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Comparative Osteology of *Bathylutichthys balushkini* and Relationship of the Family Bathylutichthyidae (Cottoidei)

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Abstract—The structure of skeleton of *Bathylutichthys balushkini* was studied and comparative analysis of it with representatives of other families of the suborder Cottoidei was performed. It was found that Bathylutichthyidae are characterized by the presence of a great number of original characters supporting its family status. They include: absence of mesethmoideum; bony canals of seismosensory system on frontale, pteroticum, and parietale and their strong reduction on infraorbitale; and absence of pterosphenoideum, intercalare, pharyngobranchiale 2, and basihyale. At the same time, Bathylutichthyidae retain a considerable number of generalized specific features: location of parietalia laterally to supraoccipitale and absence of their joint between themselves, presence of mesoptergoideum and basibranchialia 2 and 3. Cladistic analysis based on osteological characters and characters of the seismosensory system of 11 families of Cottoidei demonstrates that Bathylutichthyidae are combined into one group with families Rhamphocottidae, Agonidae, Psychrolutidae, Cyclopteridae, and Liparidae occupying an intermediate position between Psychrolutidae and the two last families. The cladogram obtained does not support the point of view of existence in the suborder Cottoidei of an independent superfamily Cyclopteroidea, including families Liparidae and Cyclopteridae.

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Keywords: Bathylutichthys balushkini, Bathylutichthyidae, comparative osteology, phylogeny

INTRODUCTION

Until recently, only one species—*Bathylutichthys taranetzi* Balushkin et Voskoboinikova—described from one specimen (Balushkin and Voskoboinikova, 1990) was known in the family Bathylutichthyidae. Recently, still another species of this family—*B. balushkini* Voskoboinikova—was found (Voskoboinikova, 2014). One of the paratypes was used to study skeleton structure in *B. balushkini*.

The purposes of this work were a comparative-osteological study of representatives of the family Bathylutichthyidae and clarification of its relationship and taxonomic position in the suborder Cottoidei.

MATERIALS AND METHODS

To study skeleton structure in *B. balushkini*, damaged specimen *SL* 104.8 mm from a type series of ZIN RAN no. 50461 was used, from which alizarin osteological preparation was made according to method described by Potthoff (Potthoff, 1984). Skeleton structure of unpaired fins and axial skeleton was examined according to radiographs of specimens of the type series of ZIN RAN nos. 50462, 50461, 50463. In addition, materials from the osteological collection of ZIN were used: *Myoxocephalus tuberculatus*, *M. joak*, *Melletes papilio*, *Cyclopsis tentacularis*, *Cyclopterus lumpus*, *Eumicrotremus andriashevi*, *E. schmidti*, *E. pacificus*, *E. soldatovi*, *E. deriugini ochotensis*, and *Liparis agassizii*. Included into the skeleton formula of caudal fin are: upper procurrent rays + principal rays on upper hypural plate + principal rays on lower hypural plate + lower procurrent rays.

Data on 11 families of Cottoidei were included into cladistic analysis: Cottidae, Abyssocottidae, Ereuniidae, Psychrolutidae, Rhamphocottidae, Hemitripteridae, Comephoridae, Agonidae, Bathylutichthyidae, Cyclopteridae, and Liparidae. The suborder Cottoidei is accepted in a volume suggested by Shinohara and Imamura (Shinohara and Imamura, 2007). Characters of the skeleton structure and seismosensory system of Cottoidei are mainly taken from the book of Mandritsa (2001). Data from monographs of Ueno (1970), Yabe (1985), Kido (1988), Kanayama (1991) and other works dedicated to this or another degree to osteological analysis of Cottoidei was also used (Shinohara, 1994; Imamua and Yabe, 2002; Shinohara and Imamuta, 2007). Taxon-character matrix was made up in NDE v. 0.5.0 program and analyzed using Nona and Winclada package of computer programs and Heuristic Search algorithm. All characters were given equal weight, and for all reversion was allowed. Characters were not ordered.

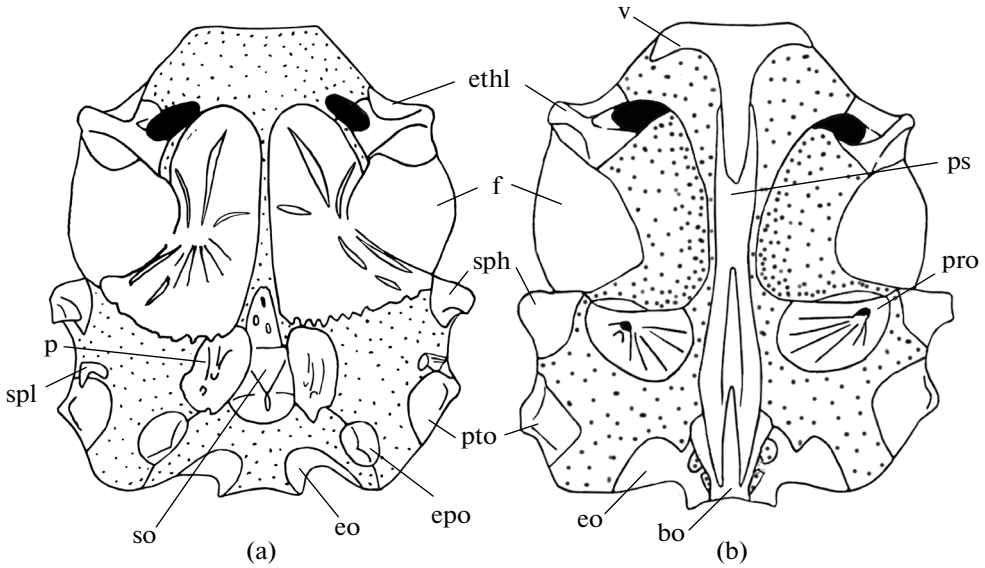

Fig. 1. Neurocranium of *Bathylutichthys balushkini* SL 104.8 mm, (a) top view and (b) bottom view: (bo—basioccipitale, (epo) epioticum, (erhl) ethmoidale laterale, (eo) exoccipitale, (f) frontale, (p) parietale, (pro) prooticum, (ps) parasphenoideum, (po) pteroticum, (so) supraoccipitale, (sph) sphenoticum, (spl) spleniale, (v) vomer.

RESULTS

Skeleton Structure

Neurocranium (Fig. 1). Very wide and low, width at level of posterior edges of pteroticum 87.8%, height at same level 24% of its length. Ethmoidal region and interorbital space (83.6% of the length of neurocranium) also wide. In ethmoidal region, weak development of bony ethmoidale laterale and absence of bony mesethmoideum noteworthy; as a result, ligaments from praemaxillare attach to cartilaginous surface in front of frontalia and to ethmoidalia lateralia. Frontalia are strongly developed, close most part of skull, and join with parietale and supraoccipitale. Parietalia do not connect between themselves all over their extent and leave free central part of supraoccipitale. Other bones forming skull are very small and do not form junctions with the surrounding bony elements. They include: sphenoticum noticeably projecting beyond lateral edge of skull, pteroticum, and epioticum. On skull canals of seismosensory system and connected with them dermal bony elements of dermosphenoticum, lateral and medial extrascapularia completely absent. Single rudiment of seismosensory canals is a small unclosed from above ring-shaped spleniale located directly in front of pteroticum but not attaching to this bone. On lower surface of neurocranium, absence of intercalare, basi- and pterosphenoideum noteworthy. Vomer having long handle and parasphenoideum not forming ascending processes are most well developed. No teeth on vomer. In prooticum, foramen for nerves of trigeminus and facialis separated from orbit by a bony septum. No vertical bony bridge above it.

Splanhnocranium (Fig. 2a). Infraorbital ring consists of four elements, three of which firmly joined together into suborbital support reaching from behind praeoperculum. Beyond orbit, rudimentary upper postorbital bone infraorbitale 4. Two bony arches of infraorbital canal present only at larger lacrimale.

In upper jaw (Fig. 2b), ascending (33% of the bone length) and articular processes moderately developed, postmaxillary process of praemaxillare not developed. Maxillare flattened with long, tooth-like process. Teeth on jaws small, conical, slightly obtuse, located in three-four rows near symphyses. Teeth of outer row smaller than of inner row. On dentale, only two openings of canal of seismosensory system separated by narrow bony bridge; same narrow bridge remains from bony roof of seismosensory canal on lateral surface of anguloarticulare (Fig. 2a).

Suspensorium apparatus (Fig. 2c) very low because of absence of lower process of hyomandibulare. Palatinum mainly consists of articulated head, without teeth, and joins with ecto- and mesopterygoideum via cartilage band. Quadratum and metapterygoideum joined in same way. Symlecticum separated from metapterygoideum and praeoperculum by rather large openings. Praeoperculum a large, oval, slightly curved bone located almost horizontally. Operculum of a shape common for Cottoidae as an elongated triangle with a small upper process. Lower edge of posterior branch of suboperculum formed by connective tissue. Preoperculo-mandibular canal of the seismosensory system is absent on praeoperculum.

In hyoid arch (Fig. 2d), no berycoid opening in ceratohyale and an elongated upper prominence of carilaginous plate between cerato- and epihyale.

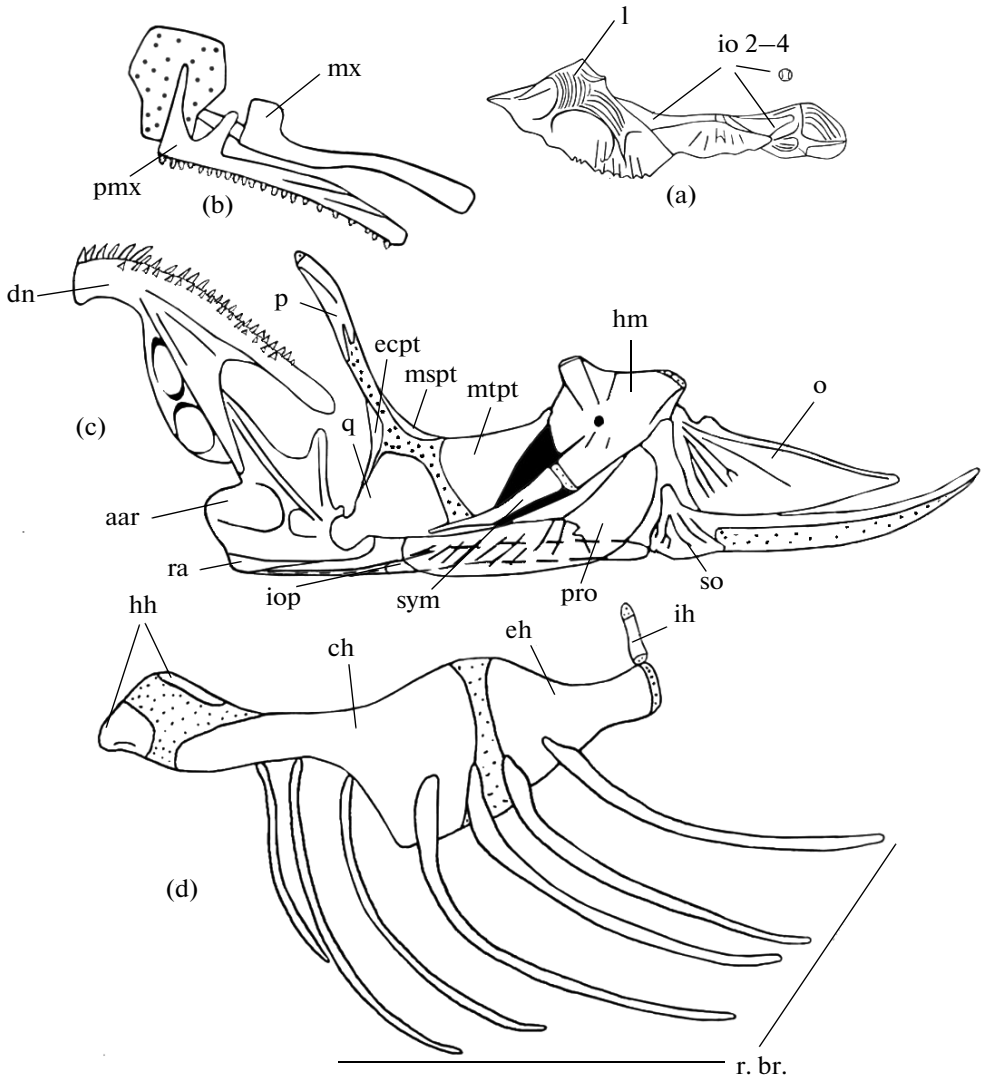

Fig. 2. Infraorbital ring and splanchnocranium of *Bathylutichthys balushkini* SL 104.8 mm: (a) infraorbital ring, (b) upper jaw, (c) lower jaw and suspensorium apparatus, (d) hyoid arch, (aar) anguloarticulare, (ch) ceratohyale, (dn) dentale, (ecpt) ectopterygoideum, (eh) epihyale, (hm) hyomandibulare, (hh) upper and lower hypohyalia, (ih) interhyale, (io) infraorbitale, (iop) interoperculum, (l) lacrimale, (mx) maxillare, (mspt) praemaxillare, (pro) praeoperculum, (q) quadratum, (ra) retroarticulare, (r.br.) radii branchiostegii, (so) suboperculum, (sym) symplecticum.

Hypohyalia considerably reduced in size, do not connect together and with anterior edge of ceratohyale. First three narrow and shortened radii branchiostegii attached to lower edge of anterior end of ceratohyale, two anterior large attached to lateral surface of ceratohyale, and two posterior large attached to lateral surface of epihyale. In different specimens of this species, five to seven gill rays were recorded. Urohyale has an unusual shape, vertical bone lobe divided into two lateral lobes, while lower horizontal lobe rather well developed and enters between these lobes. Urohyale attached to inner surface of upper and lower hypohyale. Without basihyale.

In skeleton of gill arches (Figs. 3a and 3b), small bony basibranchialia 2 and 3 located in a unique basibranchyal cartilage, the fourth cartilaginous basibranchiale rounded, rather large. Two anterior hypobranchialia as small cylinders, with well-developed cartilaginous sites on ends; third hypobranchiale as sector with directed forward elongated top, with strongly developed cartilage along posterior edge. Only one bony pharyngobranchiale 3 of rounded shape, with rounded plot in center bearing small acute conical teeth whose sizes noticeably increase posteriorly. Pharyngobranchialia 1, 2, 4 absent. Epibranchialia 3 and 4 join together by ligament. On ceratobranchiale 5, small conical teeth. Eleven gill rakers in exterior row of first gill arch and 13 in the inner row.

Shoulder girdle and pelvis (Fig. 4). Rudimentary postcleithrum is a small, flattened, rod-shaped bone

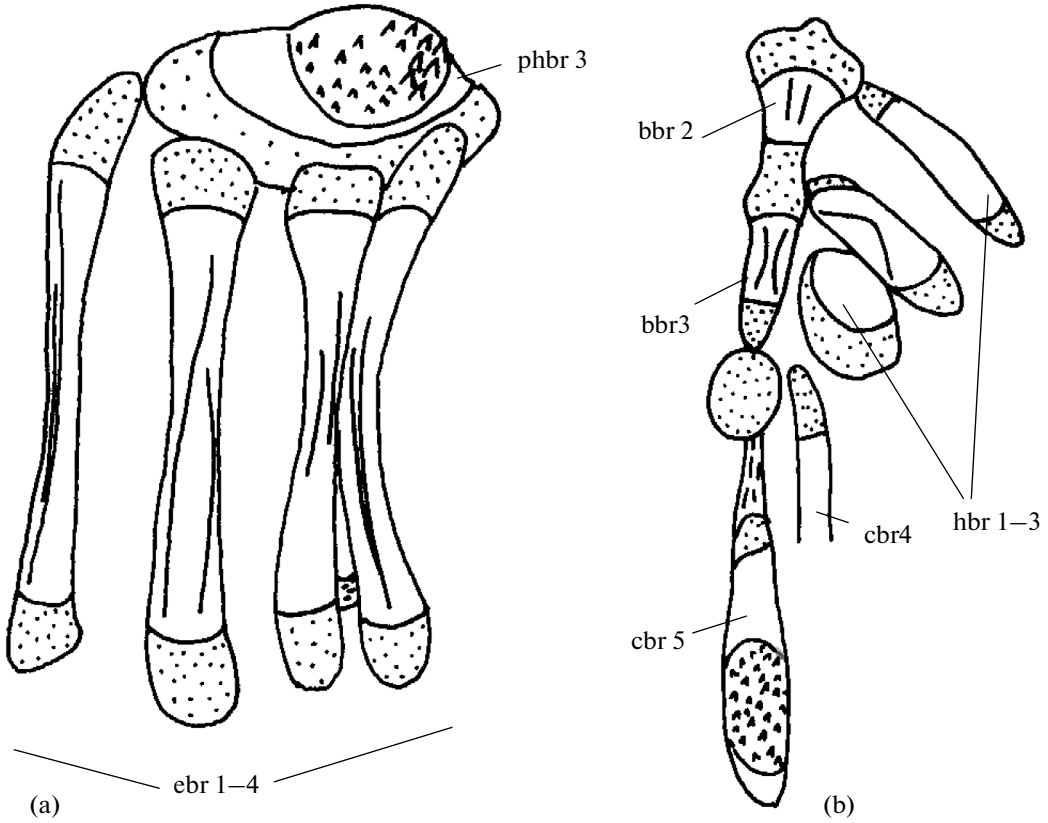

Fig. 3. Skeleton of (a) upper and (b) lower parts of gill arches of *Bathylutichthys balushkini SL* 104.8 mm: (bbr) basibranchiale, (chr) ceratobranchiale, (ebr) epibranchiale, (hbr) hypobranchiale, (phbr) pharyngobranchiale.

with curved lower end by which it is fixed on inner surface of upper lobe of cleithrum by strong ligament. Bone very small and has an unusual location: above from site of fixation to cleithrum. Scapula and coracoideum well separated by cartilaginous plate. Three radialia located in back of them. Scapular opening not closed and opens towards cleithrum. Pelvis as thin, elongated bone to whose distal end three segmented rays are fixed.

Axial skeleton. Vertebrae, including urostyle, 10–11 + 38–40, total 49–50. On first four truncate vertebrae, parapophyses not developed. First haemal process in 11th–12th vertebra. First pterygiophore of dorsal fin without ray, enters between neural processes of fourth and fifth vertebrae. Remaining proximal pterygiophores with one ray each, except for last to which two rays are fixed. First pterygiophore of anal fin without ray, enters between the 10th–11th or 11th–12th vertebrae. Remaining pterygiophores with one ray each, except for last to which two rays are fixed. There are 2–3 free caudal vertebrae above and 2–3 below. Pleural ribs absent, epipleural ribs 7. They begin on first vertebra, absent on second, continue on third, and reach eighth vertebra. Center of preurostylary vertebra fuses with haemal arch (Fig. 5). Ural center fused with parhypurale and hypuralia forming behind medial notch. One elongated epurale with one–two displaced anteriorly upper procurrent nonsegmented rays. All fin rays unbranched. In caudal fin, 1–2 + 4–5 + 4 +1 rays.

Cladistic Analysis

For cladistic analysis, characters obtained as a result of study of the skeleton structure of *B. taranets* and *B. balushkini* were used. Taxon character matrix includes 11 families of Cottoidei and 55 characters (table), As a result of cladistic analysis, one tree with indices—tree length 113, CI 63, RI 62—was obtained (Fig. 6). The tree was reweighed using Paup program.

Family Cottidae without apomorphies and located in basis of cladogram. Its sister group also without apomorphies and divided into two clades. First of them without apomorphies and includes families Ereuniidae and Hemitripteridae. Ereuniidae isolated by one apomorphy: the presence of seven main pores in praeoperculum [5(0)]. Hemitripteridae isolated by one apomorphy: presence of three neuromasts in pteroticum [6(1)]. Families Abyssocottidae, Rhamphocottidae, Comephoridae, Agonidae, Psychrolutidae, Bathylutichthyidae, Cyclopteridae, and Liparidae characterized by two synapomorphies: fixation of one–two rays to first pterygiophore [18(2)], opening in scapula opens to cleithrum [36(1)]. Of them, Abyssocottidae and Comephoridae are isolated according to two syn-

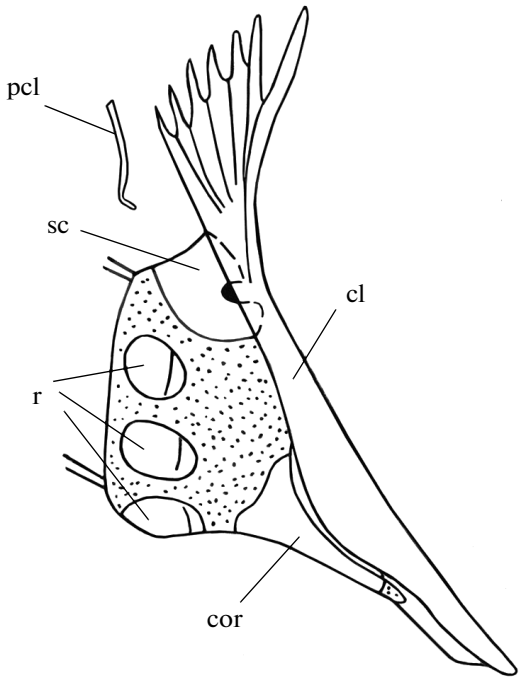

Fig. 4. Skeleton of right pectoral fin of *Bathyluctichthys balushkini SL* 104.8 mm: (cl) cleithrum, (cor) coracoideum, (pcl) postcleithrum, (r) radiale, (sc) scapula.

apomorphies: gill membrane is not connected with isthmus [12(1)], distribution exclusively in Lake Baikal [47(1)]. In Abyssocottidae, apomorphies absent. Comephotidae characterized by five apomorphies: absence of rays in ventral fin [14(1)], 0–1 ray on the first interhaemale [19(2)], presence of ten truncal vertebrae [23(0)], absence of articulation of palatinum and lacrimale [24(1)], absence of postcleithrum [38(2)]. Next clade includes six families: Rhamphocottidae, Agonidae, Psychrolutidae, Bathylutichthyidae, Cyclopteridae, and Liparidae. They are separated by one synapomorphy: no more than one neuromast in suborbitale 1 [1(1)]. Rhamphocottidae separated from remaining listed families by one apomorphy: minimal number of gill rays 7 [34(0)]. Agonidae, Psychrolutidae, Bathylutichthyidae, Cyclopteridae, and Liparidae separated by three synapomorphies: no spines on praeoperculum [30(1)], minimal number of gill rays five [33(2)], and presence of bony structures on a skin [42(1)]. Agonidae characterized by two apomorphies: 0–2 rays on first interhaemale [19(3)], maximum number of truncal vertebrae 12–13 [23(3)]. Psychrolutidae, Bathylutichthyidae, Cyclopteridae, and Liparidae separated from Agonidae by following four apomorphies: maximum number of truncal vertebrae 11[23(1)], considerable skull width [43(1)], small mouth opening [44(1)], and presence of movable skin on the body [53(1)]. Psychrolutidae characterized by one apomorphy: gill rays no less than six [33(1)]. Bathylutichthyidae, Cyclopteridae, and Liparidae separated from Psychrolutidae by six synapomorphies: two principal pores of the seismosensory system in dentale [3(2)], 4–1 principal pore of the seismosensory system in praeoperculum [5(2)], no neuromasts in extrascapulare [7(1)], no segment of seismosensory system in parietale [9(1)], more than one bony segment in the lateral line [11(1)], no intercalare [25(1)]. Bathylutichthyidae is separated from Cyclopteridae and Liparidae by four apomorphies: no neuromasts in infraorbitale 1 [1(2)], no basal pore between dentale and articulare [8(1)], no pterosphenoideum [27(1)], presence of one pharyngobranchiale

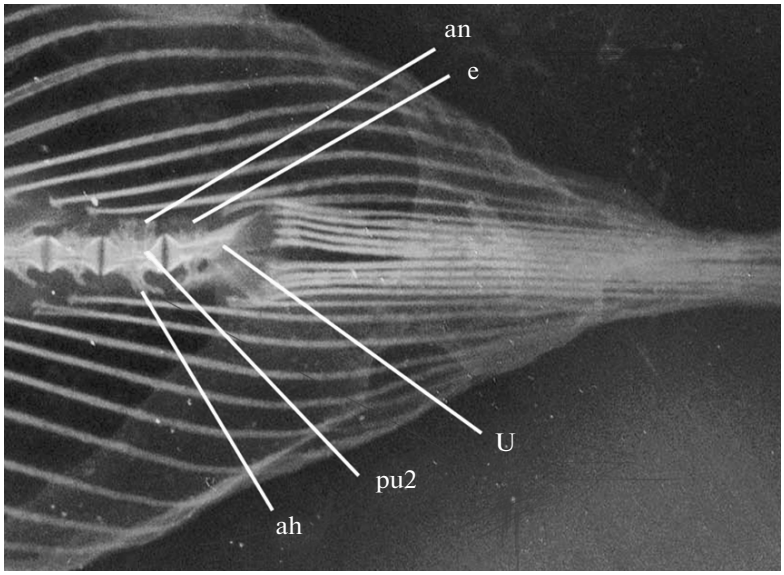

Fig. 5. Radiograph of caudal fin of *Bathylutichthys balushkini SL* 104.8 mm: (ah) haemal arch, (an) neural arch, (e) epurale, (pu2) center of preurostilar vertebra, (U) integrated terminal center.

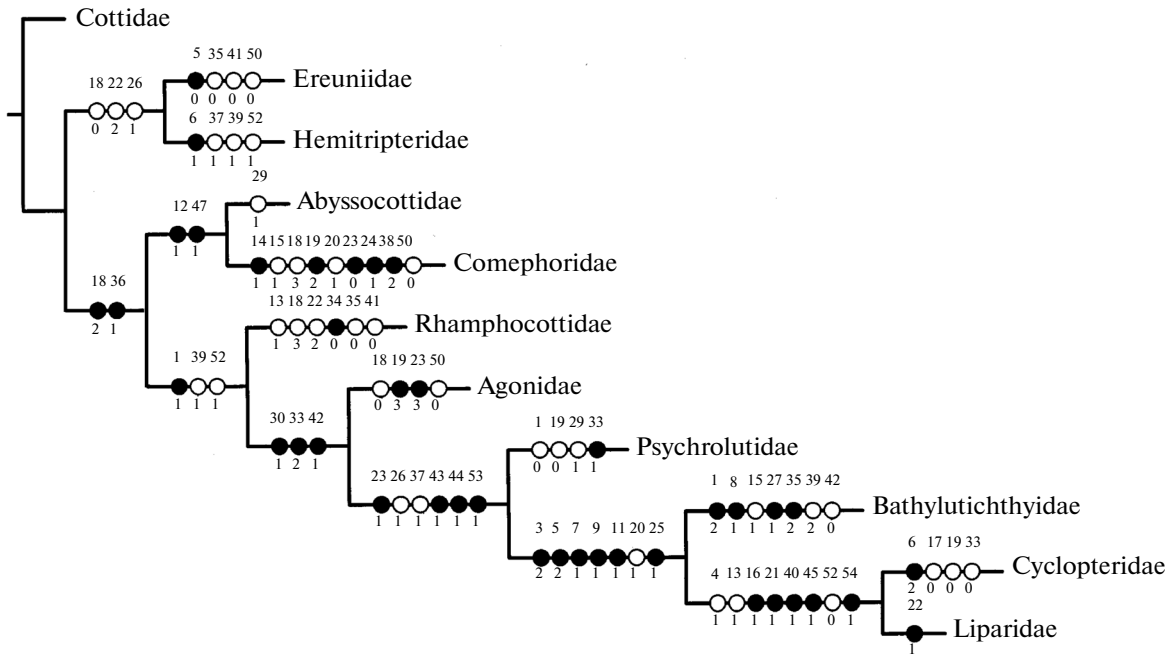

Fig. 6. Cladogram of relationship of 11 families of Cottoidei. Taxon-character matrix of 11 families of Cottoidei: (○) parallelisms and (●) synapomorphies.

[35(2)]. Cyclopteridae and Liparidae connected by five synapomorphies: presence of disk [16(1)], epipleural ribs begin at second–fourth center [21(1)], no Bodelo ligament [40(1)], presence of elongated pectoral fin [45(1)], radialia in one row with scapula and corcoid [54(1)]. Cyclopteridae separated by one apomorphy: presence of one neuromast in pteroticum [6(2)]. Liparidae also characterized by one apomorphy: minimal number of truncal vertebrae 8 [22(1)].

DISCUSSION

There are different points of view on the taxonomic position of the family Bathylutichthyidae. Balushkin and Voskoboinikova (1990) supposed that Bathylitichthyidae is one of the most specialized families of Cottoidei and belongs to its psychrolutid-liparid branch. Mooi and Gill (1995) consider inclusion of Bathylutichthyidae into Scorpaeniformes controversial because of dissimilarity in the position of the first dorsal pterygiophore. Nelson (2006) expressed an opinion that, despite a definite external similarity with *Psychrolutes*, the position of Bathyluitichtyidae in Cottoidei remains unclear. In revision of the order Scorpaeniformes, Shinohara and Imamura (2007) include the family Bathylurichthyidae into suborder Cottoidei. This study demonstrates that Bathylutichthyidae are shared with Cottoidei the most osteological synapomorphies established for this group by Yabe (1985). The absence of intercalare is a logical continuation of the character of Yabe: intercalare is a small bone that does not reach prooticum. The absence of pleural ribs in Bathylutichthyidae does not allow to us assess their correspondence to the character by Yabe: the first pleural rib is fixed to the sixth center (Yabe, 1985, p. 107).

Wiley and Johnson (2010) also include Bathylutichthyidae into suborder Cottoidei. At the same time, Bathylutichthyidae do not have three of seven osteological diagnostic characters established by these authors for the order Cottiformes in Percomorpha incertae sedis on the basis of studies on the systematics of Scorpaeniformes of several authors (Quast, 1965; Yabe, 1985; Shinohara, 1994; Imamura, 1996, 2000; Imamura and Yabe, 2002). Parasphenoideum in Bathylutichthyidae is not connected with pterosphenoideum (which is absent) and does not form ascending processes. In particular, parasphenoideum is separated with pterosphenoideum also in genera *Hemitripterus* and *Blepsias* (Hemitripteridae) in families Erenundiidae, Psychrolutidae (Yabe, 1985; Imamura and Yabe, 2002), Cyclopteridae (Ueno, 1970; Imamuro and Yabe, 2002), and Liparidae (Kido, 1988; Imamua and Yabe, 2002) that also belong to Cottiformes (according to Wiley and Johnson, 2010). Gill rays in Bathylutichthyidae 5–7. Number of gill rays varies from five in Agonidae, Cyclopteridae, and some Liparidae to seven in Psychrolutidae. Medial and lateral extrascapularia in Bathylutichthyidae are absent. Imamua and Yabe (2002) distinguish five morphotypes of lateral extrascapularia in Cottoidei: one element with three pores in Rhamphocottidae, Agonidae, and *Hemitriptems bolini* from Hemitripteridae; two elements (horizontal and longitudinal) with two pores in Ereunidae. *Dasycottus* and *Eurymen* from Psychtolutidae,

Taxon character matrix of Cottoidei

Family	Character																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Cottidae	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	2	0	0	0	0	0
Abyssocottidae	?	?	?	?	?	?	?	?	?	?	?	1	0	0	0	0	2	2	1	0	0	0	2	0	0	0	0	1
Ereuniidae	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	2	2	0	0	1	01	1
Psychrolutidae	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0	1	0	0	1	01	0
Rhamphocottidae	1	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	3	3	1	0	0	2	2	0	0	0	0	1
Hemitripteridae	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	3	0	?	0	0	2	2	0	0	1	0	1
Comephoridae	0	0	1	1	1	0	0	0	0	0	0	1	0	1	1	0	0	3	2	1	0	0	0	1	0	0	0	1
Agonidae	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	3	01	0	0	3	0	0	0	0	0
Bathylutichthyidae	2	2	2	0	2	0	1	1	1	1	1	0	0	0	1	0	1	4	1	1	0	0	1	0	1	1	1	1
Cyclopteridae	1	1	2	1	2	2	1	0	1	1	1	0	1	0	0	1	0	2	0	1	1	0	1	0	1	1	0	1
Liparidae	1	1	2	1	2	0	1	0	1	0	1	0	1	0	0	1	1	4	1	01	1	1	1	0	1	1	01	1
	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	
Cottidae	1	0	0	0	0	01	1	0	0	0	2	0	01	0	0	0	0	0	0	0	0	1	01	0	0	0	0	
Abyssocottidae	1	0	0	0	0	1	1	1	0	1	2	0	1	0	0	0	0	0	1	0	0	1	01	0	0	0	?	
Ereuniidae	0	0	0	0	0	1	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Psychrolutidae	1	1	0	1	1	1	1	1	1	0	1	0	1	1	1	1	0	0	0	01	01	1	1	1	1	0	01	
Rhamphocottidae	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	
Hemitripteridae	0	0	0	0	0	1	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	01	
Comephoridae	0	0	0	0	0	1	1	1	0	2	2	0	1	0	0	0	0	0	1	01	0	0	0	0	0	0	?	
Agonidae	0	1	1	0	2	01	1	1	0	0	1	0	1	1	0	0	0	0	0	0	01	0	01	1	0	0	1	
Bathylutichthyidae	0	1	1	1	2	1	2	1	1	1	2	0	1	0	1	1	0	1	0	01	1	1	1	1	1	0	2	
Cyclopteridae	0	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	01	0	1	1	12	
Liparidae	0	1	1	0	2	01	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	01	0	1	1	12	

Characters (plesiomorphy–apomorphy): (1) number of neuromasts in suborbitale 1 (2–1–0), (2) same in suborbitale 2 (2–1–0), (3) number of main pores in dentale (4–3–2), (4) number of neuromasts in frontale (4–3), (5) number of main pores in praeoperculum (7–5–6 – 4–1), (6) number of neuromasts in pteroticum (2–3–1), (7) the same in extrascapulare laterale (1–0), (8) main pore between dentale and articulare (present–absent), (9) seismosensory segment in parietale (present–absent), (10) the same in extrascapulare mediale (present–absent), (11) more than one segment in lateral line (present–absent), (12) connection of gill membrane with isthmus (absent–present), (13) small gill opening (present–absent), (14) rays in ventral fin (present–absent), (15) spiny rays in ventral fin (present–absent), (16) disk (present–absent), (17) position of the first pterigyophore of dorsal fin between vertebrae (between the second-third–between the second-third and behind them–between the second-third and in front of them–in front of the second), (18) number of rays on the first pterigiophore of dorsal fin (3–3–2–2–1–0–1), (19) the same of anal fin (2–1–0–1–0–2), (20) pleural ribs (present–absent), (21) epipleural ribs begin on vertebra (1–2–4–2–4), (22) minimal number of trunk vertebra (10–8 – 12–13), (23) their maximum number (10–8–12–13, 17), (24) articulation of lacrimale and palatinum (present–absent), (25) intercalare (present–absent), (26) articulation of para- and pterosphenoideum (present–absent), (27) pterosphenoideum (present–absent), (28) connection of parietalia along the midline (present–absent), (29) mesopterygoideum (present–absent), (30) spines on praeoperculum (present–absent), (31) spines on the posterior part of praeoperculum (present–absent), (32) maximum number of radii branchiostegii (6–7), (33) their minimal number (6–7–5), (34) basihyale (present–absent)), (35) number of pharyngobranchialia (3 – 2 – 1), (36) scapular opening opens (to coracoideum–to cleithrum), (37) number of radialia on scapula (1–0), (38) maximum number of postcleitra (2 – 1 – 0), (39) their minimal number (2–1–0), (40) Bodelo ligament (present–absent), (41) pharyngobranchiale 1 (present–absent), (42) armament on the body (absent–present), (43) width of neurocranium no less than 70% of its length (no–yes), (44) small mouth opening (present–absent), (45) elongated pectoral fin (no–yes), (46) dorsal, anal, and caudal fins are combined by a membrane (no–yes), (47) distribution (marine–freshwater), (48) number of suborbitalia (4–5–3), (49) teeth on vomer (present–absent), (50) teeth on palatinum (present–absent), (51) interradial foramena (at least one) (present–absent), (52) branched rays in caudal fin (present–absent), (53) movable skin (present–absent), (54) radially located (between scapula and coracoideum–behind scapula and coracoideum), (55) number of extrascapularia (2–1– 0).

Hemitripteridae, except for *Hemitriptems bolini* and Cottidae; one horizontal element with two pores or its absence in Cyclopteridae. We consider that the absence of listed characters in Bathylutichthyidae more likely indicates the imperfection of these diagnostic characters than the necessity of excluding Bathylutichthyidae from the order Cottiformes sensu Wiley and Johnson, 2010.

The cladogram obtained in no way pretends to an ultimate solution of the issue on relationship of Cottoidei, nevertheless it does not support the point of view of existence in this suborder of an independent superfamily Cyclopteroidea (Nelson, 2006) including families Liparidae and Cyclopteridae. These two most advanced families only terminate clade of six families of Cottoidei representing a sister group of Bathylutichthyidae and together with it sister group Psychrolutidae. The results of the study confirm the point of view of Balushkin and Voskoboinikova (1990) on the position of Bathylutichthyidae in the suborder Cottoidei.

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