

Fishes of the Astrakhan Nature Reserve: an updated checklist with comments of recent records

Ихтиофауна Астраханского государственного заповедника: обновленный список видов и новые находки

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Since publication of the previous list (Litvinov & Podolyako, 2013), new data on species composition of fish fauna in the Astrakhan State Reserve have been obtained. As a result of revisions of the collected material and new records (e.g., the first finding of Khvalyn spined loach *Cobitis amphilekta* Vasil'eva, Vasil'ev, 2012), the list of fish species has been corrected and widened. At present, the list of fish species in the Reserve includes one species of Petromyzontidae and 60 species of Acipenseridae, Clupeidae, Cyprinidae, Cobitidae, Siluridae, Coregonidae, Salmonidae, Esocidae, Lotidae, Atherinidae, Gasterosteidae, Syngnathidae, Percidae, and Gobiidae. Identifications used in previous lists of fishes found in the Astrakhan reserve in 1936–2016 and brief information on biology and dates of latest records of each species are given.

Со времени выхода предыдущего списка (2013) появились новые данные по видовому составу Craniata в заповеднике. В результате ревизий материала из коллекций и новых находок (первая находка в заповеднике хвалынской щиповки *Cobitis amphilekta* Vasil'eva, Vasil'ev, 2012), список видов ихтиофауны был значительно изменён и дополнен. Современный список ихтиофауны Астраханского государственного заповедника включает 1 вид бесчелюстных из семейства Petromyzontidae и 60 видов лучепёрых рыб из семейств Acipenseridae, Clupeidae, Cyprinidae, Cobitidae, Siluridae, Coregonidae, Salmonidae, Esocidae, Lotidae, Atherinidae, Gasterosteidae, Syngnathidae, Percidae, Gobiidae. В статье приведена синонимия видов в предшествующих списках ихтиофауны Астраханского заповедника, включены краткие сведения по биологии каждого вида в период 1936–2016 гг., указаны даты последних встреч особей каждого вида.

Key words: agnathans, teleosts, phaunistics, Astrakhan State Reserve, Volga delta, Caspian Sea

Ключевые слова: бесчелюстные, костные рыбы, фаунистика, Астраханский государственный заповедник, дельта Волги, Каспийское море

INTRODUCTION

The Astrakhan Nature Reserve is located in the Volga Delta lowlands. It consists of three sectors — Damchiksky (western),

Trikhizbinsky (central), and Obzhorovsky (eastern), located in the Lower, Kultuk Delta and the Island Avandelta zones of the Volga River (Fig. 1).

Systematic ichthyological observations have been held in this area since 1936. In early 1950s, a monitoring network of ich-

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thyological observation stations was established in the Reserve. The fish fauna is studied by means of net fishing carried out in the lower zone on a weekly basis and in the kultuk zone and islands of the avandelta on a monthly basis. Tkanka (a fingerling trawl) was used at observation stations located not only in channels but also temporary water bodies (inundated meadows) that made it possible to reveal places of occurrence of juvenile fish and marine fish that are not commonly caught by nets. Continuity of monitoring surveys allows to trace and analyse an overall impact on the fish fauna of the Volga-Caspian Region.

Ichthyologists Konstantin P. Batov, Anatoliy D. Bondarenko, and Klavdiya R. Fortunatova initiated regular studies of the fish fauna in the Reserve in the late 1930s. Later, the studies were continued by Anna F. Koblitskaya, Ludmila N. Tryapitsina, Lina P. Kizina, Ludmila E. Alentyeva, Kirill V. Litvinov, Stepan A. Podolyako, and some others.

In 1936–2016, six checklists of agnathan and fish species were prepared based on ichthyological studies conducted in the Reserve. The first one, a manuscript written by one of the first ichthyologists in the Reserve (Bondarenko, 1948, unpubl.), “Biology of juvenile fish in coastal waters of the Delta”, included 31 fish species. The next checklist (Fortunatova, 1948, inpubl.) was presented as a part of an unpublished report on ichthyological research in 1946–1947. The first edition of “Identification keys of juveniles of fishes of the Volga Delta” (Koblitskaya, 1966) included 47 species recorded in the Reserve. The second edition of this book (Koblitskaya, 1981) contained 52 fish species. The fifth checklist was published by Kizina and Koblitskaya (1999) and included 56 species.

The sixth checklist of agnathan and fish species occurring in the Reserve (Litvinov & Podolyako, 2013) was published in 2013 (Bogutskaya et al., 2013) and included 39 species recorded during the period of 2006–2010.

Since 2010, the list of agnathan and fish species recorded in the Reserve has been considerably updated based on results of field observations in 2011–2016, archive analyses of phenological observations carried out by the Reserve scientists in 1934–2015, and of the Reserve fish collection. As a result, some new species were added to the list and a new version is presented in this paper as an updated catalogue.

Taxonomic identifications follow Bogutskaya et al. (2013). Identifications of species (species names) given in the previous faunal catalogues are provided in species accounts below. This information is followed by data on population structure or abundance, indication to ecological form of the species, and brief information on its biology (migration, reproduction) in the Reserve. Besides, whenever possible, the period and locality of latest observations of species are given. The checklist consists of 61 species belonging to 11 orders and 15 families recorded in the Reserve in 1934–2016.

LIST OF SPECIES

Order **PETROMYZONTIFORMES**

Family **PETROMYZONTIDAE**

1. *Caspiomyzon wagneri* (Kessler, 1870) – the Caspian lamprey. A rare anadromous species. Listed in the Red Data Book of the Russian Federation (category 2, declining number), the Red Data Book of the Astrakhan Region (category 1, endangered) (Fedorovich, 2014d). The migration routes are water courses with fast flow. It does not reproduce in the Reserve. Recorded in the Reserve five times, in Obzhorovsky sector in 1949, 1963 and 2010, in Damchiksky sector in 2010 and, the latest record, in December 2011.

Order **ACIPENSERIFORMES**

Family **ACIPENSERIDAE**

2. *Acipenser gueldenstaedtii* Brandt et Ratzeburg, 1833 – Russian sturgeon. As

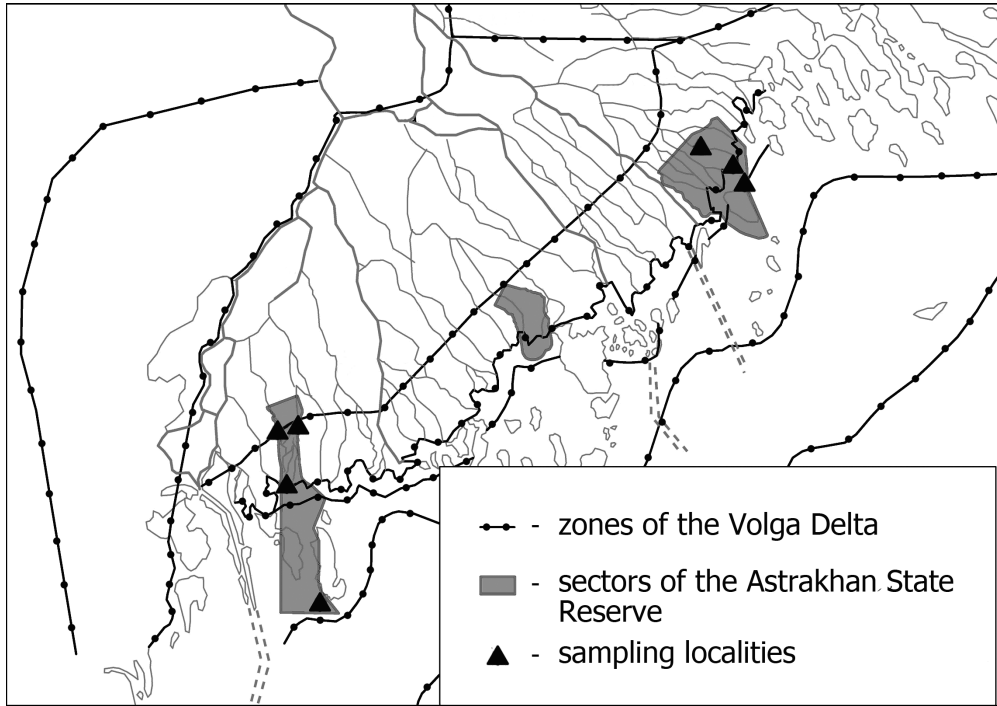


Fig. 1. A map of the Volga Delta showing the Astrakhan State Reserve.

Acipenser güldenstädti Brandt in Koblitskaya (1981). Not included in Bondarenko (1948) and Fortunatova (1948). A rare anadromous species that does not reproduce in the Reserve. Often caught only in the 1940s. In recent years, only downstream migrating juveniles bred in hatcheries upstream were recorded in the Reserve. Last observed in Damchiksky sector in December 2015.

3. *Acipenser ruthenus* Linnaeus, 1758 – starlet sturgeon. Not included in Bondarenko (1948) and Fortunatova (1948). A very rare anadromous species. It does not reproduce in the Reserve. Since the 1970s the catches of this fish species has significantly decreased because owing to a general decline in abundance of its population in the Volga–Caspian Region. Last recorded in Damchiksky sector, in 1978.

4. *Acipenser stellatus* Pallas, 1771 – starry sturgeon. Not listed in Bondarenko (1948). A very rare anadromous species that does not reproduce in the Reserve.

Since the 1970s catches of the species have significantly decreased due to a general decline in its population in the Volga–Caspian Region. In recent years, only downstream migrating juveniles bred in hatcheries were found in the Reserve. Last recorded in Damchiksky sector in 2003.

5. *Acipenser huso* (Linnaeus, 1758) – beluga. Not listed in Bondarenko (1948) and Fortunatova (1948). As *Huso huso* in Koblitskaya (1966, 1981) and Kizina & Koblitskaya (1999). In the genus *Acipenser* based on recent morphological, molecular, and karyological data showing that the genus *Huso* is polyphyletic (Artyukhin, 1995; Artyukhin 2006; Artyukhin, 2008; Birstein et al., 1997; Ludwig et al., 2000; De la Herrán et al., 2001; Hilton et al., 2011; Krieger et al., 2008; Vasil'eva et al., 2009). A very rare anadromous species. It does not reproduce in the Reserve. Single specimen catches were recorded in the 1950s – 1980s. Last recorded in Damchiksky sector in June 1989.

Order **CLUPEIFORMES**Family **CLUPEIDAE**Subfamily **ALOSINAE**

6. *Alosa caspia* (Eichwald, 1838) – the Caspian shad. A very rare anadromous species. Endemic to the Caspian Sea. It was not numerous in the Reserve catches till the 1960s–1970s (Kizina & Koblitskaya, 1999). Last recorded in Damchiksky sector in June 1993.

7. *Alosa kessleri* (Grimm, 1887) – Caspian anadromous shad. Not listed in Koblitskaya (1981). As *Clupea pontica* in Bondarenko (1948) and Fortunatova (1948) and as *Alosa kessleri kessleri* in Koblitskaya (1966) and Kizina & Koblitskaya (1999). A rare anadromous species that does not reproduce in the Reserve. Endemic to the Caspian Sea. Main spawning migration routes are the fish pass channels. Single downstream migrating specimens are recorded in the Reserve's catches from June to August. The downstream migrating juveniles are caught in August–October. Last recorded in Damchiksky sector in October 2016.

8. *Alosa volgensis* (Berg, 1913) – Volga shad. Not listed in Bondarenko (1948), Fortunatova (1948), and Koblitskaya (1981). As *Alosa kessleri volgensis* in Koblitskaya (1966) and Kizina & Koblitskaya (1999). Often considered to be a subspecies or a synonym of *Alosa kessleri*, though clear morphological and biological differences between the two and the fact of sympatric speciation support them as distinct species (Kottelat, 1997; Bogutskaya & Naseka, 2004; Kottelat & Freyhof, 2007; Naseka, Bogutskaya, 2009). A very rare anadromous species. Endemic to the Caspian Sea. In the Red Data Book of the Russian Federation (category 2, decreasing number), in the Red Data Book of the Astrakhan region (category 1, endangered) (Fedorovich, 2014f). It does not reproduce in the Reserve. The Volga shad was a numerous species till the mid 1970s. The main spawning migration routes are fish pass channels. Downstream

specimens are caught in May in the Reserve. Downstream larvae are sometimes caught in June. Last recorded in Damchiksky sector, Kultuk Zone in June 2016.

Subfamily **CLUPEINAE**

9. *Clupeonella caspia* Svetovidov, 1941 – Caspian tyulka. Not listed in Bondarenko (1948) and Fortunatova (1948). As *Clupeonella delicatula* in Koblitskaya (1966) and *Clupeonella cultrivensis* in Koblitskaya (1981) and Kizina & Koblitskaya (1999). A rare species endemic to the Caspian Sea. Rare records on spawning in the Reserve from June to July in inundated meadows (polois) of the Lower zone. Last observed in Damchiksky sector in July 2010.

Order **CYPRINIFORMES**Family **CYPRINIDAE**Subfamily **BARBINAE**

10. *Luciobarbus brachicephalus caspius* (Berg, 1914) – Caspian barbel. Not listed in Fortunatova (1948) and Koblitskaya (1966). As *Barbus obtusirostris* in Bondarenko (1948) and as *Barbus barbatus* in Koblitskaya (1981). A rare anadromous species, listed in the Red Data Book of the Astrakhan region (category 4, uncertain status) (Fedorovich, 2014b). Endemic to the Caspian Sea. Bondarenko (1948) included the species in his catalogue but mentioned that nothing is known about biology of this species. A single specimen was recorded in August 1981 in Damchiksky sector.

Subfamily **CYPRININAE**

11. *Carassius carassius* (Linnaeus, 1758) – crucian carp. As *Carassius vulgaris* in Bondarenko (1948) and Fortunatova (1948). Bondarenko (1948) points out that it was rarely found in the delta channels. It spawns in May. The crucian carp was not abundant in the Reserve in the 1960s being mostly distributed in the Upper and Central Zones and in the Lower Volga at that

time (Koblitskaya, 1966, 1981). At present, it is not numerous in the Lower Zone and Island Avandelta mainly inhabiting narrow channels (eriks) and floodplain lakes heavily overgrown with aquatic vegetation. The species has almost never been recorded in the channels with fast current and is rarely found in Kultuk Zone. Crucian carp are more abundant in ilmens of the Western Ilmeno–Bugrovoi Region. Hybridizes with Prussian carp. Spawns from May to July laying eggs on aquatic vegetation in slow-flowing or stagnant waters of inundated meadows, ilmens, and kultuks. Last recorded in Damchiksky sector, the Island Avandelta in September 2016.

12. *Carassius gibelio* (Bloch, 1782) – Prussian carp. Not listed in Bondarenko (1948), Fortunatova (1948), and Koblitskaya (1966). As *Carassius auratus gibelio* in Koblitskaya (1981) and Kizina & Koblitskaya (1999). An abundant species that spread in the Reserve in the late 1960s. It became a mass species in the mid-1980s. At present, Prussian carp constitute up to 10% in test catches in the Reserve. During feeding period it is mainly found in slowly flowing waters overgrown with aquatic vegetation, while crucian carp inhabit waters with faster current. The Prussian carp inhabits the Avandelta, the Lower and Kultuk zones. In autumn and spring the Avandelta fish population migrates to the Lower and Kultuk zones. During wintering migration period schools of the Prussian carp move to wintering pits or to lotus fields. This species spawns from April to June laying eggs on aquatic vegetation in low-flowing and stagnant waters such as inundated meadows (polois) and kultuks. Compared to other phytophilic fishes of the Volga Delta, the Prussian carp larvae have a very high rate of embryonic development. Last recorded in Obzhorovsky sector, Kultuk Zone in October 2016.

13. *Cyprinus carpio* Linnaeus, 1758 – common carp. A common widespread species. Inhabits the Island Avandelta and Kultuk Zone. It is usually found in the Lower

Zone during spawning and winter migration periods. Spawns on inundated meadows from April to May laying eggs on soft green or last year aquatic vegetation. In autumn it migrates to wintering pits in the Lower Zone or lotos and cattail fields in the Kultuk Zone along with Prussian carp. Last recorded in Damchiksky sector in October 2016.

Subfamily **GOBIONINAE**

14. *Romanogobio albipinnatus* (Lukasch, 1933) – white-finned gudgeon. As *Gobius fluviatilis* in Bondarenko (1948) and Fortunatova (1948). as *Gobio gobio* in Koblitskaya (1966, 1981) and Kizina & Koblitskaya (1999). A common species endemic to the Caspian Sea. As this species inhabits the bottom of the central channel part, it cannot be caught by usual fishing gear such as set net or, fingerling trawls. According to Bogutskaya et al. (2013) specimens caught in the 1950–1970s and identified as *Gobio gobio* actually belong to *Romanogobio albipinnatus*. Thus, the common gudgeon *G. gobio* reported in earlier publications is absent from the Reserve. Spawns in late April to May laying eggs on rocks and limestone at the bottom of channels. Last recorded in Obzhorovsky sector in September 2012.

Subfamily **HYPOPHTHALMICHTHYINAE**

15. *Aristichthys nobilis* (Richardson, 1845) – bighead carp. Not listed in Bondarenko (1948), Fortunatova (1948), Koblitskaya (1966, 1981), Kizina & Koblitskaya (1999), and Litvinov & Podolyako (2013). A rare introduced herbivorous species (Fedorovich & Belotserkovsky, 1988). It does not reproduce in the Reserve. Single specimens have been recorded in the Reserve. The species appeared due to aquaculture development in the Astrakhan Region at the beginning of the 21st century and unintentional releases of the species specimens into the Delta waters. Reproduction of the bighead carp in natural environments in the

Volga Delta is not confirmed. Last recorded in Damchiksky sector in 2012.

16. *Hypophthalmichthys molitrix* (Valenciennes, 1844) – silver carp. Not listed in Bondarenko (1948), Fortunatova (1948), and Koblitskaya (1966). A rare invasive herbivorous species. In 1955, 505 silver carp fingerlings were released in Damchiksky sector in order to establish its natural population in the delta of Volga. In 2006–2012, the silver carp population has increased (from a few specimens up to schools of 50 specimens) in channels of the lower western part of the Volga Delta. During wintering migration period small specimens of the silver carp are observed together with the Prussian carp and the European carp. The species is not found in Kultuk Zone and the Avandelta. In May–June 2010 about 50 silver carp prolarvae and early larvae were caught by fingerling trawls. It allows to suppose that natural reproduction of the silver carp in the Lower Zone is quite successful. Last recorded in Damchiksky sector in May 2012.

Subfamily LEUCISCINAE

17. *Abramis brama* (Linnaeus, 1758) – bream. The species is represented by rare resident and widespread semi-anadromous forms. Single non-migratory specimens have been recorded in the Lower Zone. Rarely found in Kultuk and Avandelta Zones. Mass catches of semi-anadromous bream are recorded during spawning migration period. In recent years the spawning migration period has been prolonged as downstream fish have been observed till late June. Catches of bream depend on the yield of separate generations. Bondarenko (1948) indicated spawning from late April to mid-May, or sometimes to mid-June. In recent years the bream spawned in mid-May in the inundated meadows and kultuks. The bream lays eggs on the lotos fields in kultuks. Last recorded in Damchiksky sector in September 2016.

18. *Alburnus alburnus* (Linnaeus, 1758) – bleak. As *Alburnus lucidus* in Bond-

arenko (1948). One of the most abundant resident species in the Volga Delta, mainly inhabiting flowing shallow waters and entering ephemeral water bodies during floods. As a small-sized species, it is rarely caught by fishing nets but frequently found in juveniles test catches. Inhabits all zones of the Volga Delta and the Avandelta. Numerous schools are found over wintering grounds in the Lower Zone. A batch spawner laying eggs on soft vegetation three times: in May, late June and July. Last recorded in Damchiksky sector in October 2016.

19. *Aspius aspius aspius* (Linnaeus, 1758) – asp. As *Aspius rapax* in Bondarenko (1948) and Fortunatova (1948). A common resident species inhabiting flowing waters of the Lower Zone. It is not numerous in Kultuk Zone and the Island Avandelta. Spawns in late April–May on the bottom of channels. Last recorded in Damchiksky sector in October 2016.

20. *Ballerus ballerus* (Linnaeus, 1758) – blue bream. As *Abramis ballerus* in Bondarenko (1948), Fortunatova (1948), Koblitskaya (1966, 1981), and Kizina & Koblitskaya (1999). A semi-anadromous, nonabundant species. During the spawning run single specimens are caught in the Lower Zone more frequently than in the Eastern Volga Delta part. The species is not recorded in the catches of Kultuk Zone and the Avandelta (as the spawning period is short and fish nets are less frequently set up in the area). The blue brim spawns in streams in mid-April to May laying eggs on the bottom. Last recorded in Obzhorovskiy sector in June 2016.

21. *Ballerus sapa* (Pallas, 1814) – white-eyed bream. As *Abramis sapa* in Bondarenko (1948), Fortunatova (1948), Koblitskaya (1966, 1981), and Kizina & Koblitskaya (1999). A semi-anadromous species. Bondarenko (1948) described this species as a common one. It is nonabundant at present mostly caught during spawning migration period usually in the eastern Delta Zone. Regular catches of single specimens from August to November may indicate that

a not numerous resident population exists. It spawns in streams in mid-April to May laying eggs on the bottom. Last recorded in Damchiksky sector in September 2016.

22. *Blicca bjoerkna bjoerkna* (Linnaeus, 1758) – common white bream. An abundant species, catches vary from 15% (the western Delta part) up to 33% (the eastern Delta part) of the total catch in the Lower Zone. It is less common in Kultuk Zone and the Avandelta. The species population tends to increase in the Western Delta part, while in the Eastern-part it decreases. It is a batch spawner laying eggs in inundated meadows in mid and late May and in kultuks in June and July. Last recorded in Damchiksky sector in October 2016.

23. *Chondrostoma variable* Yakovlev, 1870 – Volga undermouth. As *Chondrostoma variabilis* in Bondarenko (1948) and Fortunatova (1948) and *Chondrostoma nasus* in Koblitskaya (1981) and Kizina & Koblitskaya (1999). A rare species not reproducing in the Reserve. Single specimens are occasionally recorded in the Reserve catches. Last recorded in Dumchiksky sector in October 1983.

24. *Leuciscus idus* (Linnaeus, 1758) – ide. As *Idus melonotus* in Bondarenko (1948). A nonabundant resident species often caught in Lower zone of the Volga delta, rarely in Kultuk Zone. Spawns from April to early May in inundated meadows of the Lower Zone. Last recorded in Obzhorovskiy sector in May 2012.

25. *Rutilus caspicus* (Yakovlev, 1870) – Caspian roach or vobla. As *Leuciscus rutilus* var. *caspica* in Bondarenko (1948) and *Rutilus rutilus caspicus* in Fortunatova (1948), Koblitskaya (1966, 1981) and Kizina & Koblitskaya (1999). Based on morphological and biological differences the Caspian roach is considered as a distinct species (Grimm, 1896; Kasyanov et al., 1982; Kasyanov et al., 1990; Mironovsky & Kasyanov 1986; Mironovsky & Kasyanov, 1987). New molecular (*cytb*) data (Levin et al., 2016) partly support this conclusion assigning *R. caspicus* to a clade of *Rutilus lacustris* dis-

tinct from the *R. rutilus* sensu stricto clade. However, until the issue is studied using other markers including nuclear genes, we follow the taxonomic concept mentioned above and do not synonymize *R. caspicus* with *R. lacustris*. A widespread species during spawning migration period providing up to 7–8% of total catch depending on the yield of the year. The main spawning grounds are in Volga-Akhtuba floodplain and in inundated meadows of the Lower Zone. Spawning period is rather short: from late April till early June, in the lower delta. Last recorded in Damchiksky sector in October 2016.

26. *Rutilus kutum* (Kamensky, 1901) – kutum. As *Leuciscus frisii* in Bondarenko (1948) and Fortunatova (1948) and *Rutilus frisii* in Koblitskaya (1966, 1981) and Kizina & Koblitskaya (1999). *Rutilus kutum* is often synonymized with *Rutilus frisii* of the Black Sea basin. A very rare anadromous species, endemic to the Caspian Sea. Included in the Red Data Book of the Astrakhan region (category 1, endangered) (Fedorovich, 2014c). The species was found in the Reserve twice, in 1948 and 1994.

27. *Rutilus rutilus* (Linnaeus, 1758) – roach (serushka). Not included in Bondarenko (1948), Fortunatova (1948) and Kizina & Koblitskaya (1999). As *Rutilus rutilus fluviatilis* in Koblitskaya (1966). Recent molecular (*cytb*) data revealed a vast zone of contact between *R. rutilus* sensu stricto and Siberian roach *Rutilus lacustris* in the Volga drainage (Levin et al., 2016) but morphologically both species cannot be distinguished as well as the two from the Volga roach in the assumed zone of contact. Until the issue is not studied using other markers including nuclear genes, we follow the traditional taxonomic concept of *R. rutilus*. The roach is a common non-migratory species mainly inhabiting eriks and floodplain lakes in the Lower zone of the Volga Delta, rarely found in the Island Avandelta. The species does not reproduce in the Reserve. Last recorded in Dumchiksky sector in October 2016.

28. *Scardinius erythrophthalmus* (Linnaeus, 1758) – rudd. As *Leuciscus erythrophthalmus* in Bondarenko (1948) and Fortunatova (1948). The most abundant species in the Reserve, up to 40% and 56% of total test catches in the Lower Zone and the Avandelta, respectively. Inhabits all types of deltaic water bodies only avoiding fast flowing waters. Often recorded in the Lower Zone catches during spawning migration period (April–June). A batch spawner, laying eggs up three or four times a year. First spawning specimens are observed in the warmest waters of Kultuk Zone and the Avandelta. The second spawning period takes place on sites in inundated meadows in May. The third and the subsequent spawning periods occur from July to August in the Avandelta and eriks overgrown with aquatic vegetation. Last observed in September 2016.

29. *Squalius cephalus* (Linnaeus, 1758) – chub. As *Leuciscus cephalus* in Koblitskaya (1966, 1981) and Kizina & Koblitskaya (1999). A rare non-migratory species, not reproducing in the Reserve. Some mature chub specimens were recorded in the channels of the Lower Zone. Last recorded in Obzhorovsky sector in May 2011.

30. *Vimba persa* (Pallas, 1814) – Caspian vimba. Not listed in Bondarenko (1948) and Fortunatova (1948). As *Vimba vimba persa* in Koblitskaya (1966, 1981) and Kizina & Koblitskaya (1999). following, e.g., Berg (1933, 1949). Based on molecular data the Caspian vimba is given a species status (Hänfling et al., 2009). A very rare anadromous species. In the Red Data Book of the Astrakhan Region (category 4, uncertain status) (Fedorovich, 2014g). The species does not reproduce in the Reserve. Single specimens were recorded in catches in the 1960s, early 1970s, mid 1990s, and mid 2010s. Last recorded in Damchiksky sector in May 2014.

Subfamily PELECINAE

31. *Pelecus cultratus* (Linnaeus, 1758) – sichel. A common semi-anadromous fish,

does not reproduce in the Reserve. The main upstream migration routes are fish pass channels. In the Reserve, downstream migrants are mostly recorded. In recent years downstream migration is extended and lasts from May to October with a peak in July. Last recorded in Obzhorovsky sector in May 2016.

Subfamily SQUALIOBARBINAE

32. *Ctenopharyngodon idella* (Valenciennes, 1844) – grass carp. Not listed in Bondarenko (1948), Fortunatova (1948), and Koblitskaya (1966). A rare introduced herbivorous species (Fedorovich & Belotserkivsky, 1988). It does not reproduce in the Reserve. In 1995, 856 grass carp fingerlings were released in Damchiksky sector in order to establish a natural population. Single specimens had been recorded before 1980 and reappeared again since 1990. A probable source is hatchery farms in the Astrakhan region and unintentional releases of juveniles into natural water bodies. Reproduction of the grass carp in natural environments in the Volga delta is not confirmed. Last recorded in Obzhorovsky sector in 2015.

Subfamily TINCINAE

33. *Tinca tinca* (Linnaeus, 1758) – tench. As *Tinca vulgaris* in Bondarenko (1948) and Fortunatova (1948). A common resident species, often found in catches in Kultuk zone and the Avandelta inhabiting slow-flowing and stagnant waters. Up to 2% in total catch. The number of tench in the Lower Zone commonly increases during its spawning migration. Spawns from May to June in kultuk reed thickets. Last recorded in Dumchiksky sector, the Island Avandelta in October 2016.

Family COBITIDAE

34. *Cobitis amphilekta* Vasil'eva & Vasil'ev, 2012 – Khvalyn spined loach. Not listed in In Bondarenko (1948), Fortunatova (1948), Koblitskaya (1966, 1981), Kizina &

Koblitskaya (1999), and Litvinov & Podolyako (2013). All spined roach specimens sampled in the Reserve were assigned to *Cobitis taenia* in earlier publications. A very rare species. The only Khvalyn spined roach specimen was caught in Damchiksky sector, Kultuk Zone, in September 2013 being the first finding of the species in the Volga Delta.

35. *Cobitis melanoleuca* Nichols, 1925 – Siberian loach. As *C. taenia* in Bondarenko (1948), Fortunatova (1948), Koblitskaya (1966, 1981), and Kizina & Koblitskaya (1999). A common species. Last recorded in Obzhorovsky sector in April 2013.

36. *Cobitis taenia* Linnaeus, 1758 – spined loach. A common species, inhabiting the Delta and the Avandelta zones all year round. Numerous schools of the spined loach can be found under the ice during wintering migration period. Spawns in May laying eggs in flowing waters. Last recorded in Obzhorovsky sector in April 2015.

37. *Misgurnus fossilis* (Linnaeus, 1758) – weatherfish. A very rare resident species inhabiting all Delta and Avandelta zones. It spawns in slow-flowing shallow waters overgrown with aquatic vegetation in May. Last recorded in Damchiksky sector in April 2016.

Order SILURIFORMES

Family SILURIDAE

38. *Silurus glanis* Linnaeus, 1758 – wels catfish. A common resident species inhabiting all Delta and Avandelta zones. The species is sometimes caught by net fishing gears. Reproduction period from May to June. Eggs are laid in slow-flowing shallow waters overgrown with aquatic vegetation. Last recorded in Damchiksky sector in October 2016.

Order SALMONIFORMES

Family COREGONIDAE

39. *Stenodus leucichthys* (Gueldenstaedt, 1772) – whitefish (beloribitsa).

As *Coregonus leucichthys* in Bondarenko (1948) and Fortunatova (1948). A very rare anadromous species endemic to the Caspian Sea. The species is included to the Red Data Book of the Astrakhan Region. (category 1, endangered) (Fedorovich, 2014h). The Sheefish does not reproduce in the Reserve. The species single specimens were recorded in the catches of 1994 and 1997.

Family SALMONIDAE

40. *Salmo caspius* Kessler, 1877 – Caspian salmon, Caspian brown trout. Commonly as a subspecies *Salmo trutta caspius*. Not listed in Litvinov & Podolyako (2013). A very rare anadromous species endemic to the Caspian Sea. In the Red Data Book of the Russian Federation (category 1, endangered), in the Red Data Book of the Astrakhan Region (category 4, uncertain status) (Fedorovich, 2014e). It does not reproduce in the Reserve. Bondarenko (1948) mentioned that the Caspian salmon was very rarely observed in the Reserve. No recent records.

Order ESOCIFORMES

Family ESOCIDAE

41. *Esox lucius* Linnaeus, 1758 – northern pike. An abundant resident species inhabiting all Volga Delta water bodies but mainly slow-flowing waters. More frequent in the Lower Zone during spawning migration from March to June. Spawns in March–June in shallow kultuks, erics, and inundated meadows. Last recorded in Dumchiksky sector in October 2016.

Order GADIFORMES

Family LOTIDAE

42. *Lota lota* (Linnaeus, 1758) – burbot. As *Lota vulgaris* in Bondarenko (1948). A very rare resident species inhabiting inhabits the Lower Zone in the Reserve. In the Red Data Book of the Astrakhan Region (category 3, rare) (Fedorovich, 2014a).

Spawns in channels from December to March. The burbot. Last recorded in Trikh-izbinsky sector in May 2005.

Order **ATHERINIFORMES**

Family **ATHERINIDAE**

43. *Atherina caspia* Eichwald, 1831 – big-scale sand smelt. Not listed in Bondarenko (1948) and Fortunatova (1948), Koblitskaya (1966). As *Atherina boyeri* in Koblitskaya (1981) and *Atheina boyeri caspia* in Kizina & Koblitskaya (1999). A very rare euryhaline species, endemic to the Caspian Sea. The sand smelt does not reproduce in the Reserve, inhabiting the open water of the Avandelta. The species was often observed in the Reserve in the 1950–60s but extirpated since then due to extension of reed thickets area to the sea outside the Reserve southern border. Last observed in 1969.

Order **GASTEROSTEIFORMES**

Family **GASTEROSTEIDAE**

44. *Pungitius platygaster* (Kessler, 1859) – southern nine-spine stickleback. As *Gasterosteus pungitius var. kessleri* in Bondarenko (1948). A common euryhaline species, mainly in the Avandelta but sometimes found in fingerling catches in the Lower and Kultuk Zones. Spawns from April to June, eggs are laid in nests. Last recorded in Damchiksky sector in September 2016.

Family **SYNGNATHIDAE**

45. *Syngnathus caspius* Eichwald, 1831 – Caspian cheeked pipefish. Not listed in Bondarenko (1948) and Fortunatova (1948). As *Syngnathus nigrolineatus caspicus* in Koblitskaya (1966), Kizina & Koblitskaya (1999), and Koblitskaya (1981); also as *Syngnathus abaster caspicus* in the latter publication. On the use of the names *nigrolineatus*, *caspicus*, and *abaster* see Lueken (1967). Commonly, the Caspian cheeked

pipefish has been considered either the subspecies, or the synonym of *Syngnathus abaster* (Coad, 1995; Kottelat, 1997; Kottelat & Freyhof, 2007). However, the taxonomy of the Mediterranean, Black-striped and the Caspian pipefish is not studied well. The Caspian cheeked pipefish differs from the Black striped pipefish by snout length (the Caspian cheeked pipefish has a longer snout) (Berg, 1933, 1949; Kazanchev, 1981). Tarasov (2001) estimates the divergence age as 5.5–6.0 million years, hence he supposes that the holoeuryhaline ancestor of the Caspian cheeked pipefish survived Balakhan crises. As a distinct species by some recent authors (Naseka & Bogutskaya, 2009; Esmaeili et al., 2010). Unlike the Caspian cheeked pipefish, the invasive Black striped pipefish spread throughout the upstream areas of the Volga Delta (Bogutskaya et al., 2013).

A common species occurring in areas with aquatic vegetation in all zones including temporary water bodies, especially abundant in the Avandelta. Endemic to the Caspian Sea. Eggs and larvae develop in the brood pouch of a male. Males with broods are caught by fingerling trawls in June to August. Last recorded in Damchiksky sector in October 2016.

Order **PERCIFORMES**

Family **PERCIDAE**

Subfamily **PERCINAE**

46. *Gymnocephalus cernua* (Linnaeus, 1758) – ruffe. As *Acerina cernua* in Bondarenko (1948), Fortunatova (1948), and Koblitskaya (1966, 1981). A nonabundant resident species mainly inhabiting the Lower Zone. It spawns in late April and early May. Early larvae can rarely be found on floodplain spawning grounds and young-of-the-year in Kultuk Zone. Never recorded in the Avandelta. In winter, sparse schools of the ruffe stay in flowing water over the bottom in the Lower Zone. Last recorded in Dumchiksky sector in October 2016.

47. *Perca fluviatilis* (Linnaeus, 1758) – perch. An abundant resident species making up to 46% of total catch in the Lower Zone of the delta and up to 25–23% in Kultuk Zone and the Avandelta. In recent years it became less abundant in the western Lower Delta area and insignificant fluctuations of the abundance in the eastern Lower Delta area have been recorded. Spawns from late March to early May in kultuks, erics, inundated meadows. Last recorded in Dumchiksky sector in October 2016.

Subfamily LUCIOPERCINAE

48. *Sander lucioperca* (Linnaeus, 1758) – pike-perch. As *Lucioperca sandra* in Bondarenko (1948) and Fortunatova (1948), *Lucioperca lucioperca* in Koblitskaya (1966, 1981), and *Stizostedion lucioperca* in Kizina & Koblitskaya (1999). Two ecomorphs: abundant semi-anadromous and less numerous resident ones. The catches are recorded in the Lower Zone throughout the year, sometimes in the Avandelta. Spawns in April-early May in the channels, the eggs are laid in nests. Last recorded in Obzhorovsky sector in June 2016.

49. *Sander volgensis* (Gmelin, 1789) – Volga pikeperch. As *Lucioperca volgensis* in Bondarenko (1948), Fortunatova (1948), and Koblitskaya (1966, 1981) and *Stizostedion volgense* in Kizina & Koblitskaya (1999). A rare resident species. Single specimens are recorded in the Reserve. It is not found in the Kultuk and Avandelta Zones. Spawns in channels in May. Last recorded in Damchiksky sector in June 2015.

Family GOBIIDAE – Gobies

Subfamily BENTHOPHILINAE

Tribe BENTHOPHILINI

50. *Benthophilus abdurahmanovi* Ragimov, 1978 – Abdurakhmanov's pugolovka. Not listed in Bondarenko (1948), Fortunatova (1948), Koblitskaya (1966, 1981), and Kizina & Koblitskaya (1999). A rare euryhaline species endemic to the Caspian Sea

that does not reproduce in the Reserve. A single specimen was recorded in June 2011 in Dumchiksky sector of the Avandelta, the northernmost locality of the species range (Bogutskaya et al., 2013).

51. *Benthophilus granulatus* Kessler, 1877 – granular pugolovka. Not listed in Bondarenko (1948) and Fortunatova (1948). A common euryhaline species endemic to the Caspian Sea. commonly found over the bottom of channels of the Lower Zone. Spawns in May, probably, also later. Last recorded in Dumchiksky sector in September 2014.

52. *Benthophilus leobergius* (Berg, 1949) – Caspian stellate tadpole-goby. Not listed in Bondarenko (1948) and Fortunatova (1948). As *Benthophilus stellatus leobergius* in Koblitskaya (1966) and Kizina & Koblitskaya (1999) and *Benthophilus stellatus* in Koblitskaya (1981). A common euryhaline species endemic to the Caspian Sea found throughout the Reserve, spawns in mid-April-early May. Last recorded in Dumchiksky sector in September 2014.

53. *Benthophilus macrocephalus* (Pallas, 1787) – Caspian tadpole goby. A very rare species, endemic to the Caspian Sea. It does not reproduce in the Reserve. A single specimen was recorded in Damchiksky sector in August 1952.

54. *Caspiosoma caspium* (Kessler, 1877) – caspiosoma. Not listed in Bondarenko (1948) and Fortunatova (1948). A common euryhaline species that was widespread in the 1950s–1980s but not abundant at present in the Lower Zone and not found in the Island Avandelta. Spawns from late July till August laying eggs on shells on the bottom. Last recorded in Damchiksky sector in September 2014.

Tribe NEOGOBIINI

55. *Neogobius melanostomus affinis* (Eichwald, 1831) – Caspian round goby. Not listed in Bondarenko (1948) and Fortunatova (1948). As *Neogobius melanostomus* in Koblitskaya (1961, 1981). Not abundant but

widely spread in the Delta and Avandelta zones in the Reserve. Spawns in May to June laying eggs on hard bottoms. Last recorded in Dumchiksky sector in October 2016.

56. *Neogobius pallasii* (Berg, 1916) – Caspian sand goby. Not listed in Bondarenko (1948) and Fortunatova (1948). As *Neogobius fluviatilis pallasii* in Koblitskaya (1966) and *Neogobius fluviatilis* in Koblitskaya (1981) and Kizina & Koblitskaya (1999). A nonabundant euryhaline species endemic to the Caspian Sea. Widely distributed in all zones in the Reserve, spawns in May–early August in flowing waters. Last recorded in Dumchiksky sector in September 2016.

Tribe PONTICOLINI

57. *Babka macrophthalma* (Kessler, 1877) – Caspian racer goby. Not listed in Bondarenko (1948), Fortunatova (1948), and Koblitskaya (1966). As *Neogobius gymnotrachelus* in Koblitskaya (1981) and *Neogobius gymnotrachelus gymnotrachelus* in Kizina & Koblitskaya (1999). A rare euryhaline species, endemic to the Caspian Sea. A single specimen has been recorded since the 1980s in Damchiksky sector in September 2016.

58. *Ponticola gorlap* (Iljin, 1949) – Caspian bighead goby. Not listed in Bondarenko (1948) and Fortunatova (1948). As *Neogobius kessleri gorlap* in Koblitskaya (1966), *Neogobius kessleri* in Koblitskaya (1981), and *Neogobius iljini* in Kizina & Koblitskaya (1999). A rare euryhaline species, endemic to the Caspian Sea. Found in all zones of the Reserve. Spawns in the Avandelta from late April to July. Last recorded in Damchiksky sector in October 2016.

59. *Proterorhinus nasalis* (De Filippi, 1863) – eastern tubenose goby. Not listed in Bondarenko (1948) and Fortunatova (1948). As *Proterorhinus marmoratus* in Koblitskaya (1966, 1981) and Kizina & Koblitskaya (1999). A numerous species endemic to the Caspian Sea. Very abundant in all zones of the Reserve. Spawns from late

April to July. Late juveniles mainly inhabit tapegrass thickets of the Island Avandelta. Adults are more often found in the Lower Zone. Last recorded in Dumchiksky sector in October 2016.

60. *Knipowitschia caucasica* (Berg, 1916) – Caucasian dwarf goby. Not listed in Bondarenko (1948) and Fortunatova (1948). As *Pomatoschistus causicus* in Koblitskaya (1966). An abundant euryhaline species in Kultuk Zone and the Island Avandelta. The species was often observed in the 1960s–70s. Since 1980s it does not enter the waters of the Lower Zone. Spawns on vegetation in late April–early June. Last recorded in Damchiksky sector in October 2016.

61. *Knipowitschia longicaudata* (Kessler, 1877) – longtail dwarf goby. Not listed in Bondarenko (1948), Fortunatova (1948), and Koblitskaya (1966). A very rare species. A single specimen have been recorded since the 1960s. Last recorded in Damchiksky sector, the Island Avandelta in October 2011.

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