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# *Assessment, causes and consequences of short opercula in laboratory-reared Atlantic salmon (*Salmo salar*)*

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## Abstract

*Opercular deformity is a common morphological abnormality of laboratory and other cultured fishes, observed in a wide variety of species but with an unclear aetiology. Following observations of short opercula in stocks of Atlantic salmon (*Salmo salar*) reared in our laboratory, we developed a photographic key to score individual fish on a scale of 1 to 5. Inter-rater reliability was assessed as 'almost perfect'. This visual method is quick and simple to use, can be used to score live fish* in situ *in tanks as well as sampled fish, does not require sophisticated equipment and provides quantitative information to investigate the aetiology of short opercula. Opercular size was scored for a cohort of in-house reared Atlantic salmon, in a time series of random samples of ≥ 30 fish (mean weights ranging from 0.8 to 299 g) over 14 months. Short opercula were first recorded during the parr stage, prevalence and severity increased as the fish grew, and the deformity was asymmetrical, occurring predominantly on the left side. Therefore, among the many potential causal factors, nipping is suggested as the primary cause of short opercula within our culture system, with asymmetry due to the clockwise current. We also present evidence that short opercula are associated with gill damage which supports this deformity being a welfare issue that merits assessment.*

**Keywords**: *animal welfare, Atlantic salmon, fish welfare, opercular damage, welfare assessment, welfare indicator*