United States
Environmental Protection
Agency

Environmental Research
Laboratory
Duluth MN 55804

Research and Development

EPA-600/S3-82-051 Oct. 1982

EPA

Project Summary

Factors Influencing Growth and Survival of White Sucker, *Catostomus commersoni*

Walter M. Koenst and Lloyd L. Smith, Jr.

Growth responses of the white sucker, *Catostomus commersoni*, were examined in relation to the influence of temperature, body size, season, daylength, light intensity, food ration level and food quality. Sucker growth was maximum at a temperature range of 19-26°C, depending upon experimental conditions. Fish reared under low light intensities grew an average 43% faster than those reared under unshaded conditions. Growth on various diets was best on live tubificid worms presented over sand substrate > tubificids (no soil substrate) > frozen *Daphnia* > Oregon Moist pellets > Glencoe Mills pellets. The optimum temperature for growth on excess rations of live tubificids was 25°C and was 19°C on restricted rations (1.5% fish body dry weight). Maximum specific growth rate decreased nearly four-fold over a size range of 12 to 175 g, but no difference in optimum temperatures was found. Fish of the same approximate size grew twice the rate in the spring as compared to other times of the year. Photoperiod showed little influence on growth rate, but fish exposed to shorter daylength showed a marked increase in time to achieve a maximum growth rate.

The ultimate upper incipient lethal temperature (UUILT), determined by slowly increasing (0.5°C/day) acclimation temperature to death, was 32.5°C for juvenile white suckers and 31.5°C for adults. The UUILT was 2-3°C higher than the upper lethal temperatures measured by the classical approach involving the direct transfer technique.

This Project Summary was developed by EPA's Environmental Research Laboratory, Duluth, MN, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The purpose of the present study was to investigate the growth and mortality rates of juvenile and adult white suckers under different temperature regimens as related to body size, season, daylength and ration level. Preliminary studies were conducted to determine conditions that maximize growth prior to initiation of experimental studies. The upper lethal temperatures of suckers of different sizes were estimated by the direct transfer method as well as by slowly raising the acclimation temperature 0.5°C/day until death occurred.

Small and large juveniles and adult white suckers were tested in this project. Growth rates were determined

at two-week intervals as a function of season (daylength and light intensity), food type (two kinds of commercially available fish food pellets, frozen *Daphnia* and live tubificid worms), and temperature. Five ration levels were given at all temperatures to determine food conversion efficiency. Upper lethal temperatures were determined by direct transfer and by slow acclimation methods for each size group of fish.

Conclusions

1. The growth optimum varied from 19-26°C for juvenile white suckers depending on experimental conditions.
2. Growth of fish was best when reared without any discernible current flow.
3. Growth of fish reared under shaded conditions was increased by an average of 43% over those reared under unshaded conditions.
4. Maximum growth was observed at 25°C on excess rations (9.11% fish body dry weight) and at 19°C on restricted rations (1.5%). Best growth was observed with live tubificid worms presented over a natural sand substrate. Growth on various diets decreased in the following order: tubificids (sand substrate) > tubificids (no soil substrate) > frozen *Daphnia* > Oregon Moist pellets > Glencoe Mills pellets. Maximum gross food conversion efficiency was 26% at 22°C and 3.0% ration level of tubificids.
5. Maximum specific growth rate decreased nearly four-fold over a size range of 12 to 175 g. Optimum temperature for growth was not influenced over this size range. The weight exponent (slope of the log-log plot of specific growth rate versus body weight) for this size range was -0.45 which decreased when smaller fish were included in the growth rate-body weight relationship.
6. Fish of a common size had a two-fold increase in maximum growth rate in spring compared to other seasons. There was no difference in growth rate between summer and winter fish under a 15hL-9hD photoperiod. Maximum growth occurred at 26°C in summer, and at 24°C in winter and spring tests.
7. Daylength changes had no significant effect on maximum growth rate or optimum temperature. However, attainment of maximum growth under test conditions was increased from 2 to 4 weeks when fish were reared under 15hL-19hD and 9hL-15hD photoperiods, respectively, in a winter test.
8. The highest UUILT (32.5°C) was achieved by slowly raising the test temperature 0.5°C/day until death. UUILT measured in this way was consistently 2-3°C higher than that measured by the classical approach involving the direct transfer of fish from an acclimation temperature to a series of lethal levels. The upper incipient lethal temperature (UILT) is dependent upon acclimation up to the maximum level (UUILT).
9. The UUILT for newly hatched larvae, swim-up larvae, juveniles, and adults were 28.2, 30.5, 32.5, and 31.5°C, respectively.

Recommendations

1. Investigators should run series of preliminary tests to optimize culture conditions prior to measurement of physiological optima for each species. Control of light intensity in bioassays with nocturnal or deep-water organisms is especially encouraged
2. Growth of white suckers on live tubificids should be compared to growth on natural components in their diet including live *Cladocera* and macroinvertebrates.
3. Future bioenergetic studies should cover a broader biokinetic range of temperatures to include the lower and upper limits of zero net growth.
4. The large variation in measurement of the physiological optima and UUILT for one species reported herein suggests that the temperature criteria data base be critically evaluated before any literature values are adapted to field problems (i e , 316a demonstrations)
5. Field validation of the laboratory data base on temperature criteria is needed to confirm the best test procedures

Walter M. Koenst is with the Department of Entomology, Fisheries and Wildlife of the University of Minnesota, St. Paul, MN 55108; Lloyd L. Smith, Jr. (deceased).
***Kenneth E. F. Hokanson** is the EPA Project Officer (see below).*
The complete report, entitled "Factors Influencing Growth and Survival of White Sucker, Catostomus commersoni, *" (Order No. PB 82-221 474; Cost: $7.50, subject to change) will be available only from:*
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650
The EPA Project Officer can be contacted at:
Monticello Ecological Research Station
Environmental Research Laboratory—Duluth
U.S. Environmental Protection Agency
Box 500
Monticello, MN 55362

★ U.S. GOVERNMENT PRINTING OFFICE. 1982-559-017/0847

United States
Environmental Protection
Agency

Center for Environmental Research
Information
Cincinnati OH 45268

Postage and
Fees Paid
Environmental
Protection
Agency
EPA 335

Official Business
Penalty for Private Use $300