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Sustainable Aquaculture for a Secure future

Title: Biological Principles Of Pond Culture: Fish

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Abstract: Production of fish biomass in pond culture systems is regulated by three parameters: stock density, mortality, and growth in individual weight (Backiel and LeCren 1967, 1978; Chapman 1971). These parameters are related through mechanisms of biotic interactions and their physico-chemical environments (Fry 1947, 1971; Kerr ~1980; Werner 1980), as previously shown in this document. For many cultured fish species, pond management for maximization of biomass production and standing stocks remains limited by knowledge of the ecological principles of the systems. The mechanisms relating stocking density, mortality, and growth are therefore key considerations of this study.

The relationship of growth to density, including definition of specific ecological mechanisms, may well be the most effective area for research on pond culture. Reasons for emphasis on density- dependent mechanisms of growth rather than on mortality or density independent processes include: 1) A vast number of studies has dealt with nutrition and dietary effects on growth. 2) Stock densities have more generally defined and stronger effects on growth than on mortality in culture systems (Backiel and LeCren 1978). The plasticity of individual growth in exploited populations in fish is well-documented and indicates the importance of density in control of growth. 3) Within a cohort, growth and mortality are more commonly controlled by density-dependent rather than density-independent processes (Larkin 1978). This may be particularly germane as intensively cultured pond systems can be controlled for stocking rates physico-chemical factors, and food or nutrient inputs. 4) Evaluation and quantification of mechanisms of density effects on growth will provide characters for genetic stock manipulation explicit to culture situations and species. Genetic control of growth in fish is well established, but selection of growth-related traits requires physiological- bioenergetic analyses (Weatherley 1976).) Many empirical and mechanistic (bioenergetic and optimum foraging) models exist

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on growth's relationship to density and ration (e.g., Ware 1975, 1978; Paoheimo and Dickie 1965, 1966; Kerr 1971a, 1971b; Sperber et al. 1977). Additionally, the balanced energy equation for metabolism and growth (Winberg 1956) provides a powerful paradigm for evaluation and analysis of factors affecting growth (Warren and Davis 1967; Webb 1978).

Unfortunately, the analysis of mechanisms and development of appropriate models for species and situations of tropical pond culture are yet in their infancy. The major purposes of this synopsis are to examine recent research efforts in pond culture principles, and to provide schemes for describing and examining density effects on growth.

This abstract is excerpted from the original paper, which was in: J.E. Lannan, R.O. Smitherman, and G. Tchobanoglous (Editors), *Principles and Practices of Pond Aquaculture: A State of the Art Review*. Oregon State University Press, Corvallis, Oregon, pp. 55–66. (1983)