Proceedings of the Iowa Academy of Science

Volume 73 | Annual Issue

Article 27

1966

# Macroscopic Invertebrates on the Higher Aquatic Plants at Clear Lake, Iowa

Roger J. Mrachek
*Iowa State University*

**Literature Cited**

Birge, E. A. and C. A. Juday. 1922. A limnological reconnaissance of West Okoboji. Univ. Iowa Studies Nat. Hist. IX (1): 1-56.
Ford, H. C. 1913. A topographic survey of the Spirit and Okoboji lakes region. Iowa State Coll. Engr. Expt. Sta. Bull. No. 32. pp. 1-38.
Iowa State Highway Commission. 1916. Report of the State Highway Commission on the Iowa lakes and lake beds. State of Iowa, Des Moines, pp. 1-250.

# Macroscopic Invertebrates on the Higher Aquatic Plants at Clear Lake, Iowa[1]

ROGER J. MRACHEK

*Abstract.* Macroscopic invertebrates were removed and counted from 355 samples of higher aquatic vegetation collected between 23 June 1965 and 3 September 1965 at Clear Lake, Iowa. It was found that all species of higher aquatic plants do not harbor the same populations of animals and that the composition of the macroscopic invertebrate populations on the plants showed a successional variation throughout the summer. A direct linear relationship was found between the surface areas of aquatic plants and the numbers of animals found on their surfaces.

Baker (1918), Muttkowski (1918), Moore (1913, 1920), Rawson (1930), and Ball (1948) all stressed the importance of vegetation to the production of fish food organisms. Ridenhour (1958) observed that in the years when the aquatic vegetation at Clear Lake was abundant, the growth of that year class of yellow bass, *Roccus mississippiensis,* was usually better. Stube (1958) found that an increase in water level which eliminated rooted vegetation also eliminated Acarina, Amphipoda, Coletoptera, Ephemeroptera, Neuroptera, Plecoptera, and most of the Trichoptera. Hart (1895) studied relationships of certain aquatic insects to plants, and Welch (1914, 1916, 1924) investigated insects of the yellow water lilly. Kecker (1939) studied animal populations on certain submerged aquatic plants and Andrews and Hasler (1943) studied summer populations of macroscopic animals on the aquatic plants at Lake Mendota, Wisconsin. Berg (1949) studied insects on plants of the genus *Potamogeton* and Rosine (1955) found that a considerable variation existed in the density of animals on the different species of aquatic plants in Muskee Lake, Colorado. Still, there remains much to

[1] Journal Paper No. J-5386 of the Iowa Agricultural and Home Economics Experiment Station, Ames, Iowa. Project No. 1564. A Contribution of the Iowa Cooperative Fisheries Research Unit, sponsored by the Iowa State Conservation Commission and Iowa State University of Science and Technology. This research was part of the Undergraduate Education Program sponsored by the National Science Foundation (NSF-GY-132).

be learned about how the populations of macroscopic invertebrates are related to the higher aquatics.

This study was designed to determine the numbers and kinds of macroscopic invertebrates found on higher aquatic plants at Clear Lake, Iowa. This is a shallow eutrophic lake located in Cerro Gordo County, north-central Iowa. The surface area of the lake is approximately 3,643 acres with 13% less than 5 feet deep, 22% 5 to 10 feet deep, and a maximum depth of about 20 feet (Iowa State Planning Board, 1935). The lake has no inlet except from Ventura marsh, and smaller marshes on the southern shores.

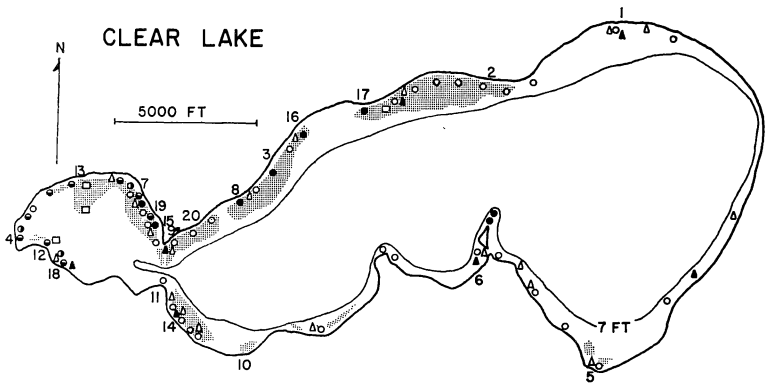


Fig. 1. Map of Clear Lake with 7 foot contour line. Sampling stations are indicated by numbers along shoreline. Aquatic vegetation is represented by the following symbols: ◒ *Ceratophyllum demersum* and *Myriophllum exalbescens;* ◑ *Nuphar* sp. and *Nymphea* sp.; ● *Najas flexilis;* ○ *Potomogetan natans, P. nodosus, P. illinoensis;* ▲ *P. pectinatus;* △ *P. richardsonii;* □ *Typha* sp. The stipled areas represent the distribution of *Scirpus validus.*

## Methods

All data were collected between 23 June and 3 September, 1965. The distribution of higher aquatic plants was estimated by traveling around the lake in a boat and recording the plant species and their abundance at all sites where higher aquatic vegetation grew. This was done three times during the collection period.

Samples were taken at the twenty stations shown in Fig. 1. A net was placed over the plants and they were cut off just above the bottom in order to exclude animals in the substrate. They were placed in appropriate sized containers and transported to the laboratory where they were examined within 4 hours of collection.

Twenty-five or more samples were taken of each dominant species to insure that an accurate picture of the animal population would be obtained. Gaufin et al. (1956) showed that 10-15% of the animal species were not found until at least eight samples had been taken.

The animals were washed off, under a jet nozzle, from plants with a smooth surface, *Typha* sp. and *Scirpus validus*. The other species, which have a more dissected surface, were placed in a sugar solution with a specific gravity 1.12 (approximately 2.5 pounds of granulated sugar per gallon of solution). The solution was very effective in floating the animals off of these plants. This sugar solution method was adopted from a method described by Anderson (1959). His work showed that with a sugar solution all the animals could be sorted from a sample, whereas only 85% of the animals at a maximum could be sorted out without it.

The animals were sorted into taxonomic groups and counted and the wet weights of the plant materials were determined with a triple beam balance. Computations were made of the number of organisms per unit weight of plants. The ratio of surface area to weight for each plant species was found by taking six randomly collected individual specimens of that species, finding the wet weights, and breaking the plants down into small pieces which approximated geometrical figures such as right cylinders, and right circular cones. Appropriate measurements were made and the areas of the individual pieces were calculated and summed. The total area was then divided by the total weight .

## Results

Twenty-two species of higher aquatic plants were identified in the 1965 collections (Table 1). The distribution of the eight dominant species and groups of species is shown in Fig. 1. Both the species composition and plant distribution were different from those described by Pearcy (1953). For example, I found no plants growing at depths exceeding 6 feet while Pearcy recorded *Najas flexilis* growing as deep as 15 feet. This is probably related to the fact that he found secchi disc readings of 4 feet 10 inches in the summer of 1951, while they averaged only 20 inches in the summer of 1965.

The following animals from the plant samples were identified by the author with the aid of various taxonomic keys. Certain of the insects that presented problems were keyed out by Prof. Jean L. Laffoon.

*Amphipoda*

*Hyalella azteca* (Saussure). Scuds were very abundant and were found on all species of plants but seemed to be the most common on *Ceratophyllum demersum* and *Napas flxilis.*

*Gastropoda*

Snails were quite common, but were found mostly on plants in

Table 1. Higher aquatic plants from the 20 collecting sites sampled in this study and their index of occurrence.

| Species | Index of occurrence* |
|---|---|
| *Ceratophyllum demersum* L. | 3 |
| *Elodea canadensis* Michx. | 2 |
| *Heteranthera dubia* Jacq. | 1 |
| *Lemna minor* L. | 3 |
| *Myriophyllum exalbescens* Fernald | 3 |
| *Najas flexilis* Willd. | 4 |
| *Nuphar advena* Ait. | 3 |
| *Nymphaea tuberosa* Paine | 3 |
| *Polygonum coccineum* Muhl. | 1 |
| *Potamogeton illinoensis* Morong | 2 |
| *Potamogeton natans* L. | 3 |
| *Potamogeton nodosus* Poir. | 5 |
| *Potamogeton pectinatus* L. | 3 |
| *Potamogeton pusillus* L. | 2 |
| *Potamogeton Richardsonii* Benn. | 3 |
| *Sagittaria teres* Wats. | 1 |
| *Scirpus validus* Vahl. | 5 |
| *Typha angustifolia* L. | 3 |
| *Typha latifolia* L. | 2 |
| *Vallisneria americana* Michx. | 2 |
| *Wolffia* sp. | 2 |
| *Zannichellia palustris* L. | 1 |

*1. Present only rarely at one collecting site.
2. Present at 1-3 collecting sites.
3. Present at 4-7 collecting sites.
4. Present at 8-10 collecting sites.
5. Present at more than 10 collecting sites.

somewhat sheltered areas.

*Physa* sp. They were the most common snail in Clear Lake in 1965. Pearcy (1952) also reported this genus as most common in Clear Lake.

*Helisoma* sp. They were common but not as prevalent as *Physa* sp.

*Lymnaea* sp. They were quite abundant in the sheltered area by the Island, but this was the only place they were collected. Here they were collected in very quiet, shallow water.

*Hirudinea*

Only eleven leeches were collected. Their distribution was erratic.

*Hydracarina*

Water mites were found on all species of plants and their density of occurrence was about the same for the entire collection period.

*Insecta*

Diptera

Chironominae. Midges were far the most abundant insect; they were found upon all species of plants. They seemed to prefer areas that were at least somewhat protected from wave action.

Stratiomyidae. Rare, only two specimens of this family were collected from a sample of *Myriophyllum exalbescens* in early July.

Coleoptera

*Dineutes* sp. These whirligig beetles were occasionally found, but never in great numbers.

Ephemeroptera

*Caenis* sp. They were the only mayflies found on the higher aquatic vegetation. Mayflies were the most abundant on *Ceratophyllum demersum, Myriophyllum exalbescens, Najas flexilis,* and *Potamogeton pectinatus.*

Hemiptera

*Sigura alternata* Say. Adults were occasionally found in the samples.

Odonata

Anisoptera

*Anax junius* (Dury). Only one specimen was collected all summer. This was found in a samples of *Najas flexilis.*

Zygoptera

*Ischnura* sp. and *Enalagma* sp. Damselflies were quite numerous, most being found upon *Najas flexilis, Potamogeton Richardsonii,* and *Potamogeton pectinatus.*

Pleidae

*Plea striola* Fieber. Pigmy backswimmers were found in the greatest numbers on *Lemna* sp. and *Myriophyllum exalbescens.*

Trichoptera

*Mystacides longicornis* L. Numerous on most species of plants, especially *Potamogeton pectinatus.* It was the dominant caddis fly.

*Ocecetis* sp. They were found only on *Potamogeton pectinatus.*

*Nematoda*

Free living members of this group were rare; only two specimens were found.

*Oligochaeta*

Naididae

*Stylaria proboscidea* (O.F.M.), *Stylaria fossularis* Leidy, and *Stylaria lacustris* L. These fresh water worms were quite abundant on all species of Clear Lake plants. They were most abundant in September.

*Turbellaria*

*Planaria* sp. These flat worms appeared in great numbers at times and at other times were very rare. They were most abundant on *Nuphar* sp. and *Nymphaea* sp.

The invertebrate samples were characterized by a high degree of variability both between species of substrate plants and on the same species collected at different times and at different locations. There was also a difference in the composition of the total population as the summer progressed. For example, Chironomids were very prevalent at the beginning of the collection period and Oligochaetes were relatively rare. Later, Chironomid populations decreased and Oligochaete populations increased proportionally (Table 2). Indications are that as the summer proceeds there is not only a plant succession, but also an animal succession for at least some of the animal groups.

Table 2. Seasonal variations in the relative abundance of Oligochaetes and Chironomids on aquatic plants in Clear Lake.

| | Percentage of total population as | |
|---|---|---|
| Date | Chironomids | Oligochaetes |
| June | 65% | 10.5% |
| July | 41% | 36% |
| August | 29% | 47% |

All species of plants did not harbor the same animal populations (Table 3). It soon became apparent that the total number of organisms on a particular species of plant was related to the degree of dissection of its leaves and other exposed parts. This was tested by plotting the average number of organisms per gram of plant material against the surface area per gram for each plant species. This relationship, as shown in Fig. 2, is linear. The equation of the regression line is $Y = 0.087 X - 0.80$ where Y is the number of animals per gram of plant material and X

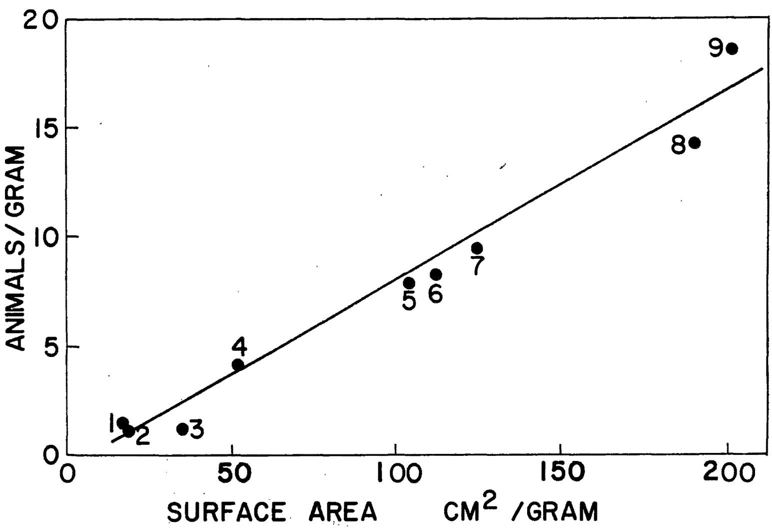


Fig. 2. Relationship between numbers of animals per gram of plant and surface area per gram of plant for various species of higher aquatics. The points are numbered as follows: 1 — *Scirpus validus;* 2 — *Typha* sp.; 3 — *Nuphar* and *Nymphea* spp.; 4 — *Potomogeton nodosus, P. natans* and *P. illinoensis;* 5 — *P. Richardsonii;* 6 — *Myriophyllum exalbescens;* 7 — *Najas flexilis;* 8 — *Ceratophyllum demersum;* 9 — *P. pectinatus.*

Table 3. Numbers of invertebrates in various taxons found a different species of higher aquatic plants in Clear Lake. Animals per kilogram of plant material (wet weight)

| Plant sp. | Number samples | Hyalella | Chironomids | Planaria | Oligochaetes | Hydracarina | Ephemeroptera | Zygoptera | Trichoptera | Gastropoda | Others | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Ceratophyllum demersum* | 26 | 2720 | 1664 | 169 | 3200 | 6625 | 70 | 8 | 0 | 3 | 2 | 14,461 |
| *Lemna* sp. | 6 | 532 | 598 | 223 | 1190 | 1890 | 2 | 0 | 0 | 225 | 266* | 4,926 |
| *Myriophyllum exalbescens* | 27 | 570 | 1320 | 138 | 2650 | 3550 | 45 | 7 | 1 | 24 | 62 | 8,367 |
| *Najas flexilis* | 25 | 1830 | 1215 | 61 | 2920 | 2440 | 13 | 14 | 4 | 2 | 41 | 9,540 |
| *Nuphar* and *Nymphea* sp. | 25 | 11 | 84 | 242 | 76 | 816 | 1 | 0 | 0 | 4 | 28 | 1,262 |
| P. *nodosus, natans, illinoensis* | 85 | 332 | 1600 | 98 | 1650 | 500 | 3 | 3 | 6 | 5 | 3 | 4,200 |
| P.*pectinatus* | 29 | 765 | 9080 | 31 | 7580 | 1365 | 10 | 11 | 23 | 19 | 7 | 18,890 |
| P.*richardsonii* | 27 | 955 | 1500 | 148 | 2540 | 2800 | 7 | 19 | 4 | 11 | 7 | 7,991 |
| *Scirpus validus* | 68 | 104 | 230 | 152 | 292 | 950 | 1 | 0 | 0 | 3 | 1 | 1,733 |
| *Typha* sp. | 10 | 31 | 333 | 129 | 239 | 323 | 1 | 0 | 0 | 1 | 1 | 1,057 |
| Mixed samples two or more sp.) | 24 | 370 | 2389 | 77 | 972 | 250 | 28 | 9 | 14 | 97 | 132* | 4,327 |

*Mostly Pleidae (pigmy backswimmers)

is the number of square centimeters of surface per gram for each plant species examined. The Y intercept of –0.80 is not statistically significant from zero. There was an increase of one organism for each increase of 11.5 square centimeters of surface area. This would make the amount of surface area a controlling factor of the density of macroscopic organisms per unit of weight. At first notice, this appears contrary to the idea expressed by other authors that plants with highly dissected leaves harbor higher populations of animals because of the added protection of many crevices; however, most of the plants with highly dissected leaves are the ones with the largest surface per unit weight.

The relationship between surface area and the number of animals present was further substantiated by the variation of the macroscopic invertebrates on the bulrush, *Scirpus validus*, (Table 4). *Spirogyra* sp., a green alga, grew on the bulrushes in varied amounts at different times in the summer. In mid July, when there were no algae visibly present upon the bulrush, the populations of animals were lowest. Correspondingly, when the algae were most prevalent in August, the populations were the highest recorded all summer. The presence of the algae on the bulrushes increased the surface area, and collection data showed a definite increase in invertebrates with increased surface area on the same species of plant.

Table 4. Summer fluctuations of invertebrate populations on *Scirpus validus*.

| Week of: | Number samples collected | Organisms per gram of plant material (wet weight) |
|---|---|---|
| 6-27-65 | 7 | 2.38 |
| 7-4-65 | 6 | 1.34 |
| 7-11-65 | 9 | 0.68 |
| 7-18-65 | 7 | 0.41 |
| 7-25-65 | - | - |
| 8-1-65 | 5 | 0.80 |
| 8-8-65 | 7 | 1.24 |
| 8-15-65 | 12 | 1.75 |
| 8-22-65 | 10 | 3.68 |

Berg (1949) found that population of insects on plants were higher in areas that were protected from uninhibited wind action. Similar results were recorded during the study at Clear Lake, but the data was insufficient to determine the quantitative importance of this factor.

## Discussion

The populations of macroscopic invertebrates on the higher aquatic plants are in a constant state of change. Some of the factors that may influence this fluctuation are: 1) predation by fish and other aquatic vertebrates, 2) predation of macroscopic invertebrates upon one another, 3) natural mortality, 4) emergence of insect pupae and naiads, 5) new broods of larvae and naiads, 6) succession of vegetation as the summer proceeds or vegetational changes due to man, 7) changes in the populations of microscopic organisms upon which the macroscopic invertebrates feed, and, 8) possible movement between the plants and a benthic environment by the macroscopic invertebrates.

There probably is a seasonal succession for at least some of the macroscopic invertebrates found on higher aquatic vegetation. At Clear Lake, Chironomids were especially abundant during the first part of the collection period, and their numbers decreased during the following months. Oligochaetes were not very numerous at the start of the collection period, but their numbers became very high during August. *Hyalella azteca,* scuds, gradually increased in numbers and were most numerous at the end of the collection period. But Ephemeroptera, Trichoptera, Gastropoda, and Hydracarina populations did not show such trends during the collection period.

There is a direct correlation between the surface area of a plant species and the number of macroscopic invertebrates found on it. This is not to say that other factors are not important in determining the populations of macroscopic invertebrates upon plants; but given a certain body of water, I believe there will be a relationship of surface area to organisms present similar to the relationship found at Clear Lake.

## Acknowledgements

I thank Dr. Roger Bachmann for initiating this study, his help and encouragement, and his aid in preparation of this paper. Also Mr. Gary Atchison and Mr. Theodore Jacobsen for their encouragement and aid in the field. I also thank Mr. Robert Cooper of the Iowa Conservation Commission at Clear Lake, Iowa for making equipment available for my use.

## Literature Cited

Anderson, R. O. 1959. Limnol. and Oceanogr. 4:223-225.
Andrews, J. D. and Hasler, A. D. 1943. Trans. Wis. Acad. Sci., Arts and Letters 35:175-185.
Ball, R. C. 1948. Mich. Agr. Exp. Sta. Tech. Bul. 206.
Baker, F. C. 1918. New York State College of Forestery, Tech. Bul. 9.
Berg, C. O. 1949. Trans. Am. Micr. Soc. 68:279-291.
Gaufin, A. R.; Harris, E. K.; and Walter, H. J. 1956. Ecology 37(4): 643-648.
Hart, C. A. 1895. Bul. Ill. State Lab. Nat. Hist. 4:149-273.
Iowa State Planning Board. 1935. Report on soundings and borings in the lakes of Iowa. Des Moines, 88p. (typewritten.)
Kecker, F. H. 1939. Ecology 20:533-562.
Moore, E. 1913. Bul. U.S. Bur. Fish. 33:255-291.
Moore, E. 1920. U. S. Bur. Fish. Doc. 881.
Muttkowski, R. A. 1918. Trans. Wis. Acad. Sci., Arts, and Letters 19:375-482.

Proceedings of the Iowa Academy of Science, Vol. 73 [1966], No. 1, Art. 27



Pearcy, W. G. 1953. Iowa State Coll. Journ. of Sci. 28(2):189-207.
Rawson, D. S. 1930. Univ. Tronto Studies, Biol. Sci. No. 34:1-183.
Ridenhour, R. L. 1958. Ecology of young game fishes of Clear Lake, Iowa. Unpub. Ph.D. Thesis. Iowa State University Library, Ames, Iowa.
Rosine, W. M. 1955. Ecology 36(2):308-314.
Stube, Maj. 1958. Rept. Inat. Freshw. Res. Drottningholm 39:162-224.
Welch, P. S. 1914. Ann. Ent. Soc. Amer. 7:135-147.
Welch, P. S. 1916. Ann. Ent. Soc. Amer. 9:159-190
Welch, P. S. 1924. Ann. Ent. Soc. Amer. 17:395-402.

# A Morphological Study of Three Iowa Carpsuckers[1]

RICHARD R. CORNELIUS[2]

*Abstract.* Detailed morphological studies were made of 78 specimens of *Carpiodes cyprinus,* 51 *C. velifer,* and 104 *C. carpio* for the purpose of finding additional morphological criteria for identifying these species in the field. The various ratios and counts were highly variable and overlapping and no new criteria were found.

The carpsuckers are a group of fishes in the sucker family (Catostomidae) and classified in the genus *Carpiodes.* Iowa Fish and Fishing (Harlan and Speaker, 1956) lists four species as occurring in Iowa, *C. carpio* (Rafinesque), the river carpsucker; *C. velifer* (Rafinesque), the highfin carpsucker; *C. cyprinus* (LeSueur), the quillback carpsucker; and *C. forbesi* Hubbs, the plains carpsucker. More recently Bailey and Allum (1962) have concluded that *C. forbesi* is not a valid species and that specimens formerly classified as such are actually environmentally modified forms of *C. cyrinus.* All are abundant in the larger rivers of interior Iowa and in the Mississippi and Missouri rivers. The morphological similarities between these species caused some confusion to the early taxonomists (see discussion by Trautman, 1957) and the group still presents practical problems of identification for the field biologist, particularly when immature specimens are involved. The purpose of this study was to search for additional morphological criteria by which they might be more readily identified.

## METHODS

The materials studied included 78 quillbacks, 51 highfins, and 104 river carpsuckers collected during the summer of 1965. Most

[1] Journal Paper No. J-5395 of the Iowa Agricultural and Home Economics Experiment Station, Ames, Iowa. Project No. 1373 of the Iowa Cooperative Fisheries Research Unit, sponsored by the Iowa State Conservation Commission and Iowa State University of Science and Technology. This research was part of the Undergraduate Research Education Program sponsored by the National Science Foundation (NSF-GY-132).

[2] National Science Foundation Undergraduate Research Participant.