Journal of Fish Biology (1994) **45**, 349–351

BRIEF COMMUNICATIONS

Activity and swimming speed at time of first feeding of halibut (*Hippoglossus hippoglossus*) larvae

A. B. SKIFTESVIK, Ø. BERGH AND I. OPSTAD

Institute of Marine Research, Austevoll Aquaculture Research Station, N-5392 Storebø, Norway

(*Received 1 March 1993, Accepted 18 September 1993*)

Atlantic halibut larvae show an increase in activity, together with a decrease in swimming speed during active periods, occurring from day 26 onwards, which corresponds approximately to 50% yolk absorption.

Key words: halibut larvae; behaviour; first feeding.

Determination of the time of first feeding in halibut (*Hippoglossus hippoglossus* L.) larvae has been hindered by the almost complete absence of observations of the larval stages of this species in nature (cf. Haug *et al.*, 1989; Haug, 1990; Kjørsvik & Reiersen, 1992). The halibut has a long yolk sac stage with the formation of fins, digestive system, swimming ability, movable jaws and visual system occurring weeks after hatching (Blaxter *et al.*, 1983; Pittman *et al.*, 1990*a*). Observations of food ingestion in aquaculture experiments have varied from about 25 days after hatching to about 45 [Blaxter *et al.*, 1983; Pittman *et al.*, 1990*b*; Lein & Holmefjord, 1992; Harboe *et al.*, (unpublished)]. However, this is highly dependent on experimental conditions (cf. Naas *et al.*, 1992). Characteristic changes in behaviour, involving increased activity and reduced speed during active periods, have previously been reported at the time of first feeding for cod, *Gadus morhua* (L.) and turbot *Scophthalmus maximus* (L.) (Skiftesvik, 1992). Thus, if similar changes occur in the behaviour of halibut, it would indicate the time of first feeding of this species.

Observations on behaviour from hatching to day 58 at 5° C were conducted during one season on 350 larvae in a 70-l aquarium. The three-dimensional movement of individual larvae was monitored and their position recorded every second with a computer-based video system described by Huse & Skiftesvik (1990). Two parameters were calculated: (1) activity defined as the percentage of time the larvae were swimming, according to Skiftesvik (1992), and (2) swimming speed during the active periods.

Activity levels were between 2 and 20% during the first 25 days after hatching (Fig. 1). The larvae moved seldom, but when they did, they were active for about 5 s. Thereafter, a gradual increase to over 60% in activity on day 40 was observed.

The swimming speed during active periods increased from about 2·5 mm s^{-1} on day 2 to about 10·5 mm s^{-1} on day 26 after hatching. Thereafter, the speed decreased (Fig. 1). The increase in the activity level and the marked decrease in swimming speed from day 26 onwards indicates a change in the motivation of behaviour. Using the same observation system, identical shifts in behaviour have been reported for cod and turbot, coinciding with the time of first feeding (Skiftesvik, 1992). A similar change of swimming mode has also been found in larvae of other fish species when the energy source changes from endogenous to exogenous (Blaxter & Staines, 1971; Hunter & Kimbrell, 1980). Such changes in behaviour could be explained as an adaptation to food searching, as described for cod and turbot (Skiftesvik, 1992), indicating a need for exogenous nutrients from this developmental stage onwards.

0022–1112/94/080349+03 $08.00/0

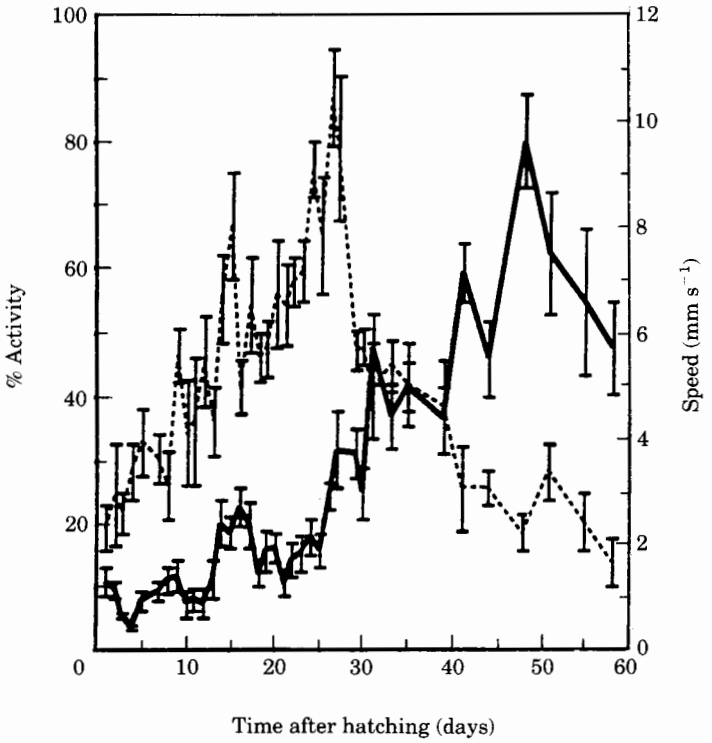

FIG. 1. Speed in active periods (mm s^{-1}, – – –, with S.E.) and percentage of activity (——, with S.E.) of halibut larvae during the first 60 days after hatching.

This study was financially supported by the Norwegian Council for Fisheries Research (NFFR) and the Royal Norwegian Council for Scientific and Industrial Research (NTNF). We are indebted to Dr Johan Glette and Dr Jens Chr. Holm for their constructive comments on the manuscript, and to Aengus Parsons for correcting the language.

References

Blaxter, J. H. S. & Staines, M. E. (1971). Food searching potential in marine fish larvae. In *4th European Marine Biology Symposium* (Crisp, D. J., ed.), pp. 467–485. Cambridge: Cambridge University Press.

Blaxter, J. H. S., Danielsen, D., Moksness, E. & Øiestad, V. (1983). Description of the early development of the halibut *Hippoglossus hippoglossus* and attempts to rear the larvae past first feeding. *Marine Biology* **73,** 99–107.

Haug, T. (1990). Biology of the Atlantic halibut *Hippoglossus hippoglossus* (L. 1758). *Advances in Marine Biology* **26,** 1–70.

Haug, T., Kjørsvik, E. & Pittman, K. (1989). Observations on a wild Atlantic halibut larva *Hippoglossus hippoglossus* (L.). *Journal of Fish Biology* **34,** 799–801.

Hunter, J. R. & Kimbrell, C. A. (1980). Early life history of Pacific mackerel, *Scomber japonicus*. *Fishery Bulletin U.S.* **78,** 89–101.

Huse, I. & Skiftesvik, A. B. (1990). A PC-aided video based system for behaviour observation of fish larvae and small aquatic invertebrates. *Aquacultural Engineering* **9,** 131–142.

Kjørsvik, E. & Reiersen, A. L. (1992). Histomorphology of the early yolk-sac larvae of Atlantic halibut (*Hippoglossus hippoglossus* L.)—an indication of the timing of functionality. *Journal of Fish Biology* **41,** 1–19.

Lein, I. & Holmefjord, I. (1992). Age at first feeding of Atlantic halibut larvae. *Aquaculture* **105,** 157–164.

Naas, K. E., Næss, T. & Harboe, T. (1992). Enhanced first feeding of halibut larvae (*Hippoglossus hippoglossus* L.) in green water. *Aquaculture* **105,** 143–156.

Pittman, K., Bergh, Ø., Opstad, I., Skiftesvik, A. B., Skjolddal, L. & Strand, H. (1990*a*). Development of eggs and yolk sac larvae of halibut (*Hippoglossus hippoglossus* L.). *Journal of Applied Ichthyology* **6,** 142–160.

Pittman, K., Skiftesvik, A. B. & Berg, L. (1990*b*). Morphological and behavioural development of halibut *Hippoglossus hippoglossus* (L.) larvae. *Journal of Fish Biology* **37,** 455–472.

Skiftesvik, A. B. (1992). Changes in behaviour at onset of exogenous feeding in marine fish larvae. *Canadian Journal of Fisheries and Aquatic Sciences* **49,** 1570–1572.