Proceedings of the Iowa Academy of Science

Volume 89 | Number | Article 8

1982

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Proc. Iowa Acad. Sci. 89(2): 62-67. 1982

The Gastropods of Lake West Okoboji, Iowa, Twenty Years Later

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The snails of Lake West Okoboji were collected at the same 53 stations, using the same techniques and with equivalent effort as in a study 20 years earlier. The total number of snails collected was very similar. The same 12 species are present. The relative densities of the 8 major species have shifted strikingly, with a decrease in the more pollution tolerant pulmonates and concomitant increase in the less tolerant gilled species. The number of species per station has increased throughout the lake. The decline in the gastropod fauna appears to have been halted, probably due to the completion of a sanitary system around the lake.
INDEX DESCRIPTORS: Lake West Okoboji, freshwater snail distribution, ecology, Mollusca

Shimek (1935) wrote of the dramatic decline of the molluscan fauna in Lake West Okoboji; he indicted pollution. Twenty years later, in a survey completed in 1959, we documented further decline (Bovbjerg and Ulmer 1960). At that time snails were collected at 53 stations ringing the lake, including small shallow embayments, larger bays, and the exposed major lake basin. We intended to establish a base line to which future surveys could refer. This paper reports a revisiting of those same 53 stations another 20 years later; the survey was done in as equivalent a manner as possible to sharpen the comparisons. The work was done at The Iowa Lakeside Laboratory, Milford, Iowa.

More is now known about the lake than 20 years ago. It has been mapped twice with congruent results, first by Bachmann and Bovbjerg (1966) and more recently by the Iowa Conservation Commission. Intensive, around-the-year limnological studies were made from the Iowa Lakeside Laboratory and compiled by Bachmann and Jones (1974).

Morphometrically, Lake West Okoboji has an area of 1540 ha, maximum depth of 42.7m, mean depth of 11.9m, and a 30 km shoreline. A north-south major basin slopes steeply to a trench and is bordered by 4 large, shallow bays; half of the lake is less than 10m in depth. The shore line of the lake is largely of boulder rip rap and the bottom materials tend to grade from boulder, cobble, gravel, sand, silt, out to the fine organic ooze of the trench. The bays have stretches of silty or sandy beaches as well as boulder shores.

Limnologically, the lake is naturally eutrophic, culturally augmented. It is a classical dimictic temperate lake; the thermocline drops toward 20m by late summer when the hypolimnion is anoxic. Surface temperatures in summer exceed 20°C and bottom temperature is about 12°C. Secchi readings range from 9m to 3m, the latter during summer algal blooms. The lake is classed as a hard-water bicarbonate type.

Aquatic macrophytes are dense in the bays but sparse along the major basin. The 30 or so species seldom exceed the 5m depth contour. The algal flora is rich and includes a diverse planktonic component as well as the filamentous and matted forms attached to boulders and macrophytes.

PROCEDURE

Collections were made at the 53 stations during July and August 1979; we attempted to duplicate the procedures used 20 years ago. Each station was visited twice for a total of 2 hours per station for 2 to 3 workers. Three collection techniques were used 1) Hand collecting was done at wading depths, which usually started with combing the boulder shore. 2) Vegetation was brought aboard by grappling or diving. 3) Bottom samples were taken with a Peterson dredge (660cm area) and brought aboard for sorting. Dredge samples were taken from depths of 2m out to about 5m or beyond where the vegetation usually thinned. Where the bottom was of cobbles, samples were collected by diving. About one third of the 2 hour period was spent collecting by each technique. Aboard the boat, vegetation was agitated in plastic dishpans and the snails sorted from the debris on the bottom. Dredge samples were washed through 2 screens (5 and 2mm mesh) and the snails picked from these. Counting and identifying were done in the laboratory. Only identifiable specimens were counted though we did find many early juveniles, especially physids.

The time and effort at each station was more consistent than in the study of 20 years ago but nevertheless roughly comparable. We repeat the caveat of 20 years ago: "While the data are presented quantitatively, many cross-comparisons between stations are of doubtful value. Regardless of variable collecting effort, sampling was not selective, so that comparative numbers of species do indicate some validity." (Bovbjerg and Ulmer 1960). The same cautions must be applied to comparing studies 20 years apart.

COMPARISON OF THE GASTROPOD FAUNA, 1959 AND 1979

Table 1 contains the data from the 2 studies.[1] Several interpretations may be made. The total number of snails collected were essentially the same, considering the imprecision of sampling (4,660 in 1959 and 4,964 in 1979) and the 12 species are the same now as 20 years ago. Both of these data are encouraging in a time of increased pressure on the lake from resort development. The 12 species are: *Physa gyrina* Say, *Physa integra* Haldeman, *Amnicola limosa* (Say), *Amnicola lustrica* Pilsbry, *Amnicola binneyana* Hannibal, *Lymnaea obrussa* Say, *Lymnaea palustris* (Miller), *Gyraulus parvus* (Say), *Promenetus exacuous* (Say), *Valvata tricarinata* (Say), *Helisoma trivolvis* (Say), and *Ferrisia rivularis* (Say).

Four species are very rare here or have a very restricted distribution in the lake; they merit but brief discussion. *L. palustris* was found only in 1 small enclosed bay which has pond-like attributes. This is the most common marsh snail of the region and indeed is abundant in a marsh adjacent to the site where it was found. Nine were collected in 1979 and 12 in 1959.

[1]Nomenclatorial changes and misidentifications of the previous study are corrected: *Menetus* to *Promenetus*, *Lymnaea reflexa* to *L. palustris*, *Physa sayii* to *P. integra* (Clampitt 1970, Brown 1979).

Table 1. Snail collections by station in Lake West Okoboji in (1959) compared with 1979.

Station	*Physa gyrina*	*Physa integra*	*Amnicola limosa*	*Amnicola lustrica*	*Amnicola binneyana*	*Promenetus exacuous*	*Gyraulus parvus*	*Valvata tricarinata*	*Ferrissia rivularis*	*Helisoma trivolvis*	*Lymnaea palustris*	*Lymnaea obrussa*	Total Snails	Total Species
1	—	(11)	—	—	—	—	—	—	—	—	—	—	(11)	(1)
	—	—	18	7	—	2	2	1	—	—	—	—	30	5
2	—	(4)	—	—	—	—	—	—	—	—	—	—	(4)	(1)
	—	—	1	1	4	2	1	9	—	—	—	—	18	6
3	—	(7)	—	—	—	(2)	—	—	—	—	—	—	(9)	(2)
	19	11	14	1	—	4	1	1	—	—	—	—	51	7
4	(8)	(39)	(3)	—	—	(7)	—	—	—	—	—	—	(57)	(4)
	1	4	12	7	—	24	27	2	—	—	—	—	77	7
5	(3)	(1)	(4)	—	—	—	—	—	—	—	—	—	(8)	(3)
	—	5	7	3	—	3	4	—	—	—	—	—	22	5
6	(87)	(3)	(2)	—	—	(2)	—	—	—	—	—	—	(94)	(4)
	—	64	250	13	1	4	1	—	—	—	—	—	332	6
7	(4)	—	(56)	—	—	(5)	—	(5)	—	—	—	—	(70)	(4)
	—	3	8	—	—	1	27	—	—	—	—	—	39	4
8	(10)	(14)	(2)	—	—	—	—	—	—	—	—	—	(26)	(3)
	—	10	13	4	—	—	27	—	—	—	—	—	54	4
9	—	(3)	(1)	—	—	—	—	—	—	—	—	—	(4)	(2)
	—	15	22	—	1	—	2	1	—	—	—	—	41	5
10	(119)	(32)	—	—	—	—	—	—	—	—	—	—	(151)	(2)
	3	14	5	5	—	7	9	—	—	—	—	—	43	6
11	(4)	(2)	(4)	—	—	—	—	—	—	—	—	—	(10)	(3)
	1	—	12	10	—	—	1	1	—	—	—	—	25	5
12	(8)	(2)	(3)	—	—	—	—	—	—	—	—	—	(13)	(3)
	—	12	32	11	—	—	14	36	—	—	—	—	110	5
13	(5)	(4)	(4)	—	—	—	—	—	—	—	—	—	(13)	(3)
	35	21	34	12	4	—	3	96	—	—	—	—	205	7
14	—	(6)	(1)	—	—	—	—	—	—	—	—	—	(7)	(2)
	—	4	16	—	—	2	49	2	—	—	—	—	73	5
15	—	—	(8)	—	—	—	—	—	—	—	—	—	(8)	(1)
	2	6	6	1	—	5	30	12	—	1	—	—	63	8
16	(1)	(4)	(29)	—	—	(25)	—	—	—	—	—	—	(59)	(4)
	—	—	6	12	—	5	5	3	—	—	—	—	31	5
17	(34)	(14)	(14)	(2)	—	(41)	—	—	—	—	—	—	(105)	(5)
	—	7	58	3	—	21	16	5	—	—	—	—	110	6
18	—	(2)	(33)	(4)	—	—	(2)	(4)	—	—	—	—	(45)	(5)
	—	—	100	7	—	8	93	—	—	—	—	—	208	4
19	(1)	(4)	—	—	—	—	(1)	—	—	—	—	—	(6)	(3)
	—	2	20	11	—	5	43	—	—	—	—	—	81	5
20	(4)	(13)	(43)	—	—	(2)	—	(1)	—	—	—	—	(63)	(5)
	7	4	1	1	—	11	47	—	—	—	—	—	71	6
21	—	(3)	—	—	—	—	—	—	—	—	—	—	(3)	(1)
	—	5	6	10	—	—	102	1	—	—	—	—	124	5
22	(78)	(9)	(4)	—	—	(7)	—	—	—	(1)	—	—	(99)	(5)
	—	7	10	18	—	—	26	—	—	—	—	—	61	4
23	—	—	—	—	—	—	—	—	—	—	—	—	(0)	(0)
	—	—	—	—	—	—	—	—	—	—	—	—	0	0
24	—	—	(20)	(13)	—	(1)	(2)	(5)	—	—	—	—	(41)	(5)
	—	3	28	2	—	51	3	1	—	—	—	—	88	6
25	(198)	(69)	—	—	—	—	—	—	—	—	—	—	(267)	(2)
	—	4	10	2	—	3	46	—	—	—	—	—	65	5
26	(86)	(4)	—	—	—	—	—	—	—	—	—	—	(90)	(2)
	—	12	—	4	—	2	23	1	—	—	—	—	42	5

Station	*Physa gyrina*	*Physa integra*	*Amnicola limosa*	*Amnicola lustrica*	*Amnicola binneyana*	*Promenetus exacuous*	*Gyraulus parvus*	*Valvata tricarinata*	*Ferrissia rivularis*	*Helisoma trivolvis*	*Lymnaea palustris*	*Lymnaea obrussa*	Total Snails	Total Species
27	(3)	(1)	(4)	—	—	—	—	(1)	—	—	—	—	(9)	(4)
	—	6	7	—	—	—	—	—	—	—	—	—	13	2
28	—	—	(4)	—	—	—	—	—	—	—	—	—	(4)	(1)
	—	3	4	10	—	—	25	1	—	—	—	—	43	5
29	(4)	—	(6)	—	—	(1)	—	—	—	—	—	—	(11)	(3)
	14	17	10	4	—	1	21	1	—	—	—	—	68	7
30	(13)	(2)	(24)	—	—	(1)	—	—	—	—	—	—	(40)	(4)
	3	11	153	26	—	1	130	2	—	—	—	—	326	7
31	(10)	(43)	(28)	—	—	(70)	—	—	—	—	—	—	(151)	(4)
	6	2	24	2	—	3	67	10	—	—	—	—	119	7
32	(42)	(65)	—	—	—	(2)	(3)	—	(1)	—	(2)	—	(115)	(6)
	2	6	13	—	—	17	23	10	—	—	—	—	71	6
33	(95)	(80)	(64)	—	—	(53)	(18)	(8)	(1)	—	(1)	—	(320)	(8)
	1	37	13	32	—	78	68	—	—	—	—	—	229	6
34	(122)	(88)	(2)	—	—	(38)	(14)	—	(1)	—	—	(202)	(467)	(7)
	21	9	3	1	—	3	79	—	—	—	12	53	181	8
35	(67)	(38)	(166)	—	—	(110)	(58)	(19)	—	—	—	—	(458)	(6)
	1	4	1	7	—	22	50	12	—	—	—	—	97	7
36	(6)	—	(16)	—	—	(43)	—	(4)	—	—	—	—	(69)	(4)
	—	—	9	7	—	—	64	1	—	—	—	—	81	4
37	(2)	—	(9)	—	—	(18)	—	(3)	—	—	—	—	(32)	(4)
	3	3	19	10	—	1	129	3	—	—	—	—	168	7
38	(8)	(4)	(8)	—	—	(4)	(5)	—	—	—	—	—	(29)	(5)
	7	14	2	1	2	4	8	—	—	—	—	—	38	7
39	—	—	(1)	—	—	—	—	—	—	—	—	—	(1)	(1)
	5	18	14	13	2	—	111	3	—	—	—	—	166	7
40	(100)	(32)	—	—	—	—	—	—	—	—	—	—	(132)	(2)
	—	2	16	4	—	—	28	43	—	—	—	—	93	5
41	—	—	—	—	—	—	—	—	—	—	—	—	(0)	(0)
	1	7	8	—	3	—	43	21	—	—	—	—	83	6
42	(22)	(68)	—	—	—	(23)	—	—	—	—	—	—	(113)	(3)
	4	—	30	1	—	—	4	21	—	—	—	—	60	5
43	—	—	(2)	—	—	—	—	—	—	—	—	—	(2)	(1)
	30	20	27	2	—	3	43	1	—	—	—	—	126	7
44	(29)	(327)	(2)	(1)	—	—	(1)	—	—	—	(3)	—	(363)	(6)
	155	47	27	—	—	1	21	2	—	—	—	—	253	6
45	(2)	(2)	(13)	(8)	—	(3)	—	—	—	—	—	—	(28)	(5)
	—	—	22	3	—	1	2	—	—	—	—	—	28	4
46	(131)	(292)	(55)	—	—	(182)	(6)	(3)	—	—	(3)	—	(672)	(7)
	6	11	50	4	—	9	28	1	—	—	—	—	109	7
47	(43)	(168)	(61)	—	—	(6)	(1)	—	—	—	—	—	(218)	(5)
	1	5	17	—	—	1	14	—	—	—	—	—	38	5
48	(8)	(3)	(3)	—	—	—	—	—	—	—	—	—	(14)	(3)
	21	27	27	—	1	4	83	—	—	—	—	—	163	6
49	(2)	(1)	(1)	—	—	(7)	—	—	—	—	—	—	(11)	(4)
	—	4	18	3	11	13	41	3	—	—	—	—	93	7
50	—	(1)	—	—	—	—	—	—	—	—	—	—	(1)	(1)
	14	10	17	8	6	1	74	12	—	—	—	—	142	8
51	—	(21)	(4)	—	—	(14)	(8)	—	—	—	—	—	(47)	(4)
	—	—	8	8	—	1	3	—	—	—	—	—	20	4
52	—	—	—	—	—	—	(3)	—	—	—	—	—	(3)	(1)
	2	4	2	—	—	—	14	17	—	—	—	—	39	5
53	(12)	(14)	—	—	—	—	—	—	—	—	—	—	(26)	(2)
	1	2	17	3	1	2	12	19	—	—	—	—	57	8
Σ1959	(1,371)	(1,500)	(704)	(28)	0	(667)	(122)	(53)	(3)	(1)	(9)	(202)	(4,660)	(176)
Σ1979	366	482	1,252	294	36	326	1,787	355	0	1	12	53	4,964	299

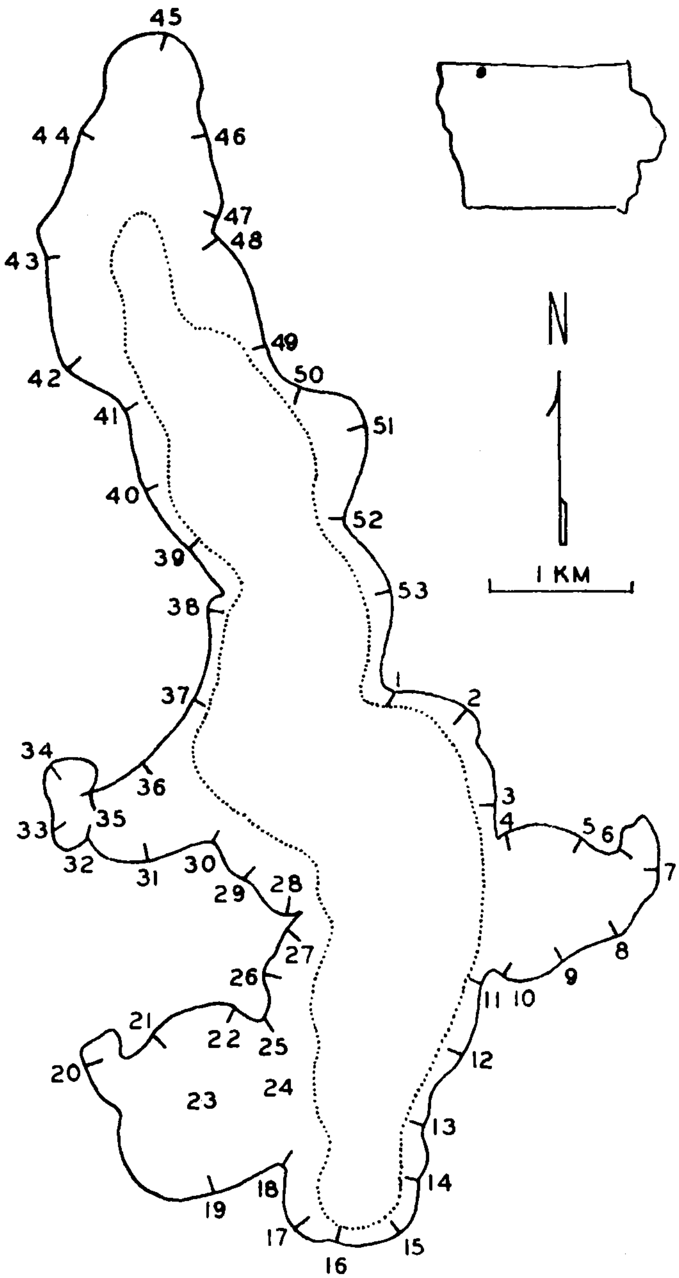

Figure 1. Map of Lake West Okoboji, Dickinson Co. Iowa showing 53 collecting stations and 10m contour (dotted line) (after Bachmann and Bovbjerg 1966).

One species has persisted at 1 exact site for 20 years. In 1959 *L. obrussa* was found in 1 small bay on mud flats; 202 were quickly collected. In 1979 this population was found only at that same site. The lake level was higher, so the mud flats were gone but the snails were present in the debris along the shore, though found with more difficulty. This is the typical marsh habitat for this species (Leonard 1959).

Three specimens of *F. rivularis* were found in 1 bay in 1959. It was not found in 1979 but it is still present at very low density; the senior author has seen it recently but rarely. This species is typically found

Table 2. Total number of snails collected at all stations and total number of stations where species were collected in Lake West Okoboji in 1959 and 1979.

	No. collected		No. stations	
	1959	1979	1959	1979
Physa gyrina	1,371 (29%)	366 (7%)	36	27
Physa integra	1,500 (32%)	482 (10%)	41	43
Amnicola limosa	704 (15%)	1,242 (25%)	37	51
Amnicola lustrica	28 (1%)	294 (6%)	5	42
Amnicola binneyana	*	36 (1%)	—	11
Promenetus exacuous	667 (14%)	326 (7%)	25	37
Gyraulus parvus	122 (3%)	1,787 (36%)	12	51
Valvata tricarinata	53 (1%)	355 (7%)	10	34
Lymnaea obrussa	202 (4%)	53 (1%)	1	1
Lymnaea palustris	9	12	4	1
Helisoma trivolvis	1	1	1	1
Ferrissia rivularis	3	0	1	0
Total	4,660	4,964	172	299

*Probably overlooked in 1959.

found in streams but is known to occur in lakes (Baker 1928, Goodrich and van der Schalie 1944, Clarke 1973).

H. trivolvis is another species typical of the marshes of the region and only 1 live specimen was taken in each of the 2 studies. In each case, these were near small outlets to adjacent marshes. Shells were seen in the same areas.

More meaningful interpretations may be made when considering the 8 species which were more numerous and more widespread in the lake. We found 1 more species in 1979 than in 1959. *Amnicola binneyana* could be an introduced species since 1959, but it resembles its 2 congeners and parsimony suggests that it was probably present in 1959 but was not distinguished from the other amnicolids. It may be present in greater numbers and at more stations than we recorded since the study was well along before the specimens were recognized as different.

While the same species are present, they are in different relative densities now than they were in 1959. This is striking and despite imprecision in sampling, the differences between the 2 studies are probably real. Table 2 presents the number of each species collected and percentage of the total collection for each study.

The physids had greatly decreased in density, especially among the shore boulders. *P. gyrina* dropped from 1,371 to 366, *P. integra* from 1,500 to 482, and *Promenetus exacuous* dropped from 667 to 326. There were also increases in the density of other species, the most dramatic of which was in *G. parvus* from 122 to 1,787. This was the highest number of specimens collected in either study. Three other species also increased: *V. tricarinata* from 53 to 355, *A. lustrica* from 28 to 294, and *A. limosa* from 704 to 1,252.

Comparison of the 2 studies also indicates a change in distribution throughout the lake. In the earlier study we noted twice as many snail species per station in the bays compared to the stations along the shores of the major basin. In the recent study we found a more equal species richness in the bays and shores of the major basin ($5.30 \pm .31$ -- $6.13 \pm .25$). The mean number of species per station for the entire lake has increased from $3.22 \pm .26$ in 1959 to $5.64 \pm .21$ in 1979. This 70% increase is significant ($p = .001$).

Further evidence for this shift to increased diversity per station may be seen by comparing the 2 studies station by station. Diversity

Table 3. Percentage of snails, by species, collected at 3 different zones in Lake West Okoboji, 1979.

	Shore (0-1m)	Vegetation (1-5m)	Bottom (2-5m)
Physa gyrina	95%	5%	0%
Physa integra	68%	30%	2%
Amnicola limosa	2%	87%	11%
Amnicola lustrica	28%	41%	31%
Amnicola binneyana	0%	3%	97%
Promenetus exacuous	30%	63%	7%
Gyraulus parvus	90%	9%	1%
Valvata tricarinata	0%	1%	99%
Total	51%	36%	13%

increased at 41 of the 53 stations, remained the same at 9, and decreased at only 3 stations (Table 2). Of the 8 major species, only *P. gyrina* decreased in the number of stations where they were collected. *A lustrica, V. tricarinata,* and *G. parvus* showed striking increases in the number of stations where they were collected (Table 2).

The habitats are partitioned by members of the snail fauna. Table 3 shows the percentage of each of the 8 major species by mode and place of collecting. The 2 physids and *G. parvus* are the inshore species, found largely on rock. Two of the amnicolids and *P. exacuous* predominate in the vegetation collections. *A. binneyana* and *V. tricarinata* were at greater depths, taken almost exclusively in the dredge samples. Here we note more changes over 20 years. As the physids declined they were replaced by *G. parvus* as the major snail of the inshore zone; this has been a remarkable shift since *G. parvus* was mostly taken from vegetation 20 years ago. *V. tricarinata* was also largely found in vegetation 20 years ago but is now almost restricted to the bottom. This species extends to greater depths than were sampled; Gale et al. (1972) collected them out to depths of 20m.

DISCUSSION

We repeat the cautions about interpreting numbers when comparisons are based on equivalency of effort by 2 teams of collectors, 20 years apart. Nevertheless, the senior author participated in both studies and the major similarities and differences did seem real in the field.

Four prominent conclusions may be made from the comparisons of the snail fauna of 1959 with that of 1979. 1) The total number of snails has remained relatively constant. 2) The total number of species has remained at 12, of which 4 are very rare or restricted to 1 site. 3) The relative densities of the 8 major species have shifted strikingly. 4) The number of species per station has increased throughout the lake.

The unchanging species composition and total number of snails collected in the 2 studies suggests that productivity and stability have been maintained in the lake for that period. The resource needs of the snails have been met and environmental extremes have not exceeded the tolerances of the 12 species. There have been no introductions and there have been no local extinctions in this period. We believe that the decline of the molluscan fauna has been halted.

While the stability of the fauna is reassuring, the changes in relative numbers and shifts in distribution are exciting. Of the 8 major species, 4 are air breathing pulmonates and 4 are gilled snails. Three of the 4 pulmonates had reduced densities and the gilled species had increased densities. This suggests that water quality may have actually improved in 20 years.

The pulmonate decline is the opposite of expectation had the lake continued to become more polluted. *P. gyrina* especially, has a high tolerance for pollution; Dewitt (1955) cited field evidence of their withstanding very low O_2 and very high H_2S. Clampitt (1970) documented the inshore position of *P gyrina,* exactly that part of the lake most apt to have been influenced by effluents from septic tanks in the past. This species dropped almost fourfold over 20 years.

The increase in the gilled species is also the opposite of expectation had the lake continued to become more polluted. Gilled snails are less tolerant of high CO_2 and polluted conditions (Carr and Hiltunen 1963, Harman and Forney 1970, Harman 1974). *A. limosa* and *A. lustrica* are often associated in lakes, especially in those lakes where pollution has not been a factor (Berry 1943, Clarke 1979). These 2 species are among those increasing in density over the 20 year period. The increase of *V. tricarinata* in dredge samples, and the general increase in number of snails from the bottom, may mean more favorable bottom conditions. Nevertheless, all of the species now in the lake are very widespread; most are found in many habitats including some which are somewhat polluted or low in O_2 or are categorized as inhabitants of eutrophic lakes (Harman 1974). These are the sturdy survivors of the once extensive molluscan fauna of the lake (Shimek 1935).

The shift in distribution is as remarkable as the shift in relative numbers. Here the data should be quite reliable when comparing between stations or between studies. Two hours of collecting at a site could be expected to yield a valid list of the major species. Seventy five percent of the 53 stations showed increased species diversity; the mean number of species per station doubled. This was largely due to increased diversity at stations along the major basin rather than in the bays. For instance, stations 1-3 had only 2 species in 1959, but had all 8 major species in 1979 (Table 1). The senior author can confirm the impression of paucity 20 years ago, a few physids. Such low numbers were not uncommon in 1959; 40% of the stations had fewer than 12 snails in 2 hours collecting; in 1979 only 1 station had fewer than 12 snails. Snails disperse readily and will slowly find their most suitable environment by responding to multiple cues (Bovbjerg 1975).

Lake West Okoboji is the pearl of the Iowa Great Lakes, so it is satisfying to report at least a halt in deterioration and possibly some reasons to suspect improvement in water quality. The decline in physid numbers means a decline in the intermediate hosts of the schistosome that causes the "swimmer's itch" dermatitis. We have the subjective impression that the incidence of this inconvenience has declined over the 20 year period. The increase in the number of amnicolids means an increase in a very important molluscan food for fish (Berry 1943).

While development of the tourist industry has burgeoned, it is also important that a sanitary sewerline was completed around Lake West Okoboji in 1964. In the last decade there has also been an increased awareness of environmental problems among the citizens of the area. These 2 changes in 20 years may explain some recovery of the health in the lake ecosystem and they give us some cause for optimism.

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In Memoriam

Dr. Elmer W. Hertel, Professor Emeritus of Biology at Wartburg College, died of bone cancer Nov. 10, 1981, at Waverly Municipal Hospital. Born and raised near Clay Center, Nebraska, Dr. Hertel earned a B.A. degree at Peru State College in Nebraska, an M.A. degree at Denver University and a Ph.D. degree at the University of Nebraska.

He was science instructor at Hebron Junior College and Academy in Nebraska, 1931-33, and Professor of Biology at Wartburg in Clinton, 1933-35, and at Wartburg in Waverly, 1935-1979.

Dr. Hertel was president of the Iowa Academy of Science (1958-59) and the American Association of Basic Science Boards. He was a member of the Iowa Basic Science Board for 22 years.

A friend of athletics, Dr. Hertel coached football, basketball and baseball at Wartburg. He was secretary of the Iowa Intercollegiate Athletic Conference for 37 years, and two years ago the IIAC named its traveling trophy for the All Sports Champion after him. Wartburg's baseball field is named Hertel Field, and each year the Hertel Award is given to an outstanding senior athlete.