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Movement and Homing of Sunfishes in Clear Lake

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Abstract: During the summer of 1964, pumpkinseeds (*Lepomis gibbosus*), bluegills (*Lepomis macrochirus*) and green sunfish (*Lepomis cyanellus*) were taken by shocking in certain areas of Clear Lake, Iowa, marked with numbered jaw tags, and displaced to other neighboring areas. Recaptures indicate that separate populations live in various parts of the lake. Recapture rates for pumpkinseeds and bluegills replaced in their home areas were higher than for those displaced to other areas. No correlation was shown between homing and distance displaced, but distances did not exceed 2200 feet. The larger fish showed a greater homing tendency. Home ranges are apparently maintained only for relatively short periods by these fish. Direct observation of homing indicated that green sunfish have a higher precision in orienting themselves and returning to the area of original capture than do the other two species.

INTRODUCTION

Investigations of fish populations were initiated in Clear Lake, Iowa, in 1941, and, with the exception of 1944 to 1946, have continued to the present. The study here reported deals with the movement of displaced pumpkinseeds, bluegills and green sunfish. Sampling with gill nets, fyke nets and seines from 1947 to 1954 produced 1,215 bluegills and 336 pumpkinseeds (Di Costanzo, 1957). Sampling with an electric shocker and gill nets in 1963 and 1964 produced 147 bluegill and 431 pumpkinseeds. This suggests a change in species composition, although gear selectivity may have had some effect on the relative numbers of fish caught.

DESCRIPTION OF AREA

Clear Lake is a shallow, eutrophic lake located in Cerro Gordo County, north-central Iowa. At outlet level, it covers an area of approximately 3,643 acres, with a maximum depth of about 20 feet (Pearcy, 1953). The bottom in the littoral zone is composed mainly of sand and gravel, while bottom areas in deeper water are silt (Bailey and Harrison, 1945). The giant

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bulrush (*Scirpus validus*) constitutes the major form of emergent vegetation, while *Potamogeton* spp. are the main submerged plants (Pearcy, 1953).

Areas of Collection

The areas of Clear Lake at which fish were tagged are shown by the abbreviations on the map of Clear Lake (Fig. 1). A general description of the areas follows:

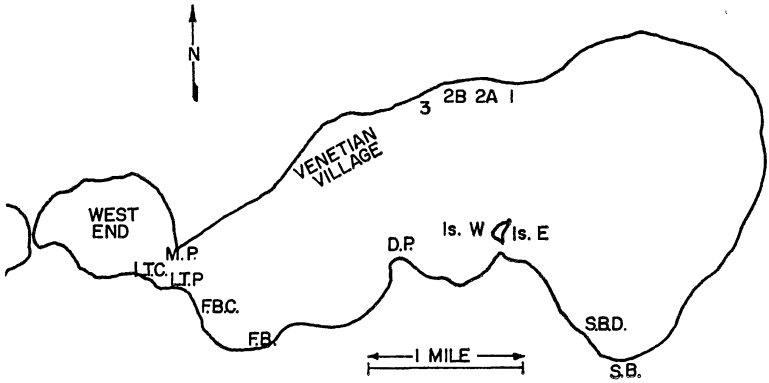

Fig. 1. Map of Clear Lake, Iowa, showing areas of tagging and/or displacing pumpkinseeds, bluegills and green sunfish during the summer of 1963 and 1964.

Area 2A extended 675 feet, area 2B extended 1,400 feet and area 3 extended 900 feet along the north shoreline. These three areas contained *Carex, Scirpus, Myriophyllum* and *Potamogeton,* but the vegetation was less dense in area 3 than in 2A or 2B.

McIntosh Point (M.P.) is north of Lone Tree Point and has densely distributed patches of *Potamogeton, Scirpus* and *Carex.*

Lone Tree Cove (L.T.C.) is an area extending 1,600 feet along the shoreline, containing dense patches of *Potamogeton, Ceratophyllum* and *Myrophyllum.*

Farmers Beach Cove (F.B.C.) is an area extending 2,000 feet along the shoreline, containing sparsely distributed patches of *Potemogeton, Ceratophyllum, Vallisneria,* and some *Myriophyllum.*

Farmers Beach (F.B.) is an area extending 2,500 feet along the shoreline, containing a 200 foot-wide patch of *Scirpus* and *Ceratophyllum,* which starts 300 feet from the shore itself.

Dodge Point (D.P.) is a quite shallow and very rocky area with no aquatic vegetation.

Island East (Is. E.) is an area along the east side of the Island, which is rock-free and deep, and contains no vegetation.

Island West (Is. W.) is an area along the west side of the Island, which is somewhat rocky and shallow, and contains no vegetation.

South Bay Dock (S.B.D.) is a dock located about 500 feet from the center of South Bay, but is lacking in vegetation.

South Bay (S.B.) is an area about the size of a football field, which is patchily distributed with *Potamogeton* and *Scirpus*.

Venetian Village is an area along the north shoreline which contains many privately owned boat docks. No tagging was done in this area.

West End includes the entire bay located at the west end of the lake. This area has much submerged vegetation. No tagging was done in this area.

Methods and Materials

During the summer of 1964, sunfish were tagged on the lower jaw with size 1, number 4 Monel metal self-piercing tags. These individually numbered tags, purchased from the National Band and Tag Company, were one-quarter inch long when clamped shut. The fishes were captured by means of an electric shocker which generated approximately 160 volts A.C. The current was transmitted into the water through two 5-foot copper electrodes spaced 8 feet apart. Since the areas in which the shocking was done were shallow, the boat was moved by pushing it manually.

Abundance in Various Areas

Sunfishes differed in abundance in the various areas selected for study (Tables 1 and 2). Area 2 had higher catches that area 3 in both years, perhaps the result of less abundance and diversity of submerged vegetation in area 3. Area 2A had more bluegills than pumpkinseeds, but the reverse was true in all other areas. The two areas with highest catch per effort for pumpkinseeds in 1964 were Lone Tree and Farmers Beach Coves.

Tagging studies indicated movements of fish between areas 2 and 3, between Lone Tree Cove and Lone Tree Point, between Farmers Beach and Farmers Beach Cove and between the two sides of the Island, but no movement between these various

Table 1. Number of sunfish caught per hour of shocking in Clear Lake, 1963.

Area	Hours Shocking effort	Number caught per hour		
		Pumpkinseeds	Bluegills	Green sunfish
2A and B	21	3.86	1.05	.05
3	11	.36	.27	0
L.T.P. and L.T.C.	27	2.00	.26	0
Island	12	1.25	0	0
South Bay	3	0	0	0
West End	10	2.40	.20	0
M.P.	4	1.00	0	0
Venetian Village	12	2.00	.17	0

Table 2. Number of sunfish caught per hour of shocking in Clear Lake, 1964

Area	Hours Shocking effort	Number caught per hour		
		Pumpkinseeds	Bluegills	Green sunfish
2A	31	.84	2.13	.06
2B	25	1.88	.88	.08
3	22	.27	.27	0
L.T.C.	16	5.62	1.94	.25
L.T.P.	9	1.22	1.00	0
F.B.	18	1.66	.89	.06
F.B.C.	22	3.23	.23	.09
Is. E.	11	1.73	0	0
Is. W.	18	1.78	.22	.56
S.B.	10	2.10	.60	0
D.P.	10	3.20	.10	0

major areas. The populations in these general areas may be independent of each other.

Movement and Homing

Movement and homing of sunfish were studied by removing the fish from the area of capture and releasing them elsewhere. Several factors, such as habitat preference, distance of displacement, size of fish and time at large were investigated as variables which would affect movement and homing. The homing behavior of sunfish was studied by observing the movement of the fish. Some of the fish were not displaced, but were replaced in the area of initial capture.

Recapture Rates. A total of 368 pumpkinseeds, 166 bluegills and 23 green sunfish were displaced from one area of the lake and transported to another area. Of the displaced pumpkinseeds 44% (163) were recaptured; of the bluegills 44% (73) were recaptured; of the green sunfish 74% (17) were recaptured. Perhaps the green sunfish are hardier fish and are more able to withstand the physical effects of handling and tagging. Since none of the fish used in this study were caught more than twice,

there is a possibility that fish suffer mortality when subjected to hyperactivity.

Homing Percentages. The percentages of homing are based on the total number of the recaptured fish which homed, compared to the total number of fish displaced and recaptured (per cent homing $= \frac{\text{Number homed}}{\text{Number recaptured after displacement.}}$)
Of the recaptured pumpkinseeds 64% homed; of the recaptured bluegills 60% homed; and of the recaptured green sunfish 76% homed. Pumpkinseeds and bluegills appear to home with about the same percentage, while green sunfish appear to home more after displacement than do the pumpkinseeds and bluegills.

Homing and Habitat Preference. Movements of sunfish in areas 2A, 2B and 3 (Table 3) show that pumpkinseeds prefer the habitat of area 2A and 2B over area 3. Pumpkinseeds shocked in area 2A and displaced to area 3 mostly returned to area 2A, but some went to area 2B. Pumpkinseeds captured in area 2B and taken to area 3 mostly returned to 2B, but some want to area 2A. Conversely, pumpkinseeds shocked in area 3 and displaced to area 2A or 2B stayed in area 2A and 2B.

Bluegills prefer the habitat of area 2A over those of areas 2B or 3 (Table 3). Bluegills shocked in either area 2B or 3 and transported to area 2A stayed in area 2A. Bluegills shocked in area 2A and transported to either area 2B or 3 tended to return to area 2A.

Pumpkinseeds shocked in Lone Tree Cove and transported to Lone Tree Point and later recaptured had a high percentage of homing (92%), as did pumpkinseeds shocked in Farmers Beach Cove and transported to Farmers Beach (70%). On the other hand, there was no homing of sunfish shocked at Lone Tree Point and released at Lone Tree Cove and a low percentage of homing of pumpkinseeds shocked at Farmers Beach and released at Farmers Beach Cove.

Homing and Distance Displaced. Most investigators of homing behavior show that the homing percentages decrease as the distance the fish are displaced increases. Data from this study (Table 3) show little effect of distance displaced upon homing percentages. The distances the fish were displaced were less than 220 feet and possibly were not great enough to have an effect on homing percentages. Pumpkinseeds captured at Dodges Point were transported various distances out into the lake in contrast to the other displacements along shore.

Homing and Size of Fish. It is commonly held that larger fish will return more often than smaller ones to the same ter-

Table 3. Percentages of sunfish which were recaptured and percentages of these which homed after being tagged in one area and displaced to another area in Clear Lake during the summer of 1964

Species	Area of initial capture	Area of displacement	Distance in feet	Number tagged	Per cent recaptured	Per cent of recaptures which homed
Pumpkinseeds						
	L.T.C.	L.T.C.	0	17	65	82
	D.P.		200	12	67	88
	D.P.		300	10	50	60
	D.P.		400	10	60	33
	S.B.	S.B.D.	500	21	57	66
	L.T.C.	L.T.P.	800	73	34	92
	L.T.P.	L.T.C.	800	11	36	0
	2A	2B	1000	14	43	50
	2B	2A	1000	22	50	82
	Is. E.	Is. W.	1000	19	42	38
	Is. W.	Is. E.	1000	32	44	57
	3	2B	1200	3	100	0
	2B	3	1200	25	40	90
	F.B.	F.B.C.	2200	30	33	30
	F.B.C.	F.B.	200	71	42	70
	2A	3	200	12	67	62
	3	2A	2200	3	33	0
Total displaced			200-2200	368	44	64
Bluegills						
	2A	2A	0	10	70	88
	D.P.		200	1	100	100
	S.B.	S.B.D.	500	6	17	0
	L.T.C.	L.T.P.	800	31	32	40
	L.T.P.	L.T.C.	800	9	44	0
	2A	2B	1000	26	46	83
	2B	2A	1000	12	67	25
	Is. W.	Is. E.	1000	4	100	100
	3	2B	1200	3	33	0
	2B	3	1200	10	70	71
	F.B.	F.B.C.	2200	16	31	40
	F.B.C.	F.B.	2200	5	60	33
	2A	3	2200	30	47	93
	3	2A	2200	3	67	0
Total displaced			200-2200	166	44	60
Green sunfish						
	L.T.C.	L.T.P.	800	4	100	50
	L.T.P.	L.T.C.	800	1	100	100
	Is. E.	Is. W.	1000	1	0	..
	Is. W.	Is. E.	1000	10	80	88
	2B	3	1200	2	100	100
	F.B.	F.B.C.	2200	1	0	..
	F.B.C.	F.B.	2200	2	0	..
	2A	3	2200	2	50	100
Total displaced			800-2200	23	74	76

ritory in which they were captured. The pumpkinseeds show this quite clearly (Table 4). Reasons for the low recapture rates for pumpkinseeds 4.6 to 5.3 inches long are not known. Bluegills also show a general increase in homing with size. Green sunfish show no indication of this trend, but the sample size is too small to give a valid interpretation of the data.

Table 4. Returns to the original site of capture by displaced sunfish according to size

Species	Total length in inches	Number tagged	Per cent recaptured	Number homed	Per cent homed
Green sunfish					
	3.4-3.7	4	50	2	100
	3.8-4.1	4	50	1	50
	4.2-4.5	4	75	3	100
	4.6-4.9	4	100	3	75
	5.0-5.3	5	80	3	75
	5.4-5.7	2	50	1	100
Pumpkinseeds					
	3.4-3.7	37	43	9	56
	3.8-4.1	85	52	24	54
	4.2-4.5	40	90	17	47
	4.6-4.9	87	21	14	73
	5.0-5.3	92	12	9	82
	5.4-5.7	24	75	17	94
	5.8-6.1	15	87	12	92
	6.2-6.5	5	60	2	67
Bluegills					
	3.0-3.3	8	37	1	33
	3.4-3.7	9	33	1	33
	3.8-4.1	11	45	3	60
	4.2-4.5	22	45	7	70
	4.6-4.9	42	29	9	75
	5.0-5.3	32	34	10	91
	5.4-5.7	15	53	4	50
	5.8-6.1	12	50	4	67
	6.2-6.5	5	20	1	100
	6.6-6.9	4	25	1	100
	7.0-7.3	8	25	0	0
	7.4-7.7	5	20	0	0
	7.8-8.1	3	33	0	0

Homing and Days at Large. Parker and Hasler (1959) are of the opinion that, the longer fish are kept at large between marking and initial recapture, the better is the percentage of homing. They attribute this increase to the fact that with more searching, the fish are more likely to find their way back home. Parker and Hasler determined their homing percentages by dividing the number of fish tagged into the number of fish returning. Homing percentages in the present study are based only on recaptured fish. Data from the present study (Table 5) show that the homing percentages decrease as the time at large increases. This may indicate that fish at large for a longer period of time have a tendency to move around, rather than to

Table 5. Returns to the original site of capture by displaced sunfish being at large for specified periods subsequent to tagging

Species	Number of days between tagging and initial recapture	Number recaptured	Number homed	Per cent homed
Pumpkinseeds				
	0-5	31	28	90
	6-11	29	23	79
	12-17	49	31	63
	18-23	13	7	54
	24+	39	15	38
Bluegills				
	0-5	12	10	83
	6-11	14	10	71
	12-17	20	11	55
	18-23	12	5	42
Green sunfish				
	0-5	2	2	100
	6-11	4	4	100
	12-17	3	3	100
	18-23	5	3	60
	24+	2	1	50

home, and that a home range may be retained only a relatively short time by these sunfish.

Direct Observations of Homing. At various times throughout the summer fish were observed directly after being displaced from an area of capture. These observations were made to determine if any patterns of orientation were being used by the fish. Because of wave action present most of the time on the lake it was difficult to find a suitable site for these observations. The southwest side of the Island was finally chosen because all three species of fish were found there, and the area was relatively calm most of the time.

The method of conducting this observation was similar to that used by Hasler and Wisby (1958). However, a small round balloon, instead of a bobber, was attached to the fish by a monofilament thread 3-4 feet long, tied to a hook. The hook was then attached to the flesh behind the dorsal fin. Different colored balloons were used to keep the species of fish separate. The time of return to the place of capture was recorded, and the course the fish took was noted by observing the balloon being pulled along the surface.

The fish were initially captured close to the shoreline along the west side of the island. They were then transported by boat to a point 1,000 feet from shore. Each fish was released individually so that the lines or balloons would not get tangled up. During all these experiments, the sun was visible to some extent.

Green sunfish took less time to home than did the pumpkin-

seeds or bluegills. The bluegill and pumpkinseed behavior differed from the green sunfish behavior in two respects. When pumpkinseeds or bluegills were released from the boat, they spent considerable time moving around in circles or even swimming around the boat. This behavior is considered as searching. The green sunfish, on the other hand, started directly toward the Island after being put into the water. When the pumpkinseeds or bluegills reached the Island, they moved along the shoreline and often reversed direction. Green sunfish usually stayed in one spot when they reached the shoreline.

Stay-at-home Fish. Some of the fish used in the study were replaced in the area of initial capture (Kudrna, 1965). Of the fish which were recaptured, the fish which stayed in the area were recaptured within 1 to 2 weeks. The fish which strayed out of the area were recaptured 3 weeks later. The fact that the fish which were recaptured later were away from the area of initial capture indicates that they may not maintain a small home range for a long period of time.

Recapture rates for fish which were not displaced are higher than recapture rates for displaced fish. Of the 17 pumpkinseeds which were not displaced, 64% (11) were recaptured; of the 10 bluegills which were not displaced 80% (8) were recaptured. While these figures are not large, they suggest that displacement reduces the recapture rate.

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