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A new maximum age observed within the family Labridae, ballan wrasse *Labrus bergylta*

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Abstract

Ballan wrasse *Labrus bergylta* is the largest species of wrasse inhabiting European waters and one of the longest-living species within the family Labridae. A large specimen was caught off the coast of Skjerjehamn, western Norway (total length = 410 mm; weight = 1274 g). The age of the specimen was determined to be 34 years old based on the analysis of its opercula bones. This specimen establishes a new maximum age for ballan wrasse, 5 years older than the previously observed maximum age.

KEYWORDS
ballan wrasse, *Labrus bergylta*, life history, longevity, maximum age, opercula

Ballan wrasse *Labrus bergylta* Ascanius 1767 is the largest species of wrasse (family: Labridae) inhabiting European waters, with a maximum observed length of 660 mm (Villegas-Ríos et al., 2021). Ballan wrasse also have the greatest longevity of European Labrids, with a maximum observed age of 29 years, as determined for a male specimen caught on the Isle of Man (Dipper et al., 1977). This species is a protogynous sequential hermaphrodite, of which the oldest observed female was 25 years (Dipper et al., 1977). In northern Europe, ballan wrasse are a relatively newly commercially exploited species after the introduction of wrasse as cleaner fish on salmonid farms (Bjordal, 1988). More than 1 million wild ballan wrasse were landed annually in Norway between 2013 and 2016 (Blanco Gonzalez & de Boer, 2017). Prior to this, ballan wrasse have been exploited as lobster bait in some parts of Norway; however, the extent of this fishery is unknown due to it being poorly documented within the literature. Ballan wrasse are considered to be vulnerable to overexploitation due to their life-history strategy as a protogynous sequential hermaphrodite, where populations have naturally female-skewed sex ratios. Fishery-independent research has estimated that males, who provide obligate parental care, make up as little as 8%–12% of the population (Dipper et al., 1977; Mucientes et al., 2019; Quignard, 1966). To our knowledge, a quantitative stock assessment has not been performed for any population of ballan wrasse in northern Europe to date. Therefore, fisheries managers rely on valid life-history information to implement appropriate management strategies. As a measure to avoid depletion of males and age- and size-truncation in exploited ballan wrasse populations, a slot size limit, with a minimum landing size of 22 cm and a maximum landing size of 28 cm, was recently implemented in Norway (pre-2022 season). Slot size limits have also been implemented for wrasse species in Sweden, Scotland, and some of the fishing districts in England (Halvorsen et al., 2021).

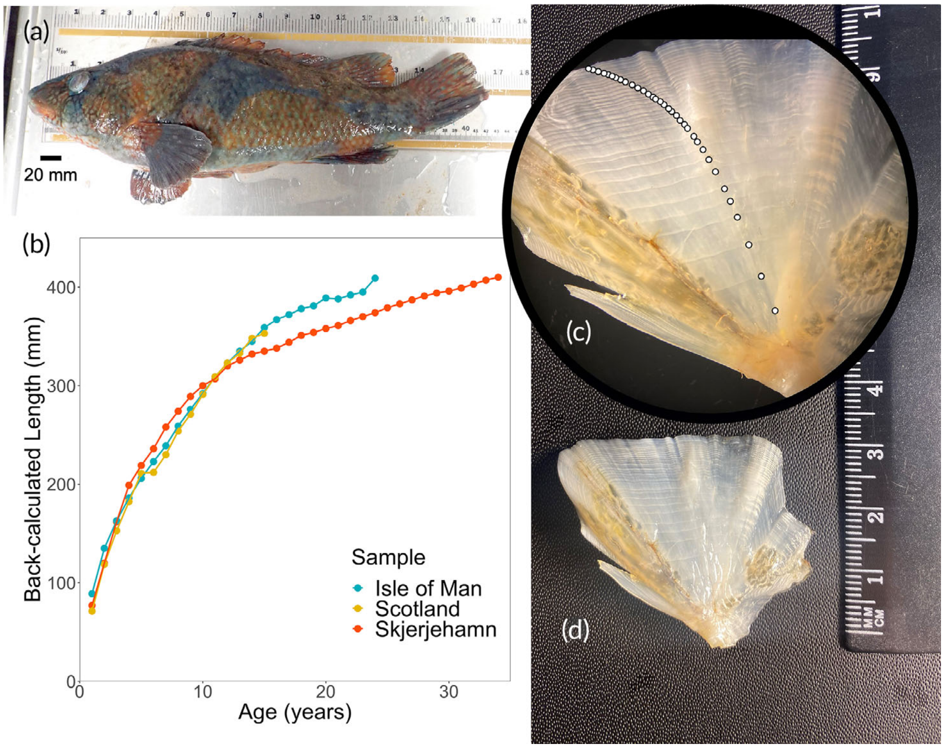

FIGURE 1 (a) Whole specimen; (b) backcalculated length-at-age; (c) magnified opercula, including marks on the annuli used to age the sample; and (d) unmagnified opercula.

A large specimen was caught in a scientific survey by gillnet in Skjerjehamn, Norway (60.9515° N, 4.966° E; depth between 3 and 30 m), on October 25, 2021 (Figure 1a; Otterå et al., 2024). The specimen was determined to be an intermediate morphotype, neither plain nor spotted, using Seljestad et al. (2020) as a guide. The specimen was frozen and processed at a later date. The specimen measured 410 mm (total length, accuracy = 1 mm) and weighed 1274 g (accuracy = 1 g). The sex of the specimen was identified as male through macroscopic inspection of the gonads. Age was determined by reading the number of annuli present within the opercula bones. Studies on the age and growth of marine fish have mainly used otoliths for age determination and, in some cases, scales. However, the opercula bone has been used previously in fishes, such as perch *Perca fluviatilis*, where scales and otoliths were less clear and reliable, reported for the first time by Nilsson (1921). Ballan wrasse otoliths are very small and often unclear, so opercula bones have been commonly used for age determination as described by Dipper et al. (1977). Both opercula bones were extracted, immersed in boiled water for 10 min, and wiped clean. Opercula were coated in a thin layer of oil and photographed using a microscope under reflected light. We assumed the birth date to be May 1 as described by Dipper et al. (1977). As the specimen was captured in October, the opercula edge was considered to be plus-growth instead of a further annulus. Length-at-age was backcalculated using the equation:

$$L_i - a = \left(\frac{R_i}{R}\right)(L_C - a)$$

where L_i is length at age, i; R_i is the radius of annulus, i; R is the radius of the opercula; L_C is the length at capture; and a is a correction factor obtained as the intercept from a regression of fish length with opercula radius. This is a modification of the direct proportionality formula used by Lee (1912) to correct for allometric growth and to account for opercula size at age zero (32.5 mm; Dipper et al., 1977). The age of the specimen was estimated as 34 years, based on readings of both opercula bones by three independent analysts (C.P., J.T., and M.S.). Backcalculated length-at-age for the Skjerjehamn specimen is shown in Figure 1b with comparison to ballan wrasse from the Isle of Man (Dipper et al., 1977) and Scotland (Treasurer, 1994).

Backcalculated lengths-at-age suggest that the first annulus was correctly identified as L_1 and is highly comparable with age-1 fish from Scotland and the Isle of Man. All ballan wrasse show a similar growth pattern up to 13 years, after which the Skjerjehamn specimen achieves a smaller length-at-age. The Skjerjehamn specimen is 20 mm shorter than that of the previous oldest observed ballan wrasse, despite being 5 years older (Dipper et al., 1977). Plain morphotype individuals have been documented to have slower growth rates and attain smaller sizes-at-age than spotted morphotype individuals (Villegas-Ríos et al., 2013), though Dipper et al. did not document the morphotype of their specimen. Whether growth rates and longevity differ among plain, intermediate, and spotty ballan wrasse in Scandinavian populations has not yet been investigated, but a recent study did not detect any genetic differences among morphotypes in Scandinavia, whereas they are clearly different in the Spanish population (Seljestad et al., 2020).

The time elapsed between the previously reported maximum age and the present paper, 47 years, initially suggests that the former was a valid representation of maximum age for this species. However, we argue that the new maximum age presented in this paper, 34 years, may remain to be an underestimate of this species' longevity as wrasse are rarely sampled and aged outside of the fishery. The live wrasse fishery directly targets the younger demographic of ballan wrasse through the use of size-selective fishing gears and in compliance with maximum landing sizes (Halvorsen et al., 2019). Targeting the youngest demographic of ballan wrasse may also be indirect as the live wrasse fishery is generally restricted to shallow water to reduce the risk of barotrauma, but research suggests that larger ballan wrasse occupy deeper depths (Halvorsen et al., 2020). Therefore, fishery-dependent surveys are biased toward sampling young fish. Although the absence of interactions between large fish and the fishery is a positive indicator for the sustainability of this fishery, the absence of large specimens available for scientific research propagates ballan wrasse as a data-limited species. Therefore, future surveys should operate independent of the live wrasse fishery to sample the entire demographic of ballan wrasse and establish a valid representation of their population dynamics (e.g., growth rates, mortality rates, and recruitment). However, caution should be taken to ensure that sampling of old males is kept to a minimum to preserve natural sex ratios. Although anecdotal, this observation may indicate a healthy ballan wrasse population on the coast of Skjerjehamn due to the lack of age truncation. The maximum age presented in this paper contributes to a greater understanding on the longevity of ballan wrasse and updates the life-history information available for this species. This finding is particularly important within the context of fisheries management, as sampling the eldest demographic is crucial for producing valid and representative growth models and estimating natural mortality rates.

AUTHOR CONTRIBUTIONS

Kim T. Halvorsen and Anne B. Skiftesvik arranged the sampling. Calum J. Pritchard and Marthe M. R. Stendal performed the dissection. Marthe M. R. Stendal prepared the opercula for aging. Calum J. Pritchard, Jim Treasurer, and Marthe M. R. Stendal examined the opercula and determined age. Calum J. Pritchard wrote the manuscript. All the authors contributed to improving the initial draft.

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