REPORT OF THE FORAGE TASK GROUP - 1988

In this report, we shall address the progress of the Forage Task Group (FTG) on the short-term objectives assigned by the Standing Technical Committee (STC) and will discuss the future plans of the group. The objectives are: (1) to identify available information, (2) to identify indicators of forage status from existing data, and (3) to identify knowledge deficiencies. Following this discussion will be a preliminary assessment of the forage base in western Lake Erie from indicator variables.

Available Information

The use of impingement data from power plants as a measure of forage fish relative abundance was identified last year as a potential source of information. To better understand the utility of such data to the FTG, we examined the data collection methods of personnel at the Nanticoke Thermal Generating Station on Long Point Bay. That exercise suggests that impingement data may be useful only as a supplemental indicator to standard collection methods. Inherent biases in the data (for example, species probably react differently to changes in flow volumes) may not be easily deciphered without potentially costly, extensive studies. Other power plants on Lake Erie were not surveyed.

A second source of information was that provided by Dr. Joseph C. Makarewicz of the State University of New York for zooplankton species composition, relative abundance, and distribution in Lake Erie during 1983-84. His study provides a framework by which future assessments could be patterned after to provide a much-needed baseline data series. Summary data from his report suggest that Lake Erie in its entirety may be considered meso-eutrophic, as indicated by declines in eutrophic species relative to the 1970's. Additionally, a large zooplankter (Daphnia pulicaria) was observed for the first time and in great abundance, which may reflect a lack of planktivorous fishes due to predation by piscivorous fishes. Unfortunately, this study is completed and does not include years after 1984.

To determine the utility of hydroacoustic techniques in Lake Erie, two members of the FTG participated in an interagency survey on Lake Michigan during summer, 1987. This method probably provides the best estimate of abundance/biomass for pelagic fishes that distribute throughout the water column. It is most effective for single-specie schools that are distributed off of the bottom and in fairly deep, offshore areas. In Lake Erie, it probably would be most useful for rainbow smelt in the central and eastern basins.

At present, we cannot justify the use of hydroacoustical gear in Lake Erie. The cost is high, the gear is sophisticated and requires special training, it is not particularly effective in shallow waters (such as in western Lake Erie) or for benthic species, and the technology is likely to improve in the immediate future. As this technique is further improved, it should be considered periodically for use in Lake Erie, particularly in the central and eastern basins.

Indicator Variables

In last year's report, we identified several indicator variables that could be used to monitor the Lake Erie forage base: (1) forage fish relative abundance and age composition from experimental trawling, (2) forage fish growth rates, (3) predator growth and maturity rates, (4) piscivore diet compositions, (5) yellow perch food consumption rates, (6) walleye prey-size selectivity, and (7) eastern basin zooplankton size-structure.

Our approach is to collect summary data and proceed with analyses geared toward integrating trends among indicator variables to ultimately provide a collective assessment of the annual forage situation in each basin. If summary data will not suffice, we shall review and evaluate raw data where available.

During 1987 and early 1988 our efforts were directed primarily toward collection of summary data among agencies. Our plans for the remainder of 1988 are to analyze the summary data sets to determine which variables provide our best (most accurate or sensitive) indicators and to integrate trends among variables to ascertain annual forage status. For example, we shall attempt to link changes in predator attributes, such as growth and maturity rates, to relative abundance of major prey items, as indicated in diets.

Additionally, we may use bioenergetics models to determine food requirements of predator standing stocks (provided by the WTG and YPTG) and then evaluate the correlation of these estimates with relative abundance estimates of forage species. We might also search for effects of predation on forage species attributes and vice-versa. The relationships seem a necessary prerequisite toward the development of a predictive community model and should also identify areas of needed research.

Knowledge Deficiencies

Deficiencies in the use of bottom trawls to effectively sample forage species were identified in last year's report. Variability of annual index values is presumably high, but undocumented, which makes interpretation of trends difficult. Data from the interagency trawling surveys conducted during summer, 1987, should provide estimates of variance for all species and, additionally, the numbers of tows needed to achieve a desired level of precision. Unfortunately, these surveys occurred only in the western basin.

Ways to improve the historical index values should also continue, as described in last year's report. Data from the U.S. Fish and Wildlife Service and Ohio have been key-entered and analyses have been initiated to examine ways of improving the accuracy of index values and to identify sources of variation.

The lack of a baseline data series on Lake Erie invertebrates also was identified last year. However, Ontario has recently implemented a standardized sampling regime that will be reviewed by the FTG and forwarded to other agencies to encourage participation. Additionally, the FTG has been in contact with Dr. Ed Mills of Cornell regarding the use of his zooplankton data from the eastern basin.

Recommended Charges for 1988

We suggest re-wording our short-term objectives to reflect the approach of the FTG more appropriately. They are as follows:

(1) Identify additional sources of forage data and determine their utility for Lake Erie.

(2) Analyze and integrate indicator variables to provide an annual assessment of forage status.

(3) Identify knowledge deficiencies.

(4) Assist other agencies in the coordination and standardization of data collection procedures.

Preliminary Assessment of Forage Base - 1987

In this section we will present an assessment of the forage base in Lake Erie as measured by two of the indicator variables previously identified. These analyses were directed at the western basin and are not complete; however, in conjunction with forage fish relative abundance estimates (that will be provided in agency reports), these indicators provide supportive measures of forage availability and more importantly, the impact on predators we harvest.

Walleye prey-size selectivity is reflected by the length frequency distributions of clupeids (their primary prey) from stomachs in relation to what occurs in the environment, as indicated from bottom trawl catches (Figure 1). During years of high gizzard shad abundance, walleyes are more selective for prey size than during years of low shad abundance. In 1987, gizzard shad abundance was extremely low (as indicated by Ohio and USFWS trawling data) and walleye were less selective for prey size. Low shad availability also may have caused the decline in mean size at age for walleyes between 1986 and 1987, as indicated in Ohio's fall gill net catches.

Walleye size-selectivity can also be examined with an electivity index, Strauss' L (Figure 2). A value of 0 indicates no selection, a negative value indicates avoidance by walleyes, and a positive value suggests preference by walleyes. Index values indicate that large (400-600 mm) walleyes select for clupeids under 120 mm during years of high forage availability but switch to larger clupeids when forage abundance is low, as in 1987.

Though further analysis of prey-selectivity by walleyes is needed, these early results suggest that bottom trawl index values provide a general estimate of forage fish availability to walleyes that is reasonably accurate when clupeid densities are high. However, it is also apparent that large (>140 mm) clupeids are not sampled effectively with this gear and they are important prey of walleyes during years of low clupeid recruitment.

While walleye-shad interactions provide an index of forage fish availability, they do not measure invertebrate availability. Yellow perch up to 200 mm (total length) feed extensively on invertebrates, including fingernail clams, snails, chironmids, and zooplankton. A model developed by Rob Hayward and Joe Margraf at the Ohio State University allows us to estimate daily feeding rations for yellow perch from point samples taken by bottom trawls at key sites in western Lake Erie. Comparing perch daily rations to maintenance rations (as predicted by bioenergetics models) then provides as an indirect indicator of invertebrate availability.

Ohio personnel obtained weekly stomach samples from two locations in western Lake Erie during summer and early fall 1987 to continue a data series initiated by R. Hayward in 1983. Results from 1987 (Figure 3) indicate that yellow perch at Middle Sister (a site in the western part of the basin) generally fed at rations well above those needed for maintenance (zero growth) throughout the summer. At a site near Kelleys Island, this was not evident for large (140-200 mm) yellow perch, which were at or below maintenance levels after mid-August. Small perch were less affected than their large counterparts at Kelleys, though they also dipped below maintenance levels during one week.

The results suggest that feeding conditions were better at Middle Sister as opposed to Kelleys and generally were high relative to previous years. Diet composition also differed between sites: Middle Sister perch ate clams and plankton, whereas those at Kelleys ate chironomids and plankton (including Bythotrephes).

Ohio's fall estimates of yellow perch size at age reflect a substantial growth increase in the western basin during 1987 relative to other years of the 1980's. Most samples, however, came from Middle Sister catches where the potential for growth appeared the greatest (Figure 3). Hence, daily ration estimates may not only reflect invertebrate availability but also indicate why growth rates may vary among areas within the western basin.

In conclusion, preliminary analyses of walleye prey-size selectivity and yellow perch consumption rates indicate the utility of these variables as indicator variables for both forage and predator organisms. Further analyses on all of the indicator variables is necessary to develop quantitative links among predator and prey organisms that can eventually be used to predict predator responses to changes in the forage base.

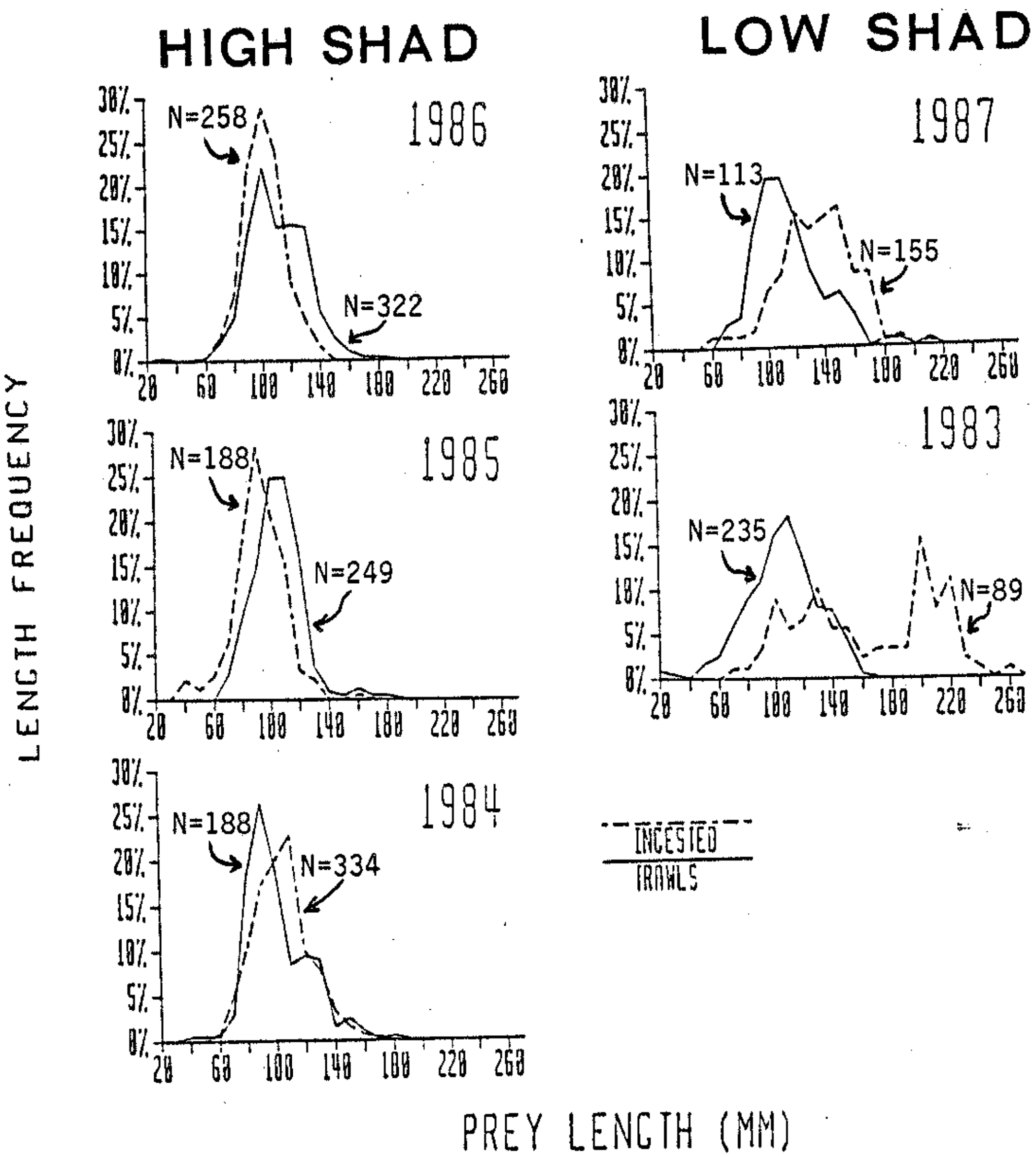

Figure 1. Size distributions of clupeids observed in walleye stomachs (dashed line) and fall bottom trawl catches (solid line) during periods of high (1984-1986) and low (1983, 1987) densities of age-0 gizzard shad. Stomach samples were taken from 400-600 mm walleyes during October gill net surveys.