

**Establishment of new wintering areas in herring co-occur with peaks in recruit to spawner ratio**

Geir Huse, Anders Fernö, and Jens Christian Holst

During late summer, Norwegian spring-spawning herring migrate to wintering areas, where they remain for about five months in dense aggregations. First-time spawning cohorts typically adopt the overwintering area of the spawning stock. However, during the last 50 years the stock has occupied seven discrete wintering grounds, spanning from high seas to narrow fjords, which reveals considerable plasticity in choice of wintering area. We here show that changes in herring wintering area take place when abundant recruit cohorts appear. The ratio in abundance between four year olds and five year and older herring is on average 14:1 in the years when changes in wintering area take place, compared with 0.3:1 in years without changes. The wintering areas vary greatly with regards to temperature and distance to the feeding and spawning grounds, features that affect energy expenditure heavily. The total migration distance of the stock has been quite stable in the last 15 years, but in the preceding period the stock had a shorter total migration distance. Rather than being strictly optimized, the establishment of wintering areas seems to be governed by general school cohesion mechanisms with the transmission of learned migration routes disrupted if the first-time spawners are too numerous.

Keywords: herring, migration, wintering.

Contact author: Geir Huse, 1Institute of Marine Research, Box 1870 Nordnes, N-5817 Bergen, Norway [e-mail [geir.huse@imr.no](mailto:geir.huse@imr.no)].