THE INTESTINAL PARASITES OF AN ASSEMBLAGE OF STREAM FISHES IN CENTRAL UTAH

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ABSTRACT.—Parasite communities of stream fish assemblages in the western United States are poorly known. We investigated the intestinal parasites of an assemblage of stream fishes in Spanish Fork River in central Utah, USA. Two species, mottled sculpin (*Cottus bairdii*) and redbelly dace (*Richardsonius balteatus*), had no observable parasites. In the other 3 species, southern leatherside chub (*Lepidomeda aliciae*), mountain sucker (*Catostomus platyrhynchus*), and longnose dace (*Rhinichthys cataractae*), we identified metacercariae of an unidentified trematode. We found adult cestodes in southern leatherside chub only. Prevalence and intensity of parasites was highest in southern leatherside chub. Reasons for differential prevalence and intensity of parasites among host fish species are unknown, but there seems to be no relationship to trophic position or habitat use in this fish community.

RESUMEN.—Conocemos poco sobre las comunidades de parásitos en los ensambles de peces de río del oeste de Estados Unidos. Estudiamos los parásitos intestinales de un ensamble de peces de río en Spanish Fork River, en el centro de Utah, Estados Unidos. *Cottus bairdii* y *Richardsonius balteatus*, no tenían parásitos observables. En las otras tres especies, *Lepidomeda aliciae*, *Catostomus platyrhynchus* y *Rhinichthys cataractae*, identificamos metacercarias relacionadas con un trematodo no identificado. Sólo encontramos céstodos adultos en *L. aliciae*. La prevalencia y la intensidad de parásitos en *L. aliciae* fueron mayores en el sur. Desconocemos los motivos de las diferencias en la prevalencia e intensidad de parásitos entre especies de peces portadoras, pero no parece haber ninguna relación con la posición trófica o el uso del hábitat de esta comunidad de peces.

Fish parasites can have potentially significant effects on the health (Hursky and Pietrock 2015), reproductive output (Moravec and Barton 2015), and behavior (Barber et al. 2000) of their hosts. However, understanding large-scale patterns of parasite infection and ecological processes that affect host-specific transmission of parasites within a community requires comparison among geographically and taxonomically diverse populations (Poulin and Forbes 2012, Heins et al. 2014, Strona 2015). Stream fishes of the western USA represent a taxonomically and geographically unique assemblage, and parasites of these fishes are not well known. Recent studies of fish parasites in western North American streams and rivers have focused on metazoan parasites in salmonids. Concern about whirling disease caused by *Myxobolus cerebralis* has prompted a significant effort directed toward detection and management of this protozoan (Kaesler et al. 2006, Koel et al. 2006, Eby et al. 2015, Fetherman et al. 2015, Murcia et al. 2015, Nehring et al. 2015). Whereas, the effort to curb whirling disease is an important management

goal for salmonid sport fishes, the consequence has been that studies on internal nonprotozoan parasites in stream fishes of the western United States have been neglected.

Community structure of parasites can vary depending on the habitat and life histories of host fish species (Weichman and Janovy 2000, Timi and Poulin 2003, Alarcos and Timi 2012, Muñoz 2014). Documenting patterns of parasite prevalence and intensity among stream fish species with different diets, habitats, and life history strategies allows us to infer mechanisms of parasite infection and parasite-host interaction (Fiorillo and Font 1996, Barger and Esch 2001, 2002, Morand et al. 2002, Hernandez et al. 2007, Pérez-del-Olmo et al. 2009). In this paper we document the intestinal parasites of an assemblage of native stream fishes in Spanish Fork River in central Utah. This report provides comparative data on parasites of an underrepresented assemblage of stream fishes.

We surveyed for intestinal parasites in 5 species of co-occurring native stream fishes from the Spanish Fork River in Utah County,

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TABLE 1. Host fish species, parasite taxa, number of parasites, prevalence (number of infected fish divided by total number of fish dissected), and intensity (number of total parasites divided by number of infected fish) in Spanish Fork River, Utah, USA. No parasites were found in mottled sculpin (*Cottus bairdii*) or reidside shiner (*Richardsonius balteatus*).

Fish species	Habitat	Diet	Parasite	Number of parasites	Prevalence	Intensity
<i>Lepidomeda aliciae</i>	Midwater	Carnivorous	Trematoda (metacercaria)	611	25.0%	47
<i>Catostomus platyrhynchus</i>	Benthic	Herbivorous	Cestoda	3	5.7%	0.2
<i>Rhinichthys cataractae</i>	Benthic	Omnivorous	Trematoda (metacercaria)	3	3.5%	3
			Trematoda (metacercaria)	3	2.5%	3

Utah (40°00'52.94"N, 111°29'50.44"W). Specifically, they are southern leatherside chub (*Lepidomeda aliciae*), reidside shiner (*Richardsonius balteatus*), and longnose dace (*Rhinichthys cataractae*)—all 3 in the family Cyprinidae; mottled sculpin (*Cottus bairdii*: Cottidae); and mountain sucker (*Catostomus platyrhynchus*: Catostomidae). Southern leatherside chub and reidside shiner are found in the midwater column in areas of slow current, and they feed on aquatic macroinvertebrates (Bell and Belk 2004, Nannini and Belk 2006, Wesner and Belk 2015). Longnose dace are benthopelagic omnivorous fishes and mottled sculpin are benthic carnivorous fishes. Both occur in habitats with faster current velocities and feed on aquatic macroinvertebrates (Sigler and Sigler 1987). Mountain sucker are benthic, mostly herbivorous fish that occur in habitats with faster current velocities. (Sigler and Sigler 1987, Wesner and Belk 2015).

We collected and dissected small samples of each species each week from mid-September to late November 2014. In total, we examined 52 southern leatherside chub, 28 mountain suckers, 40 longnose dace, 50 mottled sculpin, and 23 reidside shiner. Samples of all species included a mix of juveniles and adults. To examine fish for parasites, we split the intestinal tracts (including stomachs) and carefully examined the inside under a dissecting microscope at 10× to 20× magnification. We temporarily preserved all parasites in an alcohol-formaldehyde-acetic acid (AFA) solution, then stained them using the following process: 70% alcohol for 20 min, 30% alcohol for 15 min, water for 15 min, Mayer's stain for 5–10 min, water for 15 min, 30% alcohol for 10 min, 70% alcohol for 10 min, 90% alcohol for 5 min, 100% alcohol for 3 min, xylene for 1 min, and Canada balsam for the permanent mount (Pritchard and Kruse 1982). We identified

parasite species using the keys and descriptions in Hoffman (1999). We calculated prevalence of parasites as number of infected fish divided by total number of fish dissected, and intensity of parasites as number of total parasites divided by number of infected fish (Bush et al. 1997).

We found 2 species of parasites among all fishes examined (Table 1): a single unidentified trematode species and a single cestode species that is either *Biacetabulum* sp. or *Glaridacris* sp. However, identifying these individuals to the species level is challenging because cestodes have many similar morphological features, and genetic tests are necessary to discriminate between species. We found trematode metacercaria (Fig. 1) in southern leatherside chub, mountain suckers, and longnose dace, but no parasites were detected in mottled sculpin and reidside shiner. Prevalence and intensity of the trematode metacercaria were considerably higher in southern leatherside chub than in mountain suckers and longnose dace (Table 1). We found adults of a cestode (either *Biacetabulum* sp. or *Glaridacris* sp.) in the family Caryophyllaeidae (Fig. 2) only in southern leatherside chub.

Parasites with complex life cycles (like the 2 species we found) use trophic webs as a route of transmission between fish hosts (Tini et al. 2011, Rossiter and Sukhdeo 2014). By exploiting predator interactions in an aquatic system, parasites can evolve transmission tactics and promote host range expansion (Strona 2015). Thus, we expected to find similar parasite occurrence and prevalence in species with similar diets (i.e., southern leatherside chub and reidside shiner, or longnose dace and mottled sculpin). On the contrary, almost all parasites were found inside the digestive tracts of southern leatherside chub, and none were found in reidside shiner and mottled

Fig. 1. Trematode metacercaria removed from the intestinal tract of *Lepidomeda aliciae*. Length is 1.31 mm, indicated by black measurement line.

Fig. 2. Adult *Biacetabulum* sp. or *Glaridacris* sp. (Cestoda) removed from intestinal tract of *Lepidomeda aliciae*. Length is 6.50 mm, indicated by black measurement line.

sculpin. This pattern suggests strong host specificity rather than a general pattern of trophic transmission.

Host specificity is rare in stream fishes (Barger and Esch 2002, Vincent and Font 2003). Thus, another likely explanation for the pattern we observed is high temporal variation in parasite communities and a tendency toward stochastic dynamics (Bartha et al. 1997, Morand et al. 2002, Kennedy 2009). Under this view, parasite occurrence and prevalence are unpredictable, and associations between parasites and hosts result mostly from chance events and conditions rather than as a consequence of ecologically based assembly rules or host specificity. The low level of trematode metacercia found in mountain suckers and longnose dace is consistent with an accidental infection as predicted by stochastic models of community composition and structure (Bartha et al. 1997, Morand et al. 2002, Kennedy 2009). In contrast, the high levels of infestation in leatherside chub are likely a result of host specificity of cestodes (Calentine et al. 1970). There appear to be few general rules that govern parasite occurrence in freshwater fish assemblages (Kennedy 2009, Bellay et al. 2012). One reason may be that the environment in which these fish live is also highly variable both seasonally and within seasons (Braicovich and Timi 2010). Additional studies of parasite communities in stream fishes are required to test these hypotheses. We view this study as a baseline that will provide opportunity for comparison with future efforts.

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