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Perspective

Productivity of Fish Bioenergetics and its Strategies Involved in Environment

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DESCRIPTION

Bioenergetics modeling is a powerful tool that quantifies the life history and ecology of an individual to the population and to the ecosystem. Fish bioenergetics models have many capacities, many of which lay outside the scope of undergraduate study. Examples include measuring interactions between trophic levels, calculating nutrient recycling and contaminant accumulation, and identifying potential bottlenecks in population ecology. This exercise focuses on quantifying the amount of food a fish consumes to the resulting growth over time. These two variables compose the core parameters in fish bioenergetics modeling. This program serves as the international standard for fish modeling. Indeed, many of you are probably unfamiliar with the concept of bioenergy modeling, and the theory and mechanism may seem overwhelming.

Metabolic rates of resting fish

A biological-level dynamic model of fish bioenergetics and growth in a controlled environment has been developed as a tool for studying, assessing and improving the management of fishpond growth systems. The model contained five key variables: body size, temperature, dissolved oxygen, non-ionized ammonia, food volume, and 17 growth parameters that defined the fish species used. Fish growth was more sensitive to changes in food intake parameters than changes in metabolic parameters. In both food intake and metabolic components, fish growth was more sensitive to changes in temperature parameters that changes in body size, dissolved oxygen, or non-ionized ammonia parameters. Model predictions of combined effects on size and temperature, size and food, temperature and food, dissolved oxygen and food growth were also in good agreement with the available data.

Model predictions of six undocumented two factor interactions were consistent with other known interactions and general principles of fish energetics. The model was also used to predict maximum, optimum, and maintenance rations under controlled environments. Increasingly, researchers are turning to bioenergetics modeling as a robust approach for evaluating effects of climate change on aging, growth, and mortality of fishes. Often referred to as the “Wisconsin model,” the popular modeling approach used today was based on the pioneering work which in turn built upon earlier work on energy partitioning in fish. This foundation, and the growing interest in bioenergetics modeling applications to research and management, sparked development of computer software applications that included Fish Bioenergetics 1.0, Fish Bioenergetics 2.0 and Fish Bioenergetics 3.0. The release of Fish Bioenergetics 3.0 by the Wisconsin Sea Grant Program has been tremendously popular among fisheries scientists worldwide, due to the sound biological foundation of bioenergetics models, the eco-friendly environment of the application, and the relatively low cost in the software.

CONCLUSION

The application of regression-based correction procedures has significantly improved bioenergy model predictions for Sunfish hybrid final body weight under three feeding regimes that elicit moderate to strong CG at near optimal growth temperatures. The mean percentage error in predicting the final weight of fish in each treatment group was significantly lower (5-8 times lower) in the corrected model compared to the uncorrected model. Significant improvements in model growth predictive ability were also observed in the treatment group which showed the most active CG response and significant overgrowth compensation (beyond the growth of free-fed fish daily). Therefore, the ability of the changes to expand the range of conditions under which the bioenergy model can provide accurate growth predictions is clearly explained.

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