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NEW PREY FISHES IN DIET OF BLACK SEA BOTTLENOSE DOLPHINS, *TURSIOPS TRUNCATUS* (MAMMALIA, CETACEA)

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New Prey Fishes in Diet of Black Sea Bottlenose Dolphins, *Tursiops truncatus* (Mammalia, Cetacea). Gladilina E. V., Gol'din P. E. — We report 7 new prey fishes in diet of the Black Sea bottlenose dolphins *Tursiops truncatus* (Montagu, 1821) and the first records of 9 prey items from their stomach contents: herring (*Alosa* sp.), sand smelt (*Atherina* sp.), horse mackerel (*Trachurus mediterraneus*), picarel (*Spicara flexuosa*), Mediterranean sand eel (*Gymnammodytes cicerellus*), Atlantic stargazer (*Uranoscopus scaber)*, garfish (*Belone belone*), gobies (Gobiidae indet.) and blennies (Blenniidae indet.). The Atlantic stargazer was recorded as a prey species for the common bottlenose dolphin for the first time. The horse mackerel and the picarel, formerly recorded in the diet of Mediterranean bottlenose dolphins, now were frequently found in the examined Black Sea dolphins. The list of prey fishes for Black Sea bottlenose dolphins now includes 23 items, with many small pelagic and demersal fishes, and it is similar to that of Mediterranean dolphins. Whiting (*Merlangius merlangus*) is still an important prey species, as 50–70 years ago, whereas turbot (*Psetta maeotica*), not recorded by us, could lose its importance due to population decline. As before, red mullet (*Mullus barbatus*) is recorded in winter feeding. Feeding on mullets (Mugilidae) is not a universal trait, and it is possibly restricted to local geographical areas.

K e y w o r d s: bottlenose dolphin, diet, Black Sea, otoliths, stomach contents.

Новые пищевые объекты в питании черноморских афалин, *Tursiops truncatus* (Mammalia, Cetacea). Гладилина Е. В., Гольдин П. Е. — Представлено 7 новых видов рыб в питании черноморских афалин *Tursiops truncatus* (Montagu, 1821) и впервые сообщается о 9 пищевых объектах из содержимого желудков: сельди (*Alosa* sp.), атерина (*Atherina* sp.), ставрида (*Trachurus mediterraneus*), смарида (*Spicara flexuosa*), средиземноморская песчанка (*Gymnammodytes cicerellus*), европейский звездочёт (*Uranoscopus scaber)*, сарган (*Belone belone*), бычки (Gobiidae indet.) и собачки (Blenniidae indet.). Европейский звездочёт впервые выявлен в питании афалины. Ставрида и смарида регистрировались ранее в питании средиземноморских афалин, а ныне часто встречаются в желудках исследованных нами черноморских афалин. Общий список рыб в питании черноморских афалин на данный момент включает 23 объекта, в том числе много мелких пелагических и демерсальных рыб, и близок к питанию средиземноморских афалин. Мерланг (*Merlangius merlangus*) по-прежнему играет большую роль в питании, как и 50–70 лет назад, в то время как значение калкана (*Psetta maeotica*), не обнаруженного нами, возможно, снизилось вследствие сокращения его численности. Как и прежде, в зимнем питании выявлена барабуля (*Mullus barbatus*). Питание кефалями (Mugilidae) не повсеместно и, возможно, ограничивается отдельными районами.

К л ю ч е в ы е с л о в а: афалина, питание, Чёрное море, отолиты, содержимое желудка.

Introduction

Diet of the common bottlenose dolphin *Tursiops truncatus* (Montagu, 1821) is well-studied across its worldwide distribution range (Santos et al., 2007 b). The Black Sea, inhabited by a relatively isolated dolphin population (Tomilin, 1957), is among the areas with the longest history of bottlenose dolphin research (reviewed by Kleinenberg, 1956). Data on bottlenose dolphin feeding have been reported from this region since the early 20th century (Zernov, 1913; Kravchenko, 1932). However, now these data need to be updated. A large bulk of results was obtained from studies of stomach content of the dolphins taken during fisheries operations before 1955 (Mal'm, 1932; Zalkin, 1940; Kleinenberg, 1956; Tomilin, 1957). The most extensive data were reported by Kleinenberg (1936, 1938, 1956): 12 prey species, mostly benthic fishes, were identified (one of them from oral reports by fishermen). Later the list of prey items was added with four species recorded in visual observations of dolphin feeding (Bel'kovich et al., 1978; Bushuev, Savusin, 2004; Krivokhizhin, Birkun, 2009).

Thus, 16 fish species from 14 families have been reported as prey objects of the Black Sea bottlenose dolphin by the beginning of this research (table 1) (reviewed by Kleinenberg, 1936, 1956; Zalkin, 1940; Krivokhizhin, Birkun, 2009; herring is not included in this list: see Discussion).

Here we report new records of prey items of Black Sea bottlenose dolphins primarily obtained from the analyses of stomach contents.

Material and methods

We analyzed stomach content of 11 bottlenose dolphins found dead on the Crimean coast in 2013 (fig. 1). 9 dolphins were found on the south-west coast, in the Kalamita Gulf and adjoining area; 1 was on the coast of the Feodosiya Gulf; and 1 was on the coast of the Kerch Strait, north-west to the Fonar Cape. Other sources of data and material, such as direct observations and occasional examinations of stomach content, are commented in the text where appropriate.

The content of both stomach chambers and oesophagus was sampled. It was rinsed under running water, and its hard elements (otoliths, bones, shells, foreign bodies) were dried and labeled.

Species identification was performed using the reference collection of otoliths and skeletons (23 species). Our collection included: thornback ray *Raja clavata* Linnaeus, 1758 (thorns); European anchovy *Engraulis encrasiolus* (Linnaeus, 1758); European sprat *Sprattus sprattus* (Linnaeus, 1758); Black and Caspian Sea sprat *Clupeonella cultriventris* (Nordmann, 1840); Black Sea herring *Alosa immaculata* Bennett, 1835; whiting *Merlangius merlangus* (Linnaeus, 1758); so-iuy mullet *Liza haematocheilus* (Temminck et Schlegel, 1845); sand smelt *Atherina* sp.; garfish *Belone belone* (Linnaeus, 1761); black scorpion fish *Scorpaena porcus* (Linnaeus, 1758); zander *Sander lucioperca* (Linnaeus, 1758); bluefish *Pomatomus saltatrix* (Linnaeus, 1766); horse mackerel *Trachurus mediterraneus (*Steindachner, 1868); picarel *Spicara flexuosa* Rafinesque, 1810; blotched picarel *Spicara maena* (Linnaeus, 1758); shi drum *Umbrina cirrosa* (Linnaeus, 1758); red mullet *Mullus barbatus* Linnaeus, 1758; Mediterranean sand eel *Gymnammodytes cicerellus* (Rafinesque, 1810); Atlantic stargazer *Uranoscopus scaber* Linnaeus, 1758; greater weever *Trachinus draco* Linnaeus, 1758; Black Sea turbot *Psetta maeotica* (Pal-

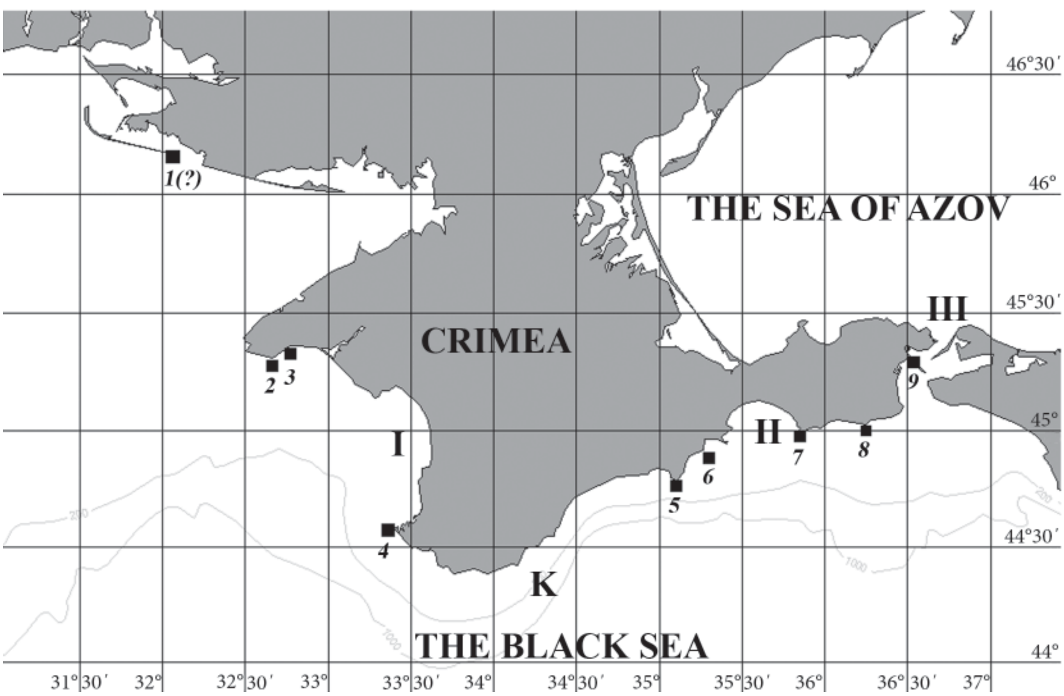

Fig. 1. Localities of sampling the stomach contents of Black Sea bottlenose dolphins: I — Kalamita Gulf, II — Feodosiya Gulf, III — Kerch Strait; K — Yalta (by Kleinenberg, 1938) and visual observations of bottlenose dolphins hunting on mullet: *1*(?) — Tendra Spit (the certain locality is not identified), *2* — Uret Cape, *3* — Okunevka, *4* — Sevastopol, *5* — Meganom Cape, *6* — Karadag Nature Reserve, *7* — Chauda Cape, *8* — Opuk Cape, *9* — Ak-Burun Cape.

Рис. 1. Места сбора материала по питанию черноморских афалин: I — Каламитский залив, II — Феодосийский залив, III — Керченский пролив; К — Ялта (Клейненберг, 1938) и визуальные наблюдения охоты афалины на кефалей: *1*(?) — коса Тендра (район указан приблизительно), *2* — мыс Урет, *3* — Окуневка, *4* — Севастополь, *5* — мыс Меганом, *6* — Карадагский природный заповедник, *7* — мыс Чауда, *8* — Опук, *9* — мыс Ак-Бурун.

las, 1814); round goby *Neogobius melanostomus* (Pallas, 1814) and rusty blenny *Parablennius sanguinolentus* (Pallas, 1814).

All otoliths were counted in each sample, and the minimum number of specimens of each species was estimated as 50 % of otolith number. Part of otoliths has been significantly digested, making it difficult to identify. Otoliths of unidentified species were referred to as a separate category. A few specimens had bone remains and partially digested fish bodies without otoliths in the stomach contents (e.g., the Specimen 7 had only three otoliths and numerous bone remains, in total belonging to at least ten fishes of five species); thus, we calculated the percentage of species composition, using bone remains, as well as otoliths.

Age determination of bottlenose dolphins was conducted as counting growth layer groups (GLG) on longitudinal sections of teeth from the middle of the lower tooth row. Thin sections of decalcified teeth were stained with Mayer haematoxylin and enclosed in glycerin, following the technique by Klevezal' (1988).

Results

Fish remains were found in 10 from 11 examined stomachs. In total, 13 species from 12 families were identified (four of them were identified to the level of genus or family). Four of them have been recorded in stomach contents in previous studies: thornback ray (*Raja clavata*), whiting (*Merlangius merlangus*), red mullet (*Mullus barbatus*) and European anchovy (*Engraulis encrasicolus*). Seven fishes are reported here as prey items for Black Sea bottlenose dolphins for the first time: herring (*Alosa* sp.), sand smelt (*Atherina* sp.), picarel (*Spicara flexuosa*), Mediterranean sand eel (*Gymnammodytes cicerellus*), Atlantic stargazer (*Uranoscopus scaber*), gobies (Gobiidae indet.) and blennies (Blenniidae indet.). Two species, horse mackerel (*Trachurus mediterraneus*) and garfish (*Belone belone*), were previously reported in visual observations only (table 1). The Atlantic stargazer (*Uranoscopus scaber*) is recorded in the diet of the common bottlenose dolphin for the first time. The previous record of Uranoscopidae in bottlenose dolphin diet only refers to *Astroscopus y-graecum* (Cuvier, 1829) (Caldwell, Caldwell, 1972).

In addition to fishes, bivalve shell fragments, isopods, small pebbles, wood and plastic pieces were found in stomachs. Numerous unidentified otoliths in specimens 1, 2 and 5 had no clear species features due to digestion process.

The examined dolphin carcasses were fresh or moderately decomposed. They had no pathological marks (when it was possible to identify any of them), and they were in normal body condition, with no signs of emaciation; four dolphins had marks, which could be interpreted as by-catch signs. Ten of eleven dolphins had stomach content with partly digested fish, fish bones or ray thorns, with no or minor portion of foreign objects. The number of otoliths in each sample varied from 4 to 3352: general data are summarized in the table 2.

The most frequent species were whiting and picarel, which were present in 50 % of samples, and horse mackerel (40 %) (table 2). Whiting and picarel were always recorded together. The combination of whiting, picarel and horse mackerel was recorded in three cases, twice also with sand smelts and Mediterranean sand eel or gobies. The red mullet was identified in two cases, in one of which the stomach was full of well-preserved fish.

The youngest dolphin with fish remains in its stomach was 1 year old. It contained 82 otoliths: whiting (59 %), picarel (22 %), *Atherina* sp. (1 %) and unidentified small specimens (18 %), and few small pebbles.

Discussion

Sample size and possible sampling bias. Many data on the stomach contents of bottlenose dolphins worldwide have been grounded on small samples. For example, Barros and Wells (1998) examined 16 specimens during 14 years, Blanco et al. (2001) — 16 specimens during 15 years, Santos et al. (2001) — 24 specimens during 10 years. Thus, our sample of ten stomachs during one year shows a relatively good picture of diet at a given time and place. However, this picture is limited in time and space, and it cannot characterize the whole diet range of bottlenose dolphins across the Black Sea, with all its possible regional and annual variations. The bottlenose dolphin is the species

Table 1. The list of prey fishes in diet of bottlenose dolphins *Tursiops truncatus* in the Black Sea (pooled data)

Таблица 1. Список объектов питания (рыб) черноморской афалины *Tursiops truncatus* (обобщённые данные)

Species	Stomach content (1933–1955)	Visual observations (1913–2013)	Stomach content (this study, 2013)	Occurrence in stomach content (this study, 2013)
Family **Rajidae** Goodrich, 1909				
Thornback ray — *Raja clavata* Linnaeus, 1758 [D]	+ [2, 3]		+	10 %
Family **Engraulidae** Gill, 1861				
European anchovy — *Engraulis encrasiolus* (Linnaeus, 1758) [A]	+ [2, 3]	+ [6]	+	30 %
Family **Clupeidae** Cuvier, 1816				
Sprat — *Sprattus sprattus* (Linnaeus, 1758) [A]		+ [6, 9]		
Herring — *Alosa* sp. [C]			+	20 %
Family **Cyprinidae** Fleming, 1822				
Common bream — *Abramis brama* (Linnaeus, 1758) [D]	+ [2]			
Family **Gadidae** Rafinesque, 1815				
Whiting — *Merlangius merlangus* (Linnaeus, 1758) [B]	+ [2, 3]		+	50 %
Family **Mugilidae** Bonaparte, 1831				
Flathead mullet — *Mugil cephalus* Linnaeus, 1758 [C]	+ [2]			
So-iuy mullet — *Liza haematocheilus* (Temminck et Schlegel, 1845) [D]		+ [7, 8, 9]		
Black Sea mullets — *Liza* sp. [C]	+ [3]	+ [1, 4, 5, 9]		
Family **Atherinidae** Rosen, 1964				
Sand smelt — *Atherina* sp. [A]			+	30 %
Family **Belonidae** Gill, 1872				
Garfish — *Belone belone* (Linnaeus, 1761) [B]		+ [7, 8]	+	10 %
Family **Scorpaenidae** Risso, 1826				
Black scorpion fish — *Scorpaena porcus* Linnaeus, 1758 [C]	+ [2, 3, 4]			
Family **Percidae** Cuvier, 1816				
Zander — *Sander lucioperca* (Linnaeus, 1758) [D]	+ [2]			
Family **Carangidae** Rafinesque, 1815				
Horse mackerel — *Trachurus meditrraneus* (Steindachner, 1868) [B]		+ [5]	+	40 %
Family **Centracanthidae** Gill, 1891				
Picarel — *Spicara flexuosa* Rafinesque, 1810 [B]			+	50 %
Family **Sciaenidae** Cuvier, 1829				
Shi drum — *Umbrina cirrosa* (Linnaeus, 1758) [D]	+ [3]			
Family **Mullidae** Cuvier, 1828				
Red mullet — *Mullus barbatus* Linnaeus, 1758 [B]	+ [2, 3]		+	20 %
Family **Ammodytidae** Bonaparte, 1832				
Mediterranean sand eel — *Gymnammodytes cicerellus* (Rafinesque, 1810) [A]			+	20 %
Family **Uranoscopidae** Bleeker, 1859				
Atlantic stargazer — *Uranoscopus scaber* Linnaeus, 1758 [C]			+	10 %
Family **Gobiidae** Fleming, 1822 [B]			+	20 %
Family **Blenniidae** Rafinesque, 1810 [B]			+	20 %
Family **Scombridae** Rafinesque, 1815				
Atlantic bonito — *Sarda sarda* (Bloch, 1793) [D]	+ [2, 3]			
Family **Scophthalmidae** Jordan, 1923				
Black Sea turbot — *Psetta maeotica* (Pallas, 1814) [D]	+ [2, 3]			

Note. References are numbered as: 1 — Zernov, 1913; 2 — Zalkin, 1940; 3 — Kleinenberg, 1956; 4 — Tomilin, 1957; 5 — Bel'kovich et al., 1978; 6 — Bushuev, Savusin, 2004; 7 — Krivokhizhin, Birkun, 2009, 8 — Gladilina, 2012, 9 — EG, unpublished data. Weight categories (kg) are labeled as A (tiny: 0–0.015), B (small: 0.015–0.010), C (medium: 0.010–1), D (large: > 1).

Table 2. Data on diet of bottlenose dolphins off the coast of Crimea (2013)

Таблица 2. Данные о питании черноморской афалины у побережья Крыма (2013 г.)

Month	Location	Age	N species	Body length (cm)	N of otoliths	N of fish	Species composition (proportion of otoliths and skeletons, %)
Jan.	Kalamita Gulf	9	4		84	46	*Merlangius merlangus* (1 %), *Spicara flexuosa* (18 %), *Mullus barbatus* (42 %), *Belone belone* (2 %), U/id (37 %)
Feb.	Kalamita Gulf	1,5	4		733	368	*Merlangius merlangus* (1 %), *Spicara flexuosa* (2 %), *Trachurus mediterraneus* (2 %), Blenniidae (1 %), U/id (94 %)
Apr.	Kalamita Gulf	15	3	210	20	11	*Gymnammodytes cicerellus* (30 %), *Engraulis encrasiolus* (25 %), Gobiidae (25 %), U/id (20 %)
Apr.	Kalamita Gulf	3	6	206	3352	1672	*Merlangius merlangus* (1 %), *Trachurus mediterraneus* (88 %), *Spicara flexuosa* + *Atherina* sp. + *Gymnammodytes cicerellus* + *Engraulis encrasiolus* (1 %), U/id (10 %)
Apr.	Kalamita Gulf	11	7	251	1848	927	*Merlangius merlangus* (24 %), *Spicara flexuosa* (5 %), *Trachurus mediterraneus* (13 %), *Engraulis encrasiolus* (0.3 %), *Atherina* sp. (6 %), Gobiidae (0.2 %), Blenniidae (0.5 %), U/id (51 %), Mytilidae, small pebbles
Apr.	Kalamita Gulf	1	3	178	82	42	*Merlangius merlangus* (59 %), *Spicara flexuosa* (22 %), *Atherina* sp. (1 %), U/id (18 %), small pebbles
May	Feodosiya Gulf	25	3	253	3	10	*Raja clavata* (10 %), *Alosa* sp. (50 %), *Uranoscopus scaber* (10 %), Gobiidae (10 %), U/id (20 %)
May	Kalamita Gulf	24	2		103	52	*Trachurus mediterraneus* (60 %), *Mullus barbatus* (3 %), U/id (37 %)
May	Kalamita Gulf	32	1	200+	11	6	*Alosa* sp. (36 %), U/id (64 %), Isopoda
Aug.	Fonar Cape	12	1	241	4	3	Gobiidae (75 %), U/id (25 %)

notable for its generalist feeding strategy and high ecological plasticity of feeding habits (Leatherwood, 1975; Mead, Potter, 1990), so its diet range in the Black Sea can be even wider than described here.

Comparison with historical data. Our sample, even small, substantially differs from the previously reported materials, particularly, from those by Kleinenberg (1938). These differences cannot be explained as resulting from different season of study or method of sampling food remains. Both samples, Kleinenberg's and ours, were largely taken in spring and were analyzed with detailed examination of stomach content, including otoliths and bones (Kleinenberg, 1938). Kleinenberg used the material from direct dolphin catches: however, the stomach content examined by him was likely to characterize individual foraging rather than group hunting on fish schools; our material also came from single strandings. Kleinenberg's and our samples came from the coastal Crimean water areas, relatively close to each other (although differing in climate and depth), namely Yalta region and Kalamita Gulf (fig. 1). However, both samples were taken during a short period of time in a relatively small area, so they possibly were affected by a spatial and temporal bias.

First, the diet of dolphins in our sample is significantly more diverse (the Shannon index calculated from the number of identified specimens is 2.05). We recorded 13 fish species in 10 stomachs, while Kleinenberg (1956) reported only 9 species in 232 stomachs (with the greatest Shannon index as 1.7 in April 1934). Thus, now the total number of known prey fish species for bottlenose dolphins in the Black Sea and the Kerch Strait is 23, the diversity comparable with the data from all the Mediterranean Sea (Mioković et al., 1999; Blanco et al., 2001; Bearzi et al., 2005) or from the Atlantic waters of Spain (Santos et al., 2007 a). Such a wide diet range is normal for the bottlenose dolphin per se (Santos et al., 2007 b), but earlier it was not observed in the Black Sea.

Second, newly found prey objects include both demersal and pelagic species. Pelagic horse mackerel is among three species (horse mackerel, picarel and whiting), which were the most frequent and abundant in our sample. Two of them, the horse mackerel and the picarel, are fishes of Mediterranean origin. They have been never recorded before from the stomachs of Black Sea bottlenose dolphins. On the contrary, the horse mackerel is a common prey for bottlenose dolphins outside the Black Sea, in the Mediterranean Sea and Atlantic (Blanco et al., 2001; Santos et al., 2007 a; Santos et al., 2007 b). In the Black Sea, bottlenose dolphin foraging on the horse mackerel was previously reported by Bel'kovich et al. (1978) from visual observations, and it is often mentioned by fishermen (S. G. Bushuev, pers. comm.). Another pelagic fish, anchovy, was reported as an important prey for bottlenose dolphins by Kleinenberg (1936, 1938, 1956), and its small portion in our material is explained by its low abundance near the Crimean coast during 2012/13 winter due to annual fluctuations (Prognosis, 2013), so it could remain an important prey for bottlenose dolphins in other local areas or during other seasons. Picarel was recorded in bottlenose dolphin diet in the western Mediterranean basin (Orsi Relini et al., 1994). The whiting was the primary prey item even a few decades ago (Kleinenberg, 1956): in general, codfishes play an important role in the diet of the common bottlenose dolphin across its geographical range (Santos et al., 2007 b).

Bearzi et al. (2005) concluded from the dive duration that neighbouring groups of bottlenose dolphins in the Ionian Sea preferred either benthic or pelagic prey. On the contrary, many of the examined Black Sea dolphins had both demersal and pelagic fishes in the stomach. It can be explained by diel vertical migrations, which are usual for prey pelagic fishes (horse mackerel, anchovy, sprat and garfish), as well as for demersal species (herring, sand smelt and mullets), so dolphins can feed on pelagic fish at depth or pursue demersal fishes near the surface. Thus, we did not find preferences of pelagic or demersal prey in the studied sample. This result corroborates the views of Bel'kovich et al. (1978) and Mikhalev (2005) who suggested the mixed feeding of bottlenose dolphins on both demersal and pelagic fishes.

Third, small fishes dominate among newly found prey species (fig. 2). Feeding of bottlenose dolphins on aggregations of small fish has been already reported: anchovy (Kleinenberg, 1956) and sprat (Bushuev, Savusin, 2004) were recorded as prey items. Now this list is added with sand smelt, Mediterranean sand eel, small specimens of picarel and horse mackerel. Meanwhile, we did not observed many of large fishes, which formerly contained an important prey source for Black Sea bottlenose dolphins. First of all, there was no turbot in the examined sample (while Kleinenberg (1938) noticed it as an important prey for bottlenose dolphins), despite the large portion of the material was taken in spring (i.e., during the spawning season of turbot) in the Kalamita Gulf, the area known as a major spawning ground and maximum concentration for turbot (Popova, 1954, 1967). It can be hypothetically explained by decline of turbot population. Long-term abundance estimates for turbot vary, depending on the method of analysis; however, they concur in describing its historical dynamics: it fluctuated in a certain range during 1930–1960s, rose in 1970s and declined in 1980s by the present level, which is lower than in 1930–1950 (Egerman, 1936; Popova, 1954, 1967; Prodanov et al., 1997; Scientific…, 2013).

Herring (*Alosa* sp.) was recorded in the stomach content of Black Sea bottlenose dolphins for the first time. Police (1932) in his review of the dolphin conflict with fisheries (cited by Tomilin, 1957 as Police, 1930) noted that dolphins entered the Danube estuary, chasing mullet and herring; however, he did not mention cetacean species or the source of data.

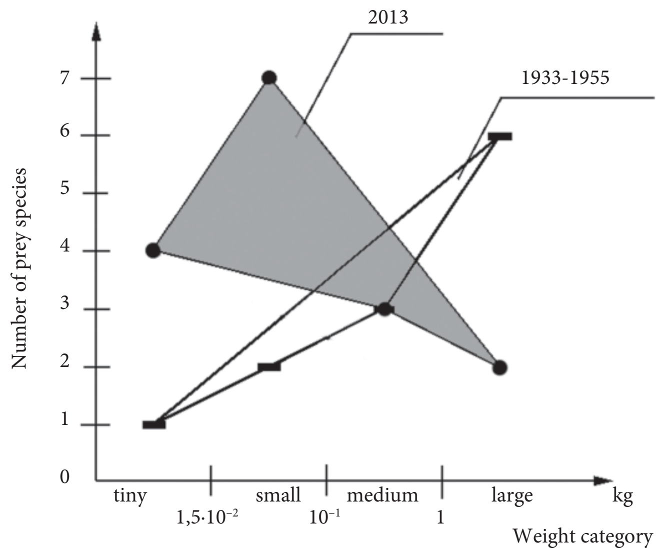

Fig. 2. Size distribution of prey fishes in diet of Black Sea bottlenose dolphins *Tursiops truncatus* in 1933–1955 and 2013, weight categories vs number of recorded species in each category.

Рис. 2. Размерное распределение рыб — объектов питания черноморской афалины *Tursiops truncatus* в 1933–1955 гг и в 2013 г.: категории по массе и количество выявленных видов в каждой категории.

The winter record of large amount of red mullet in a dolphin stomach is notable. There is little evidence on bottlenose dolphin diet during the cold season. A young bottlenose dolphin stranded in Alupka (Crimea) in December 2008 had horse mackerels in its gastro-intestinal tract. Bushuev and Savusin (2004) reported winter feeding on sprat near trawler vessels, but this feeding mode does not directly depend on a season. Kleinenberg (1956), based on limited material, reported the red mullet as the main prey of bottlenose dolphins in October. Thus, the distribution of red mullet is worth to be taken into consideration in the further studies of winter dispersal of Black Sea bottlenose dolphins.

The fact of particular interest is the absence of mullets (Mugilidae) in our sample and their rare records in old materials (3 % in Kleinenberg's July sample, the only month it was recorded). The first record of dolphin feeding was the mullet hunting in Sevastopol Bay reported by Zernov (1913). Mal'm (1932) stressed on a special role of the flathead mullet and other mullets in bottlenose dolphin life history. Kleinenberg (1956) listed the flathead mullet as a prey species for bottlenose dolphins based on evidences from fishermen. Birkun (2012) hypothesized that successful introduction of so-iuy mullet into the Black Sea was an important factor of recovery of bottlenose dolphin abundance after 1990s. There are numerous reports on observations of bottlenose dolphin hunt on mullet in coastal areas.

Among the possible explanations of this contradiction there are general incompleteness of the data from stomach content and exaggerated view of mullets in dolphin diet (Barros, Clarke, 2009). According to the first explanation, we get information only on the last meal from the stomach contents; and the diet of animals found dead can present biases: for example, a sick animal can take unusual prey. However, Kleinenberg (1956), unlike us, examined the specimens obtained from unselective pound net takes, when whole dolphin groups were entangled; but he also recorded very few mullets. The second explanation is that the mullet hunt is very spectacular, so an observer attributes an excessive importance to it. Another aspect of this explanation is that feeding on mullets can be a habit restricted for some local areas, which were not sufficiently covered by our study. This hypothesis is supported by the fact that we, as well as other researchers (Zernov, 1913; Bel'kovich et al., 1978; Krivokhizhin, Birkun, 2009), observed bottlenose dolphins hunting a mullet (including so-iuy) in three regions: 1) eastern Crimean waters (Meganom Cape, Karadag (see also Gladilina, 2012), Chauda Cape, Opuk Cape, Ak-Burun Cape, Kerch Strait); 2)near the Tarkhankut Peninsula; 3) Sevastopol and Balaklava area (fig. 1). The fourth region where mullets can be an important prey for dolphins is the north-western Black Sea (A. K. Chashchin, S. G. Bushuev, Z. V. Selyunina, pers. comm.): further research is needed in this area. Thus, our study does not confirm the idea of universality of bottlenose dolphin feeding on mullets and mullet as its dominating prey in the Black Sea.

Someone could suggest the differences between historical data and this study would be explained as differences in diet specialization across various populations or social groupings. Temporal fluctuations of abundance and migration pathways could also affect the dolphin diet across years or areas. For example, horse mackerel is a common wintering species in the waters of southern Crimea (Ambroz, 1954). Nevertheless, Kleinenberg (1936, 1938) recorded only few horse mackerel in stomachs of common dolphins and no horse mackerel in bottlenose dolphins near Yalta in 1934. Meanwhile, Ambroz (1954) indicated low level of horse mackerel catches near Crimea in 1934; so dolphins could take it in other years but not during Kleinenberg's study.

The diet composition of bottlenose dolphins examined by us is similar to that of harbour porpoises, as reported by recent research (Tonay et al., 2007; Krivokhizhin, Birkun, 2009). Morozova (1981) hypothesized this overlapping of diet ranges from the patterns of cetacean distribution. However, she suggested shifts of harbour porpoises and bottlenose dolphins into the same pelagic niche and their competition for declining schools of pelagic fish. This study suggests another possible trend: both species would widen their diet preferences and now follow generalized feeding strategies. Our data corroborate the prediction by Bushuev (2000) who suggested the bottlenose dolphin diet range to become wide and robust for fish abundance fluctuations. Bushuev (2000) hypothesized whiting, flatfish, rays, mullets, anchovy and, in some regions, horse mackerel to be new important prey items, and his hypothesis is mostly confirmed by this research.

Conclusions

New data on bottlenose dolphin diet in the Black Sea show its diversity (in total numbering 23 species), presence of both pelagic and demersal fishes, frequent occurrence of small school-forming fishes and similarity with the diet composition of Mediterranean bottlenose dolphins. The horse mackerel and picarel, also known as a prey for Mediterranean dolphins, were frequently recorded, and whiting is still a primary prey, whereas turbot possibly lost its importance. The winter feeding of dolphins on red mullet was recorded, as before. The universal role of mullets in dolphin diet is questioned, but it could be a local feeding habit. Generalized pattern of feeding gained new evidence.

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