

To the biology of flies of the genus *Ephydra* Fallén, 1810, with the descriptions of larvae of seven Palaearctic species (Diptera: Ephydriidae)

К биологии двукрылых рода *Ephydra* Fallén, 1810, с описанием личинок семи палеарктических видов (Diptera: Ephydriidae)

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КЛЮЧЕВЫЕ СЛОВА: Diptera, Ephydriidae, личинки, описания, определительная таблица, биология.

ABSTRACT. The larvae and puparia of seven palae-arctic species are described, among them *Ephydra afghanica* Dahl, 1961, *E. attica* Becker, 1896, *E. flavipes* Macquart, 1844, *E. glauca* Meigen, 1830, *E. pseudomurina* Krivosheina, 1983, *E. riparia* Fallén, 1813, *E. scholtzi* Becker, 1896. The key to the larvae is given. The data on biology are discussed.

РЕЗЮМЕ. Описываются личинки и пупарии семи палеарктических видов рода *Ephydra* Fallén, 1810, в том числе *Ephydra afghanica* Dahl, 1961, *E. attica* Becker, 1896, *E. flavipes* Macquart, 1844, *E. glauca* Meigen, 1830, *E. pseudomurina* Krivosheina, 1983, *E. riparia* Fallén, 1813, *E. scholtzi* Becker, 1896. Приводится определительная таблица видов по личинкам. Обсуждаются данные по биологии видов.

Introduction

Ephydra Fallén, 1810 is one of few genera of Ephydriidae with well-studied biology. The larvae of all known species breed in saline waters. Up-to-date, biology of five Palaearctic species, namely *E. bivittata* Loew, 1860 [Zavattari, 1921], *E. riparia* Fallén, 1813 [Tragardh, 1903; Beyer, 1939], *E. glauca* Meigen, 1830 [Popova, 1929], *E. macellaria* Egger, 1862 [Willcocks, 1917], *E. pseudomurina* Krivosheina, 1983 [Krivosheina, 1983], is known. Biology of five Nearctic species was studied by Aldrich [1912] and Johannsen [1935].

Morphology of larvae of few palae-arctic species was studied, among them *E. riparia* [Beyer, 1939], *E. bivittata* [Zavattari, 1921] and *E. pseudomurina* [Krivosheina, 1983]. However each work contains description of larva of a single species; no paper compiling all these data was published, no key to larvae was proposed.

Materials and methods

Imagoes of *Ephydra* are known to be very close in morphology and determinable mainly by male genitalia; morphological

uniformity is typical also for larvae. In Palaearctic larvae of several species regularly breed in same pond, and this circumstance doesn't make the research easier. I have got the larvae and puparia of the following species: *E. riparia*, *E. scholtzi* Becker, 1896, *E. attica* Becker, 1896, *E. glauca*, *E. pseudomurina*, *E. afghanica* Dahl, 1961 and *E. flavipes* Macquart, 1844. Larvae of *E. riparia* were collected on the Baltic seashore in saline pond. Larvae of *E. scholtzi* were reared under laboratory conditions from females and males caught in copula. Larvae of *E. pseudomurina* were found in very saline continental lake in Uzbekistan, where no other species occurred. For the rest of species method of individual rearing of larvae with subsequent determination of emerged imago was used.

Biology

Life histories of all species are similar. They breed on decaying salt algae on sea shores or in saline waters of continental lakes. They are common in salt fields. As a rule, strong salinity excludes less tolerant species from such habitats. Very often *Ephydra* larvae remain the only inhabitants of such water reservoirs.

Imagoes are noticed on water surface or on moist soil or on floating vegetation. They prefer shallow stagnant ponds. Sometimes they breed in such amounts that the surface of water seems to be covered with continuous layer of imagoes [Krivosheina, 1986]. Females lay eggs on the surface of water, eggs sink almost immediately [Willcocks, 1917]. Females can also lay eggs on floating vegetation. Larvae emerge in 1–4 days; they feed on detritus and microscopic algae, mainly Diatomea, which they find crawling on the bottom or on submerged parts of aquatic plants. As a rule larvae feed, putting out into the air their posterior breathing tube, if the depth of pond doesn't allow to eat and breath at the same time, larvae have to float up to the surface every 5–10 minutes.

The stage of first instar lasts for 1–3 days, second — 2–3 days and third — 4–7 days, pupa — 7–10 days and active stage of feeding imago lasts for 7–13 days. These data were got for the most suitable conditions, or the temperature of water about 25°C for the southern spe-

cies (*E. afghanica*, *E. attica*, *E. flavipes* and *E. pseudomurina*). The close longevity of different stages was got for *E. scholtzi*, reared under laboratory conditions (water $t^{\circ} = 22-23^{\circ}\text{C}$). However we think that in nature on the shore of the Baltic Sea where we observed this species the time of development may differ because real temperature of water is lower ($18-19^{\circ}\text{C}$).

The mature larvae pupate, seizing by the roots, stems or leaves of plants with claws of VI and VIII abdominal segments. For the pupation they use living as well as dead plants.

The facts of discovering of *Ephydra* puparia on leaves and stems of plants brought to the opinion that larvae of *Ephydra* are serious pests of plants, especially rice. We observed fields with damaged plants completely covered with puparia of *Ephydra*. Very likely such situation was caused by breaking of agrotechnics and as a result — high salinity of water. Seedlings perished and the great numbers of *Ephydra* larvae found these conditions to be favourable for their breeding. During pupation larvae crawled to leaves, stems and roots of dying or dead plants for the pupation and were taken for their pests.

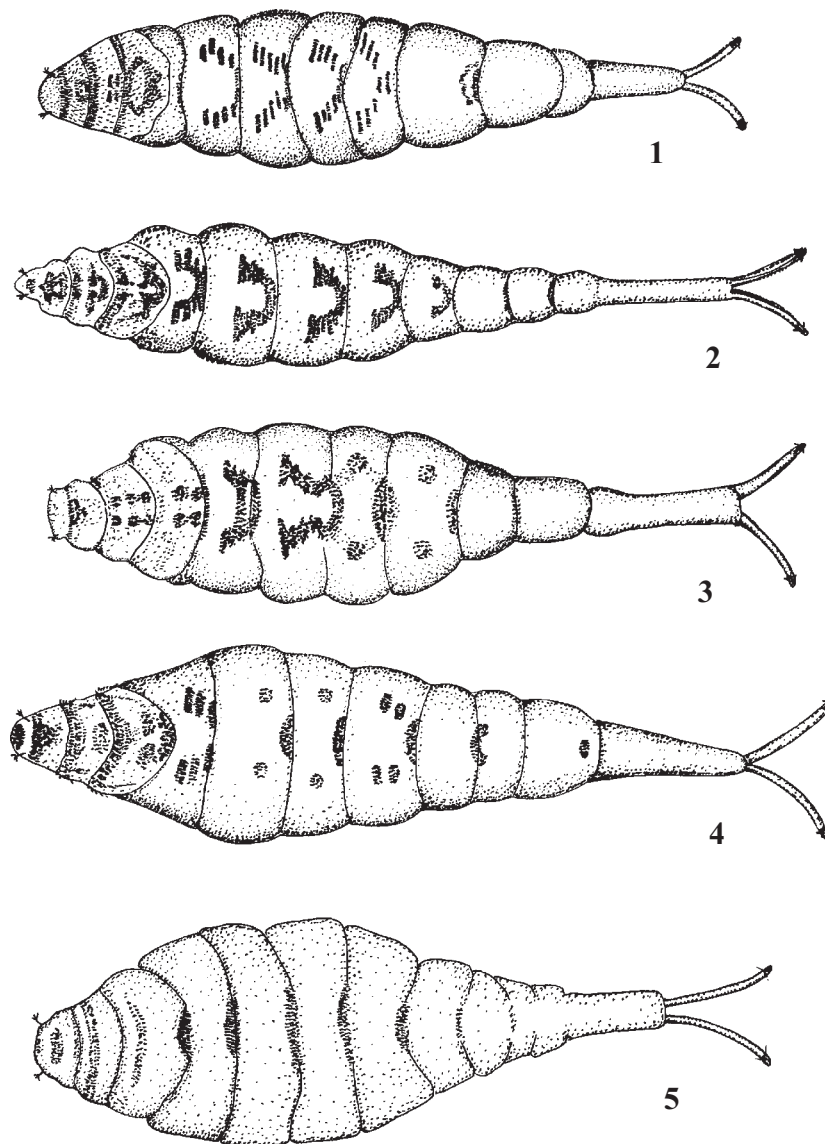
Our observations showed that larvae of *Ephydra* can complete their life-cycle in ponds without plants. Special investigation [Nasr et al., 1971] showed that seedlings of rice did not perish in presence of *Ephydra* larvae. Besides claws of larvae are too small

to cause serious damage of plants as it happens, for example, with *Notiphila* larvae [Krivosheina, 1993].

Imagoes of *Ephydra* are not able to distinguish between salt and fresh water. They can be found on the surface of shallow water of lake margins, ponds, marshes or sea shores. They lay eggs on surface of salt as well as of fresh water, but larvae complete their development only in salt waters.

Optimal salinity for larval breeding is 40–50 ‰ at temperature $23-35^{\circ}\text{C}$ though some species survive salinity 10–100 ‰ and temperature $0-40^{\circ}\text{C}$ [Ping, 1921]. Other authors informed about successful breeding of larvae under salinity 170 ‰ [Galdean, 1976] and 200 ‰ [Zernov, 1949].

We observed breeding of *Ephydra* larvae under salinity 3.5–48 ‰ and temperature $19-32^{\circ}\text{C}$. Very often close spe-



Figs. 1–5. Puparia of the species of *Ephydra*, dorsal view: 1 — *E. riparia*; 2 — *E. flavipes*; 3 — *E. afghanica*; 4 — *E. scholtzi*; 5 — *E. pseudomurina*.

Рис. 1–5. Пупарии видов рода *Ephydra*, сверху: 1 — *E. riparia*; 2 — *E. flavipes*; 3 — *E. afghanica*; 4 — *E. scholtzi*; 5 — *E. pseudomurina*.

cies breed in same water reservoirs [Krivosheina, 1986]. *E. riparia* and *E. scholtzi* proved to be typical for sea coasts, the rest of species were discovered in continental saline lakes.

Descriptions of immature stages

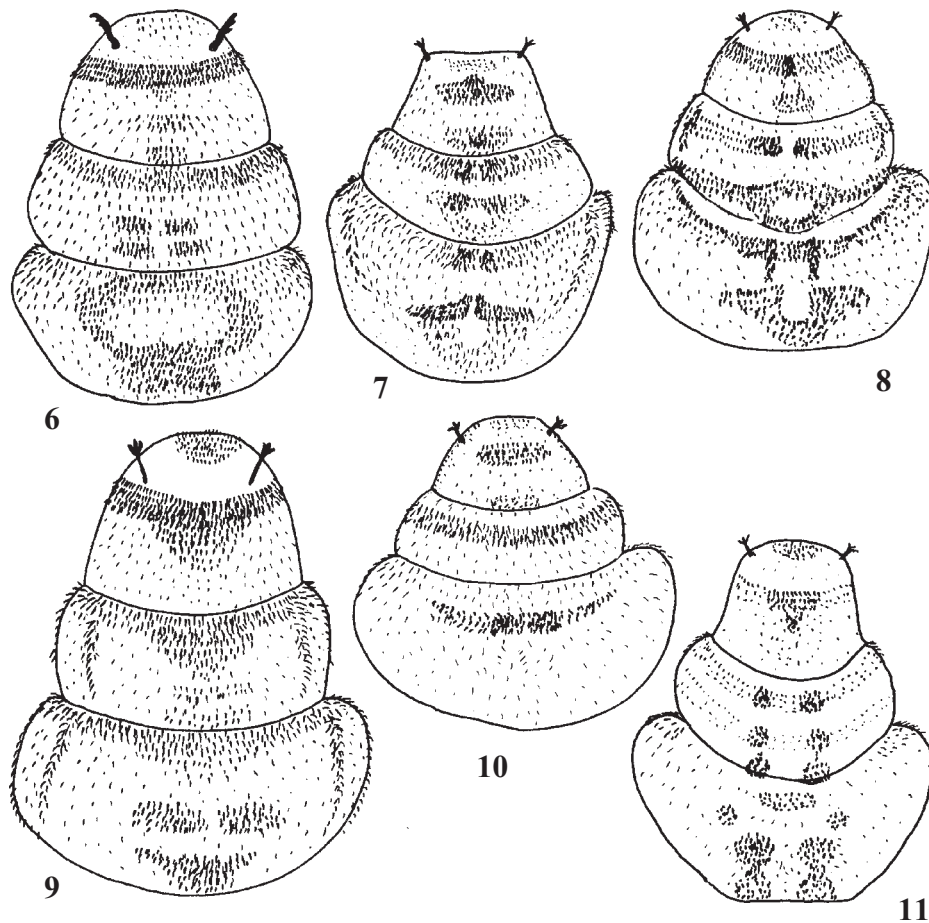
Ephydra afghanica Dahl, 1961

Figs. 3, 11, 17, 24.

Material: 2 puparia, 2 ♂♂, reared from puparia. Turkmenistan, Sarykamysh, 16–22.IV.1984 (M. Krivosheina).

Puparium. Length 11 mm, width 2 mm.

Integument brown, the cup with typical dark pattern formed by spinula — cup with combinations of round spots, abdominal segments with spinules placed in semicircular



Figs. 6–11. Cups of puparia of the species of *Ephydra*, dorsal view: 6 — *E. riparia*; 7 — *E. attica*; 8 — *E. flavipes*; 9 — *E. scholtzi*; 10 — *E. pseudomurina*; 11 — *E. afghanica*.

Рис. 6–11. Крышечки pupариев видов рода *Ephydra*, сверху: 6 — *E. riparia*; 7 — *E. attica*; 8 — *E. flavipes*; 9 — *E. scholtzi*; 10 — *E. pseudomurina*; 11 — *E. afghanica*.

order or round spots. Cylindrical, straight dorsally and swollen ventrally, both ends tapering and upturned. Anterior end invaginated, bearing anterior spiracles laterally, each spiracle with 3 papillae. Posterior end elongated into breathing tube. Anal proleg curved forward; each armed with 4 large and 3 smaller claws; as a rule it attaches puparium to stems, roots of plants or floating vegetation.

Anal plate square, postanal tubercle covered with many small spinules.

Cephalopharyngeal skeleton with paired slightly curved dentate mouth hooks. Dental sclerite triangular. Hypostomal sclerite paired, broader anteriorly than posteriorly, with 2 narrow hypostomal bridges. Epistomal sclerite with many openings, uniformly sclerotized. Parastomal bars rod-like. Pharyngeal sclerite weakly sclerotized, dorsal cornua weakly pigmented, connected anteriorly by dorsal bridge with many small windows and one posterior window. Ventral cornua moderately sclerotized with 2 windows posteroapically. Lateral pharyngeal process round.

Ephydra attica Becker, 1896

Figs. 7, 14, 28.

Material. 3 larvae, 4 puparia, 4 ♂♂, reared from larvae. Turkmenistan, Sarykamysh, N 1, 20.IV.1984 (M. Krivosheina).

Mature third-instar larva. Total length 10–11 mm, width 1.6–2 mm, breathing tube 2.6–3 mm, branches of the breathing tube 1.6–1.8 mm.

Elongate, nearly cylindrical, both ends tapering, posterior end telescoping and forming branched breathing tube. Integument yellowish-white, dorsal surface covered with dark spinules which form complex pattern on thoracic segments, abdominal segments with single bands. This pattern is closer to *E. pseudomurina*, than to the other species. Prolegs present on ventral surface of segments V–XII, anal proleg is the largest. Each proleg with 4+4 black claws. Segment I (pseudocephalic) invaginated bearing 2-segmented antenna, segment II bearing anterior spiracles, each spiracle with 3 finger-like papillae. Segment XII (caudal) bearing breathing tube posteriorly and anal proleg ventrally, armed with 7 large dark claws and several small ones. Breathing tube is branched apically, the branches ending by spiracular plates, each of them with 4 spiracular openings and 4 groups of perispiracular hairs. Anal plate round, anal opening transverse, postanal tubercle with dark blunt short spinules.

Cephalopharyngeal skeleton with paired curved dentate mouth hooks. Dental sclerite square. Hypostomal sclerite paired, 1.6 times as long as the mouth hooks, with 2 narrow hypostomal bridges. Epistomal sclerite with many openings,

uniformly sclerotized. Parastomal bars rod-like. Pharyngeal sclerite relatively strong, dorsal cornua weakly pigmented, connected anteriorly by dorsal bridge with few windows and one posterior window. Ventral cornua moderately sclerotized with 2 windows posteroapically. Lateral pharyngeal process round.

Puparium. Length 8–9 mm, width 2.0 mm.

Light brown. Integument dorsally with weak brown pattern formed by short bands of spinula. Cylindrical, swollen ventrally, both ends tapering and upturned. Anterior end invaginated, bearing anterior spiracles laterally, posterior end elongated into breathing tube. Anal proleg curved forward; with 7 black claws which attach the puparium to water vegetation.

Ephydra flavipes Macquart, 1844
Figs. 2, 8, 18, 21, 22.

Material: 1 larva, 15 puparia, 3 ♂♂, reared from larvae. Turkmenistan, Sarykamysh, N 5, 16–22.IV.1984 (M. Krivosheina).

Mature third-instar larva. Total length 10 mm, width 1.8 mm, breathing tube 2 mm, branches of the breathing tube 1.5 mm.

Elongate, nearly cylindrical, both ends tapering, posterior end telescoping and forming branched breathing tube. Integument yellowish-white, dorsal surface densely covered with dark spinules which form typical pattern of fused bands. Prolegs present on ventral surface of segments V–XII, anal proleg is the largest. Each proleg with 4+4 black claws. Segment I (pseudoccephalic) invaginated, bearing 2-segmented antenna, segment II bearing anterior spiracles, each spiracle with 3 finger-like papillae. Segment XII (caudal) bearing breathing tube posteriorly and anal proleg ventrally, the latter is armed with 5 large and 4 smaller black claws. Breathing tube is branched apically, the branches ending by spiracular plates, each of them with 4 round spiracular openings and 4 groups of perispiracular hairs. Anal opening transverse, post-anal tubercle with dark blunt triangular short spinules.

Cephalopharyngeal skeleton with paired curved dentate mouth hooks. Dental sclerite of triangular form. Hypostomal sclerite paired, 2.2 times longer than the mouth hooks, connected by 2 narrow hypostomal bridges. Epistomal sclerite lost. Parastomal bars rod-like. Pharyngeal sclerite relatively strong, dorsal cornua weakly pigmented, connected anteriorly by dorsal bridge with several small windows. Ventral cornua strongly sclerotized, with 1 window posteroapically. Lateral pharyngeal process sclerotized.

Puparium. Length 8 mm, width 2 mm.

Integument brown, the cup with typical dark pattern formed by spinula — darker anterior bands and washed posterior spots. Cylindrical, straight dorsally and swollen ventrally, both ends tapering and upturned. Anterior end invaginated, bearing anterior spiracles laterally, posterior end elongated into breathing tube. Anal proleg curved forward; as a rule it attaches puparium to stems, roots of plants or floating vegetation.

Ephydra glauca Meigen, 1830
Figs. 15, 20, 25, 29.

Material: 1 larva, 1 pupa, 3 ♂♂, 2 ♀♀, with the only label: "Kazakhstan, IX.1998".

Mature third-instar larva. Total length 11 mm, width 2 mm, breathing tube 2 mm, branches of the breathing tube 1.5 mm.

Elongate, nearly cylindrical, both ends tapering, posterior end telescoping and forming branched breathing tube. Integument yellowish-white, dorsal surface densely covered with dark spinules which form typical pattern of fused 9–13 short bands. Prothoracal creeping welt consists of 4 rows of larger and 4 rows of smaller spinules. Prolegs present on ventral surface of segments V–XII, anal proleg is the largest. Each proleg with 4+4 black claws. Segment I (pseudoccephalic) invaginated bearing 2-segmented antenna, segment II bearing anterior spiracles, each spiracle with 3 finger-like papillae. Segment XII (caudal) bearing breathing tube posteriorly and anal proleg ventrally, armed with 13–14 black claws. Breathing tube is branched apically, the branches ending by spiracular plates, each of them with 4 spiracular openings and 4 groups of perispiracular hairs. Anal opening transverse, post-anal tubercle with dark blunt short spinules.

Cephalopharyngeal skeleton with paired curved dentate mouth hooks. Dental sclerite of triangular form. Hypostomal sclerite paired, relatively long, connected by 2 narrow hypostomal bridges. Epistomal sclerite broad anteriorly and posteriorly with narrow stem. Parastomal bars rod-like. Pharyngeal sclerite relatively strong, dorsal cornua weakly pigmented, connected anteriorly by dorsal bridge with few small windows. Ventral cornua weakly pigmented with 2 windows posteroapically. Lateral pharyngeal process round.

Puparium. Length 10 mm, width 2 mm.

Integument brown with typical dark pattern formed by 16 fused bands of spinula. Cylindrical, straight dorsally and swollen ventrally, both ends tapering and upturned. Anterior end invaginated, bearing anterior spiracles laterally, posterior end elongated into breathing tube. Anal proleg curved forward with 13–14 large claws; as a rule it attaches puparium to stems, roots of plants or floating vegetation.

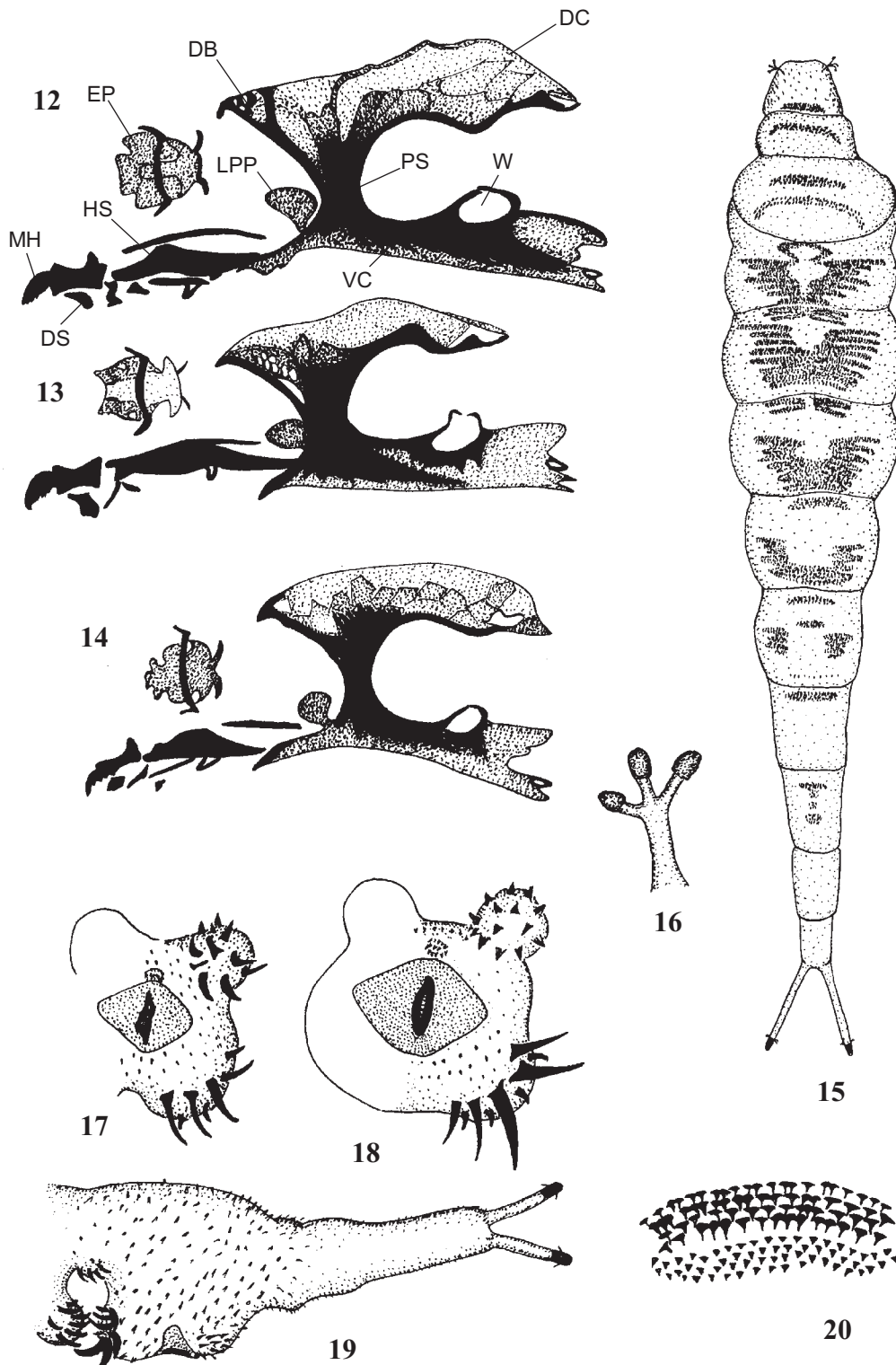
Ephydra pseudomurina Krivosheina, 1983
Figs. 5, 10, 23, 26.

Material. 10 larvae, 15 puparia, 5 ♂♂, 5 ♀♀ reared from larvae. Uzbekistan, Syrdarinskaja Area, Mekhnatabat Distr., Jangier, 24.V.–10.VI.1980 (M. Krivosheina).

Mature third-instar larva. Total length 8.5–9 mm, width 1.6–2 mm, breathing tube 2.6–3 mm, branches of the breathing tube 1.6–1.8 mm.

Elongate, nearly cylindrical, both ends tapering, posterior end telescoping and forming branched breathing tube. Integument yellowish-white, dorsal surface covered with dark spinules which form single brown band on each segment. Prolegs present on ventral surface of segments V–XII, anal proleg is the largest. Each proleg with 8–9 black claws.

Рис. 12–20. Детали строения личинок видов рода *Ephydra*: 12 — ротоглоточный скелет *E. riparia*, сбоку; 13 — ротоглоточный скелет *E. scholtzi*, сбоку; 14 — ротоглоточный скелет *E. attica*, сбоку; 15 — личинка *E. glauca*, сверху; 16 — переднее дыхальце *E. riparia*; 17 — ложная ножка VIII брюшного сегмента *E. afghanica*; 18 — ложная ножка VIII брюшного сегмента *E. flavipes*; 19 — задний конец тела личинки *E. scholtzi*, сбоку; 20 — ползательный валик проторакального сегмента личинки *E. glauca*. Условные обозначения: ДВ — дорсальная перемычка фарингеального склерита; ДС — дорсальные отростки фарингеального склерита; ДЗ — зубной склерит; ЕР — эпистомальный склерит; НС — гипостомальный склерит; ЛРР — латеральный отросток фарингеального склерита; МН — ротовые крючья; ПС — фарингеальный склерит; ВС — вентральные отростки фарингеального склерита; W — окно.



Figs. 12–20. Details of larval morphology of the species of *Ephydra*: 12 — cephalopharyngeal skeleton of *E. riparia*, lateral view; 13 — cephalopharyngeal skeleton of *E. scholtzi*, lateral view; 14 — cephalopharyngeal skeleton of *E. attica*, lateral view; 15 — larva of *E. glauca*, dorsal view; 16 — anterior spiracle of *E. riparia*; 17 — anal proleg of *E. afghanica*; 18 — anal proleg of *E. flavipes*; 19 — posterior end of the larva of *E. scholtzi*, lateral view; 20 — ventral welt of prothoracic segment of the larva of *E. glauca*. Abbreviations: DB — dorsal bridge of pharyngeal sclerite; DC — dorsal cornua; DS — dental sclerite; EP — epistomal sclerite; HS — hypostomal sclerite; LPP — lateral pharyngeal process; MH — mouth hook; PS — pharyngeal sclerite; VC — ventral cornua; W — window.

Segment I (pseudocephalic) invaginated bearing 2-segmented antenna, segment II bearing anterior spiracles, each spiracle with 3 finger-like papillae. Segment XII (caudal) bearing breathing tube posteriorly and anal proleg ventrally, armed with 10 claws. Breathing tube is branched apically, the branches ending by spiracular plates, each of them with 4 spiracular openings and 4 groups of perispiracular hairs. Anal plate round, anal opening transverse, postanal tubercle with dark blunt short spinules.

Cephalopharyngeal skeleton with paired curved dentate mouth hooks. Dental sclerite elongated. Hypostomal sclerite paired, 2 times as long as the mouth hooks, with 2 narrow hypostomal bridges. Epistomal sclerite broader anteriorly than posteriorly, with narrow stem. Parastomal bars rod-like. Pharyngeal sclerite relatively strong, dorsal cornua weakly pigmented, connected anteriorly by dorsal bridge with many small windows. Ventral cornua strongly sclerotized with 1 window posteroapically. Lateral pharyngeal process round.

Puparium. Length 8–8.2 mm, width 2.0–2.1 mm.

Light brown. Integument dorsally with brown bands formed by spinula. Cylindrical, swollen ventrally, both ends tapering and upturned. Anterior end invaginated, bearing anterior spiracles laterally, posterior end elongated into breathing tube. Anal proleg curved forward; with 10 black claws which attach the puparium to water vegetation.

Ephydra riparia Fallén, 1813

Figs. 1, 6, 12, 16.

Material: 5 larvae, 16 puparia, 10 ♂♂ and many ♀♀ reared from larvae, Russia, Leningrad Area, Sosnoviy Bor, N 77, N 81, 1.VII.–10.VIII.1984 (M. Krivosheina).

Mature third-instar larva. Total length 11–12 mm, width 2 mm, breathing tube 2 mm, branches of the breathing tube 1.8 mm.

Elongate, nearly cylindrical, both ends tapering, posterior end telescoping and forming branched breathing tube. Integument yellowish-white, dorsal surface covered with dark spinules which form typical pattern of 8 isolated bands. Prolegs present on ventral surface of segments V–XII. Segment I (pseudocephalic) invaginated bearing 2-segmented antenna, segment II bearing anterior spiracles, each spiracle with 3–4 finger-like papillae. Segment XII (caudal) bearing breathing tube posteriorly and anal proleg ventrally. Breathing tube is branched apically, the branches ending by spiracular plates, each of them with 4 spiracular openings and 4 groups of perispiracular hairs. Anal opening transverse, postanal tubercle with dark short spinules.

Cephalopharyngeal skeleton with paired curved dentate mouth hooks. Dental sclerite thin. Hypostomal sclerites paired, 1.6 times as long as the mouth hooks, connected by 2 narrow hypostomal bridges. Epistomal sclerite moderately sclerotized, oval, blunt anteriorly. Parastomal bars rod-like. Pharyngeal sclerite relatively strong, dorsal cornua weakly pigmented, connected anteriorly by dorsal bridge with several small windows and 1 posterior window. Ventral cornua strongly sclerotized, with 2 windows posteroapically. Lateral pharyngeal process oval.

Puparium. Length 9–10 mm, width 2 mm.

Integument brown, the cup with typical dark pattern formed by spinula — long anterior and shorter posterior bands or united in semicircular structure. Cylindrical, straight dorsally and swollen ventrally, both ends tapering and upturned. Anterior end invaginated, bearing anterior spiracles laterally, posterior end elongated into breathing tube. Anal proleg curved forward; as a rule it attaches puparium to stems, roots of plants or floating vegetation.

Ephydra scholtzi Becker, 1896

Figs. 4, 9, 13, 19, 27.

Material: 5 larvae, 6 puparia, 10 ♂♂ and many ♀♀ reared from larvae, Russia, Leningrad Area, Sosnoviy Bor, N 81, 1.VII.–10.VIII.1984 (M. Krivosheina).

Mature third-instar larva. Length 9–10 mm, width 1.4–1.5 mm, breathing tube 1.6–1.8 mm, branches of the breathing tube 1.5 mm.

Elongate, nearly cylindrical, both ends tapering, posterior end telescoping and forming branched breathing tube. Integument yellowish-white, dorsal surface densely covered with dark spinules which form typical pattern: thoracic segments with anterior bands and posterior round spots, abdominal segments with following combinations of short bands and round spots. Prolegs present on ventral surface of segments V–XII, anal proleg is the largest. Each proleg with 4+5 black claws. Segment I (pseudocephalic) invaginated bearing 2-segmented antenna, segment II bearing anterior spiracles, each spiracle with 3 finger-like papillae. Segment XII (caudal) bearing breathing tube posteriorly and anal proleg ventrally, armed with 9 dark claws; the integument of the proleg is covered with long thin and acute spines. These spines differ *E. scholtzi* from all the other species. Breathing tube is branched apically, the branches ending by spiracular plates, each of them with 4 spiracular openings and 4 groups of perispiracular hairs. Anal opening transverse, postanal tubercle with dark blunt short spinules.

Cephalopharyngeal skeleton with paired curved dentate mouth hooks. Dental sclerite of square form. Hypostomal sclerite paired, 2.4 times as long as the mouth hooks, connected by 2 narrow hypostomal bridges.

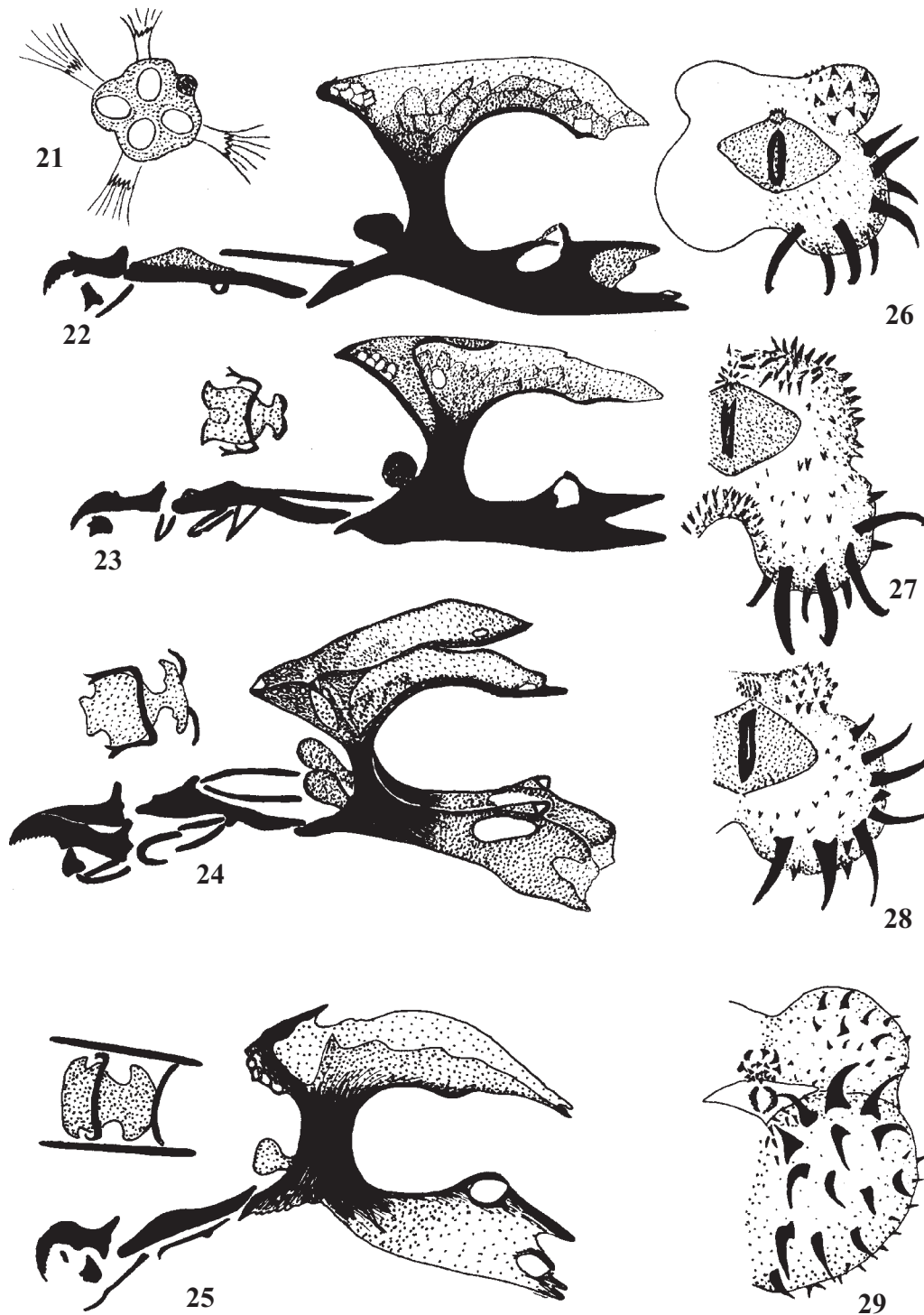
Epistomal sclerite round, stronger sclerotized anteriorly, in posterior third with narrow stem and broadened at the end. Parastomal bars rod-like. Pharyngeal sclerite relatively strong, dorsal cornua pigmented, connected anteriorly by dorsal bridge with many small windows and one window posteriorly. Ventral cornua sclerotized, with 1 window posteroapically. Lateral pharyngeal process oval.

Puparium. Length 8 mm, width 1.6 mm.

Integument brown with typical dark pattern formed by spinula: the cup with anterior bands and posterior round spots; abdominal segments with combinations of short bands and round spots. Caudal segment covered with long acute thin spines, which differ this species from all the other known species. Cylindrical, straight dorsally and swollen ventrally, both ends tapering and upturned. Anterior end invaginated, bearing anterior spiracles laterally, posterior end elongated into breathing tube. Anal proleg curved forward, with 4 large and 5 smaller claws; as a rule it attaches puparium to stems, roots of plants or floating vegetation.

KEY TO IMMATURE STAGES OF THE GENUS *EPHYDRA* FALLÉN (MATURE LARVAE AND PUPARIA)

1. Caudal segment of the body is densely covered with acute short thin spines. The relation length to width of the cup of puparium is 4 : 3. Sclerotization of the pharyngeal sclerite moderate. Epistomal sclerite round, stronger sclerotized anteriorly, in posterior third with narrow stem and broadened at the end *E. scholtzi* Becker — Caudal segment of the body is covered with blunt short triangular spines 2
2. Dorsal pattern of dark brown spinules is formed only by bands 3



Figs. 21–29. Details of larval morphology of the species of *Ephydra*: 21 — posterior spiracle of *E. flavipes*; 22 — cephalopharyngeal skeleton of *E. flavipes*, lateral view; 23 — cephalopharyngeal skeleton of *E. pseudomurina*, lateral view; 24 — cephalopharyngeal skeleton of *E. afghanica*, lateral view; 25 — cephalopharyngeal skeleton of *E. glauca*, lateral view; 26 — anal proleg of the larva of *E. pseudomurina*; 27 — anal proleg of the larva of *E. scholtzi*; 28 — anal proleg of the larva of *E. attica*; 29 — anal proleg of the larva of *E. glauca*.

Рис. 21–29. Детали строения личинок видов рода *Ephydra*: 21 — заднее дыхальце *E. flavipes*; 22 — ротоглоточный скелет *E. flavipes*, сбоку; 23 — ротоглоточный скелет *E. pseudomurina*, сбоку; 24 — ротоглоточный скелет *E. afghanica*, сбоку; 25 — ротоглоточный скелет *E. glauca*, сбоку; 26 — ложная ножка VIII брюшного сегмента личинки *E. pseudomurina*; 27 — ложная ножка VIII брюшного сегмента личинки *E. scholtzi*; 28 — ложная ножка VIII брюшного сегмента личинки *E. attica*; 29 — ложная ножка VIII брюшного сегмента личинки *E. glauca*.

- Dorsal pattern of spinules represents combination of bands and round spots 5
3. Each dorsal pattern consists of 10–16 fused bands. Ventral thoracal welt of larva is formed by 4 rows of acute and 3–4 rows of blunt triangular spines. Dorsal cornua of cephalopharyngeal skeleton without window. Epistomal sclerite as on Fig. 25 *E. glauca* Meigen
- Dorsal pattern consists of less bands 4
4. Dorsal pattern is formed by 8–10 fused bands. Hypostomal sclerite weakly sclerotized *E. flavipes* Macquart
- Bands of dorsal pattern are isolated. Hypostomal sclerite is moderately sclerotized. Epistomal sclerite as on Fig. 12 *E. riparia* Fallén
5. Dorsal pattern of spinules is moderately developed like combination of fused bands and round spots. Cup of puparium with double row of round spots. Epistomal sclerite is as on Fig. 24 *E. afghanica* Dahl
- Dorsal pattern of spinules is weakly developed and formed only by small central bands 6
6. Cup of puparium only with transverse rows of spinules. Pharyngeal sclerite with many windows. Epistomal sclerite roundish, blunt anteriorly, with short stem in caudal third *E. pseudomurina* Krivosheina
- Cup of puparium with many central spots. Pharyngeal sclerite with few windows. Epistomal sclerite with many openings *E. attica* Becker

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References

- Aldrich J.M. 1912. The biology of some western species of the dipterous genus *Ephydra* Fallén // J. N.Y. Ent. Soc. Vol.20. No.2. P.77–99.
- Beyer A. 1939. Morphologische, ökologische and physiologische Studien an der Larven der Fliegen: *Ephydra riparia* Fallén, *E. micans* Haliday und *Cania fumosa* Stenhammar // Kieler Meeresforschungen. Bd.3. S.265–320.
- Galdean N. 1976. Observations on Larvae and Pupae of the species *Ephydra californica* Pack. (Diptera, Ephydriidae) from Lacu-Sarat, Braila // Travaux du Muséum d'Histoire Naturelle. Grigore Antipa. T.17. P.115–124.
- Johannsen O.A. 1935. Aquatic Dptera. Part II. Orthorrhapha-Brachycera and Cyclorrhapha // Cornell University Agric. Exper. St. Memoir. No.177. P.1–62.
- Krivosheina M.G. 1983. [A new species of the fly genus *Ephydra* Fl. (Diptera, Ephydriidae) from Uzbekistan] // Entomol. Obozr. Vol.62. No.2. P.367–370 [in Russian, with English summary].
- Krivosheina M.G. 1986. To the biology of the shore flies in the anthropogenic landscapes of desert zone // Nauch. Dokl. Vyssh. Shkoly, Biol. Nauki. No.5. P.40–43 [in Russian, with English summary].
- Krivosheina M.G. 1993. Larvae of the ephydrid flies of the genera *Notiphila* Fl. and *Dichaeta* Mg. (Diptera, Ephydriidae) and their significance for understanding of the position of these genera in the system // Entomol. Obozr. Vol.72. No.1. P.222–231 [in Russian, with English summary].
- Nasr S., Abul A.L., Isa T. Kira & A.M. El-Tantawy. 1971. Biological studies on the rice fly *Ephydra macellaria* Egger. // Agric. Res. Review. Vol.49. No.1. P.23–29.
- Ping C. 1921. The biology of *Ephydra subopaca* Loew. // Cornell Univ. Agric. Exper. St. Memoir. No.49. P.557–616.
- Popova A. 1929. Zur Biologie von *Ephydra obscuripes* Beck. aus den Gewässern des Eltonsees // Russische Hydrobiologische Zeitschr. Bd.8. S.140–141.
- Trågårdh I. 1903. Beiträge zur Kenntnis der Dipterenlarven. 1. Zur Anatomie und Entwicklungsgeschichte der Larve von *Ephydra riparia* Fall. // Arkiv för Zoologi. Bd.1. H.1–2. S.1–42.
- Willcocks F.C. 1917. Miscellaneous insect notes, Metamorphose of *Ephydra macellaria* Egger. // Bull. Soc. Entomol. d' Egypte. Vol.9. P.100–105.
- Zavattari E. 1921. Biologia neritica mediterranea. III: Ricerche morfologiche ed etologiche sul dittero alofilo *Ephydra bivittata* Loew. // R. Comitato Talassografico Italiano. Memoria. T.83. P.1–58.
- Zernov S.A. 1949. [General Hydrobiology]. Moscow-Leningrad: Acad. Sci. USSR Publ. 587 p. [in Russian]