



Temperature and size dependent growth of larval and juvenile cod (*Gadus morhua* L.) - a comparative study between Arcto-Norwegian and Norwegian coastal cod

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Introduction

Although the influence of temperature on growth of cod, *Gadus morhua* L., has been apparent for years (Jobling, 1988), knowledge about the temperature and size dependent growth of larvae and juvenile stages is limited. Few experiments have also been set up to compare the growth pattern of the two common Norwegian stocks of cod, Arcto-Norwegian and Norwegian coastal cod (van der Meeren *et al.*, 1994; Svåsand *et al.*, 1996). The purpose of the present study is to characterise temperature and size dependent growth of cod larvae and juveniles reared under controlled conditions.

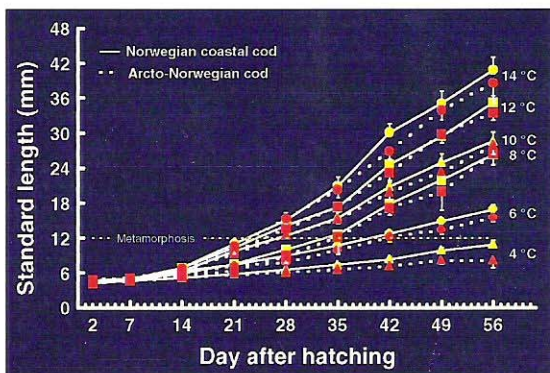


Fig. 1. Growth (mean standard length, \pm 2SE) of Norwegian coastal cod and Arcto-Norwegian cod reared at 6 different temperatures. Data from parallels are combined.

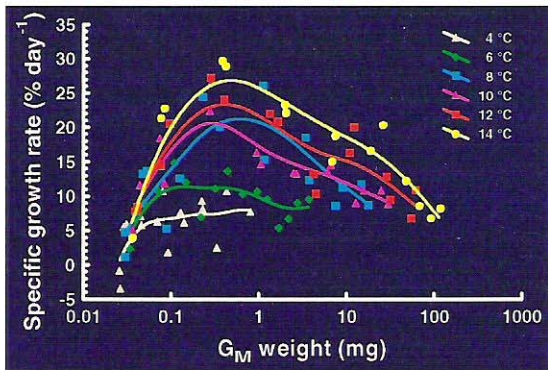


Fig. 3. Specific growth rate versus geometric mean dry weight of larval and juvenile cod reared under six temperature regimes. The fitted lines (least square) indicate the general trend in growth. Data from parallels and stocks (Norwegian coastal cod and Arcto-Norwegian cod) are combined.

Results

Larval and juvenile growth was clearly temperature and size dependent (Fig. 1. and Fig. 3-4). Larvae reared at 14 °C reached metamorphosis (12 mm) after 23 days, compared to more than 60 days for fish at 4 °C. A peak in growth rate occurred at a larval size of 0.1-1.0 mg dry weight. Norwegian coastal cod seemed to grow somewhat better than the Arcto-Norwegian cod. Mean stock specific survival (including sampling) ranged from 6-44 % (NC) and 5-56 % (AN) after 8 weeks post hatch for larvae and juveniles reared at temperatures from 4 to 14 °C.

References

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- van der Meeren, T., Jørstad, K. E., Solemdal, P. & Kjesbu, O. S. (1994). Growth and survival of cod larvae (*Gadus morhua* L.): comparative enclosure studies of Northeast Arctic cod and coastal cod from western Norway. *ICES Marine Science Symposia* 198, 633-645.

Materials and methods

Arcto-Norwegian cod (AN) and Norwegian coastal cod (NC) larvae were reared under identical conditions in replicate 500 l tanks for 8 weeks in the laboratory at six temperatures ranging from 4 to 14 °C during 1995 and 1996. In order to distinguish coastal cod from Arcto-Norwegian cod, the otoliths of the latter stock were marked with alizarin complexone (100 mg/l for 24 h) 2-days pre hatching in 1995, whereas coastal cod were marked the following year. The larvae and juveniles were fed natural zooplankton (prey density in tank > 1000 ind/l). Thirty larvae were sampled from each tank weekly, and subject to morphometric measurements. The otoliths (lapilli) were dissected out, checked for alizarin marks, and classified as either AN or NC using a fluorescence microscope.

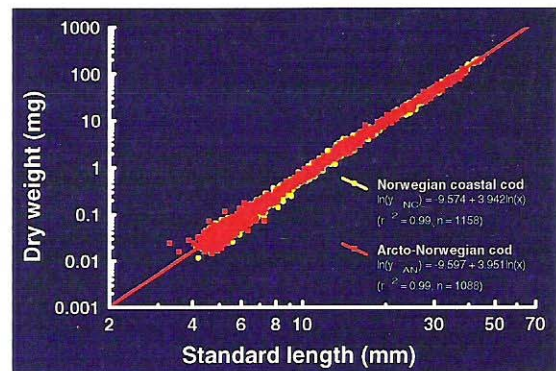


Fig. 2. Log dry weight versus log standard length of Norwegian coastal cod and Arcto-Norwegian cod. Data from parallels and temperature regimes are combined.

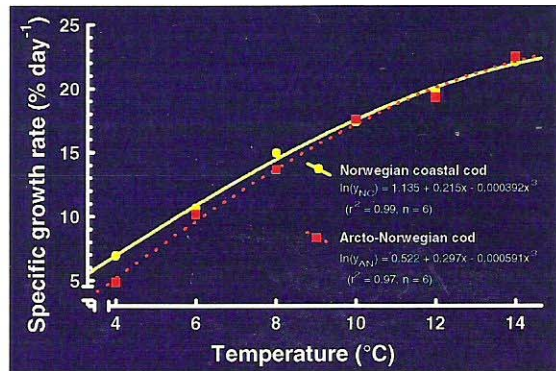


Fig. 4. Effects of temperature on mean specific growth rates of Norwegian coastal cod (NC) and Arcto-Norwegian cod (AN) during the larval stage (dry weight < 1.2 mg).

Conclusions

- During the larval stage cod has a potential for growth above 25 % (daily weight increment)
- A peak in growth occurs at a larval size of 0.1-1.0 mg dry weight
- Temperature optimum for maximum growth of larval cod fed in excess is indicated above 14 °C
- In general Norwegian coastal cod seemed to grow better than the Arcto-Norwegian cod, especially at lower temperatures
- No stock specific difference in survival was observed

Acknowledgement

This study was funded by the Norwegian Research Council grant no. 108920/120.