

North New Hebrides, B.M. 13. 4. 6. 1. A paratype (♀ ad.) from same locality. Both specimens have been skinned from alcohol, but the colour of the fur is probably uninfluenced by the preserving fluid.

LV.—*A Review of the Clupeoid Fishes of the Caspian Sea, with Remarks on the Herring-like Fishes of the Russian Empire.* By Dr. L. S. BERG (St. Petersburg).

THE family Clupeidæ is represented within the limits of the Russian Empire by the following genera:—

1. CLUPEONELLA, Kessler.

Clupeonella, Kessler, Fishes of the Aralo-Caspio-Pontical Region, 1877, p. 187, tab. vi. fig. 24 (Russ.; type *Cl. grimmi*, Kessler, juv.).
Alosa auctorum.

Belly compressed; ventral scutes strong, not concealed, 29 to 35 in number. Scales more or less deciduous, 49 to 60 in a longitudinal series; two elongate scales (alæ) at base of caudal fin. Mouth large, terminal, the maxillary nearly or quite reaching vertical from posterior edge of eye; jaws nearly equal anteriorly; upper jaw distinctly notched. Teeth on vomer persistent; teeth usually present in jaws and on palatines and tongue. Eyelids distinct; cheek higher than long; operculum with radial striæ. Dorsal II–IV 12–16; origin nearer to tip of snout than to base of caudal; last ray not produced. Anal II–IV 17–20. Pelvics I 8–9, inserted below origin or anterior third of dorsal. Vertebrae 48 to 52. Pyloric appendages about 50. Ovaries yellow.

Total length 160–500 mm.

Black and Caspian Seas. Some ascending rivers. Accidentally penetrating in the Mediterranean as far west as Cette, France (1885) *.

2. ALOSA, Cuvier, 1829.

Type, *Clupea alosa*, L.

Closely allied to *Clupeonella*, but vomer toothless. Vertebrae 56–59. Appendices pyloricæ 100. Transverse series of scales 60–80.

In Russia only *A. finta*, Cuv. (Baltic Sea, Gulf of Finland, Gulf of Bothnia).

* Moreau, 'Histoire naturelle des poissons de la France,' Supplement (Paris, 1891), p. 75.

3. CLUPEA, Linn.

Type, *Cl. harengus*, L.

Belly rounded; ventral scutes weak, inconspicuous, 36 to 48. 56 to 70 scales in a longitudinal series. Maxillary extending to below middle of eye; lower jaw projecting; upper jaw not notched. Small but persistent teeth on vomer; sometimes minute teeth in jaws and on palatines and tongue. Eyelids rudimentary; cheek longer than high; operculum smooth. Gill-rakers about 70. Dorsal III-V 13-17; origin nearer to tip of snout than to base of caudal. Anal II-IV 12-17. Pelvics I 7-8 (9), inserted below anterior $\frac{1}{3}$ of dorsal. Vertebrae 50-59. Pyloric appendages 18-23.

A single species, with many subspecies, races, and forms in the northern parts of the Atlantic and Pacific; absent from the Black and Caspian Seas.

4. SPRATELLA, Val.

Spratella, Valenciennes, Hist. nat. poiss. xx. 1847, p. 356 (*pumila* = *sprattus*).

Meletta, Val. t. c. p. 366 (*vulgaris* = *sprattus*).

Pomolobus (non Raf.), Jordan and Evermann, Fish. of N. Amer. i. 1896, p. 424 (only synonymy, partim).

Differs from *Clupea* in the absence of vomerine teeth. Ventral scutes distinct. Maxillary scarcely extending beyond vertical from anterior edge of eye. Dorsal origin nearer to base of caudal than to tip of snout; pelvics inserted below or somewhat in advance of origin of dorsal. Vertebrae 45 to 50. Pyloric appendages 8 to 10.

S. sprattus, L., from the Baltic, *S. phalerica*, Risso, from the Mediterranean, and *S. sulinae*, Antipa, from the Black Sea.

5. HARENGULA, Val.

Harengula, Val. t. c. pp. 277, 280 (*latula*); Jordan and Herre, Proc. U.S. Nat. Mus. xxxi. 1906, p. 633.

Closely related to *Spratella*, but the dorsal fin more anterior in position. The following diagnosis is based on the species of the Black and Caspian Seas:—

Belly compressed; ventral scutes strong, not concealed, 22 to 31 in number. Scales deciduous, 40 to 63 in a longitudinal series; no alae at base of caudal fin. Mouth rather small, the maxillary reaching vertical from anterior edge of eye; lower jaw projecting; upper jaw not notched. No

vomerine teeth; teeth sometimes present on palatines. Eyelids absent or rudimentary; cheek longer than high; operculum without radial striæ. Dorsal III-IV 11-14; origin nearer to tip of snout than to base of caudal. Anal II-III 15-18. Pelvics I 6-7, inserted below anterior $\frac{1}{3}$ of dorsal. Vertebrae 44. Pyloric appendages 8. Ovaries pink or purplish violet. No spots on side of body.

Total length to 165 mm.

Coasts of the Atlantic and Pacific; four species in the Black and Caspian Seas.

6. SARDINELLA, Val.

Sardinella, Val. Hist. nat. poiss. xx. 1847, p. 261 (*aurita*).

Sardinia, Poey, Memorias, ii. 1860, p. 31 (*pseudohispanica*; fide Jord. & Everm.).

Clupanodon (non Lac.), Jordan and Evermann, Fish. N. Amer. i. 1896, p. 422.

Sardina, Antipa, Denkschr. Ak. Wien, lxxviii. 1905, p. 42 (*pilchardus*).

Intermediate between *Clupea* and *Alosa*.

Ventral scutes nearly concealed. Scales deciduous, 28 to 52 in a longitudinal series; alæ present. Maxillary scarcely extending beyond vertical from anterior margin of eye; upper jaw slightly notched. No vomerine teeth; very feeble teeth on palatines and tongue. Eyelids present; opercles with or without radial striæ. Dorsal origin much nearer to tip of snout than to base of caudal; pelvics inserted below anterior $\frac{1}{3}$ or middle of dorsal. Vertebrae 50-54. Pyloric appendages numerous.

Coasts of the Atlantic and Pacific; within Russian limits *S. euxina*, Antipa, 1905, and *S. pilchardus* (Walbaum), both from the Black Sea.

Two of the six genera occur in the Caspian Sea, namely, *Clupeonella* and *Harengula*. A revision of the Caspian species follows, with the Black Sea species of these genera included, so that all the known species of *Clupeonella* are enumerated.

CLUPEONELLA.

Synopsis of the Species of the Caspian Sea *.

I. Less than 50 gill-rakers on first arch; teeth in jaws distinct.

A. Pectoral extending more than 61 % of distance from its base to root of pelvics; diameter of eye 5 to 7.4 % of length of fish (to end of middle caudal rays); total length not more than 200 to 250 mm.

* *C. grimmi*, Kessler, is not included in this synopsis (v. p. 479).

1. Body immaculate or with spots larger than pupil; no dark lateral stripe.

Head acute, with straight upper profile; depth at occiput 70 to 77.4 % of its length. Lower jaw with a distinct symphysial tubercle *saposhnikovi*.

Head with convex upper profile; depth at occiput 78.7 to 85.7 % of its length. Lower jaw without or with feeble tubercle *sphaerocephala*.

2. A dark lateral stripe *curensis*.

B. Pectoral (in adults) extending less than 61 % of distance from its base to root of pelvics; diameter of eye 4 to 5.9 % of length of fish; total length usually more than 250 mm.

25 to 44 gill-rakers on first arch; lower jaw with a tubercle *brashkinovi*.

18 to 26 gill-rakers on first arch; lower jaw rounded at tip *leucocephala*.

- II. More than 50 but less than 100 gill-rakers on first arch; teeth in jaws distinct.

Gill-rakers 60 to 89 *kessleri*.

Gill-rakers about 53 *suworowi*.

- III. Gill-rakers long, slender, reaching in advance of base of tongue, 100 or more on first arch; lower jaw sometimes toothless. *caspia*.

1. *Clupeonella saposhnikovi* (Grimm).

Clupea saposchnikovi, Grimm, The Herring of Astrakhan (in Russ.), 1887, pp. 7, 16 (Volga Delta).

Clupeonella saposhnikovi, Berg, The Herrings of the Caspian Sea (in Russ.), 1913, p. 15, tab. viii.-ix. (full synonymy).

D. III-IV 12-13. A. III-IV 17-18. Sq. 52-55. Gill-rakers 26-40 (average 30-31). Teeth strong. Eye large, 6.0-7.4 % of the length of the fish *. Body deep, its depth 23.3-28.7 % of the length (if more than 27 %—*morpha elata*).

Total length usually 220-250 mm., sometimes 300 mm.; *morpha elata* 340 mm.

Caspian Sea, ascending only the lower part of the Volga Delta.

2. *Clupeonella sphaerocephala*, Berg.

Clupeonella sphaerocephala, Berg, The Herrings of the Caspian Sea (in Russ.), 1913, p. 20, tab. xii. figs. 1, 1 a.

D. III 13-14. A. III 17-19. Sq. 49. Ventral scutes 30-32. Gill-rakers long, robust, 26-36 (average 30).

* The length of the fish is measured to the end of the middle caudal rays, the total length to the tips of the caudal lobes.

Teeth strong. Upper profile of head rounded. Depth of body 24.4–28.8 % of the length of fish, least depth 8.1–9.1 % of the length of head 24.5–26.0 % of the length of head at occiput 78.7–85.7 % of its length. Eye large, 5.1–6.5 % of the length of fish. Pectorals extending 70–77 % of the distance from their base to that of pelvics. Scales rather firm. Sometimes dark spots on the sides of body.

Total length 160–185 mm. (sometimes to 233 mm.).

Caspian Sea: Bay of Agrakhan, Tiuleniy (Seal) Island.

3. *Clupeonella curensis* (Suworow).

Clupea (Alosa) curensis, Suworow, Trudy, Casp. Exp. 1904 (in Russ.), i. 1907, pp. 166, 192–194; ii. 1908, p. 46.

Clupeonella curensis, Berg, The Herrings of the Caspian Sea (in Russ.), 1913, p. 22, tab. xiii. figs. 1, 2.

D. III–IV 12–14. A. III 17–19. Sq. 52–53. Ventral scutes 29–35. Gill-rakers 30–45 (average 35.7), long, slender. Teeth moderate. A distinct tubercle at the antero-inferior end of the lower jaw. Upper profile of head straight. Depth of body 18.4–27.2 % of the length of the fish, eye 5.4–6.2 % of the length of head. Depth of head at occiput 65.8–73.6 % of the length of head. Pectoral extending 68–81 % of the distance from its base to that of pelvics. A dark band along sides of body. Small specimens with back in front of dorsal fin distinctly keeled.

Total length to 200 mm.

West coast of the Caspian Sea, from the mouth of Kura to near Petrowsk.

4. *Clupeonella brashnikovi* (Borodin).

Clupea saposchnikowi, var., Brashnikov, Viest. Rybopr. 1898, p. 231 (in Russ.).

Clupea caspiopontica, var. *braschnikowi*, Borodin, *ibidem*, 1904, p. 176 (in Russ.).

Clupeonella brashnikovi, Berg, The Herrings of the Caspian Sea (in Russ.), 1913, p. 24, tab. x., xi.

D. III 15. A. III 18. Sq. 51–54. Gill-rakers 25–40 (average 32.2), long, thick. Teeth strong. Head cuneiform. Eye small, in adults 4.5–5.0 % of the length of body. Body usually elongate, its depth 21–24 % of the length of the fish, but sometimes as much as 29 % (morpha *elata*). Pectoral, in adults, extending not more than 61 % of the distance from its base to that of pelvics.

Total length to 483 mm.

Caspian Sea, principally at Manghyshlak. Not entering rivers.

5. *Clupeonella leucocephala*, Berg.

Clupea caspiopontica, var. *grimmi* (non Kessl.), Borodin, Viest. Rybopr. 1904, p. 180 (in Russ.).

Clupea (Alosa) grimmi (non Kessl.), Suworow, Trudy Casp. Exp. 1904 (in Russ.), ii. 1908, p. 45.

Clupeonella leucocephala, Berg, The Herrings of the Caspian Sea (in Russ.), 1913, p. 27, tab. xiv.

D. III 13-15. A. III 18-20. Sq. 51-53. Ventral scutes 31-33. Gill-rakers 18-26 (average 20.9), strong, long. Teeth strong. Tip of lower jaw rounded. Body elongate, its depth 18.6-22.8 % of the length of the fish. Head cuneiform, its depth at occiput 62-63 % of its length. Eyes small, 4.0-4.7 % of the length of the fish. Pectoral as in *Cl. brashnikovi*, extending 40-58 % of the distance from its base to that of pelvics.

Total length to 375 mm.

South part of the Caspian, northward to Belidshi.

6. *Clupeonella mæotica* (Grimm).

Clupea mæotica, Grimm, Viest. Rybopr. 1901, p. 67 (Kerch Strait) (in Russ.).

Alosa mæotica, Brauner, Trav. Soc. Nat. Bessarabie, ii. 1912, pp. 218, 221 (Limn. of Dniestr).

Gill-rakers 27-35. Depth of head at occiput 70-71.5 % of its length.

Total length 330 mm. or more.

Sea of Asov and Black Sea (mouth of Dniestr).

7. *Clupeonella suworowi*, Berg.

Clupeonella suworowi, Berg, The Herrings of the Caspian Sea (in Russ.), 1913, p. 28, tab. xii. fig. 2.

D. IV. 13. A. III 18. Sq. 51. Ventral scutes 31. Gill-rakers 53. Teeth weak. Scales rather firm. Depth of body 27.2 % of the length of the fish, head 25.3 %, eye 6.0 % of the length of the fish. Depth of head at occiput 81.4 % of its length. Pectoral extending 72.5 % of the distance from its base to that of pelvics.

Allied to *Cl. kessleri*, from which it differs by fewer gill-rakers, weaker teeth, and deeper body.

Total length 190 mm.

One specimen from near Volga Delta.

8. *Clupeonella pontica* (Eichwald).

Clupea piltshardus (non Walb.), Pallas, Zoogr. ross.-as. iii. 1811, p. 204 (ex parte: Pontus Euxinus, Palus Mæotis).

Clupea pontica, Eichwald, Bull. Soc. Nat. Moscou, 1838, p. 135 (in Ponto Euxino prope Odessam).

Clupea eichwaldi, Grimm, Viest. Rybopr. 1901, p. 67 (in Russ.) (Asov Sea, Don, Kalmius).

Alosa pontica, var. *russac*, Antipa, Denkschr. Akad. Wien, math.-nat. Kl. lxxviii. 1905, p. 22, Taf. ii. figs. 1-5 (N.W. part of the Black Sea).

Alosa pontica, Brauner, l. c. p. 218.

Gill-rakers 40-60. Body elongate.

Allied to *Cl. kessleri*.

Black Sea.

8 a. *Clupeonella pontica nigrescens* (Antipa).

Alosa pontica, var. *nigrescens*, Antipa, t. c. p. 21, Taf. i. figs. 1-3.

Body deeper than in *Cl. pontica* typica.

West coast of the Black Sea.

9. *Clupeonella kessleri* (Grimm).

Clupea piltshardus, var., Pallas, Zoogr. rosso-asiat. iii. 1811, p. 206 (Volgam usque ad Camam et Occam fl. adscendit anadromus).

Clupea pontica (non Eichw.), Kessler, Trav. Soc. Nat. Pétersb. (in Russ.) i. 1870, p. 281 (Volga).

Clupea kessleri, Grimm, The Herring of Astrakhan (in Russ.), 1887, p. 7 (Volga Delta).

Clupeonella kessleri, Berg, The Herrings of the Caspian Sea (in Russ.), 1913, p. 29, tab. vi., vii.

D. III-IV 13-15. A. III 17-20. Sq. 53-56. Ventral scutes 33. Gill-rakers short, 60-89. Teeth distinct. Body elongate, its depth 21.1-25.1 % of the length of the fish, sometimes (morpha *elata*) to 30 %. Length of head 22.8-26.9 % of the length of the fish. Eye small, 4.1-4.9 % of the length of the fish. Pectorals extending 54.1-66.1 % of the distance from their base to that of pelvics. Scales rather firm.

Total length to 492 mm.

Caspian Sea, entering Volga and Ural. In the Volga as high as Nishni-Novgorod.

10. *Clupeonella caspia* (Eichwald).

Clupea caspia, Eichwald, Bull. Soc. Nat. Moscou, xi. 1838, p. 134 (habitat in Caspio mari).

Clupeonella caspia, Berg, The Herrings of the Caspian Sea (in Russ.), 1913, p. 36, tab. i. fig. 1, tab. ii.-iv.

D. III-IV 13-15. A. III 16-20. Sc. 49-54. Gill-rakers long, slender, 101-135. Teeth weak, in lower jaw

usually absent. Body compressed, deep, its depth 25–30 % of the length of the fish (25–26 % = *morpha elongata*, 28–30 % = *morpha elata*).

Total length 200–260 mm., rarely 320 mm.

Caspian Sea, entering Volga Delta.

10 a. *Clupeonella caspia volgensis* (Meissner).

Clupea caspia, var. *volgensis*, Meissner, in litt.

Clupeonella caspia volgensis, Berg, The Herrings of the Caspian Sea (in Russ.), 1913, p. 34, tab. v.

D. IV 13–14 (15). A. III 15–19. Sq. 55. Ventral scutes 32–35. Differs from *Cl. caspia typica* in its elongate form (depth 23.2–25.5 % of the length of the fish), stronger teeth, and more acute snout. External shape very similar to *Cl. kessleri*, from which it differs by more numerous gill-rakers (100–140), &c. Scales deciduous.

Total length to 387 mm.

Caspian Sea, entering Volga.

11. *Clupeonella tanaica* (Grimm).

Clupea tanaica, Grimm, Viest. Rybopr. 1901, p. 67 (in Russ.) (Sea of Asov).

Alosa tanaica, Brauner, Trav. Soc. Nat. Bessarabie, ii. 1912, p. 217.

Allied to *Cl. caspia*.

Gill-rakers 58–77. Lower jaw toothless. Body deep.

Total length to 175 mm.

Sea of Asov, entering Don.

12. *Clupeonella nordmanni* (Antipa).

Alosa nordmanni, Antipa, Denkschr. Ak. Wien, lxxviii. 1905, p. 28, Taf. ii. figs. 6–10.

Replaces *Cl. tanaica* in the west part of the Black Sea.

Gill-rakers 76–90. Teeth in lower jaw present. Pelvics inserted under origin of dorsal.

Total length to 200 mm.

N.W. part of the Black Sea, entering Danube, Dniestr, Dniepr.

13. *Clupeonella grimmi*, Kessler.

Clupeonella grimmi, Kessler, Fishes of the Aralo-Caspio-Pontical Region, 1877, p. 187 (in Russ.), tab. vi. fig. 24.

Only young specimens, up to 45 mm., are known. Gill-rakers 17–30.

Middle part of the Caspian Sea.

Types in the Zool. Mus. of the Acad. Sc. St. Petersburg.

HARENGULA.

Synopsis of the Caspian Species.

I. Profile of back arched.

- Body deep, compressed, its depth more than 20 % of the length of the fish. Gill-rakers 44-56..... *delicatula*.
 Body low, cylindrical, its depth not more than 19 % of the length of the fish. Gill-rakers 59-63..... *engrauliformis*.

II. Back and head forming a straight line. Body compressed, deep. Gill-rakers 43 *tscharchalensis*.

1. *Harengula cultriventris* (Nordmann).

Clupea cultriventris, Nordmann, Faune pontique, iii. 1840, p. 522 (Black Sea); Antipa, Denkschr. Ak. Wien, math.-nat. Kl. lxxviii. 1905, p. 32, Taf. ii. figs. 15-18.

Black Sea.

2. *Harengula delicatula* (Nordmann).

Clupea delicatula, Nordm. t. c. p. 524 (Odessa); Antipa, t. c. p. 32, Taf. ii. figs. 11-14 (near Danube Delta).
Harengula delicatula, Berg, The Herrings of the Caspian Sea (in Russ.), 1913, p. 45, tab. i. fig. 2 (Caspian Sea).

Black and Caspian Seas, entering deltas of rivers.
 There are two forms, *elata* and *elongata*.

3. *Harengula tscharchalensis* (Borodin).

Clupea cultriventris, var. *tscharchalensis*, Borodin, Ann. Mus. Zool. Pétersb. i. 1896, pp. 82, 88, fig. (in Russ.) (Lake Charkhal).
Harengula tscharchalensis, Berg, t. c. p. 45.

Lake Charkhal (tributary of the Ural River), middle Volga.

4. *Harengula engrauliformis* (Borodin).

Clupea engrauliformis, Borodin, Trudy, Casp. Exp. 1904, ii. 1908, p. 50.
Harengula engrauliformis, Berg, t. c. p. 46, tab. i. fig. 3.

West coast of the Caspian Sea.



Berg, L. S. 1913. "A review of the clupeoid fishes of the Caspian Sea, with remarks on the herring-like fishes of the Russian empire." *The Annals and magazine of natural history; zoology, botany, and geology* 11, 472–480.

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