Systemic mycoses in lumpfish (*Cyclopterus lumpus* L.) in Ireland: aetiology and clinical presentation

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Abstract

Systemic infections with predominantly *Exophiala* species have emerged as regular and significant pathogens of lumpfish in Ireland and abroad. *Exophiala* is a genus of melanised fungi in the order *Chaetothyriales*. They are regularly found as opportunistic pathogens of cold blooded vertebrates and several species have caused high mortalities in aquaculture. In 2016 and 2017, *E. angulospora*, *E. psychrophila, E. salmonis* and a *Cyphellophora* sp. were identified as the causes of phaeohyphomycosis in lumpfish in Ireland, as confirmed through clinical presentation, histopathology, wet mounts, fungal culture, sequencing of the ITS region and phylogenetic analysis. Systemic pathology was severe, characterised by segmented, pigmented hyphae in the host tissues associated with severe necrosis and inflammation. Significant chronic mortality in lumpfish broodstock in Ireland was attributed to *E. angulospora* and *E. psychrophila*. *E. angulospora* was also isolated from cases with multiple infectious aetiologies. *E. salmonis* and a *Chyphellophora* sp. were diagnosed in lumpfish at sea. This is the first record of *E. salmonis* in lumpfish.

Introduction

Lumpfish (*Cyclopterus lumpus*) are widely used as cleaner fish for the biological control for sea lice (*Lepeophtheirus salmonis*) on Atlantic salmon (*Salmo salar*) farms in Ireland and other northern European countries (Bolton-Warberg, 2017). Cleaner fish use has increased exponentially since 2008 and an estimated 50 million individuals, predominantly hatchery reared lumpfish, will be required by 2020 (Powell et al., 2017). High mortalities are currently a threat to the efficacy and the sustainable use of lumpfish, with infectious diseases being a significant cause of mortality. Known fungal pathogens of lumpfish include the microsporidian species *Nucleospora cyclopteri* (Freeman et al., 2013; Alarcón et al., 2015) and *Tetramicra brevifilum* (Scholz et al., 2016). Suspicion of *Ichthyophonus hoferii* infection has also been reported (NVI, 2015). Several cases of phaeohyphomycosis, a collective term for infections with dematiaceous fungi, have

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