Chapter 13

The Turbellarian Fauna of the Romanian Littoral Waters of the Black Sea and Its Annexes

Valeria Mack-Fira
Faculty of Biology (Invertebrate Zoology),
University of Bucharest, Romania

Romania is situated at the crossroad of the faunal population exchange between the north and the south, the east and the west. Owing to its paleogeographical history and to its relief of different shapes harmoniously combined with the most various types of waters, under favorable climatic conditions, this country is a true natural reservation comprising a fauna of unexpected heterogeneous origin and age. In this area endemic populations meet northern and Siberian elements, Central European, Atlantic-Mediterranean, and Indo-Pacific species, the Ponto-Caspian and glacial relicts, and Palaearctic, Holarctic, and cosmopolitan species.

Such a mosaic structure of the Romanian fauna, demonstrated in many animal groups, may be noted also in turbellarians, which are inhabitants of the inland waters or of the various biotopes in the Black Sea and its littoral annexes (Table 1).

No comprehensive study on the Romanian seashore turbellarians of the

TABLE 1 – THE SYNOPSES OF THE STUDIED SPECIES

Nr	The species	The Black Sea			The Danube Delta: The pre-deltaic region: The North Bay		The "melea" St. George (L. Sahalin)		The lagoon-complex Razelm-Sinoë: The Northern System			The Southern System		The Littoral Lakes							Zoogeography	Distribution in Rumania
		Sand	Stone	Littoral basins	The brackish area	The freshwater area	The brackish area	The freshwater area	Razelmul Mare Lake (Dolosman)	Golovitza Lake	Portitza	Sinoe Lake	Tuzla-Duingi Lake	Siut-Ghiol Lake	Tasaul Lake	Agigea Lake	Mangalia Lake	Techirghiol Lake	Permanent swamps	Sources		
		14-17‰			9.9‰		3-34‰		7.5-45‰			17-70‰		–	15‰	13‰	12‰	80‰	–	–		
1	Oligochoerus sp.							•		•											Ponto-caspian relict	
2	Convoluta convoluta (Abildg. 1806)		•																		Atlantic-medit. immigrant	
3	Convoluta albomaculata (Per. 1892)		•																		endemic	
4	Mecynostomum auritum (Schultze 1851)																•				Atlantic-medit immigrant	
5	Mecynostomum arenarium Ax 1959		•																		Atlantic-medit immigrant	
6	Archaphanostoma agile (Jensen 1878)		•																		Atlantic-medit immigrant	
7	Stenostomum leucops (Ant Dugès 1828)					•		•	•	•	•	•		•	•						holarctic	in all inner freshwater basins
8	Stenostomum unicolor O. Schmidt 1848					•		•	•	•	•	•		•	•						palaearctic	in all inner freshwater basins
9	Catenula lemnae Ant Dugès 1832								•	•	•	•		•	•						cosmopolitan	Rumanian Plain, alpine Lakes
10	Macrostomum hystricinum Bekl 1951						•			•		•									European	
11	Macrostomum romanicum Mack-Fira 1968																	•			Mediterranean	
12	Macrostomum distinguendum Papi 1951					•		•													European	Transylvania and Danube swamps
13	Macrostomum clavistylum Bekl. 1951														•						Ponto-caspian relict	
14	Macrostomum rubrocinctum Ax 1951																•				Northern immigrant	
15	Macrostomum ventriflavum Per 1892		•																		endemic	
16	Macrostomum [illegible] Mack-Fira 1971		•																		endemic	
17	Microstomum lineare (Müller 1774)							•		•				•							palaearctic	in all inner freshwater basins
18	Plagiostomum ponticum Per 1892		•																		Atlantic-medit. immigrant	
19	Plagiostomum lemani (Plessis 1874)									•				•							European	
20	Pseudostomum klostermanni (v. Graff 1874)		•																		Atlantic-medit. immigrant	
21	Allostomum pallidum Beneden 1861		•	•																	Atlantic-medit. immigrant	
22	Allostomum catinosum (Bekl. 1927)		•																		Mediterranean	
23	Monocelis lineata (Müller 1774)		•	•													•				Atlantic-medit. immigrant	
24	Monocelis longiceps (Ant Dugès 1830)		•																		Atlantic-medit immigrant	
25	Archilina endostyla Ax 1959		•																		Atlantic-medit. immigrant	
26	Promonotus ponticus Ax 1959				•																endemic	
27	Promonotus sp.												•								Atlantic-medit immigrant	
28	Postbursoplana fibulata Ax 1955	•																			Atlantic-medit immigrant	
29	Coelogynopora sp.		•																		Atlantic-medit. immigrant	
30	Procerodes lobata (O. Schmidt 1862)		•																		Atlantic-medit. immigrant	
31	Bresslauilla relicta Reisinger 1929		•																		Atlantic-medit immigrant	Rumanian Plain
32	Pseudograffilla hymanae n. sp.		•																		Atlantic-medit immigrant	
33	Microdalyellia armigera (O. Schmidt 1861)																			•	palaearctic	Rumanian Plain and Carpathian Mt.
34	Microdalyellia fusca (Fuhrmann 1894)								•	•				•							palaearctic	
35	Microdalyellia brevimana (Bekl. 1921)					•															North Euro-Siberian immig.	Cătuşa swamps
36	Gieysztoria cuspidata (O. Schmidt 1861)								•	•				•							palaearctic	Danube swamps
37	Gieysztoria ornata maritima Luther 1955															•					Northern immigrant	
38	Gieysztoria macrovariata (Weise 1942)										•										Central-European	
39	Gieysztoria triquetra (Fuhrmann 1894)					•		•	•	•	•										Central-European	Danube swamps
40	Castrella truncata (Abildg. 1789)							•													palaearctic	in all inner freshwater basins
41	Typhloplana viridata (Abildg. 1789)							•						•							European	Transylvania and Romanian Plain
42	Strongylostoma radiatum (Müller 1774)							•													cosmopolitan	in all inner freshwater basins
43	Strongylostoma elong. spinosum Luther 1950									•											Northern immigrant	Danube swamps
44	Strongylostoma [illegible]tum Bekl 1922							•		•		•									Siberian immigrant	Danube swamps
45	Castrada viridis Volz 1898																		•		European	Transylvania
46	Papiella olophthalma (Plotnicov 1906)							•													Ponto-caspian relict	Danube and Rumanian Plain
47	Mesostoma lingua (Abildg. 1789)							•	•	•	•					•					cosmopolitan	in all inner freshwater basins
48	Bothromesostoma personatum (O. Schmidt 1848)																			•	holarctic	in all inner freshwater basins
49	Phaenocora unipunctata (Örsted 1843)																			•	cosmopolitan	Rumanian Plain and Carpathian Mt.
50	Phaenocora typhlops (Vejdovsky 1880)																		•		palaearctic	
51	Hartogia pontica Mack-Fira 1968		•																		Atlantic-medit immigrant	
52	Proxenetes angustus Ax 1951		•		•																Atlantic-medit immigrant	
53	Trigonostomum [illegible] (Per 1892)		•																		Atlantic-medit immigrant	
54	Trigonostomum venenosum (Ulj. 1870)		•																		Atlantic-medit immigrant	
55	Ptychopera plebeia (Bekl. 1927)		•														•				Atlantic-medit immigrant	
56	Promesostoma bilineatum (Per 1892)		•	•																	Atlantic-medit. immigrant	
57	Paramesostoma pachidermum (Per 1892)		•																		Atlantic-medit immigrant	
58	Polycystis naegeli Kölliker 1845		•																		Atlantic-medit. immigrant	
59	Gyratrix hermaphroditus Ehrenb. 1831		•			•		•	•	•	•			•							Atlantic-medit immigrant	ubicviste
60	Progyrator mamertinus (v. Graff 1874)		•																		Atlantic-medit immigrant	
61	Phonorhynchus pernix Ax 1959												•								Atlantic-medit immigrant	
62	Phonorhynchoides flagellatus Bekl. 1927									•											Ponto-caspian relict	
63	Utelga heinckei Attems 1897		•																		Atlantic-medit immigrant	
64	Itaipusa karlingi Mack-Fira 1968		•																		Atlantic-medit. immigrant	
65	Utsurus camarguensis Brunet 1965		•																		Atlantic-medit. immigrant	
66	Pontaralia beklemischevi Mack-Fira 1968									•											Ponto-caspian relict	
67	Pontaralia relicta (Bekl. 1927)									•											Ponto-caspian relict	
68	Tarkarlingia euxinica Mack-Fira 1971		•																		Atlantic-medit. immigrant	
69	Schizorhynchus tataricus v. Graff 1905				•																endemic	
70	Cheliplana evcinos Ax 1959		•																		endemic	

Pontic basin was made before our investigations (1968–1970). They were known only from the classic writings of Uljanin (1870), Pereyaslawzewa (1892), Graff (1904, 1905, 1911), Jacubova (1909), Beklemischev (1927) concerning the U.S.S.R. Black Sea coast, Valkanov (1936, 1954, 1957) for the Bulgarian shore, and Ax's work on the pre-Bosporus area (1959).

The present paper is a synthesis of my observations on marine Turbellaria and those living in freshwater and brackish coastal lakes, which were originally stream mouths or Black Sea lagoons. I am obliged to include annexes as well as the predeltaic area, for the zoogeographical origin of the Pontic turbellarian fauna to be understandable, since they shelter many relicts surviving the periods of unrest and faunal calamities which represent the early history of the eastern region of the ancient Pliocene brackish sea.

The following is a summary report on the basins and biotopes where the material was collected, the listing of the species studied, and ecological and zoogeographical considerations.

LIST OF SPECIES

1. *Convoluta convoluta* (Abildgaard, 1806)

OCCURRENCE. The Black Sea, stony bottom, 0.5 m depth, algae: Agigea, Costineşti, Vama Veche. Numerous specimens.

GEOGRAPHICAL DISTRIBUTION. The Barents, the Baltic, and the North Seas, the European coast of the Atlantic, the Mediterranean, the Marmara Sea, Bosporus, the Black Sea (the Anatolian coast, Sevastopol, Yalta, Suhumi).

2. *Convoluta albomaculata* (Pereyaslawzewa, 1892)

OCCURRENCE. The same as *C. convoluta*. A few specimens.

GEOGRAPHICAL DISTRIBUTION. The Black Sea (Sevastopol).

3. *Archaphanostoma agile* (Jensen, 1878)

OCCURRENCE. The Black Sea: Agigea, stony bottom, 2.5 m depth, in sand, 20 August, 1970. A few specimens.

GEOGRAPHICAL DISTRIBUTION. The Baltic–North Sea canal, the North Sea, the Adriatic Sea.

4. *Mecynostomum auritum* (O. Schultze, 1851) (Fig. 1)

OCCURRENCE. Mangalia Lake (village Limanu), 12‰ salinity, 0.5 m depth, 17 October, 1968. One specimen.

GEOGRAPHICAL DISTRIBUTION. Finnish Gulf, the Baltic, the North Sea, the Baltic–North Sea canal, the Marmara Sea.

5. *Mecynostomum arenarium* Ax, 1959

OCCURRENCE. The Black Sea: Agigea, stony bottom, in sand, 0.5 to 3 m depth. A few specimens.

GEOGRAPHICAL DISTRIBUTION. The Marmara Sea, the Black Sea (Anatolian coast).

Figure 1 *Mecynostomum auritum* (O. Schultze, 1851), general organization (from life).

6. *Oligochoerus* sp.

OCCURRENCE. The lagoon complex Razelm-Sinoë: Golovitza Lake, among *Enteromorpha*, one specimen; the predeltaic region: in the freshwater area of the "melea" of Sahalin, a few specimens.

7. *Stenostomum leucops* (Ant. Dugès, 1828)

OCCURRENCE. The lagoon complex Razelm-Sinoë: Razelmul Mare (Doloşman), Golovitza, Portitza, among plants in a swamp near the fisheries station, the Sinoë Lake (Grindul Lupilor); Taşaul Lake, in sand; Siut-Ghiol; in the freshwater area of the Northern Bay–Sulina arm (predeltaic region), 0.20 m depth. Numerous specimens.

GEOGRAPHICAL DISTRIBUTION. Europe, Asia, North America

IN ROMANIA. In all inner freshwaters.

8. *Stenostomum unicolor* O. Schmidt, 1848

OCCURRENCE. The same as for *S. leucops*.
GEOGRAPHICAL DISTRIBUTION. Europe and Asia.
IN ROMANIA. In all inner freshwater basins.

9. *Catenula lemnae* Ant. Dugès, 1832
OCCURRENCE. The lagoon complex Razelm-Sinoë. The same stations as for *S. leucops*. Numerous specimens.
GEOGRAPHICAL DISTRIBUTION. Europe, Asia, North America, Brazil.
IN ROMANIA. The Danube (the delta and the flooded area), the Romanian Plain, the alpine lakes (the Retezat Mountains–southern Carpathians).

10. *Macrostomum hystricinum* Beklemischev, 1951
OCCURRENCE. The lagoon complex Razelm-Sinoë: Golovitza, the end of Sinoë Lake; the predeltaic sector: Ciotic-Zaton, the south of Sahalin Island, 3 to 3.4‰ salinity. Numerous specimens.
GEOGRAPHICAL DISTRIBUTION. The brackish basins of the North Atlantic and of the North Sea, the Baltic–North Sea canal (Kiel Bay), the Finnish Gulf, the brackish basins of the Mediterranean (Pisa, the Canet marsh), the Black Sea (Sile, in front of a freshwater flow), the Caspian Sea, and the Aral Lake.

11. *Macrostomum romanicum* Mack-Fira, 1968
OCCURRENCE. Tekirghiol Lake, among *Cladophora*, 0.5 m depth, 80 to 100 ‰ salinity. Very numerous.
GEOGRAPHICAL DISTRIBUTION. La Camargue (Mediterranean basin).
IN ROMANIA. Lake Sărat-Brăila (Romanian Plain), 100 to 200‰ salinity (Mack-Fira, 1968).

12. *Macrostomum distinguendum* Papi, 1951
OCCURRENCE. Predeltaic sector: the Northern Bay and the "melea" of Sahalin (St. George arm), in freshwater areas. Among plants.
GEOGRAPHICAL DISTRIBUTION. Finland, the U.S.S.R., Poland, Italy, Austria.
IN ROMANIA. Danube swamps (the delta and the flooded zone), Transylvania (Mack-Fira, 1968).

13. *Macrostomum clavistylum* Beklemischev, 1951
OCCURRENCE. Taşaul Lake, in sand, 30 September, 1970. Prevailing.
GEOGRAPHICAL DISTRIBUTION. Ai-Dai Lake (U.S.S.R.).

14. *Macrostomum rubrocinctum* Ax, 1951
OCCURRENCE. Mangalia Lake (village Limanu), 0.5 m depth, among plants, 12‰ salinity, 17 October, 1968. Numerous specimens.
GEOGRAPHICAL DISTRIBUTION. Kiel Bay, Skagerrak.

15. *Macrostomum ventriflavum* Pereyaslawzewa, 1892
OCCURRENCE. The Black Sea: Costineşti, in the sand of the stone zone, 21 September, 1969; Agigea, sand, stone, 1 m depth. 18 August, 1970; Cape Midia, stone, in sand, 1 m depth. 5 December, 1970. Five specimens.

GEOGRAPHICAL DISTRIBUTION. Black Sea (Sevastopol).

16. *Macrostomum peteraxi* Mack-Fira, 1971
OCCURRENCE. The Black Sea, in the sand of the stone zone: Agigea, 2.5 m depth; Costineşti, 0.5 m depth; Vama Veche, 1 m depth. Few specimens.

17. *Microstomum lineare* (Müller, 1774)
OCCURRENCE. Lagoon complex Razelm-Sinoë: Golovitza Lake; predeltaic sector: Sahalin Island, freshwater area. Numerous specimens.
GEOGRAPHICAL DISTRIBUTION. Widespread in Eurasia.
IN ROMANIA. In all inner freshwaters.

18. *Plagiostomum ponticum* Pereyaslawzewa, 1892
OCCURRENCE. The Black Sea, stone zone: Agigea, Costineşti, Vama Veche, 1 m depth; Mamaia, among *Enteromorpha* and *Cystoseira*, 3.5 and 5.5 m depth. Numerous specimens.
GEOGRAPHICAL DISTRIBUTION. The Adriatic Sea, the brackish basins of the French coast of the Mediterranean Sea, the Black Sea (Sevastopol).

19. *Plagiostomum lemani* (Plessis, 1874)
OCCURRENCE. Lagoon complex Razelm-Sinoë: Golovitza Lake, 1 to 2‰ salinity; Siut-Ghiol Lake, among plants, September 1965, 1967, 1969. Numerous specimens.
GEOGRAPHICAL DISTRIBUTION. England, Finland, Denmark, Baltic countries, U.S.S.R. (the Caspian Sea), Germany, France, Italy, Switzerland.

20. *Pseudostomum klostermanni* (von Graff, 1874)
OCCURRENCE. The Black Sea: Costineşti, the "littoral basins," among *Cladophora*, 0.2 to 0.3 m depth; Agigea, Costineşti, and Vama Veche, stone zone, among algae, 1 m depth. Numerous specimens.
GEOGRAPHICAL DISTRIBUTION. The North Atlantic, the North Sea, the English Channel, the Mediterranean, the Adriatic Sea, the Black Sea (Sevastopol).

21. *Allostomum pallidum* Beneden, 1861
OCCURRENCE. The Black Sea: Costineşti, the "littoral basins," among *Cladophora*, 0.2 to 0.3 m depth; Agigea, Costineşti, Vama Veche, stone zone, among algae, 1 m depth. Numerous specimens.
GEOGRAPHICAL DISTRIBUTION. The North Sea, the Adriatic Sea.

22. *Allostomum catinosum* (Beklemischev, 1927)
OCCURRENCE. The Black Sea: Agigea, the stone zone, among algae, 0.5 m depth. Rare.
GEOGRAPHICAL DISTRIBUTION. The French Mediterranean marshes (Salses) and the Black Sea (Odessa).

23. *Monocelis lineata* (O. F. Müller, 1774)
OCCURRENCE. The Black Sea, stone zone: Agigea, sand, 0.5 to 3 m depth; Costineşti, the "littoral basins," 0.2 to 0.3 m depth; Constantza, among *Enteromorpha*; Vama Veche, in the sand of the stone zone; Cape

Midia, 5 December, 1970, in sand, 1 m depth. Very numerous. Mangalia Lake (village Limanu), in sand, 12‰ salinity. Many specimens.

GEOGRAPHICAL DISTRIBUTION. Greenland, the White Sea, the North Atlantic, North Sea, the Baltic, the English Channel, the Mediterranean, the Adriatic Sea, the Marmara Sea, the Bosporus, the Black Sea (Odessa, Sevastopol, Suhumi, Yalta, the Anatolian coast).

24. *Monocelis longiceps* (Ant. Dugès, 1830) (Fig. 2)

OCCURRENCE. The Black Sea: Cape Midia (5 December, 1970), Agigea, Costineşti, Vama Veche, in the sand of the stone zone, 0.5 to 3 m depth. Abundant.

GEOGRAPHICAL DISTRIBUTION. The North Atlantic, the North Sea, the Mediterranean, the Adriatic Sea, the Black Sea (Sevastopol, Suhumi).

25. *Archilina endostyla* Ax, 1959

OCCURRENCE. The Black Sea: Agigea, Costineşti, Vama Veche, in the sand of the stone zone, 0.5 to 1 m depth, very numerous; in the "littoral basins" (Costineşti).

GEOGRAPHICAL DISTRIBUTION. The Mediterranean Sea (Banyuls-sur-mer), the Marmara Sea, the Bosporus, the Black Sea (Anatolian coast).

26. *Promonotus ponticus* Ax, 1959

OCCURRENCE. The predeltaic region: the Northern Bay, 3 and 5 m depth, and in the Danube (fog signal), 1 km away from the river mouth. Ten specimens.

GEOGRAPHICAL DISTRIBUTION. The Black Sea (Anatolian coast), the Bosporus, and the Marmara Sea.

27. *Promonotus* sp.

OCCURRENCE. The lagoon complex Razelm-Sinoë: Tuzla-Duingi Lakes. Five specimens.

28. *Postbursoplana fibulata* Ax, 1955 (Figs. 3, 4)

OCCURRENCE. The Black Sea: Agigea, sand zone, "the *Otoplana* zone," November 1968. Two specimens.

GEOGRAPHICAL DISTRIBUTION. The Mediterranean Sea (Banyuls-sur-mer).

29. *Coelogynopora* sp. (Fig. 5)

OCCURRENCE. The Black Sea: Agigea, stone zone, in sand, 2 m depth, 31 July, 1969. One immature specimen.

30. *Procerodes lobata* (O. Schmidt, 1862)

OCCURRENCE. The Black Sea, stone zone: Agigea, Constantza, Vama Veche, 0.5 m depth, among *Enteromorpha* and in the phreatic layer close to the shore (1 August, 1970). Very numerous.

GEOGRAPHICAL DISTRIBUTION. The English Channel (Plymouth), the Meterranean, the Black Sea (Sevastopol, Yalta, Suhumi).

31. *Bresslauilla relicta* Reisinger, 1929

OCCURRENCE. The Black Sea: Agigea, in phytal, 1 m depth, August 1970. Two specimens.

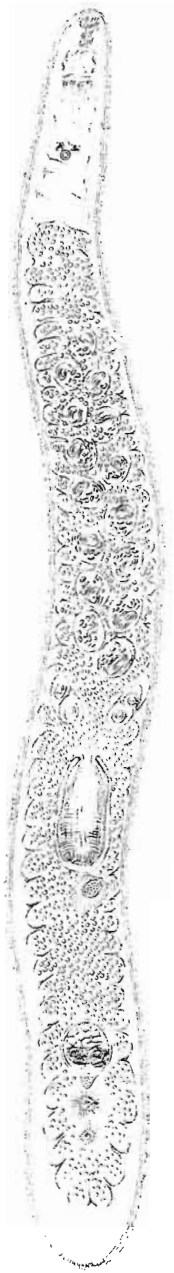

Figure 2 *Monocelis longiceps* (Ant. Dugès, 1830), general organization.

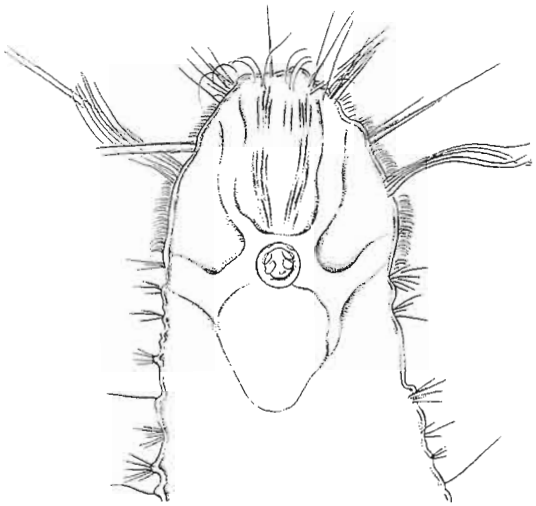

Figure 3 *Postbursoplana fibulata Ax*, 1955, cephalic region (from life).

GEOGRAPHICAL DISTRIBUTION. Finnish Bay, the Baltic Sea, Kiel Bay, Germany, Switzerland, Austria, Italy, France, the Anatolian coast of the Black Sea.

IN ROMANIA. In the sources and the stagnant basins of the Romanian Plain (Mack-Fira, 1970).

32. *Pseudograffilla hymanae* sp. n. (Fig. 6)

OCCURRENCE. Black Sea, stone zone, in sand at the algae base, 2 to 3 m depth, 20 August, 1970, in great numbers.

MATERIAL. Studies on living specimens, six series of sections, several specimens in alcohol. Holotype (one slide, sagittal sections) and two paratypes in the Swedish Museum of Natural History, Section for Invertebrate Zoology, Stockholm; three paratypes in the Faculty of Biology, University of Bucharest, Romania.

DIAGNOSIS. Length of living animals 1 to 1.25 mm. Clumsy little transparent body. Brick-red-yellowish pigment within the parenchyma. Frontal border with a few tactile hairs. Black eyes, with two or three retinal cells, equally spaced to each other and to the body sides. Subterminal mouth. Pharynx about one-third to one-quarter of the animal length. Slightly lobated intestine. Lobated testes in the second body quarter. Largely developed prostatic glands, with cyanophile and erythrophile secretion. Egg-shaped male copulatory organ, with strong muscular walls. Deferent ducts joining within the copulatory bulb. Ductus ejaculatorius very long and winding, with strong muscular walls, crossing the copulatory organ from one end to the other. Copulatory bulb having no male atrium prominence. Large ovary on the right side, with a much-developed germinative portion. Vitellogens dorsally and ventrally extended on the hind-half sides of the animal, surrounding the intestine. The elongated uterus, flattened in the animal's front plane and connected by a short genito-intestinal duct with the intestine, and by an orifice closed by a strong sphincter with a vesicula resorbiens having lacunose walls. The genital atrium, without a diverticulum playing the role of a bursa copulatrix, is followed by a long muscular duct leading to the uterus, from which it is separated by a small sphincter. The genital orifice lies in the middle of the ventral side of the animal.

DISCUSSION. *Pseudograffilla hymanae* sp. n. is very close to *P. arenicola* Meixner, 1938, from which it differs in the form and length of the ductus ejaculatorius, the form of the uterus, and the lack of a distinctive bursa copulatrix as an annex of the atrium.

33. *Microdalyellia armigera* (O. Schmidt, 1861)

OCCURRENCE. The freshwater sources of the Mangalia Lake. 17 October, 1968. Few specimens.

GEOGRAPHICAL DISTRIBUTION. Widespread in Europe.

IN ROMANIA. In the sources and rivulets of the Bucegi Mountains, in glacial

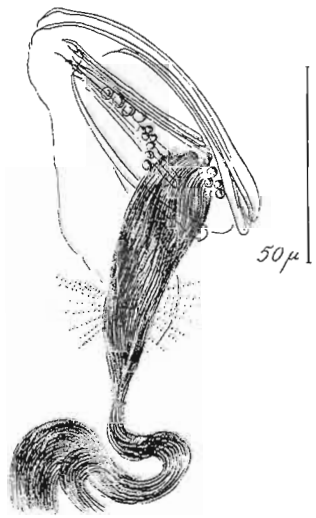

Figure 4 *Postbursoplana fibulata Ax*, 1955, male copulatory organ (from life).

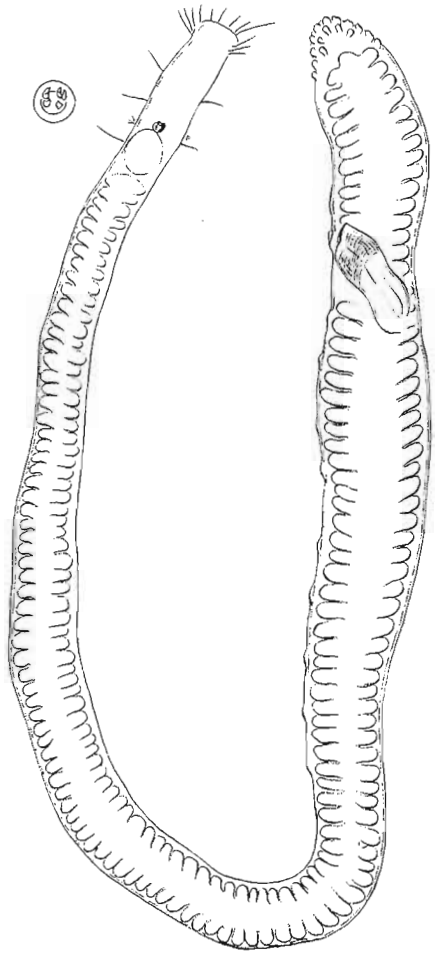

Figure 5 *Coelogynopora* sp., the organization of an immature animal (from life).

lakes (the Retezat Mountains–southern Carpathians), in the sources of the Romanian Plain (Mack-Fira, 1967).

34. *Microdalyellia fusca* (Fuhrmann, 1894)

OCCURRENCE. Lagoon complex Razelm-Sinoë: Golovitza Lake (among *Enteromorpha*), Dolosman; Siut-Ghiol Lake, among plants.

GEOGRAPHICAL DISTRIBUTION. Europe and Asia.

IN ROMANIA. In the sources of the Romanian Plain and Carpathian Mountains (Mack-Fira, 1967).

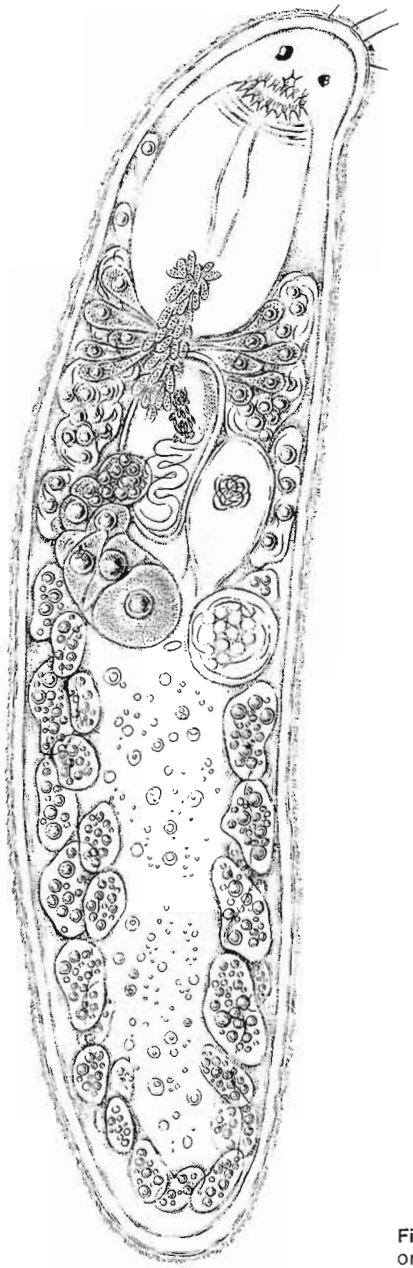

Figure 6 *Pseudograffilla hymanae* sp. n., general organization (from life).

35. *Microdalyellia brevimana* (Beklemischev, 1921)

OCCURRENCE. The predeltaic region: the Northern Bay, the freshwater area, 10 cm depth, among plants, alluvial bottom. 12 August, 1970. Numerous specimens.

GEOGRAPHICAL DISTRIBUTION. Sweden, Finland, Germany (Kurmark), Poland, Italian Alps, northern U.S.S.R., Siberia.

IN ROMANIA. Cătuşa swamp (the Siret River meadow).

36. *Gieysztoria cuspidata* (O. Schmidt, 1861)

OCCURRENCE. Lagoon complex Razelm-Sinoë: Golovitza, Doloşman, among plants, numerous; Siut-Ghiol Lake, among plants. Very numerous.

GEOGRAPHICAL DISTRIBUTION. Widespread in Eurasia.

IN ROMANIA. In the Danube swamps (Mack-Fira, 1967, 1968).

37. *Gieysztoria ornata maritima* Luther, 1955

OCCURRENCE. The Agigea Lake, among plants, 0.5 to 1 m depth, salinity 1.3‰ Very numerous.

GEOGRAPHICAL DISTRIBUTION. Finnish Bay.

38. *Gieysztoria macrovariata* (Weise, 1942)

OCCURRENCE. Lagoon complex Razelm-Sinoë: Portitza, swamp with a rich vegetation, 4 August, 1970. Few specimens.

GEOGRAPHICAL DISTRIBUTION. Italy, Germany.

39. *Gieysztoria triquetra* (Fuhrmann, 1894)

OCCURRENCE. Predeltaic region: the freshwater area of the "melea" of the Sahalin Island and the Northern Bay, 10 to 30 cm depth, among plants; the lagoon complex Razelm-Sinoë: Golovitza, Doloşman. Portitza, (Mack-Fira, 1970). Very numerous.

GEOGRAPHICAL DISTRIBUTION. Germany, Switzerland, Italy, Yugoslavia.

IN ROMANIA. In the Danube swamps (Mack-Fira, 1967, 1968).

40. *Castrella truncata* (Abildgaard, 1789)

OCCURRENCE. The predeltaic region: Sahalin Island, the freshwater area of the "melea." A few specimens.

GEOGRAPHICAL DISTRIBUTION. Greenland, Faeroes, Europe, Siberia.

IN ROMANIA. In the Danube swamps (delta and the flooded zone), the stagnant waters from Transylvania and the Romanian Plain (Paradi, 1882; Mack-Fira, 1967, 1968).

41. *Typhloplana viridata* (Abildgaard, 1789)

OCCURRENCE. The predeltaic region: Sahalin Island, the freshwater area of the "melea," among *Salvinia natans*. A few specimens.

GEOGRAPHICAL DISTRIBUTION. Greenland, Europe, Asia, Africa, North America.

IN ROMANIA. The delta and the flooded zone of the Danube; the stagnant freshwater of the Romanian Plain and Transylvania (Paradi, 1882; Mack-Fira, 1967, 1968, 1970).

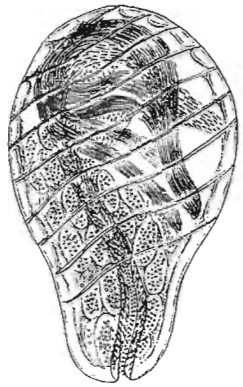

Figure 7 *Strongylostoma cirratum* Beklemischev, 1922, male copulatory organ (from life).

42. *Strongylostoma radiatum* (O. F. Müller, 1774)

OCCURRENCE. The predeltaic region: freshwater area of the "melea" Sahalin. Numerous specimens.

GEOGRAPHICAL DISTRIBUTION. Europe, Asia, South America.

IN ROMANIA. The delta and the flooded zone of the Danube; the stagnant freshwater basins of the Romanian Plain; the Cătuşa swamp (Mack-Fira, 1970).

43. *Strongylostoma elongatum spinosum* Luther, 1950

OCCURRENCE. The lagoon complex Razelm-Sinoë: Golovitza Lake. Numerous specimens.

GEOGRAPHICAL DISTRIBUTION. The Finnish Bay.

IN ROMANIA. The flooded zone of the Danube (Mack-Fira, 1968, 1970).

44. *Strongylostoma cirratum* Beklemischev, 1922 (Figs. 7, 8)

OCCURRENCE. The lagoon complex Razelm-Sinoë: Golovitza and Sinoë (Grindul Lupilor) Lakes; predeltaic region: freshwater area of "melea" Sahalin. Among plants. Numerous specimens.

GEOGRAPHICAL DISTRIBUTION. Northern Siberia (Tomsk).

IN ROMANIA. In the Danube swamps (Mack-Fira, 1968, 1970).

45. *Castrada viridis* Voltz, 1898

OCCURRENCE. Mangalia Lake, in the swamp at the lake end, 0.98‰ salinity. 17 October, 1968. Four specimens.

GEOGRAPHICAL DISTRIBUTION. Iceland, Faeroes, Europe.

IN ROMANIA. In the stagnant freshwaters of the Romanian Plain and Transylvania.

46. *Papiella otophthalma* (Plotnicov, 1906)

OCCURRENCE. The predeltaic region: the freshwater area of the "melea" Sahalin. Abundant.

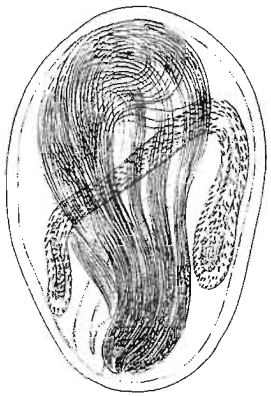

Figure 8 *Strongylostoma cirratum* Beklemischev, 1922, male copulatory organ (from life).

GEOGRAPHICAL DISTRIBUTION. U.S.S.R. (Bologovsk and the Volga steppe).

IN ROMANIA. In the Danube swamps (delta and the flooded zone), Snagov and Herăstrău Lakes (Romanian Plain) (Mack-Fira, 1968, 1970).

47. *Mesostoma lingua* (Abildgaard, 1789) (Figs. 9, 10)

OCCURRENCE. The predeltaic region: in the freshwater sector of the Sahalin Island "melea," among plants, very numerous; the lagoon complex Razelm-Sinoë: Golovitza Lake, Doloşman, Portitza; Agigea Lake, 1.3‰ salinity.

GEOGRAPHICAL DISTRIBUTION. Western Greenland, Europe, Asia, Africa.

IN ROMANIA. Common in all the stagnant freshwaters and in the Danube swamps (Mack-Fira, 1968, 1970).

48. *Bothromesostoma personatum* (O. Schmidt, 1848)

OCCURRENCE. Mangalia Lake: among green and filamentous algae of a freshwater source, 17 October, 1968. Numerous specimens.

GEOGRAPHICAL DISTRIBUTION. Greenland, Iceland, Europe, Asia, North America.

IN ROMANIA. Common in the stagnant freshwater basins and in the Danube swamps (Mack-Fira, 1970).

49. *Phaenocora unipunctata* (Örsted, 1843)

OCCURRENCE. Mangalia Lake: in a holocrene freshwater source without vegetation, 17 October, 1968. Numerous specimens.

GEOGRAPHICAL DISTRIBUTION. Europe, Asia.

IN ROMANIA. In the Carpathian sources and the stagnant freshwater basins of the Romanian Plain (Mack-Fira, 1970).

50. *Phaenocora typhlops* (Vejdovsky, 1880)

OCCURRENCE. Costineşti: in a large permanent swamp with vegetation, close to the beach, 17 June, 1966. Very abundant.

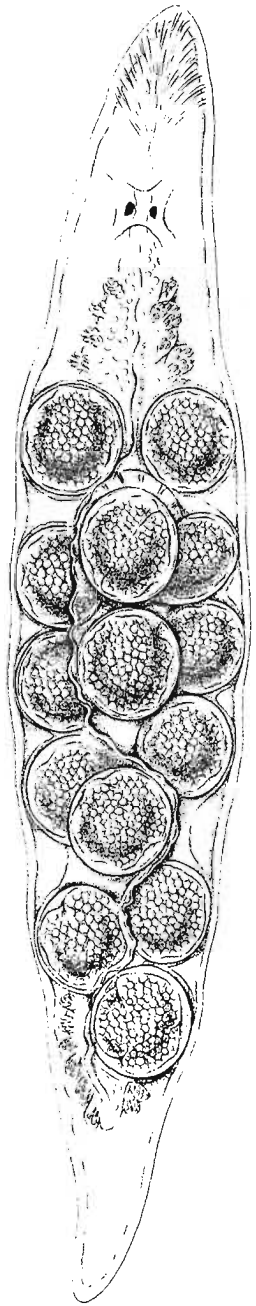

Figure 9 *Mesostoma lingua* (Abildgaard, 1789), specimen with thick-shelled (dormant) eggs, dorsal view (from life).

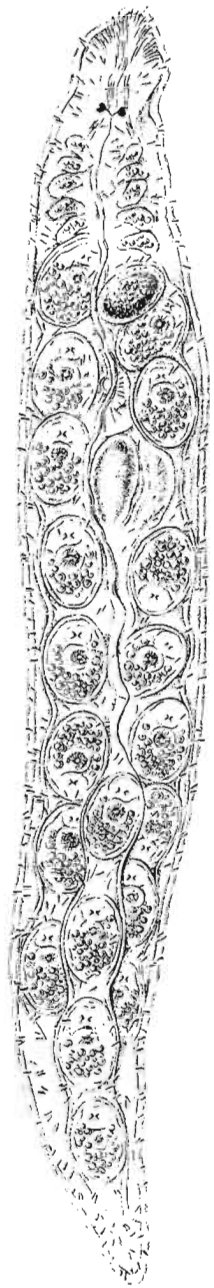

Figure 10 *Mesostoma lingua* (Abildgaard, 1789), specimen with thin-shelled (subitaneous) eggs, dorsal view (from life).

GEOGRAPHICAL DISTRIBUTION. Europe, Asia.

IN ROMANIA. Known in the surroundings of Sibiu (Paradi, 1881).

51. *Hartogia pontica* Mack-Fira, 1968

OCCURRENCE. The Black Sea, the stone zone: Agigea, 2.5 m depth, two specimens; Costineşti, 0.5 m depth, 21 September, 1969, one specimen.

52. *Proxenetes angustus* Ax, 1951 (Fig. 11)

OCCURRENCE. The predeltaic region: the Northern Bay (Sulina arm), 3 m and 5 m depth; Agigea (the Black Sea shore), stone, 1 m depth, in a little quiet bay, 16 August, 1970. Numerous specimens.

GEOGRAPHICAL DISTRIBUTION. The North Sea, the marshes of the French Mediterranean Sea, the Marmara Sea, the Black Sea (Sile).

53. *Trigonostomum mirabile* (Pereyaslawzewa, 1892)

OCCURRENCE. The Black Sea, stony bottom: Mamaia, among *Cystoseira*, 5 m depth; Agigea, 3 m. Rare. Cape Midia, among algae, 1 m depth, 5 December, 1970. Numerous specimens.

GEOGRAPHICAL DISTRIBUTION. The Black Sea (Sevastopol, Odessa, Sile) and Marmara Sea.

54. *Trigonostomum venenosum* (Uljanin, 1870)

OCCURRENCE. The Black Sea, stony bottom: Vama Veche, among *Cystoseira*, 1 m depth. Numerous specimens.

GEOGRAPHICAL DISTRIBUTION. The North Atlantic, the North Sea, the Mediterranean Sea, the Marmara Sea, the Black Sea (Sevastopol, Sile), Bosporus.

55. *Ptychopera plebeia* (Beklemischev, 1927) (Fig. 12).

OCCURRENCE. Mangalia Lake, 12‰ salinity, among algae and sand, few specimens. The Black Sea, stony bottom: Cape Midia, 1 m depth, among algae, 5 December, 1970. Numerous specimens.

GEOGRAPHICAL DISTRIBUTION. The marshes of the French Mediterranean (Salses and Canet), the Marmara Sea, the Black Sea.

56. *Promesostoma bilineatum* (Pereyaslawzewa, 1892)

OCCURRENCE. The Black Sea, stony bottom: Agigea, 1 m depth; Constantza, among *Enteromorpha*, 1 m depth; Costineşti, the "littoral basins." Numerous specimens.

GEOGRAPHICAL DISTRIBUTION. Kiel Bay, the English Channel, the Black Sea (Sevastopol, Odessa).

57. *Paramesostoma pachidermum* (Pereyaslawzewa, 1892) (Fig. 13)

OCCURRENCE. The Black Sea, the stone zone: Vama Veche and Agigea, among *Cystoseira*; Constantza, among *Enteromorpha*. Few specimens.

GEOGRAPHICAL DISTRIBUTION. The Marmara Sea, the Bosporus, the Black Sea (Sevastopol).

58. *Polycystis naegeli* Kölliker, 1845

OCCURRENCE. The Black Sea, the stone zone, among algae: Agigea and

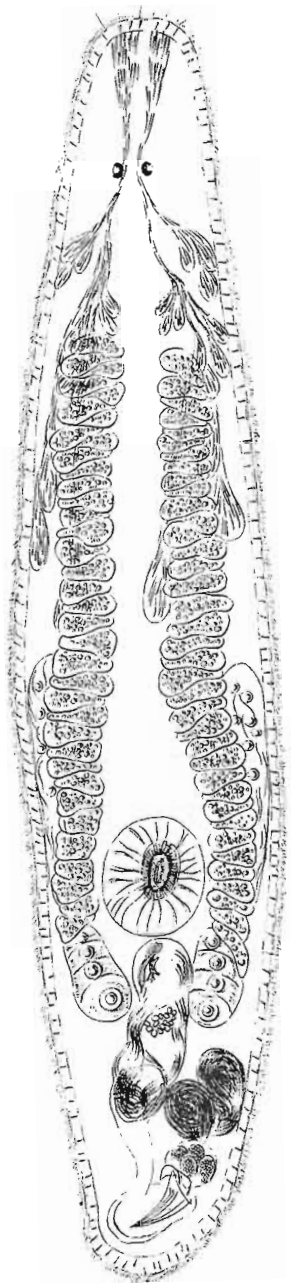

Figure 11 *Proxenetes angustus Ax*, 1951, general organization (from life).

Mamaia, among *Cystoseira* and *Enteromorpha*, 0.5 to 5.5 m depth; Costineşti, Vama Veche, 1 m depth, among algae. Very numerous.

GEOGRAPHICAL DISTRIBUTION. North Atlantic, the North Sea, the Baltic Sea, the English Channel, the Mediterranean, the Black Sea (Sevastopol, Yalta, Suhumi, the Anatolian coast).

59. *Gyratrix hermaphroditus* Ehrenberg, 1831

OCCURRENCE. The Black Sea, stony bottom, Agigea, 0.5 to 1 m depth; the lagoon complex Razelm-Sinoë: Golovitza, Doloşman, Portitza; Siut-Ghiol Lake, among plants; Mangalia Lake: freshwater source without vegetation, 17 October, 1968; predeltaic region: the Sulina and St. George arms, in the freshwater portion of the "melea."

GEOGRAPHICAL DISTRIBUTION. Ubiquitous.

Figure 11 *Proxenetes angustus* Ax (1951), general organization (from life).

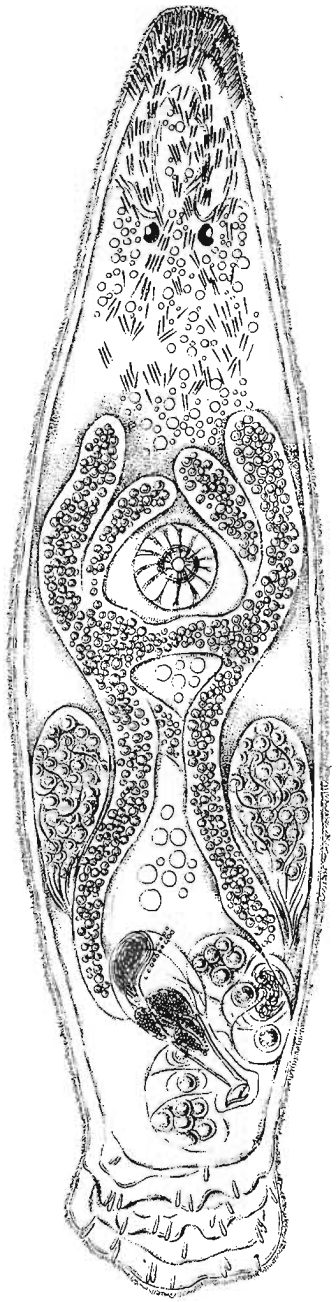

Figure 13 *Paramesostoma pachidermum* (Pereyaslawzewa, 1892), general organization, dorsal view (from life).

IN ROMANIA. In all inner basins except the supersalines.

60. *Progyrator mamertinus* (Graff, 1870)

OCCURRENCE. The Black Sea, stony bottom, Vama Veche, among *Cystoseira* and *Enteromorpha*, 1 m depth. Two specimens.

GEOGRAPHICAL DISTRIBUTION. The North Atlantic, the English Channel, the Mediterranean, the Black Sea (Odessa, the Anatolian coast), the Marmara Sea.

61. *Phonorhynchus pernix* Ax, 1959 (Fig. 14)

OCCURRENCE. The lagoon complex Razelm-Sinoë: Tuzla-Duingi, 4 August, 1970. Three specimens.

GEOGRAPHICAL DISTRIBUTION. The Marmara Sea.

62. *Phonorhynchoides flagellatus* Beklemischev, 1927 (Fig. 15)

OCCURRENCE. Lagoon complex Razelm-Sinoë: Golovitza Lake, 1 to 2‰ salinity.

GEOGRAPHICAL DISTRIBUTION. The Aral Lake.

63. *Utelga heinckei* (Attems, 1897) (Figs. 16, 17)

OCCURRENCE. The Black Sea, stony bottom, Agigea, 2 to 3 m depth, in the sand among algae, August, 1970. Eight specimens.

GEOGRAPHICAL DISTRIBUTION. The North Sea (Helgoland, Blyth), Skagerrak (Kristineberg), the North Atlantic coast of Ireland, the Mediterranean Sea (Marseille).

64. *Itaipusa karlingi* Mack-Fira, 1968

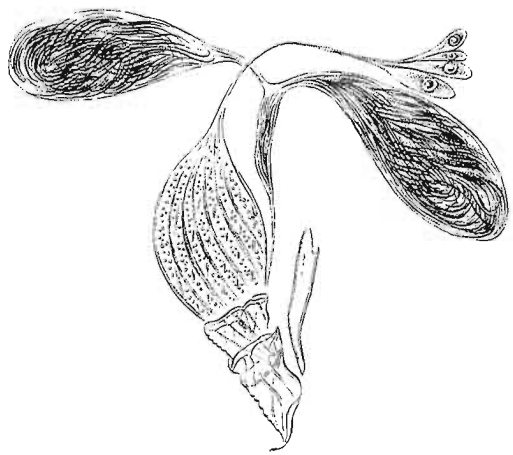

Figure 14 *Phonorhynchus pernix* Ax, 1959, male copulatory organ (from life).

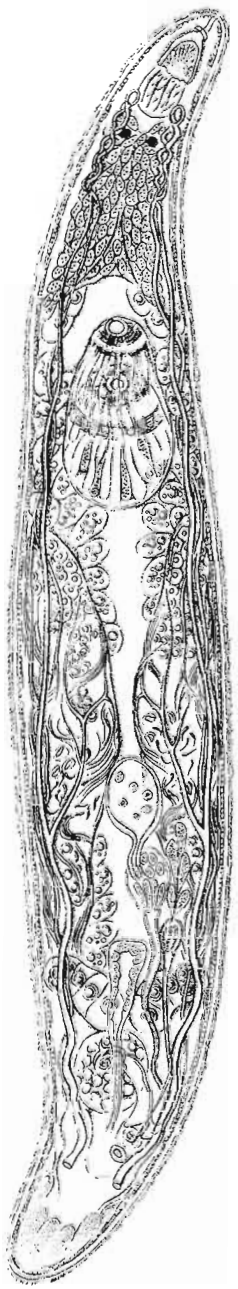

Figure 15 *Phonorhynchoides flagellatus* Beklemischev, 1927, general organization (from life).

OCCURRENCE. Black Sea shore, stone, in the sand under the algae: Agigea, Costineşti, Vama Veche, 0.5 to 3 m depth. Numerous.

GEOGRAPHICAL DISTRIBUTION. The Mediterranean Sea (Marseille, M. Brunet, *in litt.*).

65. *Utsurus camarguensis* Brunet, 1965 (Figs. 18, 19)

OCCURRENCE. The Black Sea shore, stony bottom: Agigea, 1 to 2 m depth, August 1970, in the sand under the algae. Few specimens.

GEOGRAPHICAL DISTRIBUTION. The Mediterranean (Marseille).

66. *Pontaralia beklemichevi* Mack-Fira, 1968

OCCURRENCE. The lagoon complex Razelm-Sinoë: Golovitza, 1 to 2‰ salinity, among algae, 31 July and 20 September, 1969. In great numbers.

IN ROMANIA. The Snagov Lake (Romanian Plain), among plants.

67. *Pontaralia relicta* (Beklemischev, 1927)

OCCURRENCE. The lagoon complex Razelm-Sinoë: Golovitza, 1 to 2‰ salinity, 31 July, 1969, among algae. One specimen.

GEOGRAPHICAL DISTRIBUTION. The Aral Lake, the Caspian Sea.

68. *Torkarlingia euxinica* Mack-Fira, 1971

OCCURRENCE. The Black Sea shore, stone: Costineşti, 0.5 m depth; Agigea, 1 to 3 m depth. Numerous specimens.

69. *Schizorhynchus tataricus* Graff, 1905

OCCURRENCE. The predeltaic region: Sulina arm, the Northern Bay, 5 m depth. One specimen.

GEOGRAPHICAL DISTRIBUTION. The Black Sea (Sevastopol).

70. *Cheliplana euxeinos* Ax, 1959

OCCURRENCE. The Black Sea shore, stone zone: Agigea, in the sand, under the *Cystoseira*, 3 m depth, 19 October, 1968. One specimen.

GEOGRAPHICAL DISTRIBUTION. The Black Sea (Sile).

BASINS AND TURBELLARIAN BIOCENOSES

1. The Black Sea (Fig. 22)

This brackish sea of Sarmatic origin, with a salinity varying vertically from 17 to 18‰ in the superficial layers and up to 22.5‰ in the deep layers (except the narrow pre-Bosporus area) (Zenkevich, 1963), occupies an intermediate position between the mesomixohaline and polymixohaline basins.

The Romanian seashore stretches from Stambulul Vechi (Chilia arm) to the Vama Veche and comprises two parts: a sandy one to the north of Cape Midia, representing 59 percent of the whole length, and another with steep cliffs of loess, limestone, and gritstone, south of Cape Midia. The investigated material came more from the rocky than from the sandy region. In the "Otoplana zone" of the sandy region I collected specimens of *Postbursoplana fibulata*.

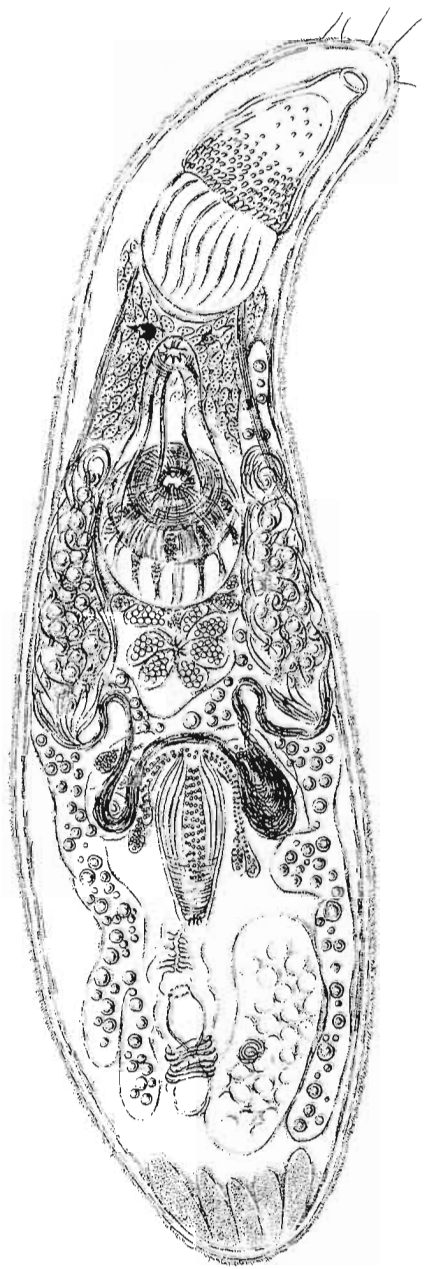

Figure 16 *Utelga heinckei* (Attems, 1879), general organization (from life).

In the rocky supralittoral of Costineşti the "littoral basins" of low depth (15 to 30 cm) with calm water subjected to great temperature and salinity variations are rich in *Cladophora* and *Enteromorpha*. Sometimes these basins may be covered by the waves, but they remain separated when the sea is calm. I found here a great number of *Allostomum pallidum*, *Pseudostomum klostermanni*, *Promesostoma bilineatum*, *Monocelis longiceps*, and *Archilina endostyla*.

In the mediolittoral occur *Monocelis longiceps*, *M. lineata*, *Archilina endostyla*, *Procerodes lobata*, *Convoluta convoluta*, and *C. albomaculata*, the latter two among vegetation.

The samples from the infralittoral were taken in 0.5 to 5.5 m depth and yielded: *Archaphanostoma agile*, *Mecynostomum arenarium*, *Convoluta convoluta*, *C. albomaculata*, *Monocelis lineata*, *M. longiceps*, *Archilina endostyla*, *Macrostomum peteraxi*, *M. ventriflavum*, *Allostomum pallidum*, *A. catinosum*, *Plagiostomum ponticum*, *Pseudostomum klostermanni*, *Trigonostomum venenosum*, *T. mirabile*, *Ptychopera plebeia*, *Hartogia pontica*, *Proxenetes angustus*, *Promesostoma bilineatum*, *Paramesostoma pachidermum*, *Bresslauilla relicta*, *Pseudograffilla hymanae*, *Gyratrix hermaphroditus*, *Progyrator mamertinus*, *Polycystis naegeli*, *Utelga heinckei*, *Utsurus camarguensis*, *Itaipusa karlingi*, *Torkarlingia euxinica*, *Cheliplana euxeinos*, and *Coelogynopora* sp.

2. The Predeltaic Region (Figs. 20, 21)

The Danube delta comprises an area of 251,000 hectares enclosed by the three main arms of the rivers, Chilia, Sulina, and Saint George. It is an early marine gulf, a remaining part of which forms today the lagoon complex Razelm-

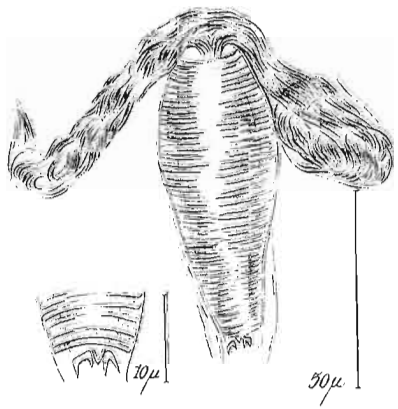

Figure 17 *Utelga heinckei* (Attems, 1879), male copulatory organ (from life).

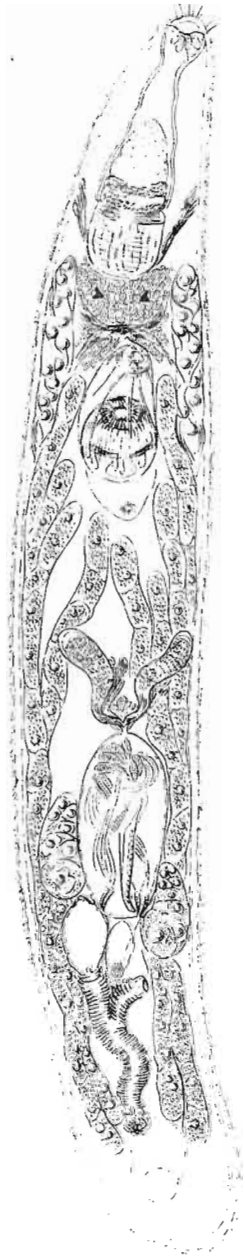

Figure 18 *Utsurus camarguensis* Brunet, 1965, general organization (from life).

Sinoë. The delta may be divided into two regions: the river delta and the river-marine delta; a further area is called the predeltaic region.

The latter region is very important for its biocenoses as well as for recurrence of the processes which led to the building of the delta. Its main features are: shallow (hence its name "melea"), brackish water with a fluctuating salinity, and good aeration. The biocenoses have mixed structures where the Ponto-Caspian elements are prevailing, the Mediterranean and freshwater species occurring at a lesser percentage. This applies to the "melea" of the Sulina arm (Musura or Northern Bay and the Southern Bay) and the "melea" Sahalin (St. George's arm).

The "melea" of the Sulina arm have a depth up to 5 m. In Musura the salinity depends on the wind force and the flow coming from the Danube. In the Southern Bay the salinity is higher.

In Musura, where a marked mixture of Ponto-Caspian, Mediterranean, and freshwater elements occurs, I established two sampling points (Fig. 20): (1) Close to the fog signal, where the bottom is alluvial and has a rich vegeta-

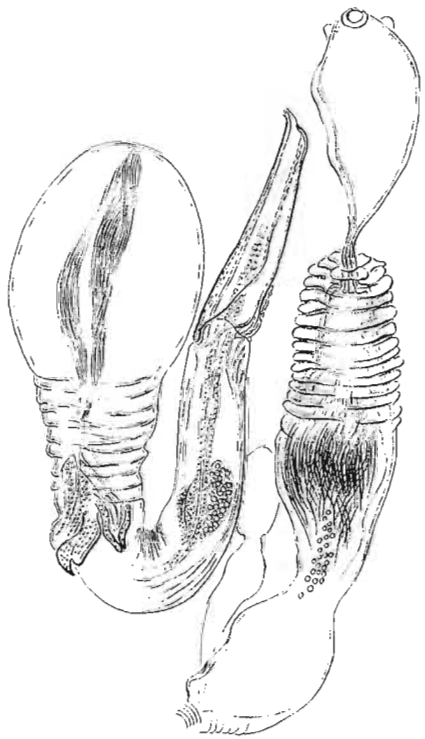

Figure 19 *Utsurus camarguensis* Burnet, 1965, male copulatory organ with stylet devaginated (from life).

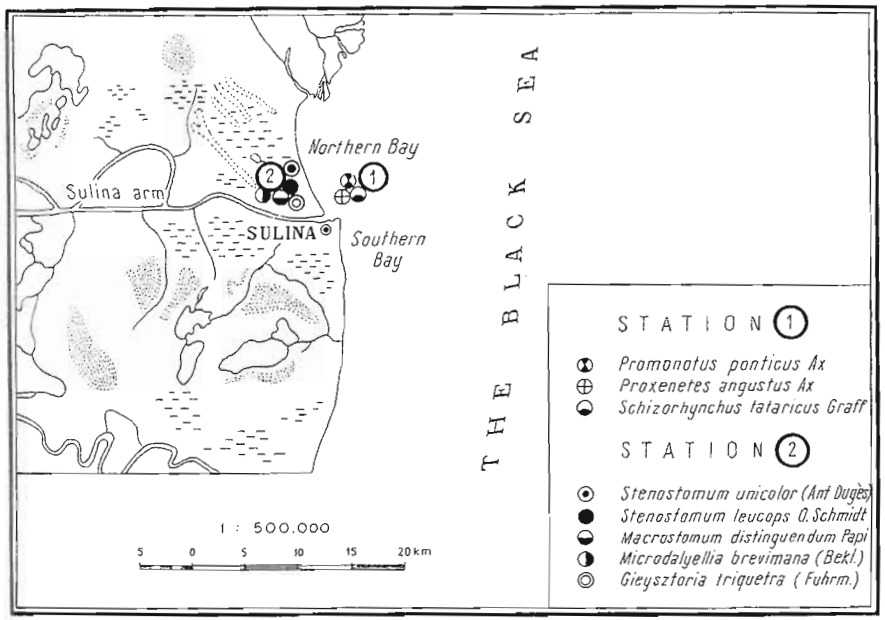

Figure 20 Distribution of the Turbellaria (excepting Tricladida) in the Northern Bay.

tion, the water being fresh and shallow (a few centimeters only), I collected *Macrostomum distinguendum*, *Microdalyellia brevimana*, *Gieysztoria triquetra*, *Strongylostoma radiatum*, *S. cirratum*, *Mesostoma lingua*, and *Gyratrix hermaphroditus*. (2) At the depth of 3 to 5 m, I found *Promonotus ponticus*, *Proxenetes angustus*, and *Schizorhynchus tataricus*, the latter being somehow questionable, since only a not well-preserved specimen was available. In this area, *Promonotus ponticus* appears to be the prevalent species; it was captured also inside the channel up to the fog signal (1 km away from the mouth of the Sulina arm).

In the St. George's "melea" (Island of Sahalin), where no human activity ever took place, the depth is small (0.5 to 1 m) and the salinity varies in general between 1.5 and 3‰, except for a sweetened area facing the mouth of the main arm. I set up four sampling stations (Fig. 21) there. At stations 1, 2, and 4, within the freshwater area (the bottom at station 4 is of alluvial nature, while at the others it is sandy) the following species live: *Macrostomum distinguendum*, *Gieysztoria triquetra*, *Typhloplana viridata*, *Strongylostoma radiatum*, *S. cirratum*, *Papiella otophthalma*, *Mesostoma lingua*, *Gyratrix hermaphroditus*, *Oligochoerus* sp., *Stenostomum leucops*, and *S. unicolor*.

At the southern end of the Sahalin Island (station 3) I collected amidst the vegetation on sandy bottom a huge number of *Macrostomum hystricinum*. This species was also found close to Zăton (3.3‰ salinity), at 10 m or more away from the lake mouth.

3. Littoral Lakes (Fig. 22)

The Lagoon Complex Razelm-Sinoë This is the largest lagoon complex of Romania and, excepting the Azov Sea, the most important annex of the Black Sea, covering an area of 88,000 hectares. At the beginning it was a part of the early marine gulf, a Danube lagoon stretching south to the Cape of Midia.

It comprises two lake systems: (1) the Northern System (the Razelmul Mare and its annex (the Babadag Lake), Golovitza and Smeica Lakes), and (2) the Southern System (Sinoë, Caranasuf, and Tuzla-Duingi Lakes). These

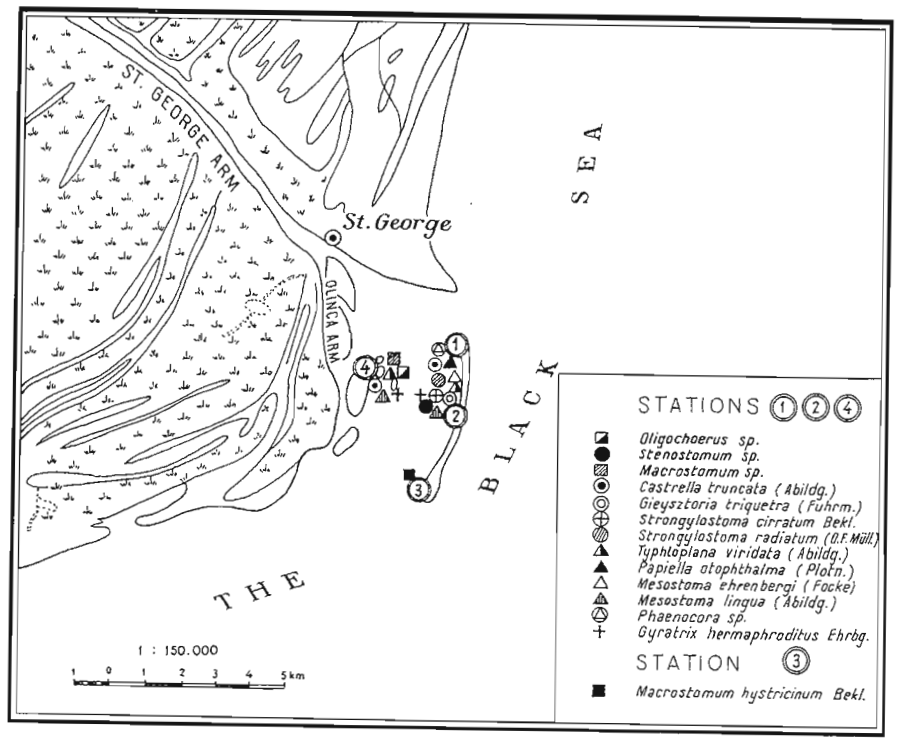

Figure 21 Distribution of the Turbellaria (excepting Tricladida) in the "melea" St. George.

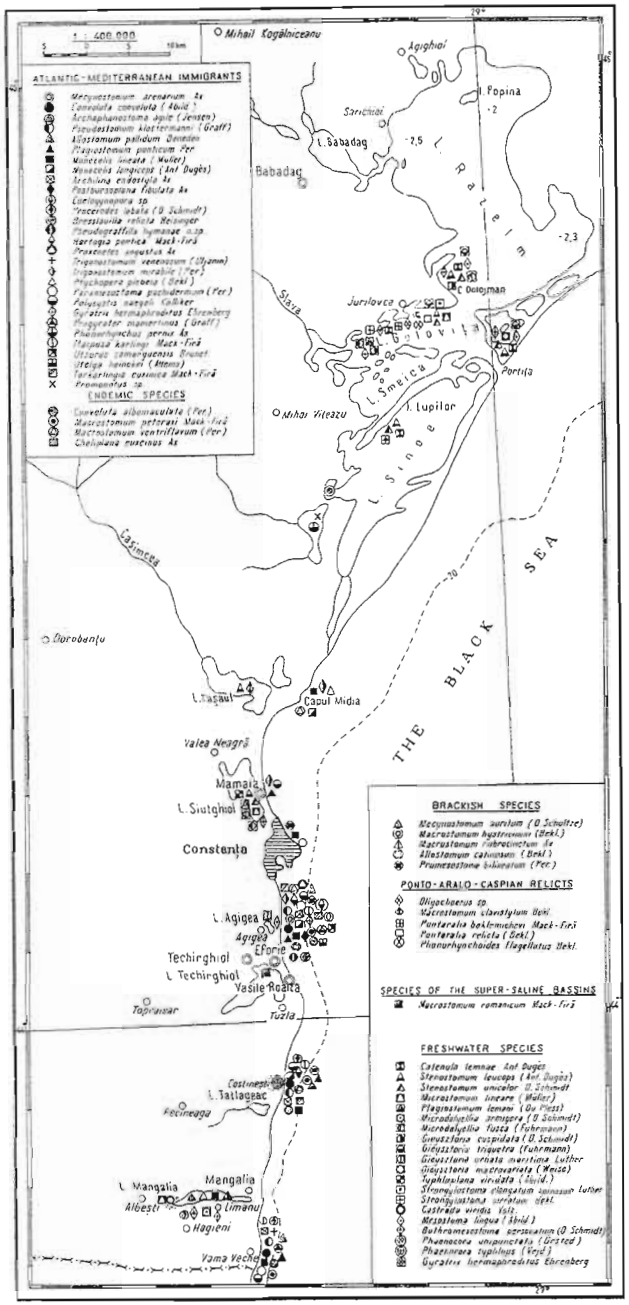

Figure 22 The turbellarian fauna (excepting Polycladida) of the Romanian littoral waters of the Black Sea and its annexes.

systems are linked with the sea at Portitza ("the little door"), the width of which varies annually between 200 m and a complete closure, depending on the Danube flow.

In the Northern System, supplied via several channels with Danube water, the average salinity is 2.5 to 4.5‰, but in the Southern System, which has a direct link with the sea at Periteaşca, the salinity reaches 12 to 20‰. Therefore, the Northern System is mixooligohaline, the Southern System being mixomesohaline.

I investigated the Turbellaria of the Razelmul Mare at the station of Doloşman, Golovitza, Portitza, Sinoë, and Tuzla-Duingi. In the Northern System the freshwater species prevail: *Stenostomum leucops*, *S. unicolor*, *Catenula lemnae*, *Microstomum lineare*, *Microdalyellia fusca*, *Gieysztoria cuspidata*, *G. triquetra*, *G. macrovariata*, *Mesostoma lingua*, *Gyratrix hermaphroditus*, and *Olisthanella* sp. In addition to the species captured also in the other parts of the system, I found in the Golovitza Lake: *Strongylostoma elongatum spinosum*, *S. cirratum*, *Plagiostomum lemani*, *Phaenocora* sp. and the relict species *Oligochoerus* sp., *Pontaralia beklemichevi*, *P. relicta*, *Phonorhynchoides flagellatus*, and the typical brackish species *Macrostomum hystricinum*, which is widely distributed in Europe.

In the Tuzla-Duingi Lakes, which have the same salinity as the sea and sometimes more, I found *Phonorhynchus pernix* and *Promonotus* sp., but no freshwater species.

The System of Lakes Taşaul-Gargalîc-Siut-Ghiol-Tăbăcăria This system consisted originally of river mouths, which the Black Sea overflowed in the Quaternary, when the Mediterranean waters broke through the Bosporus, and were later submitted to a progressive closure and partial (external complex constituents: Gargalîc and Tăbăcăria) or complete (central constituents: Siut-Ghiol and Taşaul) isolation caused by the formation of offshore bars. These lakes have a meanderlike shape, recalling the early river beds.

The Siut-Ghiol Lake is the main component of this complex. It covers an area of 2,500 hectares and has an average depth of 7 m. It is separated from the sea by an offshore bar. Its water supply is secured by rainfall and the phreatic layer of the Dobrudga. The lake bottom is made up of *Gyttya* mud, underlaid by a sandy layer with subfossil remnants of mollusks and *Balanus* shells. An area of 35 hectares is stony. The prevailing genus among algae is *Chara*, which covers 80 percent of the bottom.

I collected *Stenostomum leucops*, *S. unicolor*, *Microstomum lineare*, *Gieysztoria cuspidata*, *Microdalyellia fusca*, *Typhloplana viridata*, *Plagiostomum lemani*, and *Gyratrix hermaphroditus*.

In the Taşaul Lake, considered to be the ancient mouth of the Casimcea river, salinity 1.5‰, I found *Stenostomum leucops* and *Macrostomum clavistylum*.

Brackish Lakes Agigea Lake: An early lagoon recently isolated from the sea by human impact. It covers an area of 70 hectares and has a maximum depth of 1.3 m. Large portions of the shore are exposed to drying. The salinity has progressively decreased to 1.3‰, and 1‰ in the region of the freshwater sources. The bottom is covered with a black organic mud and Characeae.

Among the turbellarians *Gieysztoria ornata maritima* and *Mesostoma lingua* occur, the first being one of the prevailing elements of the microfauna in this basin.

Mangalia Lake: This lake is south of the town of Mangalia and has a meanderlike shape, with high banks and an area of 289 hectares and maximum depth of 16 m. The stony bottom is covered with mud or sand. The water supply is a mixed one: rainfall, strong freshwater sources proceeding from the phreatic layer of the Dobrudga, and seawater.

The salinity reaches 12.75‰ at the end of the channel linking it to the sea, 12‰ in the middle of the lake (village Limanu), 2.34‰ at the lake end, and only 0.98‰ in its swamp prolongation. In the three sampling stations I found the following Turbellaria species:

1 In the area of 12‰ salinity (fishing point Limanu): *Macrostomum rubrocinctum*, *Mecynostomum auritum*, *Ptychopera plebeia*, and *Monocelis lineata*, the first and last being prevalent

2 In the swamp at the lake end (0.98‰ salinity): *Microstomum lineare*, *Macrostomum* sp., and *Castrada viridis*, which are typical freshwater species

3 In the freshwater sources which supply the lake: *Microdalyellia armigera*, *Phaenocora unipunctata*, *Gyratrix hermaphroditus*, and among the vegetation developed in the basin of a captured source. *Bothromesostoma personatum*

Supersaline Lakes Tekirghiol Lake: A former Black Sea gulf, now isolated by a sandy bar with a maximum width of 150 m and a height of less than 5 m, having an area of 1270 hectares and 2500 m^2 and a maximum depth of 10 m. It is situated in a Sarmatic depression where the evaporation caused a concentration in Cl^- and Na^+ ions and a decrease in those of K^+ and Ca^{2+}. H_2S production is particularly high in the border area, with a maximum concentration of 0.161 cm^3/l (Tuculescu, 1965). The lake is supplied by rainfall and the freshwater sources surrounding it. The salinity varies between 55 and 100‰ and is lower in the neighborhood of the sources. The temperature and the density also fluctuate, and the water pH has a range of 7.5 to 8.5.

Because of the high salinity, the fauna and the flora are poor. *Cladophora* is abundant, but it disappears toward the bottom (3 to 4 m). The only turbellarian detected in this basin was *Macrostomum romanicum*.

ECOLOGICAL CONSIDERATIONS

From the short description of the biotopes and the species found in them, it is obvious that the most populated Black Sea area is the phytal zone. Here most of the turbellarians occur in the muddy sand at the vegetation bases or among the vegetation.

Mecynostomum arenarium, *Monocelis lineata*, *M. longiceps*, *Archilina endostyla*, *Macrostomum ventriflavum*, *M. peteraxi*, *Torkarlingia euxinica*, *Cheliplana euxeinos*, *Coelogynopora* sp., *Utelga heinckei*, *Utsurus camarguensis*, and *Itaipusa karlingi* are specific for the sand interstices.

As Ax (1959) pointed out and as my observations demonstrated (Mack-Fira, 1968), *Polycystis naegeli* is an inhabitant of the algal vegetation, whereas *Mecynostomum arenarium* could be found only in the sand. Not less specific for the phytal are *Allostomum pallidum*, *Trigonostomum venenosum*, *T. mirabile*, *Paramesostoma pachidermum*, and *Progyrator mamertinus*, which we always collected among the vegetation. Although the Proseriata are specific for the sand interstices, we found *Monocelis lineata* in great numbers at Constantza among the filaments of *Enteromorpha* and even inside them where it seems to take shelter.

The maximum density occurs in *Convoluta convoluta* and *Polycystis naegeli*, the latter prevailing in the stony region of the Romanian littoral, followed by *Pseudostomum klostermanni*, *Plagiostomum ponticum*, *Monocelis lineata*, *M. longiceps*, *Archilina endostyla*, and *Itaipusa karlingi*. Without being common species, *Proxenetes angustus* and *Torkarlingia euxinica* are well represented. I encountered rather rarely *Bresslauilla relicta*, *Hartogia pontica*, *Macrostomum peteraxi*, and *Gyratrix hermaphroditus*. Compared with *Convoluta convoluta*, *C. albomaculata* is a rather poorly represented species. I found *Postbursoplana fibulata* only in the sand area.

The greatest density and variety in the turbellarians of the stony area occurs at a low depth (0.5 to 1 or 2 m), where the water is well aerated by wave action.

Promesostoma bilineatum, *Allostomum pallidum*, and *Pseudostomum klostermanni* are abundant mainly in *Mytilus* agglomerations at a low depth (1 m), where they take shelter between the byssus filaments and in shells of dead individuals after having consumed their content.

The "littoral basins" seem to be particularly favorable for the development of some turbellarian species.These tiny sea basins are very quiet so long as waves do not reach them, but their salinity may fluctuate by evaporation and their temperature is subjected to considerable variations under the influence of the sun's radiation. I feel, therefore, that the Turbellaria which are thriving therein (*Pseudostomum klostermanni*, *Allostomum pallidum*, *Promesostoma bilineatum*, *Archilina endostyla*, *Monocelis lineata*) are forms

showing some inclination to euryhalinity and chiefly to eurythermy. I have also noticed that these species accommodate themselves to laboratory captivity. Moreover, *Monocelis lineata*, a eurytope species, can live at 49‰ salinity in the saline of La Louvelle (France), and together with *Macrostomum rubrocinctum* it is the representative element of Turbellaria in a 12‰ salt concentration in the Mangalia Lake.

I could find *Trigonostomum venenosum* and *Progyrator mamertinus* only at Vama Veche, a locality at the most southern end of the Romanian littoral, not being reached by the Danube waters. I assume, therefore, that these species prefer seawater of fairly constant salinity.

The brackish-water species are confined in the predeltaic region, the lagoon complex Razelm-Sinoë, and the coastal brackish lakes. The salt concentration of these basins varies from one to another and even in the same basin, depending on rainfall and the stream direction.

A review of the turbellarian fauna of the brackish basins of the Romanian Black Sea shore led us to the conclusion that it differs, in both the composing species and the dominant species, not only between the various basins, but even in the same basin, depending on the salinity and the bottom structure.

In this respect a clear-cut delimitation can be found in the predeltaic sector, in both the Northern Bay (Sulina arm) and the "melea" of Sahalin (St. George's arm). The marine or brackish-water species are living in biotopes with sandy bottom and oligo- or mesohaline brackish water, while in the freshwater areas with alluvial bottom and typical swamp vegetation only freshwater forms occur. In Musura, where the maximum salinity is 9.9‰, occur the marine species *Promonotus ponticus* and *Proxenetes angustus*, which show throughout their entire range the ability to tolerate rather wide limits of salinity: the former lives in the Marmara Sea at 20.5‰ salinity (highest limit) and on the Bosporus' Asiatic shore at 4.5‰; the latter in Marmara at 34.2‰ and in the Bosporus (Baltaliman) at 14.6‰ salinity (Ax, 1959).

Macrostomum hystricinum, a typical brackish-water species, was collected in oligohaline waters: 1 to 2‰ salinity in Golovitza Lake, 3‰ at the southern point of the Sahalin Island (station 3, Fig. 21) and 3.4‰ at Ciotic (Zaton), but never in the freshwater area. In mesohaline water I found it in great numbers at the end of Sinoë Lake.

Pontaralia beklemichevi, *P. relicta*, and *Phonorhynchoides flagellatus*, typical brackish-water species, are lacking in the Black Sea and are confined to the lagoon complex Razelm-Sinoë (Golovitza, 1 to 2‰ salinity), but *Pontaralia beklemichevi* also occurs in the freshwater lake of Snagov (Romanian Plain). The brackish *Oligochoerus* sp. is present in the oligohaline water of the Razelm complex and enters far upstream in the Danube.

In the basins having a salinity close to that of the Black Sea (Mangalia Lake 12‰, Tuzla-Duingi 17‰) there are the following brackish-water species of marine origin and marine species: *Mecynostomum auritum*, *Macrostomum rubrocinctum*, *Monocelis lineata*, *Ptychopera plebeia* in Mangalia Lake; *Phonorhynchus pernix*, *Promonotus* sp. in Tuzla-Duingi.

Macrostomum romanicum occurs in very great numbers among the filaments of *Cladophora* in the supersaline basins (Tekirghiol Lake). I did not find it in other water types, although Ax and Borkott (1968, 1970) report its presence in La Camargue and assume it to be a eurhyaline species, with a lower salinity limit of 5‰. In our country it occurs also in the supersaline lakes of the Romanian Plain (Lake Sărat-Brăila with 100 to 200‰ salinity) (Mack-Fira, 1968).

Macrostomum clavistylum is considered to be a constant oligohaline species, living in Ai-dai Lake (Beklemischev, 1951), and in Romania in the sand interstices in Taşaul Lake, where it appears to be the representative species of the Turbellaria.

Some of the freshwater species in the littoral lakes of the Black Sea are eurytopic: *Stenostomum leucops*, *S. unicolor*, *Catenula lemnae*, *Microdalyellia fusca*, *Gieysztoria cuspidata*, *Castrella truncata*, *Mesostoma lingua*, *Microstomum lineare*, and *Gyratrix hermaphroditus*. This is also one of the reasons for their presence in the Danube swamps (the flooded area and the delta) and other inner freshwater basins of our country. Their occurrence (except *Castrella truncata*) which develops on piles and submersed stones in the microcoenosis with *Enteromorpha* at the fishing station at Golovitza (fishing point Jurilofca) at a salinity of 1 to 2‰, may be an indication that they have some inclination toward euryhalinity. In the Finnish Gulf *Microdalyellia fusca* can endure a salt concentration of 5 to 6.5‰ (Luther, 1955).

Mesotoma lingua, *Gieysztoria triquetra*, and *Strongylostoma cirratum* are very abundant in the freshwater portion of the "melea" of Sahalin among the root filaments of *Salvinia natans*, producing a phenomenon of homochromy.

It should be noted that various populations of *Gyratrix hermaphroditus*, a ubiquitous and euryhaline species, have stylet constituents of different length relations, but these relations are constant in individuals of the same population.

THE ORIGIN OF THE TURBELLARIAN FAUNA IN THE BLACK SEA AND ITS ANNEXES

The Black Sea and its related basins, the Caspian and the Aral Seas, originated from the Tertiary Sarmatic Sea, which in turn was separated from the Tethys Sea, this latter surrounding the globe like a girdle during the Eocene and Oligocene. A northern portion of this sea, which in the lower and middle Miocene bordered the southern part of the U.S.S.R. and was still largely connected with the ocean, having a typical Mediterranean salinity and fauna, was

separated toward the end of the middle Miocene, forming the so-called Paratethys Sea. During the upper Miocene its Mediterranean link was definitively lost and it became the brackish Sarmatic Sea. This sea became, gradually, less saline and the composition of its fauna began to change, owing to the disappearance of the stenohaline Mediterranean forms, which were not able to adapt to the new living conditions, and the sea became an evolutionary center for an endemic brackish-water fauna.

According to the investigations by Ax (1959) in the pre-Bosporus area of the Pontic basin, and to my own research in the Romanian Black Sea littoral, the turbellarian fauna is composed of Mediterranean eurhyaline immigrants, which adapted themselves to the new living conditions, remaining as such or producing endemic forms, brackish-water species of marine origin with a wider dissemination, relicts of the ancient Pontic lake, Arctic and Baltic immigrants, and species of a limnic origin (Mack-Fira, 1970).

1. Atlantic-Mediterranean Immigrants

This category is the largest one, consisting of 85 species [75 species according to Ax (1959)], 31 of which I have found on the Romanian coast. The following Mediterranean immigrants were identified on the Romanian seashore:

Convoluta convoluta (Abildgaard, 1806)
Mecynostomum auritum (Schultze, 1851)
Mecynostomum arenarium Ax, 1959
Archaphanostoma agile (Jensen, 1876)
Plagiostomum ponticum Pereyaslawzewa, 1892
Pseudostomum klostermanni (Graff, 1874)
Allostomum pallidum Beneden, 1861
Monocelis lineata (Müller, 1774)
Monocelis longiceps (Ant. Dugès, 1830)
Archilina endostyla Ax, 1959
Promonotus sp.
Postbursoplana fibulata Ax, 1955
Coelogynopora sp.
Procerodes lobata (O. Schmidt, 1862)
Bresslauilla relicta Reisinger, 1929
Pseudograffilla hymanae sp. n.
Hartogia pontica Mack-Fira, 1968
Proxenetes angustus Ax, 1951
Trigonostomum mirabile (Pereyaslawzewa, 1892)
Trigonostomum venenosum (Uljanin, 1870)
Ptychopera plebeia (Beklemischev, 1927)
Promesostoma bilineatum (Pereyaslawzewa, 1892)
Paramesostoma pachidermum (Pereyaslawzewa, 1892)

Polycystis naegeli Kölliker, 1845
Gyratrix hermaphroditus Ehrenberg, 1831
Progyrator mamertinus (Graff, 1874)
Phonorhynchus pernix Ax, 1959
Utelga heinckei Attems, 1897
Itaipusa karlingi Mack-Fira, 1968
Utsurus camarguensis Brunet, 1965
Torkarlingia euxinica Mack-Fira, 1971

Ax (1959) listed 49 species known only in the Black Sea. This includes the following species, which I found on the Romanian seashore but which have a geographical origin difficult to explain:

Convoluta albomaculata (Pereyaslawzewa, 1892)
Macrostomum ventriflavum (Pereyaslawzewa, 1892)
Macrostomum peteraxi Mack-Fira, 1971
Promonotus ponticus Ax, 1959
Schizorhynchus tataricus Graff, 1905
Cheliplana euxeinos Ax, 1959

2. Brackish-water Species of Marine Origin

According to Ax (1959), the brackish-water species of marine origin in the Ponto-Aralo-Caspian basin are to be put in two categories: those widely distributed in Europe but with an origin difficult to establish, and the others confined to the Ponto-Aralo-Caspian area, representing the relicts of the great Pliocene lake.

A. Brackish Species of Marine Origin Widely Distributed in Europe Ax (1959) reports from the Black Sea nine species belonging to this category: *Macrostomum hystricinum*, *Enterostomula graffi*, *E. catinosum*, *Pseudosyrtis subterranea*, *Pseudomonocelis agile*, *Vejdovskya pellucida*, *V. helictos*, *Tvaerminnea karlingi*, *Promesostoma bilineatum*.

I am able to add *Mecynostomum auritum*, *Macrostomum hystricinum*, *Macrostomum rubrocinctun*, *Allostomum catinosum* (Beklemischev, 1927), and *Promesostoma bilineatum* from the Romanian littoral.

B. Ponto-Aralo-Caspian Relicts I found species of this category confined to the lagoons and the predeltaic sector of the Romanian Black Sea shore: *Oligochoerus* sp., *Macrostomum clavistylum*, *Pontaralia beklemichevi*, *Pontaralia relicta*, *Phonorhynchoides flagellatus*.

The only relict species known till now as being common to the three Sarmatic basins was *Thalassoplanina geniculata*, discovered by Ax (1959)

on the Anatolian shore (Sile) of the Black Sea, at the mouth of a freshwater tributary. My investigations demonstrate, however, that the number of common relicts living in the three basins is greater as the turbellarian fauna in these basins becomes better known. *Pontaralia relicta* of the Aral Lake and Caspian Sea occurs in some lagoons of the Black Sea with low salinity (Golovitza). On the other hand, the presence of *Phonorhynchoides flagellatus*, from the Aral Lake in the lagoon complex Razelm-Sinoë induces us to assume that more careful investigations in the Caspian would lead to the same conclusion concerning this Sarmatic remnant.

The genus *Oligochoerus* from the Caspian Sea, found by An der Lan (1964) in the Danube, and by Ax and Dörjes (1966) in other Central European rivers, and recently reported by the author from the predeltaic area and from the oligohaline brackish water at Golovitza (Mack-Fira, 1970), but not yet known from the Aral Lake, also may be considered to be a relict in the Ponto-Caspian basin, having produced limnic species which were able to reach the Central European rivers.

Among the relicts of Ponto-Caspian origin I may include also *Macrostomum clavistylum*, described from Ai-Dai (Beklemischev, 1951), a brackish lake in the eastern Ural Mountains. It was found in our country in Taşaul Lake (1 to 1.5‰ salinity). Although its present distribution and its occurrence in basins with a very low salinity would induce us to consider this species as a Sarmatic relict of limnic origin, I completely agree with Ax (1959) that the brackish-water *Macrostomum* species are originally marine forms and I classify *M. clavistylum* among the Ponto-Caspian relicts which along with the relicts of limnic origin formed the populations of the outlying brackish-basin areas.

3. Northern Immigrants

The annexes on the Romanian Black Sea littoral shelter several turbellarian species which according to their geographical distribution should be northern Baltic or Siberian forms. These may be divided into two groups: (1) the brackish-water elements of marine origin and (2) the forms of a limnic origin which can live in oligohaline brackish water.

In the first group is included *Macrostomum rubrocinctum* from the Bay of Kiel (Ax, 1951) and the Swedish shore (Westblad, 1953), both being found in our country in Mangalia Lake (12‰ salinity).

The second group occurs in our oligohaline littoral basins and in the Danube swamps. *Gieysztoria ornata maritima* occurs in the Finnish Gulf, and in Romania in Agigea Lake (1.3‰ salinity). It is surprising, on the one hand, that this species occurs under the same living conditions in two so geographically remote basins, and on the other hand, that the environmental conditions are so similar in Agigea Lake and the lagoon adjacent to Rosore Lake near Pisa (Mediterranean coast of Italy), where it is represented by its vicarial species, *Gieysztoria subsalsa* Luther, 1955. *Strongylostoma elongatum spinosum* from the Finnish Gulf occurs in Romania in Golovitza Lake (Razelm) (1 to 2‰ salinity) and in the Danube flooded area (Mack-Fira, 1968, 1970).

There are other species of Siberian origin. *Strongylostoma cirratum* described by Beklemischev (1922) from Tomsk (Siberia) was found by the author in the Ponto-Aralo-Caspian area in the complex Razelm-Sinoë, the freshwater portion of the "melea" Sahalin, and the Danube swamps (the delta and the flooded area) (Mack-Fira, 1968, 1970).

Strongylostoma cirratum, for instance, is known so far from the Tomsk region, which is a part of the area of the large glacial accumulation lake in the Tobolsk region (de Lattin, 1967) and from the Ponto-Aralo-Caspian area in the Razelm system and the Danube.

4. Species of Limnic Origin

In addition, there are species of limnic origin, some of them being known from Europe and others having a Palaearctic or cosmopolitan repartition, present in the freshwater or brackish annexes of the Romanian Black Sea littoral. Most of them are common in the inner freshwater basins of Romania.

Among these, *Gieysztoria triquetra*, a Central European species, occurring in Germany, Switzerland, Italy, and Yugoslavia, is living in our country in the lagoon complex Razelm-Sinoë, the predeltaic area, and the Danube swamps (delta and the flooded area). *Gieysztoria macrovariata*, also of Central Europe (Italy, Germany) was found by the author in a swamp near Portitza (Razelm-Sinoë complex). *Microdalyellia brevimana* is a North European form, but it was found also in the freshwater portion of the Northern Bay (Sulina arm) and in the Cătuşa swamp (near Galatz), the latter being an early estuary of the Siret River, a Danube tributary.

CONCLUSIONS

The fauna of Turbellaria in the Pontic basin, including its annexes, has a mixed origin.

1. The prevailing element is composed of the Atlantic-Mediterranean immigrants, which entered the Pontic region at several stages after the breaking down of the Aegeais and the cutting through of the Bosporus at the same time as the salt Mediterranean waters. Most of these animals disappeared in the period when the basin became brackish after the raising of the Black Sea level and the interruption of its Mediterranean link (New Euxinic phase).

The Mediterranean stock of immigrants was renewed after the link was restored (the second and still existing Mediterranean phase of the Black Sea). Others of these animals adapted themselves to the new conditions and became endemic, remaining confined in the Black Sea or reentering the Marmara.

2. In the brackish Black Sea annexes there are brackish-water species of marine origin. These represent in part species widely distributed in Europe outside the Ponto-Aralo-Caspian region, the geographical origin and age of which are difficult to specify, and in part relicts of the brackish Pliocene sea, which are remainders of the first Mediterranean phase of the Black Sea. They entered there after the overflowing of the river mouths by the Mediterranean water coming across the Bosporus and were able to survive by avoiding the noxious salinity and the competition of the Mediterranean immigrants. These species are apparently lacking in the proper Black Sea.

3. The number of the Ponto-Caspian relicts in the western area of the Pontic basin and of those which are common to the three existing Sarmatic basins proves to be larger than estimated and will probably increase during future investigations. This suggests that they occurred in the area before the Pliocene breaking up of the inner Pontic sea. To the species *Thalassoplanina geniculata*, existing in front of some river mouths in the Aral, Caspian, and Black Seas, may be certainly added *Pontaralia relicta*, recently found in the complex Razelm-Sinoë (Northern System) and probably *Phonorhynchoides flagellatus*, living in the Aral and Black Seas and which may be discovered in the near future in the Caspian Sea also. The limnic elements of Baltic (*Gieysztoria ornata maritima, Strongylostoma elongatum spinosum*) or Siberian (*Strongylostoma cirratum, Microdalyellia brevimana*) origin are living in the brackish oligohaline or freshwater annexes.

4. The Mediterranean immigrants entered only into the annexes of equal or higher salinity as compared to the Black Sea (Southern System of the lagoon complex Razelm-Sinoë; *Phonorhynchus pernix*).

5. In addition to the Ponto-Caspian elements and the northern immigrants, there are in the oligohaline and freshwater annexes (which were primarily river mouths), Central European, Palaearctic, Holarctic, and cosmopolitan freshwater species, all being remnants of the native limnic fauna able to bear slight salinity fluctuations.

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Chapter 14

Further Studies on the Vertical Distribution of Freshwater Planarians in the Japanese Islands

Masaharu Kawakatsu
Biological Laboratory, Fuji Women's College,
Sapporo (Hokkaidô), Japan

Kawakatsu (1965a, 1967) published a description of the distributional ecology of freshwater planarians in the Japanese Islands based on analysis of the factors controlling the vertical distribution of this animal group from ecological and chorological standpoints. The present paper is a general revision of my 1965 article. The objective is to define the vertical distribution of the stream-dwelling planarians in the Japanese Islands as well as in the Far Eastern countries adjacent to Japan. Further considerations about the factors controlling the vertical distribution are reported below.

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