

# Infections by Helminth Parasites in "Puyenes", *Galaxias maculatus* (Galaxiidae, Salmoniformes), from Southern Argentina with Special Reference to *Tylodelphys barilocheensis* (Digenea, Platyhelminthes)

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*The occurrence of Tylodelphys barilocheensis, Acanthostomoides apophalliformis, Contracaecum sp. and Camallanus corderoi infecting Galaxias maculatus ("puyenes") was quantified for the first time in Lake Nahuel Huapi, southern Argentina. T. barilocheensis was recorded in this lake for the first time. The role of G. maculatus population in transmission of parasites to the salmonids is more important for Contracaecum sp. (prevalence 14-34%) and A. apophalliformis (prevalence 30-54%) than for C. corderoi (prevalence 6-8%). The absence of Diphyllbothrium spp. in samples shows that the G. maculatus population does not play any role in the life cycles of these important zoonotic parasites. The sex of the host had no effect on T. barilocheensis abundance. Statistical differences in T. barilocheensis abundance between "puyenes" of the same size class between sampling stations and positive correlation between prevalence of infected snails and T. barilocheensis abundance in fish suggest that different stocks have been sampled. Factors influencing T. barilocheensis abundance are discussed.*

Key words: parasitism - *Tylodelphys* - *Galaxias maculatus* - salmonids - southern Argentina

Salmonid fishing is of economic importance in the Argentinian Patagonia.

The "puyen" *Galaxias maculatus* (Galaxiidae, Salmoniformes) is a small autochthonous fish (total asymptotic growth length = 97 mm in Ezquerro pond, near Lake Nahuel Huapi), (Cervellini et al. 1993) that inhabits southern South America and Oceania (Quaggiotto & Valverde 1993) and may be predated by salmonids whereby transmission of parasites may occur (Revenga 1993). Studies in New Zealand (McDowall 1968) and Australia (Pollard 1971) agree that most of each population dies during its first year, immediately after spawning, but a small proportion might reach three years of age.

In a population study in a dam in North Patagonia, Ferriz (1987) observed an annual cycle. The "puyenes" are found in Patagonia in various lakes and rivers where they inhabit littoral waters.

Different helminth parasites have been recorded in "puyenes" from the Nahuel Huapi Lake (Ortubay et al. 1994) and information on their biology appears in articles by Szidat and Nani (1951), Szidat (1956), and Torres et al. (1990).

*Tylodelphys* is a digenetic trematode genus and its species range extensively in both the northern and southern hemispheres. The species parasitizing "puyenes" that have been described for the region are *T. argentinus*, *T. barilocheensis* and *T. crubensis* (Quaggiotto & Valverde 1992). Adults develop in the intestine of ichthyophagous birds (species unknown for the region). The first stage (miracidium) is a swimming larva. The following stages (sporocysts, rediae, cercariae) develop in snails (*Chilina* sp.). When the cercariae emerge, they can swim and actively infect "puyenes", where the metacercariae develop (Scheinert et al. 1997).

This paper presents the first quantitative parasitological records of "puyenes" from Nahuel Huapi Lake and analyses species abundance of *T. barilocheensis* and migratory movements of fishes.

## MATERIALS AND METHODS

The study was carried out in Lake Nahuel Huapi, in the Nahuel Huapi National Park and Reserve (40°8'-41°35'S, 71°2'-71°57'W). The coastline is very irregular with a series of bays, peninsulas, and isthmuses, gravel or sandy beaches, and rocky cliffs, favouring the existence of differ-

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ent microhabitats. The lake bed harbors few macrophytes, partly because of the low proportion of shallow waters and partly because of wave action, strongly influenced by west winds (Thomasson 1959). The town of San Carlos de Bariloche is located on the eastern coast.

Six sampling stations were established on the eastern littoral zone over approximately 40 km (named A, B, C, D, E and F). Distance from the town of San Carlos de Bariloche increases from A (0 km) to F (40 km). From January 20 to February 10, 1994, 579 "puyenes" *G. maculatus*, were trapped (Table I). Traps were submerged at a depth not greater than 0.5 m for 1-5 days. After not longer than five days, fish were put to death, total length and weight were measured and sex was determined (162 males and 154 females; the remaining fish were immature). Necropsies were carried out under stereomicroscope and internal helminth parasites collected, identified and counted.

On February 12 and 13, 1994, *Chilina dombeiana* snails were sampled from the Nahuel Huapi stations where fish were captured. Random samples were taken (manual collection within an area of 1 m<sup>2</sup>) every 4 m along a transect of approximately 150 m, at a depth between 0.0 and 0.40 m. From each sample, 70 snails were separated at random in individual glasses at room temperature, to observe cercariae emergence. The cercariae that emerged were "furcocercaria type A" and "echinocercaria sp.", as described by Ostrowsky and Quaggiotto (1995), but never coexisted. Absence of trematode larvae was verified by necropsy under stereomicroscope for snails that failed to shed cercariae. Specific identity of cercariae was determined by experimental infections with "furcocercaria type A" on "puyenes" free of parasites, as in Scheinert et al. (1997). They were found to correspond to *T. barilocheensis* (Quaggiotto & Valverde 1992).

In this paper, the terms abundance and prevalence are used according to the recommendations of Margolis et al. (1982).

The Mann-Whitney, Kruskal-Wallis and multiple comparison (Conover 1980) tests were used

to compare abundances. Correlation analysis was used to relate prevalence of infected snails and parasite abundance in fish and density of snails and parasite abundance in fish. The significance level considered was 0.05.

## RESULTS

Table I shows the number of "puyenes" of different size classes captured at the different sampling stations.

The following parasites were found: *T. barilocheensis* (unencysted metacercariae in the encephalic cavity), *A. apophalliformis* (metacercariae encysted in the liver), *Contracaecum* sp. (larvae in the body cavity) and *C. corderoi* (adults in intestine). Table II shows abundance and prevalence of the parasites found at the different sampling stations.

For *T. barilocheensis*, no significant difference in parasite abundance was found between fish sexes. The analysis of *T. barilocheensis* metacercariae abundance for each "puyenes" size class showed significant differences between sites for size classes 41-50, 51-60 and > 60 mm (Kruskal-Wallis test). Comparing abundance in pairs (*a posteriori*), the multiple comparison test permits a distinction of fish as follows (Fig. 1), in size class 41-50 mm 3 stocks (A, B-E, C-D). In size class 51-60 mm 3 stocks (B-E, C, F) and in size class > 60 mm 3 stocks (B, E, F). Increased abundance with fish size and stocks of fish is also shown (Fig. 1). Fig. 2 shows positive correlation between prevalence of snails infected by *T. barilocheensis* and parasite abundance in fish of 3 size classes (41-50, 51-60, > 60 mm),  $r^2 = 0.98$ ,  $r^2 = 0.96$  and  $r^2 = 0.79$  respectively. In contrast, Fig. 3 shows no correlation between density of snails and abundance of parasites in fish of size classes 41-50, 51-60 and > 60 mm;  $r^2 = 0.44$ ,  $r^2 = 0.40$  and  $r^2 = 0.41$ .

## DISCUSSION

This is the first time that the presence of *T. barilocheensis*, *A. apophalliformis*, *Contracaecum* sp. and *C. corderoi* in *G. maculatus* is quantified in the Nahuel Huapi National Park and Reserve. It

TABLE I  
Number of *Galaxias maculatus* per size class captured in different sampling stations of Lake Nahuel Huapi

Size (mm)	Sampling station						Total
	A	B	C	D	E	F	
31-40	6	25	25	0	28	0	84
41-50	71	27	51	32	31	8	220
51-60	4	51	33	8	34	30	160
> 60	0	36	2	5	32	40	115
Total	81	139	111	45	125	78	579

TABLE II  
Abundance ( $\pm$  SD) and prevalence of different parasites infecting *Galaxias maculatus* from different sampling stations of Nahuel Huapi Lake

Sampling station	n	<i>Tylodelphys barilocheensis</i>		<i>Acanthostomoides apophalliformis</i>		<i>Contracaecum</i> sp.		<i>Camallanus corderoi</i>	
		Abundance $\pm$ SD	Prevalence (%)	Abundance $\pm$ SD	Prevalence (%)	Abundance $\pm$ SD	Prevalence (%)	Abundance $\pm$ SD	Prevalence (%)
A	81	27.63 $\pm$ 20.63	100	0.62 $\pm$ 0.81	30	0.00 $\pm$ 0.00	0	0.00 $\pm$ 0.00	0
B	139	124.42 $\pm$ 74.05	100	0.72 $\pm$ 1.00	44	0.00 $\pm$ 0.00	0	0.00 $\pm$ 0.00	0
C	111	57.28 $\pm$ 28.12	100	0.66 $\pm$ 0.89	46	0.33 $\pm$ 0.66	14	0.13 $\pm$ 0.52	8
D	45	90.37 $\pm$ 80.53	100	0.60 $\pm$ 0.78	40	0.00 $\pm$ 0.00	0	0.00 $\pm$ 0.00	0
E	125	112.97 $\pm$ 65.19	100	0.90 $\pm$ 1.20	54	0.90 $\pm$ 1.02	24	0.15 $\pm$ 0.67	6
F	78	32.05 $\pm$ 29.15	100	0.80 $\pm$ 0.80	34	0.75 $\pm$ 0.90	34	0.21 $\pm$ 0.60	6

SD: standard deviation.

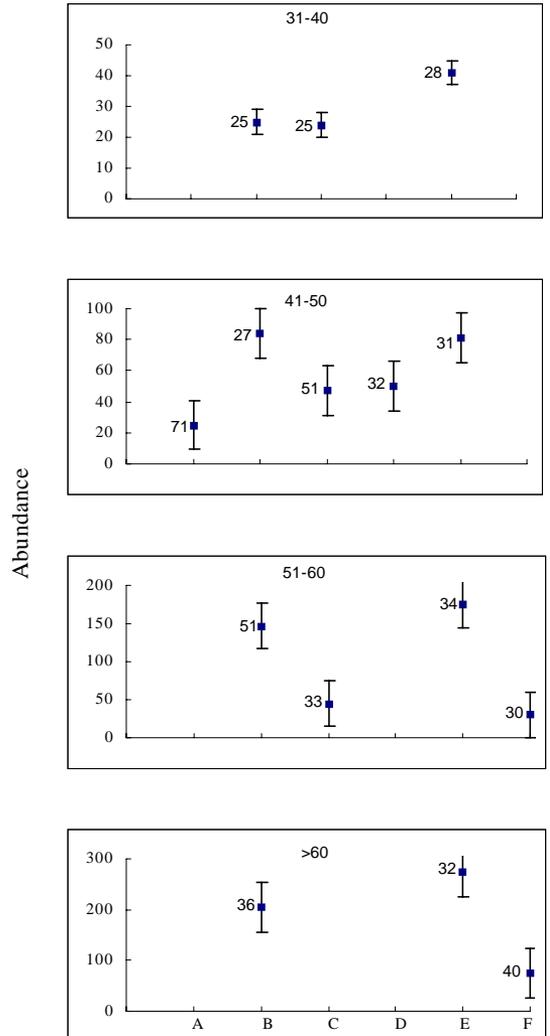


Fig. 1: abundance ( $\pm$  SD) for different size classes (31-40, 41-50, 51-60, >60 mm) of *Galaxias maculatus* infected with *Tylodelphys barilocheensis* (metacercariae) in different sampling stations in Lake Nahuel Huapi.

is also the first time that *T. barilocheensis* has been recorded in “puyenes” from Lake Nahuel Huapi. To date, it is the most abundant parasite reported from fish in the entire Park.

The final hosts of *Tylodelphys* spp. are birds. For *A. apophalliformis*, *Contracaecum* sp. and *C. corderoi* fish may act both as intermediate and definitive hosts, thus transmission by predation may occur. This mechanism has been proposed for *G. maculatus* and salmonids for *Contracaecum* sp. and *C. corderoi*, in Chile (Torres et al. 1991). According to our results, the role of *G. maculatus* population in transmission of parasites to the salmo-

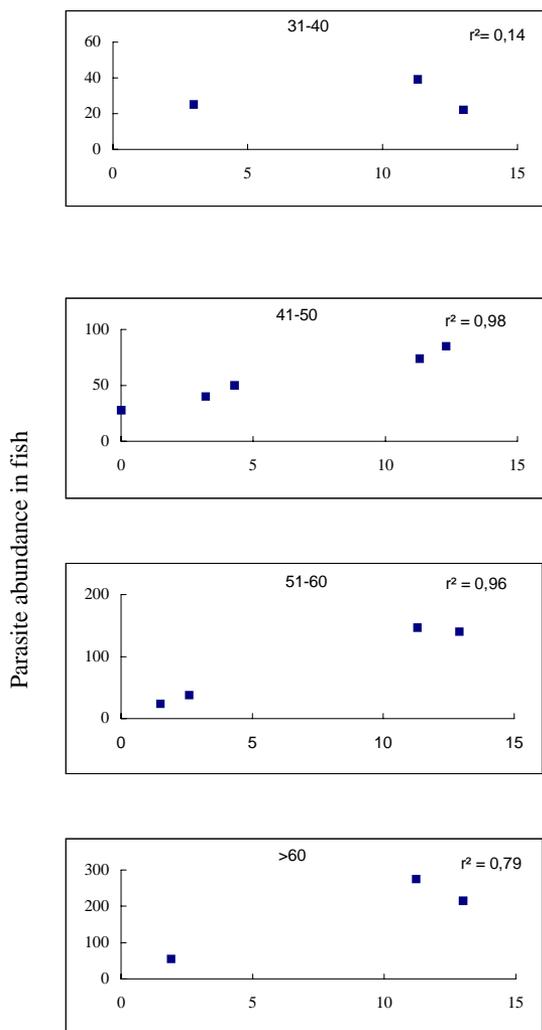


Fig. 2: correlation between prevalence of infected *Chilina dombeiana* and abundance of *Tylodelphys barilocheensis* infecting *Galaxias maculatus* of different size classes (each point represents one sampling station).

nids is more important for *Contracaecum* sp. (prevalence 14-34%) and *A. apophalliformis* (prevalence 30-54%) than for *C. corderoi* (prevalence 6-8%). Revenga (1993) reports two parasites with zoonotic importance: *Diphyllbothrium dendriticum* and *D. latum* in fish from Lake Moreno, which is connected with Nahuel Huapi Lake. He suggests that salmonids can act as paratenic hosts for both species and states the importance of studying the role of *G. maculatus* populations in the life cycle of *D. dendriticum* and *D. latum*. The absence of *Diphyllbothrium* spp. in this study shows that the *G. maculatus* population does not play a role in life cycles of these para-

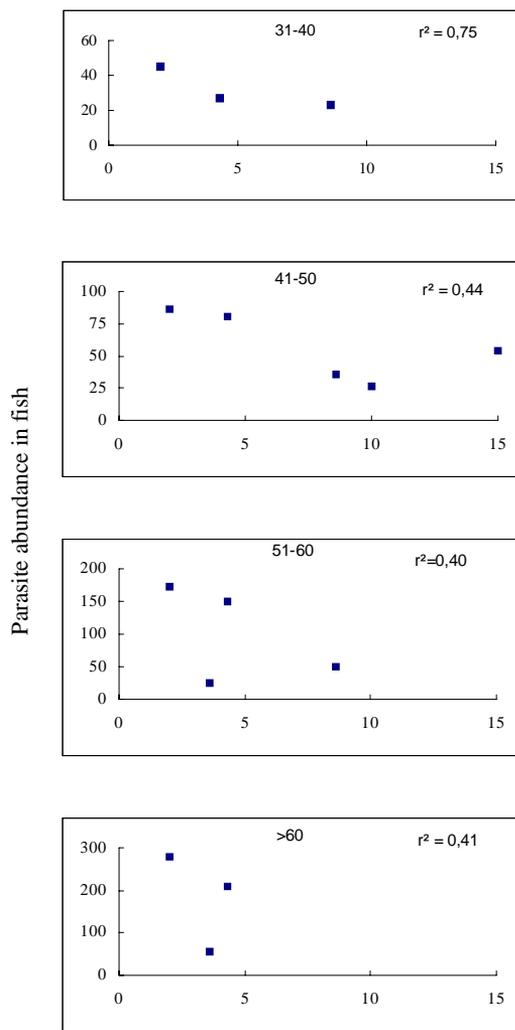


Fig. 3: the lack of correlation between density of *Chilina dombeiana* and abundance of *Tylodelphys barilocheensis* infecting *Galaxias maculatus* of different size classes (each point represents one sampling station).

sites and contradicts the argument of salmonids as paratenic hosts.

The absence of significant differences in *T. barilocheensis* abundance between sexes shows that susceptibility to infection is not associated with sex.

The use of parasites for separating fish stocks has been reviewed by different authors (MacKenzie 1983, 1987, Lester 1990). In this study the absence of *Contracaecum* sp. and *C. corderoi* at stations A, B and D suggests different fish stocks. The significant differences in the abundance of *T. barilocheensis* from fish in the same size (as age indicator) class from neighbouring stations (Fig. 1) reinforces the hypothesis of different stocks.

When more than one size class repeats the same result (Fig.1) this idea is further reinforced. The positive correlation between metacercariae abundance and prevalence of infected snails (also analyzed by size class in "puyenes") at different stations (Fig. 2), constitutes additional information in favor of this hypothesis. All these results strongly suggest that different stocks have been sampled, although this does not exclude the possibility of a certain degree of mixing, which is difficult to quantify (Lester 1990).

This stock separation in small fishes with short lives (*Gambusia affinis*) was observed by Aho et al. (1982) and Camp et al. (1982) in studies on population biology of metacercariae of the family Diplostomatidae. The Lake Nahuel Huapi receives urban contaminants at some points. If the movement of fishes from place to place were restricted and certain stocks remained permanently in contaminated areas, the effect of contamination on fishes could be studied. Further studies including more sampling stations, greater sample size and analyses of water quality would be of interest.

The lack of correlation between density of snails and *T. barilocheensis* metacercariae abundance in fishes analyzed by size class suggests that it is prevalence rather than number of previous hosts, that regulates parasite abundance in fishes. Thus, the controlling factor would be number of birds (definitive hosts) that visit or remain in different areas of the lake. Further studies are needed.

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