The current status of bottlenose dolphins (*Tursiops truncatus*) in the Black Sea*

ALEXEI A. BIRKUN, JR.

S.I. Georgievsky Crimean State Medical University, Lenin Boulevard 5/7, Simferopol 95006, Ukraine
Phone/Fax: (380) 652 253503; E-mail: alexeibirkun@home.cris.net

ABSTRACT

The common bottlenose dolphin (*Tursiops truncatus*) is one of three cetacean species in the Black Sea. The review, based on updated report to the 1st Meeting of the Parties to ACCOBAMS (Monaco, 28 February – 2 March 2002), collates the existent knowledge on the conservation status of this population regarded by some authors to be an endemic subspecies. Recent genetic data confirm that the population is substantially isolated from the nearest one in the Mediterranean and therefore it can be especially vulnerable to anthropogenic influences. Bottlenose dolphins inhabit territorial waters of all Black Sea riparian countries (Bulgaria, Georgia, Romania, Russia, Turkey and Ukraine), occur mainly in circumlittoral shelf waters less than 200m deep and form scattered communities of some tens to perhaps 1.5-2 hundred animals. The aggregations of dolphins are on repeated record round the Crimea including the Kerch Strait and coastal waters off the western and southern extremities of the peninsula. Casual individuals may visit the Sea of Azov and estuaries of big rivers. Bottlenose dolphins are known to occur in the Bosphorus, Marmara Sea and Dardanelles which interconnect the Mediterranean and Black seas and thereby constitute the only route for possible crossing between the neighbouring cetacean populations. In view of a low reproductive output that is typical for this species, the bottlenose dolphin number usually is considered the smallest of cetacean populations in the Black Sea in spite of absolute lack of dependable abundance estimates. Actually in the northern Black Sea, bottlenose dolphins attain relative numerical predominance over harbour porpoises vastly affected by gill-net fisheries, while before the mid 1990s the ratio between these species was generally opposite. Up to the ban in 1983, commercial killing was the main human activity depressed the population, although the catch of bottlenose dolphins was usually less than those of short-beaked common dolphins and harbour porpoises. Nevertheless, the population is inferred to have declined due to past exploitation. Nowadays, the most important threats are habitat degradation including pollution, physical deterioration of the seabed and overexploitation of marine living resources, disturbance, incidental capture in fishing gear and natural diseases. Since the mid 1960s hundreds of animals have been live-captured for dolphinaria. The bottlenose dolphin is listed as Data Deficient by IUCN. The Black Sea population is protected by numerous worldwide, European, regional and national legislative acts, which should have potential value for its conservation, however, actual realization of this value is still very limited.

KEYWORDS: BLACK SEA; COMMON BOTTLENOSE DOLPHIN; TAXONOMY; DISTRIBUTION; HABITAT; MIGRATION; ABUNDANCE; THREATS; DIRECT CAPTURE; LIVE CAPTURE/CAPTIVITY; POLLUTANTS; FISHERIES; DISTURBANCE; DISEASE; PARASITES; CONSERVATION; REVIEW

1 INTRODUCTION

Black Sea biodiversity in general and the Black Sea’s marine mammal fauna of in particular, are rather limited owing to inherent features of this basin, including the high degree of geographical isolation of the sea (Fig. 1), its low water salinity and the large amount of hypoxic and anoxic waters below 100-250m of depth. Three species of cetaceans – the harbour porpoise (*Phocoena phocoena*), the short-beaked common dolphin (*Delphinus delphis*) and the common bottlenose dolphin (*Tursiops truncatus*) – and one pinniped species – the Mediterranean monk seal (*Monachus monachus*) – crown the trophic pyramid of the Black Sea as top predators with no natural enemies in this basin (Kleinemburg, 1956; Geptner et al., 1976; Jefferson et al., 1993).

In the last three decades, Black Sea biodiversity has been seriously damaged as a result of human-caused degradation of the sea proper and its drainage basin (Zaitsev and Mamaev, 1997). The species composition of most

* The review is based on the document presented at the 1st Meeting of the Parties of the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (Monaco, 28 February – 2 March 2002).
marine communities has been modified with the explosive expansion of some organisms and the depression of many others. The Mediterranean monk seal has almost disappeared from the region (Kiraç and Savaş, 1996; Öztürk, 1999). Black Sea dolphins and porpoises, drastically affected by commercial killing that continued until the early 1980s, are exposed to ongoing anthropogenic threats which cause habitat deterioration and depletion of food resources.

The bottlenose dolphin population is assumed as the smallest of the Black Sea cetacean populations (Kleinenberg, 1956; Klinowska, 1991; Birkun et al., 1992; Birkun and Krivokhizhin, 1996 b). It is protected by a long list of international and national legislative instruments, but in practical terms this population’s conservation status is not assured. This review is intended as a critical evaluation of what is known about Black Sea bottlenose dolphins, with special reference to their taxonomic position, distribution, abundance, important threats and survival prospects.

## 2 TAXONOMY

The common bottlenose dolphin is one of two currently recognized species in the genus *Tursiops* and one of two Delphinidae species in the Black Sea. It was first recorded in this basin by Rathke (1837), under the name *Delphinus tursio*. Fifty-five years later, Ostroumov (1892) confirmed its presence and assigned it to the species *Tursiops tursio* Fabricius. Then, within the taxonomic revision of Black Sea cetacean fauna by Barabasch-Nikiforov (1940), bottlenose dolphin population in the Black Sea was designated as a subspecies, *Tursiops truncatus ponticus*. Barabasch-Nikiforov compared his own data (1,450 individuals and 19 skulls were measured) with those in a few publications on the Atlantic bottlenose dolphin. This work led him to identify four morphological peculiarities as diagnostic markers of the Black Sea subspecies:

1. shorter body length (120-310cm; 225cm on average);
2. some difference in typical coloration;
3. abbreviated beak with relatively wide base; and
4. fewer teeth (from 74 to 90 in both jaws).

The proposed new taxonomic position of the Black Sea bottlenose dolphins elicited strong objections from some cetologists (e.g. Zalkin, 1941). Later, Kleinenberg (1956) examined 21 skulls and 50 carcasses that ranged from 155-310cm long with mean lengths of 275 and 233cm for mature males and females, respectively. He strongly criticized Barabasch-Nikiforov’s diagnosis and considered the features listed above (especially, coloration, beak characteristics and number of teeth) as insufficient and unreliable criteria for the subspecies determination. However, he measured only two skulls of bottlenose dolphins from other (unspecified) sea(s). Of course, that was not enough for a proper comparative morphometric investigation.

No indisputable evidence, supporting either Barabasch-Nikiforov’s or Kleinenberg’s viewpoint, has been reported during the last 45 years. Nevertheless, in spite of persistently unresolved controversy, *de jure* and *de facto*, this animal is mentioned as a ‘rare endemic subspecies’ in many publications originating mainly in the former USSR (Tomilin, 1957, 1983; Barabasch-Nikiforov, 1960; Geptner et al., 1976; Anonymous, 1985; Birkun and Krivokhizhin, 1994; Sokolov and Romanenko, 1997).

Modern genetic and biometric studies are needed to clarify the Black Sea bottlenose dolphin’s taxonomic status, and use of the subspecies name cannot be recommended until appropriate data and analyses are available to justify such usage. By the way, in a recent pilot study, using microsatellite data analysis, certain differentiation was found between the Black Sea and Mediterranean populations as well as between above populations and bottlenose dolphins in the Northeastern Atlantic (Natoli, 2002).

## 3 DISTRIBUTION AND MIGRATIONS

Bottlenose dolphins inhabit territorial waters of all six Black Sea riparian countries (Petranu, 1997; Sokolov and Romanenko, 1997; Komakhidze and Mazmanidze, 1998; Konsulov, 1998; Zaitsev and Alexandrov, 1998; Öztürk, 1999) where they are known under the following common names (Birkun et al., 1999 c):

- **Bulgaria** – afala;
- **Georgia** – afalina;
- **Romania** – afalin, delfinul cu bot de sticla, delfinul cu bot gros;
- **Russia** – afalina chernomorskaya, butylkonosy del’fin, and (archaic) nezarnak, chornaya morskaya svinya [black porpoise], ofalina, afalin, afelin;
- **Turkey** – afalina;
- **Ukraine** – afalina chornomors’ka.

### 3.1 General occurrence
Bottlenose dolphins can be found anywhere in Black Sea coastal waters (e.g. Kleinenberg, 1956; Tomilin, 1957; Sal’nikov, 1967; Arsenyev et al., 1973; Gephter et al., 1976; Arsenyev, 1980), and occasionally far offshore in deep areas (Morozova, 1981; Beaufbrun, 1995; Mikhailov, 1996 b; Yaskin and Yukhov, 1997). They have long been known to occur in the Turkish straits system, including the Bosphorus, Marmara Sea and Dardanelles (Kleinenberg, 1956; Beaufbrun, 1995; Öztürk and Öztürk, 1997), which connects the Black and Mediterranean Seas (Fig. 1). Bottlenose dolphins are common in the Kerch Strait (Kleinenberg, 1956; Birkin and Krivokhizhin, 1998, 2000; Birkin et al., 2002), and they sometimes visit the Sea of Azov (Zalkin, 1940; Birkin et al., 1997). There are a few records of Black Sea bottlenose dolphins entering fresh waters, e.g. the Danube delta (Policio, 1930; cited after Tomilin, 1957). In 2000, a group of four animals was sighted in the Dnieper river about 40km upstream of the estuary, i.e. nearly 100km from the proper sea (S.M. Chorny, pers. comm.).

3.2 Main habitat
Circumlittoral shelf waters are the primary habitat of Black Sea bottlenose dolphins. During four boat surveys carried out in 1985-1987 (Yaskin and Yukhov, 1997), most sightings (83.3-100%) were recorded in waters less than 200m deep (in the northern part of the sea) or located within five miles of shore (in the eastern part of the sea) (Table 1). Unfortunately, Yaskin and Yukhov did not provide sufficient data to determine whether their sightings data were effort-biassed.

The Black Sea shelf is wide (up to 200-250km) in the northwestern part of the sea where depth varies from zero to 160m (Vylkanov et al., 1983; Zaitsev and Mamaev, 1997; Readman et al., 1999). In other coastal areas the shelf is only from 0.5 to 50km wide. Thus, only about one quarter (24-27%) of the total sea area is shallower than 200m. The shelf is slightly inclined offshore; its relief includes underwater valleys, canyons and terraces. Pebbles, gravel, sand, silt and rocks cover the bottom. The intimate attachment of bottlenose dolphins to shelf waters is related to the distribution of their preferred prey – benthic and nearshore pelagic fishes.

The Black Sea is stratified into upper layer of oxygenated waters and the deeper anoxic waters saturated by high concentrations (0.2-9.6mg/l) of poisonous hydrogen sulphide (Zaitsev and Mamaev, 1997; Aubrey et al., 1999). There is a transitional layer between those strata at a depth of 100-250m. Thus, only the upper 10-13% of the water mass is suitable for habitation by aerobic marine organisms, including those eaten by dolphins.

3.3 Possible ‘residency’
There is no reliable information on the existence of ‘resident’ dolphin communities in the Black Sea, although small groups and even large schools of foraging animals may stay in areas close to the Crimean and Caucasian coasts for a few days to several months. In particular, annually from spring to autumn, bottlenose dolphins form high-density aggregations near Tarkhankut peninsula of the Crimea (Zatevakhin and Bel’kovich, 1987, 1996; Bel’kovich and Zatevakhin, 1996) and in the Kerch Strait and adjacent Black Sea area (Kleinenberg, 1956), with a peak presence in the Kerch Strait in June-July (Birkin and Krivokhizhin, 1998, 2000) (Fig. 2). Most sightings in the Bosphorus were recorded in May-June; in the Marmara Sea, – in October (Öztürk and Öztürk, 1997). Four discrete aggregations of bottlenose dolphins were observed off the Crimea in June 1995, respectively in the northwestern (around Tarkhankut peninsula), western (between capes Lukull and Khersonese), southern (between capes Sarych and Ayudag) and southeastern (between capes Meganom and Ilyi) (Birkin and Krivokhizhin, 2000). In summer 1997 and 1998 bottlenose dolphins were distributed mainly along the southern and southeastern Crimean coasts. Dolphin schools typically aggregate during the fall and early winter in the small delta-shaped area at the southern extremity of the Crimea between Balaklava and Foros (Fig. 3).

3.4 Migrations
Concentrations of several hundred bottlenose dolphins move each autumn along the southern coast of the Crimea, from the east towards the south-west (Birkin and Krivokhizhin, 1996 a, 2000). As noted above and in Fig. 3, at least some of the animals congregate at this time between Balaklava and Foros. According to indirect data, other schools migrate at the same time to the same place from the west and northwest coasts of the Crimean peninsula. Such annual convergence of different groups may have considerable significance for maintaining gene flow (panmixis) within Black Sea bottlenose dolphin population. The hypothesized east to southwest movement in autumn was confirmed for two individuals by means of tagging experiment (Veit et al., 1997). Two Black Sea bottlenose dolphins, a male and a female, were released in late August 1996 in Taman’ Bay of the Kerch Strait after their dorsal fins had been marked by the removing dermal tissue in a characteristic pattern. Two weeks later, both dolphins were sighted near Yalta, southern Crimea, more than 200km from the release site. The marked animals were observed foraging within a larger group of bottlenose dolphins.

The distribution and migratory behavior of bottlenose dolphins certainly needs to be studied more thoroughly, and particularly in the Turkish straits system, which constitutes the only possible route for mixing (and thus genetic exchange) between Black Sea and Mediterranean cetaceans. At present, there is no scientific evidence to evaluate whether such mixing occurs. Systematical sightings surveys covering coastal waters during various seasons, photo-identification data and radio tagging/tracking of free-rangering animals are among the approaches that could be employed to address the question. The mapping of distribution patterns and migrations of key prey
species could also be helpful, considering the hypothesis that the distribution and movements of Black Sea cetaceans are tightly correlated with the movements of their food sources (e.g. Kleinenberg, 1956).

4 POPULATION ESTIMATES

4.1 Absolute abundance
The bottlenose dolphin population usually is considered the smallest of the three cetacean populations in the Black Sea (Silantyev, 1903; Zalkin, 1940; Kleinenberg, 1956; Geppter et al., 1976). In the 20th century the overall abundance of cetaceans was reduced by massive direct killing for the dolphin-processing industry, however the total numbers of animals taken were not recorded. Also, there are no reliable scientific data on current abundance. Estimates for USSR waters in 1967-1974 (Zemsky and Yablokov, 1974) and for Turkish waters in 1987 (Celikkale et al., 1989) were discredited by the IWC Scientific Committee, citing methodological and interpretative problems (Smith, 1982; Klinowska, 1991; Buckland et al., 1992; IWC, 1992). More recent estimates for 1975-1993 (Mikhailiev et al., 1978; Yukhov et al., 1986; Sokolov et al., 1990; Mikhailiev, 1996 a; Yaskin and Yukhov, 1997) have yet to be reviewed by the IWC Scientific Committee but suffer from similar inadequacies of survey design and statistical treatment. Therefore, published figures referring to abundance of Black Sea bottlenose dolphins (Table 2) have mainly historical significance, providing a record of data collection and analyses that were attempted, but these figures should not be taken at face value or used for further comparative analyses.

4.2 Local stocks
It has been claimed that the Black Sea bottlenose dolphin population consists of several quite distinctly separated herds (variously referred to below as ‘local stocks’ or ‘communities’), each consisting of 60-150 animals (Bel’kovich, 1996).

The best-studied herd (‘local population’) is centred during the warm season in an area of 800km² close to the Tarkhankut peninsula (northwestern Crimea), between Bakal Spit and Lake Donuzlav (Zatevakhin and Bel’kovich, 1987, 1996; Bel’kovich and Zatevakhin, 1996). According to the results of two aerial surveys carried out with a three-year interval in the 1980s, this herd included from 104 to 112 individuals. Meantime, according to land-based observations during five field seasons, the size of this community averaged 69 dolphins with a maximum of 98 animals. From spring to autumn the Tarkhankut herd was estimated to consist of several groups with a mean group size of about six individuals (from 4.0 to 8.2 animals, on average, in different years) and a maximum group size of 42 individuals (Zatevakhin and Bel’kovich, 1987).

A line-transect aerial survey conducted in July 2001 (Birkun et al., 2002) revealed a herd of bottlenose dolphins (13 sightings; 33 individuals) in the Strait of Kerch (890km²), and no cetaceans of this species were found in the Sea of Azov. Dolphins were present in the northern and middle thirds of the strait, including shallow Taman’ Bay. The minimum abundance estimate of the Kerch herd was 91 individuals, uncorrected for availability or detection bias. During the same survey, harbour porpoises were recorded in the northern half of the strait (7 sightings; 12 individuals) and in the Azov Sea proper (78 sightings; 110 individuals); their minimum uncorrected abundance estimates: 46 and 2,417 animals in the strait and sea, respectively. Earlier, in 1997, bottlenose dolphins were recorded by specialists and trained volunteers aboard fishing boats and local ferry between the Crimea and Caucasus during every month (except January and December). In this latter data set, single animals constituted 17%, small groups (2-10 individuals) 74%, and medium-sized schools (11-20 individuals) 9% of all sightings. Groups of three to approximately 100 animals were recorded during a boat survey in the strait in June 1997 (Birkun and Krivokhizhin, 1998).

In coastal waters at the south extremity of the Crimea (between Balaklava and Foros; Fig. 3) the mean size of bottlenose dolphin groups was 48-54 individuals in August and 36-44 animals in September 1998, while the largest groups consisted of 150-200 dolphins (Birkun and Krivokhizhin, 2000).

4.3 Relative abundance
During the past century the relative abundance of the two inshore species of Black Sea cetaceans has been axiomatic: it has been assumed that the harbour porpoise is numerically predominant (e.g. Kleinenberg, 1956; Geppter et al., 1976). Sightings surveys carried out 15-17 years ago in Soviet and Turkish waters generally affirmed this relationship. A total of 261 bottlenose dolphins and 787 harbour porpoises (1:3) were recorded in 1985-1987 during five boat surveys in the northern and eastern portions of the Black Sea from Odessa to Batumi (Yaskin and Yukhov, 1997). A similar ratio – 14.8% bottlenose dolphins and 52.7% harbour porpoises (1:3.6) – was estimated in 1987 for a 58-km-wide strip along the entire southern coast of the sea (Celikkale et al., 1989).

During the period 1990-1999, 397 cetacean sightings were recorded in coastal Black Sea waters, including a 20 to 60km-wide strip surrounding the Crimean peninsula from Karkinitsky Bay to the Kerch Strait (Birkun and Krivokhizhin, 2000; Birkun et al., 2001). Special searches were carried out in June 1995, June 1997, and June-July and September 1998 by means of sailing and motor yachts covering distances of 255 to 934km (10,371km in total). There was a striking change in the relative abundance of bottlenose dolphins, with a sighting rate five times higher in 1997 and 1998 than in 1995. A corresponding decline occurred in the relative abundance of harbour porpoises.
resulting in a trend toward clear prevalence of bottlenose dolphins: 1995 – 0.8:1; 1997 – 0.9:1; June-July 1998 – 6.8:1; September 1998 – 12.9:1. The difference between last two ratios can be explained by the annual autumn accumulation of bottlenose dolphins in waters closed to the southern extremity of the Crimea, between Balaklava and Foros (see above). Regular surveys of that area in September-October 1997 and August-December 1998 confirmed that bottlenose dolphins were far more abundant than harbour porpoises (Fig. 4). As mentioned above, groups of hundreds of bottlenose dolphins migrate every fall to this relatively small area from the eastern and, probably other, parts of the Black Sea. On the other hand, large-scale incidental mortality in bottom-set gill nets is the most likely cause of a marked decrease in the number of harbour porpoises present in this area (Birkun et al., 2000).

No recent data are available on relative abundance of cetaceans in other parts of the Black Sea or indeed in Crimean waters from January to May inclusive. Thus, for now, the numerical predominance of bottlenose dolphins over harbour porpoises should be considered typical for the Black Sea shelf area along the Crimean coast from June to December.

5 REPRODUCTION HABITS

Bottlenose dolphins in the Black Sea have a long life span (perhaps, 25-30 years or more) and low fertility (Tomilin, 1957; Gaetner et al., 1976). Females mature earlier (at 5-6, maximum 12 years) than males (8-12 years). Sexual behaviour can be observed during the whole year with a peak in spring-early summer. The ovulatory season (maximum five spontaneous ovulations) extends from March to October with a peak in June; the highest concentrations of testosterone in males were recorded in July and the lowest in January (Ozhavorovskaya, 1997). Gestation lasts 11-12 months. The interval between births is from two or three to six years (Tomilin, 1957), but in captive females the reproductive cycle can be as short as two years (Ozhavorovskaya, 1997). Twinning was not recorded in Black Sea bottlenose dolphins, thus, litter size is invariably one. Lactation can last from four months to more than 1.5 years. It is assumed that one female is unlikely to produce more than eight calves in her lifetime (Tomilin, 1984; cited after Ozhavorovskaya, 1997).

6 IMPORTANT THREATS

In the past, commercial killing was the main human activity affected the population, although the catch of bottlenose dolphins was usually less than those of common dolphins and harbour porpoises. Nowadays, the most important human threats are habitat degradation, disturbance and incidental capture in fishing gear. Since the mid 1960s hundreds of animals have been live-captured in the former USSR and Romania for military, commercial and scientific purposes. The Russian Federation and Ukraine are continuing to live-capture bottlenose dolphins in their waters. Natural diseases also play a role in limiting the abundance of Black Sea bottlenose dolphins.

6.1 Direct killing

The dolphin processing industry, based on the mass direct killing of small cetaceans (common dolphins, harbour porpoises and bottlenose dolphins), took place in all Black Sea riparian countries (Silantyev, 1903; Kleinenberg, 1956; Nikolov, 1963; Danilevsky and Tyutyunnikov, 1968; Berkes, 1977; Dima and Vasiliiu, 1992; Yel et al., 1996; etc.). It was banned in the former USSR (present-day Georgia, Russia and Ukraine), Bulgaria and Romania in 1966, and in Turkey in 1983. Purse-seining and shooting were the principal methods used in the Black Sea cetacean fisheries.

In the 19th century cetaceans were killed almost exclusively for the oil that could be obtained by melting fat. This was sold as lamp-oil for home lighting (Silantyev, 1903). In the 20th century, in the Soviet Union, new applications for dolphin oil were found in the pharmaceutical industry as raw material for vitamin-D-containing medicines and in the tanning industry as currier's oil. It was also used for the manufacture of paint, varnish and soap, and in engine and lubricating oil. The muscle tissue was used for tinned meats and sausages, the skin for leather goods, and the carcass residues for the production of 'fish' meal, bone fertilizer and glue (Kleinenberg, 1956; Tomilin, 1957). The lubricating oils, ‘Delfinol’ vitaminous remedy, shoe polish, leather and dried meat were produced in Bulgaria (Tsvetkov and Boyev, 1983). The main products of Turkish dolphin fisheries were the oil and meal for poultry feed (Berkes, 1977; Yel et al., 1996; Öztürk, 1999).

During the 20th century, the number of cetaceans killed in the former Russian Empire and later the USSR undoubtedly exceeded 1.5 million animals, including all three species, while other Black Sea states together probably killed about four to five million (Birkun et al., 1992; Birkun and Krivokhizhin, 1996 b). It is commonly acknowledged that the Black Sea cetacean populations were strongly reduced by the directed fishery (Zemsky and Yablokov, 1974; Smith, 1982; Klimowska, 1991), and that perhaps they did not recover until now (Birkun and Krivokhizhin, 2001). A lack of reliable historical and current abundance estimates (Smith, 1982; Buckland et al., 1992; IWC, 1992 ), however, makes it difficult to judge the extent of recovery, or indeed whether any of the populations have recovered at all.
The statistics of Black Sea cetacean fisheries were usually expressed as total weight or total numbers of animals in the catch without species differentiation. However, since the 19th century in Tsarist Russia and the USSR, the bottlenose dolphin was known as numerically the least abundant species in the catch, while the common dolphin was the most abundant (Silantyev, 1903; Kleinenberg, 1956). According to Bodrov et al. (1958), a total of 1,201,803 individuals of all three Black Sea cetacean species were killed and processed in the Soviet Union from 1931 to 1957. Between the early 1930s and mid 1950s the estimated average proportions of the three species in the Soviet harvest were: one bottlenose dolphin (0.5%) per 10 harbour porpoises (4.7%) per 200 common dolphins (94.8%) (Zalkin, 1940; Kleinenberg, 1956). Thus, the number of bottlenose dolphins processed in the USSR during the 27 years from 1931-1957 can be roughly estimated as a little more than 6,000 individuals. This figure seems very dubious (i.e. negatively biased) given that in spring 1946, more than 3,000 bottlenose dolphins were caught during a single day (!) in one location close to the southern Crimea (Kleinenberg, 1956, page 74).

In the late 1950s and early 1960s the common dolphin fraction began to decrease (80-90%), and harbour porpoises were numerically dominant in the Soviet catches from 1964-1966 (Danilevsky and Tyutyunnikov, 1968). According to these authors, a similar change in species composition occurred at the same time in Bulgaria. Nevertheless, the number of bottlenose dolphins killed was sometimes very high, in some years even exceeding the kills of the other two species. For example, in 1961, the Bulgarian cetacean fishery was concentrated almost exclusively on T. truncatus and about 13,000 individuals were taken (Nikolov, 1963). The sex ratio of 53 bottlenose dolphins, examined in April 1966 at the Novorossiysk dolphin processing factory, was almost 1:1 (27 males and 26 females); pregnant and lactating females constituted 63% and 7.4%, respectively, of all females examined (Danilevsky and Tyutyunnikov, 1968).

From 1976 to the early 1980s the Turkish harvest consisted mainly of harbour porpoises (80%), with a relatively small proportion of bottlenose dolphins (2-3%) (IWC; Klinowska, 1991).

No dependable information on intentional killing of wild Black Sea bottlenose dolphins is available since the ban on cetacean fisheries in 1983. Unlawful direct takes of dolphins seem to be limited by the lack of adequate markets for cetacean products in the riparian countries, rather than by an effective management and enforcement programme. Some deliberate killing may occur as a result of interactions between dolphins and coastal fisheries (see 6.4). Also, in some Black Sea countries intentional killing has been replaced, to some extent, by the live-capture of bottlenose dolphins for dolphinaria (see 6.5).

6.2 Habitat degradation
The habitat of Black Sea T. truncatus is used by humans for shipping, fishing, mineral exploitation, tourism, recreation, military exercises and waste disposal (Vylkanov et al., 1983; Bilyavsky et al., 1998; Kerestecioğlu et al., 1998; Tuncer et al., 1998). In addition, the drainage basin and coastal zone are under pressure from urban development, industry, hydro- and nuclear energy production, agriculture and land-improvement. The numerous factors responsible for degradation of bottlenose dolphin habitat can be classified into three principal groups:

- pollution;
- physical modification of the seabed; and
- overexploitation of natural resources, including marine living resources.

6.2.1 Pollution
Irrespective of sources, anthropogenic pollution of the Black Sea is subdivided into (Black Sea Transboundary Diagnostic Analysis, 1997; Mee and Topping, 1999):

(a) contamination related to various chemical substances (nutrients, crude oil and petroleum products, persistent synthetic pollutants and trace elements);
(b) radioactive contamination;
(c) pollution by solid wastes;
(d) biological pollution including microbial contamination and introduction of alien species of marine organisms; and
(e) acoustic pollution.

The effects of pollution on Black Sea bottlenose dolphins are poorly documented, but there is no shortage of speculations on the subject. No scientific data are available on cetaceans-applied effects of sounds and noises caused by technogenic intervention into the Black Sea environment.

6.2.1.1 Nutrient pollution The Black Sea is severely polluted by organic matter and inorganic nutrients originating from agriculture, animal husbandry, domestic and industrial sewage, etc. The excessive loading of sea water with nitrogen- and phosphorus-containing substances is considered a primary cause of the deterioration of shelf ecosystems (Zaitsev, 1993; Mee and Topping, 1999) which are crowned by inshore top predators including bottlenose dolphins. A large share of nutrients is contributed to the sea by rivers. The peak of nutrient inputs was observed in the 1970s and 1980s (Zaitsev and Mamaev, 1997). Huge inputs of nutrients are causing the eutrophication of shallow waters, especially in the northwestern Black Sea shelf area. This phenomenon includes the production of algal and zooplanktonic blooms; decline of water transparency; oxygen deficiency in the near-
bottom water layer; disappearance of benthic phytocenoses at a depth below 10m; mass mortalities of benthic fishes and invertebrates with associated decay of their remains and seaweed residues (Zaitsev and Mamaev, 1997). Fish mass mortality events have occurred in the Black Sea since the late 1960s; blooms of dinoflagellates have become annual since the early 1970s. The areas of eutrophication in the northwestern Black Sea expanded from 3,500km² in 1973 to 40,000km² in 1990 (Zaitsev, 1993). Finally, the ‘hyperfertilization’ of sea water has resulted in a widespread decline of biodiversity (Zaitsev, 1999). Nutrient pollution is assumed to affect Black Sea cetaceans by reducing the extent of their foraging habitat and depleting their benthic food resources. Both effects would be stressful for bottlenose dolphins given their dependence upon benthic fishes. Moreover, nutrient-enriched water provides a growth medium for potentially pathogenic bacteria (see 6.2.1.7 and 6.6.2) and for toxin-producing planktonic organisms whose toxins may accumulate in cetacean prey.

6.2.1.2 Oil pollution in the Black Sea is concentrated predominantly in coastal areas around river mouths, sewage outfalls, harbours and industrial sites. Accidental and operational spillage of oil and other petroleum products from vessels contributes to the pollution in both inshore and offshore areas. According to incomplete data presented in the Black Sea Transboundary Diagnostic Analysis (1997), about 111,000tn of oil are discharged into the Black Sea every year. The Danube’s outflow of 53,300tn/year contributes about half of the estimated total annual load. Significant concentrations of total petroleum hydrocarbons and products of oil degradation were detected in sea water and sediments near the Danube delta, close to the ports of Sevastopol, Odessa, Kerch, Sochi and Varna and in the Prebosphoric area (Bayona et al., 1999; Mikhailov, 1999; Readman et al., 1999). Oil pollution induces deterioration of coastal marine ecosystems and affects the neuston superficial layer (Zaitsev and Mamaev, 1997), causing the destruction of eggs and larvae of fishes, including different mullet species and anchovy, which constitute a considerable part of the bottlenose dolphin’s diet.

6.2.1.3 Persistent organic pollutants Important synthetic pollutants are represented in the Black Sea by organohalogens: DDT and its derivatives (DDD, DDE), polychlorinated biphenyls ( PCBs), hexachlorohexanes (HCHs), hexachlorobenzene (HCB), chlordanes, butyltin compounds, heptachlor, heptachlor epoxide, aldrin, dieldrin, endrin, methoxychlor and mirex. These chemicals enter the sea mainly from agriculture, industry and municipal sewage. Although there is no evidence of widespread contamination of the sea by these substances, levels in sea water and sediments sampled in some coastal areas (near the Danube delta, Odessa, Sevastopol, Sochi, close to the Bosphorus and in the Kerch Strait) are quite high (Mikhailov, 1999; Readman et al., 1999). The latter publication ranks organohalogen concentrations in Black Sea surficial sediments as follows: DDTs > HCHs > PCBs > HCB > cyclodienes. A similar ranking has been earlier reported for Black Sea fishes and harbour porpoises (Tanabe et al., 1997). The low DDE/DDT values combined with relatively high concentrations indicate current, certainly illegal DDT usage around the Black Sea (Readman et al., 1999). Persistent organic pollutants are lipophilic and liable to bioaccumulation in food webs, attaining maximal concentrations in the fat of top predators including marine mammals. In studies to date, the contamination of Black Sea bottlenose dolphins appears to be less investigated (samples from six animals were studied; Table 3) than that of harbour porpoises. Bottlenose dolphins probably accumulate higher concentrations of DDTs, HCHs and HCB in their blubber than common dolphins, but lower concentrations than harbour porpoises (Birkun et al., 1992, 1993). Bottlenose dolphins also accumulate in their tissues (blubber, muscle, liver and kidney were sampled) PCBs, heptachlor, heptachlor epoxide, aldrin, dieldrin, endrin, methoxychlor and mirex (BLASDOL, 1999).

6.2.1.4 Trace elements Contamination by trace elements, including heavy metals, is not a basin-wide problem in the Black Sea but in some coastal areas the surface sediments reveal increased inputs of chromium, lead, copper, zinc, vanadium, cadmium, cobalt, nickel, arsenic, mercury, iron, and manganese (Readman et al., 1999; Windom et al., 1999). The known hot spots of contamination are the outlets of the Danube and Dniester rivers, the areas near Odessa, Sevastopol, Yalta and Sochi cities, the Strait of Kerch and the area near the Bosphorus. Elevated concentrations of nickel were also found in the eastern part of the Turkish Black Sea. The concentrations of total mercury and methylmercury have been determined in tissues of four bottlenose dolphins sampled in the Crimea (BLASDOL, 1999) and 17 individuals from the northern Caucasus (Glazov and Zhulidov, 2001), while the content of cadmium, chromium, copper, lead, manganese, selenium and zinc was studied in latter individuals only (Table 3). Mercury levels found in Black Sea bottlenose dolphins were one order of magnitude lower than in Mediterranean bottlenose dolphins (BLASDOL, 1999). Kidney tissue in bottlenose dolphins from the Caucasus is more contaminated by all of the above-mentioned elements than the kidney tissue of harbour porpoises from the same area (Glazov and Zhulidov, 2001).

6.2.1.5 Radioactive contamination The principal sources of radioactive pollution of the Black Sea are: (a) past nuclear weapon tests, carried out in the air in different parts of the world in the 1950s-1960s, and (b) the Chernobyl catastrophe, which occurred in the USSR in 1986 (Vakulovsky et al., 1994; Osvald and Egorov, 1999). As a consequence of those events, the anthropogenic radionuclides (137 caesium, 90 strontium, 239,240 plutonium, etc.) were introduced to the sea mainly by atmospheric precipitations and rivers, particularly the Dnieper and Danube. In the 1990s the Black Sea showed relatively high concentrations of radionuclides in comparison with other marine basins.
except the Baltic and Irish Seas, which were also strongly polluted. Mean concentrations of $^{137}$cesium in the water, sediments and fish were one order of magnitude higher in the Black Sea than in the Mediterranean (Osvath and Egorov, 1999). Nevertheless, existing levels of radioactive contamination are considered not to represent a radiological problem for Black Sea biota or for humans in the region (Zaitsev and Mamaev, 1997; Osvath and Egorov, 1999). Harbour porpoise tissues have been examined for concentrations of $^{137}$cesium (Güngör and Portakal, 1996), but no tissues from Black Sea bottlenose dolphins have been tested thus far.

6.2.1.6 Marine debris The Black Sea and its coasts are subjected to very high inputs of solid wastes, although no formal studies of extent, sources, patterns and effects have yet been conducted. Marine dumping of municipal garbage is known to occur in Turkey (Mee and Topping, 1999). Disposal sites for explosive objects are mapped off the Crimea; five such areas are located at depths from 80 to 1,300m. Navigation charts also reflect the distribution of sunken vessels and other scrap metal over the shelf area; in particular, numerous destroyed and lost weapons have been deposited on the seabed of the northern part of the Black Sea since World War II. Floating litter, including plastics and lost fishing nets, represents a particular threat to cetaceans (Zaitsev, 1998). The animals are known to ingest inedible things and to become entangled in netting. A number of foreign bodies have been collected from the stomachs of Black Sea common dolphins: coal slag, pieces of wood and paper, bird feathers, cherry stones, and even a bunch of roses, whereas only pebbles and sand were found in the stomachs of wild bottlenose dolphins (Kleinengel, 1956).

6.2.1.7 Microbe (faecal) pollution Pathogens associated with land-based discharges, coastal disposal sites and liquid wastes discharged from ships represent a potential health risk to cetaceans (Birkun, 1994). Almost all Black Sea cities and settlements discharge their effluents (treated, partially treated or untreated) into the marine environment directly or via rivers. The estimated (probably underestimated) total volume of sewage entering the sea comes to over 571,000,000m$^3$ per year (Bartram et al., 1999). Up to 44% of seawater samples taken during warm months (May-September) near beaches in different Black Sea countries were significantly contaminated by intestinal bacteria. In particular, the number of faecal coliforms and faecal streptococci exceeded, respectively, 20,000-100,000 and 4,000 per litre (Bartram et al., 1999). The concentration of Escherichia coli in sea water near Odessa sometimes rose to 2,400,000 microbe cells per litre (Zaitsev, 1998). A wide variety of enterobacteria (Escherichia, Proteus, Edwardsiella, Klebsiella, Citrobacter, Entero bacter and Salmonella spp.) and pyogenic cocci (Staphylococcus spp.) has been recorded in Georgian coastal waters (Zhgenti, 1998). Elevated concentrations of coprostanol have been detected in surficial sediments sampled near Sochi, Danube delta and Bosphorus (Readman et al., 1999). The effects of microbial pollution on cetaceans are usually regarded as natural pathological processes (see 6.6) even though faecal contamination of sea water is mainly anthropogenic. Bacteria identified in wild Black Sea bottlenose dolphins are listed in Table 4.

6.2.1.8 Introduction of alien species Invasive marine organisms usually arrive in the Black Sea from oceanic vessels either as their external ‘foulings’ or in ballast water, which is often discharged without preventive treatment (Zaitsev and Mamaev, 1997). The ctenophore (comb jellyfish) Mnemiopsis leidyi, accidentally introduced in the early 1980s, has reportedly had a negative effect on the stocks of Black Sea pelagic fishes (mainly anchovy and scad), with consequent impacts on cetaceans that feed on those fishes (Vinogradov, 1996). During the course of only a few years, this ctenophore has become a dominant Black Sea species in terms of biomass, estimated at about 1,000,000,000tn by the end of the 1980s (Vinogradov et al., 1989) with a gradual decrease during the 1990s (Mutlu et al., 1994; Mutlu, 2001). The proliferation of M. leidyi in 1988-1990 led to the depletion of zooplankton forage sources for pelagic fishes and to the large-scale consumption of their eggs and larvae. Both of these effects, combined with overfishing, have contributed to the collapse of pelagic fish resources (Zaitsev and Mamaev, 1997). It is therefore reasonable to consider the introduction of M. leidyi as a form of biological pollution, potentially able to affect the population of Black Sea bottlenose dolphins by depleting their food supply.

Another kind of biological intervention in the Black Sea relates to coastal dolphinarium and oceariaria that keep exotic species of marine mammals in nearshore open-air pens. Such enclosures sometimes fail to prevent captive animals from escaping into the sea. Accidental releases are known to have occurred from the early 1980s in the former USSR and during the last decade in the Russian Federation and Ukraine (Birkun and Krivokhizhin, 1996 a, 2001). These have included white whales (Delphinapterus leucas), northern fur seals (Callorhinus ursinus), Steller sea lions (Eumetopias jubatus), harbour seals (Phoca vitulina), Caspian seals (Phoca caspica) and, perhaps, one or two other pinniped species. The exact number of exotic marine mammals to have escaped into the Black Sea is unknown, but it probably comes to a few tens, including at least two white whales that were observed many times in the wild near the Turkish, Romanian, Bulgarian and Ukrainian coasts in the early 1990s. During the last 13-15 years, solitary otariids have been recorded in the Black and Azov Seas, including Karkinitsky, Kazantipsky, Feodosia and Sevastopol bays, the coast of Kerch peninsula, Arabat Spit and beaches of Sochi and Batumi. In April 1988 and April 1989 two different fur seals were recorded near Ereğli, Turkey (Kiraç and Savaş, 1996). According to the observations of local inhabitants and fishermen, in 1995-1998 two or three individuals of true seals (one of them allegedly had a collar) were seen annually in winter and spring in the Kerch Strait at the coast of Tuzla island (Birkun and Krivokhizhin, 2001). The fates of most accidentally released marine mammals and their possible
influence on indigenous Black Sea cetaceans, including bottlenose dolphins, remain uncertain. Presumably, they could be sources of infections circulating in dolphinarium.

6.2.2 Physical modification of the seabed

The main habitat of Black Sea bottlenose dolphins – shelf waters – is under relentless pressure from human efforts to ‘improve’ the seabed, coasts and rivers flowing into the sea. Some of these activities represent important threats to cetaceans because they are responsible not only for widespread habitat degradation, but also for continuous or episodic disturbance to groups of dolphins:
- channel dredging and marine dumping of removed sediments;
- sand extraction from the sea bottom;
- offshore gas and oil exploitation; and
- bottom trawling.

6.2.2.1 Channel dredging, sand extraction and marine dumping of removed sediments

Efforts to deepen navigation channels and build or reconstruct port facilities cause noise pollution and lead to a decline in water transparency, destruction and silting of benthic communities, and, thereby, to reduced foraging opportunities for cetaceans. These human activities are most intensive in shallow waters of the northwestern shelf area, estuaries of big rivers (Danube, Dnieper, Dniester and South Boug) and the Kerch Strait. According to Bilyavsky et al. (1998), there are more than 30 dumping sites in Black Sea coastal waters, and ten of them are in the northwestern area, where some 5,000,000 m$^3$ of soil has been dumped annually since 1963 by the USSR and Ukraine. In the Kerch Strait 21,000,000 m$^3$ of soil was dredged and dumped during 1991-1997. In Romania from the mid 1980s to mid 1990s up to 7,000,000 m$^3$ of sediment was removed each year in order to enlarge the port of Constantza, and about 1,000,000 m$^3$ was dredged annually from the entry of the Sulina channel connected with the Danube (Petranu, 1997). The rate of sediment accumulation at Black Sea dumping sites exceeds the natural sedimentation rate by more than 1,000 times (Bilyavsky et al., 1998).

Sand extraction for the construction industry is widespread on the northwestern Black Sea shelf. The effects of this activity are similar to those of dredging, although marine dumping is not associated with sand extraction. Millions of tonnes of sand are extracted in Ukraine from Dzharylgachsky, Karkinitsky and Tendrovsky bays, from sandy banks near Odessa, Dniester and Shagany estuaries (Zaitsev, 1998) and from Lake Donuzlav.

6.2.2.2 Offshore gas and oil exploitation

Human activity associated with offshore oil and gas exploitation can disturb bottlenose dolphins and harm their habitat at different stages of the exploration and extraction processes – from geological and geophysical reconnaissance (trial boring, seismic prospecting) to the transportation of extracted gas and oil by bottom pipelines or tankers. Appraisal drilling and seismic exploration are widely spread on the Black Sea shelf. Bulgaria, Romania and Ukraine started commercial gas and oil extraction from the sea bottom approximately 40 years ago. Centres of the industry, which might be regarded as ‘hot spots’ of risk to the marine environment, are situated in the northwestern part of the sea. During the 1980-1990s seven gas and gas condensate deposits were being exploited by Ukraine, and another 150 sites on the Ukrainian shelf with a total area of 70,500 km$^2$ were being considered for exploitation (Bilyavsky et al., 1998).

6.2.2.3 Bottom trawling

Bottom trawling, in the usual sense of the term, has been prohibited in the Black Sea since the beginning of the 20th century (Zaitsev et al., 1992). In the 1970s the riparian countries opened trawl fisheries described as ‘near-bottom’ trawling, allegedly specialized to catch sprat. However, both ‘near-bottom’ and pelagic trawls can easily be transformed into bottom trawls (Konsulov, 1998), and their modified use in the shelf area seems to be practically uncontrolled today. The detrimental effects of bottom trawling include direct mechanical damage to benthic communities and the mobilization of sediment, which decreases water transparency and smothers bottom biocoenoses in neighbouring areas. The net impact of bottom-trawling on cetaceans, including decreased foraging opportunities, has not been assessed.

6.3 Other sources of disturbance

6.3.1 Marine traffic

Shipping lanes and marine traffic are concentrated in coastal shelf waters and therefore overlap areas inhabited by bottlenose dolphins. Three harbor areas are of particular concern in this regard, as follows:
- the Bosphorus shipping junction with adjacent areas in the Black and Marmara Seas (Turkey);
- the Kerch Strait shipping junction with adjacent areas in the Black and Azov Seas (Russia and Ukraine);
- the northwestern portion of the Black Sea, including the ports in Odessa Bay and the estuaries of the Dnieper, Dniester and South Boug rivers (Ukraine).

Shipping in the Black Sea tends to increase from spring to autumn, with a summer peak due the sharp increase in small-scale cabotage traffic and marine tourism. Most domestic and international passenger lines operate only in the warm season. Black Sea marine traffic was most intense between 1985-1992. However, further development of shipping facilities is expected (Strategic Action Plan, 1996). It has been suggested that the number of cetaceans
passing through the Bosphorus has decreased due to heavy traffic that forms a barrier to their move between the Black and Marmara Seas (Öztürk, 1999). Sometimes cetaceans visit internal space of harbors with a risk for animals safety (B.G. Alexandrov, pers. comm.). Thus, the collisions between bottlenose dolphins and vessels seem to be possible (e.g. Wells and Scott, 1997), but probably they are not so frequent in the Black Sea.

6.3.2 Military activities
Since the Second World War, there has been no armed conflict in the Black Sea. However, some long-term after-effects of past battles represent a latent threat to marine wildlife (see 6.2.1.6). During the post-war era, military activity escalated from the mid 1960s to mid 1980s, a period when the USSR navy established special marine areas in the Black and Azov Seas as firing ranges and as proving and training grounds. Some ‘entry-prohibited’ areas of the shelf continue to be used for war games and other exercises. High frequency irradiation and noise pollution from naval ships, submarines and navy-co-operating aviation are also included in the list of major environmental problems related to military activities in the Black Sea (Bilyavsky et al., 1998).

6.3.3 Cetaceans rescue and release events
One sick bottlenose dolphin was rescued in Laspi Bay, Ukraine, in 1997; that animal after veterinary examination and first aid was released without further monitoring. In 1996 two captive Black Sea bottlenose dolphins were released in Taman’ Bay, Russia (Veit et al., 1997); one of them (male) spent six years in the ‘Dolphin Reef Eliat’ in the Red Sea (Israel), another (female) – has been caught three months before the liberation; both animals were sighted in two weeks after release among wild dolphins (see 3.4). A fair amount of bottlenose dolphins escaped from the military oceanarium in Sevastopol (Zhabanov, 1996) and from some other Ukrainian and Russian dolphinaria. It is necessary to underline that release operations, in spite of their obvious benevolence, usually are stressful and may cause a disturbance/damage to both the discharged and wild marine mammals.

6.4 Interaction with fisheries
Cetaceans and fishermen continue to be in a chronic state of conflict because they have similar vital interests in fish consumption and often catch their prey in the same areas during the same time.

6.4.1 Impact of bottlenose dolphins on fisheries
Bottlenose dolphins are primarily piscivorous in the Black Sea, taking both benthic and pelagic fishes, large and small. A total of 14 fish species have been recorded as prey of Black Sea bottlenose dolphins off the Crimean and Caucasian coasts (Table 5). Black Sea scad and shad are also mentioned in some publications (Birkun et al., 1999 c). Among the former list, seven fish species are likely the most important nutritionally. They are: three species of indigenous mullets (Magil cephalus, Lisa aurata and L. saliens), introduced far-east mullet (M. so-iuy), Black Sea turbot (Psetta maeotica), whiting (Merlangius merlangus euxinus) and thornback ray (Raja clavata). The latter two species are considerably less important to commercial fisheries than the first five. Another three fish species – anchovy (Engraulis encrasicholus ponticus), red mullet (Mullus barbatus ponticus) and bonito (Sarda sarda) – are valuable for fisheries, but obviously play only a secondary role in the bottlenose dolphin’s diet. Four species occasionally recorded in the stomach of dolphins – corb (Umbrina cirrhosa), sea scorpion (Scorpaena porcus), zander (Lucioperca lucioperca) and bream (Abramis brama) – are of very little importance to Black Sea fisheries. Finally, some fishes that are enormously attractive for human consumption, e.g. sturgeons (Acipenser spp. and Huso huso), are of no significance in the diet of cetaceans. Thus, the fish resources that provoke the greatest concern about direct competition between bottlenose dolphins and fisheries are probably various mullet species and turbot.

At present, no quantitative data are available on the adverse effects of such competitive interactions on fisheries. Some Ukrainian and Russian fishermen mention episodes in which bottlenose dolphins have damaged their nets or catch, or stolen caught fish from the nets. The same problem is known to occur in Romania and Turkey (Police, 1930, cited after Tomlin, 1957; Öztürk, 1999). 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 bottlenose dolphins.

6.4.2 Impact of fisheries on bottlenose dolphins
Fisheries could have a number of effects on Black Sea bottlenose dolphins:

• alteration of foraging possibilities;
• modification of behaviour;
• mortality and non-lethal injuries in fishing gear.

Moreover, fisheries contribute to the general problem of habitat degradation as they add to the ship-borne sewage, oil and noise pollution, but they also create specific problems. The wide distribution of various types of fishing gear can be considered a kind of marine pollution (see 6.2.1.6). This extends to the countless illegal nets and nets that have been discarded or abandoned. High concentrations of fixed and drifting gear in some coastal areas
actually reduce the amount of habitat available and represent a potential risk of entanglement. Another problem relates to seafloor trawling (see 6.2.2.3).

6.4.2.1 Fisheries-related changes in forage resources  Mainly coastal but also pelagic fisheries can affect Black Sea bottlenose dolphin population by depleting their prey populations. Declining trends have been observed in the abundance of indigenous mullets and turbot, especially in the northern part of the Black Sea (Zaitsev and Mamaev, 1997), where there is considerable pressure from legal and illegal fisheries. Overfishing, combined with eutrophication (see 6.2.1.1) and the irruption of an invasive raptor Mneniopsis leidyi (see 6.2.1.8), has led to a rapid decline in anchovy abundance. The total catch of anchovy decreased by 12-fold, from 468,800tn in the 1987-1988 fishing season to 39,100tn in 1990-1991 (Prodanov et al., 1997).

At the same time, the deficiency of cetacean forage resources, assumed by several authors (Vinogradov, 1996; Bushuyev, 2000), might be compensated at least in part by the introduced far-east mullet, *M. so-iuy*. The intentional introduction of this species 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 has become widespread throughout the region and at present it is caught in all Black Sea countries. Bottlenose dolphins willingly include this new species in their ration (Krivokhizhin et al., 2000; Birkun and Krivokhizhin, 2001).

6.4.2.2 Modification of feeding strategy and behaviour  It is known from Ukrainian fishermen that fishing activities can be attractive for bottlenose dolphins. Some dolphins use fisheries as a food source and incorporate visits to fishing boats and stationary nets into their foraging strategies. Bottlenose dolphins interact with both active and passive inshore fisheries. Solitary individuals 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, southeastern 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. Ivanikov, pers. comm.). Bottlenose dolphins tend to gather around trawling boats, probably attracted by occasional discards e.g. whiting (S.V. Krivokhizhin, pers. comm.).

6.4.2.3 Accidental mortality in fishing gear  Bottlenose dolphins are taken as by-catch in continental shelf waters of all six riparian countries, although they have never been the predominant species in national by-catch statistics. The total reported by-catch of cetaceans in the Black Sea from 1990-1999 was 448, including 425 harbour porpoises (95%), 10 common dolphins (2%) and 13 bottlenose dolphins (3%) (Vasiliu and Dima, 1990; Pavlov et al., 1996; BLASDOL, 1999; Öztürk et al., 1999). Those numbers have not been used in most Black Sea countries to estimate absolute by-catch levels. Öztürk (1999) claimed that at least 200-300 bottlenose dolphins are taken annually in Turkey, but it is impossible to understand the basis for this estimate as according to published statistics only one by-caught bottlenose dolphin was recorded during the years 1993-1997 along the entire European Black Sea coast of Turkey (Öztürk et al., 1999).

According to Öztürk et al. (1999), all reported cetacean by-catches in Turkey (62 harbour porpoises and 1 bottlenose dolphin) have been in bottom gill nets set for turbot from April to June. However, it has also been mentioned that harbour porpoises and bottlenose dolphins die in Turkish waters in sturgeon and sole (*Solea spp.*) bottom fisheries (Öztürk, 1999). According to BLASDOL (1999), cetacean by-catches are also most frequent during April-June (108 cases, or 68% of the reported total) off the Ukrainian, Bulgarian and Georgian coasts. By-catches during those months occurred in bottom-set gill nets for turbot (99 harbour porpoises and 5 bottlenose dolphins) and trap nets (2 bottlenose dolphins); during other months only one bottlenose dolphin was found in a turbot net. In addition, local fishermen reported that bottlenose dolphins were sometimes caught incidentally in purse seines used to catch far-east mullet (*M. so-iuy*) in the Kerch Strait and in the winter fishery for anchovy off the coast of Crimea (A. Chashchin, pers. comm. to S. Krivokhizhin). Thus, bottom-set gill nets used to catch turbot between April and June appear to be the principal direct threat to Black Sea bottlenose dolphins and, especially, harbour porpoises. Other fishing gears, including purse seines, trammel and trap nets, seem to be of secondary importance.

Almost all recorded by-catches are lethal. Only two bottlenose dolphins, entangled with their teeth and tail flukes in trap nets, were released alive in Ukraine in 1997-1999 (BLASDOL, 1999). Fishermen interpret the sudden appearance of ragged holes in nets as evidence that dolphins have been entangled but managed themselves to break free. Indeed, some free-ranging bottlenose dolphins show signs of having been by-caught. 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 rope tightly looped around its tail stock, while another individual was missing the left flipper (S.A. Popov, pers. comm.), probably as a result of traumatic amputation.

6.5 Capture for dolphinaria  From the early 1960s, the USSR Navy showed particular interest in Black Sea bottlenose dolphins. The military oceanarium was established in June 1965 and began its activities in Kazachya Bay of Sevastopol in April 1966 (Zhbanov, 1996). This governmental institution (Scientific Research Center ‘The State Oceanarium’) is now functionally dependent upon the Ministry of Defence and National Academy of Science of the Ukraine (Lukina et
al., 2001). During the 1980s the Romanian Navy repeatedly captured cetaceans for the civil dolphinarium in Constantza (Vasiliu and Dima, 1990). The statistics on live-capture cetacean fisheries in the Black Sea are not published. Since the 1960s many hundreds (probably up to one thousand) of bottlenose dolphins were taken alive in the former USSR (mainly) and Romania for military, commercial and scientific uses. The Russian Federation and Ukraine are continuing that practice periodically in Taman’ Bay (Kerch Strait) and off the south Crimea. During the last 16-19 years the captures were concentrated on T. truncatus as the other two Black Sea cetacean species are not as desirable for dolphinaria. The capture operations, carried out by means of purse-seines, sometimes resulted in the accidental deaths of one or more dolphins, although only one such case was published in the Soviet Union (Abramov, 1989). At least four bottlenose dolphins have died due to the ‘live’ capturing in Romania in September 1986 (Vasiliu and Dima, 1990).

There are eight dolphinaria in Russia, where Black Sea bottlenose dolphins are kept together (sometimes in the same pool) with other marine mammals mainly from the Far East and Arctic. Four Russian dolphinaria located on the Caucasian coast (Anapa [Bolshoy Utrish], Novorossiysk [Malyy Utrish], Gelendzhik and Sochi) are supplied by natural sea water. The other four facilities (Moscow, St.-Petersburg, Rostov-na-Donu and Yessentuki) use artificially salted or artesian saline water. Eight dolphinaria are functioning in Ukraine (Yalta, Alushta [Partenit], Feodosia [Karadag], Dnepropetrovsk, two in Evpatoria and two in Sevastopol). Half of these share common defects (lack of adequate water purification systems, too slow water circulation, obsolete equipment, and deteriorated constructions). Romania and Bulgaria each possess one dolphinarium, in Constantza (Vasiliu and Dima, 1990). The statistics on live-capture cetacean fisheries in the Black Sea are not published. 80-120 marine mammals (primarily Black Sea bottlenose dolphins) are currently maintained in the pools and open air cages of all mentioned facilities, including 40-50 bottlenose dolphins in Ukraine (Birkun and Krivokhizhin, 2001) and three in Romania. In addition, there is a dolphinarium in Georgia (Batumi), but it has been closed since the early 1990s when its bottlenose dolphins were exported to Yugoslavia, with further re-export to Malta (Entrup and Cartlidge, 1998).

Black Sea countries have no strict legal requirements concerning captive cetaceans. Approximately 20-30 bottlenose dolphins of reproductive age are live-captured every year in Russia and sporadically in Ukraine to replace captive animals that have died. A total of about 40 individuals were caught in Ukraine from 1995-2000 (Birkun and Krivokhizhin, 2001). The fate of most captive cetaceans is clear: a short ‘working life’ in captivity followed by disease and death, usually involving multi-bacterial pneumonia and septicaemia (Birkun et al., 1992). No successful breeding programmes exist for Black Sea cetaceans, although some publications portray the opposite (Bogdanova et al., 1996; Lukina et al., 2001). Anyhow, the second generation of captive bred Black Sea bottlenose dolphins has never been achieved during almost 40-year history of dolphinarium business.

During the 1980s and 1990s the number of seasonal dolphinaria for public display and for ‘swimming with dolphins’ programs has increased. During Soviet times Black Sea military bottlenose dolphins were translocated to facilities in the Sea of Japan and Barents Sea. The export of bottlenose dolphins from Russia and Ukraine for permanent and seasonal shows has expanded, for example, to Argentina, Bahrain, Byelorussia, Chile, Cyprus, Egypt, Hungary, Iran, Israel, Kuwait, Lithuania, Romania, Saudi Arabia, Syria, Turkey, United Arab Emirates, Vietnam, and former Yugoslavia countries. Instances are known in which dolphins that died during a performance tour were replaced with freshly caught animals (Birkun et al., 1992). More details on the export of Black Sea bottlenose dolphins and their fate are available from the report prepared by the Whale and Dolphin Conservation Society (Entrup and Cartlidge, 1998).

6.6 Natural mortality and pathology
No rigorous analysis of mortality rates for Black Sea bottlenose dolphins exists. Stormy weather has been supposed as a probably important mortality factor for newborn bottlenose dolphins (Zalkin, 1940; Kleinenberg, 1956). According to annual compilations of cetacean strandings in the Crimea (Krivokhizhin and Birkun, 1999), there was a prominent peak of T. truncatus strandings in 1990 (20 dead animals, representing 44% of all bottlenose dolphin strandings reported from 1989-1996) (Krivokhizhin and Birkun, 1999), but stranded calves less than 1.5m long were never recorded. The cause of that spike in bottlenose dolphin mortality, accompanied by mass strandings of dead common dolphins and harbour porpoises, remains unclear.

6.6.1 Virus infections
An outbreak of morbilliviral disease occurred in Black Sea common dolphins in July-September 1994 (Birkun et al., 1999 b). This disease was thought to have spread to the Black Sea from the Mediterranean, where it affected striped dolphins (Stenella coeruleoalba) in 1990-1992 (Aguilar and Raga, 1993). An alternative view is that the Black Sea may have been a persistent site of cetacean morbilliviral infection long before the epizootic in common dolphins. Two facts related to bottlenose dolphins may be regarded as support for this hypothesis:

(a) serum antibodies against parainfluenza II and III viruses were detected, respectively, in 10% and 2% of the bottlenose dolphins kept in Sevastopol’s oceanarium in the early 1980s (Gulov, 1984). These viruses and morbilliviruses belong to the same family, Paramyxoviridae, therefore antigenic crossing between them is possible, and an infectious interaction between bottlenose dolphins and morbilliviruses can not be excluded in those cases;
induce superficial mycoses. Such fungi include the genera Tomilin and Bliznyuk, 1981; Zakharova et al., 1978). Besides, 16.5% of 200 wild cetaceans, sampled in the early 1980s in coastal waters off the Crimea, were seropositive to Flavivirus too. Neither virus was not isolated, and no specific symptoms of sickness were recorded in these cases.

6.6.2 Bacterial diseases
Current knowledge on bacteria that infect wild Black Sea bottlenose dolphins is rather limited (Table 4). In the 1980s screening for various antibacterial serum antibodies was carried out in several tens of animals that were sampled just after live-capture for dolphinariums (GABION, 1983; Gulov, 1984; Reichuk et al., 1986). As a result, diagnostic titers of antibodies to Leptospira and Erysipelothrix spp. were determined in some cases, although bacterial cultures were not isolated and no specific lesions were found by means of routine veterinary examination. Nevertheless, it was supposed that Black Sea bottlenose dolphins could be the victims, carriers and reservoirs of leptospirosis and erysipelas. The role of these bacterial infections in cetacean natural morbidity and mortality has not yet been specified. Fatal epizootics of erysipelas (Nifontov, 1969; Rodin et al., 1970; GABION, 1983) and listeriosis (Oleinik and Gulov, 1981; Gulov, 1984) have been recorded for captive bottlenose dolphins, which usually end up dying from septicemia.

Inshore species of cetaceans are susceptible to effects of polymicrobial anthropogenic pollution of the Black Sea (Birkun, 1994). A number of opportunistic bacteria that probably originated from untreated sewage were isolated from the skin, respiratory tracts and internal organs of wild bottlenose dolphins examined post mortem and alive (Table 4) (Birkun et al., 1988; Birkun and Miloserdova, 1989; BLASDOL, 1999). Those organisms, including intestinal microflora (Alcaligenes, Escherichia, Klebsiella and Proteus spp.), halophilic aquatic bacteria (Vibrio and Aeromonas spp.) and pyogenic cocci (Staphylococcus spp.), may cause local and generalized secondary infections in weakened individuals affected, for instance, by helminth infestation, non-infectious pathology or trauma (Birkun and Miloserdova, 1989). In this respect the mass mortality event recorded in 1990 could be the convincing example (Birkun et al., 1992; Krivokhizhin and Birkun, 1999). Multi-microbial pollution of coastal waters creates a constant risk of mixed infections (mainly pneumonias and septicaemias), when two and more species of opportunistic bacteria and fungi are involved in a pathological process. Staphylococcus aureus in combination with various enterobacteria (most often Proteus mirabilis) constitutes a continual threat for wild and captive Black Sea bottlenose dolphins (YEVLAKH-2, 1986; Birkun et al., 1990; Birkun, 1994). Development of local suppurative inflammation and generalization of septic lesions are accompanied by immune response and immunopathological reactions to the antigens of different members of morbillifl bacterial associations.

6.6.3 Microalgae vegetation
Microphytic algae, predominantly diatoms (Bacillariophyta), produce a film on the skin of captive bottlenose dolphins in Russian and Ukrainian dolphinariums. The pathogenic significance of this condition is uncertain (Birkun and Goldin, 1997; Goldin and Birkun, 1999). However, pronounced microalgal coverage of the skin surface is a reliable indicator of poor health in captive cetaceans and/or unfavourable husbandry and veterinary conditions (e.g. insufficient space, stagnant and polluted water, etc.). Visible algal film has never been recorded in wild Black Sea cetaceans, but sparse cells of the diatoms Licmophora sp. and Nitzschia hybrida L. hyalinum were detected in skin scrapes collected from a few newly captured bottlenose dolphins (Goldin, 1996, 1997). Numerous cells of non-parasitic dinoflagellates (Dinophyta) and unidentified unicellular seaweeds were found in blowhole swabs of bottlenose dolphins and belukhas (Delphinapterus leucas) kept together in an open-air sea pen in Laspi Bay, southern Crimea (Krivokhizhin and Birkun, unpubl. data). Unfortunately, no data are available concerning the effects of Black Sea dinoflagellates and their toxins on cetaceans. ‘Red tides’ caused by blooms of these microalgae have become common in the region since the 1970s (see 6.2.1.1).

6.6.4 Mycoses
Black Sea bottlenose dolphins can be contaminated by microscopic fungi which may cause secondary infections of integumentary tissues (superficial mycoses or dermatomycoses) and internal organs (deep or systemic mycoses). According to research conducted in the former Soviet Union, opportunistic fungi invade bottlenose dolphin skin and induce superficial mycoses. Such fungi include the genera Alternaria, Rhodotorula, Cladosporium, Mortierella, Trichophyton, Rhomphobryum and Hyphomycoses (Zakharova and Zagoryuk, 1978; Zakharova et al., 1978 a; Tomilin and Bliznyuk, 1981; Zakharova et al., 1982; Zakharova and Dralkin, 1985). Maculated, papulous and ulcerative dermatities, caused by fungi and bacterial-mycotic associations, are widespread in bottlenose dolphins off the Crimea coast. There is no evidence that dermatomycoses are themselves lethal, but they usually open a gateway for further microbial intrusion and promote systemic dissemination of pathogens.
6.6.5 Parasitic diseases

Protozoan infections and external macroparasitism are unknown in Black Sea bottlenose dolphins. The internal macroparasites of Black Sea T. truncatus are represented by six species of helminths belonging to the flukes (Trematoda; 3 species), tapeworms (Cestoda; 1 species) and roundworms (Nematoda; 2 species). The life circles are not investigated for all of them.

Flukes *Braunina cordiformis* and *Synthesis tursionis* were recorded in gastrointestinal tract; all infrequent findings of these parasites belong to the 1950s-1960s (Delamure *et al*., 1963; Delamure and Serdyukov, 1966). Their role in dolphin mortality remains unclear. Stomach fluke *Pholetter gastrophilus*, a causative agent of chronic deforming gastritis (pholetterosis), have been first reported in Black Sea *T. truncatus* in the early 1990s (Birkun *et al*., 1992; Krivokhizhin, 1992). The extensiveness of this invasion came to 63% in stranded bottlenose dolphins (Krivokhizhin, 2000). In cases with pronounced sclerotic, necrotic and granulomatous lesions in gastric wall, the pholetterosis can be complicated by pyloric stenosis and, presumably, by gastric bleeding and perforation which may lead to animal deaths.

The intestinal invasion, caused by tapeworm *Diphyllobothrium stemmacephalum* (diphyllobothriosis) (Delamure, 1945, 1971), is characterized by relatively low extensiveness (13% of stranded bottlenose dolphins were infected) (Krivokhizhin, 2000) and low to moderate intensity (1-14 worms per host) (S.V. Krivokhizhin, pers. comm.). A death, admittedly, may be caused by obstructive intestinal impassability (ileus, volvulus) due to the bundling of twisted helminths in gut’s lumen.

The nematode *Stenurus ovatus* is known for a long time as a lung parasite of Black Sea bottlenose dolphins (Delamure, 1945), but any indices of the extent of this invasion and any opinion on its role in cetacean morbidity were not published before the 1990s (Krivokhizhin, 1997). Delamure (1955) recorded *S. ovatus* in a blowhole, bronchi and blood vessels. Among eight stranded animals, examined in 1989-1999, there was one animal with the parasites in bronchi and with calcified residues, probably originated from nematodes, in the lung tissue; two more individuals had calcifications only (Krivokhizhin, 1997, 2000). In all those cases, chronic broncho-pneumonia combined with focal purulent bronchitis and alveolitis suggested associative participation of helminths and pyogenic microflora in the development of tissue injury.

The first finding of spirurids *Crassicauda sp.* in Black Sea cetaceans has been recorded in 1989 in a harbour porpoise stranded on the Crimean coast (Krivokhizhin, 1989). During the 1990s these worms were repeatedly found in porpoises and also in common and bottlenose dolphins (Birkun *et al*., 1992; Krivokhizhin, 1992; Birkun and Krivokhizhin, 1993; Krivokhizhin and Birkun, 1994; Birkun *et al*., 1999 a). After consultations (J.A. Raga, pers. comm.; A.S. Skryabin, pers. comm.) the nematodes have been preliminary attributed to *Crassicauda grampicola* (Krivokhizhin, 2000). The parasites always located in cranial sinuses (predominantly in pterygoid sinus) and inner ear and usually caused osteolytic lesions in the surrounding skull bones with their perforation, in particular, to cranial cavity. The reactive focal meningitis has been observed in some cases. According to the data collected during eleven years (1989-1999), the crassicaudosis affected 25% of stranded bottlenose dolphins (Krivokhizhin, 2000). The intensity of the invasion did not exceed four nematodes per host (S.V. Krivokhizhin, pers. comm.). It is thought that this infection may lead to cetacean live strandings and lethal end due to cerebral disorders.

Unidentified helminths have been extracted from tumour-like formation located in bottlenose dolphin’s skin (Zakharova *et al*., 1978 b). Microscopic calcifications, presumably originated from necrotized helminths (nematode larvae?), were indicated in kidneys of another individual (BLASDOL, 1999).

Other disease conditions and injuries found occasionally in Black Sea bottlenose dolphins – acute broncho-pneumonia and bronchitis, chronic pulmonary abscesses, splenitis, lymphadenitis, nephritis, adenitis, stomatitis, glossitis, pharyngitis, gastritis, gastric ulcers, gastroenteritis, enteritis, hepatitis, pancreatitis and some dermatites (BLASDOL, 1999; Birkun, unpubl. data) – were not attributed to the above-mentioned types of infectious pathology, although most inflammatory lesions may be caused by known (but not isolated and identified) viruses, bacteria, fungi or helminths. The current knowledge on non-infectious diseases and congenital anomalies, including arteriosclerosis and partial albinism (BLASDOL, 1999), is very limited. Parallel skin scars caused by intraspecific interaction are the most frequent traumatic lesions recorded in bottlenose dolphins (Belkovich *et al*., 1978).

7 CONSERVATION MEASURES

The future of marine mammals in the Black Sea is of great concern locally, regionally and internationally. The protection of bottlenose dolphins and their habitats is envisaged by a series of worldwide, European and regional legislative acts, including the Convention on Biological Diversity (CBD), the Convention on the Conservation of Migratory Species of Wild Animals (CMS, the Bonn Convention), the Convention on the Conservation of European Wildlife and Natural Habitats (the Berne Convention), the Convention on the Protection of the Black Sea Against Pollution (the Bucharest Convention, which includes since June 2002 the Black Sea Biodiversity and Landscape
Conservation Protocol\textsuperscript{1}), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and the Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS, the affiliated agreement to CMS).

The above instruments should have potential value for Black Sea bottlenose dolphins conservation, nevertheless its actual realization is still very limited. In March 2002 the 1st Session of the Meeting of the Parties to ACCOBAMS has adopted a resolution to strengthen prohibition measures for deliberate catch, keeping and trade of Black Sea bottlenose dolphins. However, up to date the Russian Federation, Turkey and Ukraine are not contracting parties to the agreement. At the 12th Conference of the Parties to CITES (November 2002), a quota of zero for commercial export of live dolphins wild-captured in the Black Sea has been secured. Thus, at present no export permits can be issued by Black Sea riparian countries owing to the fact that all of them are parties to CITES.

The species \textit{T. truncatus} is listed as Data Deficient (DD) by IUCN. Meanwhile, a proposal for listing the Black Sea population as Vulnerable (VU) is under review by the IUCN Species Survival Commission Cetacean Specialist Group (SSC/CSG). This population is highlighted in the IUCN SSC/CSG Conservation Action Plan (Reeves et al., 2001), which recommends development of a project to investigate the distribution and abundance of bottlenose dolphins in the Mediterranean and Black Seas, and to evaluate their conservation status and threats to their survival. The Action Plan emphasizes also a particular need in genetic studies to determine the extent to which Black Sea bottlenose dolphins are distinct from other populations.

The list of international documents and institutions which recognize the necessity of conservation and research of Black Sea cetaceans is quite long. There are many talks around these animals, but few activities only for their real protection and monitoring of their status. The IWC Scientific Committee is concerned because of a lack of reliable data on Black Sea cetacean abundance and on the numbers of their kills (1977, 1983, 1990, 1992). In 1994 the European Cetacean Society (ECS) has sent the appropriate Letter of Concern on the ‘Future of Black Sea Dolphins’ to the governments of Black Sea countries and to the European Union. The 1st International Symposium on Marine Mammals of the Black Sea (Istanbul, 1994) has adopted a similar Declaration. Both documents distributed among various governmental, intergovernmental and nongovernmental organizations were as a summary of urgent needs for Black Sea cetacean research and conservation. In 1996 the Ministers of Environment of Black Sea countries have adopted a number of cetacean conservation measures listed in the Strategic Action Plan for the Rehabilitation and Protection of the Black Sea (paragraph 62). All three cetacean species inhabiting the Black Sea are mentioned in the EC Directive No.92/43/EEC on the conservation of natural habitats of wild fauna and flora: common dolphin – in Annex IV ‘Animal and plant species of Community interest in need of strict protection’; harbour porpoise and bottlenose dolphin – in Annex II should mean that special protected areas have to be created for them.

At the national level Black Sea cetaceans are protected by the Animal World Laws, governmental decrees and various ministerial regulations. The bottlenose dolphin is included in the National Red Data Books of Bulgaria, Georgia, Russia and Ukraine and in the Regional Black Sea Red Data Book (Birkun et al., 1999 c). Under the national legislation of most Black Sea countries, the endangered species as well as other species listed in national Red Data Books should be monitored and managed by appropriate governmental programmes. In March 2001 the Parliament of Ukraine has approved by law the National Programme for the Conservation and Rehabilitation of the Environment of the Azov and Black Seas. Some specific measures concerning the monitoring and conservation of marine mammals are specified in paragraph 3.1 of this document.

The research and management activities require development and harmonization among various national and international institutions, involved in the conservation of Black Sea cetacean populations. The coordination can be realized under the auspices of ACCOBAMS by the agency of its Scientific Committee and Coordination Unit for the Black Sea represented by the Commission for Protection of the Black Sea against Pollution (Black Sea Commission, Istanbul). As the next step, the Parties to ACCOBAMS have adopted among the international implementation priorities for 2002-2006 (Notarbartolo di Sciara, 2002) the preparation of Conservation plan for cetaceans in the Black Sea, which should include (citation) ‘efforts to fill the existing knowledge gaps concerning the distribution, abundance, population structure, and factors threatening the conservation of the three species involved, as well as management measures such as the establishment of specially protected areas, the development and implementation of regulations to increase sustainability of human activities in the region, and the organisation of training, education and awareness initiatives’.

ACKNOWLEDGEMENTS

The preparation of this review was supported by the Government of the Principality of Monaco. I am grateful to Giuseppe Notarbartolo di Sciara for proposed draft layout of the paper, Patrick Van Klaveren for correction of my English, Sergey Krivokhizhin for kind assistance with the artwork and two anonymous reviewers for their very helpful comments and suggestions.

\textsuperscript{1} The bottlenose dolphin is included as endangered species in the Annex 2 entitled the Provisional List of Species of the Black Sea Importance.
REFERENCES


Gulov, V.P. 1984. Infectious Diseases Common for Humans and Marine Mammals: Epidemiology, Microbiology, Prophylaxis. Author's abstract of the thesis for the candidate of medicine scientific degree. Moscow, 18pp. [unpublished; in Russian].


---

**Table 1**

Number of sightings (%) of bottlenose dolphins in different zones of the Black Sea (after Yaskin and Yukhov, 1997)

<table>
<thead>
<tr>
<th>Term of boat survey</th>
<th>Number of sightings (%) in the zones with various depth (in brackets)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Waters over the shelf mainly (0-200m)</td>
</tr>
<tr>
<td>July 1985</td>
<td>100.0</td>
</tr>
<tr>
<td>June 1986</td>
<td>98.8</td>
</tr>
<tr>
<td>October 1986</td>
<td>83.3</td>
</tr>
<tr>
<td>June 1987</td>
<td>86.3</td>
</tr>
<tr>
<td>On average</td>
<td>92.1</td>
</tr>
</tbody>
</table>

---

**Table 2**

Estimated absolute abundance of Black Sea bottlenose dolphin population

<table>
<thead>
<tr>
<th>Period</th>
<th>Abundance (no. of animals)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early 20th century</td>
<td>30,000-50,000</td>
<td>Bushuyev (2000)</td>
</tr>
<tr>
<td>1973</td>
<td>31,000</td>
<td>Zemsky (1975)</td>
</tr>
<tr>
<td>1976</td>
<td>56,000</td>
<td>Mikhail et al. (1978)</td>
</tr>
</tbody>
</table>
Between 55,000 and 60,000 cetaceans, including nearly 50,000 common dolphins (*Delphinus delphis*), were estimated for the entire Black Sea area. Consequently, the overall number of bottlenose dolphins and harbour porpoises did not exceed 5,000-10,000 animals.

A total of 454,440 individuals was estimated for all three Black Sea cetacean populations (*D. delphis*, *T. truncatus* and *P. phocoena*) taken together, and a share of bottlenose dolphins constituted 14.8%.

### Table 3

Studies on contaminants and microelements in Black Sea bottlenose dolphins

<table>
<thead>
<tr>
<th>No. of animals</th>
<th>Stranded, by-caught or captive</th>
<th>Year of sampling</th>
<th>Location of sampling</th>
<th>Substances considered</th>
<th>Tissues considered</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>stranded</td>
<td>1990</td>
<td>Crimea (Ukraine)</td>
<td>Σ DDTs, Σ HCHs</td>
<td>blubber</td>
<td>Birkun <em>et al.</em> (1992)</td>
</tr>
<tr>
<td>2</td>
<td>stranded</td>
<td>1990</td>
<td>Crimea (Ukraine)</td>
<td>2,4'-DDE, 4,4'-DDE, 2,4'-DDD, 4,4'-DDD, 2,4'-DDT, 4,4'-DDT, Σ DDTs, HCB, α-HCH, β-HCH, γ-HCH, δ-HCH, Σ HCHs</td>
<td>blubber</td>
<td>Birkun <em>et al.</em> (1993)</td>
</tr>
<tr>
<td>2</td>
<td>stranded</td>
<td>1997</td>
<td>Crimea (Ukraine)</td>
<td>mercury (total and organic), PCB isomers and congeners, Σ PCBs, p,p'-DDE, o,p'-DDE, p,p'-DDD, o,p'-DDD, Σ DDTs, HCB, Σ HCHs, aldrin, dieldrin, endrin, mirex, heptachlor, heptachlor epoxide, methoxychlor</td>
<td>blubber, muscle, liver, kidney, brain</td>
<td>BLASDOL (1999)</td>
</tr>
<tr>
<td>17</td>
<td>by-caught and stranded</td>
<td>1996-1999</td>
<td>Caucasus (Russia)</td>
<td>mercury (total and organic), cadmium, chromium, copper, lead, manganese, selenium, zinc</td>
<td>muscle, liver, kidney, skin</td>
<td>Glazov and Zhulidov (2001)</td>
</tr>
</tbody>
</table>

### Table 4

Bacteria and antibacterial antibodies detected in wild Black Sea bottlenose dolphins

<table>
<thead>
<tr>
<th>Species</th>
<th>Isolated cultures</th>
<th>Detected antibodies</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Leptospira interrogans</em></td>
<td>+ h, i</td>
<td>+ b, d</td>
</tr>
<tr>
<td><em>Pseudomonas putida</em></td>
<td>+ h</td>
<td></td>
</tr>
<tr>
<td><em>Pseudomonas alcaligenes</em></td>
<td>+ h, i</td>
<td></td>
</tr>
<tr>
<td><em>Flavobacterium lutescens</em></td>
<td>+ h, i</td>
<td></td>
</tr>
<tr>
<td><em>Alcaligenes faecalis</em></td>
<td>+ h, i</td>
<td></td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>+ h, i</td>
<td></td>
</tr>
<tr>
<td><em>Salmonella sp.</em></td>
<td>+ h</td>
<td></td>
</tr>
<tr>
<td><em>Klebsiella pneumoniae</em></td>
<td>+ h, i</td>
<td></td>
</tr>
<tr>
<td><em>Proteus mirabilis</em></td>
<td>+ h, i</td>
<td>+ e</td>
</tr>
<tr>
<td><em>Yersinia enterocolitica</em></td>
<td>+ h, i</td>
<td>+ e</td>
</tr>
<tr>
<td><em>Vibrio proteolyticus</em></td>
<td>+ h, i</td>
<td></td>
</tr>
<tr>
<td><em>Aeromonas hydrophilia</em></td>
<td>+ h, i</td>
<td></td>
</tr>
<tr>
<td><em>Aeromonas caviae</em></td>
<td>+ h, i</td>
<td></td>
</tr>
<tr>
<td><em>Micrococcus luteus</em></td>
<td>+ h, i</td>
<td></td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>+ h, i</td>
<td></td>
</tr>
<tr>
<td><em>Staphylococcus epidermidis</em></td>
<td>+ h, i</td>
<td></td>
</tr>
<tr>
<td><em>Staphylococcus saprophyticus</em></td>
<td>+ h, i</td>
<td></td>
</tr>
<tr>
<td><em>Sarcina spp.</em></td>
<td>+ h, i</td>
<td></td>
</tr>
<tr>
<td><em>Bacillus licheniformis</em></td>
<td>+ h, i</td>
<td></td>
</tr>
<tr>
<td><em>Bacillus spp.</em></td>
<td>+ h, i</td>
<td></td>
</tr>
<tr>
<td><em>Listeria monocytogenes</em></td>
<td>+ h, i</td>
<td></td>
</tr>
</tbody>
</table>

23
<table>
<thead>
<tr>
<th>Species</th>
<th>Isolated cultures</th>
<th>Detected antibodies</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Erysipelothrix rhusiopathiae</em></td>
<td>+, i</td>
<td>+, *</td>
</tr>
<tr>
<td><em>Corynebacterium sp.</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*a* – GABION (1983); *b* – Gulov (1984); *c* – Kileso et al. (1986); *d* – Reichuk et al. (1986); *e* – YEVLAKH-2 (1986); *f* – Yushchenko et al. (1986); *g* – Birkun et al. (1988); *h* – Birkun and Miloserdova (1989); *i* – Birkun (unpubl. data).

**Table 5**

Target fish species of Black Sea bottlenose dolphins and their importance for the cetaceans and commercial fisheries:

P – primary, S – secondary and U – undefined

<table>
<thead>
<tr>
<th>Fish species</th>
<th>Bottlenose dolphins</th>
<th>Fisheries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Sea turbot, <em>Psetta maeotica</em></td>
<td>P a, b, d</td>
<td>P</td>
</tr>
<tr>
<td>Far-east mullet, <em>Mugil so-iuy</em></td>
<td>P *</td>
<td>P</td>
</tr>
<tr>
<td>Whiting, <em>Merlangius merlangus euxinus</em></td>
<td>P b, e, S a</td>
<td>S</td>
</tr>
<tr>
<td>Thornback ray, <em>Raja clavata</em></td>
<td>P a, S b, d</td>
<td>S</td>
</tr>
<tr>
<td>Mullets, <em>Lisa aurata</em> et <em>L. saliens</em></td>
<td>P *</td>
<td>P</td>
</tr>
<tr>
<td>Grey mullet, <em>Mugil cephalus</em></td>
<td>P e, S a, b, d</td>
<td>P</td>
</tr>
<tr>
<td>Anchovy, <em>Engraulis encrasicolus ponticus</em></td>
<td>P a, b, e</td>
<td>P</td>
</tr>
<tr>
<td>Red mullet, <em>Mullus barbatus ponticus</em></td>
<td>S a, b, d</td>
<td>P</td>
</tr>
<tr>
<td>Bonito, <em>Sarda sarda</em></td>
<td>S a, b, d</td>
<td>P</td>
</tr>
<tr>
<td>Zander, <em>Lucioperca lucioperca</em></td>
<td>S a</td>
<td>U</td>
</tr>
<tr>
<td>Bream, <em>Abramis brama</em></td>
<td>S a</td>
<td>U</td>
</tr>
<tr>
<td>Sea scorpion, <em>Scorpaena porcus</em></td>
<td>S a, b, d</td>
<td>U</td>
</tr>
<tr>
<td>Corb, <em>Umbrina cirrhosa</em></td>
<td>S b, d</td>
<td>U</td>
</tr>
</tbody>
</table>

*a* – Zalkin (1940); *b* – Kleinenberg (1956); *c* – Tomilin (1957); *d* – Geptner et al., 1976; *e* – Krivokhizhin et al. (2000); *f* – according to Prodanov et al. (1997), with additions.
Fig. 1. Map of the Black Sea region showing the locations mentioned in the text.
Fig. 2. The predominance of bottlenose dolphin sightings in the Strait of Kerch in summer according to results of boat survey conducted in June 1997 in the western part (Ukrainian waters) of the strait (after Birkun and Krivokhizhin, 1998).
Fig. 3. The predominance of sightings of bottlenose dolphins (above) in comparison with harbour porpoises (below) in coastal waters off the south Crimea in August-December 1998. Tracklines of observation boat are shown; rough scale of cetacean group sizes is presented in the legend (after Birkun and Krivokhizhin, 2000).
Fig. 4. Bottlenose dolphin and harbour porpoise relative abundance estimated for coastal area between Balaklava and Foros, south Crimea, in August-December 1998 (after Birkun and Krivokhizhin, 2000; Birkun et al., 2001).