Global Examination of Relationship between Net Primary Production and Fish Yield

Interim Work Plan, Thailand Study 1

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Introduction

PD/A CRSP study of pond ecosystems has focused on primary productivity. This focus was a natural and appropriate consequence of the principle, and some evidence, that photosynthesis, as the source of fixed carbon to the food chain, must be critical to fish production in fertilized ponds. There were earlier efforts by two DAST components which examined productivity from the Central Database, but no recent or fully global syntheses of the relationships. Additionally, several CRSP papers have shown the positive relationship between primary productivity and fish yield within more limited data sets (for example, Knud-Hansen and Batterson, 1994)

The objective of this study was to synthesize and analyze pertinent information contained in the CRSP Central Database on the relationship between primary productivity and fish production.

Materials and Methods

The CRSP Central Database as it existed in late 1995 and early 1996 was used as the source of raw data. Information on fish yields and primary productivity as indicated by photosynthetic oxygen production was available for 505 ponds. Photosynthetic oxygen production for this purpose means the daytime net increase in dissolved oxygen (DO) concentration. This is termed "daytime net primary production (dNPP)" and is, in practical terms, close to the "DO at 1600 hours minus DO at 0600 hours" quantity which is available from the diel sampling regimes. This quantity is integrated through the water column, and over the time intervals during which fish growth is measured. "Production of fish biomass" or Net Fish Yield (NFY) means the net increment in total weight of the stock in a pond during a given period, in this case, excluding the weight of fry produced after stocking.

Analysis consisted of computation of frequency distributions and curve-fitting using Excel and Cricket Graph.

Results and Discussion

Analysis began with 505 ponds from PD/A CRSP experiments reported to the Database, for which data on primary production and fish yield could be rationalized and averaged for the entire experimental period, generally about 150 days. There is a strong central tendency to dNPP values, with most ponds producing 2 to 8 mg/l DO during daylight periods (Figure 1). The range of values (0-14) is large enough to be amenable to large scale regression and correlation analyses.

Daytime net production of DO and fish yield are strongly related (Figure 2). The exponential equation presented (other relationships will be examined in future papers) accounts for 62 percent of the observed variation in fish yields over the 505 ponds. It is certain that this relationship differs among

individual experiments, and highly likely that it differs for various subsets of the data, such as season, site, environmental conditions, and various aspects of fertilization regime. The "complete" analytical task can now be seen to be large, and limited mainly by the pertinence and prioritization of questions to be asked.

The increased variation in fish yields at higher levels of dNPP is a natural consequence of the "resource limitation" phenomenon, in which the process or product of interest (fish biomass) is closely dependent on the resource (dNPP: oxygen, carbon, etc.) when the resource is in short supply, but is determined by other factors (not analyzed

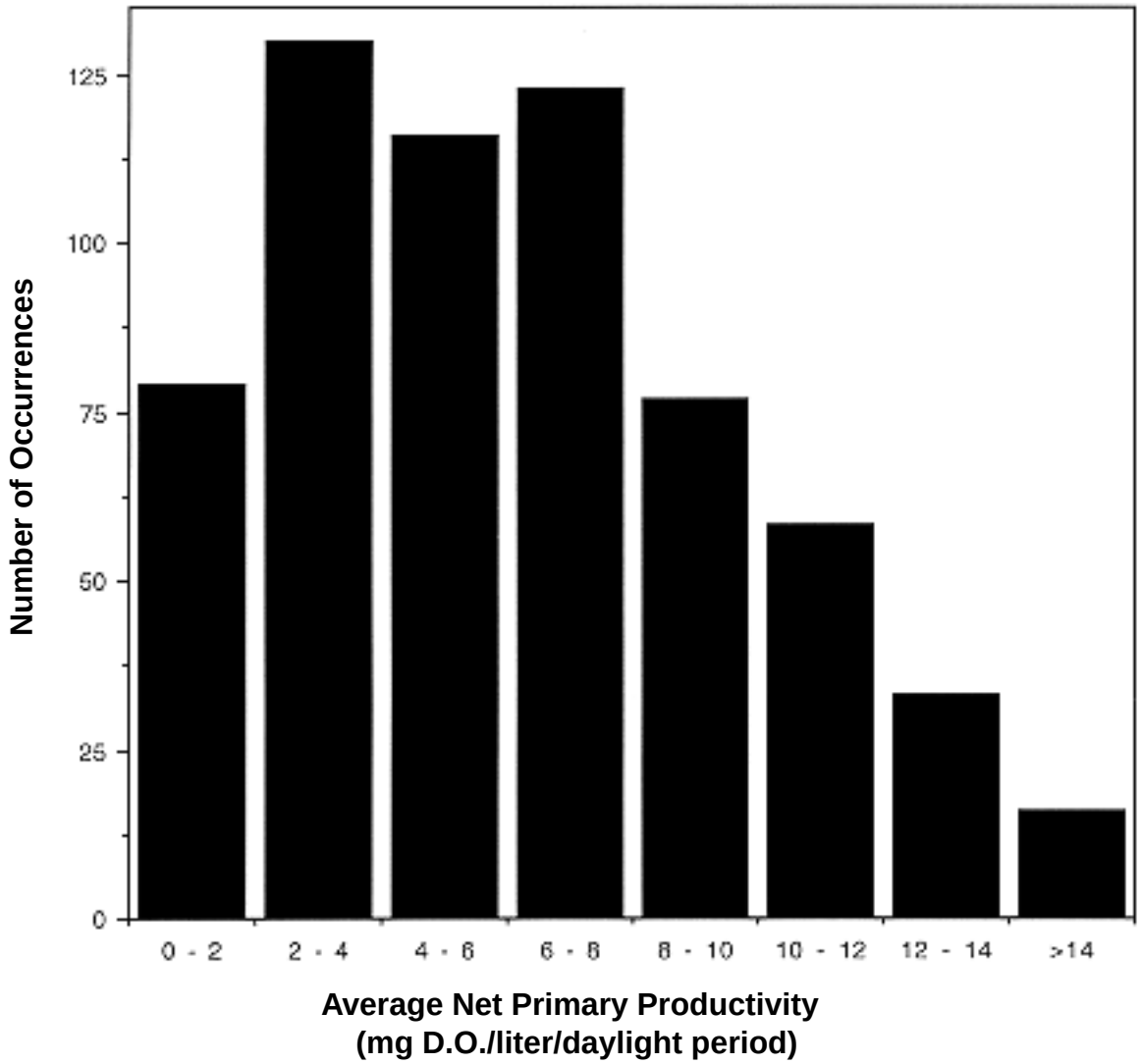

Figure 1. Frequency of average NPP extracted from the CRSP Central DataBase. Each occurrence is the average NPP for a pond during an experiment.

here) when the resource is more abundant. This data set thus provides a guide to the levels of dNPP which are likely limiting to fish production (below 10 mg/l DO during daylight). This guide will be particularly valuable for selecting subsets of the data for further analysis.

Literature Cited

Knud-Hansen, C.F. and T.R. Batterson, 1994. Effect of fertilization frequency on the production of Nile tilapia (*Oreochromis niloticus*). Aquaculture, 123:271-280.

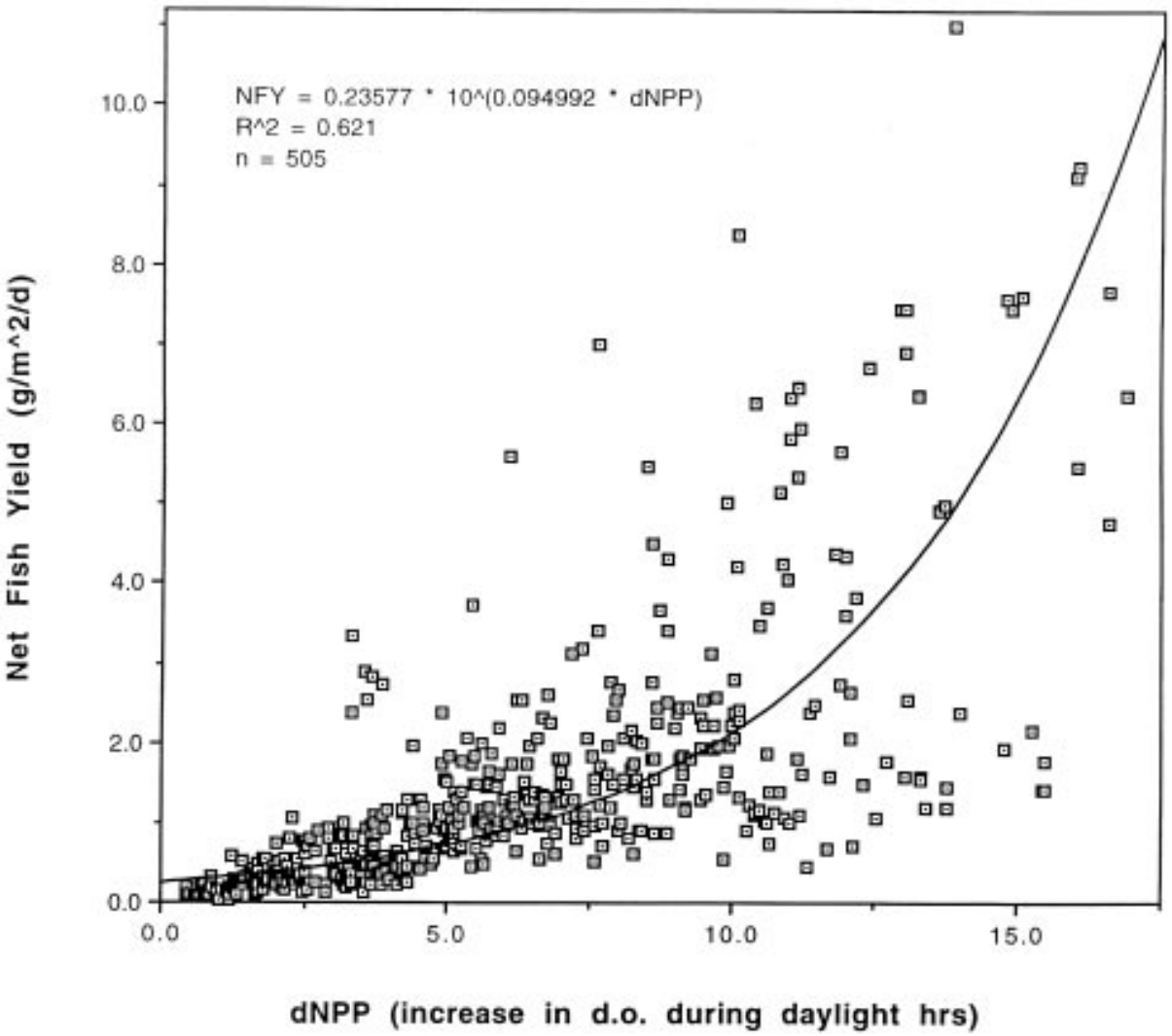

Figure 2. Relationship of fish yield and net primary productivity.