – according to Prodanov *et al.* (1997), with additions

Table 10.2. Studies on incidental catch of cetaceans in the Black Sea due to fishing operations

	Russia and Ukraine [a]	Romania [b]	Turkey [c]	Bulgaria [d]	Georgia [d]	Ukraine [d]
Study period	26 years; 1968-1993	7 years; 1984-1990	1993-1997	2 years; 1977-1999	2 years; 1977-1999	2 years; 1977-1999
Study area (waters off)	Crimea and north Caucasus	south part of the coast	European coast; from Bulgarian border to Istanbul	entire coastline	Adjaria and Georgia	Crimea
Length of study area, km	1,637	60		355	100	650
Number of by-caught cetaceans recorded:	2,086	566	63	14	11	130
harbour porpoises, *n* (%)	1,685 (80.8)	541 (95.6)	62 (98.4)	13 (92.9)	7 (63.6)	123 (94.6)
common dolphins, *n* (%)	297 (14.2)	22 (3.9)	0 (0.0)	0 (0.0)	3 (27.3)	0 (0.0)
bottlenose dolphins, *n* (%)	104 (5.0)	3 (0.5)	1 (1.6)	1 (7.1)	1 (9.1)	7 (5.4)
Extra data available:						
sex	n.a.	n.a.	n.a.	Yes	Yes	Yes
age	n.a.	n.a.	n.a.	Yes	Yes	Yes
measurements	n.a.	n.a.	n.a.	Yes	Yes	Yes
nutritional state	n.a.	n.a.	n.a.	Yes	Yes	Yes
state of reproductive system	n.a.	n.a.	n.a.	Yes	Yes	Yes
stomach contents	n.a.	n.a.	n.a.	Yes [e]	Yes [e]	Yes [e]
pathological findings	n.a.	n.a.	n.a.	Yes	Yes	Yes
concentrations of xenobiotics	n.a.	n.a.	n.a.	Yes	Yes	Yes

[a] – after Pavlov *et al.* (1996), with additions and corrections according to the reports of the Crimean Black Sea Fish Protection Service
[b] – Vasiliu and Dima (1990)
[c] – Öztürk *et al.* (1999 b)
[d] – BLASDOL (1999)
[e] – Krivokhizhin *et al.* (2000)
n.a. – not available

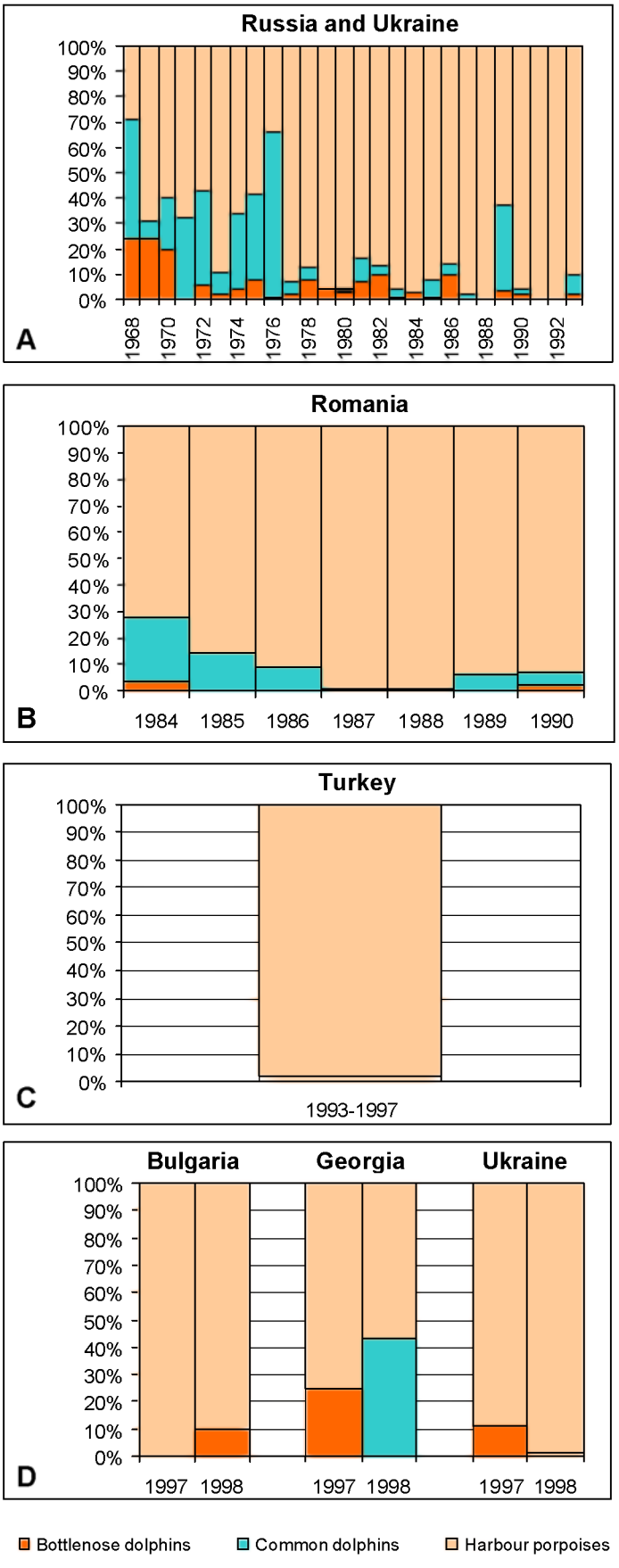

Fig. 10.1. Species composition of cetacean by-catches in the Black Sea. After Pavlov *et al.* 1996 (A), Vasiliu and Dima 1990 (B), Öztürk *et al.*,1999 b (C), and BLASDOL 1999 (D).