



## **Non-lethal hypoxia reduces growth rate in fish due to a narrowing of their metabolic scope: demonstration with Atlantic cod, common wolffish and sole**

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Even though the most acute effects of hypoxia (massive mortality, change in distribution, reduction in diversity, etc.) attract more attention, sub-lethal effects can be significant as well for the productivity of marine species. Here we compare three fish species that differ vastly in their natural history and ecology, the Atlantic cod (*Gadus morhua*), common wolffish (*Anarhichas lupus*) and sole (*Solea solea*). Lethal threshold is 28% oxygen saturation for cod (LC<sub>05</sub>-96h) whereas that of wolffish and sole is estimated to be around 22 and 20%, respectively. Growth of all three species was limited by oxygen between their lethal threshold and an upper threshold of 70% (cod), 80% (wolffish) and 30% (sole). Food consumption in graded hypoxia was measured for cod and wolffish and was found to be proportional to dissolved oxygen. In fact food ingestion explained > 97% of the variability in growth due to hypoxia for these two species. Monitoring the kinetics of the post-prandial increase in oxygen demand (SDA) in sole showed for same size meals, SDA had a lower amplitude but a longer duration in hypoxia than in normoxia. We propose that hypoxia reduces metabolic scope, which limits the amplitude of SDA and lengthens its duration. This results in slower digestion and reduced food consumption and, ultimately, slower growth.