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Freshwater Malacostracans in Chilean Inland Waters

PATAGONIAN INLAND WATER MALACOSTRACANS AS HOSTS FOR PARASITES

BY

CARLOS RAUQUE[1,4]) and PATRICIO DE LOS RÍOS ESCALANTE[2,3])

[1]) Laboratorio de Parasitología, INIBIOMA (CONICET-Universidad Nacional del Comahue), Quintral 1250, (8400) San Carlos de Bariloche, Río Negro, Argentina

[2]) Escuela de Ciencias Ambientales, Facultad de Recursos Naturales, Universidad Católica de Temuco, Casilla 15-D, Temuco, Chile

[3]) Núcleo de Estudios Ambientales, Universidad Católica de Temuco, Chile

ABSTRACT

The host-parasite interactions of inland water malacostracans have been poorly studied. The aim of the present study is to provide an overview of parasites recorded for these hosts and to study the ecological implications of host-parasite relations. According to the literature, these parasites have exotic or native fishes, and aquatic birds as definitive hosts. As most definitive and all intermediate hosts are endemics, the parasite species are endemics as well.

RESUMEN

Las relaciones parásito-hospedador en crustáceos malacostracos de aguas continentales han sido poco estudiadas. El objetivo del presente trabajo es realizar una revisión bibliográfica de las taxa parásitas registradas en estos hospedadores y estudiar las implicancias ecológicas de las relaciones parásito-hospedador. La literatura describe que estos parásitos tienen como hospedadores definitivos a peces, ya sea nativos o introducidos y a aves acuáticas. Dado que los hospedadores intermediaros y la mayoría de los definitivos son endémicos, las especies parásitas son marcadamente endémicas.

INTRODUCTION

The ecology of host-parasite interactions involves the life cycle relations of the parasites with their respective hosts during all of their ontogeny, especially when one or more intermediate hosts are involved before the parasite infects the definitive host (Jaksic, 2001). Parasitological studies in aquatic environments of Chile are focused on definitive hosts, mainly marine fishes (Muñoz & Olmos, 2008), whereas the inland water studies are more restricted (Olmos & Muñoz, 2006;

[4]) Corresponding author; e-mail: carlos.rauque@crub.uncoma.edu.ar

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Rauque, 2007; Hinojosa-Saez et al., 2009). Crustaceans can be host for various parasite taxa such as rickettsias, gregarines, fungi, microsporideans, ciliates, trematodes, cestodes, nematodes, rotifers, and acanthocephalans (Batten & DeGiusti, 1949; García & Camino, 1987; Dunn & Dick, 1998; Fauchier & Thomas, 2001; Latham & Poulin, 2001; Messick et al., 2004). Many inland water parasites in South America infect malacostracan crustaceans as larvae. These malacostracans are prey for native and introduced fishes and aquatic birds, mainly Anseriformes (Canevari et al., 1991; Rauque et al., 2003; Macchi et al., 2007).

If we considerate the marked endemism and the extinction risk of many malacostracans species in Patagonia (Jara et al., 2006), that can be host for parasites, we would have a parasitological microendemism scenario (Olmos & Muñoz, 2006). The aim of the present study is to provide an overview of parasite records for inland water crustaceans for Argentinean and Chilean Patagonia (38-55°S) and to study the potential ecological implications of the host-parasite relations.

CHECKLIST OF PARASITES AND THEIR CRUSTACEAN HOST REPORTED FOR PATAGONIAN INLAND WATERS

Phylum Microspora
- Class MICROSPOREA
  - Order MICROSPORIDIA
    - Family THELOHANIIDAE
      - *Thelohania* sp., host: *Hyalella patagonica* (Cunningham, 1871): Lake Los Juncos (41°03′S 71°00′W), Río Negro Province, Argentina (Rauque & Semenas, 2013).

Phylum Platyhelminthes
- Class CESTODA
  - Order CYCLOPHYLLIDEA
    - *Cyclophyllidea* spp., host: *H. patagonica*: Lake Los Juncos (41°03′S 71°00′W), Río Negro Province, Argentina (Rauque & Semenas, 2013).

Phylum Nematoda
- Class SECERNENTEA
  - Order SPIRURIDA
    - Family HEDRURIDAE
      - *Hedruris suttonae* Brugni & Viozzi, 2010, host: *H. patagonica*: Lake Moreno (41°05′S 71°19′W), Río Negro Province, Argentina (Brugni & Viozzi, 2010).

Phylum Acanthocephala
- Class PALAEACANTHOCEPHALA
  - Order ECHINORHYNCHIDA
    - Family ECHINORHYNCHIDAE
      - Subfamily ECHINORHYNCHINAE
        - *Acanthocephalus tumescens* (von Linstow, 1896), host: *H. patagonica*: Lakes Gutiérrez (41°12′S 71°26′W), Moreno (41°05′S 71°19′W), and Mascardi (44°17′S 71°38′W), Río Negro Province, Argentina (Trejo et al., 2000; Rauque et al., 2003, 2006; Rauque & Semenas, 2007, 2009, 2011; Paterson et al., 2013).

Family POMPHORHYNCHIDAE

Pomphorhynchus patagonicus Ortubay, Úbeda, Semenas & Kennedy, 1991, host: *H. patagonica*: Lake Rosario (43°15′S 71°17′W), Chubut Province, Argentina (Ortubay et al., 1989, 1991; Semenas et al., 1992; Úbeda et al., 1994).

Order POLYMORPHIDA

Family POLYMORPHIDAE

Pseudocorynosoma sp., host: *H. patagonica*: Lakes Los Juncos (41°03′S 71°00′W) and Mascardi (44°17′S 71°38′W), Río Negro Province, Argentina (Rauque & Semenas, 2007, 2009, 2011, 2013).

Phylum Platyhelminthes

Class TREMATODA

Order PLAGIORCHIIDAE

Family MICROPHALLIDAE

Maritrema patagonica Rauque, Flores & Brugni, 2013, host: *Aegla riolimayana* (Schmitt, 1942): Lake Nahuel Huapi (41°05′S 71°19′W), Río Negro Province, Argentina (Rauque et al., 2013); *Aegla* spp.: Rivers Limay (38°50′S 68°15′W and 38°50′S 68°30′W), Aluminé (38°55′S 71°10′W), and Caleufu (40°30′S 71°17′W), and Lake Rucachoroi (39°12′S 71°12′W), Neuquén Province, Argentina; Rivers Comallo (41°01′S 70°15′W) and Ñireco (41°55′S 71°10′W), Río Negro Province, Argentina (Rauque et al., 2013).

Phylum Nematoda

Class SECERNENTEA

Order ASCARIDA

Family ANISAKIDAE

Hysterothylacium sp., host: *Aegla denticulata* Nicolet, 1849: Lake Rupanco, Chile (40°29′S 72°30′W) (Torres & Jara, 1986).

The present overview is based on 15 published studies, 13 studies concern the amphipod *H. patagonica* and two the crabs *Aegla riolimayana*, and *A. denticulata* as hosts. Six parasite taxa were recorded from the amphipod *H. patagonica* and one from the crabs *Aegla riolimayana*, and *A. denticulata*, respectively. The parasite richness for this amphipod was higher than that known of other South American species; for example, in the amphipod *H. curvispina* Shoemaker, 1942 from Buenos Aires province four parasite species were recorded (García & Camino, 1987). This however, could be an effect of the larger number of parasitological studies focused in *H. patagonica* from southern Argentina. In freshwater crabs, parasite richness is lower in comparison to marine crabs (Haye & Ojeda, 1998; Alda et al., 2011). This indicates that these species do not play an important role in parasite life cycles.

On the basis of available literature, life cycles are known for the nematode *H. suttonae* and the acanthocephalans *A. tumescens*, and *P. patagonicus* (Semenas et al., 1992; Rauque, 2007; Brugni & Viozzi, 2010). In the first, the adults develop mainly in native galaxiid fishes *Galaxias maculatus* (Jenyns, 1842) and *G. platei* Steindachner, 1898, and in the two last, adults infect especially the native *Percichthys trucha* (Cuvier & Valenciennes, 1833), and the introduced rainbow trout *Oncorhynchus mykiss* (Walbaum, 1792). Both fish species are piscivorous and

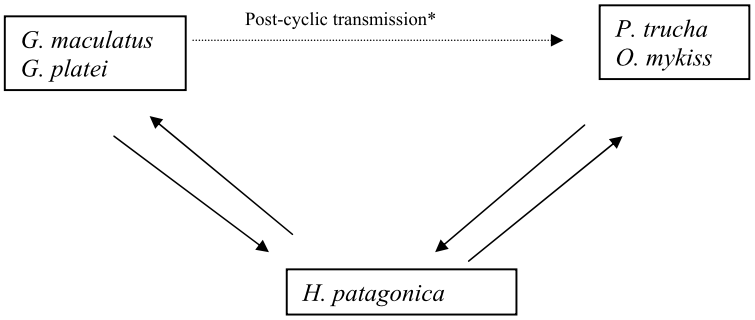

Fig. 1. Generalised life cycle of *Acanthocephalus tumescens* (von Linstow, 1896), *Hedruris suttonae* Brugni & Viozzi, 2010 and *Pomphorhynchus patagonicus* Ortubay, Úbeda, Semenas & Kennedy, 1991. *Post-cyclic transmission was only found for *A. tumescens* between *Galaxias maculatus* (Jenyns, 1842) to *Oncorhynchus mykiss* (Walbaum, 1792).

in the top of trophic webs (fig. 1). All of these host species receive parasite juvenile individuals from amphipods (*H. patagonica*) that are their prey (Semenas et al., 1992; Rauque et al., 2003). An alternative transmission route called post-cyclic transmission, involving the transit of adult parasites from prey fish (*G. maculatus*) to piscivorous fishes, has been recorded for the acanthocephalan *A. tumescens* (see Rauque et al., 2002).

If we consider the marked endemism of crustacean and fish species in Patagonia (Jara et al., 2006; Vila et al., 2006), parasitological microendemisms is most likely (Olmos & Muñoz, 2006). The introduced host species, mainly salmonid fishes, can generate alterations in this microendemisms. This involves the native acanthocephalan *A. tumescens* and the introduced cestode *Diphyllobothrium latum*. *Acanthocephalus tumescens* probably altered its reproductive cycle after the introduction of *O. mykiss*, thus this salmonid enhanced the life cycle of this parasite (Rauque et al., 2006). *Diphyllobothrium latum* is able to successfully infect several

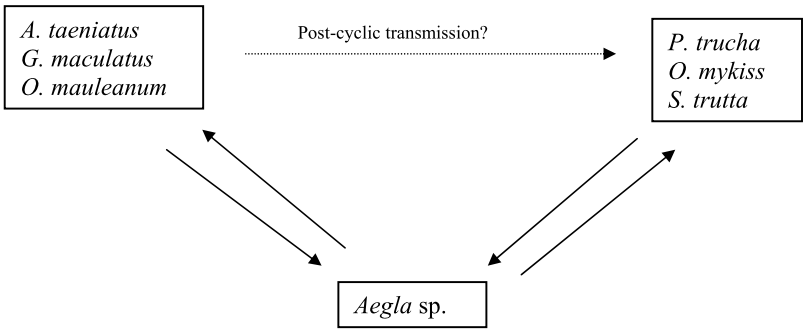

Fig. 2. Life cycle of *Hysterothylacium* spp.

native host species, coexisting and interacting with the native parasites (Ortubay et al., 1994; Semenas, 2006).

For *Hysterothylacium* spp., hosts are crustaceans of the genus *Aegla* (see Torres & Jara, 1986), native fishes such as white bait *G. maculatus*, *Aplochiton taeniatus* Jenyns, 1842, creole perch *P. trucha* (see Torres et al., 1992), Chilean silverside *Odontesthes mauleanum* (Steindachner, 1896) (see Torres et al., 1998), and the introduced rainbow trout *O. mykiss*, and brown trout *Salmo trutta* (Linnaeus, 1758) (see Torres et al., 1992) (fig. 2). It has been suggested that fishes would prey on *Aegla* (see Torres et al., 1992, 1998). Although no published information is available, post-cyclic transmission could be also possible between prey and piscivorous fish (fig. 2).

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