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Department of Limnology, Academy of Natural Sciences of Philadelphia

INTRODUCTION

The material upon which this study is based was collected during five surveys performed on three Gulf Coast rivers. These were as follows:

1. Escambia River near Pensacola, Florida, Oct. 22 through Nov. 7, 1952 (low-water survey); March 23 through April 10, 1953 (high-water survey).
2. Sabine River near Orange, Texas, Aug. 12 through Sept. 2, 1952 (low-water survey); April 13 through April 26, 1953 (high-water survey).
3. Neches River near Beaumont, Texas, Aug. 10 through Aug. 24, 1953 (low-water survey).

The surveys were conducted by the Department of Limnology of the Academy of Natural Sciences of Philadelphia under the direction of Dr. Ruth Patrick, curator of the department.

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PHYSIOGRAPHY

The Escambia River rises in the Red Hills and on the Chunnenugga Ridge of the eastern Gulf Coastal Plain. The Coastal Plain here is a young to mature, belted coastal plain and the river headwaters rise at elevations of about 500 feet. The upper reaches of the river do not reach to the Fall Line. The greatest length of the stream channel is approximately 100 miles, but only south of the Florida state line is it called the Escambia River. It empties into Escambia Bay near Pensacola, Florida.

The Sabine River rises in the Black Prairie district of the western Gulf Coastal Plain. The headwaters have their origin at elevations of about 700 feet. The upper reaches of the river do not extend to the Fall Line. The river has a maximum length of about 575 miles and empties into Sabine Lake below Orange, Texas.

The Neches River, like the Sabine River, rises in the Black Prairie district of the western Gulf Coastal Plain. It lies southwest of the Sabine River and roughly parallels the course of that river. It is somewhat shorter than the Sabine River, being approximately 500 miles long. It empties into Sabine Lake near Port Arthur, Texas.

STATIONS

The stations studied in each river were all within the influence of the tides, i.e., in the lowermost stretches of the rivers, and were all influenced to some extent by brackish water or the close proximity of brackish water. Each station is a stretch of the river varying from about 100 to 200 yards in length and including both banks as well as the intervening area. Both the Escambia River and the Sabine River were surveyed twice—once at low water and once at high water. The Neches River was surveyed only at low water. The location and description of each station is presented below. The Escambia River stations are numbered to correspond with those of Bailey et al (1954) who studied the fish taken from these stations.

Escambia River, Station 15.—At 12.7 miles above the river mouth where it enters Escambia Bay. This is about 0.1 mile above the bifurcation of the river at the top of Brosnaham Island. (The channel flowing to the east of the island is called White's River.) The river here flows through a mixed forest and both banks are shaded. The banks are steep, nearly vertical, and ascend to about three feet above the high-water level. A sloping shelf is present along the left bank at the foot of the station. The bottom material is chiefly a muddy sand along the sides to very coarse sand in the main axis of the current. During the low-water survey the temperature was 22.5° C. During the high-water survey it varied with depth from 19.0° to 19.5° C. At this point the river is 350 feet wide. The average depth (based on 25

soundings) during the high-water survey was 14 feet with a maximum recorded depth of 21 feet.

Escambia River, Station 16.—At 8.9 miles above the river mouth. This is about 0.7 mile below Upper Bluff near Gonzales. The river here, as at Station 15, flows through a mixed forest. However, the right bank is here bordered by a patch of sawgrass. Offshore from this sawgrass is a band of spatterdock (Nymphaeaceae). This is the furthest downstream occurrence of this fresh-water plant. The left bank is nearly vertical, ascending to two to three feet above high-water level, and covered with over-hanging trees and shrubs. The bottom material is the same as at Station 15. During the low-water survey the temperature varied with depth from 21.0 to 22.0° C while during the high-water survey it varied with depth from 19.0 to 19.5° C. At this point the river is 160 feet wide. The average depth (based on 25 soundings) during the high-water survey was 13 feet with a maximum recorded depth of 25 feet.

Escambia River, Station 17.—At 6.1 miles above the river mouth. The river here, as at Stations 15 and 16, flows through a mixed forest. Like Station 16 this station is bordered along the right bank by a patch of sawgrass. The left bank is nearly vertical, ascending two to three feet above high-water level, and covered with overhanging trees and shrubs. In the main axis of the current the bottom material includes granules which are larger than the very coarse sands of Stations 15 and 16. The shoreline bottom material is a muddy sand. The temperature during the low-water survey varied with depth from 16.5 to 19.5° C. During the high-water survey it varied from 19.5 to 20.0° C. At this point the river is 175 feet wide. The average depth (based on 25 soundings) during the high-water survey was 22 feet with a maximum recorded depth of 31 feet.

Escambia River, Station 19.—At 3.8 miles above the river mouth. This is about 0.1 mile above the confluence of the White's and Escambia rivers at the foot of Brosnaham Island. The river here flows through an area that is transitional between the more inland forest and the more seaward salt marsh. The right bank is overhung with trees and shrubs; the left bank is mixed trees (chiefly cypress) and sawgrass. The left bank rises about one foot above the high-water level while the right bank ascends more vertically to three or four feet above the high-water level. There is very little mud in the bottom material, which ranges from medium sand to granules with the latter composing the bottom in the main axis of the current. The temperature during the low-water survey varied with depth from 18.5 to 19.5° C. During the high-water survey it varied with depth from 20.0 to 21.0° C. At this point the river is 390 feet wide. The average depth (based on 25 soundings) during the high-water survey was 12 feet with a maximum recorded depth of 17 feet.

Escambia River, Station 21.—At 1.2 miles above the river mouth. This is 100 yards below the bridge of U. S. Highway 90. The river here flows through a salt marsh zone and both banks are covered with salt marsh vegetation. A few scattered scrub trees are present along the right shore. The river here has had a channel dredged for navigation. The bottom material ranges from clay to coarse sand in particle size. The temperature during the low-water survey varied with depth from 22.0 to 22.5° C. During the high-water survey it varied with depth from 20.0 to 21.5° C. At this point the river is 440 feet wide. The average depth (based on 25 soundings) during the high-water survey was 17 feet with a maximum recorded depth of 30 feet.

Sabine River, Station A.—Just above the newly completed bridge for U. S. Highway 90, and extending from Piling 54 upstream to Piling 60. The river here flows through a mixed forest which provides overhanging foliage on both banks. The right bank ascends at a sharp angle to a height of about 2-3 feet above high-water level. The left bank is about one foot above high-water level. This left bank is apparently commonly inundated by any unusually high waters. The bottom material is clay, with sand in the channel. Along the left bank a thin stratum of fine sand is exposed under a higher clay stratum. Along the right side the clay becomes jelly-like in its consistency. The estimated width of the river at this point is 400 feet. The average depth (based on ten soundings) during the high-water survey was 15 feet with a maximum recorded depth of 21 feet.

Sabine River, Station B.—This station has its lower limit approximately 100 feet above the junction of the Sabine River with the Intracoastal Waterway. The river here flows through a transitional zone between the more inland forest and the more seaward salt marsh. The right bank is low and covered with grasses; the left bank is also low and grass covered, but scattered cypress trees are present. This station, and the two following, have been dredged for navigation. The bottom material is a soft, jelly-like, black clay. The estimated width of the river at this point is 600 feet. The average depth (based on ten soundings) during the high-water survey was 20 feet with a maximum recorded depth of 32 feet.

Sabine River, Station C.—The river here, as at the above station, flows through a transitional zone between the more inland forest and the more seaward salt marsh. The left bank supports a salt marsh vegetation while the right bank is lined by cypress. The bottom material is clay like that of Station B. Some sand is present in the channel. The width of the river at this point, according to an earlier survey, is 1060 feet. The average depth (based on ten soundings) during the high-water survey was 15 feet with a maximum recorded depth of 33 feet.

Sabine River, Station D.—Just below nun buoy "6". The river here flows through a salt marsh and both banks are low and bear typical salt-marsh vegetation. The bottom material is a soft, jelly-like, black clay. The estimated width of the river at this point is 1000 feet. The average depth (based on ten soundings) during the high-water survey was 16 feet with a maximum recorded depth of 31 feet.

Neches River, Station E.—Approximately 1.5 miles upstream from the Beaumont Country Club. The river here flows through a mixed forest but the right bank bears a patch of sawgrass presaging the salt marshes further downstream. The left bank is nearly vertical and rises six to eight feet above low-water level. The bottom material varies from soft clay to granules, the latter in the main axis of the current. The estimated width of the river at this point is 400 feet. The average depth (based on ten soundings) was 9 feet with a maximum recorded depth of 11 feet.

Neches River, Station F.—At Beacon "54" along the Beaumont ship channel. The river here flows through salt marsh country which is given over to pasturage. The bottom material is composed of medium to coarse sand overlain by a jet-black layer of colloidal material a few millimeters thick. The width of the river at this point, scaled from the U. S. C. and G. S. Chart No. 533, is 783 feet. The average depth (based on ten soundings) was 31 feet with a maximum recorded depth of 45 feet.

Neches River, Station G.—At Beacon "40" along the Beaumont ship channel. The river here flows through salt marsh as at the preceding station. The bottom material is a homogeneous, jet-black clay of jelly-like consistency. The width of the river at this point, scaled from the U. S. C. and G. S. Chart No. 533, is 391 feet. The average depth (based on ten soundings) was 27 feet with a maximum recorded depth of 41 feet. The apparent reduction of river volume at this station compared to Station F, which is upstream, is explained by the diversion of part of the river flow into a berthing area adjacent to the river at this station. The outflow from this berthing area rejoins the river immediately below the station.

Neches River, Station H.—At Beacon "28" along the Beaumont ship channel. The river here flows through salt marsh as at the preceding two stations. The bottom material is chiefly a homogeneous, jet-black clay of jelly-like consistency. In addition the left side of the channel yielded a medium sand that was gray in color. The width of the river at this point, scaled from the U. S. C. and G. S. Chart No. 533, is 653 feet. The average depth (based on ten soundings) was 16 feet with a maximum recorded depth of 21 feet.

Throughout the following text these stations (13) are coded in order to prevent confusion and conserve space. The Escambia River stations are prefixed by the letter "E", the Sabine River stations by "S", the Neches

River stations by "N". The low-water surveys are indicated by the Roman numeral I, the high-water surveys by II. The stations are numbered in Arabic numerals or letters for each river. As mentioned previously the Escambia stations are numbered to correspond to the numbers given these stations in Bailey et al (1954). The station number is separated from the river code letter and survey numeral by a hyphen. The complete list of stations studied is as follows:

EI-15, EI-16, EI-17, EI-19, EI-21
EII-15, EII-16, EII-17, EII-19, EII-21
SI-A, SI-B, SI-C, SI-D
SII-A, SII-B, SII-C, SII-D
NI-E, NI-F, NI-G, NI-H

CHEMISTRY

The following data, presented in Table 1, include certain prevailing chemical conditions at the time of each survey. In general the tests were done in the manner prescribed by "Standard Methods" (1946). Where duplicate or triplicate tests were done the average is given. The data include alkalinity expressed as parts per million (ppm) of calcium carbonate (using Methyl Orange as an indicator); total hardness expressed as ppm of calcium carbonate; the four major ions, chloride, calcium, magnesium and sulphate expressed as ppm; the dissolved oxygen content as ppm; the turbidity as ppm; and the hydrogen ion concentration (pH).

It is evident from the data that the various samples taken for chemical analyses at each station for the three rivers were not all taken at the same stage of the tide. As a result some of the more seaward stations show a lower salt concentration than some of the more inland stations, and this during the time of one survey. To sample each station of a river at the same, or nearly same tide stage would have extended the chemical studies beyond the economic limits of the surveys. In spite of these inconsistencies, however, the data do enable a visualization of increasing chlorides with increasing depths as well as with nearer approaches to salt water. The data also demonstrate the reduced chlorides of the high-water surveys.

A discussion of salinity and its influence on the ecology of these rivers is reserved for a later section of this study.

TABLE 1

		Alkalinity as $CaCO_3$	Total Hardness as $CaCO_3$	Cl	Ca	Mg	SO_4	D.O.	Turbidity	pH
EI-15	surface	27.6	23.2	3.2	7.44	1.12	3.2	8.65	15	7.1
	bottom	26.2	23.2	3.2	7.44	1.12	....	8.65	...	..
EI-16	surface	29.0	86.8	185	11.0	14.4	25.5	8.40	8	7.1
	bottom	28.3	160	375	15.4	29.5	160	8.30	...	..
EI-17	surface	32.4	370	965	28.0	73.0	240	8.20	9	7.1
	bottom	88.0	4500	12500	280	920	1900	4.30	...	..
EI-19	surface	41.0	1000	2750	68.0	200	570	7.40	9	7.2
	bottom	58.0	2500	6500	150	520	1100	5.55	...	..
EI-21	surface	39.0	900	2500	60.0	180	480	7.65	8	7.3
	bottom	92.0	5000	13500	310	1000	2000	6.90	...	..
EII-15	surface	21.2	21.0	3.1	6.5	1.1	3.5	7.50	35	6.7
	bottom	21.1	21.2	3.3	6.6	1.1	3.8	7.40	...	..
EII-16	surface	21.1	20.6	3.1	6.4	1.1	3.6	7.40	25	6.7
	bottom	21.1	21.3	3.1	6.6	1.1	3.4	7.30	...	..
EII-17	surface	21.0	20.5	3.7	6.3	1.1	3.6	7.10	15	6.7
	bottom	21.0	21.4	3.8	6.8	1.1	4.3	7.10	...	..
EII-19	surface	21.0	20.7	4.8	6.5	1.1	3.5	7.20	15	6.7
	bottom	21.0	21.6	4.9	6.8	1.1	2.9	7.10	...	..
EII-21	surface	21.0	20.6	6.9	6.4	1.1	3.5	7.10	10	6.7
	bottom	21.0	21.9	7.5	6.8	1.2	2.9	7.00	...	..
SI-A	surface	37.6	75	156	11.6	11.2	5.2	6.5	70	7.3
	bottom	44.0	550	1500	44	107	285	0.8	...	..
SI-B	surface	41.0	425	1170	36.8	80.8	115	5.7	75	7.1
	bottom	66.0	2100	6000	150	420	890	0.7	...	..
SI-C	surface	49.6	625	1740	52.0	120	170	3.2	85	7.2
	bottom	58.0	1500	4400	110	300	650	2.7	...	..
SI-D	surface	52.0	740	2090	58.8	144	190	2.9	75	7.3
	bottom	68.0	2200	6400	160	440	950	1.6	...	..
SII-A	surface	29.6	46.0	46.2	11.0	4.5	25.3	6.8	300	6.9
	bottom	31.0	44.0	45.9	10.2	4.5	....	5.7	...	..
SII-B	surface	37.6	292	788	28.0	53.9	53.2	5.4	220	6.9
	bottom	44.2	515	1467	42.8	99.3	120	5.1	...	..
SII-C	surface	37.6	400	1121	35.4	75.5	85.0	6.9	230	7.1
	bottom	40.3	368	1025	31.9	69.8	224	6.9	...	..
SII-D	surface	35.4	232	610	23.9	41.8	120.8	5.0	200	7.1
	bottom	51.2	1173	1930	82.9	235.6	212	4.1	...	..
NI-E	surface	30.1	34.5	46.0	8.96	2.94	8.9	5.7	130	6.9
	bottom	30.8	93.4	192	12.9	14.9	64	5.5	...	..
NI-F	surface	41.8	270	816	29.2	48.0	106	1.1	55	7.1
	bottom	87.3	3270	9050	224	659	1560	0	...	..
NI-G	surface	41.0	324	988	33.1	58.5	115	6.0	35	7.1
	bottom	81.7	2690	7370	184	542	1500	0	...	..
NI-H	surface	39.3	313	946	31.2	57.0	112	2.4	40	7.2
	bottom	89.2	3650	10100	248	736	1700	0	...	..

METHODS

The collections of the invertebrate fauna of each of the rivers were made in the same manner. Several methods of collecting were used. These included hand collecting for large or sessile forms, the use of dip net and Needham scraper for forms associated with vegetation or burrowers in littoral zones, the use of a Petersen dredge for deep water bottom fauna, seining for vagile forms, and the microscopic examination of samples of vegetation, bottom material and debris. We are confident that our collecting methods are comprehensive and intensive enough to collect some specimens of virtually all of the species of the invertebrate fauna present in the stations studied.

BIOTIC STRUCTURE

During the work of the Limnology Department we have been impressed by the constancy of various groups of organisms in relation to the entire population of plants and animals. This constancy appears to be a basic principle that allows an interpretation of a balanced or unbalanced population depending upon the variation of the size of the contained groups. Thus, in general, the algae found in any given station usually represent a little less than 40 per cent of the population; the fish represent approximately 15 per cent of the population; and the invertebrates represent the remaining population of 45 per cent of organisms. There is, of course, some variation above and below these figures, but the various groups retain this relationship remarkably well. In comparing the uppermost station of each of the three rivers, we find that the relationship presented in Table 2 prevails.

TABLE 2

	Algae	Invertebrates	Fish
Escambia, low-water	37%	45%	18%
Escambia, high-water	34%	51%	15%
Sabine, low-water	33%	58%	9%
Sabine, high-water	42%	42%	16%
Neches, low-water	38%	45%	17%

For convenience we have formulated the expression that the fish, in a normal, healthy habitat, represent one-sixth of the population; the algae one-third; and the invertebrates one-half.

We present below, in Table 3, a complete breakdown of one river (the Escambia River) that demonstrates this principle. In Table 3 the Protozoa (including the flagellates) have been separated from the other invertebrates. This has been done because the Protozoa represent a group of animals that are able to build sizeable populations in a very short period of time; and, conversely may be greatly reduced in a relatively short period of time within the habitat.

The data presented in Table 3 include the low-water survey (I), the high-water survey (II), and the combined population from each station for both surveys (I and II). The concluding three lines of the table are a consolidation of all the species found during each survey and of all the species found during both surveys. The total number of different species found was 781.

In addition to the number of species found, Table 3 includes (under SR)

TABLE 3

Number of species of organisms found and species ratio

Station	Algae	SR	Proto-zoa	SR	Inverte-brates	SR	Fish	SR	Totals
EI-15	79	37%	38	18%	57	27%	39	18%	213
EII-15	69	34%	30	14%	76	37%	32	15%	207
EI & II-15	103		63		109		43		318
EI-16	111	48%	39	13%	51	22%	39	17%	230
EII-16	77	37%	30	14%	79	38%	24	11%	210
EI & II-16	132		55		110		43		340
EI-17	78	46%	27	16%	36	22%	26	16%	167
EII-17	100	46%	24	11%	63	29%	31	14%	218
EI & II-17	121		46		86		42		295
EI-19	69	47%	24	17%	33	23%	19	13%	145
EII-19	84	48%	27	15%	56	32%	8	5%	175
EI & II-19	110		49		76		23		258
EI-21	80	44%	32	18%	36	20%	33	18%	181
EII-21	108	50%	26	12%	61	27%	24	11%	219
EI & II-21	135		55		80		45		315
EI	192	36%	128	24%	145	27%	71	13%	536
EII	186	35%	106	20%	183	35%	50	10%	525
EI & II	253	32%	201	36%	248	32%	78	10%	781

the species ratio, i.e., the per cent of the population represented by each group considered. The total number of different species found for any station is, of course, 100%. The species ratio, expressed as a per cent, is obviously more useful in comparing faunae and florae than are the absolute numbers of species, since the relationships among the various groups are more readily comprehended.

An examination of Table 3 reveals several interesting features as regards the relationships of the biota among the various stations of the Escambia River. Of particular interest is the constancy of the proportion of the biota composing each of the four groups presented. Among the five stations of the Escambia River the algae represent 32% to 50% of the organisms present; a range of 18%. The Protozoa had a range of 14% varying from 24% to

38% of all species present. The invertebrates had a range of 18% (20% to 38% of the species present), and the fish had a range of 13% (5% to 18% of the species present). These ranges and relative proportions are characteristic of unpolluted and undisturbed streams.

There is a slight tendency toward an increase in the species ratio of algae as the river progresses downstream toward the more saline stations. There also appears to be an ill-defined tendency for the species ratio of the fish to decrease in progressing downstream. Both these possible gradients need further study based on more extensive data.

Among the animals that form the data for this study we recognize three basic groups. The first of these are the Rotifera, which, like the Protozoa, are microscopic in size and have a short life cycle. As a result these animals can build up quite large populations in response to transient environmental conditions. They are animals that are "here today and replaced tomorrow." The second group includes all other so-called lower invertebrates. It is composed of phyla with representatives in fresh, brackish and salt water. The third group, the insects, differs fundamentally by living only their larval life in water in most cases, and in being limited chiefly to fresh or mildly brackish water. Table 4 presents the same kind of data as Table 3 for these three invertebrate groups.

TABLE 4

Station	Rotifers	SR	Lower Invertebrates	SR	Insects	SR	Totals
EI-15	1	2%	25	44%	31	54%	57
EII-15	5	7%	22	29%	49	64%	76
EI & II-15	6		32		71		109
EI-16	4	8%	17	33%	30	59%	51
EII-16	5	6%	28	36%	46	58%	79
EI & II-16	8		34		68		110
EI-17	4	11%	13	36%	19	53%	36
EII-17	9	14%	15	24%	39	62%	63
EI & II-17	12		23		51		86
EI-19	3	9%	16	49%	14	42%	33
EII-19	9	16%	14	25%	33	59%	56
EI & II-19	11		23		42		76
EI-21	0	0	24	66%	12	34%	36
EII-21	18	30%	15	25%	28	46%	61
EI & II-21	18		27		35		80
EI	8	6%	65	44%	72	50%	145
EII	26	14%	56	31%	101	55%	183
EI & II	29	11%	80	32%	140	57%	249

From Table 4 it is evident that the largest invertebrate element of the Escambia River was the insect fauna. It is interesting to note on the low-water Escambia River survey that the species ratio of insects does not fluctuate greatly in spite of the increased salinity of the lower stations. This is no doubt due to the depressed number of species in general. The variation between the low-water and high-water surveys as regards the lower invertebrates is apparently associated with seasonal variation.

The Collections

In the following annotated list of species collected all of the species listed are not included in Tables 2 and 3. The tables are based on collections from restricted areas, the stations. In the list, however, are included some species from peripheral areas of the survey region where the occurrence of the species seemed worthy of note.

Porifera

DEMOSPONGIAE

Haplosclerina

The single family of fresh-water sponges was represented in the collections by five species. Four of these were from the stations themselves while one occurred outside the area of the survey proper.

SPONGILLIDAE

Meyenia crateriformis Potts. From EI-15. Taken on wood substrate at the surface where it occurred in small colonies varying from ¼ to one inch in diameter.

Heteromeyenia conigera Old. An extra-limital species taken from a log at the surface of the Escambia River at Molino, Florida. The specimen occurred as a very small colony. Previous to this the species was known only from the Chattahoochee River, Ga., the type locality.

Spongilla cf. *lacustris* (L.). From SI-A. The small colony taken did not possess gemmules so a positive specific identification could not be made.

Trochospongilla leidii (Bowerbank). From EI-15 and EI-17. At EI-15 the species was growing on logs under ten feet of water. At EI-17 it was found growing between the bark and bole of a surface log along the shaded left bank. This species occurred in larger colonies than any other species from any survey.

Trochospongilla horrida (Weltner). From EII-16, EII-19, SII-A and NI-E. The species occurred as small colonies on wood substrate in surface collections.

Coelenterata

HYDROZOA

HYDROIDA

Three families of the order were found.

CAMPANULARIIDAE

Unidentified species. From SI-B, SI-C, and SI-D. This hydroid occurred at SI-C on drifting root mat material brought up from the bottom by a trawl. It is not considered a part of the fauna of that station, but rather an adventitious species.

HYDRACTINIDAE

Unidentified species. From EI-21. Found commonly in association with the next species.

CLAVIDAE

Cordylophora lacustris Allman. From EI-21. An abundant population occurring on saw grass stalks and roots along the left bank. The species is of particular interest because it is a stenohaline, brackish-water species.

SCYPHOZOA

SEMAEOSTOMEAE

A single jelly-fish was found.

ULMARIDAE

Unidentified species. From EI-19. Two specimens were taken, though others were seen at this station. Its presence is considered to be fortuitous and the product of inshore winds with a flood tide.

Rhynchocoela

Unidentified species. From SI-B, SII-A and SII-D. Immature specimens of a tube-building species from a sand and clay habitat.

HOPLONEMERTINI

TETRASTEMMATIDAE

Prostoma rubrum (Leidy). From SI-A.

Platyhelminthes

TURBELLARIA

Unidentified species. From NI-H. Three specimens of a non-triclad turbellarian were present in the protozoan collections.

TRICLADIDA

PLANARIIDAE

Dugesia tigrina (Girard). From EII-16. A single specimen of this ubiquitous species was taken from the right bank.

Aschelminthes

ROTIFERA

These minute animals were represented by some specimens from all but two stations, EI-21 and SI-D. The group is predominantly a fresh-water group, and their absence from the two most seaward, and therefore more saline, stations is not surprising. The list of species is presented without annotations and as prepared by Mr. John T. Gallagher.

BDELLOIDEA

PHILODINIDAE

Dissotrocha aculeata (Ehr.). From SII-A.
Dissotrocha macrostyla (Ehr.). From SI-C.
Philodina roseola Ehr. From SI-C.
Rotaria neptunia (Ehr.). From SII-D.

MONOGONONTA

CONOCHILIDAE

Conochiloides coenobasis Skorik. From SI-B.

TESTUDINELLIDAE

Filinia terminalis (Plate). From SI-A and SI-B.
Pedalia jenkinae de Beauchamp. From SI-A and SI-B.
Pompholyx complanata Gosse. From EI-15, EI-16 and EII-21.
Pompholyx sulcata Gosse. From NI-F and NI-G.
Testudinella discoidea Ahlstrom. From EII-21.

ASPLANCHNIDAE

Asplanchnopus multiceps (Schrank). From EII-21 and NI-H.

BRACHIONIDAE

Anuraeopsis fissa (Gosse). From EII-21.
Anuraeopsis n. sp. From SI-B.
Brachionus angularis Gosse. From SI-A, SI-B and SII-B.
Brachionus bidentata Anderson. From SII-B.
Brachionus calyciflorus Pallas. From SII-D and NI-A.
Brachionus dimidiatus var. *inermis* (Schmarda). From SII-D.
Brachionus havanaensis Rousselet. From SI-A, SI-B and NI-E.
Brachionus mirabilis Daday. From EII-21 and NI-E.
Brachionus plicatilis Müller. From SI-A, SI-B, NI-F, NI-G and NI-H.
Brachionus quadridentatus Hermann. From SII-A and SII-D.
Brachionus variabilis Hempel. From SI-B and SI-C.
Kellicottia bostoniensis (Rousselet). From EII-17, EII-19, EII-21 and SII-A.
Keratella cochlearis (Gosse). From EI-16, EI-17, EI-19, EII-16, EII-17, EII-19, EII-21, SI-A, SI-B, SII-A, SII-B, SII-C, SII-D and NI-E.
Keratella crassa Ahlstrom. From EII-17, EII-19 and EII-21.
Keratella gracilenta Ahlstrom. From EII-16, EII-17, EII-19, EII-21 and SII-A.
Platyias patulus (Müller). From SI-A and SII-D.
Platyias polyacanthus (Ehr.). From SII-D.
Platyias quadricornis (Ehr.). From EII-19 and SII-D.

LECANIIDAE

Colurella colurus (Ehr.). From EI-19, EII-21, SI-B and SII-D.
Lecane brilla (Gosse). From EII-17.
Lecane bulla (Schmarda). From SI-B and SII-D.
Lecane hamata Stokes. From SII-B.
Lecane luna (Müller). From SI-A.
Lecane lunaris (Ehr.). From EII-17, EII-19 and EII-21.
Lecane scutata (Harring & Myers). From EII-21.
Lecane stokesii (Pall). From EII-21.
Lecane sylvatica (Harring). From EII-15.
Lepadella ovalis (Müller). From EII-16, EII-17 and EII-19.
Lepadella patella (Müller). From EI-17 and EII-15.
Macrochaetus subquadratus Perty. From EI-16.
Trichotria tetractis (Ehr.). From EII-21.

NOTOMMATIDAE

Cephalodella gibba (Ehr.). From EII-16.
Cephalodella poitera Myers. From EI-17.
Monommata grandis Tessin. From SII-D.
Resticula nyssa Harring & Myers. From SII-A.

SYNCHAETIDAE

Ploesoma hudsoni (Imhof). From EII-15.

Ploesoma lenticulare Herrick. From EII-15.

Ploesoma truncatum (Levander). From EII-17, EII-19 and EII-21.

Polyarthra minor (Voigt). From EII-21 and SII-B.

Polyarthra remata (Skorikov). From EI-16, EI-17, EI-19, SI-A and NI-E.

Polyarthra vulgaris (Carlin). From EII-15, EII-16, EII-17, EII-19, EII-21, SII-A, SII-B, SII-D.

Synchaeta longipes Gosse. From SII-B.

TRICHOCERCIDAE

Trichocerca longiseta. From EI-17 and EII-21.

Trichocerca stylata (Gosse). From SII-B and NI-E.

Nematoda

Although the nematode worms are a common and widespread group which includes many fresh-water species, they did not enter our collections very commonly. None were found in the Sabine or Neches Rivers. However, at EI-21 one species occurred abundantly. They were found in tubes (of *Polydora*?) on the stalks and roots of the saw grass along the left bank. Four or five individuals were present in each tube.

Entoprocta

URNATELLIDAE

Urnatella gracilis (Leidy). From SI-A.

Bryozoa

GYMNOLAEMATA

STENOSTOMATA

NOLELLIDAE

Nolella sp. From SI-A, SI-B and SI-D.

CRISIIDAE

Unidentified species. From SI-A, SII-A and NI-E.

AETEIDAE

Unidentified species. From EI-21.

CTENOSTOMATA

PALUDICELLIDAE

Paludicella sp. From NI-E.

PHYLACTOLAEMATA

PLUMATELLINA

LOPHOPODIDAE

Pectinatella magnifica Leidy. The species was common and formed large colonies in bayous near EI-15, but it was not found in the river proper nor in bayous further downstream than the region of EI-15.

PLUMATELLIDAE

Plumatella repens (L.). From EI-15, EI-17, EI-19, SI-A, SII-A and NI-E.

FREDERICELLIDAE

Fredericella sultana Blumenbach. From EII-19.

Annelida

Many of the annelid worms taken were found only as immature specimens, which made specific identification impossible. Many species were represented by very small populations and the collections, therefore, included only a very few specimens.

ARCHIANNELIDA

NERILLIDAE

Unidentified species. From EI-21. Two specimens were found.

POLYCHAETA

PILARGIIDAE

Loandalia americana Hartman. From SI-D and SII-D.

NEREIDAE

Laeonereis culveri (Webster). From EI-19, EI-21, EII-19, EII-21, SI-B, SI-D, SII-A and SII-D. This was the commonest polychaete in all collections where it occurred.

Nereis sp. From SI-D.

ARABELLIDAE

Drilonereis (?) sp. From EI-21. Only a single specimen was found.

SPIONIDAE

Polydora cf. *hamata* Webster. From SI-B and SI-D.

Polydora sp. From EI-21. This worm was common in the station. It was associated with hydroids and a nudibranch mollusk on the stalks and roots of saw grass along the left bank. A tube building species.

OLIGOCHAETA

NAIDIDAE

Pristina longiseta Ehr. From NI-E.

Stylaria fossularis Leidy. From EII-16.

Stylaria lacustris (L.). From EII-16.

Stylaria sp. From SI-A and NI-E. At Station NI-E this worm was found only in the algae collections where a sparse population was present.

Dero (*Dero*) sp. From SI-A.

Dero (*Aulophorus*) sp. From SI-A and SI-C. At the latter station this worm developed in a laboratory-held protozoan culture from the station.

ENCHYTRAEIDAE

Unidentified species. From SII-B. Four immature specimens were found as burrowers along the left bank.

TUBIFICIDAE

Limnodrilus sp. From EI-15, EI-16 and EII-15.

Monopylephorus sp. From EII-17 and EII-19. A burrowing species in a mud bottom.

Branchiura sowerbyi Beddard. From EI-15 and EII-15. This Asiatic worm has a wide North American distribution. It has been reported from Illinois, Ohio, Michigan, Tennessee, Iowa and Wisconsin (Pennak, 1953). We are able to report collections of the species from the Guadalupe River in Texas at Seguin and below Victoria as well as collections from the Brandywine Creek near West Chester, Pennsylvania. These additional records extend the known North American range from midwestern drainage basins to both Atlantic and Gulf Coast drainage basins. No doubt further records will be forthcoming with more survey studies.

LUMBRICULIDAE

Premnodrilus (?) sp. From EI-15, EI-17, EII-16, EII-17, EII-19 and EII-21. A bottom-burrowing species present in limited numbers. All specimens taken were immature but were referable to this genus.

GLOSSOSCOLECIDAE

Drilocrius (?) sp. From EI-15 and EII-15. Three non-clitellate specimens were taken during the low-water, fall survey and a single, larger, clitellate specimen during the high-water, spring survey. A pair of copulatory appendages occurred on the ventrum at 8/9 of all specimens. The clitellum extended from 8 through 12. The setae were more deeply buried at the anterior end than the posterior end, but this may be an artifact of fixation. The copulatory appendages of the clitellate specimen were relatively shorter and stouter than those of the non-clitellate specimens.

SPARGANOPHILIDAE

Sparganophilus (?) sp. From EI-16 and EII-15. Several non-clitellate specimens from EI-16. Three clitellate specimens from EII-15. The clitellum extended from 14 through 22. The setae were deeply buried, though still visible. All specimens were taken with the Petersen dredge.

BRANCHIOBDELLIDAE

Unidentified species. From EI-15 and EI-17. Specimens were found only as parasites of the blue crab, *Callinectes sapidus*.

HIRUDINEA

GLOSSIPHONIIDAE

Helobdella stagnalis (Say). From EII-16. Five specimens were taken of which three were carrying young.

Helobdella nepheloidea (Graf). From EI-19, EII-15, EII-16 and EII-19. Each collection was represented by a single specimen. The specimen from EII-1 was carrying young.

Placobdella parasitica (Say). From EI-16, EII-15 and EII-16. Not common, the three collections including only four specimens.

ERPOBDELLIDAE

Erpobdella punctata (Leidy). From EI-16. One young specimen. Two rows of irregularly spaced, small, black spots occurred along the dorsum but otherwise this leech was colorless except for some blotches on the caudal sucker.

Dina microstoma Moore. From EII-16 and EII-17. Not common, each collection including but a single specimen.

PISCICOLIDAE

Piscicola sp. From EI-19. A single, small specimen from bottom material.

Illinobdella sp. From EII-16. Taken from the warmouth bass, *Chaenobryttus coronarius* (Bartram).

Unidentified species. From SI-A and SII-D. The specimen from SII-D was taken from a blue crab (*Callinectes sapidus*).

Mollusca

GASTROPODA

PROSOBRANCHIATA

NERITIDAE

Neritina reclivata Say. From EI-17, EI-19, EI-21 and EII-21.

VIVIPARIDAE

Campeloma lewisii Walker. From EI-15 and EII-15. The species is a bottom form and occurred commonly at this station. It was found alive in the river as far downstream as 10.8 miles above the river mouth (1.9 miles above Station 16).

VALVATIDAE

Valvata bicarinata Lea. From EI-16 and EII-16. Two specimens from EI-16 and ten from EII-16.

AMNICOLIDAE

Amnicola sp. From EI-15, EI-16, EII-15 and EII-16. An apparently undescribed species found commonly at EI-15 and EII-16, but sparingly from EI-16 (one specimen) and EI-15 (three specimens).

Lyrodes sp. From EII-16. Represented by two eroded, though living, specimens.

Pomatiopsis lapidaria (Say). From EI-17. A single specimen of what appears to be this species was taken from a leaf substrate along the left bank in shallow water. We are not aware of any other Florida record for the species.

Littoridina sp. From SI-A. An apparently undescribed species of this family of minute snails.

PLEUROCERIDAE

Goniobasis mutabilis Lea. An extra-limital species found between Stations EI-15 and EI-16. It occurred on submerged logs in a small sunny area along the bank at about 11.7 miles above the river mouth. It was common within this very restricted area. Specimens were also found at 11.1 and 10.6 miles above the river mouth.

OPISTHOBRANCHIATA

AEOLIDAE

Unidentified species. From EI-21. Found commonly on saw grass stalks and roots along the left bank. This animal is possibly an undescribed species. It was not present during the highwater (spring) survey.

PULMONATA

LYMNAEIDAE

Pseudosuccinea columella (Say). From EI-15, EI-16, EI-17 and EII-15. Sparse populations with each lot containing only one to three specimens.

PHYSIDAE

Physa sp. From EI-16, EI-21, EII-15, EII-16 and EII-21. All specimens collected were immature. The only populations of any size were from EII-15 and EII-16. The records from Station 21, both at the low-water and high-water river stages, are based on single specimens that probably represent drift material.

PLANORBIDAE

Menetus alabamensis Pilsbry. From EI-15 and EII-15. Not very common as only one specimen was taken during the low-water survey. Nine were taken during the high-water survey.

ANCYLIDAE

Ferrissia fusca (C. B. Adams). From EI-16, EI-17 and EII-16. Common.

Ferrissia sp. From SII-A. A single specimen.

PELECYPODA

EULAMELLIBRANCHIATA

UNIONIDAE

In the Escambia River a particular effort was made to determine the point at which these fresh-water clams disappeared from the river fauna. This study was made during the low-water survey in the fall of the year. The closest approach to the river mouth where living clams were discovered was at 10.6 miles above the river mouth. This was 1.7 miles upstream from Station 16. At this point a single specimen of *Elliptio crassidens* was found alive. Five species were living at 10.8 miles above the river mouth. Eleven species were found at Station 15, which was 12.7 miles above the river

mouth. In the following list of the species collected the occurrence of species downstream from Station 15 is indicated by the mileage above the river mouth. The absence of half the species from the high-water collections probably reflects the limitations of collecting rather than a real depauperization of the clam fauna.

Micromya vibex (Conrad). From EI-15, EI-mile 11.1 and EII-15.

Micromya lienosa (Conrad). From EI-mile 11.1, EI-mile 10.8 and EII-15.

Lampsilis claibornensis (Lea). From EI-15, EI-mile 10.8 and EII-15.

Lampsilis anodontoides (Lea). From EI-15 and EI-mile 10.8.

Anodonta gibbosa Say. From EI-15 and EI-mile 10.8.

Anodonta imbecillis Say. From EI-15.

Quadrula succissa (Lea). From EI-15, EI-mile 11.1 and EII-15.

Quadrula near *succissa* (Lea). From EI-15.

Quadrula sp. From EI-15.

Elliptio crassidens (Lam.). From EI-15, EI-mile 11.1 and EI-mile 10.6.

Elliptio arctatus (Conrad). From EI-15, EI-mile 11.1, EI-mile 10.8 and EII-15.

Unidentified species. From NI-E. A single, very immature specimen which was probably an incident of adventitious distribution.

SPHAERIIDAE

Sphaerium (*Musculium*) *partumeium* (Say). From EII-15.

Pisidium sp. From EI-15, EII-15, EII-16 and EII-17.

Eupera cubensis (Prime). From EII-16.

DREISSENSIIDAE

Mytilopsis leucophaeatus (Conrad). From EI-17, EI-19, EI-21, EII-17, EII-19, EII-21, SI-A, SI-B, SI-D, SII-A, SII-B and NI-E.

MACTRIDAE

Rangia cuneata (Gray). From EI-19, EI-21, EII-19, EII-21, SI-A, SI-B, SI-D, SII-A, SII-C, SII-D, and NI-E. Only immature specimens were found in the Escambia River stations, and these were scarce. The only extensive beds found were at SI & II-A and NI-E. The latter was a very extensive bed.

TELLINIDAE

Tellina sp. From SII-D. A very few small specimens.

Arthropoda

CRUSTACEA

CLADOCERA

CHYDORIDAE

Eurycercus lamellatus (Müller). From EII-16. Scarce.

OSTRACODA

Unidentified species. From NI-E. Scarce.

COPEPODA

CYCLOPODIDAE

Unidentified species. From EII-17. A small bottom form. Scarce.

BRANCHIURA

ARGULIDAE

Argulus sp. From EI-19. A single specimen, swimming freely, was taken.

CIRRIPEDIA

BALANIDAE

Balanus amphitrite niveus Darwin. From EI-21, EII-21, SI-A, SI-B, SI-D, SII-A, SII-B, and SII-D.

Balanus improvisus Darwin. From NI-E.

MYSIDACEA

MYSIDAE

Mysis stenolepis Smith. From EI-16, EI-19, EI-21, EII-16, EII-19 and EII-21.

ISOPODA

SPHAEROMIDAE

Cassidisca lunifrons (Richardson). From EI-19, EII-16, EII-17, EII-19, and EII-21. A collection of 27 specimens from EII-19 indicates the presence of a good population. The other lots contained from one to three specimens only.

Sphaeroma terebrans Bate. From EI-21, EII-21 and SI-B. Station 21 of the Escambia River contained a very large population of this wood-boring isopod at both low-water and high-water river stages. They were found along the right bank in submerged tree trunks.

ASELLIDAE

Asellus attenuatus Richardson. From EI-15, EI-16, EI-17, EII-15, EII-16 and EII-17. During the high-water (spring) survey ovigerous specimens were taken.

PARASELLIDAE

Munna sp.? From SI-A.

BOPYRIDAE

Probopyrus (?) sp. From SI-A. Parasitic on *Palaemonetes pugio.*

AMPHIPODA

BATEIDAE

Unidentified species. From EI-21. Only two specimens found. Both were ovigerous.

GAMMARIDAE

Carionogammarus mucronatus (Say). From EI-17, EI-19, EI-21, EII-16, EII-19 and EII-21. No ovigerous specimens were found.

Crangonyx gracilis Smith. From EI-16, EII-15, EII-16 and EII-17. Specimens taken in the spring were ovigerous.

Melita nitida Smith. From EI-21, EII-19 and EII-21. Not common. Specimens taken in the fall were ovigerous.

Gammarus fasciatus Say. From SI-A, SII-A, SII-D and NI-E.

TALITRIDAE

Hyalella azteca (Saussure). From EI-16, EII-16 and EII-17. No ovigerous specimens were found.

Orchestia agilis Smith. From SII-B.

COROPHIIDAE

Corophium cf. *lacustris* van Hoffen. From SI-A.

Corophium crassicorne Bruz. From EI-19, EI-21, EII-16 and EII-21. Ovigerous specimens were taken in the fall.

Ericthonius brasiliensis (Dana). From EI-17, EI-19 and EI-21. Ovigerous specimens were found in each station. A total of seven individuals was taken.

DECAPODA

PALAEMONIDAE

Macrobrachium ohione Smith. From EI-21, EII-17, SII-A, SII-B and SII-C. This vagile species was taken by seine in the Escambia River stations. Only three specimens were captured. The specimens from SII-A were abundant in bait-shrimp traps set by a local bait dealer. The Sabine River collections were composed chiefly of ovigerous specimens.

Palaemonetes pugio Holthuis. From SI-15, EI-17, EII-15, EII-16, EII-17, SI-A, SI-B, SI-D, SII-A, SII-B, SII-C, SII-D, NI-E and NI-G. None were ovigerous.

PENAEIDAE

Penaeus aztecus Ives. From SI-B, SI-D and NI-H. These were all small specimens.

Penaeus setiferus (L.). From SI-A, SI-B, SI-C and SI-D. These were all small specimens.

ASTACIDAE

Procambarus clarki (Girard). From SII-A and SII-D. A single female from SII-A and a single, first-form male from SII-D.

Unidentified species. From *EI-15, EI-16, EII-15* and *EII-16.*

Two fresh crayfish burrows with low chimneys were seen at Station NI-E, but no specimens could be located. The burrows were in clay on the left bank.

CALLIANASSIDAE

Callianassa sp. From EI-19. Only a single specimen was found.

PORTUNIDAE

Callinectes sapidus Rathbun. From EI-16, EI-17, EI-19, EI-21, EII-17, SI-A, SI-B, SI-C, SI-D, SII-A, SII-B, SII-C, SII-D, NI-G and NI-H. This species was represented by many dead specimens at NI-F.

OCYPODIDAE

Uca minax LeConte. From NI-G and NI-H.

Uca pugnax (Smith). From SII-B and SII-C.

Uca pugnax rapax (Smith). From EI-16 and EII-21.

XANTHIDAE

Rithropanopeus harrisii (Gould). From EII-17, EII-19, EII-21, SI-A, SI-B, SI-D, SII-B, SII-C, SII-D and NI-E.

ARACHNOIDEA

ACARINA

LEBERTIIDAE

Lebertia sp. From EI-16, EI-19, EII-16 and EII-17.

INSECTA

In all, 152 species of insects were taken from the three rivers collected. All the orders normally considered aquatic in some stage of their life history were represented. These orders ranged from 27 species of Diptera to one Neuropteran.

Of the three rivers the Escambia was the best populated, with 140 species. In the other two the species number is reduced to 27 on the Sabine and 6 on the Neches. It can be seen by adding these figures that there was an overlap of only 21 species among these rivers.

PALEOPTILOTA

ODONATA

Members of this order were taken only from the Escambia and Sabine rivers. The Escambia fauna was quite diverse, with three genera and seven species of Zygoptera and twelve genera and fourteen species of Anisoptera. The Sabine fauna, on the other hand, was restricted to two genera and four species of Zygoptera, all from one station. Only one species was unique to the Sabine.

ZYGOPTERA

COENAGRIONIDAE

Argia moesta (Hagen). From EI-15. A relatively rare nymph in this area. It was represented by a single specimen.

Argia sedula (Hagen). Taken from EI-16 and EII-17 and EII-19. A total of five nymphs were taken.

Argia tibialis (Ramb.). Ten nymphs from EI-15, EI-16, EI-17 and EII-16 and EII-17. A very common species in northern Florida. It was the commonest odonate species in the Escambia.

Enallagma sp. These specimens (sixteen) were juvenile nymphs, too small to be accurately determined. They were found on the first Escambia Survey at all stations and SI-A and undoubtedly represent the following three species which, in the case of the Escambia, were identifiable only on the second survey.

Enallagma species have been previously recorded from brackish water.

Enallagma pallidum Root. Found only on EII-17 and EII-19. Fairly common as were the following two species.

Enallagma signatum (Hagen). Taken at EII-17, EII-19 and SI-A.

Enallagma weewa Byers. Taken from EII-16, EII-19, EII-21. An endemic Florida species according to Byers (1930).

Ischnura posita (Hagen). From EI-21 and SI-A. A relatively rare nymph represented by one specimen at each station.

Ischnura nr. *verticalis* (Say). From SI-A. This species could not be positively identified.

ANISOPTERA

Members of this suborder were found only in the Escambia River and were never especially common.

AESHNIDAE

GOMPHINAE

Aphylla williamsoni Gloyd. From EII-21. Recorded by Byers as *Negomphoides ambigua* (Selys). Is not usually found in rivers.

Dromogomphus spinosus Selys. Found only from EI-15.

Gomphus lividus Selys. One specimen from EI-16.

Gomphus (*stylurus*) *plagiatus* Selys. From EI-15, EII-15 and EII-17. Relatively common.

Gomphus dilatatus Ramb. From EII-15. Two specimens were taken.

AESHNINAE

Boyeria vinosa (Say). Taken only from EI-17.

Nasiaeshna pentacantha (Ramb.). From EI-17 and EI-16. Only one specimen taken each time.

LIBELLULIDAE

CORDULIINAE

Macromia sp. From EI-15 and EI-16. The commonest anisopteran taken.

Neurocordulia molesta Walsh. From EI-15, EII-15.

Tetragoneuria cynosura? Say. One specimen from EI-16.

Somatochlora sp. From EI-16 and EII-16.

LIBELLULINAE

Libellula vibrans Fabr. From EI-16 and EI-17.

Erythemis simplicicollis (Say). Only a single specimen taken from EI-21. It may have washed in from above since there is no evidence that it was established at the high salinity here.

Pachydiplex longipennis (Burm). From EII-16. Like the above species, only one specimen was taken.

EPHEMEROPTERA

The mayfly nymphs from the three rivers collected, consisted of 21 species. There were 18 species from the Escambia, three from the Sabine and one from the Neches. One species (*Stenonema*) sp. 1 was common to the Escambia and Sabine. The genus *Hexagenia* was common to all three rivers, but the species differ. In the two rivers (Escambia and Sabine) where low-water and high-water surveys were undertaken, the mayfly fauna was well represented on only the high-water surveys. On the Sabine no mayfly nymphs were taken on the low-water survey and three on the high-water survey, while on the Escambia six were taken on the low-water survey and 15 on the high-water survey. On both these rivers the decreased salinity during the high-water periods was probably the prime factor responsible for the increase. Specimens were common in sawgrass roots.

The classification used is that of Burks (1953).

EPHEMERIDAE

Hexagenia sp. Taken from SII-A.

Hexagenia bilineata (Say). From NI-E. A characteristic large river form.

Hexagenia munda elegans? Trav. From EI-15, EII-15, EII-17 and EII-21. A widely distributed species.

CAENIDAE

Tricorythodes sp. One specimen from EI-16. A rare species here.

Brachycercus nitidus Trav. From EII-15. Represented by a single specimen. Berner (1950) does not list this species from Florida.

EPHEMERELLIDAE

Ephemerella hirsuta Bern. From EII-16. Only one specimen taken.

Ephemerella trilineata Bern. From EII-15 to EII-21. Very common, 50 specimens taken.

LEPTOPHLEBIIDAE

Leptophlebia poss. *intermedius* (Trav.). Taken from EII-19.

Paraleptophlebia volitans (McD.). Taken from EII-16.

BAETIDAE

Isonychia sp. B Bern. Found on EII-15 and EII-19. The only previous Florida record is from Washington County.

Isonychia sp. From SII-A.

Callibaetis sp. This was the only ephemerid nymph taken from EI-21 where the chlorinity was 2500 ppm. Berner (1954) records *Callibaetis floridans* as living in a chlorinity range of 2130 ppm to 10,000 ppm.

Baetis spinosus McD. From EI-19, EI-21 and EII-15 to EII-21. A very common species, 100 specimens were taken on EII-16.

Pseudocloeon sp. Rare from EII-16.

Pseudocloeon prob. *parvulum* McD. Found on EI-15 to EII-21, but only one or two specimens at each station.

Neocloeon prob. *alamance* Trav. This species found on EI-17 and EII-19 may be the species Berner (1950) lists as *Cloeon* sp. A, also found in northwestern Florida.

Cloeon poss. *rubropictum* McD. From EII-21. This is a northern species which Berner has tentatively identified from northwestern Florida. Its identity is as yet not certain.

HEPTAGENIIDAE

Stenonema sp. 1 (*pulchellum* group). From EI-15, EI-16, EII-15 to EII-21 and SII-A. A very common species.

Stenonema pulchellum sp. ?. From EII-15 and EII-17. This species is tentatively placed in the *pulchellum* group.

Heptagenia flavescens Walsh. From EII-21. A widely distributed species not previously recorded from Florida.

Heptagenia nr. *julia* Trav. A single specimen taken on EII-15. Also not recorded from Florida.

NEOPTILOTA

PLECOPTERA

The plecopteran fauna of the Gulf Coast is very meager. No nymphs were taken from the Neches or Sabine and only three species from the Escambia. With the exception of the *Togoperla* sp. the species are common and widely distributed.

PERLIDAE

Neoperla clymene (Newm.). Taken from EI-15 and EII-15.

Perlesta placida (Hagen). Very common from EII-15 to EII-21, in the roots of sawgrass.

Togoperla sp. A single specimen from EI-15.

HEMIPTERA

HETEROPTERA

The Heteroptera fauna is, though not populous, fairly well diversified. There are 13 species present from all three rivers. The distribution of the species is extremely sporadic, no species being found at more than one stream. Within a river such as the Escambia, their distribution is also slightly spotty. This is not surprising in a group of free-swimming forms. It is interesting to note that the surface living gerrids present on the low-water survey are completely absent at high water.

HYDROMETRIDAE

Hydrometra hungerfordi Bueno. Found only on EII-15.

GERRIDAE

Metrobates hesperius Uhl. Present on EI-15 and EI-16; common.

Rheumatobates tenuipes Mein. Very common species on EI-15, EI-16 and EI-21.

Rheumatobates hungerfordi Wiley. Found on SI-A.

Tropobates sp. (*immature*). Only at SII-A.

Trepobates inermis Esaki. Only three specimens from EII-19 and EII-17.

NEPIDAE

Ranatra australis Hung. One specimen from EII-15.

Ranatra buenoi Hung. Only from NI-E.

Ranatra nigra H. & S. A single specimen from EII-17.

NAUCORIDAE

Pelocoris femoratus P. de B. From EII-17. Taken at the base of some sawgrass.

NOTONECTIDAE

Notonecta sp. (*immature*). From SII-A.

CORIXIDAE

Trichocorixa calva (Say). Present at SI-C; common in Texas.

Trichocorixa kansa Sailer. Present at EII-15. Only other Florida record from Ponce de Leon (Hungerford 1948).

Trichocorixa sp. (*immature*). From EII-19. Probably nymph of above species.

NEUROPTERA

SISYRIDAE

Sisyra sp. Found on some brush roots at EII-16. The only neuropteran taken from any of the rivers.

MEGALOPTERA

The Megaloptera were rare in these rivers collected. The three species taken were all from the Escambia River and all of them were represented by one specimen of each.

SIALIDAE

Sialis sp. From EI-16.

CORYDALIDAE

Corydalis cornutus (L.). From EI-15.
Chauliodes sp. From EII-15.

COLEOPTERA

The Coleoptera fauna consists of 23 species from the Escambia and Sabine rivers combined. There are 21 species from the Escambia and seven species from the Sabine River. Four species are common to the two rivers. The larvae are not counted as separate species. The bulk of the species are in the Dytiscidae (6), Gyrinidae (6) and the Elmidae (8).

ADEPHAGA

DYTISCIDAE

sp. (larva). From EII-15 and EII-21.
Desmopachria convexa Aubé. Taken on EII-17 and EII-19.
Coelambus sp. 1. Among sawgrass roots at EII-15 and EII-16; also at SI-B and SII-A.
Coelambus sp. 2. As above, from EII-16 and SII-A.
Coelambus inaequalis (Fab.). From EI-16 and EII-15.
Coptotomus interrogatus (Fab.). Only from EII-16.
Thermonectes basillaris (Harr.). Found at EII-21.

GYRINIDAE

Dineutes assimilis (Kby.). Only from SII-A.
sp. 1 (larva). From EII-15 to EII-19.
sp. 2 (larva). From EII-19.
Gyrinus borealis Aubé. Taken only at EI-15.

Gyrinus lugens Lec. From EI-17, EII-19 and SII-A.
Gyrinus pectoralis Lec. Only from EI-16.
Gyrinus analis Say. EII-15, EII-17 and SII-A.
Gyretes sinuatus Lec. Rare, only at EII-15.

HAPLOGASTRA

HYDROPHILIDAE

Tropisternus glaber (Hbst.). One of the two insects from SI-A.
Hydrobius tesselatus Zimm. Only from EII-15.

POLYPHAGA

ELMIDAE

Essentially an Escambia stenelmid fauna. None of the species represented by many specimens, in most cases only one.
Stenelmis sp. (larva). From EI-15, EII-15.
Stenelmis sp. From EI-15 and EI-16.
Stenelmis (*sinuata-humerosa*) sp. From EI-15.
Stenelmis grossa Sand. Only from EI-15.
Stenelmis fuscata Blatch. Found at EII-15 and EII-16.
Stenelmis antennalis Sand. At EI-15.
Machronychus glabratus (Say). At EI-16, EII-16 and EII-17.
Ancyronyx variegatus (Germ.). Found at EI-15 and EI-16.
Simsonia sp. Found at EI-19. The only dryopid below Station 17 on EI.

CHRYSOMELIDAE

Donacia sp. (larva). The larva of the species below; from EII-16 and EII-19.
Donacia palmata Oliv. Found on lily pads at EII-16.

TRICHOPTERA

The Trichoptera fauna of the rivers collected was rather meager. There were a total of ten species taken and only one of these (Psychomyiidae nr. genus A. Ross) was present at all three rivers. The Trichoptera fauna here is not too well known and it is difficult to determine the larvae with any degree of certainty.

PHILOPOTAMIDAE

Chimarra sp. A single larvae of this genus was taken from EI-15. It appeared to be close to *C. feria* Ross but could not with certainty be called that species.

PSYCHOMYIIDAE

Sp. nr. Genus A Ross. Present at NI-E, SI-A, EI-17, EI-19, EI-21, EII-15 and EII-19. This was the commonest caddisfly larva found in the Gulf streams collected. The specimens agreed with psychomyiid genus A Ross in the dentition of the mandibles and form of the anal segments, but the anal hooks lacked the fine spines and the head maculation was different. Ross' species has been recorded from Florida.

Phylocentropus prob. *placidus* Banks. A single specimen, from EII-15.

Polycentropus nr. *remotus* Banks. A single specimen from EII-17.

HYDROPSYCHIDAE

Macronemum carolina (Banks). One specimen from EI-15. A widely distributed southern species.

HYDROPTILIDAE

Oxyethira sp. Two specimens from EI-16 and EI-17.

LEPTOCERIDAE

Leptocella sp. Found on EI-16 and EII-15.

Athripsodes nr. *alagmus* Ross. Found on EII-15, EII-16 and EII-19.

Oecetis inconspicua (Walk.). A widely distributed species found on EII-16 and EII-17.

Triaenodes injusta ? (Hagen). From EII-15, EII-16, EII-19 and EII-21. A common species on EII. Specimens key to this species in Ross (1944), but it is doubtful if it is *T. injusta*, a restricted more northern species.

DIPTERA

The Diptera with 57 species is the largest single insect order in these Gulf Coast rivers. As has been found in other cases, the Tendipedidae with 47 species are the dominant element of Diptera in these rivers. Of the three rivers, the Escambia had 56 species, the Sabine had nine species and the Neches only three species of Diptera. There was an overlap of six species between the Escambia and Sabine, one between the Escambia and Neches and one between the Neches and Sabine.

NEMATOCERA

CULICIDAE

Chaoborus punctipennis (Say). Found on EI-17, EII-19, EII-21 and SI-A.

HELEIDAE

The species listed under this family, as far as could be determined, belonged to the *Palpomyia* group. Further definite separation into genera was impossible. The "species" used here were separated on obvious morphological characters but there is no certainty that they actually represent true species.

Sp. 1. Probably a *Probezzia* sp. from EI-15, EII-15, EII-17 and NI-E.
Sp. 2. From EI-17; EII-15 to EII-21.
Sp. 3. From EI-17, EI-19, EII-15 to EII-19.
Sp. 4. From EII-15, EII-16 and EII-19.
Sp. 5. Probably a *Bezzia* sp. from EI-21, EII-15, EII-19 and EII-21.

TENDIPEDIDAE

This family constitutes the greatest part of the Diptera fauna. Unfortunately, as was pointed out in Roback (1953), most of the larvae cannot be identified and must be referred to by letter. The letters used correspond to those used in the Savannah River Tendipedidae unless the species listed here was not found on the Savannah. Only the Tendipedini were found on the Sabine and Neches Rivers. Overall, as on the Savannah, the Tendipedini dominate with 24 species to 14 Hydrobaeninae, five Pelopiinae and four Calopsectrini.

PELOPIINAE

Pentaneura monilis Joh. From EI-16, EI-17 and EII-15 to EII-21. This species was reared from the Escambia. *Pentaneura* sp. b on the Savannah is probably this species.

Pentaneura (*melanops* group) sp. Taken on EII-16.

Pentaneura sp. From EI-15. An immature specimen, probably of the above species.

Procladius adumbratus ? Joh. From EI-17, EI-19 and EII-21.

Clinotanypus pinguis ? Loew. From EI-15, EI-21, EII-16 and EII-21. Agrees with this species in Johannsen (1937).

Coelotanypus concinnus (Coq.). From EI-15 and EI-19. A very common species.

HYDROBAENINAE

Corynoneura (*Thienemanniella*) sp. b. Taken only from EII-15.

Corynoneura (*Corynoneura*) sp. Fairly common on EII-15, EII-16, EII-17 and EII-21. The species is close to *C. celeripes* Winn., but differs in antennal ratio from any of the species listed in Roback (1953).

Cricotopus (Group *Eucricotopus*). From EII-21. This is probably *C. trifasciatus* (Panz.).

Cricotopus bicinctus (Meig.). From EI-16, EI-21, EII-15 to EII-21. This is the species designated as *Hydrobaenus* (*Hydrobaenus*) sp. c in Roback (1953).

Cricotopus bicinctus (Meig.) var. From EII-15 and EII-21.

Hydrobaenus sp. a. From EII-17. Fig. 1B. Could not be definitely assigned to any subgenus, may be a *Psectrocladius*.

Hydrobaenus sp. b. Also from EII-17. Fig. 1C.

Hydrobaenus (*Eukiefferiella*) sp. From EII-17. Fig. 1E. A single specimen which apparently falls in this subgenus.

Hydrobaenus (*Hydrobaenus*) sp. a. Only from EII-19.

Hydrobaenus (*Hydrobaenus*) prob. *nivoriundus* (Joh.). From EII-17.

Hydrobaenus (*Psectrocladius*) sp. a var. From EII-16 to EII-21.

Hydrobaenus (*Psectrocladius*) sp. b. Found on EI-19.

Hydrobaenus (*Psectrocladius*) sp. f. From EI-17. Fig. 1G.

Hydrobaenus (*Psectrocladius*) sp. g. From EII-17. Fig. 1F.

Hydrobaenus (*Psectrocladius*) prob. *flavus* (Joh.). From EII-15.

TENDIPEDINAE

Calopsectrini

Calopsectra nr. *exigua* (Joh.). From EII-16.

Calopsectra nr. *curticornis* ? (Kieff.). From EI-15. Pupal-abdominal spine pattern resembles *C. curticornis* as figured in Bause (1915).

Calopsectra (*Micropsectra*) sp. a. From EI-16, EI-17 and EII-15. Both this and sp. b differ from the *C.* (*Micropsectra*) species on the Savannah.

Calopsectra (*Micropsectra*) sp. b. From EI-17 and EII-21.

Tendipedini

Sp. B. Taken from EI-16.

Sp. C. One specimen from EI-15.

Sp. D. One specimen from EII-16. Resembles *Stenochironomus*, but antenna has only five segments. Fig. 1D.

Stenochironomus sp. b. From EI-16. Fig. 1H. Both *Stenochironomus* species represented by only one specimen.

Stenochironomus sp. c. From EI-19. Fig. 1I.

Polypedilum sp. b. Found in EII-21.

Polypedilum illinoense (Mall.). Found on EI-15, EI-19, EI-21, EII-15, EII-16, EII-19 and SII-A, SII-B, SII-D.

Polypedilum fallax (Joh.). Found only on EI-15, EI-16 and SII-A.

Polypedilum prob. *scalaenum* (Schrank). Common on EII-16, EII-17, EII-19 and EII-21.

Polypedilum halterale (Coq.). Only two specimens from EII-15.

Tanytarsus (*Endochironomus*) *nigricans* ? (Joh.). Taken on EI-15, EI-16, EI-21, EII-21, SI-A and SII-A.

Tanytarsus (*Tanytarsus*) *flavipes* (Meig.). From EII-15 and EII-16.

Tanytarsus sp. d. Only one specimen from EI-19.

Tanytarsus sp. (pupa). From SI-A. Probably that of *T. nigricans*.

Cryptochironomus digitatus (Mall.) var. Taken at SI-A.

Cryptochironomus s. 1 sp. b (Joh.). Taken from SI-B and NI-E. This species and the following one are in all probability not *Cryptochironomus*, and may not be Tendipedinae. The " paralabials " are neither striate nor movable. They resemble some of those found in the Diamesinae. The maxillary palpi are barely longer than wide and there is no mandibular comb to be found. Until reared, however, their placement must of necessity be a tentative one.

Cryptochironomus s. 1 sp. c. From EII-16 and EII-19. Differs from above in antennal ratio 33:9:1.5:4:2 and in having only eight labial teeth instead of ten. Fig. 1A.

Tendipes sp. From EI-17 and EII-15.

Tendipes (*Limnochironomus*) prob. *modestus* (Say). From EI-16, EI-17, EII-19 and NI-E. This is the species called *Glyptotendipes* nr. *senilis* sp. d in Roback (1953). The antennal ratio should be 30:9:4.5:5:2.

Tendipes (*Limnochironomus*) sp. From SI-A. Labial plate as species above but antennal ratio 26:10:4:7:2.

Glyptotendipes sp. From EI-16. A single specimen tentatively assigned to this genus.

Glyptotendipes nr. *senilis* (Joh.) sp. c. Found on EI-21 and SI-B and SI-D. This may be a *Limnochironomus*.

Harnischia sp. (pupa). Found on EI-21.

Harnischia sp. Found on EII-16, EII-17 and EII-19. Fig. 1J.

Harnischia nr. *camptolabis* (Kieff.). From EII-17. A single specimen whose labial plate resembles that of *H. camptolabis* (Kieff.). Fig. 1K.

Harnischia abortiva ? (Mall.). From EII-16 and SI-A. Specimens agree very closely with Johannsen's (1937) description of the larvae of this species.

SIMULIIDAE

Similium nr. *jenningsi* Mall. Very common from EII-15, EII-16 and EII-17.

ITONIDAE

sp. (larva). At EII-17. One specimen from sawgrass root.

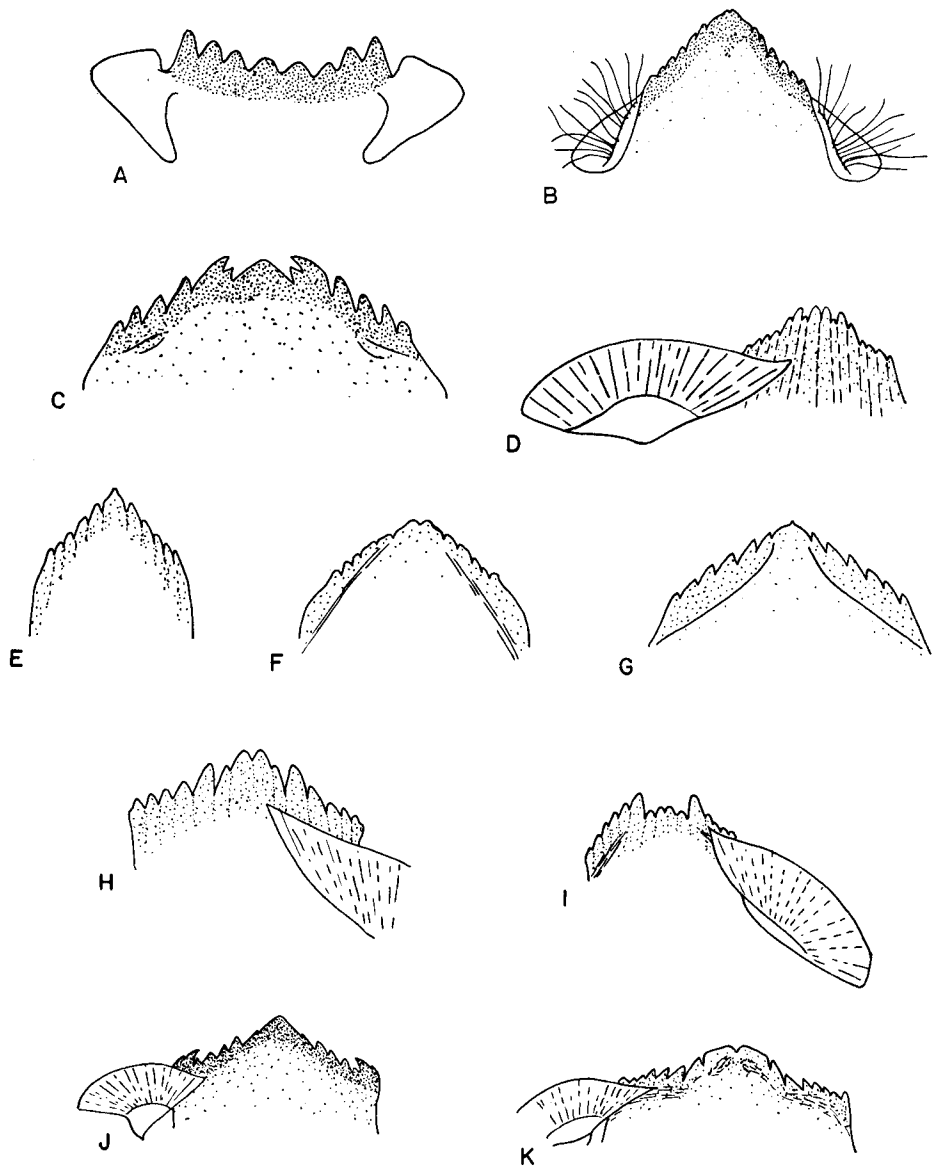

Fig. 1. A—*Cryptochironomus* s. l. sp. c. B—*Hydrobaenus* sp. a. C—*Hydrobaenus* sp. b. D—*Tendipedini* sp. D. E—*Hydrobaenus* (*Eukiefferiella*) sp. F—*Hydrobaenus* (*Psectrocladius*) sp. g. G—*Hydrobaenus* (*Psectrocladius*) sp. f. H—*Stenochironomus* sp. b. I—*Stenochironomus* sp. c. J—*Harnischia* sp. K—*Harnischia* sp. nr. *camptolabis* (Kieff.).

BRACHYCERA

TABANIDAE

Tabanus sp. 1. From EI-16 and EII-15 and EII-16.
Tabanus sp. 2. From EI-16.

SALINITY AND ITS INFLUENCE

The single, most important ecological factor in the area of these surveys was salinity. This single feature is the most influential in the biotic composition of the lower reaches of these rivers. All the salinity data presented here were calculated from the chlorides which in turn were derived by the silver nitrate titration method. Total salinities were calculated according to the formula: chlorinity as parts per million times 1.805 plus 0.03 equals total salinity as parts per million.

The classification of waters according to the total salinity which is used herein is essentially that of Redeke (1922). This classification consists of four categories. These are: fresh water (less than 100 ppm salinity), oligohaline (100–1000 ppm salinity), mesohaline (1000–10,000 ppm salinity) and polyhaline (greater than 10,000 ppm salinity). Table 5 presents the total salinities in parts per million for each station.

TABLE 5

Total Salinities in ppm

Station	Surface	Bottom	Station	Surface	Bottom
EI-15	5.8	5.8	EII-15	5.6	5.6
EI-16	334	676.8	EII-16	5.6	5.6
EI-17	1742	22,562	EII-17	6.7	6.7
EI-19	4962	11,732	EII-19	8.7	8.7
EI-21	4512	24,175	EII-21	12.5	13.5
SI-A	281	2,707	SII-A	89	82
SI-B	2111	10,830	SII-B	1322	2547
SI-C	3140	7,942	SII-C	2023	1840
SI-D	3772	11,552	SII-D	1101	6191
NI-E	83	346			
NI-F	1542	16,335			
NI-G	1783	13,302			
NI-H	1707	18,230			

Wind, tides and river discharge modify salinities considerably, and oscillation of the various zones in relation to their relative distances from the river mouth is continuous. As with all continuous variates, and especially with those which fluctuate, the borders between the various arbitrarily assigned categories are not rigid. However, as the data in Table 5 demonstrate, the highest salinities occur during the low-water river stages and the lowest salinities during high-water river stages.

A characteristic of rivers within range of tidal influence is the vertical salinity gradient, which, typically, shows a higher bottom than surface salinity. (No attempt is made to explain the inversions shown in Table 5 at SII-A and SII-C.) The surface salinities are more subject to fluctuation than are bottom salinities because of the influence of rain, surface run-off and wind. Because of these local and transient surface fluctuations we feel that a classification of waters based on salinity should be based on the bottom salinities.

The various stations of the three rivers concerned in this study were all within tidal influence. Station 15 of the Escambia River, however, was a fresh-water station. An interpretation of the influence of salinity on faunal composition cannot be made for the Sabine and Neches rivers because the salinity effects at the lower stations were masked by other factors. In the broadest view, of course, it is evident from the species list above that marine and brackish-water species dominated in the lower stations of these rivers while brackish- to fresh-water species dominated the most upstream station in each case.

Any detailed discussion of salinity influences, then, are confined to the Escambia River, which structurally appears to be typical of the lowermost reaches of coastal streams. As spring rains and run-off brought the Escambia River to fresh water during the high-water survey our following discussion is limited to the low-water survey.

At the mouth of the river the river bed is below mean sea level and, as expected, the depths were more saline than the surface. This salt-water layer underlay a less saline surface water and penetrated quite some distance upstream to a point in the vicinity of Station 16. The interface between deeper, more saline waters and the higher, less saline waters was quite sharply marked in the Escambia River low-water survey and this was indicative of the tranquility of the current due to the lack of turbulence or diffusion currents. As a result, shallow littoral areas and the surface area supported a fresh- to brackish-water fauna while the river bottom supported a brackish-water fauna. Station 17 was the pivotal point between the brackish-water and fresh-water faunas. Reference to the distribution of the animals in the preceding species list amply illustrates this point.

With the exception of the insects the invertebrates along a salinity gradient replace one another in sequence as the salinity increases or decreases. Thus fresh-water species disappear from the fauna as salt water is approached, but brackish-water and marine species begin to make their appearance. Both fresh water and salt water are richer in numbers of invertebrate species present than is brackish water. The adjustment to

fluctuating salinities is a difficult barrier for animals to overcome. Certain migratory species are able to adjust to salinity fluctuation, but even in such cases there are limitations. Odum (1953), for example, studied the invasion of fresh water by marine organisms and demonstrated that the blue crab (*Callinectes sapidus*) does not penetrate above oligohaline waters. The distribution of this species in our collections supports this view.

No truly marine species were found during these surveys. There was a complete absence from our collections of such typical marine groups as the salt-water sponges, echinoderms, primitive chordates, etc. These animals do not make their appearance in the faunal complex until marine or near marine conditions prevail.

Unlike the other invertebrates, where a process of replacement takes place as one moves from fresh, through brackish, to salt water conditions, the insect fauna tends to drop out with increased salinity. There are relatively few truly marine insects.

In the Escambia River, Station 15 had 31 species; Station 16, 30 species; Station 17, 19 species; Station 19, 14 species and Station 21, 12 species. Collections were made below in some of the salt marshes but no insect life was found. The breaking point, if it may be called such, as far as the insects are concerned, apparently falls around Station 17. The greatest drop (11 species) in species number occurs between Station 16 and 17. Station 16, though having a total salinity of 676.8 ppm at the bottom and 334.0 ppm at the surface, is by no means brackish and its species differences from Station 15 are as much a product of habitat differences as any other factor. From Stations 17 to 21 the species drop is slower.

Of all the orders of insects the greatest salinity tolerance is apparently found in the Diptera and in particular the Tendipedidae. At both Stations 19 and 21 the number of species of Diptera (9 and 6 respectively) is half or more than half of the total number of insect species at those stations. At Station 17 the Diptera (8 species) are just below half the total number of species at that station. Below Station 17, Heleidae and Tendipedidae are the only Diptera present. Within the Tendipedidae, the Tendipedinae show the greatest salt tolerance, followed by the Pelopiniae.

The Zygoptera and the Ephemeroptera are the only other groups which on the basis of our collections show any real tolerance for salt conditions. The Zygoptera nymphs seemed to be fairly well established at Stations 19 and 21, particularly among the exposed submersed roots of terrestrial plants. The anisopteran found at Station 21 was represented by only one specimen and may have washed in.

In the Ephemeroptera only Baetinae were found below Station 17. Though they were not numerous, Berner's (1954) report of *Callibaetis* liv-

ing in rather saline conditions could indicate that their presence at Stations 19 and 21 of the Escambia is not accidental.

All the other orders give no evidence of any particular salt tolerance. The Hemiptera (gerrids) are surface forms and not affected by the saline conditions. The only beetle found below Station 17 was a single specimen of Elmidae (*Simsonia*). The single trichopteran found at Stations 19 and 21 was the larva of a species of Psychomyiidae, represented only by very immature specimens. These may have floated down on the sawgrass in which they were found. No Plecoptera were found below Station 15 and no Megaloptera below Station 16.

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