

How far north can juvenile cod survive winter?

Size dependent condition in young cod along a latitude gradient

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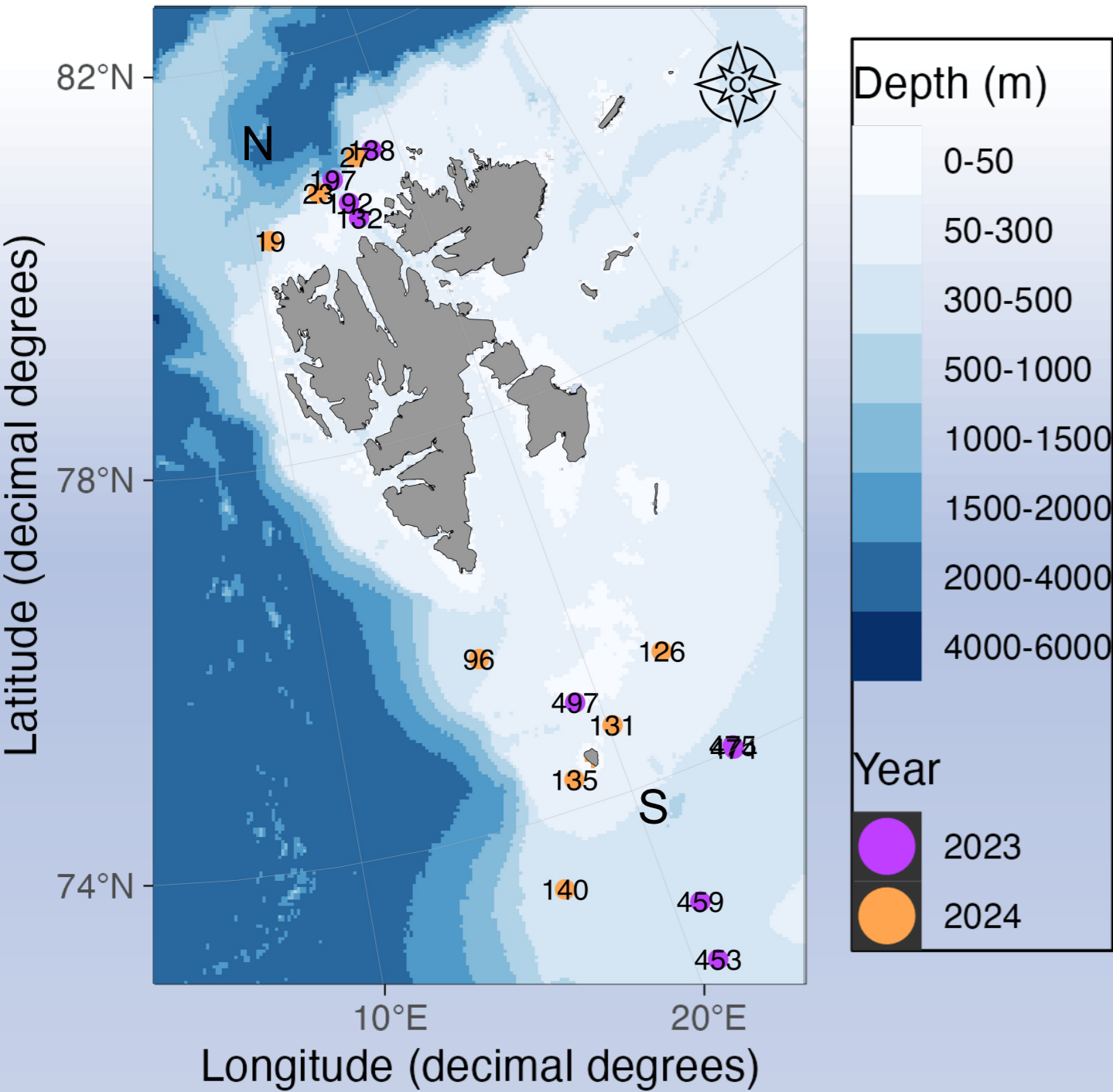


Fig. 1: Map of the Barents Sea with marked stations.

1 Surviving the first winter

Cod from the Barents Sea (*Gadus morhua*) spawn along the coast of Norway (62° N -71° N) in the spring^[1].

The survival during the first winter is critical for young cod, because the Barents Sea is cold and nutrient poor. It is therefore important that the fish have put up sufficient energy in the first summer/autumn to survive. The young cod store most of their easily accessible energy in their liver, in form of lipids ^[2].

We therefore studied liver weight to assess the potential of overwinter survival in cod and compared the stations in north (N) and south (S) from the winter survey in 2024, and autumn survey in 2023 (Fig. 1), due to the different light conditions in the winter. **Is there a difference in stored energy in cod between the north and south stations?**

2 Methods

To investigate this research question, 380 cod have been measured. For each fish we measured length and weight. Otoliths and liver were taken out and weighed (Fig. 2a-c). The weight of otoliths compared to total weight of the fish was used to determine the age of the cod. The liver were measured in wet and dry weight.

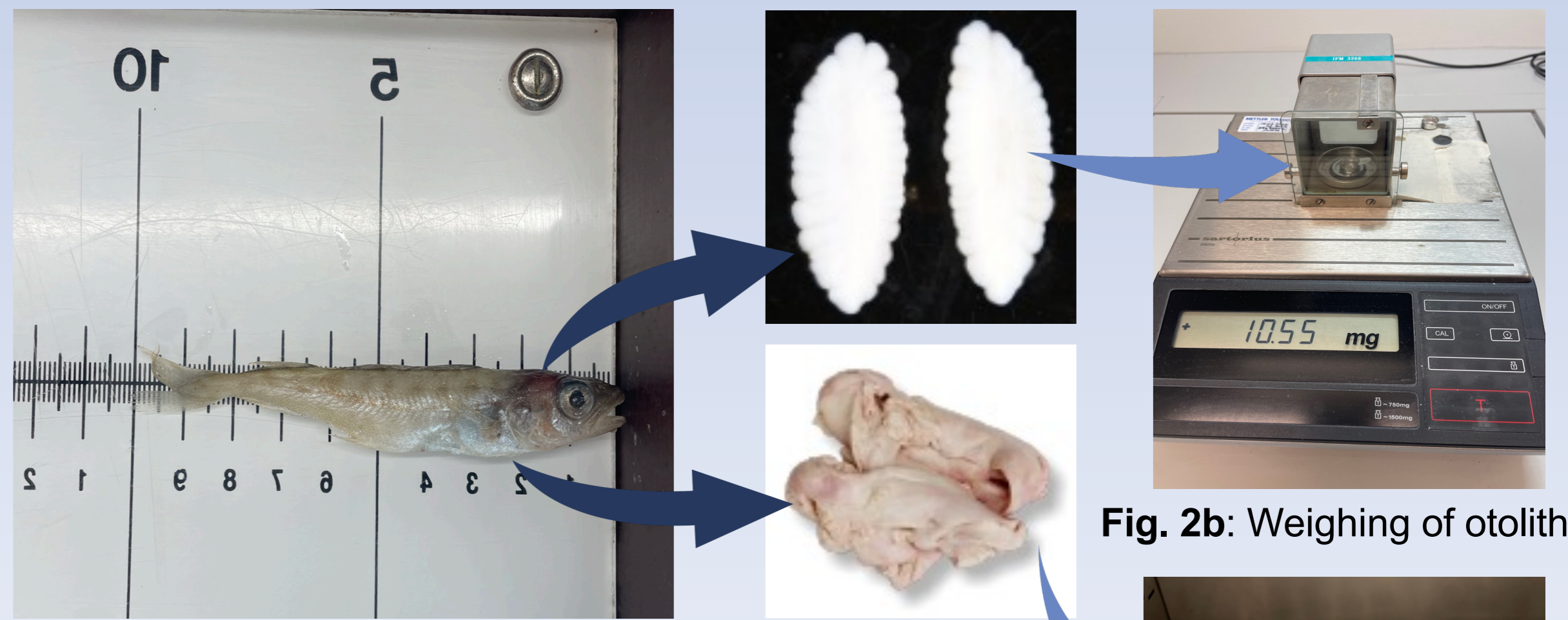


Fig. 2a: Measuring the cod, taking out the liver and otoliths.

Fig. 2b: Weighing of otoliths.

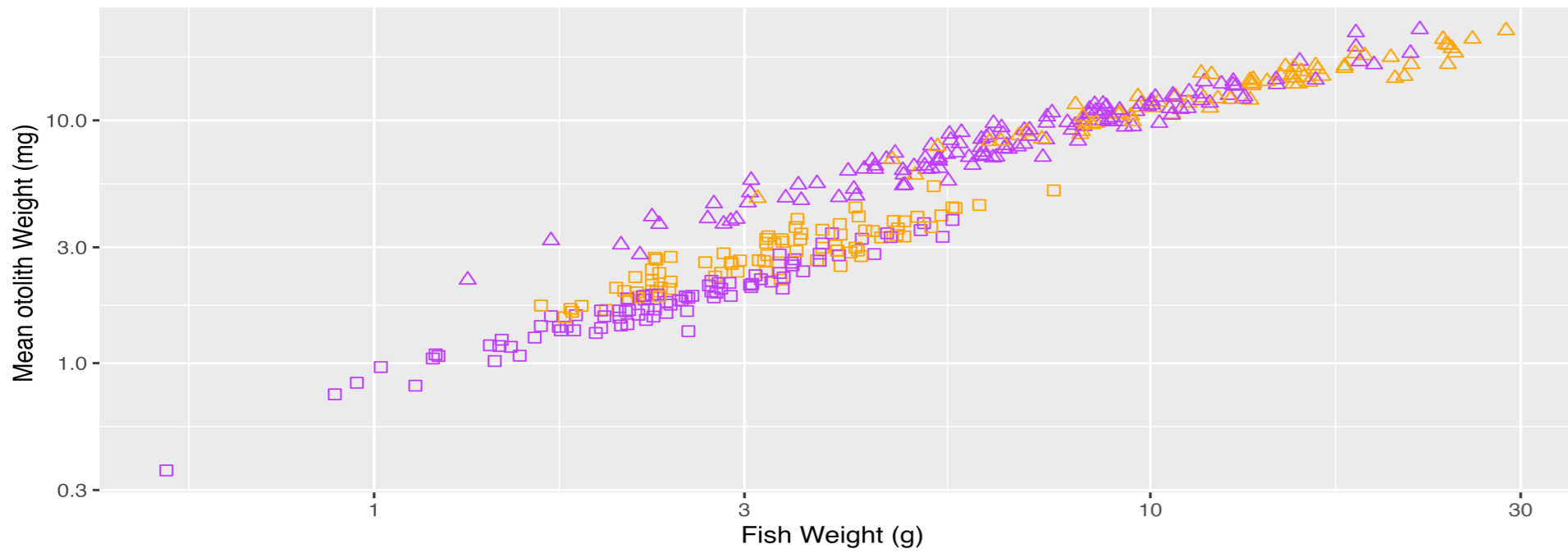


Fig. 2c: Livers drying in the oven, at 55 °C for 3 days.

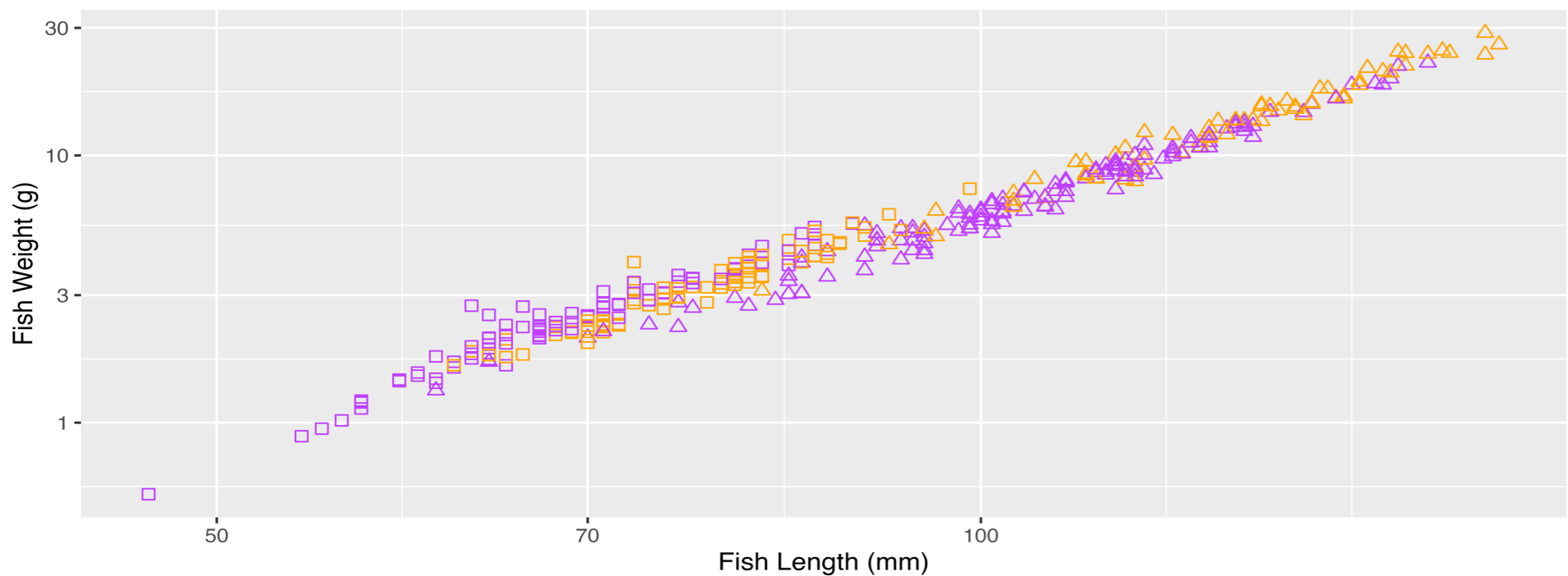
3 Results

Year	Region
□ 2023	● NORTH
△ 2024	● SOUTH

A Fish Weight versus Mean Otolith Weight



B Fish Length versus Fish Weight



C Fish Weight versus Dry Liver Weight



Fig. 3a-c: Scatterplots of the results. All axes on log scale.

4 Key points

Cod from 2023 (square) are 0 year old, and cod from 2024 (triangel) are 1 year old. Cod from north (orange) are bigger with heavier otoliths compared to south (purple) (Fig. 3a).

Cod are longer and heavier in the north compared to south for 2023 and 2024 (Fig. 3b).

Mean dry weight in the north in 2024 was 0.167 significant higher than in the south where it was 0.072 ($p < 0.0001$, Fig. 3c). Mean dry weight for 2023 was 0.051 in the north and 0.044 in the south, but the difference was not significant ($p > 0.05$).

5 Conclusion and further work: Yes there is a difference in stored energy. There is more stored energy from cod from the north stations. This may be due to individuals being older (Fig.3a) or because the water temperature was higher, but this needs further work to be determined.

Referanses: [1] Bergstad OA, Jørgesen T, Dragesund O (1987) 'Life history and ecology of the gadoid resources of the Barents Sea', Fish Res 5:119-161
 [2] Langnes, Ø., Eriksen, E. and Folkvord, A. (2023) 'Liver condition of 0 and 1-group cod (*Gadus morhua*) in the Barents Sea', Marine Biology, 171(2), p. 41.

