

The Reproductive Stages of Cod (*Gadus morhua*): Gross Anatomy and Histology*

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Abstract

There have been many studies, including morphological ones, of reproduction in female cod (*Gadus morhua*) because of its great commercial value. Knowledge of the reproductive cycle, and factors affecting the cycle and the viability of eggs is important for stock recruitment studies. In contrast, there have been few studies of the reproduction in the male. For stock management studies, it is important to be able to determine what stages of maturity a cod has reached. For example, this knowledge is needed to determine minimum size at capture to allow for reproduction; to determine stock structure, because groups spawning at different times may best be managed separately; to determine timing of area closures to protect spawning fish; to understand the relationships between age at maturation or fecundity, availability of food and population size, and estimate the reproducing stock biomass.

Many maturity scales have been devised which describe the gross appearance of the ovary and testis at different stages of development, so that the fish can easily be "staged" on board a vessel. These scales have usually incorporated (1) an immature stage in young fish, (2) two or more ripening stages, (3) a ripe stage, (4) a spawning stage in which eggs or spermatozoa are released, (5) a spent stage, (6) a recovering stage in which remaining eggs and spermatozoa are resorbed, and (7) a resting stage in preparation for the next spawning season. In practise it is difficult to differentiate these stages using gross criteria only, so an atlas was prepared (Morrison, 1990), in which the reproductive cycle in both ovary and testis was described using light and electron microscopy, and the gross appearance was correlated with histology.

It was found that, since the reproductive cycle is, of course, continuous, any attempts to divide it into stages are artificial. For example, an ovary staged as "resting" using most criteria may have some oocytes beginning the phase of major growth, or a "resting" testis may have spermatogonia starting to divide. It was difficult to tell a virgin from a resting fish even with histological criteria. Naturally, the presence of empty or atretic follicles in the ovary, or a few spermatozoa in the testis confirmed that the fish was resting, but often large fish were found without these. The latter were either virgin fish that were very late maturing; or fish that had not spawned for a long time, so that evidence of previous spawning had disappeared.

Some fish which did not fit into any of the existing scales were found. The gonad was apparently recovering from a previous spawning, but was already preparing for the next. In the female, empty follicles were present along with oocytes starting vitellogenesis; and in the male the proximal part of the testis was white and flabby, and still contained spermatozoa that were being released, while a distal frill had developed, which contained cysts of dividing spermatogonia and spermatocytes. These fish were staged as "spent-ripening" fish, to differentiate them from fish with resting gonads.

Key words: Cod, *Gadus morhua*, gross anatomy, histology, reproductive tract

Reference

- MORRISON, C. M. 1990. Histology of the Atlantic cod, *Gadus morhua*: An Atlas. Part Three. Reproductive Tract. *Can. Spec. Publ. Fish. Aquat. Sci.*, **110**.

* Material presented in this Abstract is fully reported in Morrison, 1990.

