Anybody who has fished has probably encountered a fish with black spots on its body. It is common among freshwater fish like trout, suckers, chub, dace and other species. But what exactly are these black spots? Commonly referred as black spot disease, black spot, black grub or neascus – the black spots appear on fish that have a parasitic infestation from either a *Uvulifer ambloplitis* or *Neascus pyriformis* trematode, or parasitic flatworm.

Are fish infected with black spot safe to eat? The answer is simply yes. The larvae are unable to survive in humans. Eating these fish is not a human health concern and freezing or cooking the fish will kill the larvae. Does black spot kill fish? Research shows for the most part black spot does not harm the fish. However, there are some reports that fish which are heavily infected with black spot may not be as strong. "In rare cases, large numbers of cysts form in the tissues over they eyes and this can lead to blindness" ("Black Spot in Fishes in Alberta"). In a short literature review, we were able to find three contemporary peer reviewed articles in which black spot is **not** referred to as a disease. Often in biology, common names are given to things we do not understand, because of limited knowledge at the time of "discovery." For example, killer whales are not whales, but dolphins; the American buffalo is not a buffalo, but a bison; and the horny-toad is not a toad or an even amphibian, but a lizard. Over time, the scientific community changes the names of some organisms, but often the original names persist. Unfortunately, the world of parasitology doesn't get the attention that would merit a renaming campaign – so we are stuck with black spot disease.

Like most trematodes, the two mentioned above have a complicated life history that involves three host species: fish-eating birds, snails and fish – with fish-eating birds as the definitive host organism where the trematode reaches maturity. The cycle starts when the trematode produces eggs inside the intestines of fish-eating birds, which can then be released (via feces) into water bodies. Then, the eggs hatch and become free-swimming larvae (miracidia) and have to find their next host, snails. Once inside the snails, the larvae go into asexual reproduction and clone themselves to produce cercaria, which are the infective parasite. The cercarial larvae emerge from the snail in search (via swimming, however not strongly) for their next host, a fish. The cercarial larvae then infect fish with cysts (metacercariae) directly under the skin of the fish. The immune system of the fish produces a wall, which surrounds the cyst with black pigmented melanin that prevents the organism from advancing further into the fish. Finally, a fish-eating bird eats an infected fish and the cycle begins anew.

Black spot is not new to the Columbia River basin. It has been observed in bull trout at the Pelton Adult Trap and in Shitike Creek since before the Selective Water Withdrawal (SWW) tower was operational. Black spot can also be found in Canada and across other areas of the United States. Black spot has been in the Deschutes River for a very long time. How long? In talking with tribal members and tribal biologists, it was seen long before the completion of the SWW. It is not a new parasite in the Deschutes River. According to ODFW Pathologist Rick Stocking, if a river has snails, fish and fish-eating birds, it will have a trematode that can cause black spot.

A recent blog post stated:

> "This summer, many have observed decreases in fish-eating birds in the lowest forty miles of the Deschutes. Kingfishers are rarely seen now in that reach of river (they were previously seen in pairs occupying nearly every reach of the river), and merganser populations in the lower forty miles have declined. Are these birds becoming infected with neascus and dying?"

This hypothesis is only a guess at best. While we don't discount other people's anecdotal observations of seeing fewer birds, there are multiple alternative hypotheses that can be developed from such observations. For example, with this past year's wet winter, an alternative hypothesis is that birds in the region were able to disperse widely and take advantage of plentiful water and prey elsewhere, giving the appearance of a die off. Another hypothesis is that given the wet and cold winter and spring, many bird populations could have experienced a local population collapse. The bottom line is, anecdotal observations should be taken in context.

They may be important tools to guide our ongoing scientific efforts, but they should not be used to make definitive conclusions. Lastly, it should be noted the size of trout generally targeted by fishermen are in the range of eight to 20 inches, which are presumably more likely to be infected with black spot. However, kingfishers are 13 inches tall and can only consume fish in a size range of three to four inches (Csuti et al. 1997). Cairns et al. (2005) reports that juvenile Coho less than 60 millimeters (approximately 2.5 inches) tend to have a lower prevalence of black spot infestation, due presumably to smaller surface area for free-swimming cercarial larvae to target.

One of the papers cited by this blog states, “the relationship between snail density, water temperature and infection rate must be cautiously interpreted due to a lack of continuous data on snail densities.” Fish that inhabit areas with high snail densities, which are primarily slow-water areas, have a higher exposure to black spot and chance of being infected. Data also suggests that certain species that inhabit slower waters were more likely to be infected than species that prefer faster water.

The key snail genera in the Deschutes River are the *Fluminicola, Vorticifex* and maybe *Juga* and *Physa/Physella*. Their densities in the lower Deschutes are highest just below the Re-regulating Dam – and less so farther downstream – so one would expect black spot to be more prevalent below the Re-regulating Dam. However, observations at the Pelton Trap have not led personnel to believe black spot below the Re-Regulating Dam is increasing. Currently, PGE and the Confederated Tribes of Warm Springs Reservation are awaiting the results of a comprehensive macroinvertebrate study of the lower Deschutes River that will help confirm snail densities. In the 2016 macroinvertebrate report, there was no statistically significant increase in gastropod densities. However, a new report available in late 2017 has separated the gastropods by species to look at increases in densities of individual species.

The claim that returning to cooler water temperatures and less nutrient loading would likely reduce black spot is unproven. We found several articles relating to climate change and increases in black spot larvae emergence in snails. This link, http://i.imgur.com/xZEYqOo.png, will take you to a site with a thermal map for all Oregon streams – which shows the Deschutes River temperatures are warmer farther downstream near the mouth. Historical records at Moody gauge show that in 1977 – 1981 – with water withdrawal from deep, cold water at Round Butte – there were days (nine to 14) when the Deschutes River at Moody was over 21.1° - 23.2°C.

Late afternoon water temperatures in the lower Deschutes near where it enters the Columbia are a product of hot air temperatures and a high sun angle directly warming the river. The sun angle is highest at noon on June 21. A high sun angle is not blocked by the canyon rim much of the day and shines on the river more directly, allowing more of the sun’s energy to penetrate the water surface to warm the stream bed instead of being reflected. This summer, Central Oregon, like most of the nation, is experiencing more hot days than normal. Hot days in July have resulted in more 70°F afternoon water temperatures than normal at the Moody gauge. However, the days are now getting shorter and the sun angle lower. “Even if the air temperature is hot, after August 15, the maximum daily river temperatures are normally cooler.” (Don Ratliff, retired PGE Biologist and Lori Campbell, PGE Water Quality Specialist). We are suggesting that climate change could be playing a more important role in the natural warming of the lower Deschutes River than any one source.

Black spot can be cyclical given that environmental conditions are a potentially strong driver in regulating larval abundance. The possibility of dry, warmer summers, mild winters and the drought conditions over the last few years may promote an increase in black spot. This year, 2017, could be a year with high black spot infestation. That said, fisheries managers across Canada and the United States have yet to sound an alarm on the occurrence of black spot. A great example of cyclical impacts would be the size of kokanee in Lake Billy Chinook during a given year. During years of a large population, kokanee in the reservoir tend to be smaller. The food base is less able to support the population, therefore kokanee don’t grow as large. Inversely, during years of lower kokanee numbers, the food source becomes more abundant and kokanee are larger.

PGE and the Tribes are committed to using the best science available to guide how we make decisions about our operations for the long-term health of the Deschutes. We have a responsibility to act in a measured, careful and thoughtful manner – and we take that responsibility very seriously. It's important to us, and the community, environmental, governmental and non-governmental partners who rely on us, to bring the best information available, based on sound science, to this important work.

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