

Early Life-History Stages of Fishes and Mid-summer Status of Juveniles and Adults in Les Cheneaux Great Lakes Bays

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I. Summary

During 1996 and 1997 we compared the phenology of juvenile and adult fishes (1996) and larvae (1997) in Mismar, Cedarville, and Mackinac Bays representative of those in Les Cheneaux. The spring of 1997 was much cooler than that of 1996, which affected larvae and young of the year abundances. We find differences among bays in both the post-larval and larval species composition, but not in size-at-age and growth rates. Cyprinids are especially variable from bay to bay, and probably from year to year, while presence of spiny rayed fish, especially perch and rock bass is less so. Our data suggest that yellow perch spawning is occurring, especially in Mackinac and Cedarville bays, and the marshes are more important nursery areas for fish than anticipated from the literature.

On the basis of these data, we propose the following studies for 1998: (1) targeted sampling for juveniles and adults in Cedarville, Mackinac, and Mismar Bays to build a multi-year survey data base. (2) study of early-life history fish populations in the same bays. We will use standard sampling methods so that ongoing development of the survey base is portable to any team.

II. Early Life-History Stages of Fishes and Mid-summer Status of Juveniles and Adults in Les Cheneaux Great Lakes Bays

We have now completed two field seasons sampling the fish community, and analyzed most of the data. In 1996 we focused on the phenology of juvenile and adult fish. In 1997 we focused on larvae. We sampled four bays 1996: St. Martins, Mismar, Mackinac and Cedarville. Cedarville and Mackinac Bays have similar morphometrics and flora, and constitute a pair to estimate effects of human impact in Cedarville on fish communities. Mismar Bay and St. Martins Bay share morphometric similarities with respect to shoreline and substratum. St. Martins proved more indicative of the open lake, and was not sampled in 1997.

A. JUVENILES AND ADULTS

In 1996 we focused on the phenology of juvenile and adult fish around marshes. Lakes were sampled using a beach seines, a larval seine, and experimental gill nets. These observations suggested that effort would be most parsimoniously and effectively used to sample these life history stages in mid summer when abundances and diversity are highest. This was done in 1997, but trap nets were added, and both beach and marsh areas were sampled.

Both field seasons showed substantial variation in the fish assemblages among bays. Most variation occurs in the soft-rayed fish components, with less variation among spiny-rayed fishes. It may be appropriate to consider the soft-rayed fishes as a guild, the dominant member of which varies, probably reflecting fine-scale differences in weather during spawning. It is clear that a multi-year sampling program is essential to understand the fish community. Our growing familiarity with the bays also shows that Mismar Bay needs to be considered as two separate regions, a dense marsh more similar to Mackinac Bay, and an open water beach.

Neither abundance, richness, species diversity nor species composition appear to have changed dramatically from 1996 to 1997. Quantitative indices characterizing richness, abundance and fish community diversity in 1997 continue to suggest that Cedarville may be impacted by development. The few species found in Cedarville marsh are generally considered most tolerant of adverse conditions and are commonly found in impacted areas: e.g. bowfin (*Amia calva*), the bullhead (*Ictalurus nebulosus*), and the rock bass (*Ambloplites rupestris*). The predominance of these "trash" species could also be a result of over-fishing in Cedarville bay. Lack of shallow, clear shoreline could account for loss of species such as Iowa darters (*Etheostoma exile*), brook stickleback (*Culea inconstans*) and the banded killifish (*Fundulus diaphanus*). This type of habitat is not common in Cedarville because of frequent wakes, steep inshore zones and murky waters, which may be due to either non-point source pollution and/or physical disturbance such as dredging or dock construction.

The inclusion of trap nets was very important. It is the only method available to sample across both open water and dense marsh regions. It also collected perch and rock bass YOY, which were absent from beach seines and gill nets. This shows the importance of the marsh for early life history stages. However, the larger-mesh nets borrowed from SNRE were not effective and should be replaced by smaller mesh nets.

Analysis of scales from the dominant species caught in gill nets in 1996 and 1997 show that size at age varies for younger fish, probably reflecting temperature patterns. One year-olds were smaller in 1997 than in 1996. This is consistent with the cooler spring in 1997 compared to 1996. Length-frequency analysis of mainly the minnow fraction, will be completed by April 1998.

B. LARVAE

Larvae were sampled approximately at 10 day intervals in 1996 in an initial survey of presence and absence using a larval seine. Early life-history stages are believed to be especially vulnerable to environmental and anthropogenic change, as well as being important to the health of the fish communities. Therefore, the field season in 1997 focused on the phenology of the larval community in marsh and beach habitats. Methods were expanded to sample all sites using a common hand tow method, plus beach seines in shallow areas with low macrophyte densities, and boat tows offshore. Larvae were sampled approximately every other day, which was found sufficient to follow this community. Longer periods between sampling were not judged viable.

The boat tows were especially effective in collecting open-water larvae, but the motor was not-sufficiently powerful and broke down during these tows. Therefore, this sampling method had to be discontinued. Larval seines continue to be very effective for more open-water beach habitats. The hand tow method provided the basis for comparison among sites.

Larval sampling appears to be extremely effective for showing trends in larval production in the Les Cheneaux Islands. On the basis of CPUE, we found Mackinac and Mismar marshes were the most productive in 1997. Within each bay, larvae were more abundant in the marshes than in the more open areas. This was evident even after the spring beach areas became vegetated. Larvae in the inshore zones (< 1 m) similarly appear to be more abundant than in the near-shore (>1 m) zones. Thus our initial analysis suggests that major factors in larval presence may be vegetation, water depth and water clarity. Larvae appear to be more abundant in areas with extensive algal and aquatic macrophyte productivity, besides bulrushes (*Scirpus*). We also think that the most protected, shallow areas with less turbulence, and hence lower turbidity, have more larvae.

Growth rates of larvae are still being analyzed, but should be completed by April 1998.

C. CONCLUSIONS

Differences among bays, especially Cedarville, validate The Nature Conservancy's concerns over the ecological impact of developing shoreline in the Les Cheneaux Islands and support the conservation of both beach and marsh shoreline.

In terms of the future of the fish survey research, the very different beach versus marsh systems of Mismar need to be sampled separately in 1998 and in ongoing annual mid-summer surveys. It is also essential to use the type of experimental gill nets employed in 1997 rather than the simpler ones used in 1996. The trap-seine-gill mix seems adequate to sample juveniles and adults, but we will to be more realistic about the time required for this sampling and follow-up analysis of data.

We also believe the larval focus should be repeated in 1998. 1997 was unusual with its late spring, and with the delayed season we did not catch the last portion of the centrarchid breeding season. We will extend collections into September in 1998. It would also be of great value to investigate the stomach contents of the larvae.

In looking at future field seasons, the development of vegetation in habitat sites should be measured over seasonal time. This would be most economically done with a time series of aerial photographs of marsh cover and development in selected bays over the spring/summer/fall period.

III. Proposed Study in the 1997 Field Season

For the same reasons as detailed in our previous request for funding, our plans for the 1998 field season are as follows:

- targeted mid-summer sampling to build the multi-year survey data base for juveniles and adult fish presence and absence, abundance (as measured by CPUE), diversity and equability,
- repeat the survey of early-life history stages in Cedarville, Mackinac Bays and Mismar Bays, beach areas and marsh areas..

A. TARGETED SAMPLING FOR JUVENILES AND ADULTS

We will repeat our sampling of Cedarville, Mackinac, and Mismar Bays during June and July. Each bay will be sampled at two dates approximately 4 weeks apart using on each occasion.

Methods for juvenile and adult fishes to be used in Cedarville, Mackinac, and Mismar		
Water depth	- in marshes with dense macrophyte growth	- beach areas with sparse macrophyte growth
< 1 m	Single trap net set for 3 to 5 days	Single trap net set for 3 to 5 days 25 ft bag beach seine, 5 hauls of 10 m at two sites
> 1 m	Two experimental gill nets	

Scales will be taken where possible. Lengths of fish will also be measured. These data will be used as in previous years to determine age structure of the most abundant species.

B. LARVAE

Our preliminary data suggest that the Les Cheneaux marshes are more important nursery areas than suggested in the literature. Therefore, we believe it is essential to perform a complete larval survey, indeed extending this further into the fall. A second year is also important because of the coolness of the spring in 1997, when most fishes breed. Observations from system that have been studied for many years suggest early growth was diminished and ontogenetic niche shifts delayed or eliminated at least for common cyprinids (P. W. Webb, unpublished observations). However, coregonid larvae were more abundant. This is probably due to the cold winter and better ice cover protecting spawning beds from disturbance by storms. A warm 1997-98 winter is expected due to El Niño which may results in greater survival of YOY of some species, but perhaps poorer recruitment of corgonids.

An important result from our first year sampling larvae in detail was that most species spawned once, with the possible exception of centrarchids breeding in August. In addition, the larval period varied from about 8 to 12 days. Given the importance of larvae for fish population dynamics and the potential consequences of development, it is desirable to build a long-term data base for this life history stage. Such a priority would require hard decisions with respect to cost-efficient sampling, and hence a complete data set is essential for effective planning of future activities.

Similar methods will be used as developed and proven in 1997. Larvae will be sampled at 2-3 day intervals (depending on weather conditions) during May, June, July, August and, if necessary, September.

Water depth	Methods for larval fishes to be used in Cedarville, Mackinac, and Mismar	
	- in marshes with dense macrophyte growth	- beach areas with sparse macrophyte growth
< 1 m	0.5 m diameter, with 0.355 to 0.450 mm mesh size hand-tow, 10 m in length and from substratum to surface at two sites.	0.5 m diameter, with 0.355 to 0.450 mm mesh size hand-tow, 10 m in length and from substratum to surface at two sites. 0.5 m ² larval seine with 0.355 to 0.450 mm mesh size at two sites.
> 1 m	0.5 m diameter, with 0.355 to 0.450 mm mesh size hand-tow, 10 m in length and from substratum to surface at two sites.	0.5 m diameter, with 0.355 to 0.450 mm mesh size hand-tow, 10 m in length and from substratum to surface at two sites.
Open water	0.5 m diameter, with 0.355 to 0.450 mm mesh size hand-tow, 10 m in length and from substratum to surface at two sites. Boat tow, 5 minutes at 4 to 5 knots.	

C. FACILITIES AND RESOURCES

1. Equipment

Seines, gill nets, and four trap nets are already available at UMBS and/or SNRE. Two additional and identical trap nets will be required to simultaneously sample three bays in mid-summer.

Boat towing is the standard method for collecting larvae in open waters. It has been thought that these waters are critical for the reproduction of essential game species, such as yellow perch. A higher horse-power motor will be required to ensure these collections can be made.

An SNRE station wagon will be fitted with a trailer hitch and used to transport boats daily to and from launch ramps in Hessel and Cedarville.

2. Personnel

Understanding population processes through early life-history stages is labor intensive. We found frequent sampling was essential for larvae because of the short spawning period of each species. In addition, frequent sampling is required from ice-off (when coregonids appear and perch spawn) to at least the end of August. The basic crew two persons will perform sampling and initial identification and data entry. This number is essential both to handle the nets and for safety.

3. Supplies

The frequency of sampling will require large quantities of jars, Forman and alcohol. Gasoline will be required for outboards and automobiles, and experience shows that repairs and servicing, especially of the outboard, will be required.

Because the work is performed off-campus, postage is necessary for sending materials among field crew and other personnel involved in the project. Similarly, some office supplies have to be obtained off-campus, such as paper, pens, books/keys etc.

D. ACCOMMODATION NEEDS DURING THE 1998 FIELD SEASON

Week	Date for week ending	Crew #
	Saturday	
1	May 9	4
2	16	2
3	23	2
4	30	2
5	June 6	2
6	13	2
7	20	2
8	27	2
9	July 4	2
10	11	2
11	18	2
12	25	2
13	August 1	2
14	8	2
15	15	2
16	22	2
17	29	2
18	September 5	2
19	12	2
20	19	2
21	26	2

IV. Budget for 1998 Field Season

Budget for 1998 Field Season	The Nature Conservancy: field season from 4/15/98 to 9/30/98	University of Michigan: 9/30/98 to 5/30/99	Total
Salaries and Wages.			TOTAL
P. Webb	\$1,000	\$5,000	\$6,000
J. Diana	\$1,000	\$1,000	\$2,000
- Hourly support for field crew	\$13,600		\$13,600
TOTAL SALARIES AND WAGES	\$15,600	\$6,000	\$21,600
Benefits			
P. Webb	\$310	\$1,550	\$1,860
J, Diana	\$310	\$310	\$620
Hourly support for field crew	\$1,156		\$1,156
TOTAL BENEFITS	\$1,776	\$1,860	\$3,636
Travel			
Food	\$3,000		\$3,000
Road Transport	\$500		\$500
Lease SNRE station wagon for towing boat to launch sites	\$3,000		\$3,000
TOTAL TRAVEL	\$6,500		\$6,500
Equipment			
25 HP motor, tank etc.	\$3,000		\$3,000
2 trap nets	\$1,000		\$1,000
TOTAL EQUIPMENT	\$4,000		\$4,000
Materials and Supplies			
Postage from UMBS and EUP	\$100		\$100
Office supplies when working off campus.	\$250		\$250
fuel, Forman, jars, fuel, engine maintenance	\$1,000		\$1,000
TOTAL MATERIALS AND SUPPLIES	\$1,350		\$1,350
GRAND TOTAL	\$29,226	\$7,860	\$37,086

In the first two years of the work on the Les Cheneaux Project, the University of Michigan Biological Station and the School of Natural Resources and Environment have provided the bulk of funds for the research. As we have pointed out to Dave Ewert, we have been very fortunate, but cannot provide such funds for 1998. The amount requested reflects this. In addition, the duration of the field season is longer in 1998 to obtain better information on end of season spawning of pan fish.

We are also requesting some equipment. As noted above, boat sampling for larvae is critical for open waters in the bays. Our 9 HP motor is unable to power the boat with the added drag of a tow, and in fact broke down under this use with potential risk to the crew. We wish to

purchase a 25 HP motor for towing. We would obtain this from local supplies as a mechanism already proven successful in building local support for the project.

We believed four trap nets would be sufficient to sample three bays in mid-summer. We were wrong. We found the nets needed to be set for longer, and their size makes handling and moving them from site to site extremely hard. The nets need to remain in situ for most of the mid-summer sampling period. Therefore we propose purchasing two more nets.

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V. Personnel Information

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