The production of larval native fish in larval rearing ponds

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Final Report

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Introduction

Most marine and freshwater fishes depend on plankton for food during a period shortly after birth until they are large enough to switch to other prey. At the Inland Fisheries Research Station, Narrandera (NIFRS), native fish are spawned and the larvae transferred to rearing ponds for approximately six weeks before the fingerlings are harvested. These ponds are managed to promote growth of the appropriate zooplankton so that the larvae can feed and grow. The research objectives in the present study were as follows:

(i) To describe the seasonal pattern of zooplankton and phytoplankton abundance as they relate to fish growth and survival under normal pond management methods.

(ii) To test the effect of larval fish stocking density on the population dynamics and abundance of zooplankton; this in turn will affect fish growth.

(iii) To study the diet of the fish larvae during the first weeks of life.

Four larval rearing ponds were studied from when they were filled in early November 1986 until just before harvesting in late December 1984. Two ponds were stocked with silver perch at "high" and "low" density (230,000 and 150,000 fry) and two with golden perch at "high" and "low" density (230,000 and 60,000).

Unfortunately low and variable survival resulted in much lower fry numbers at the time of harvest. The numbers of silver perch at harvest were 55,545 (from 230,000) and 20,550 (from 150,000) and for golden perch the numbers were 21,650 (from 230,000) and 10,300 (from 60,000). Thus the experimental design of high and low density was disrupted and all harvests were in the moderate range for the NIFRS.

Fish densities at the time of harvest were 5.7 and 14.1 m^{-2} in the silver perch fry ponds and 3.7 and 5.3 m^{-2} in the golden perch ponds.

Aspects of this study are being prepared for publication by myself, Professor D.A. Culver and Mr Phillip Arumugam.

Phytoplankton and zooplankton abundance and succession

Photosynthesis, representing algal production, increased rapidly from when the ponds were filled to a peak on about November 24, and subsequently fell to near zero in mid December although fertilization continued on November 30 and December 4 and 13 (Fig. 1). This may be related to grazing by the zooplankton. Only rotifers, which represent a small biomass and small grazing pressure, were abundant before November 24 but then large cladocerans peaked in abundance in the succession Boeckella Moina → Mesocyclops → Daphnia (Fig. 2). In December heavy grazing pressure would have been experienced from Daphnia and Boeckella.

Fish effects on zooplankton and fish growth

There were no clear differences between the zooplankton communities in the ponds stocked with different densities of fish but rather all ponds showed the succession and abundance patterns shown in Fig. 2. This probably reflects the facts that fish densities were low relative to those sometimes achieved in the ponds at NIFRS and zooplankton sampling was terminated before fish reached harvest. It is likely that the different intensities of fish predation would have effected the zooplankton communities as fish grew larger up to harvest. The growth of fish in the various ponds is shown in Fig. 3. These data suggest that the fry are following an exponential growth in weight up until about day 40, suggesting that food is not limiting, but that when golden perch are held to day 48 in pond 35 and to day 52 in pond 37 growth is suppressed.

Diet of fry

The fry can predate and eat items from the array of zooplankton that occurs in the ponds. However fry are limited by their ability to detect and catch prey and by their mouth gape which limits the size of prey that can be ingested. The relative sizes of the dominant zooplankters, the fish larva at first feed and the mouth gape of different sized fish fry are shown in Fig. 4. At first feed and until fry are about 20 mm long (with a mouth gape of about 2 mm) the prey that can be taken is limited by mouth gape. Small fry feed on early developmental stages of copepods and, especially, Moina. Larger fry predate preferentially upon larger copepods and, especially, Daphnia but will eat whatever is available in the zooplankton or on the mud (especially chironomids). Thus in considering feeding and diet of the fry it is essential to have high densities of small zooplankters (< 0.5 mm) available at first feed and for the ensuing two weeks.

Conclusions

Management practices in the fry ponds produced populations of zooplankters that should ensure good survival and growth of fish fry for the first 30 days of development. It appears that the zooplankton could withstand higher densities of fry than in the present experiment (density of up to 15 fry m^{-2}). It would be interesting to study the

zooplankton community under higher fish density or at the latest stages of fry production when low photosynthesis and higher fish predation might be expected to cause a drastic fall in zooplankton biomass. The data on fry growth for those fry held for a longer period (> 40 days) suggest that food (zooplankton) is limiting growth at this stage.

Acknowledgement

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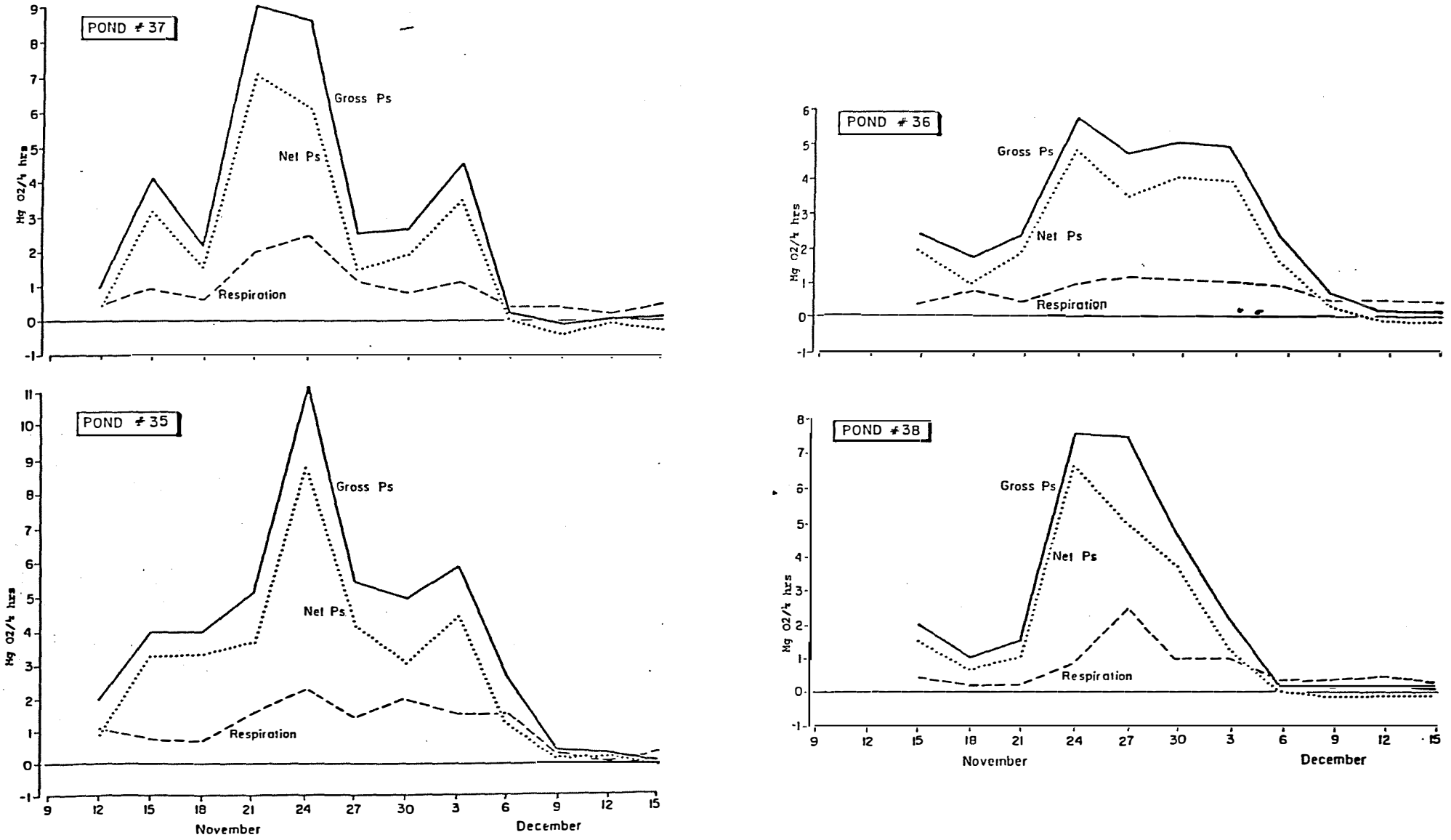

Fig. 1. Photosynthesis of the phytoplankton in the experimental fish fry ponds.

Fig. 2. Succession and abundance of major zooplankters in the experimental fry ponds.
(Also shown are the stocking and harvesting times and the fertilization regime; I is inorganic fertilization and O is organic fertilization).

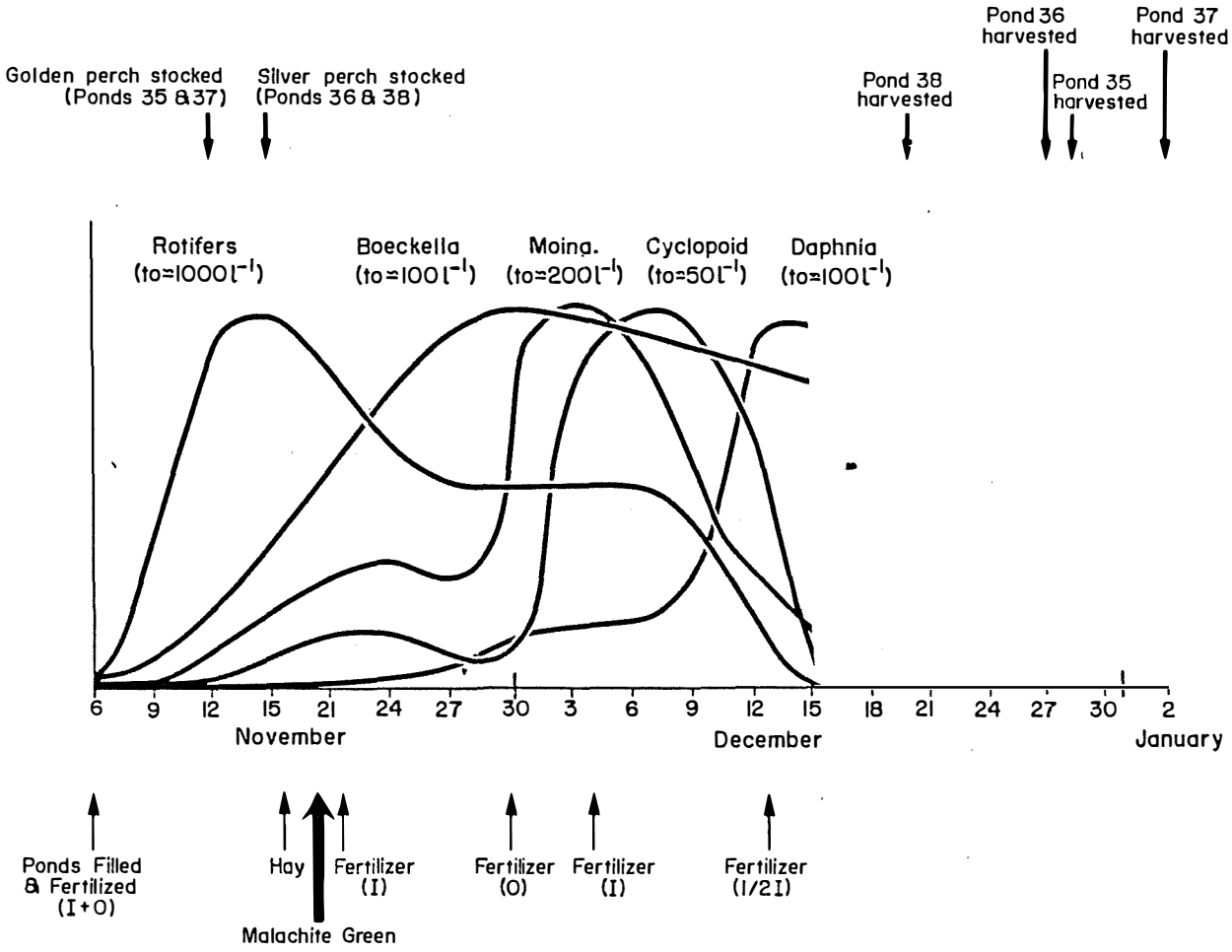

Fig. 3. Comparative sizes of zooplankters and of fish larva at first feed and an indication of the mouth gape of different sized fry.

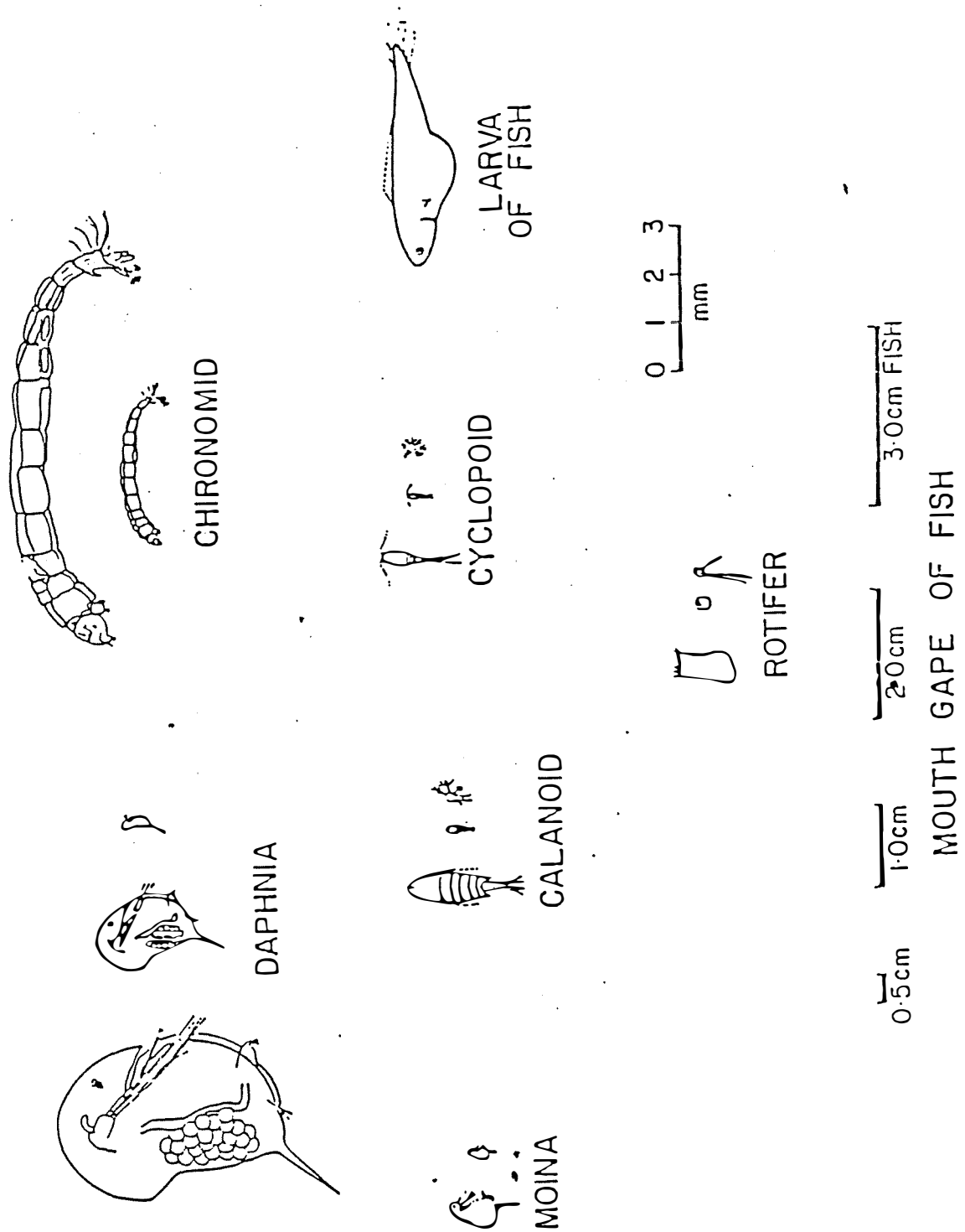

Fig. 4. Growth of golden perch (GP) and silver perch (SP) fry in the experimental fish fry ponds.