



Developing an egg-survey approach to monitoring the biomass of cod and other demersal fish species in the Irish Sea

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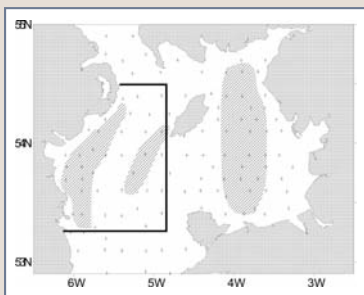
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Why use egg surveys?

Egg surveys can be used for estimating spawning stock biomass (SSB), establishing spawning patterns and mapping spawning grounds. They provide a direct method for monitoring SSB of depleted stocks such as cod and their distribution relative to spawning closures. In the Irish Sea in 1995 and 2000, application of the Annual Egg Production Method (AEPM) showed about half of the SSB of cod was within the area of the current seasonal cod spawning closure (Figure 1). Further AEPM surveys are being carried out in 2006, 2008 and 2010 to monitor stock status during the EU cod recovery programme.

Demersal fish stocks in the Irish Sea have undergone major changes since the 1990s. SSB of cod and whiting has declined, whilst plaice and haddock stocks have increased (Figure 2). Catch-based assessments carried out by ICES suffer from poor quality or incomplete fishery data. Fishery-independent surveys are therefore an important source of data on abundance.



Above: Gulf-7 plankton sampler used on Irish Sea egg surveys

Figure 1: Spawning sites for cod in the Irish Sea (hatched) in relation to the current spring cod closure (boxed). Crosses show the egg survey grid sampled in 2006

The annual egg production method (AEPM)

The AEPM is suitable for determinate spawners in which all the eggs that potentially could be spawned during the year are present in the ovaries immediately prior to the commencement of spawning.

The method requires a series of ichthyoplankton surveys to determine seasonal and annual egg production (Figure 3). Sampling of adult fish provides estimates of potential fecundity and rates of egg loss due to follicular atresia during the spawning season. The ratio of annual egg production to mean fecundity per unit weight (adjusted for atresia) provides an estimate of SSB of females. Total SSB can be calculated if the sex ratio is known.

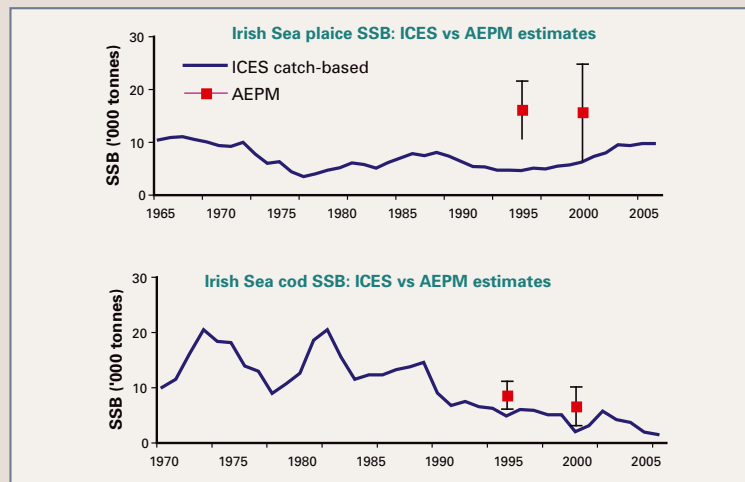


Figure 2: ICES catch-based estimates of SSB of plaice and cod in the Irish Sea, and annual egg production estimates of SSB in 1995 and 2000.

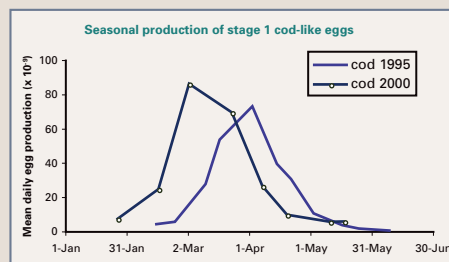


Figure 3: Seasonal production of stage-1 gadoid eggs in 1995 and 2000.

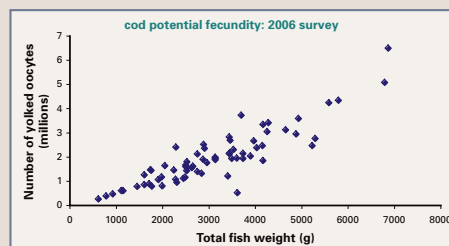
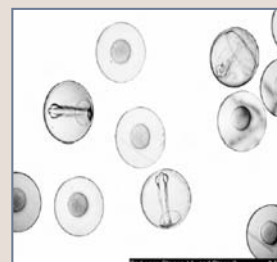
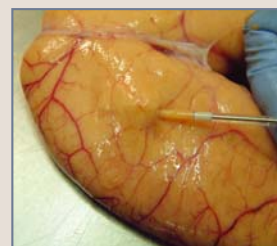


Figure 4: Potential fecundity of Irish Sea cod in 2006.



When should the egg surveys take place?

The seasonal egg production cycle of cod and plaice in the Irish Sea was about a month earlier in 2000 than in 1995, perhaps reflecting changes in environmental triggers for spawning (Figure 3). In 2006, five egg surveys were carried out in February - April to quantify the annual egg production of cod, haddock and plaice, assuming the same production cycle as in 2000. Analysis of these surveys is nearing completion. Mean daily egg production per survey is calculated from abundance of early-stage (1A) eggs adjusted for stage duration at ambient temperature.

Estimating mean fecundity in the population

Adult cod, haddock and plaice are sampled shortly before their first spawning event to estimate the total annual potential fecundity. Fecundity is estimated from small tissue samples. The samples are screened for evidence of spawning and if down-regulation of fecundity due to pre-spawning atresia is taking place. Samples are also collected during spawning to estimate the rate of loss of eggs due to atresia. Potential fecundity tends to be mainly a function of fish weight (Figure 4).

Differences between catch-based and AEP estimates of SSB

The Annual Egg Production Method (AEPM) was applied to cod and plaice in the Irish Sea in both 1995 and 2000 to try and determine absolute spawning stock biomass (see Armstrong *et al.*, 2001). The SSB estimates in both years were well in excess of the ICES catch-based estimates (Figure 2). This could be due to known inaccuracies in the fishery catches due to misreporting and discarding, or to aspects of the biology of the Irish Sea stocks that could be causing bias in the AEPM results.

One problem for AEPM surveys of cod and haddock is identification of early stage eggs. An electrophoresis method was used in 2000 to identify eggs. The surveys are being repeated in 2006, 2008 and 2010 using modern, highly sensitive gene-probes to allocate cod-like eggs to species (see Goodsir *et al.*, ICES CM/Q:23 this symposium, and Fox *et al.* 2005).

References

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Fox C.J., Taylor M.L., Pereyra R., Villasana-Ortiz, M.J. and Rico, C. (2005). TagMan DNA technology confirms likely over-estimation of cod (*Gadus morhua* L.) egg abundance in the Irish Sea: implications for the assessment of the cod stock and mapping of spawning areas using egg based methods. Molecular Ecology, 14, 879-884.