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Original Article

First report of inventory and role of macroinvertebrates and fish in Cautín river (38° S, Araucania region Chile)

R. Vega[a,b]*, *P. De los Ríos*[c,d], *F. Encina*[d,e], *J. A. Norambuena*[e], *J. Barile*[a] and *A. Mardones*[a,b]

[a]Departamento de Ciencias Agropecuarias y Acuicolas, Facultad de Recursos Naturales, Universidad Católica de Temuco – UCTemuco, Casilla 15-D, Temuco, Chile

[b]Núcleo de Producción Alimentaria, Universidad Católica de Temuco – UCTemuco, Temuco, Chile

[c]Departamento de Ciencias Biológicas y Químicas, Facultad de Recursos Naturales, Universidad Católica de Temuco – UCTemuco, Casilla 15-D, Temuco, Chile

[d]Núcleo de Estudios Ambientales, Universidad Católica de Temuco – UCTemuco, Temuco, Chile

[e]Departamento de Ciencias Ambientales, Facultad de Recursos Naturales, Universidad Católica de Temuco – UCTemuco, Casilla 15-D, Temuco, Chile

*email: rvega@uct.cl

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(With 2 Figures)

Abstract

The Cautin river is located in the 137 years old Araucania region, Chile (38°S), and is characterized by alterations through human interference due agriculture and towns in its surrounding basin, the presence of salmonids, and by its mixed regime, originated from snow melting in summer and rains in winter. The aim of the present study was to make a review of the inventory and ecological role of the benthic inland water macroinvertebrates of the River Cautin, in order to understand their importance in the ecosystem of the river. The fauna of this river includes a fauna composed of endemic and introduced fish, which has, however, been only poorly studied until now. The literature revealed the presence of abundant populations of Diptera, Trichoptera and Ephemeroptera larval stages, and few crustaceans specifically amphipods and freshwater crabs along the river's course. Many of these macroinvertebrates are prey for both introduced salmonids and native fishes. Similar results have been reported for other southern Argentinean and Chilean Patagonian rivers.

Keywords: Cautin river, North Patagonia, Diptera, Trichoptera, Ephemeroptera, *Aegla*, trouts.

Primeiro relato do inventário e papel dos macroinvertebrados e peixes no rio Cautín (39° S, região de Araucania Chile)

Resumo

O rio Cautin está localizado na região de Araucania, no Chile (38°S), é caracterizado por alterações através da interferência humana devido à agricultura e as cidades da bacia circundante, a presença de salmonídeos e pelo seu regime misto, originado pela queda de neve verão e chuvas no inverno. O objetivo do presente estudo foi fazer uma revisão do papel ecológico dos macroinvertebrados bentônicos das águas interiores do rio Cautin, para entender sua importância no ecossistema do rio. A fauna deste rio inclui uma fauna composta de espécies de peixes endêmicos e introduzidos, que, no entanto, tem sido mal estudada até agora. A literatura revelou a presença de abundantes populações de estádios de larvas Diptera, Trichoptera e Ephemeroptera, e poucos crustáceos especificamente anfípodes e caranguejos de água doce ao longo do curso do rio. Muitos desses macroinvertebrados são presas tanto para salmonídeos introduzidos quanto para peixes nativos. Resultados semelhantes foram relatados para outros rios sul da Patagônia Chilena e Argentina.

Palavras-chave: rio Cautin, Patagônia Norte, Diptera, Trichoptera, Ephemeroptera, *Aegla*, trutas.

1. Introduction

The central and southern-central Chilean rivers (33-38°S) are characterized by their mixed regime, i.e., their discharge originates from winter rains and snow melting in summer. As a result of the combined conditions of relatively large quantities of water all year round and the fact that their courses run in mountainous regions and they flow rapidly in ocean showing a markedly turbulent flow (Niemeyer and Cereceda, 1984; Arenas, 1995; Vega et al., 2017). These circumstances have generated, and still continue to generate, a specific composition in the benthic communities that are adapted to these particular flow conditions (Figueroa, 2000; Colin et al., 2012; Piedra et al., 2012).

The literature about macroinvertebrates in this kind of rivers is quite fragmented, and mainly describes the presence of Malacostraca such as amphipods of the genus *Hyalella* (S.I. Smith), freshwater crabs of the genus *Aegla* (Leach, 1820), and the southern Chilean river prawn, *Samastacus spinifrons* (Phillippi, 1882) (De los Ríos-Escalante et al., 2012; Jara, 2013; Rudolph, 2013), and Diptera, Trichoptera and Ephemeroptera larval stages (Figueroa, 2000; Figueroa et al., 2003, 2007), many of these groups are currently endangered due to human-induced alterations in their habitats and the introduction of alien salmonids species since 1914 (Golusda, 1907, 1927; Barros, 1931; Jara et al., 2006; Encina et al., 2017; Vega et al., 2017). The (introduced) salmonids, specifically, constitute non-selective, active predators (Soto et al., 2006, 2007; Fierro et al., 2012, 2015, 2016; Piedra et al., 2012; Valdovinos et al., 2012; Vargas et al., 2010, 2015). Also, some rivers of this kind have undergone alterations in their surrounding drainage basins, viz., through anthropogenic enterprises as agriculture, deforestation, forestatation, growing cities, industry, among others, these new conditions affect the water quality (Kristensen et al., 2009), and, by consequence, also the benthic species that are sensitive to water pollution are affected in their abundance (Figueroa et al., 2003, 2007; Tello et al., 2010; Vega et al., 2013, 2017; Gorski et al., 2015; Nimptsch et al., 2015).

The River Cautin is located in the young Araucania region founded in 1881 (Figure 1) and originates in the Andes mountains (Rivera et al., 2004); its course includes zones with low levels of human intervention, close to its origin, and zones with increasing of human interference from the towns of Curacautin, Lautaro and Temuco (Niemeyer and Cereceda, 1984; Figueroa, 2000; Marchant et al., 2016) while finally this river ends as a tributary to the Imperial river (Niemeyer and Cereceda, 1984; Figueroa, 2000). The benthic macroinvertebrate fauna included aquatic insects (mainly Diptera, Ephemeroptera, Plecoptera, and Trichoptera larval stages), crustaceans (amphipods and decapods) (Campos, 1973; Campos et al., 1993 a, b; Ruiz, 1996; Figueroa, 2000; Vega et al., 2013; Fierro et al., 2015). After 137 years the Araucanía region needs to have an inventory of its macrofauna of benthic invertebrates as a baseline to evaluate the impact of the anthropogenic activities growth and to generate conservation measures for the ecosystem of the rivers of the Cautín river basin (Yoshida and Uieda, 2014). Also, to know the roles of the macrofauna of the river and particularly of the native fish and introduced salmon.

The aim of the present study was to make an inventory and review of the role of macroinvertebrate inland water in the ecosystem(s) of the Cautin river, which constitutes an important resource for the Araucania region as a fresh water source and also as a habitat for macroinvertebrates and fishes species.

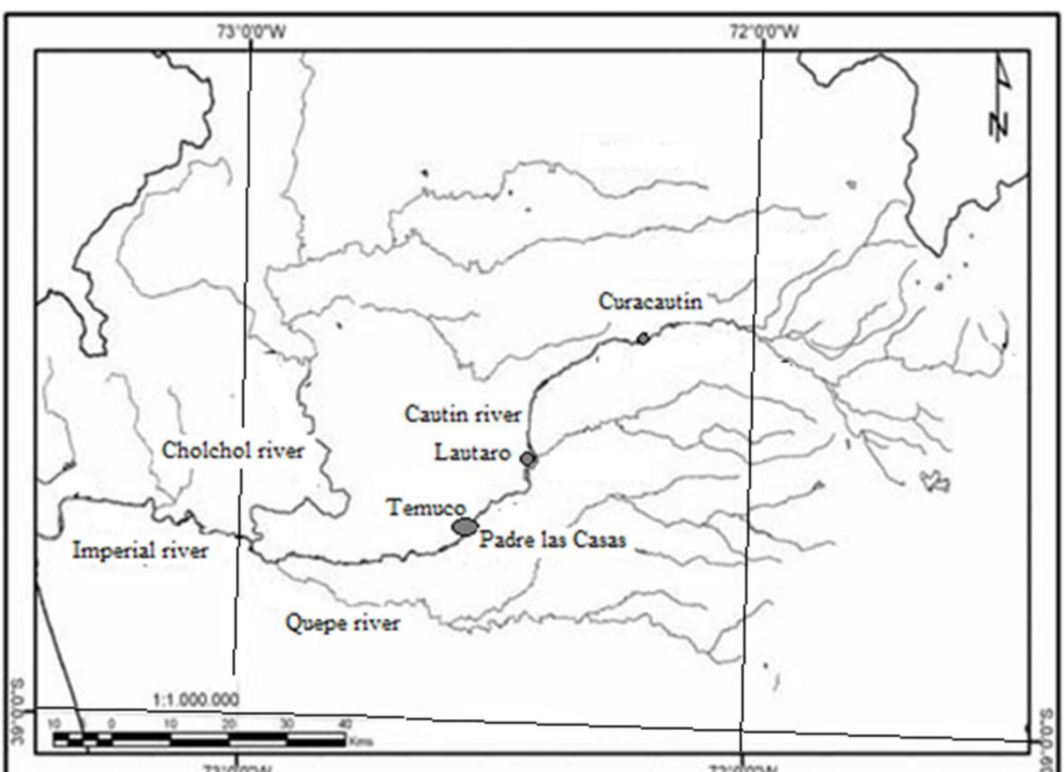

Figure 1. Map of Cautin river.

2. Materials and Methods

It was searched literature published between 1980 to present year, from scientific data bases (Scopus, 2018; Scholar Google) and university libraries of the Araucania region for river Cautín macroinvertebrate data obtained from thesis from 1980 to present year. Taxonomic names were confirmed and corrected in according to specialized literature (Jara et al., 2006; Dominguez and Fernandez, 2009; Jara, 2013). The on-line bibliographic database of the Universidad Catolica de Temuco, Chile, mainly Science Direct and Scielo, was used. In order to know the geographical distribution of the mentioned species and update their systematic classification, the link of the Global Biodiversity Information Facility (GBIF, 2018) was used.

3. Results and Discussion

3.1. Benthic communities under potentially native conditions

The literature seems to indicate that benthic invertebrates would have a marked gradient in heterogeneity as a function of the gradient in water conditions of the Cautin river (Figure 1), as in this aspect it is similar to existing descriptions of other Patagonian rivers (Arenas, 1995; Figueroa et al., 2003, 2007, 2010, 2013; Fierro et al., 2012, 2015, 2016; Encina et al., 2017). Previous reports thus indicate that the taxa Plecoptera, Ephemeroptera and Trichoptera larval stages and *Aegla* are abundant under turbulent flow, associated with a high oxygen concentration and much particulate matter that makes a food source (Oyanedel et al., 2008; Moya et al., 2009). Between 1986 to 2012 the Cautin river has 88 species joined in four phyllums, six classes, 15 orders and 42 families (Table 1). One species and three genera were mentioned by literature reviewed are not present in South America: *Lipe*, *Rheotanytarsu*s, *Atherix variegata* and *Bibiocephala*). In this scenario, the River Cautin hosts abundant populations of these groups in unpolluted as well as in low polluted zones (approximately 10-300 ind/m^2) (Figueroa, 2000; De los Ríos-Escalante, 2017). Preliminary research indeed revealed that a marked seasonal variation in abundance of aquatic insects juvenile and freshwater crabs occurs in the Cautin river, and both groups being markedly abundant in the spring and summer, whereas their abundance decreases in autumn and remains low winter (R. Vega, pers. comm.; Figueroa, 2000). Similar results would be in other rivers in Central Chile (Figueroa et al., 2003, 2007, 2010, 2013), whereas a different situation was observed in Chilean rivers at south of 50°, where it is not possible found decapods in benthic fauna (Oyanedel et al., 2011; Rudolph, 2013), and the crustaceans are represented by amphipods (De los Ríos-Escalante et al., 2012, 2013). We are not aware of the characteristics of the benthic ecosystem of the rivers of the Cautin river basin of 137 years ago, however, there is no doubt that its current state reflects a degree of impact due to the diverse anthropogenic activities and climate change, reason why It makes it fundamental at this time to have a baseline of knowledge for future research.

3.2. Trophic interactions between macroinvertebrates and fish

The literature about the trophic role of macroinvertebrate in inland waters revealed that in those ecosystems there are herbivorous, detritivores, shredders, omnivorous, carnivorous, and feed on vegetal residuals that originated from the surrounding catchment basins (Figueroa, 2000; Oyanedel et al., 2008; Moya et al., 2009; Encina et al., 2017). According to the literature (Figure 2, Table 2), the amphipods feed on dead vegetal matter and macrophytes, whereas the Ephemeroptera, Trichoptera and Plecoptera larval stages are shredders and decapods feed on dead vegetal matter and also predate on freshwater mollusks, finally freshwater mollusks (gastropoda) are herbivores, detritivorous and scrappers (Table 2). The crustacea and larval insects stages, on their turn, are preys for native fishes such as the galaxiids, *Percichthys trucha* (Valencienne, 1833), *Percilia gillissi* (Girard, 1855) and *Cheirodon galusdae* Eingennman, 1928, and salmonids such as *Oncorhynchus mykiss* (Walbaum, 1792), *O. tschawytsha* (Walbaum, 1792), and *Salmo trutta* Linnaeus, 1798. The freshwater fishes reported for Araucania region are included in 12 families, 17 genus and 40 species, and 24 species, many of these species are carnivorous, two parasitic of fishes and seven omnivorous. There are 14 literature reports about freshwater feeding in Araucania region, the preys are grouped in five phyla (Arthropoda, Annelida, Mollusca, Porifera, and Vertebrata) and vegetables, 11 classes (Insecta, Crustacea, Ostracoda, Acarina, Oligochaeta, Polychaeta, Hirudinea, Gastropoda, Bivalvia, Osteichthyes, Porifera Class no identified), distributed in 24 families and 42 genus (Tables 3 and 4). Also, species of the genus *Aegla* and larval insects stages are prey for *P. trucha* as well as for the salmonids (Encina et al., 2017). In this scenario, the benthic invertebrates and native fish reported from Cautin river thus are important preys for *O. mykiss* (R. Vega, pers. comm.; Palma et al., 2002; Pascual and Ciancio, 2007; Penaluna et al., 2009; Figure 2), and these results are similar to observations for *O. tschawytsha* in the Allipen river, which is located in the same region, as well as for other rivers in northern Patagonia between 39° and 41°S (Soto et al., 2006, 2007; Arismendi et al., 2009).

In view of the above considerations, the macroinvertebrate benthic fauna would have an important role in the scenario describing the new food web, which involves the presence of introduced salmonids in the Cautin river, considering that salmonids, specifically rainbow trouts, *Oncorhynchus mykiss*, brown trouts, *Salmo trutta and Salmo salar* Linnaeus 1758, were introduced approximately ten decades ago (Golusda, 1907, 1927; Barros, 1931; Wetzlar, 1979; Vega et al., 2017). The current presence of salmonids acclimatized to Chilean inland waters has evoked management regulations, which include a specific open sport fisheries season ranging between November and March (National Fisheries Service, SERNAPESCA, 2016). In spite of these measurements and the possible monitoring of their effects, there are only some previous studies that report about temporal variations in the potential preys of salmonids, as there are the young

Table 1. Eighty eight macroinvertebrate benthic species reported for Cautin river, Araucania region, Chile.

N°	Species	N°	Species
1	*Dugesia anceps* (Kenk, 1930) (1)	8	*Gundlachia* L. Pfeiffer, 1850. *G. gayana* (F. Ancylidae. currently F. Planorbidae) (1).
2	*Tubifex* sp. Lamarck, 1816 (1): (P. Annelida, C. Oligochaeta (2), O. Prosopora, F. Tubificidae) (1). C. Oligochaeta (2).	9	*Ancylus* sp. Müller, 1774. (2, 3).
3	*Mesobdella* Blanchard, 1893 *M. gemmata* (C. Hirudinea, O. Arthycobdellidae (Gnathobdella), F. Haemadipsidae) (1).	10	*Aegla araucaniensis* Jara, 1980 (P. Arthropoda, C. Crustacea, O. Decapoda, F. Aeglidae) (1).
4	*Oligobdella* sp. Moore, 1918 (O. Rhyncobdellida (Glossiphoniformes), F. Glosiphoniidae) (2).	11	*Aegla abtao* Schmitt, 1942 (1, 2, 3).
		12	*Aegla rostrata* Jara, 1977 (2).
5	*Chilina dombeyana* (Bruguiere, 1789) (P. Mollusca, C. Gastropoda, O. Basommatophora, F. Chilinidae) (1). *Chilina* sp. (2, 3).	13	*Hyalella* S.I. Smith, 1874. *Hyalella* sp. (O. Amphipoda, F. Hyalellidae) (2).
		14	*Chiloporter penai* Demoulin, 1955, synonym of *Ch. eatoni* Lestage, 1931 (C. Insecta; O. Ephemeroptera, F. Syplonuridae) (1)
6	*Physa chilensis* Clessin, 1886 (F. Physidae) (1), *Physa* sp. (2, 3).		
7	*Lymnaea* Lamarck, 1799. *L. viator* (F. Lymnaeidae) (1). *Lymnaea* sp. (2).	15	*Meridialaris diguillina* (Demoulin, 1955) (F. Leptophlebiidae) (1) *Meridialaris* sp (1, 2).
16	*Meridialaris chiloeensis* (Demoulin, 1955) (1).	29	*Caenis* Stephens, 1835. *Caenis* sp. (F. Caenidae) (2).
17	*Meridialaris laminata* (Ulmer, 1920) (1).	30	*Klapopteryx armillata* Navás, 1928 (O. Plecoptera, F. Austroperlidae) (1, 2).
18	*Meridialaris spina* Pescador & Peters, 1987 (1).		
19	*Hapsiphlebia anastomosis* (Demoulin, 1955) (1).	31	*Klapopteryx kuscheli* Illies, 1960 (1).
20	*Nousia delicata* Navás, 1918 (1).	32	*Potamoperla myrmidon* (Mabille, 1881) (F. Gripopterygidae) (1).
21	*Nousia maculata* (Demoulin, 1955) (1).	33	*Perlugoperla personata* (1, 2, 3). Currently *Chilenoperla elongata* Vera, 2008 (4).
22	*Nousia minor* (Demoulin, 1955) (1).		
23	*Atalonella* sp (2, 3); currently *Nousia* sp. (4).	34	*Notoperlopsis femina* Illies, 1963 (1, 2).
24	*Penaphlebia* Peters & Edmunds, 1972. *Penaphlebia* sp. (1, 2).	35	*Senzilloides panguipulli* (Navas, 1928) (1).
		36	*Teutoperla* Illies, 1963. *T.* sp (1).
25	F. Leptophlebiidae. Unidentified species (2).	37	*Aubertoperla* Illies, 1963. *A.* sp (1).
26	*Baetis* sp (1) (F. Baetidae 2). Possibly *Andesiops* Lugo-Ortiz & McCafferti, 1999. *Andesiops* sp. (4).	38	*Limnoperla jaffueli* (Návas, 1928) (1, 3).
		39	*Ceratoperla* Illies, 1963. *C.* sp (1), *C. schwabei* Illies, 1963 (2, 3).
27	*Pseudocleon* sp. (1). Possibly *Andesiops* Lugo-Ortiz & McCafferti, 1999. *Andesiops* sp. (4).	40	*Antarctoperla michaelseni* (Klapálek, 1904) (1, 2).
		41	*Austronemoura* Aubert, 1960. *Austronemoura* sp. (F. Notonemouridae) (1, 2, 3).
28	*Dactylobaetis* sp. synoymous of *Camelobaetidiu* Demoulin, 1966 (1).	42	*Udamocercia* Enderlein, 1909. *U.* sp (1).

(1) Figueroa (2000); (2) Fuentealba and Vergara (1987), (3) Fuentes et al. (1986), (4) Norambuena (2012) non published data. (P: Phylum; SP: Sub Phylum; C: Class; SpC: Superclass; SbC: Sub Class; O: Order; SO: Sub Order; F. Family; Sf: Sub family; ?: Insecure identification).

Table 1. Continued...

N°	Species	N°	Species
43	*Neofulla* Claassen, 1936. *Neofulla* sp. (2, 3).	53	F. Hydrobiosidae (4).
44	*Neonemura* Navás, 1919. *Neonemura* sp. (2, 3).	54	55 F. Limnephilidae (1). Two sps. (2).
45	*Pictetoperla gayi Pictet,* (F.J, 1841) (F. Perlidae) (1, 2, 3).	56	F. Leptoceridae (1). One sp. (2).
46	*Kempnyella* Illies, 1964. *Kempniella* sp. (2).	57	F. Glossosomatidae (1).
47	*Diamphipnoa* Gerstaecker, 1873. *Diamphipnoa* sp. (F. Diamphipnoidae) (1, 2).	58	F. Helicopsychidae (1).
48	*Smicridea* McLachlan, 1871. *S. chilensis.* Possibly *Smicridea* sp. (O. Trichoptera, F. Hydropsychidae) (1).	59	*Andogyrus* Ochs, 1924. *Andogyrus* sp. (P. Arthropoda, C. Insecta, O. Coleoptera, F. Gyrinidae) (1, 2).
49	*Hydropsyche* Pictet, 1834. *Hydropsyche* sp. (2, 3).	60	61 *Elmis* Latreille, 1802. *Elmis* sp. (F. Elmidae) (1).Two sps. (2, 3).
50	*Ochrotrichia* Moseli, 1934. *Ochrotrichia* sp. (F. Hydroptilidae) (1). One sp. (2, 3).	62	*Tychepsephenus* Zaitzev, 1908. *Tychepsephenus felix* (F. Psephenidae) (2).
51	*Lype* McLachlan, 1878. *Lype* sp. (F. Psichomyiidae) (2). Not mentioned for the Southern Hemisphere.	63	F. Dytiscidae (1, 2, 3).
52	F. Rhyacophilidae (1). Two sps. (2). Currently	64	*Derataphurus oregonesis* (?) (F. Colydiidae) (2).
66	F. Hydrophilidae (1, 2).	65	F. Staphylinidae (2, 3).
67	F. Amphizoidae (1) Misclassification. From the Northern Hemisphere and a registry in South Africa	79	F. Athericidae (1).
68	*Rheotanytarsus* Thienemann & Bause, 1913. *Rheotanytarsus* sp. (O. Diptera, F. Chironomidae, SF. Chironominae) (1).	80	*Atherix variegata* (F. Rhagionidae; currently F. Athericidae (2, 3). It is not mentioned for Chile, only H. North. Family Athericidae cited for VIII Region.
69	*Pentaneura* (Philippi, 1865) *Pentaneura* sp. (F. Chironomidae) (2).	81	*Tendipes* Meigen, 1800. *Tendipes* sp. (F. Tendipedidae) (2, 3).
70	Una sp. (3)	82	*Bibiocephala* Osten-Sacken, 1874. *Bibiocephala* sp (?) (F. Blepharoceratidae, currently F. Blephariceridae) (2). Distribution Northern Hemisphere.
71	SF. Tanypodiinae (1).	83	*Simulium* Latreille, 1802. *Simulium* sp. (F. Simulidae) (1).
72	SF. Diamesiinae (1).	84	*Edwardsina* Alexander, 1920. *Edwardsina* sp. (F. Blephariceridae) (1).
73	SF. Orthocladiinae (1).	85	F. Empididae. Una sp. (1, 2).
74	*Tipula abdominalis* (Say, 1823) (?) (F. Tipulidae) (2, 3) *T. abdominalis* Northern Hemisphere.	86	O. Hemíptera, F. Corixidae. 1 sp (2, 3).
75	*Tipula* Linnaeus, 1758. *Tipula* sp. (2).	87	*Neogomphus molestus* Hagen in Selys, 1854 (O. Odonata, F. Gomphidae) (2).
76	77 *Tipulida* sp. Dos sps. (2). Posiblemente *Tipula* sp.	88	O. Neuroptera. F. Corydalidae. Una sp. (2, 3).
78	SF. Limoniinae (1).		

(1) Figueroa (2000); (2) Fuentealba and Vergara (1987), (3) Fuentes et al. (1986), (4) Norambuena (2012) non published data. (P: Phylum; SP: Sub Phylum; C: Class; SpC: Superclass; SbC: Sub Class; O: Order; SO: Sub Order; F. Family; Sf: Sub family; ?: Insecure identification).

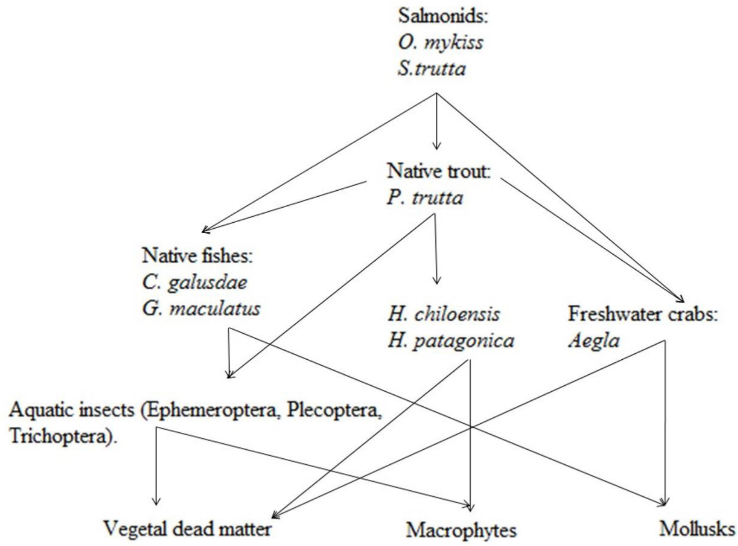

Figure 2. Potential trophic interactions at Cautin river (adapted from Encina et al., 2017).

Table 2. Trophic role of benthic invertebrate found at Cautin river.

Taxa	Role
Platyhelminthes	Predators, scavenger
Mollusca, Gastropoda	Herbivores, detritivorous, scrappers
Crustacea, Decapoda	Omnivores.
Crustacea, Amphipoda	Detrivorous (vegetal dead)
Insecta, Coleoptera	Predators
Insecta, Diptera	Herbivores, carnivores, scavengers, schredders, decomposers
Insecta, Ephemeroptera	Herbivores, schredders, detritivorous, carnivores, omnivores
Insecta, Hemiptera	Carnivores
Insecta, Plecoptera	Herbivores, schredders, carnivores
Insecta, Trichoptera	Perifiton scrapers, schredders, detritivorous, predators

of the native fishes and benthic macroinvertebrates, but fortunately similar situations have been reported upon for other Chilean inland water ecosystems (Campos, 1973; Arenas, 1978; Habit et al., 2006, 2010, 2012; Soto et al., 2006, 2007; Arismendi et al., 2009; Colin et al., 2012; Piedra et al., 2012; Valdovinos et al., 2012; Vargas et al., 2015; Encina et al., 2017; Vega et al., 2017). The results of those studies reveal that benthic macroinvertebrates has an important role in native and introduced fishes, and these macroinvertebrates preys are more abundant in southern spring and summer. As an early example of the magnitude of the anthropic impact in the Cautín river basin, Golusda (1927) reports that at the beginning of the introduction of the salmon from 1914, the schools of the native carnivore, *Percichthys trucha* (Valencienne, 1833), abounded, decreasing noticeably, possibly due to the predation of the salmon. Later, when the *Salmo salar* Linnaeus, 1758 was introduced, it was caught with nets and even with dynamite, making it disappear. Currently, we are perceiving the effects of climate change with hotter, drier summers that dramatically decrease the river's water volume and increase its temperature.

3.3. Current trends in the ecology of macroinvertebrates in Cautin river

The current situation with regard to the ecosystem(s) of the River Cautin as estimated herein from literature data as well as a series of preliminary observations (R. Vega, pers. comm.; Vega et al., 2017), indicates a need for more exhaustive studies, including fieldwork. The comparison of fauna species reported for Cautin river in fishes stomach contents denotes that *Dugesia* has not reported in stomachs, as well as 11 classes identified in stomachs, in Cautin river only was six identified. The river has 15 orders and 11 species were identified in stomachs too. The non-identified orders belonged to Platyhelminthes and Annelida orders, that has soft bodies that can not be recognize. To improve the knowledge on fish feeding and impacts on benthic fauna as preys it would be necessary do more studies in the species fauna reported, and use molecular tools at stomach contents and fecal material, that would allow to know the prey specialization predated on fishes, and its trophic role. On many crucial topics, such as management of the drainage basin and its consequences for water quality and consequently for the abundance of both

Table 3. Carnivore freshwater native fish alimentation for Araucanian region.

Item	*T. a.*	*P. g.*	*D. c.*	*D. n.*	*G. m.*	*B. b.*	*A. z.*	*A. t.*	*P. t.*	*P. m.*	*N. i.*	*H. m.*
P. Arthropoda, C. Insecta			X					X				X
O. Diptera, F. Chironomidae												
(la, pu, ad)	X	X		X	X	X	X		X	X		
F. Tipulidae (la)	X								X		X	
F. Ceratopogonidae					X							
Culicoides sp.									X			
F. Simuliidae, *Simulium*.									X			
F. Tanyderidae									X			
F. Psichodidae					X							
F. Culicidae				X								
O. Ephemeroptera		X		X			X					
F. Baetidae (ni)	X											

Item	*T. a.*	*G. m.*	*B. b.*	*A. z.*	*P. t.*
F. Leptophlebiidae					
(pu, ni)	X				
Metamonius sp.					X
Traverrella sp.					X
Meridialaris laminata.					X
Penaphlebia exigua.					X
O. Trichoptera		X	X	X	
F. Limnephiliidae (la)	X				
F. Hydropsychidae (la)	X				
Smicridea sp.					X
Plectomacronema sp.					X
F. Leptoceridae.					
Nectopsyche sp.					X

Item	*T. a.*	*P. g.*	*D. n.*	*G. m.*	A. t.	*P. t.*
F. Hydroptilidae						
Neotrichia sp.					X	
Hydroptila sp.					X	
Oxyethira sp.					X	
F. Polycentropodidae						
Polycentropus sp.					X	
O. Plecoptera		X	X	X	X	X
F. Gripopterygidae	X					
(la. Sps 1y 2).						
F. Perlidae (la).	X					
O. Coleoptera						
F. Elmidae (la)	X					
F. Dytiscidae				X		X

Item	*T. a.*	*G. m.*	B. b.	A. z.	*P. t.*	*N. i.*
F. Hidrophilidae						
Berosus sp.					X	
O. Odonata						
SO. Zigoptera (ni)	X					
Ischnura sp.					X	
Cyanallagma sp.					X	
Oxyagron sp.					X	
IO. Anisoptera.					X	
Aeshna sp					X	
Erythodiplax sp.					X	
O. Hemiptera.			X			X
O. Hymenoptera						
F. Formicidae		X		X	X	

T.a. Trichomycterus aerolatus Valencienne en Cuvier y Valencienne (Ruiz, 1993; Habit et al., 2005), *P.g. Percilia gillisi* Girard (Campos, 1985; Ruiz, 1993; Ruiz and Marchant, 2004) , *D.c. Diplomystes camposensis* (Arratia) (Arratia, 1987), *D.n. Diplomystes nahuelbutensis* (Arratia) (Ruiz et al., 1993), *G.m. Galaxias maculatus* (Jenyns) (Fischer, 1963; Ferriz, 1984; Campos, 1985; Campos et al., 1993a; Ruiz et al., 1993; Ferriz and Salas, 1996; Macchi et al., 2007; Ruiz and Marchant, 2004; Vega et al., 2013), *G.p. Galaxias platei* Steinchdachner (Ruiz and Marchant, 2004; Cussac et al., 2004; Habit et al., 2005), *B.b. Brachygalaxias bullocki* (Regan) (Fischer, 1963; Campos, 1972; Ruiz and Marchant, 2004), *A.z. Aplochiton zebra* Jenyns (McDowall and Nakaya, 1988), *A.t. Aplochiton taeniatus* Jenyns (McDowall and Nakaya, 1988; Ruiz and Marchant, 2004), *P.t. Percichthys trucha* (Valenciennes) (Ferriz, 1989; Campos et al., 1993a; Ruiz et al., 1993; Ruiz, 1993; Ruzzante et al., 1998; Ferriz, 2000; Lopez Cazorla and Tejera, 2003), *P.m. Percichthys melanops* Girard (Campos et al., 1998; Ruiz and Marchant, 2004), *N.i. Nematogenys inermis* (Guichenot)(Ruiz and Marchant, 2004), *H.m. Hatcheria macraei* (Guirard) (Ruiz and Marchant, 2004). See References in superindices for native inland water fish species alimentation for Araucania región, Chile. la: larvae, pu: pupa, ni: nimphs, ad: adults. ++ Preys consumpted by all fishes. +: Preys consumpted by many fishes, +: Preys consumpted by few fishes, -: not consumpted, ¿: not offered for species. la: larvae, pu: pupa, ni: nimphs, ad: adults. (1) Sobenes et al. (2012). (P: Phylum; SP: Sub Phylum; C: Class; SpC: Superclass; SbC: Sub Class; O: Order; SO: Sub Order; F. Family; Sf: Sub family; ?: Insecure identification).

Table 3. Continued...

Item	*T.*	*D.*	*D.*	*G.*	*G.*	B.	A.	A.	*P.*	*P.*	*N.*	*H.*
	a.	*c.*	*n.*	*m.*	*p.*	b.	z.	t.	*t.*	*m.*	*i.*	*m.*
SP. Crustacea							X	X				
O. Amphipoda. *Hyalella*			X	X	X	X				X	X	X
H. curvispina,												
H. pampeana	X								X			
O. Decapoda *Aegla*		X	X		X					X		X
Samastacus spinifrons	X		X		X				X			
Parastacus									X			
Freshwater prawn												X
SO. Cladocera				X		X						
Daphnia spp.	X					X						
Simocephalus vetulus									X			
C. Ostracoda				X	X	X						
Clamydotheca incisa									X			

Item	*T.*	*P.*	*G.*	*B.*	*P.*
	a.	*g.*	*m.*	*b.*	*t.*
Herpetocypris sp.					X
SbC. Copepoda			X		
Harpacticoidea				X	
SbC. Acarina, Hydracarina			X		
C. Oligochaeta			X		
F. Lumbriculidae	X				
Lumbriculus spp	X				
C. Polichaeta			X		
C. Hirudinea			X		X
P. Mollusca, C. Gastropoda		X			
Gundlachia gayana	X				
Aplexa sp.					X
Littoridina sp.					X

Item	*G.*	*B.*	*P.*	*P.*
	m.	*b.*	*t.*	*m.*
Chilina			X	X
Eggs		X		
C. Bivalvia, *Pysidium*				X
Cl. Osteichthyes				
F. Percichthydae. *Percichthys*			X	
F. Anablepidae *Jenynsia* sp.			X	
F. Galaxiidae. *G. maculatus.*			X	
Cheirodon			X	
O. Collembola		X		
Terrestrial insects			X	
Arachnids	X			
Macrophites	X			

Item	*T.*	*P.*	*G.*
	a.	*g.*	*p.*
Natural food zoobenthos:			
Ephemeroptera, Plecoptera, Trichoptera	++	++	++
Cultivated Food:			
Enchytraeus buchholzi	+	++	-
Tenebrio molitor	+	+	-
Eisenia foetida	+	+	++
Commercial:			
Tubifex sp.	++	+	+
Artemia sp.	+	+	-
Euphausia sp.	+	?	+
Flake	+	-	-
Granulated	-		-
Spirulina	+	-	?
Micropellet	+	-	++

T.a. Trichomycterus aerolatus Valencienne en Cuvier y Valencienne (Ruiz, 1993; Habit et al., 2005), *P.g. Percilia gillisi* Girard (Campos, 1985; Ruiz, 1993; Ruiz and Marchant, 2004) , *D.c. Diplomystes camposensis* (Arratia) (Arratia, 1987), *D.n. Diplomystes nahuelbutensis* (Arratia) (Ruiz et al., 1993), *G.m. Galaxias maculatus* (Jenyns) (Fischer, 1963; Ferriz, 1984; Campos, 1985; Campos et al., 1993a; Ruiz et al., 1993; Ferriz and Salas, 1996; Macchi et al., 2007; Ruiz and Marchant, 2004; Vega et al., 2013), *G.p. Galaxias platei* Steinchdachner (Ruiz and Marchant, 2004; Cussac et al., 2004; Habit et al., 2005), *B.b. Brachygalaxias bullocki* (Regan) (Fischer, 1963; Campos, 1972; Ruiz and Marchant, 2004), *A.z. Aplochiton zebra* Jenyns (McDowall and Nakaya, 1988), *A.t. Aplochiton taeniatus* Jenyns (McDowall and Nakaya, 1988; Ruiz and Marchant, 2004), *P.t. Percichthys trucha* (Valenciennes) (Ferriz, 1989; Campos et al., 1993a; Ruiz et al., 1993; Ruiz, 1993; Ruzzante et al., 1998; Ferriz, 2000; Lopez Cazorla and Tejera, 2003), *P.m. Percichthys melanops* Girard (Campos et al., 1998; Ruiz and Marchant, 2004), *N.i. Nematogenys inermis* (Guichenot)(Ruiz and Marchant, 2004), *H.m. Hatcheria macraei* (Guirard) (Ruiz and Marchant, 2004). See References in superindices for native inland water fish species alimentation for Araucania región, Chile. la: larvae, pu: pupa, ni: nimphs, ad: adults. ++ Preys consumpted by all fishes. +: Preys consumpted by many fishes, +: Preys consumpted by few fishes, -: not consumpted, ¿: not offered for species. la: larvae, pu: pupa, ni: nimphs, ad: adults. (1) Sobenes et al. (2012). (P: Phylum; SP: Sub Phylum; C: Class; SpC: Superclass; SbC: Sub Class; O: Order; SO: Sub Order; F. Family; Sf: Sub family; ?: Insecure identification).

Table 4. Omnivorous freshwater native fish alimentation for Araucania region.

Item	*B.*	*Ch.*	*Ch.*	B.	O.	Item	*B.*	*Ch.*	*Ch.*	B.	O.
	m.	***a.***	***g.***	**a.**	**m**		***m.***	***a.***	***g.***	**a.**	**m**
P. Arthropoda, C. Insecta	X			X	X	SO Cladocera			X		
O. Diptera					X	*Daphnia* spp.			X		
F. Chironomidae (la, pu, ad)			X			C. Ostracoda		X	X		X
O. Trichoptera		X		X		SbC. Copepoda		X			
O. Coleoptera				X		SbC. Acarina	X	X			
O. Hemiptera.				X		P. Annelida					X
F. Cydnidae	X					C. Polichaeta, F. Nereidae					X
SP. Crustacea				X		P. Mollusca, C. Gastropoda, *Chilina*				X	
O. Amphipoda, *Hyalella*	X	X	X		X	F. Ancylidae			X	X	
H. curvispina, *H. pampeana*						P. Chordata, SC. Osteichthyes, Huevos					X
O. Decapoda, *Hemigrapsus crenulatus*					X						
Sponges spicules			X			Cultivated food:					
Epilithics microalgae		X				*Enchytraeus buchholzi*				?	
Chlorophyceae Ulotrichales			X	X		*Tenebrio molitor*				?	
Cyanophyceae *Microcystes*				X		*Eisenia foetida*				?	
Filamentous microalgae				X		Commercial food:					
Detritus	X		X	X		*Tubifex* sp.				++	
Plankton					X	*Artemia* sp.				?	
Phytoplanckon				X		*Euphausia* sp.				+	
Filamentous diatoms *Melosira,*			X	X		Flake				+	
Navicula, Synedra						Granulated					
Natural food zoobenthos (1):						*Spirulina*				?	
Ephemeroptera, Plecoptera,				++		Micropellet				?	
Trichoptera				++							

B.m. Bullockia maldonadoi (Eigenmann)(Ruiz and Marchant, 2004), *Ch.a. Cheirodon austral* Eigenmann (Victoriano and Habit, 1993; Vila et al., 1999a, 1999b), *Ch. g. Cheirodon galusdae* Eigenmann (Fisher, 1963; Ruiz, 1993), *B.a. Basilichthys australis* Eigenmann (Bahamondes et al., 1979; Duarte et al., 1971; Ruiz, 1993, Ruiz and Marchant; 2004, Urzua et al., 1977; Vila and Soto, 1981), *O.m. Odonthestes* (*Cauque*) *mauleanum* (Steindachner) (Campos et al., 1993a, 1993b; Klink and Eckman, 1985; Ruiz and Marchant, 2004). See References in superindices for native inland water fish species alimentation for Araucania región, Chile. la: larvae, pu: pupa, ni: nimphs, ad: adults. ++ Preys consumpted by all fishes. +: Preys consumpted by many fishes, +: Preys consumpted by few fishes, -: not consumpted, ¿: not offered for species. (1) Sobenes et al. (2012). (P: Phylum; SP: Sub Phylum; C: Class; SpC: Superclass; SbC: Sub Class; O: Order; SO: Sub Order; F. Family; Sf: Sub family; ?: Insecure identification).

macroinvertebrate and fishes at temporal-spatial scales, hardly any relevant information is available until now. Concurrently, it is necessary to perform detailed studies on the role of both the native and the introduced fishes in the now existing ecosystems, especially also their influence on the abundance of the various macroinvertebrate benthic species (see. e.g., Campos, 1973; Artigas et al., 1985; Habit et al., 2006, 2010, 2012; Soto et al., 2006, 2007; Colin et al., 2012; Piedra et al., 2012; Valdovinos et al., 2012; Vargas et al., 2015).

The problems can be expected to be similar to the situation observed for other Chilean Patagonian rivers as described by Encina et al. (2017) and Vega et al. (2017). In this context, a marked temporal variation was observed for the Cautin River, due to the yearly seasonality. In addition, human intervention in the surrounding basin also showed variation, as in the high zones of the river, there is a low level of human interference and we still find zones with a mix of native forest and low-intensity agricultural zones. In the medium zones of the stream, there are two small towns (Curacautin and Lautaro), inevitably with the associated anthropogenic pollution (Figueroa, 2000; Rivera et al., 2004; Vega et al., 2017). Finally, in the last, i.e., the lower zone of the river are the towns of Temuco and Padre las Casas, the main towns of the area with ca. 300.000 inhabitants, obviously with the usual consequences in terms of potential pollution sources, while still further down the river, after both towns, there are agricultural zones of relatively higher intensity, before the confluence of the Cautin and the Imperial river, of which the Cautin thus is a tributary (Figueroa, 2000; Marchant et al., 2016). For a similar ecosystem, i.e., the Gibbs channel, located within Temuco city, Correa-Araneda et al. (2010), found marked temporal variations in terms of seasonality, as well as spatial variations as a function of urban pollution, in the occurrence and abundance of macroinvertebrates. According to this scenario, it would be probable to also find such variations in the River Cautin.

Another important aspect is formed by the component of the salmonids in the ecosystem(s). These fishes are active predators on macroinvertebrates and fish, while the native fish, mainly galaxiids, that predate, inter alia, on microcrustaceans and small larval insects stages. Together, these elements in the food web would have a potential cascade effect considering the trophic interactions between benthivorous fishes, and top predator fishes that would affect the low trophic levels on which also the macroinvertebrates must be important at bottom level (Soto et al., 2006, 2007; Arismendi et al., 2009; Penaluna et al., 2009). The literature revealed the existence of such cascade effects in small rivers and streams with presence of salmonids, where, in contrast, it is possible to find abundant populations of native fishes and benthic macroinvertebrates in both Argentinean and Chilean Patagonian rivers (Grossman, 1993; Soto et al., 2006, 2007; Young et al., 2010; Ibarra et al., 2011), as part of complex trophic web interaction systems when no introduced salmonids are present (Ings et al., 2009; Woodward et al., 2010; Schmid-Araya et al., 2012). In conclusion, according to our extensive literature research as well as to the preliminary observations made until now, it would be necessary to study the populations of benthic macroinvertebrates with an emphasis on the conservation biology of these taxa. Only then we shall be able to actually evaluate their important role in the ecosystem of the river as detritivorous of particulate organic matter, among others, and as prey of the endemic, native fishes. This would also clearly reveal the potential threats posed by the predation activity of introduced salmonids, and as a result of the changes due to human alterations in the surrounding catchment basins.

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