Insler 1985

ially with regard to
eded.

· perch in Oneida Lake.
erch *Morone americana*
).
f Maine. U.S. Fish and
ıdroscoggin and Kenne-
Dept. Inland Fish and
ecological conditions in
ecies collected in deeper
acrozooplankton in the
ibrary.
Nebraska. Trans. Am.
ipeake Bay. U.S. Bur.
Canada. Fish. Res. Bd.
ıe white perch, *Roccus*
:142-205.
fect of the Connecticut
Merriam and L. M.
nst., Bull. 141.
ed storage project and
nphasis on striped bass
n Co. of New York).
e white perch, *Roccus*
niv. Delaware Library.
dson River cooperative
)-October 1971. (Final
forage by white perch
):608-612.
benthic macroinverte-
55-266.
e white perch, *Morone*
Am. Fish. Soc. 98:322-
d. and Econ. Survey 2.
ation to supply. Jour.
e white perch, *Morone*
yellow perch in Maine
americana (Gmelin),
l.
ods for Assessment of
Handbook 3. Black-

GILL PARASITES OF THE WHITE PERCH: PHENOLOGIES IN THE LOWER HUDSON RIVER[1]

Vincent M. Liquori
Graduate Student
Biology Department, Adelphi University,
Garden City, N.Y. 11530[2]

Gayle D. Insler
Associate Professor
Biology Department, Adelphi University,
Garden City, N.Y. 11530

ABSTRACT

Samples of white perch were collected from the Hudson River at St. Vincent's Point (N.Y.) from June through November in 1978 and examined for gill parasites. Numbers of *Pterocleidus nactus* (Monogenea), *Ergasilus labricus* (Copepoda) and the glochidia of a fresh-water mussel fluctuated seasonally, each with its greatest prevalence and incidence in June, the period of white perch downstream migration. Evidence suggests that these patterns are governed by a combination of host spawning time, water temperature and salinity.

The white perch (*Morone americana*) is a typical temperate region bass which is common to salt, brackish and fresh waters along the Atlantic coast of the United States. These include the Hudson River, brackish waters on Long Island and Chesapeake Bay. The migratory habits of white perch have been studied in various bodies of water. During the cold winter months, perch in estuarine waters in the Northeast migrate from shallow, brackish areas to deeper waters, brackish or fresh, where they remain in groups close to the bottom and pass the cold season in a sluggish state (Bigelow and Schroeder, 1953). In the spring they spawn in fresh water, following which they make extensive migrations to the shallow and/or brackish waters where they pass the summer and early fall feeding and growing (Mansueti, 1960, 1961). This basic pattern appears to occur in the Hudson River where the fish migrate between shallow, brackish waters and deeper, freshwater areas. After spawning in May and June, they move downstream to brackish water. Tagging studies have shown that white perch seldom travel more than 10 miles following their post-spawning migration and prior to their winter migration (Mansueti, 1961).

Thus far, work published on the parasites infecting white perch has centered on the identification and classification of the species observed. Hoffman (1967) reported 21 known species, and since then several others have been added including monogenes, copepods and nemetodes (Tedla and Fernando, 1969a; Hogan and Williams, 1976; Mayes and Johnson, 1975; Hanek and Fernando, 1972). The purpose of the present study was to examine the phenologies of the gill parasites. Seasonal fluctuations in

[1]The authors gratefully acknowledge the critical reading of the manuscript by Dr. Edmund D. Brodie, Jr.

[2]Present affiliation: Center for Marine Biotechnology, Harbor Branch Institution, Fort Pierce, Florida 33450.

parasite populations were observed and related to changes in the habitat of white perch.

MATERIALS AND METHODS

Samples of white perch were collected bi-weekly from June through November in 1978 from the Hudson River at St. Vincent's Point (N.Y.). Fish were caught by angling using sandworms (*Nereis* sp.) for bait, and for each the size and weight were recorded as well as salinity, water temperature and date of capture. Fish were pithed immediately upon capture and placed in individual specimen bags on ice. In the laboratory each bag was rinsed with saline and any sediment remaining was examined microscopically for parasites that may have been shed during transfer. Gills were then removed and examined with the aid of a dissecting microscope for the presence of ectoparasites.

Parasites were removed and preserved in 70 per cent ethanol (ETOH) for copepods or alcohol-formal-acetic formulation (AFA) for all other species recovered (after Cable, 1977). Monogenes were stained with Semichon's Carmine (Cable, 1977), and parasitic copepods were cleared and mounted in Hoyer's medium.

The 6-month sampling period was divided into three periods in relation to migratory behavior. The first (June) corresponded to the time when the fish were migrating downstream into brackish water. The second (July to early September) was the period of no migration. The third (mid-September through November) was the period of upstream migration. Analysis of variance was used to distinguish differences between the migratory periods with respect to parasite populations. Differences were considered statistically significant when $P<0.05$.

RESULTS

From June through November, 177 white perch were caught and examined for gill ectoparasites. Representatives of three phyla (Mollusca, Platyhelminthes and Arthropoda) were identified, including the glochidia of a freshwater mussel, the monogene *Pterocleidus nactus* (Mayes and Johnson, 1975), the copepod *Ergasilus labricus* and the isopod *Lironeca ovalis*. In addition to these, metacercariae of an unidentified species of trematode and eggs of an unidentified monogene were found. The monogene eggs were present until August, but it could not be determined whether they were eggs of *P. nactus* or another species. While no other adult monogenes were encountered, no increase in the number of eggs was observed prior to the increase of adult *P. nactus* that occurred in the fall.

The incidence of *L. ovalis* was so low that it was not considered a significant parasite of the white perch collected at St. Vincent's Point. Since it was found on only four of the 177 specimens examined, seasonal variation could not be determined. The remaining species showed considerable fluc-

TABLE 1. PREVALENCE OF GILL PARASITES ON WHITE PERCH IN THE LOWER HUDSON RIVER, ACCORDING TO PERIOD OF MIGRATION*

	Period of migration§		
Parasite	Downstream (53)	None (97)	Upstream (27)
Pterocleidus nactus	68.5 ± 10.3	1.9 ± 0.6	6.0 ± 2.2
Ergasilus labricus	1.47 ± 0.18	0.18 ± 0.03	0.26 ± 0.16
Glochidia	18.6 ± 3.8	0.10 ± 0.02	0.0

*Data expressed as mean number of parasites plus or minus standard error.
§Figures in parentheses at head of each column are number of perch examined.

TABLE 2. INCIDENCE OF WHITE PERCH INFECTED WITH GILL PARASITES IN THE LOWER HUDSON RIVER, ACCORDING TO PERIOD OF MIGRATION*

	Period of migration§		
Parasite	Downstream (53)	None (97)	Upstream (27)
Pterocleidus nactus	94.3	18.5	33.3
Ergasilus labricus	58.5	15.5	7.4
Glochidia	52.8	3.1	0.0
Combined†	96.2	33.0	29.6

*Data expressed as percentage of perch examined that were infected.
§Figures in parentheses at head of each column are number of perch examined.
†Proportion infected with any of these parasites.

tuation in population density over the study period. All had their greatest prevalence (mean number of parasites per fish) during June when the fish began their downstream migration (Table 1).

Glochidia were most numerous immediately following migration downstream and essentially disappeared for the remainder of the study period. The mean density for *P. nactus* was also greatest during downstream migration, but after decreasing sharply during the period of no migration it increased slightly when the fish migrated upstream. The prevalence of *E. labricus* followed a pattern similar to that of the monogene, although at a much lower level. All the decreases in parasite population that occurred from the period of downstream migration to the period of no migration were statistically significant. The subsequent increases were not significant.

The proportion of fish infected with these parasites also fluctuated over the study period (Table 2). As with density, it was greatest during the period of downstream migration (June) when 96.2 per cent of the perch caught were infected with at least one of the parasites. The incidence declined during the period of no migration and decreased further when the fish moved upstream.

DISCUSSION

There are many causes for the seasonal fluctuation of parasitic organisms in an aquatic environment (Chubb, 1977, 1979, 1980). Factors such as temperature, pH, dissolved oxygen and carbon dioxide levels may directly influence the free-swimming stages of parasites, or influence the survival rate of the host and subsequently affect any stage of the parasite requiring that host.

White perch of the Hudson River spawn in the freshwater part of the system, north of Poughkeepsie, during May and June. During spawning one may expect to find large numbers in the same area. The importance of high fish densities in relation to monogene and glochidia infections can be postulated.

The free-swimming oncomiracidium larvae of monogenes have approximately 24 to 48 hours to locate and attach themselves to a definitive host. It would be clearly advantageous for the larvae to be present at a time when their host is available at high population densities. It is possible that *P. natcus* has evolved to reproduce at the same time as its white perch host. Temperature may possibly be the stimulus for spawning and migration of the white perch. If so, then it is possible that the moderate or changing water temperatures of spring and fall stimulate reproduction in this gill parasite.

The glochidia showed consistent declines in prevalence and incidence during June and had completely disappeared by mid-July. In this study, microscopic examination showed that none of the glochidia recovered had undergone metamorphosis. Tedla and Fernando (1969b) reported that infections of *Lampsilis radiata* glochidia on yellow perch (*Perca flavescens*) lasted 40 to 79 days and clearly exhibited metamorphosis to mussels. Since glochidia are the larvae of freshwater mussels and the white perch had their highest infections of the parasite during the downstream migration period, it can be concluded that infection occurred when the fish were spawning just prior to their downstream migration. The salinity of the water at St. Vincent's Point (consistently 10 ppt) may have been too great for the freshwater larvae causing the infections to be lost during the first few weeks after the host entered brackish water.

It is known that millions of eggs are produced per individual mussel per year with only a small proportion developing into adults (Tedla and Fernando, 1969b). The infection process is usually random and is dependent on water currents or water movement caused by passing fish. Most likely, those glochidia which attach to a white perch prior to the fish's migration into brackish water will never metamorphose and become adult mussels.

It would also be expected that the white perch would not be the only host available to the glochidia. Quite likely a host that permanently resides in the area where the mussels spawn or that at least remains in fresh water throughout the developmental period of the glochidia would be more suitable for continuing the life cycle. Information on alternate hosts in the upper Hudson River was not compiled in this study, but it is known that

many freshwater species, such as the bluegill (*Lepomis macrochirus*), inhabit that part of the river.

The copepod, *E. labricus*, like the monogene, *P. nactus*, and the glochidia, was most numerous during June. The patterns of prevalence and incidence again followed each other, decreasing during the period of no migration and increasing during upstream migration. In most cases only one copepod was found per perch, in direct contrast to infections of a closely related host species, the striped bass (*Morone saxatilis*). Small numbers of striped bass (fewer than 20) that were caught during the study period showed a prevalence as high as 50 or 60 of these copepods per fish. The individuals present on the striped bass were also larger than the ones collected from the white perch. Although a complete survey of striped bass was not undertaken, thorough investigation might reveal it to be the preferred host for *E. labricus*, using the standards described by Dogiel (1964) or Tedla and Fernando (1969c).

No copepods were found following the highest water temperatures recorded during the study (25° C. in August), but they reappeared on white perch gills when the water temperature had cooled (16° C. in October). However, prior to their disappearance all the copepods recovered from both white perch and striped bass were gravid. Perhaps the free-swimming nauplius or copepodid stages of the parasite were not tolerant of the higher temperatures and the eggs released by adult *E. labricus* during that period remained dormant until conditions again became favorable for the larvae. This sensitivity would explain a lag of a month before the reappearance of the species on the gills.

CONCLUSIONS

Four species of parasites were found on the gills of white perch following the fish's migration from fresh water into the lower, brackish water of the Hudson River estuary. The isopod, *L. ovalis*, occurred so infrequently that it was not considered a major parasite of the specimens examined. The remaining three species (*P. nactus, E. labricus* and a mussel) followed patterns in which the prevalence and indicence were greatest during the downstream migration of white perch and dropped to low levels while their hosts resided in brackish water. Factors that may play a role in these patterns include spawning of the perch, water temperature, salinity and host preference of the parasites.

LITERATURE CITED

BIGELOW, H. B., and W. C. SCHROEDER. 1953. Fishes of the Gulf of Maine. U.S. Fish and Wildl. Serv., Fish. Bull. 74.

CABLE, R. M. 1977. An Illustrated Laboratory Manual of Parasitology, 5th ed. Burgess Publ. Co., Minneapolis.

CHUBB, J. C. 1977. Seasonal occurrence of helminths in freshwater fishes. Part I, monogenea. In: Advances in Parasitology (B. Dawes, Ed.) 15:133-199.

———————— 1979. Seasonal occurrence of helminths in freshwater fishes. Part II, trematoda. In: Advances in Parasitology (W. H. R. Lumsden, R. Muller and J. R. Baker, Ed.) 17:141-313.

———————— 1980. Seasonal occurrence of helminths in freshwater fishes. Part III, larval cestoda and nematoda. In: Advances in Parasitology (W. H. R. Lumsden, R. Muller and J. R. Baker, Ed.) 18:1-120.

DOGIEL, V. A. 1964. General Parasitology. Leningrad Univ. Press. (English translation: Z. Kabata, Oliver and Boyd, Edinburgh).

HANEK, C., and C. H. FERNANDO. 1972. Monogenetic tremotodes from the Bay of Quinte area, Ontario. III, genera *Actinocleidus*, *Cleidodiscus* and *Tetraonchus*. Can. Jour. Zool. 50:1303-1312.

HOFFMAN, G. L. 1967. Parasites of North American Freshwater Fish. Univ. Calif. Press, Berkeley.

HOGAN, T. M., and B. S. WILLIAMS. 1976. Occurrence of the gill parasite *Ergasilus labricus* on striped bass, white perch and tomcod in the Hudson River. N.Y. Fish and Game Jour. 23(1):97.

MANSUETI, R. 1960. Selection of the body site for scale samples in the white perch, *Roccus americanus*. Chesapeake Sci. 1(2):103-109.

———————— 1961. Movements, reproduction and mortality of the white perch, *Roccus americanus*, in the Patuxent Estuary, Maryland. Chesapeake Sci. 2(3-4):142-205.

MAYES, M. A., and C. A. JOHNSON III. 1975. A new species of *Urocleidus* (Trematoda: Monogenea) from the gills of the white perch, *Morone americana* (Grelia). Jour. Parasitol. 61(6):1050-1053.

TEDLA, S., and C. H. FERNANDO. 1969a. Occurrence of plerocercoids of *Triaenophorous nodulosus* (Pallas) in the white perch, *Roccus americanus*. Jour. Parasitol. 55:334.

———————— 1969b. Observations on the glochidia of *Lampsilis radiata* (Gmelin) infesting yellow perch *Perca flavescens* (Mitchill) in the Bay of Quinte, Lake Ontario. Can. Jour. Zool. 47(1):705-712.

———————— 1969c. Observations on the biology of *Ergasilus* spp. (Cyclopoidea: Copepoda) infecting North American freshwater fishes. Can. Jour. Zool. 47:405-408.