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DEEPWATER FLOWTHROUGH AS A TEMPERATURE STABILIZER IN REARING OF HALIBUT (HIPPOGLOSSUS HIPPOGLOSSUS) FRY

by

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ABSTRACT

Through the period of yolk sac absorption, halibut larvae were kept in plastic bags in plastic basins with flowthrough of deepwater.

When maintaining sufficient flowthrough, in this period the temperature in the bags was consistently around 6^{0}C, while the ambient temperature varied between 2 and 11^{0}C.

INTRODUCTION

Atlantic halibut (Hippoglossus hippoglossus) spawn at great depths. The eggs are pelagic in water masses with temperature between 4.5 and 7 ^{0}C (Haug et al. 1984). At least for a period the larval distribution is most likely the same, and a stable temperature regime might be a critical factor for successful larval rearing.

The development of other marine fish larvae is further demonstrated of many authors to be related to temperature, among them Danielsen and Iversen 1974, Fonds 1979, Iversen and Danielsen 1984, Makhotin et al. 1984.

The pond method with the use of floating plastic bags (Berg & Øiestad 1986), is a potential rearing method of halibut fry. The considerable variation in pond temperature, including fairly large diurnal variation in early spring, however is regarded as a disadvantage to this method. This report describes a successful way of stabilizing temperature in the rearing of halibut fry, using floating plastic bags in a pond.

MATERIALS AND METHODS

Three rearing units, each with four plastic bags for storing of yolk sac larvae (marked Pb1-12) placed in a plastic basins with deepwater flowthrough (fig. 1a), were used for halibut experiments in the Hyltropond at the Aquaculture Station Austevoll in the spring of 1987 (basins are marked B1-3). Both the basins and the bags were covered with roofs of plastic.

The water volume of each of the plastic bags was 11.5 m^3. Total basin volume was 125 m^3 and basin water volume (theoretically) was then 80 m^3.

Deepwater from below 50 m depth outside the pond, was pumped to the bottoms of the basins (Fig. 1a). Four overflow openings

(diameter 160 mm) in each basin, diametrically opposed to each other at the water surface level, induced a vertical current from the bottom to the surface.

The plastic basins were moored to floating collars made of plastic conduits (200 mm) with railings (70 mm, height 75 cm) (Fig. 1a). To operate the system and for inspection of larval bags, platforms were moored to the railings (Fig. 1b). For further desription of larval storing plastic bags, see Berg & Øiestad 1986.

A maximum flowthrough of about 500 litre/min, was possible without sinking the basins.

Aanderaa Datalogging System, used to monitor temperature, consisted of a module (Sensor-board 3010), for automatic scanning and reading of sensors (platinum) with 10 intervals from 0.5 to 180 minutes. A recording was taken every hour and data stored in a Psion Organiser II for further analysis.

Six sensors were used, one in each of Pb2 (in B1), Pb8 (in B2), Pb12 (in B3) and one in each of B1-B3. Monitoring depth was 1.5 m. In addition sensors were placed in the pond at 0,3 and 5 m depth. Occasionally temperature was checked at 0 m in bags and basins together with occasionally checking of bottom temperature.

RESULTS AND DISCUSSION

The two cohorts of larvae were transferred to the storing bags March 7 (cohort 1, Pb1-Pb4) and March 20 (cohort 2, Pb5-Pb12 in B2 and B3). The cohorts exhausted their yolk reserves about day 45 after hatching corresponding to April 21 and May 4. Feeding was first time observed on April 26 for cohort 1 and on April 29 for cohort 2 (Naas et al. 1987, Pittman et al. 1987).

Figure 2-4 show a rather stable temperature in the rearing units as measured in Pb2, Pb8 and Pb12, while there was considerable

variation in pond temperature with most variation in 0m, but some what less in 5m (not shown in figures).

A stretching of sensor cable by accident, caused the Pb2 sensor to be positioned at the uppermost surface the first week (March 7-14). Diurnal variation in temperature, not shown in figure, indicates considerable effects from air temperature, having a general influence at the surface traceable down to about 0.5 m depth. This caused, however, little problem as the larval distribution is below 1 m depth during the yolk sac period. Still a more effective flowthrough with branched deepwater inflow, for instance, with flow from surface to the bottom, probably will reduce the impact of air temperature.

A general rise in temperature, together with increased variation, at the end of yolk sac absorbtion (from April 15 in B1 and April 24 in B2 and B3), is due to a regulation of flowthrough at this time from about 300 to less than 100 litre/min, in connection with larval startfeeding. An immediate rise in storing bag temperatures, indicates the ability to regulate in addition to stabilizing temperature. This regulation also explain the temperature peak in B3 on May 3.

However, temperature regulation by this method is only possible within limits, either by reducing the water flowthrough or by mixing different temperatures by using water from different depths. Although technically this is possible, temperature regulation by this method will of course always be restricted by the temperature extremes of the available water masser.

The results have, however, shown the possibility of stabilizing temperature in halibut rearing by a simple and cheap method, provided that deepwater with stable temperatures is available.

In this experiment, larval survival was as high as 50% at the time of first feeding and in all storing bags larvae start to feed and grow (except in one bag with a technical accident) (Pittman et al. 1987, Naas et al. 1987).

The method, in addition, makes possible a prolonged production time in halibut fry rearing. When zooplankton are available for startfeeding, transferance of larvae to such a system is possible, throughout the whole spawning season from January to late April.

ACKNOWLEDGEMENT

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REFERENCES

Berg, L. and V. Øiestad 1986. Growth and survival studies of halibut (Hippoglossus hippoglossus L.) from hatching to beyond metamorphosis carried out in mesocosms. Coun. Meet Int. Coun. Explor. Sea. 1986 (F:16).

Danielsen, D.S. and S.A. Iversen, 1974. Egg og larveutvikling hos rødspette (Pleuronects plotessa L.), torsk (Gladus morhua L.) og vårgytende sild (Clupea hareugus L.) ved konstante temperaturer. Fisken og Havet. Ser. B 1974 22:1-29.

Fonds, M., 1979. Laboratory Observations on the Influence of Temperature and Salinity on Development of the Eggs and Growth of the Larvae of Solea Solea (Pisces). Marine Ecology - Progress Series 1:91-99.

Haug, T., E. Kjørsvik and P. Solemdal 1984. Vertical Distribution of Atlantic Halibut (Hippoglossus hippoglossus L.) Eggs. Can. J. Fish Aq. Sci. 41(5):798-804.

Iversen, S.A. and D.S. Danielsen, 1984. Development and mortality of cod (Gadus morhua L.) eggs and larvae in different temperatures. In: E. Dahl, D.S. Danielsen, E. Moksness and P. Solemdal (Editors). The Propagation of cod (Gadus morhua L.) Flødevigen rapportser. 49-65.

Makhotin, V.V., G.G. Novikov, S.G. Soin and V.N. Timeiko, 1984. The peculiarity of the development of white sea cod. In: E. Dahl, D.S. Danielsen, E. Moksness and P. Solemdal (Editors). The Propagation of cod (Gadus morhua L.). Flødevigen rapportser. 695-620.

Naas, K., L. Berg, J. Klungsøyr and K. Pittman, 1987. Natural and enriched zooplankton as food for halibut (Hippoglossus hippoglossus L.) larvae. Coun. Meet. Int. Coun. Explor. Sea. 1987 (F:17).

Pittman, K., Leif. Berg and K. Naas, 1987. Morphological development of halibut (Hippoglossus hippoglossus L.) larvae, with spesial reference to mouth development and metamorphosis. Coun. Meet. Int. Coun. Explor. Sea. 1987 (F:18).

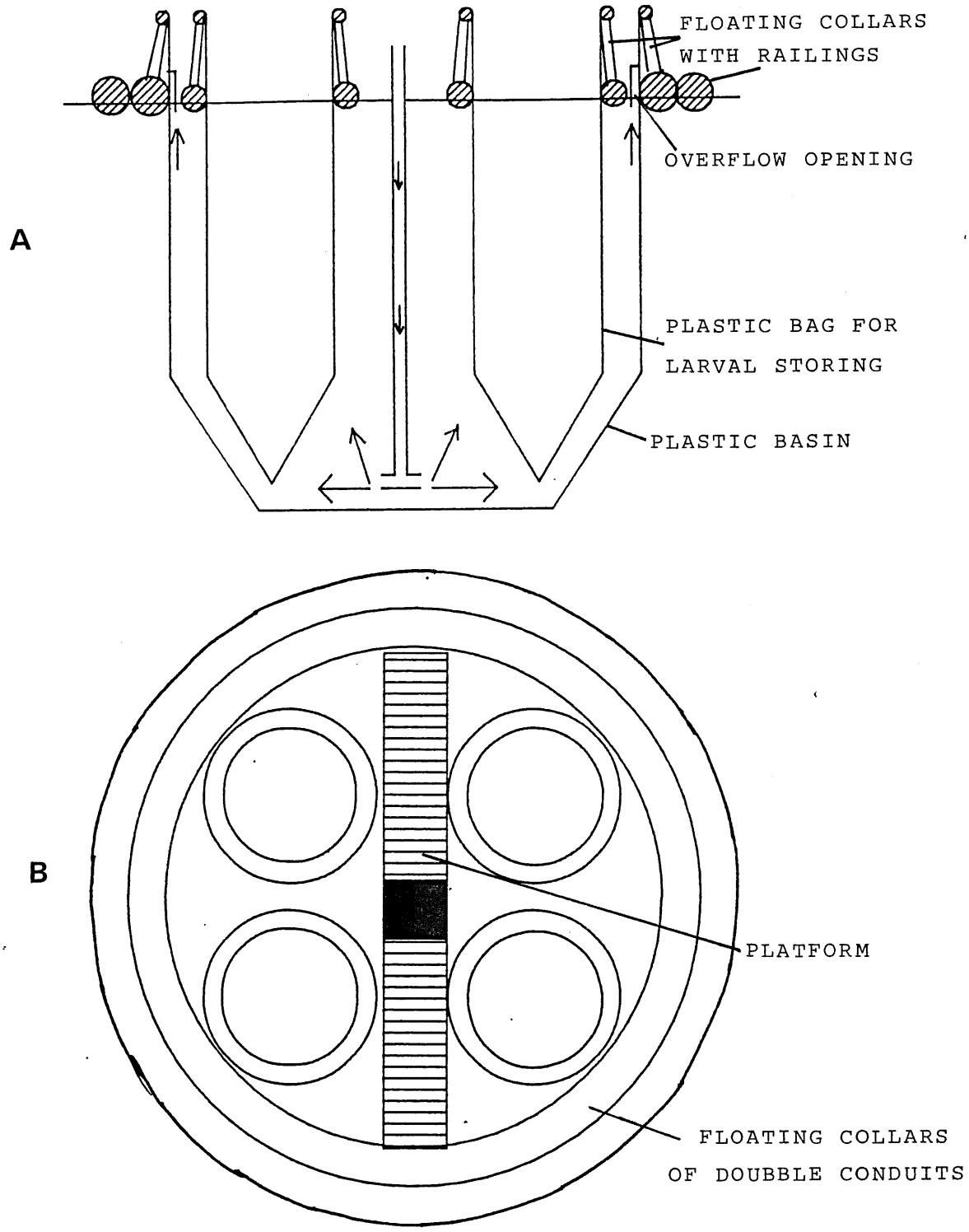

Figure 1. Larval rearing unit with deep water flow through (**A**) and with four plastic bags in one basin (**B**).
⟶ is deepwater flowthrough.

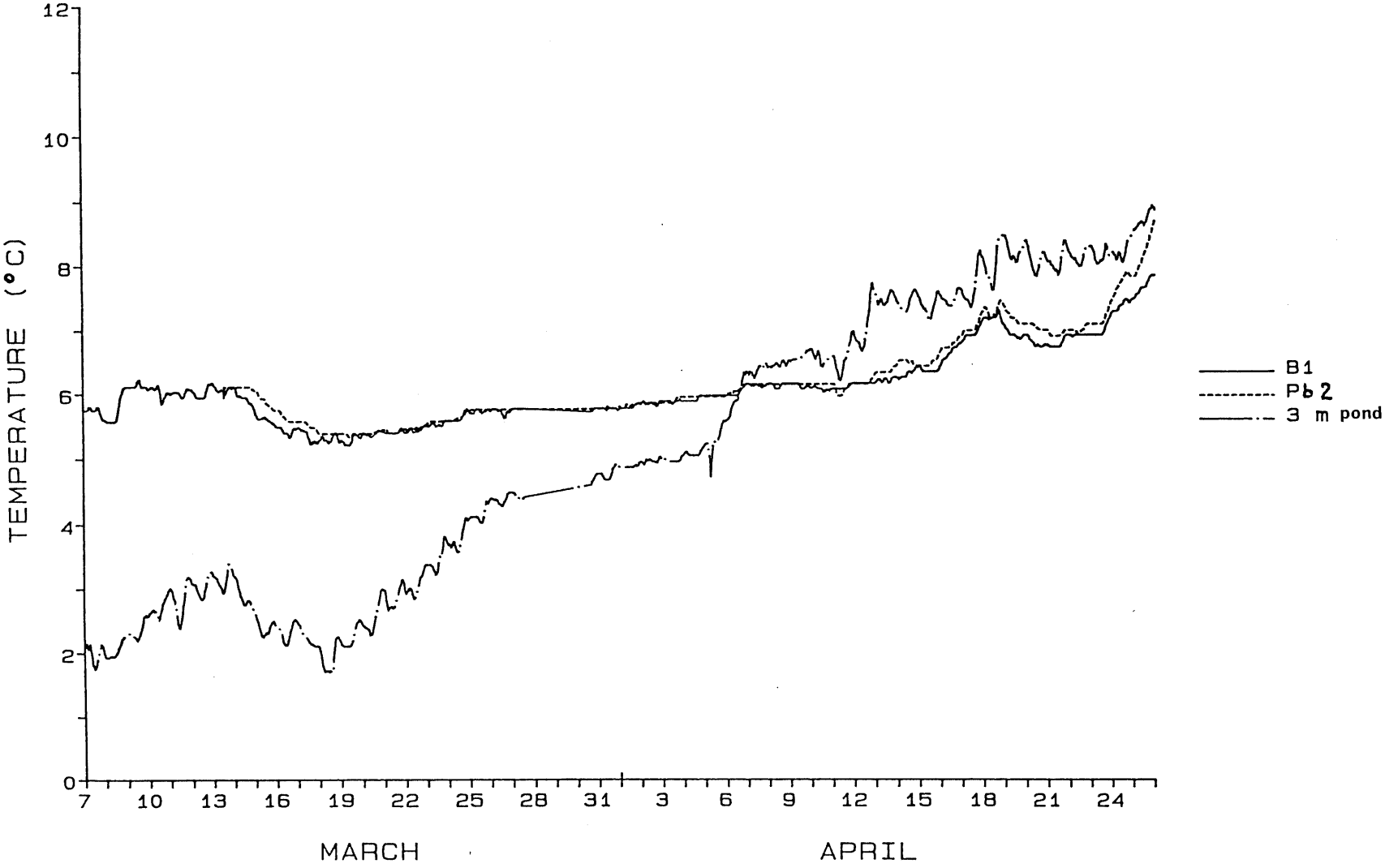

Figure 2. Temperature in the period of yolk sac absorption for cohort 1 larvae.

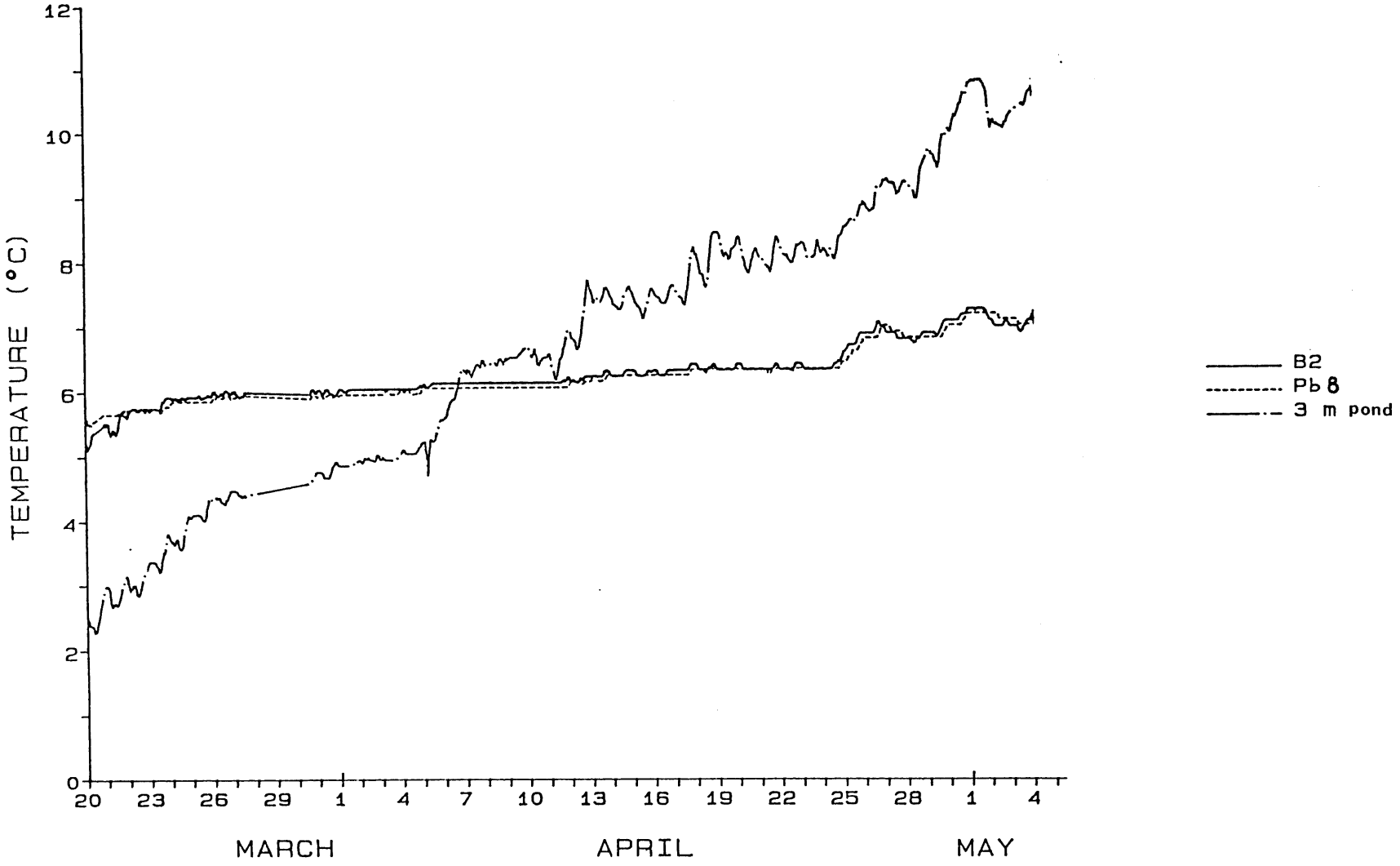

Figure 3. Temperature in the period of yolk sac absorption for cohort 2 larvae in Pb5-Pb8 in B2.

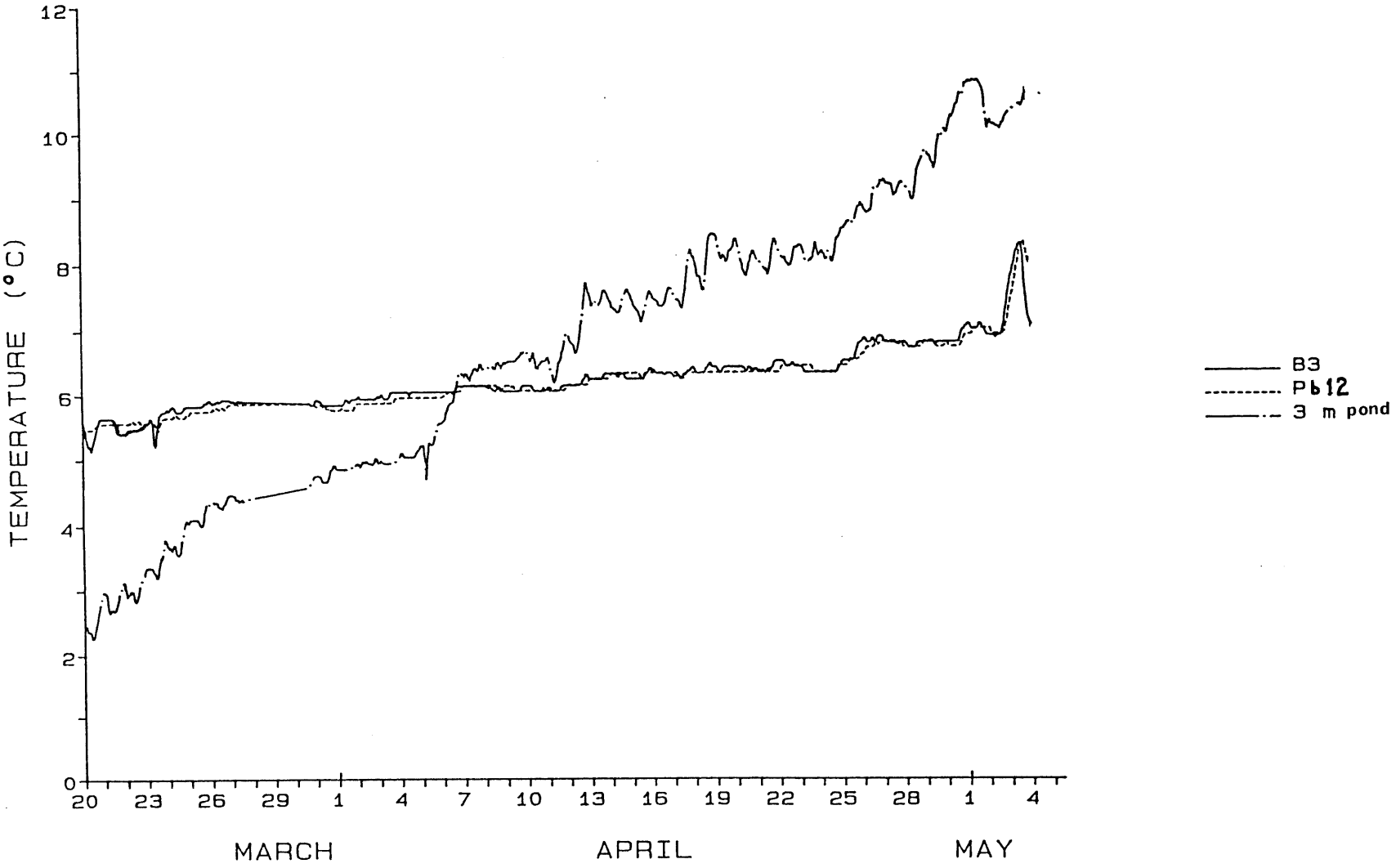

Figure 4. Temperature in the period of yolk sac absorption for cohort 2 larvae in Pb9-Pb12 in B3.