Characteristics of Yellow Perch Cannibalism in Oneida Lake and the Relation to First Year Survival[1]

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ABSTRACT

Because adult yellow perch were known to be cannibalistic in Oneida Lake, New York, this species was studied in 1965–71 to identify factors affecting the intensity of cannibalism and to evaluate the effect of cannibalism on the abundance of young perch. Adult perch changed their food habits in response to changes in the availability of different food items from June through September. Although young-of-the-year perch were most abundant in adult stomachs in August of most years, wide variations occurred in the annual intensity of cannibalism. Length and abundance of young perch, abundance of large chironomids and amphipods, and the size of the adult predator were identified as important factors for explaining variations in the frequency of occurrence of young perch in stomachs of adults. Correlations between the annual intensity of perch cannibalism and length and abundance of young perch imply that cannibalism operates as a compensatory or possibly an extrapensatory mortality process.

The consumption of young perch by adults in 1971 was estimated from the incidence of young perch in stomachs, the rate of food evacuation, and the size of the adult perch population. About 25% of the perch fry that were available as forage in early June succumbed to cannibalism in June–September. This level of consumption of young perch by adults in a year of intense cannibalism, together with evidence that perch cannibalism likely does not operate in a manner consistent with the observed depensatory mortality of young perch, imply that cannibalism was not decisive in limiting the strength of year classes in 1965–71.

This study was initiated to determine seasonal and annual differences in food habits of adult yellow perch, *Perca flavescens*, to identify factors affecting the intensity of cannibalism, and to estimate the proportion of the young perch population consumed by adults. Cannibalism has been reported frequently in populations of yellow perch (Pearse and Achtenberg 1920; Eschmeyer 1937; Maloney and Johnson 1955) and also in populations of the closely related Eurasian perch *Perca fluviatilis* (Alm 1946; Manteyfel et al. 1965; Popova 1967; Chikova 1970; McCormack 1970). Although Alm (1946) viewed perch cannibalism as an important population regulatory mechanism in several small Swedish lakes and McCormack (1970) also investigated this possibility in Windermere, quantitative estimates of mortality attributable to cannibalism were not obtained.

Young yellow perch are the predominant forage fish in Oneida Lake and they are utilized primarily by walleye and adult perch. Forney (1971) examined survival of young perch during the demersal stage and presented evidence that walleye predation limited young perch abundance. The role of perch cannibalism, however, was not assessed even though adult perch were abundant and at times fed extensively on their young.

STUDY AREA AND YELLOW PERCH POPULATION

Oneida Lake, a eutrophic body of water located in central New York, has a surface area of 207 km^2 and a mean depth of 6.8 m. Morphological and limnological features have been described by Greeson and Meyers (1969). The lake is generally homothermal in summer although temporary stratification may occur during periods of prolonged calm weather, and oxygen depletions may develop at depths over 8 m. The most important sport fish are walleye *Stizostedion vitreum vitreum*, yellow perch, and smallmouth bass *Micropterus dolomieui* (Grosslein 1961). Adult perch and walleye are the fish taken in greatest numbers in experimental gill nets and these species together usually comprise over 70% of the catch.

Yellow perch in Oneida Lake spawn in mid- to late April and young which hatch in May average 50–70 mm total length by fall. Generally, males mature at age II or III when

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they attain a total length of 110–190 mm, and females mature at age III or IV at lengths of 170–220 mm. In most years perch 230–280 mm total length comprise approximately 75% of the adult population, and individuals over 300 mm are common. The population of age III and older perch estimated by mark and recapture was 2.5 million in 1969 and 2.1 million in 1971. Although size of the adult population in earlier years is not known, catch/effort in gill nets has fluctuated little for over a decade.

METHODS

The diet of adult perch, seasonal variations in the abundance of important invertebrate food organisms, and fluctuations in abundance and growth of young perch were monitored in 1965–71 to identify factors affecting the intensity of perch cannibalism. Perch were taken in gill nets with equal lengths of 3.8-, 5.1-, 6.4-, 7.6-, 8.9-, and 10.2-cm stretch mesh set at approximately sunset and fished overnight once each week at a different site in June–September. Nets were lifted at about 0730 hr and all perch were examined except on days when catches were exceptionally large; then a representative sample of about 50 fish was selected. Total lengths of perch were recorded and food organisms identified from individual fish. Occurrence of invertebrates was noted and all fish in stomachs were counted.

Density of *Daphnia* spp. was estimated from the catch and volume strained in vertical hauls with a No. 10 half-meter ring net or in oblique hauls with an Isaacs-Kidd sampler. Hauls were taken at approximately biweekly intervals from June through September at one to three sites in 1965–67 and at four to seven sites in 1968–71. *Daphnia* spp. were enumerated in two to three aliquots of each sample from which the density per liter was calculated.

Density of benthic invertebrates was determined from two to five Ekman dredge samples taken at three sites biweekly from June through August. Samples were washed through a screen (0.55 mm aperture) and live invertebrates were removed and preserved in alcohol. All organisms were identified to order and counted, and in addition, insects were identified to family and the volume of chironomid larvae was determined by water displacement.

The population of yellow perch fry was estimated in 1965–71 from the catch and volume strained by Miller high-speed samplers (Noble 1971, 1972a). After the young became demersal, samples were collected by trawling at 10 sites at weekly intervals from late July to mid-October. Samples of perch fingerlings were measured and relative abundance was estimated from the regression of log values of catch/effort on time (Forney 1971).

Consumption of young perch in 1971 was determined from examination of adults collected weekly at Shackelton Point at approximately 4-hr intervals between sunrise and sunset in a 9.1-m bottom trawl. Number of young perch in stomachs of perch over 200 mm total length (minimum adult size representatively sampled by the gear) was recorded, and the five samples taken during a 24-hr period were pooled to estimate the average number per stomach. To evaluate the adequacy of sampling, the periodicity of perch feeding was determined from the same samples. For this purpose, wet weight of pooled stomach contents from each sampling period was determined.

SEASONAL FOOD HABITS

Frequency of occurrence of food items in stomachs of perch taken in gill nets in 1965–71 illustrate monthly and yearly changes in diet (Table 1). In June zooplankton and chironomids generally dominated the diet. The frequency of occurrence of zooplankton and chironomids in stomachs typically declined in July, whereas the frequency of amphipods and fish increased. In August fish were of greatest importance in the diet, whereas the frequency of occurrence of invertebrates decreased. In September fish usually became less important and invertebrates became more important as food. Since slightly over half of the fish observed in stomachs were identifiable and 97% were young-of-the-year perch, all unidentified fish were assumed to be young perch.

The pattern of perch feeding reflects changes in the availability of different food items

TABLE 1.—*Percentage frequency of occurrence of food items in stomachs of perch taken in gill nets June–September, 1965–71*

Year	Number of stomachs examined	Percentage of empty stomachs	Food items in stomachs containing food				
			Zooplankton	Chironomids	Amphipods	Total invertebrates	Fish
				June			
1965	199	39.2	6.6	87.6	1.7	100.0	1.6
1966	184	36.4	19.6	59.8	11.1	97.4	2.6
1967	203	62.6	22.4	65.8	10.5	98.7	0.0
1968	200	39.5	62.8	11.6	14.9	94.2	7.5
1969	139	43.2	45.6	29.1	25.3	94.9	8.9
1970	257	28.0	50.8	44.8	2.7	95.7	8.6
1971	221	26.7	88.3	9.2	9.9	98.8	8.0
Mean	200	39.4	42.3	44.0	10.9	97.1	5.3
				July			
1965	146	44.5	1.2	54.3	17.3	71.5	50.6
1966	201	56.2	0.0	46.6	31.8	96.6	3.4
1967	203	47.3	2.8	43.9	28.0	85.0	23.4
1968	193	40.4	9.4	21.7	37.0	77.4	35.5
1969	180	36.1	5.3	40.9	54.5	79.1	31.1
1970	168	35.1	57.8	41.3	30.2	92.7	9.2
1971	98	38.8	11.7	20.0	10.0	38.3	68.3
Mean	170	42.6	12.6	38.4	29.8	77.2	31.6
				August			
1965	258	57.4	0.0	10.0	1.8	34.5	82.7
1966	205	67.3	3.0	17.9	47.7	80.6	20.9
1967	187	71.1	7.6	30.3	10.6	79.6	18.5
1968	228	56.1	3.9	5.2	7.8	20.0	79.2
1969	229	68.6	3.6	7.3	12.7	54.2	70.9
1970	144	63.2	17.6	0.0	11.8	64.2	67.6
1971	143	46.2	0.0	10.4	10.4	48.0	68.8
Mean	199	61.4	5.1	11.6	14.7	54.4	58.4
				September			
1965	35	71.4	20.0	20.0	20.0	60.0	40.0
1966	17	58.2	14.3	28.6	42.9	85.7	14.3
1967	45	73.3	58.4	0.0	0.0	91.7	8.3
1968	92	79.4	0.0	34.6	0.0	52.6	57.9
1969	45	51.1	4.5	45.4	40.9	81.8	18.2
1970	18	50.0	22.2	0.0	11.1	66.7	55.5
1971	16	50.0	0.0	0.0	0.0	25.0	87.5
Mean	38	61.9	17.1	18.4	16.4	66.2	40.2

during the summer. For analyses, densities of *Daphnia* spp. and amphipods are expressed as numbers of organisms and density of chironomids is expressed as volume (see Fig. 2). Chironomid larvae taken in benthic samples varied in size, but perch ate only the larger individuals; consequently it was assumed that availability of chironomids is best represented by volume which emphasizes the presence of larger larvae.

The mean frequency of occurrence of zooplankton, chironomids, and amphipods in stomachs of perch during June, July and August, 1965–71 (Fig. 1) paralleled trends observed in monthly mean densities of these food organisms (Fig. 2). The decline in the density of *Daphnia* spp. and chironomids from June through August and the peak in amphipod abundance in July coincided with the occurrence of these food items in perch stomachs for those months. Increase in occurrence of fish in stomachs from June to August (Fig. 1) coincided with the decline in densities of *Daphnia* spp. and chironomids (Fig. 2). Although young perch were pelagic and most abundant in June, few were eaten by adults. In July through August the young were primarily demersal and a major food item.

The typically lower frequency of occurrence of fish in stomachs of perch caught in September than in August may have been caused by a combination of decreasing abundance and increasing size of young perch. In 1971 when the total length of young perch on 1 September averaged 48 mm, the frequency of

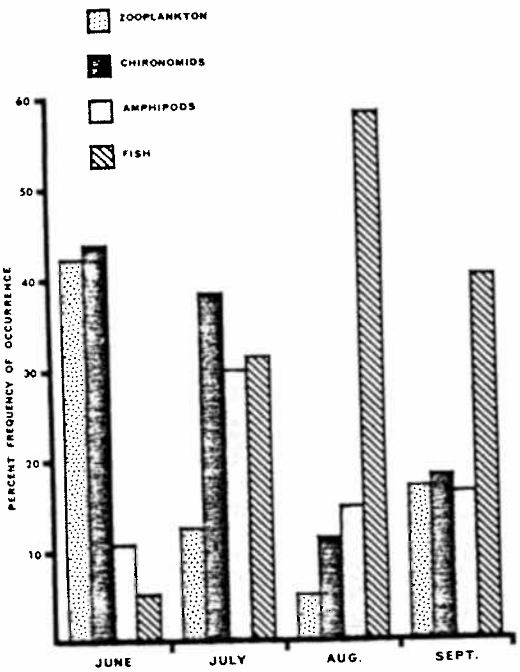

FIGURE 1.—Percentage frequency of occurrence of food items in perch stomachs containing food for fish taken in gill nets, June–September 1965–71.

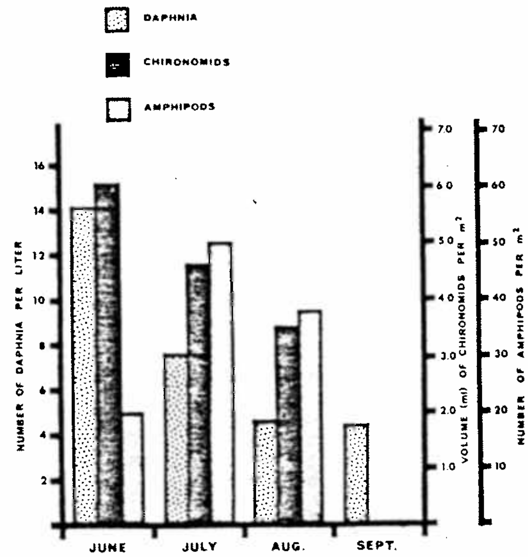

FIGURE 2.—Average monthly density of invertebrates in Oneida Lake, June–September 1965–71.

occurrence of fish in perch stomachs increased from August to September, but it decreased in other years when young perch averaged 51 to 71 mm. This suggests that growth rate of young perch may affect the seasonal duration of cannibalism.

FACTORS AFFECTING THE INTENSITY OF PERCH CANNIBALISM

The frequency of occurrence of fish in stomachs of perch taken in gill nets in June–September ranged from 3.3% in 1966 to 24.5% in 1971 which indicates that there was wide variation in the intensity of cannibalism among years. The relative importance of size and abundance of young perch and the abundance of other food items in determining the annual intensity of cannibalism was determined by multiple regression analysis. Since cannibalism was relatively insignificant until July, the percentage frequency of occurrence of young perch in stomachs of perch taken in gill nets in July–September 1965–71 was chosen as an index of the annual intensity of cannibalism (the dependent variable). Independent variables included total length of young perch and indices of abundance of young perch, chironomid larvae, and amphipods. Abundance of *Daphnia* spp. was not included as an independent variable because their mean density from June through September was significantly correlated with the total length of young perch on 1 October ($r = .928$, $P < 0.01$), and daphnids were relatively unimportant food items of adult perch after June in most years.

Fairly high correlation of the intensity of cannibalism index with young perch length ($r = -.80$), young perch abundance ($r = .48$) and amphipod density ($r = -.50$) suggest that these relationships could be adequately described by straight line fits (Fig. 3). Although there was low correlation between the intensity of cannibalism and chironomid density ($r = -.15$), the data suggest a straight line function (Fig. 3) and a linear model was considered adequate for all variables. The order of increase in R^2 for independent variables demonstrates that young perch length was of primary importance, that young perch abundance was of secondary importance, and that the abundance of chironomids and amphipods was much less important in explaining vari-

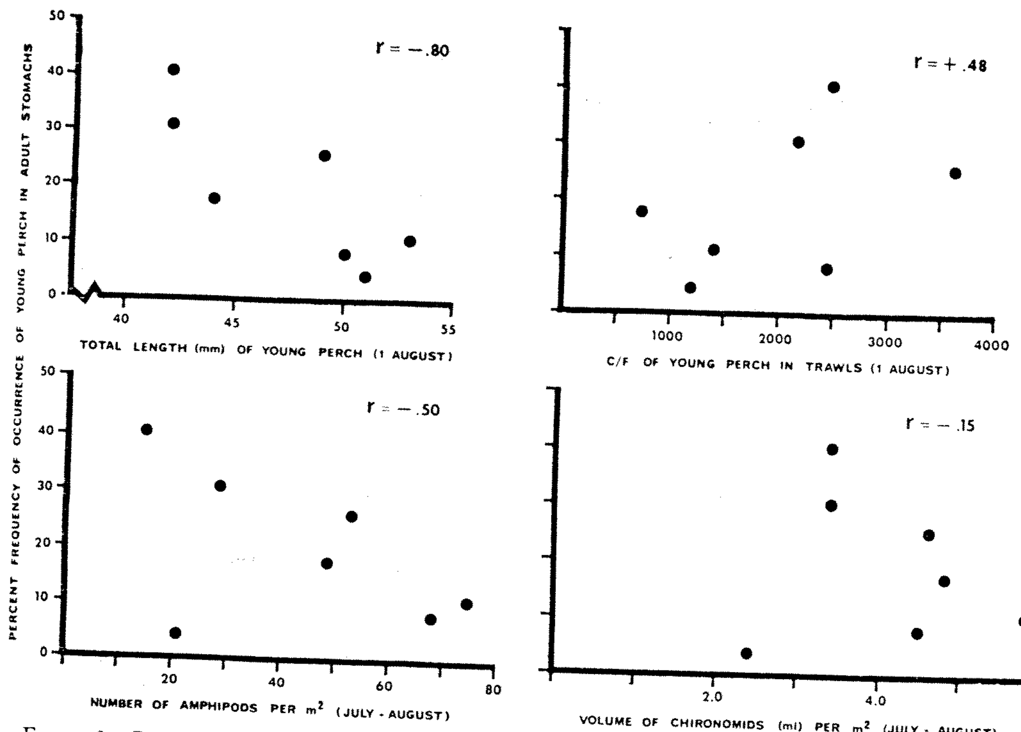

FIGURE 3.—Percentage frequency of occurrence of young perch in stomachs of perch taken in gill nets in July–September and parameters apparently related to the annual intensity of cannibalism from 1965–71.

ability observed in intensity of cannibalism in 1965–71 (Table 2). These four factors in combination were significantly correlated with the intensity of cannibalism ($R = .9901$, $P < 0.01$). More precisely in this model approximately 98% ($R^2 = .9803$) of the annual intensity of cannibalism was explained by the combined effect of the length and abundance of young perch, and the availability of chironomids and amphipods as alternate forage.

Perch taken in gill nets in 1965–71 were combined and separated into five length groups to determine the relationship between the intensity of cannibalism and size of the adult predator. The percentage frequency of occurrence of young perch in stomachs progressively increased from 15.5 for length group 200–224 mm to 23.7 for length group ≧ 275 mm which suggests that larger fish were more cannibalistic than smaller fish (Table 3). To eliminate effects of seasonal differences in feeding and weekly variations in catch of perch of different lengths, the relationship between the intensity of cannibalism and the size of the adult predator also was analyzed by tests of independence with contingency tables. These tests confirmed that larger perch were more cannibalistic than smaller perch (Student's t test, $P < 0.10$).

A further analysis of the data in June–September 1965–71 indicated that the mean number of young perch per adult stomach also increased with size of the adult predator (Table 4). For example, the average number of young perch per cannibalistic adult increased from 2.4 for perch under 200 mm to 5.3 for perch over 274 mm.

TABLE 2.—*Multiple regression analysis with intensity of cannibalism as the dependent variable and mean length of young perch, abundance of young perch, and density of amphipods and chironomids as independent variables*

Variable entered	Multiple correlation R	Multiple correlation R^2	Increase in R^2
Perch length	.8046	.6474	.6474
Perch abundance	.9127	.8330	.1857
Chironomid density	.9209	.8480	.0150
Amphipod density	.9901	.9803	.1323

TABLE 3.—*Percentage frequency of occurrence of young perch in stomachs of five length groups of perch taken in gill nets in 1965–71; number of fish examined in parentheses*

Year	Total length (mm)				
	≥ 275	250–274	225–249	200–224	< 200
1965	38.7 (75)	36.2 (130)	27.2 (103)	26.6 (64)	22.4 (67)
1966	7.6 (79)	3.4 (145)	2.3 (88)	5.4 (56)	3.6 (55)
1967	10.3 (68)	6.8 (118)	10.2 (98)	8.7 (104)	4.3 (47)
1968	34.5 (55)	24.5 (102)	25.0 (108)	35.2 (54)	21.7 (143)
1969	18.6 (70)	20.0 (135)	16.8 (95)	14.3 (70)	17.9 (84)
1970	21.1 (38)	12.4 (97)	11.9 (101)	3.0 (67)	11.1 (27)
1971	47.4 (38)	35.7 (98)	39.1 (64)	50.0 (12)	44.4 (45)
Mean	23.7 (423)	19.3 (825)	18.3 (657)	15.5 (427)	18.8 (468)

CHARACTERISTICS OF CANNIBALISM IN 1971

Gastric Evacuation

In 1971, the rate of consumption of young perch by adults was estimated from Bajkov's (1935) formula

$$D = A \cdot (24\,hr/n)$$

where D is daily food consumption, A is the average quantity of food in the stomach, and n is the time required for gastric evacuation. Principal objections to application of this formula have been related to difficulties encountered in determining evacuation time, and to an inherent assumption that feeding need be continuous if A is determined from a sample of fish collected at a single interval in a 24-hr period. However, if fish are collected at intervals over an extended period of the day and stomach evacuation time is longer than the time between sampling intervals, as was the case in the present study, the Bajkov method should provide a reasonably accurate estimate of food consumption.

In July and August 1971, young perch (averaging 0.4 g in early July to 1.4 g by late August) were fed to perch over 200 mm total length to determine the rate of evacuation of fish from stomachs. A sample of perch taken before dark in a monofilament nylon gill net or a trawl was placed in shaded outdoor tanks (570 liter capacity) supplied with a constant flow of water from the lake. The morning following capture, fish which appeared active were fed young perch recently collected from the lake. Young perch (approximately 1% of the body weight) were forced into the stomach with a glass tube and wooden plunger. The force-fed perch were then released, no more than five per tank, and not disturbed for a period which varied from 2 to 16 hr. After the predetermined time had elapsed, stomach contents of individual fish were weighed and the percentage of the food evacuated was calculated.

Results of feeding experiments performed at approximately 1-wk intervals in late July and August 1971 were pooled. Time for 100% evacuation of young perch from the stomach of an adult (the n in Bajkov's formula) as regressed from 104 observations of the percentage of food evacuated in varying lengths of time was 15.2 hr. Although there was wide variation in gastric evacuation among individual fish, this estimate agrees well with that reported by Manteyfel et al. (1965) who found that adult perch evacuated a meal of young perch in slightly under 15 hrs at 24 C. Assuming effects of handling and captivity were minimal, mean evacuation time observed for perch in tanks should have approximated that of perch in the lake; tank temperatures of 20–25 C were within 2 C of lake temperatures.

Feeding Periodicity and the Average Stomach Content

Stomachs of perch taken in trawls at intervals between sunrise and sunset in 1971 were

TABLE 4.—*Average number of young perch in stomachs of cannibalistic perch taken in gill nets, June–September 1965–71*

Length class (mm)	Number of stomachs containing young perch	Number of young perch per stomach
< 200	88	2.4
200–224	66	3.0
225–249	120	3.6
250–274	159	4.5
≥ 275	100	5.3

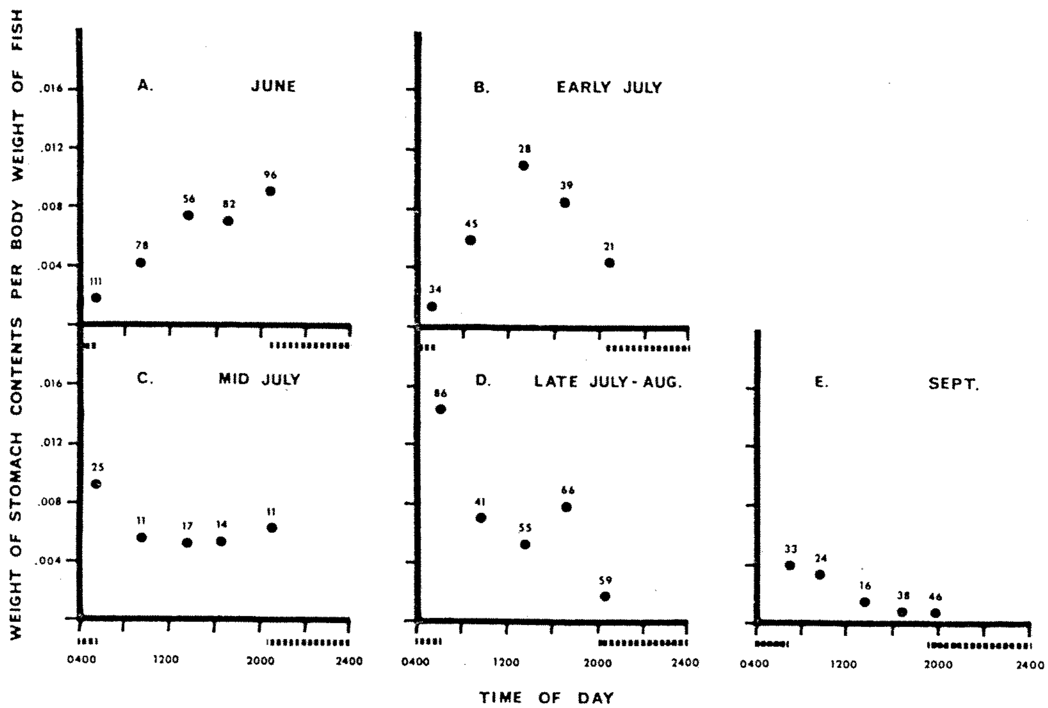

FIGURE 4.—Seasonal trend in weight of stomach contents per body weight of perch taken by weekly trawling over 24-hr periods, June–September 1971; dashed lines specify the approximate daily period of darkness and numerals indicate number of fish examined.

examined to determine daily feeding periodicity. Pooled weight of stomach contents per body weight of perch in the catch in each sampling period was taken as an index of feeding activity. The amount of food in stomachs in June (Fig. 4A) increased rather steadily from sunrise to sunset, suggesting that feeding began at dawn and continued throughout the day, and that feeding ceased and stomachs were evacuated at night. The quantity of food in stomachs peaked in midday in early July (Fig. 4B), was fairly constant through the day in mid-July (Fig. 4C), but generally decreased from early morning until darkness later in the season (Fig. 4D, E). This gradual change in feeding periodicity tended to coincide with the increased frequency of occurrence of young perch in stomachs of adults from July through September (Table 5). The utilization of larger food items (young perch) may have enabled adult perch to fill their stomachs earlier in the feeding period in early July if feeding began at dawn. However, diurnal feeding alone does not explain the morning peaks in feeding curves later in the season. Since only 13% of the total number of fish counted in stomachs from the sunrise sampling period from mid-July through September were freshly consumed, and since the number of fish per adult stomach at sunrise was significantly greater than the number of fish per stomach at sunset (Wilcoxon sign-rank, $P < 0.005$), it appears that some perch fed during hours of darkness.

Although several authors (Carlander and Cleary 1949; Sieh and Parsons 1950; Scott 1955; Hergenrader and Hasler 1966) have reported that perch are generally inactive at night, Tibbles (1956) found that a population of perch in Lake Mendota was active 24 hr a day, and Manteyfel et al. (1965) reported that piscivorous adult perch in Rybinsk Reservoir fed at all hours of the day.

Although it appears that perch feeding generally is not continuous in Oneida Lake,

TABLE 5.—*Percentage frequency of occurrence of food items in stomachs containing food for perch taken in trawls at weekly intervals in June–September 1971*

Week	Number of stomachs examined	Frequency of occurrence	
		Invertebrates	Young perch
4 June	170	100.0	3.4
11 June	134	97.6	17.9
18 June	117	92.5	30.1
25 June	70	89.6	41.7
2 July	94	85.0	57.5
9 July	78	79.0	53.2
16 July	47	29.3	95.1
23 July	40	13.8	100.0
30 July	82	52.3	76.1
6 August	34	30.4	86.3
13 August	33	17.4	94.7
20 August	72	15.6	93.3
27 August	32	33.3	75.0
3 September	19	0.0	100.0
10 September	36	36.4	72.7
17 September	37	5.6	94.4
24 September	33	9.1	100.0

the average number of young perch per adult stomach in several samples taken in 24-hr periods should not be seriously affected by the periodicity of feeding. Combining samples taken at intervals as suggested by Darnell and Meierotto (1962) is a reasonably sound procedure for estimating the average daily number of young perch per adult stomach (the A in Bajkov's formula).

Daily Consumption of Young Perch

The daily intake of young perch by an adult each week, as calculated from Bajkov's equation, increased from 0.02 in early June to a peak of 12.28 in late July and declined rapidly in late August through September (Table 6). Although actual feeding experiments were conducted only during July and August, calculations were based on the assumption that the time of evacuation of young perch from the stomach of an adult was similar in June–September. If young perch of small size are digested more rapidly than those of larger size, evacuation times for June may be shorter, whereas those for September may be longer than the average for July–August. These possible errors would lead to an underestimate of daily intake in June and an overestimate in September, but total consumption for the 4-mo period would not be seriously biased since the number of young perch per stomach was relatively low in both June and September (Table 6).

TABLE 6.—*Weekly estimates of young perch consumed by adult perch, June–September 1971*

Week	Mean daily number of young perch per stomach	Daily intake of young perch	Number of young perch consumed by adult population ($\times 10^6$)
4 June	.01	.02	.29
11 June	.08	.13	1.91
18 June	.75	1.18	17.35
25 June	1.24	1.96	28.81
2 July	4.00	6.32	92.90
9 July	4.10	6.47	95.11
16 July	7.78	12.28	180.52
23 July	6.26	9.88	145.24
30 July	6.96	10.99	161.55
6 August	3.02	4.77	70.12
13 August	2.79	4.41	64.83
20 August	2.75	4.34	63.80
27 August	1.22	1.93	23.37
3 September	1.10	1.74	25.58
10 September	.37	.58	8.52
17 September	.94	1.48	21.76
24 September	.43	.68	10.00
Total			1,011.66

Total Consumption

To determine total weekly consumption (from 4 June to 30 September) of young perch by adults in Oneida Lake, the daily intake was multiplied by seven (for each day of the week) and by the number of adult perch in the population. The population of perch age III and older in April 1971, estimated by mark and recapture, was 2,130,000 with a 95% confidence interval of 1,783,000–2,476,000 (Noble 1972b). Since seasonal distribution of mortality is not known, weekly consumption was calculated by assuming that the perch population was 2.1 million throughout the summer. This yielded an estimated total consumption by age III and older perch from June through September of over 1.0 billion young or 48,300 per ha (Table 6).

DISCUSSION

The incidence of perch cannibalism in Oneida Lake in 1965–71 was typically most intense in August when young perch averaged 40–70 mm total length. Although perch hatch in mid-May and are concentrated in the upper 3 m of the water column, examination of several hundred stomachs of yearling and older perch failed to reveal any cannibalism during this period. The shift from a diet of zooplankton and benthic invertebrates in early summer to one of primarily young perch in late summer also has been reported in other perch populations (Maloney and Johnson 1955; McCormack 1970). Seasonal increase in the incidence of perch cannibalism in Oneida Lake coincided with the decline in the spring pulse of *Daphnia* spp. which are an important food of adult perch in May and June. Although it seems likely that the increase in cannibalism and the decline in the density of *Daphnia* spp. are causally related, the transition of young perch to a demersal stage and their increase in size probably influenced their vulnerability to predation.

A number of implications arise from the analysis of factors affecting the annual intensity of cannibalism and the estimate of consumption of young perch by adults. Multiple regression analysis identified length and abundance of young perch as the two most important factors controlling the intensity of cannibalism in 1965–71. The positive relationship between the incidence of perch cannibalism and the abundance of young suggests that cannibalism operates as a compensatory mortality factor. Intuitively, the strong negative relationship between the intensity of cannibalism and length of young perch suggests that this compensatory effect should be accentuated because high density of young perch would seem likely to suppress their growth. However, in Oneida Lake during the period of study, the growth rate of young perch appeared independent of density (Noble 1972a) which implies that cannibalism may be extrapensatory, that is, unrelated to young perch abundance. In either case it appears that perch cannibalism does not act in a depensatory manner which Forney (1971) demonstrated was typical of first year mortality of perch in Oneida Lake. Forney was probably correct in attributing most mortality of young perch during the demersal stage to walleye predation.

In all, about ¼ of the 4.4 billion perch fry (Noble, personal communication) that were available as forage in early June succumbed to cannibalism by October. Since the mortality of young perch between August and the following May generally exceeds 96% judging from the catch/effort in trawls (Forney 1971), even the relatively high yellow perch predation in 1971 would not be decisive in determining year class abundance in Oneida Lake. Adult perch are nonetheless important competitors with walleye for limited forage supply, and in some years, these two predators undoubtedly suppress young perch abundance.

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