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8 March 2022

Dear Finlay

**Clyde Cod Seasonal (February to April) Closure for 2022 and 2023**

I am looking forward to meeting you and members of the RAINE Committee on Wednesday 9 March 2022 to discuss the Clyde Cod spawning closure. In advance of that, I have asked the Chief Fisheries Advisor for Scotland, Dr Coby Needle, to provide a submission to you detailing our scientific rationale that underpins The Sea Fish (Prohibition On Fishing) (Firth Of Clyde) (No. 2) Order 2022.

I hope that this is helpful and will frame our discussions on Wednesday, for which Dr Needle will be present.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Mairi Gougeon'.

**MAIRI GOUGEON**

## **Background to Clyde cod spawning closures**

**Dr Coby Needle, Chief Fisheries Advisor for Scotland  
Marine Scotland Science, 3 March 2022**

### **Summary**

MSS were asked to consider whether the existing Clyde cod spawning closure was sufficient to achieve the policy objective of protecting spawning cod. Good, consistent, detailed time-series of data regarding the distribution of spawning cod in the Clyde area do not currently exist. Given this, we have taken a risk-based approach. Existing scientific literature highlights the preference for Atlantic cod to spawn in areas of gravel or coarse sand, with sandy mud or muddy sand being less optimal, and fine mud being least suitable. We therefore determined the areas of gravel and sand within the existing closure and developed two new closures which covered these areas, along with small buffers to ensure cod spawning just outside the optimal areas would still be protected. We believe these are likely to give the maximum potential protection to cod during spawning time.

We were also asked to consider the fishing gears which should be included in these closures. Further scientific literature highlights the spawning behaviour of cod, which includes territorial activity and movement up to 10 metres above the seabed. We therefore concluded that any fishing gear that descends to within 10 metres of the seabed has the potential to disturb (and potentially prevent) cod spawning in the Clyde, and should therefore not be permitted in the closed areas.

These conclusions are not definitive, and there remains a lack of data and observations specific to the Clyde area. We must consider whether (and how) to address this lack in the near future. In the meantime, our advice takes a risk-based precautionary view and attempts to maximise the likelihood of cod spawning, in an effort subsequently to increase stock biomass and generate a sustainable cod fishery in the Clyde.

## Background

A seasonal spawning closure in the Firth of Clyde (Figure 1) has been in place for 20 years, to provide an area to protect cod during their spawning season (14th February – 30th April). From its introduction in 2001 until 2021, the closure included exemptions to allow Nephrops trawlers, creels and scallop dredgers to continue to fish in the area, due to the low numbers of cod they catch. The closure was implemented through a statutory instrument, latterly on a biennial cycle. In late 2021, Marine Scotland Science was asked for advice on whether the closure was in the correct place, and whether the correct fishing methods were prohibited. The intention was to ensure that the closure was more targeted and focussed on the aim of improving the likelihood of Clyde cod spawning success, and subsequently increasing abundance.

### Disturbance to cod spawning

North Sea cod mating activity takes place during the first quarter of the year. Spawning areas are chosen according to suitable substrate type (e.g. gravel or sand), with further requirements including high salinity, low temperature (5-7 °C) and low-to-moderate current flow. Given a suitable area, males will identify small territories (known as leks) that they subsequently defend from other males (González-Irusta and Wright 2016, Grabowski et al 2009, Nordeide and Folstad 2000; Figure 2). During mating, males will patrol their leks, using muscles around their swim-bladders to emit characteristic grunting and rumbling sounds. Females are attracted by this noise, and will visit leks in turn to mate. Some leks are better than others, and a strict male hierarchy develops in which weaker males are relegated to areas that are less suitable (and therefore less attractive to females).

While spawning, cod are extremely vulnerable to fishing activity. They are focussed on mating, and the males are unwilling to leave their hard-won leks, so both sexes are less likely to try and evade oncoming nets. Physical disturbance during mating will disrupt the activity and potentially destroy the lek areas, and cod so disturbed may not return (and therefore may not spawn that year). If the stronger males are caught or disrupted leaving the weaker males, the latter that remain may not be able to attract females. Stressed males are less likely to initiate mating. Noise may also disrupt mating, with females potentially unable to hear mating calls (Slabbekoorn et al 2010). Most mating takes place on or near the seabed, but a recent study using data storage tags on male cod indicated that males will follow females around 5-10 metres up through the water column to initiate spawning (P. J. Wright pers. comm.: see Figures



Figure 1. Map for Sea Fish (Prohibited Methods of Fishing) (Firth of Clyde) Order 2021.

2 and 3). This suggests that any fishing gear which operates within 10 metres of the seabed has the potential to disrupt or prevent cod spawning.

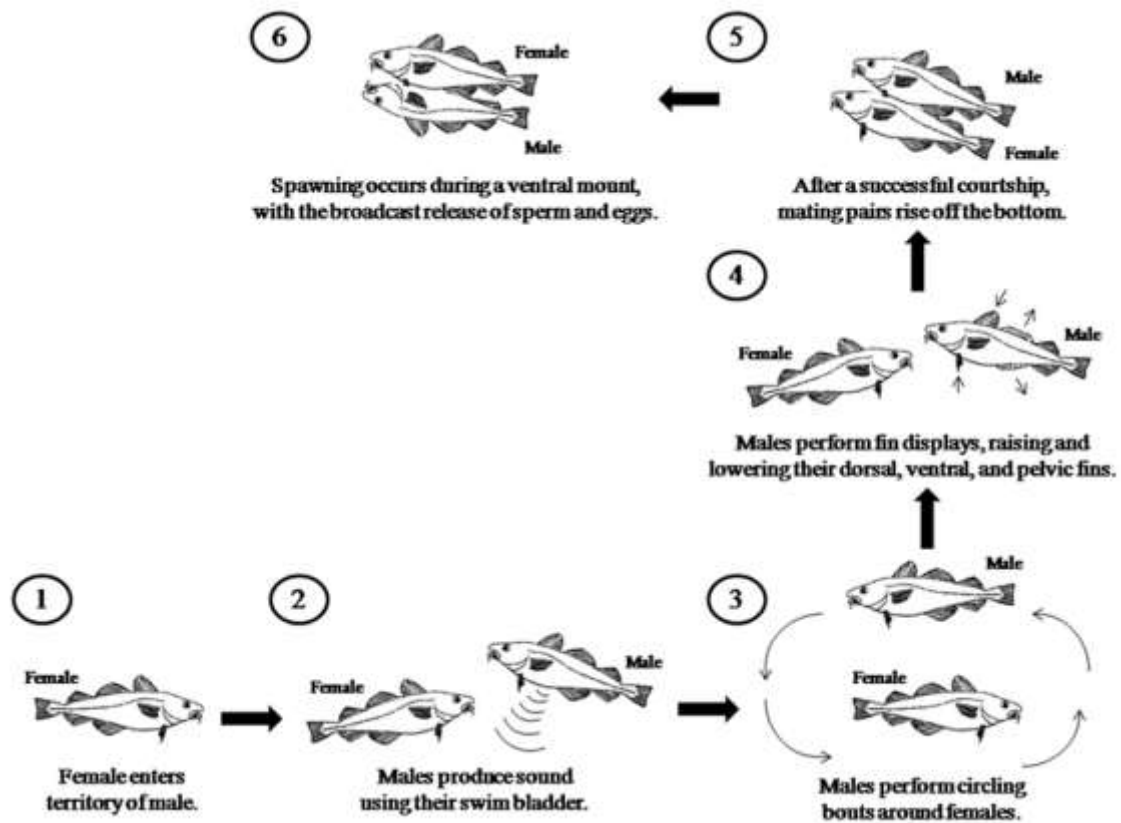


Figure 2. Infographic of Atlantic cod mating behaviour. Source: Zemekis (2016).



Figure 3. Data storage tag records for a male cod in the northern North Sea during mating activity. Two instances of the male ascending to chase females are circled.

Fishing activity is just one potential reason for the current long period of reduced recruitment, with environmental change and pressure from other species being others. Reducing fishing on spawning cod is likely to improve the amount of eggs produced, and could therefore result in improved recruitment in the following year, but this is difficult to evaluate in advance. We are therefore unable to quantify the potential improvement in recruitment (and subsequent stock dynamics) that spawning closures in the first quarter should provide. However, it does seem clear that there are unlikely to be many young fish entering the adult population of per capita egg production is reduced through disturbance.

## Revised closure

Scientific evidence indicates that cod are very unlikely to spawn on areas of fine mud, with a sliding scale of suitability up through sandy mud or muddy sand, to sand, gravel and cobbles. We therefore decided to propose a revised closure area, based on the existing area (Figure 1) but modified to exclude areas of fine mud, sandy mud or muddy sand. The suggested area was then extended slightly to ensure straight edges (for implementation), and to ensure a buffer zone around the preferred spawning habitat to protect spawning cod in between mating episodes and when feeding. The proposed area is shown in Figure 4, and represents a reduction of 28% overall on the previous closure.

In addition, the proposed closure was to encompass all methods of fishing that encroach within 10 metres of the seabed. The aim with this was to ensure that spawning cod (where present) are not disturbed, as this would prevent spawning and ultimately impinge on stock sustainability. Diving and creeling are less impactful than dredging or trawling, but it still seems reasonable to assume that a creel landing on a lek or a diver working in the vicinity of spawning will be likely to interfere with spawning activity. Local fishermen estimate between 4000 and 5000 creels are in operation in the Clyde at any given time, and shooting and hauling these is likely to cause disturbance.

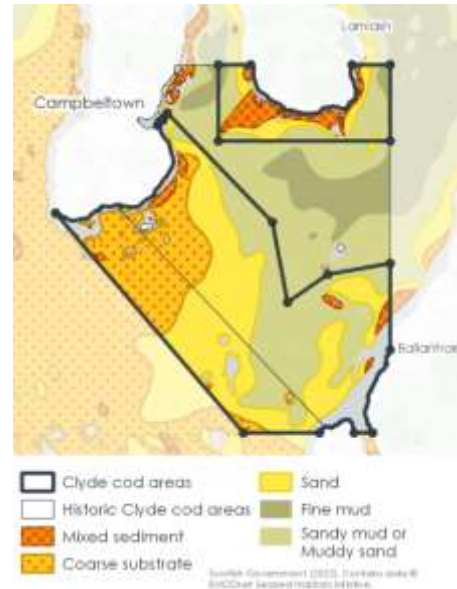


Figure 4. Proposed closed area from 2022.

Firm evidence of the distribution of spawning cod in the Clyde area is lacking. Over the past 21 years, the principal Q1 West Coast survey (IBTS) has conducted just 2-3 hauls annually in the Clyde area, catching a total of 52 spawning cod (maturity stage 3) at an average of just under 2.5 fish per year. This is insufficient information on which to base a detailed closure definition. The corresponding CFA/St Andrews surveys (2016-2018) were developmental, exploratory and not intended to be used as the basis for management action, with different methods used in different years. Occasional surveys have been undertaken in other years, but there is no time-series information of sufficient length and detail. Given this, the MSS approach was to consider existing science on the observed preferences for spawning areas used by Atlantic cod, and to use the preferred sandy or gravelly areas in the Clyde as the basis for the proposed closure. Our hypothesis was that if cod are spawning in the Clyde south of Arran, they will be doing so in the closed areas, and the risk of spawning being hindered or prevented will be reduced. We have thus followed a precautionary approach in the face of limited data.

Clyde cod represents a relatively discrete substock of the wider West of Scotland population, and shows sufficient genetic and physiological distinctiveness to suggest that it is a closed, self-sustaining population (EU 2007). Historically, the Clyde has been one of the key cod spawning areas south of the Minches, and juveniles arising from spawning in the Clyde are likely to remain within that area as adults. Seeking to improve the per capita egg production rate through a spawning closure may or may not improve the subsequent number of juveniles, as there are many sources of mortality that affect young cod, but if there are no eggs to begin with there certainly will not be any subsequent improvement to the adult population.

**Marine Scotland Science**  
**4 March 2022**

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