Ichthyophonus prevalence in Pacific halibut – a pilot study

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Abstract

In 2011 the IPHC and USGS Marrowstone Marine Field Station conducted a pilot survey to determine prevalence of the parasite *Ichthyophonus* in Pacific halibut sourced from three geographically disparate areas. *Ichthyophonus* was detected in 26.6, 33.8, and 76.7% of halibut sampled from the northern Bering Sea, Oregon coast, and Prince William Sound, respectively. Prevalence in Prince William Sound is the highest reported for any northeast Pacific marine fish species, and is indicative of an epizootic. It is not clear if these infection patterns are unusual, or what effect if any *Ichthyophonus* may be having on Pacific halibut population (mortality) or growth dynamics.

Introduction

Ichthyophonus[1] is a cosmopolitan, parasite of the class Mesomycetozoea, that displays low host specificity and has been isolated from over 80 fish species worldwide (McVicar 1999, Mendoza et al. 2002). It is an internal histozoic parasite that can be found in all visceral organs and the musculature of infected hosts. Effects of infection vary greatly among individuals and host species. The most profound disease effects have probably occurred in Atlantic herring (*Clupea harengus*) stocks, where periodic epizootics resulting in massive fish kills have been reported since early in the 20th century (Cox 1916, Fish 1934). Through the last decade epizoootics have occurred in the northeastern Atlantic (Kramer-Schadt et al. 2010) and one occurring over the last 2 years has significantly impacted the Iceland-based herring fishery (Gudmundur Oskarsson, Marine Research Institure, Iceland, personal communications).

The first description of *Ichthyophonus* in the northeast Pacific occurred in 1986 (Olson 1986) and subsequently the reported host range has expanded dramatically. It is ubiquitous in Pacific herring (*Clupea pallasii*) stocks south of the Bering Sea and is believed to exhibit population limiting effects in Prince William Sound (Marty et al. 1998) and Puget Sound (Hershberger et al. 2002). Chinook salmon (*Onchorychus tshawytscha*) stocks in the Yukon River have also been affected with significant pre-spawn mortality occurring during a recent epizootic (Kocan et al. 2004).

As part of a North Pacific Research Board (NPRB) funded project surveying novel species for the presence of *Ichthyophonus*, the United States Geological Survey (USGS) and Alaska Department of Fish and Game (ADF&G) collected tissue samples from sport-caught halibut on

[1]Phenotypic (Hershberger et al. 2008) and genotypic (Criscione et al. 2002, Rasmussen et al. 2010) differences have been identified among isolations of *Ichthyophonus hoferi* from the northeastern Pacific, suggesting that there are multiple sympatric species in the region. Due to this taxonomic uncertainty, here we refer to parasite by its generic name.

the Kenai Peninsula. Prevalence (the percent of the population that is infected at any given time.) of the parasite was 50% in these samples. In response to the initial reports from the USGS/ADF&G survey, the IPHC contacted Jacob Gregg of the USGS for more information, and a pilot survey was mobilized onto the 2011 IPHC longline survey.

Methods

Three target charter regions were identified to collect samples from survey operations: Oregon, Prince William Sound (PWS), and the 4D Edge portion of the Bering Sea (Fig. 1). These areas would provide large spatial coverage as well as overlap an area of interest (PWS) with known herring prevalence. As this was an early phase study, samples were not randomly collected, but rather were geographically targeted. Sixty to sixty-five halibut were sampled on each of three vessels. Heart tissue was sampled for parasite culture; length, sex, and collection location were recorded; and otoliths were obtained from all sampled fish (this required additional otolith collections in PWS)

Heart tissue from sampled halibut was cultured in Eagle's Minimum Essential Medium, buffered to pH 7.8 with Tris, and supplemented with fetal bovine serum (5% v/v), penicillin (100 IU ml^{-1}), streptomycin (100 IU ml^{-1}), and gentamycin (100 IU ml^{-1}). Cultures were initiated onboard vessels and kept on ice until they could be shipped to USGS Marrowstone Marine Field Stations. After 14 d incubation at 15°C cultures were examined microscopically for the presence of *Ichthyophonus* schizonts and/or pseudo-hyphae.

Results

Ichthyophonus was detected in 26.6, 33.8, and 76.7% of Pacific halibut sampled from the northern Bering Sea, Oregon coast, and Prince William Sound, respectively (Table 1). These prevalences are higher than those detected in several other species in the Bering Sea and Cook Inlet in 2011 (USGS, unpublished data). The PWS sampling was focused inside Prince William Sound proper, and did not sample fish from outside of Montague and Hinchinbrook Islands (Fig. 1).

Prevalence in females was slightly higher than males (Table 2), but this may be solely a function of the gear being more selective for larger females, as females comprised a larger share of the samples.

No obvious patterns of prevalence in relation to size or age were seen in this pilot (Figures 2, 3). Limited sampling across age groups precluded any formal analysis of infection demographics. Similarly, graphing analysis by geographical area showed no obvious size or age trends in the prevalence rates.

Discussion

Pacific halibut have a high prevalence of *Ichthyophonus* infection throughout their range. Comparable testing in rockfish species in the North Pacific have shown mean prevalence ranging from 10% in Puget Sound (Halos et al. 2005) to as high as 51% offshore of Oregon, Washington, and British Columbia (Kent et al. 2001). The PWS prevalence we detected is higher than any reported for marine fish in the northeast Pacific, and should be considered an epizootic.

It is important to note that we have no historical data on *Ichthyophonus* infection in Pacific halibut and do not know if *Ichthyophonus* is a new or long-term parasite to halibut. Additionally, we do not know what effect if any *Ichthyophonus* may be having on the health of individual Pacific halibut, and on population (mortality) or growth dynamics. In other species *Ichthyophonus* can

cause mortality (Kocan et al. 1999, Kocan et al. 2004) reduce swimming performance (Kocan et al. 2006) and can affect energy consumption and growth (Vollenweider et al. 2011).

Further studies aimed at expanding our understanding of the spatial prevalence and the age/size prevalence in *Ichthyophonus*are planned for 2012. Intensive lab studies investigating how *Ichthyophonus* infection affects growth and mortality are contemplated for future years.

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Table 1. Prevalence of *Ichthyophonus* infections in Pacific halibut by geographic region.

Geographic region	Number of Positive Samples	Total Number of Samples	Percent
Bering Sea	17	65	26.2%
PWS	46	60	76.7%
OR Coast	22	65	33.8%
Grand Total	85	190	44.7%

Table 2. Prevalence of *Ichthyophonus* infections in Pacific halibut by gender.

Gender	Number of Positive Samples	Total Number of Samples	Percent
Female	68	141	48.2%
Male	17	80	35.4%
Unknown	0	1	0.0%
Grand Total	85	190	44.7%

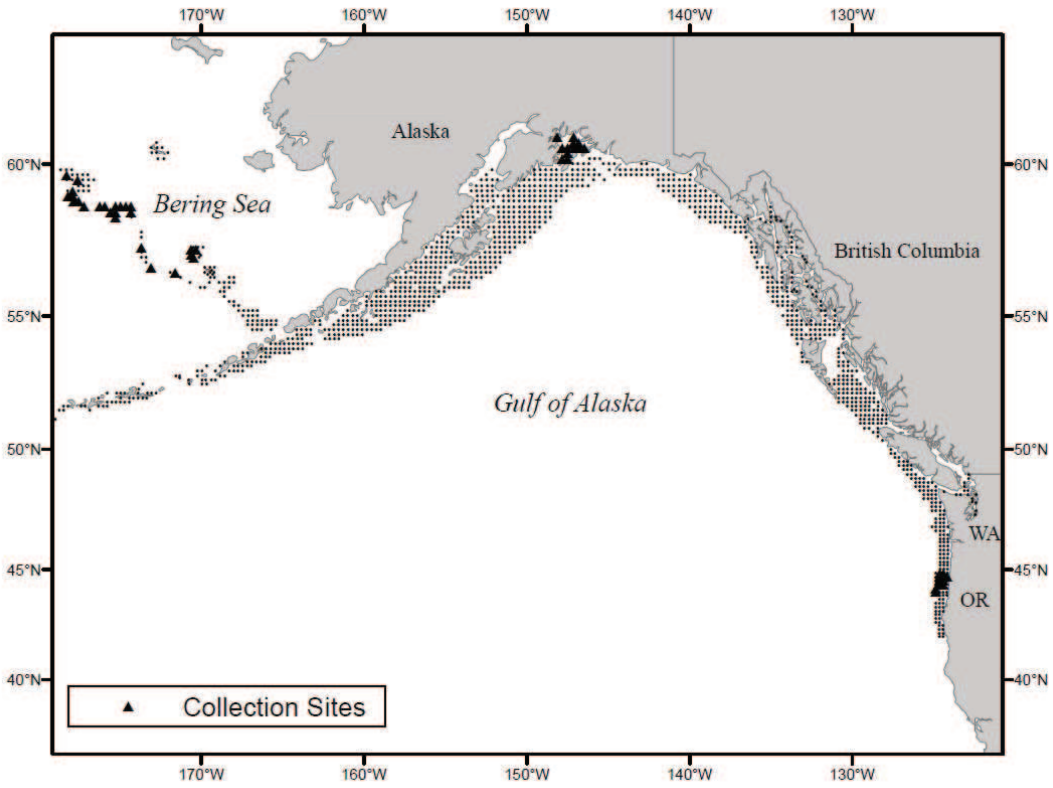

Figure 1. Map of *Ichthyophonus* sampling sites.

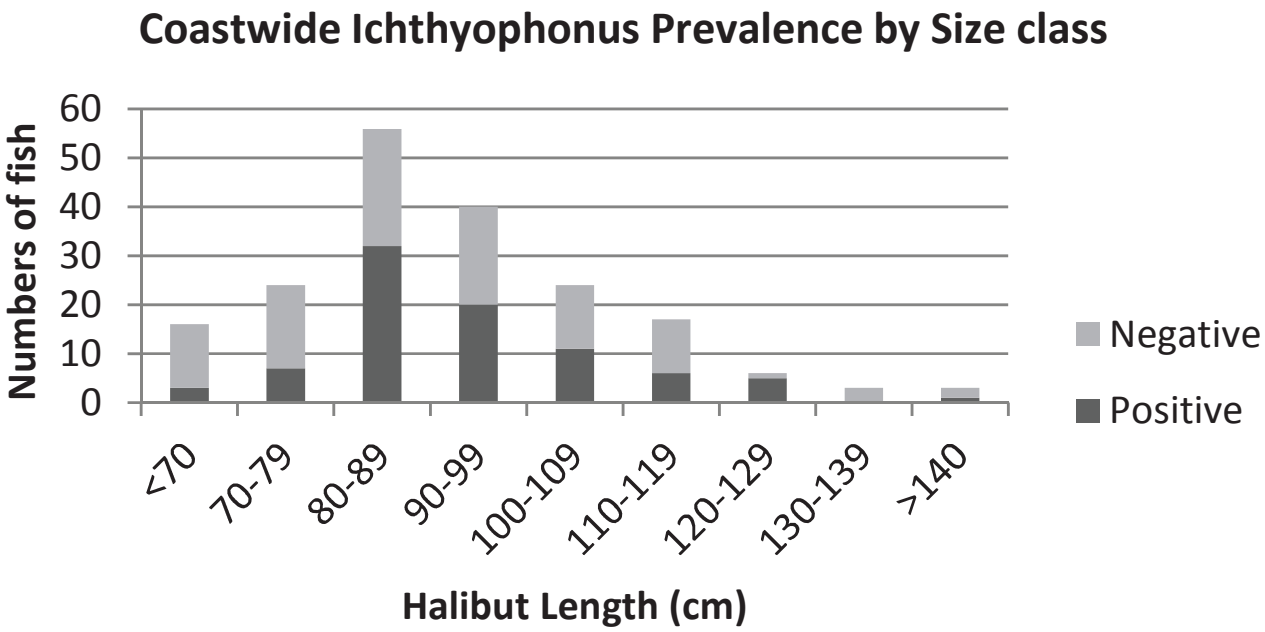

Figure 2. Coastwide *Ichthyophonus* prevalence by size class from 2011 IPHC pilot study.

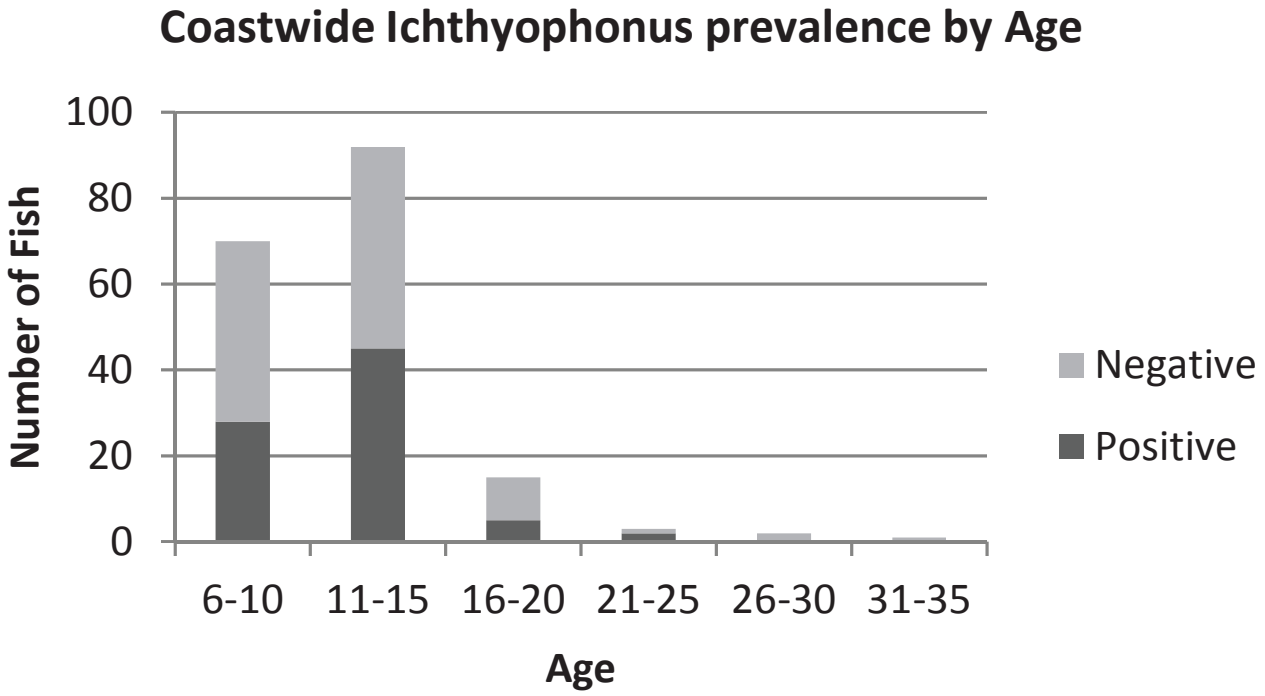

Figure 3. Coastwide *Ichthyophonus* prevalence by age class from 2011 IPHC pilot study.