Report of the

FORAGE TASK GROUP

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Great Lakes Fishery Commission

I. INTRODUCTION

This report addresses progress made by the Forage Task Group (FTG) in addressing four charges assigned by the Standing Technical Committee (STC). These charges are: (1) identify available information, (2) assemble and integrate indicators of forage status, (3) identify knowledge deficiencies, and (4) standardize sampling procedures. In addition, future plans of the FTG are discussed and brief descriptions of forage status are provided for each basin of Lake Erie.

II. PROGRESS IN ADDRESSING CHARGES

A) Identify Available Information

No new promising sources of data were added to the seven previously identified forage indicators during 1988. However, the FTG will remain watchful for any additional sources of information that become apparent during 1989.

B) Analyze Indicator Variables

Annually monitored indicators that appear to have utility in assessment of the Lake Erie forage base include: (1) forage fish relative abundance and age composition, (2) forage fish growth rates, (3) predator growth and maturity rates, (4) piscivore diet composition, (5) yellow perch food consumption rates, (6) walleye prey-size selectivity, and (7) zooplankton size structure. Previous FTG efforts were directed at assembling summary data sets for these indicators. With much of this information now assembled, the current focus is to develop standardized data formats and collection methods, where practical, and begin integrating and analyzing trend-through-time data for a more comprehensive assessment of the forage base. The following describes progress made in analyzing two of the indicator variables:

Relative Abundance. Relative abundance indicators produced by annual trawl assessments are being examined in an attempt to improve the reporting format from the currently utilized arithmetic means of number-per-trawling-hour.

All of ODNR's raw catch data from original collection records were entered into computer (ASCII) files and new seasonal index values were computed. New index values were expressed as the geometric means of the catch-per-hour-trawling across stations and are considered more statistically appropriate than arithmetic means given the high variances in trawl catches. Additionally, some analyses were performed to select "key" stations (which varied among species based on fish distributions) that were used for indexing purposes.

Preliminary analyses with the 30-year USFWS data set suggest these data may be extremely valuable to further examine effects of station depth and time of day on trawl catch rates for all forage species. Additionally, data from two years of joint trawling surveys in the western basin have not been fully examined and should depict basin-wide distribution patterns.

Walleye Prey-Size Selectivity. Considerable effort was made to evaluate walleye prey-size selectivity (i.e., length statistics for ingested clupeids in walleye stomachs) as an indicator of prey availability in the western basin. The hypothesis behind this approach is that walleyes select for prey-size on the basis of availability: when availability is high, selectivity is high and small prey from a narrow size range are eaten. When annual forage availability is low, selectivity is low and, on average, larger prey are eaten and from a wider size range.

Six years of fall survey data were used to compare the annual means and ranges of ingested clupeids with direct measures of availability (bottom trawl data) and with indirect measures of availability (walleye instantaneous growth rates, based on wet weights). Results indicate that trawls do not representatively sample large (>140 mm) clupeids that are eaten by walleyes during years of apparent low clupeid availability. Mean length and length range of ingested clupeids both increased during low years of availability. In contrast, lengths of ingested clupeids decreased (on average) and the length range narrowed during years of apparent high availability. Negative correlations between the mean length of ingested clupeid and walleye growth rate (ages 1-2, 2-3, 3-4) were significant ($p < .05$) for two of three walleye age groups and further support the use of size-selectivity data as appropriate indicators of forage availability.

C) Indentify Knowledge Deficiencies

Several knowledge deficiencies must be overcome for attainment of FTG objectives. One such area involves the annual bottom trawling programs conducted by Lake Erie assessment agencies. Documentation of trawl fishing dimensions for various gear operating on Lake Erie is desirable for interpretation of catch rates from different sources. Hence, the FTG recommends that these dimensions be determined for all time-series trawling programs used to index forage fish abundance.

An expanded data base of salmonid growth rates and food habits is needed to better understand the impact of annual stocking programs on the forage base. Currently, lake trout represent the only salmonid species targeted as part of annual open lake assessment netting program. The remaining salmonid data rest with annual creel census and angler diary programs.

Lack of sufficient trend-through-time invertebrate data represents another deficiency. Expansion of standardized zooplankton collections (see Section D) may soon help address part of this unmet need. However, a similar interagency effort needs to be implemented to address benthic macroinvertebrates. Also lacking is information concerning forage fish life histories and the FTG urges academic and research-oriented organizations to pursue studies in this area.

Finally, components of the yellow perch food consumption model need validation. Laboratory studies likely will be conducted at the Ohio State University to correct a potential bias in the model concerning water temperature effects on evacuation rates. Yellow perch stomach contents data are available since 1983 and will continue to be collected by ODNR during 1989 in both the western and central basins; thus, a 7-year data base shall be available after the model is corrected. Other agencies are encouraged to collect food consumption data for use in the corrected model to produce an indirect indicator of invertebrate availability.

D) Standardize Sampling Procedures

Progress in standardization occurred in the development of a common coding format for food habits data collected by member agencies. Implementation of this universal coding format will facilitate pooling of information from different sources and enable interagency summaries that are compatible with other pooled data for shared stocks of piscivores, such as walleye and yellow perch.

A proposal for a standardized zooplankton sampling program was also drafted by the FTG. The purpose of this effort is to montior zooplankton size distribution and species composition as a supplement to fish collections. This assessment program is currently in place in New York's portion of Lake Erie and Lake Ontario.

III. FUTURE PLANS

Efforts in 1989 will remain focused on addressing the short-term objectives assigned by the STC. Continuation of some specific assignments will include: (1) examination of the utility of various bioenergetics models, (2) investigation of the relationships between walleye growth rates and prey-size selectivity, and (3) using insights from historical trawl data to determine potential for reducing variance of relative abundance estimates. New initiatives will include: (1) preparation of a document establishing standards for food habits data collection, (2) development of software for compiling the standardized food habits data, and (3) validation of the yellow perch food consumption model for higher temperatures.

IV. FORAGE STATUS

A) Eastern Basin (summarized by D. Einhouse)

Forage status in the eastern basin of Lake Erie is being monitored by independent, annual assessment programs conducted by NYSDEC, PFC, and OMNR. Forage fish relative abundance indicators are produced by each of these agencies and summarized in annual agency reports to the Lake Erie Committee. Other annually monitored forage indicators in this basin include predator growth rates, piscivore diet composition, and zooplankton size structure.

Eastern basin forage fishes that are known to comprise important components of piscivore diets include rainbow smelt, alewife, gizzard shad, white perch, spottail and emerald shiners. The relative contribution to the diet by each species varies in response to annual fluctuations in abundance.

Annual trawling programs provide indices of relative abundance for rainbow smelt, minnow species, and white perch. Results from three independent 1988 trawl assessments suggest yearling rainbow smelt abundance declined relative to 1987. This suggestion is corroborated by walleye stomach analyses in New York waters that portrays a diminished role for rainbow smelt as a prey item (Einhouse et al. 1989). Trawl indices of YOY abundance suggest 1988 produced a stronger rainbow smelt year class. This continues a long-term pattern of alternate years of strong year classes that has been characteristic of this population.

Emerald and spottail shiner abundance in the 1980s has experienced a decline relative to the previous decade (Pennsylvania Fish Commission 1988). However, recent trawl assessments do not seem to reflect a continuation of a long-term declining trend.

Clupeids (YOY gizzard shad and alewife), when abundant, have been an important forage species for eastern basin predators. NYSDEC data found YOY gizzard shad to be the most frequently encountered, identifiable prey in walleye and smallmouth bass stomachs during fall 1988 sampling programs. During some other years, YOY gizzard shad were a minor contributor to the fall diet, apparently reflecting low abundance.

The status of eastern basin invertebrates is less well known, although the diets of many fishes have recently included the European cladoceran, Bythotrephes cederstroemi. Zooplankton size, species composition, and density has been monitored since 1984 in New York's portion of the eastern basin, but a summary of results is not yet available for this report.

B) Central Basin (summarized by K. Muth)

The USFWS initiated a multi-year forage fish assessment survey in the U.S. waters of the central basin of Lake Erie in 1987. Five geographically dispersed nearshore sampling stations located at Huron, Lorain, Cleveland, Fairport, and Ashtabula were again sampled each month from April through October in 1988 by trawling along the 30- and 40-foot contours with a rockhopper trawl. Five species of forage fish were originally selected for this study including rainbow smelt, emerald shiner, spottail shiner, young-of-the-year (YOY) gizzard shad, and trout-perch, but YOY alewife and white perch were added when it became apparent that predators were also utilizing these species.

Sampling effort in 1988 increased to 38.5 hours of trawling and resulted in a total catch of more than 38,000 fish representing 20 species. White perch dominated the catch (54%), while all other forage species combined constituted 27% of the catch with rainbow smelt (16%) being the most abundant. Relative abundance of most forage species in 1988 was higher than in 1987, when spawning success was apparently poor, with the exception of trout-perch, which showed a significant decrease in abundance.

Preliminary examination of species distribution data suggests white perch may be more prevalent in central basin waters west of Cleveland, particularly in the fall, while rainbow smelt tend to be more abundant in waters east of Cleveland during most seasons. Other species seem to be randomly distributed throughout the central basin but much more data, collected over a longer time period, will be required for all species before seasonal and geographical distribution patterns can be clarified.

Growth and food habits data are collected each month for each forage species to identify these characteristics of central basin fishes and determine seasonal changes. Results from these analyses will be compared with similar data from the western basin forage fish.

C) Western Basin (summarized by R. Knight)

A qualitative assessment of forage conditions in the western basin during 1988 is available from indicator trends. This assessment should be considered preliminary because statistics for some indicators have not been calculated for previous years to provide a temporal perspective.

Relative abundance estimates from ODNR and USFWS bottom trawl surveys during summer and fall for the six targeted forage species suggest that four of the six species experienced moderate to high recruitment relative to long-term averages. Only emerald and spottail shiners were indexed as low in abundance, which continues a declining trend that first became apparent in the late 1970s. YOY clupeids (gizzard shad and alewife) had moderately high recruitment with apparent late spawns that sustained an important source of small prey during fall.

Relative abundance indices were supported by indirect measures of the forage base, specifically walleye diet composition and prey-size selectivity, and growth-maturity rate data for several predators (walleyes, yellow perch, white bass, and white perch).

Diets of adult walleyes reflected the paucity of shiners during June/July when they fed primarily on yellow and white perch (K. Hartman, OSU, personal communication). Walleyes switched to abundant clupeids by fall and ate primarily small individuals of a relatively narrow size range, which indicated availability was much higher than during 1987.

Slight to moderate declines in growth and maturity rates were evident for age-1 and older walleyes, white perch, and yellow perch during fall 1988. Declines for walleyes were attributed primarily to density-dependent effects from a strong 1986 year class, despite high availability of YOY clupeids. Causes for the declines of growth and maturity rates for white and yellow perch are not known at present, but might indicate low availability of invertebrates relative to predatory demands. Indicators of invertebrate status (plankton size-structure and yellow perch food consumption rates) are not yet available for 1988. Growth and maturity rates apparently increased in 1988 for age-1 and older white bass relative to past years, but sample sizes are low and preclude definitive comparisons.

In general, a cursory examination of designated indicators suggest forage fish production was moderate during 1988 and was adequate for piscivores. Invertebrate availability, however, may have declined relative to 1987, as evidenced by growth declines in benthic fish predators. Growth differences between basins were once again apparent for all major predator species during 1988 and likely reflect differences in forage availability between basins.