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Comparative analysis between gill netting and sport fisher catches in a small patagonic andean lake: its implications for resource evaluation and management

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Abstract. Knowledge of lake fish communities of Argentine Patagonia has grown in the past 20 years thanks to the use of gill nets. However, National Park officials and Fisher organizations dislike their use and would prefer the use of recreational fisher catch data. The present paper addresses advantages and disadvantages of using gill nets as compared to fishers. This was accomplished by analysis of gill net and fisher catch data from Lake Guillelmo, Parque Nacional Nahuel Huapi for the period 1997-1999. Both sets of data revealed the presence of only two salmonids, brook trout (*Salvelinus fontinalis*) and rainbow trout (*Oncorhynchus mykiss*). However, relative abundances of each species differed between fishing techniques, rainbow trout being dominant according to fisher catches and brook trout according to gill net catches. In addition, differences in size, age and spatial distribution brought about by the highly selective nature of fisher catches were clearly observed. This shows that fisher catch data can only be used to assess existing recreational Patagonian lake fisheries in terms of current or historical trends in catch composition, structure and fishing pressure. Studies of community composition, structure and processes leading to conservation or recreational fishery management should rely on gill net sampling designs tailored to different ecological and management questions, which can be complemented by fisher catch data.

[Keywords: sport fisheries, Patagonian lakes, fishing nets, fisher catches]

Resumen. Análisis comparativo de capturas entre redes agalleras y pescadores deportivos en un pequeño lago andino patagónico: sus implicancias en el estudio de evaluación y manejo: El conocimiento de las comunidades de peces de lagos Andino Patagónicos se incrementó de manera notable en los últimos 20 años mediante el empleo de redes agalleras. No obstante, la Administración de Parques Nacionales y las organizaciones de pescadores recreacionales se oponen a su uso. El presente trabajo compara ventajas y desventajas del uso de redes agalleras con respecto a datos de captura de pescadores recreacionales a partir de datos de captura de ambas fuentes obtenidos entre 1997 y 1999 en el lago Guillelmo, Parque Nacional Nahuel Huapi. Ambos conjuntos de datos mostraron la presencia de dos salmónidos: trucha de arroyo (*Salvelinus fontinalis*) y trucha arco iris (*Oncorhynchus mykiss*), y sus abundancias relativas variaron entre metodologías. La trucha arco iris fue dominante en las capturas de los pescadores y la trucha de arroyo predominó en las capturas con redes agalleras. También se observaron diferencias entre tamaños, edades y distribución espacial, originadas por la naturaleza selectiva de las capturas de los pescadores recreacionales, que solo deberían utilizarse para caracterizar pesquerías recreacionales en términos de la situación actual y las tendencias históricas de las capturas y de la presión de pesca. Deberían

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realizarse estudios que incluyan muestreos especialmente diseñados, con redes agalleras y datos de pescadores, orientados a conocer la composición, estructura y los procesos de las comunidades de peces de lagos patagónicos profundos con miras a la conservación del recurso y/o al manejo de las pesquerías recreacionales.

[Palabras clave: pesca deportiva, lagos patagónicos, pesca con redes]

INTRODUCTION

Fish communities of southern South America are characterized by low diversity, totaling 38 species including both native and exotics, of which 8 correspond to salmonids. In Argentinean Patagonia, salmonids were introduced initially for sport fishing purposes at the beginning of the XX century (Macchi et al. 2007; Pascual et al. 2002-2007). Interest in management of Patagonian freshwater fish resources arose recently due to the economic importance of salmonid sport fisheries as generators of local economic movement (Vigliano & Alonso 2000, 2007).

Studies of fish communities in Patagonian lakes have been carried out mostly by gill netting perpendicularly to the coast in surface littoral waters of lakes (Quirós & Baigún 1984, 1986), or the use of gill net gangs stratified according to habitat types and depths following specific depth contours (Vigliano et al. 1999). According to these authors, stratified (or parallel) gill netting following depth contours gives a more comprehensive view of fish community composition and structure than surface gill netting perpendicularly to the coastline. This latter technique underestimates fish species composition and numbers by species, failing to sample the area close to the bottom in the littoral and deeper parts of the lake or the open pelagic waters. Stratified gill netting is more time consuming and complicated because it requires the concomitant use of an echo sounder to deploy the net over specific depths, and complicated deployment techniques for pelagic waters. Another possible strategy is to set sinking gill nets perpendicular to the coastline towards greater depths. However, studies on distribution and productivity by depth or habitats require knowledge of the operational range of each mesh panel of the gill net gang. Because a particular mesh size panel position and depth will depend on bottom slope, profiles of possible gill net transect sites would have to be constructed. Moreover, a sampling design to ensure that all sizes of mesh panels will fish at all depths is required. This procedure thus becomes, at least for the deeper parts of the lake, more time consuming than the use of parallel gill net gangs.

While parallel gill netting has proven so far to be the most effective way of studying Patagonian Andean lakes, its use in any configuration is highly resisted by sport fishers, their organizations and National Park officials. Creel census, roving creel census diaries and logbook programs have been extensively used in northern hemisphere sport lake fisheries to assess both fisheries and fish assemblages (Guthrie et al. 1991). Related experiences in the area are restricted to the works of Vigliano & Lippolt (1991a, 1991b), Vigliano et al. (2000), and Rechencq (2003) in relation to multiple-gear sport fisheries in lakes and rivers of Nahuel Huapi National Park. Censuses, logbooks and/or the use of handpicked fishers are continuously proposed by park authorities and NGO's such as fishing and conservation organizations as the standard sampling method. This is because of their perception that gill netting can cause detrimental effects by catching birds and aquatic mammals, and excessive fish mortality. Our experience of twenty-two years of gill netting in Patagonian lakes with null catches of either birds or mammals clearly show that gill netting in transparent lakes poses practically no threat to them. Year round studies of four regional lakes have shown that the percentage of the standing fish stock caught through depth stratified gill net sampling designs is minor (i.e., Nahuel Huapi lake 0.0005%, Traful lake 0.02%, Guillelmo lake 0.2%). Because of differential fisher biases, experience and gear selectivity it is probable that catches reflect actual fisheries and not fish communities and/or population structures. We also have to consider that fishers as stakeholders in sport fishery management hold views on management policies and strategies based on their catch experience without any real knowledge of how representative of fish community composition and processes their experience is.

If we consider that each fishing system acts upon a specific sector of the fish community and that its catches may be superimposed with those of other fishing methods, it becomes interesting to find out if and how they relate to one another and what part of the information required for management purposes and biases are generated by each one. Thus, the present paper addresses the general demand of park authorities and NGO´s for studies on the advantages and disadvantages of using traditional gill nets versus actual fisher catches in a small Andean Patagonian lake.

MATERIALS AND METHODS

The study was conducted on data collected between 1997 and 1999 in Lake Guillelmo during the course of an extensive monitoring program (C.R.U.B., U.N.Co. B920:1996-2000). Lake Guillelmo is an ultraoligotrophic monomictic glacial lake, like many Southern Hemisphere temperate lakes, stratifies in summer only. With a surface of 5.4 km^2, a Z max. of 107.2 m, a Z mean of 61.3 m and a volume of 331 hm^3, it drains into the larger Mascardi lake through a small stream that was dammed for hydroelectric purposes in the 1940's, increasing the lake level by 2 m. The dam effectively blocked the possibility of migration into and from Mascardi Lake, creating a situation where fish populations can be considered closed. The lake's main axis runs from north to south creating a wind corridor. Annual average water Secchi disk transparency fluctuates between 20 m in summer and 6 m in winter.

For analytical purposes we defined three different fish habitats: littoral, epibenthic and pelagic. The littoral extended from the coastline to the 10-m depth contour from this depth on, the epibenthic was defined as the water column extending up to 2 m from the lake bottom. The pelagic was defined as open waters. The lake's fish were studied through the use of three different methodologies. Two techniques were based on gill nets and the third one on fly fishing and lure casting from the shore, which are the only sport fishing methods allowed in the lake by the National Park administration. Because fish tend to use habitats differentially (Vigliano et al. 1999), sampling with nets took into account all three defined habitats. Maximum depth for setting gill nets was defined according to fish echo distribution using a echosounder (unpublished data). On the littoral habitat nets were set on the bottom perpendicularly and parallel to the coastline. Perpendicular nets extended from the coast down to 10 m; for analytical purposes catches were subdivided into those from shallow littoral 0-5 m (PCS) and deep littoral 5-10 m (PCD) zones. No perpendicular nets extended beyond 10 m depths because of the problem of relating catches to depth. Parallel nets were set on the 2 m (EPIO) and 10 m (EPI10) depth contours. Nets for the epibenthic habitat were also set parallel to the coastline on the 30 m (EPI30) and 50 m (EPI50) depth contours. The pelagic nets were set on the surface (PEL0) and midwater at 10 m (PEL10) and 20 m (PEL20) depths over the deepest part of the lake. In all cases, gill net gangs consisted of six meshes of differing size, 10 m in length and 2 m in height, randomly attached to one another and modified so they could be set at a specific depth (Table 1). Net construction details have been reported in Vigliano et al. (1999). Nets were set once every season, from autumn 1997 through summer 1999; gill nets were left in the water for 24 h. For each fish caught in gill nets we recorded the particular net from which it came, species, total length (TL) in mm, total wet weight (W) in grams and sex. Scale samples and/or otoliths were taken for age determination.

Gill net catches by species were examined in relation to time of the year and habitat use. Where possible, proportions of numbers

Table 1. Gill net systems. Bar mesh size: 15-20-30-52.5-60-70 mm; *: 15-20 -30 mm; ° 52.5-60-70 mm.

Tabla 1. Sistema de redes agalleras. Tamaño de malla bar: 15-20-30-52.5-60-70 (mm); *: 15-20-30 mm; °: 52.5-60-70 mm.

System	Habitat	Operation depth (m)	Code
Depth Strata (DSS)	Pelagic	0	PEL 0
		10	PEL 10
		20	PEL 20
	Epibenthic	0	EPI 0
		10	EPI 10
		30	EPI 30
		50	EPI 50
Perpendicular to the Coast Surface	Epibenthic	0 to 5	PCS*
Perpendicular to the Coast Depth	Epibenthic	5 to 10	PCD°

caught by species within habitat depths and between habitats were compared through a χ^2 test. Seasonal and year-round catch per unit effort (CPUE) in numbers and weight were calculated for each species, depth and habitat type, and expressed in terms of 100 m^2 of net and 15 h of fishing.

Age-length distributions within and between littoral, epibenthic and pelagic habitats were tested through ANOVA or Kolmogorov-Smirnov, two tailed, two sample test depending on normality and variance homogeneity of the data. According to the range of sizes and number of fish caught for each species, length frequency analyses were done over 20 mm intervals. Catches from all three methodologies were first analyzed separately and later compared.

Sport fishing was conducted in autumn, winter and spring of 1998 and summer 1998-1999. Twenty volunteer fishers were asked to fish the lake at least twice a month in the same general area where the nets operated. In order to reflect the common mixture of fishing gears and techniques used by fishers in lakes, which is the data gathering procedure advocated by some national park officials and NGO's, they were asked to follow their usual behavior so as to reflect the real fishery. Each fisher was provided with log cards where he recorded fishing date, species caught, length (mm), weight (g) and sex of each fish and time spent fishing. Seasonal and year round fisher catches were calculated in terms of CPUE in numbers and weight considering one fishing hour as the effort unit. Size and age distributions of fisher catches were analyzed as in gill nets when possible. Species composition, relative abundance, sex ratios and length–weight relationships were compared within and between habitats for all methods.

RESULTS

Only two fish species, *Salvelinus fontinalis* (Mitchill,1814) and *Oncorhynchus mykiss* (Walbaum 1792) were present in both gill netting and fisher catches, clearly showing species specific differences between fishing methods and habitats (Figure 1).

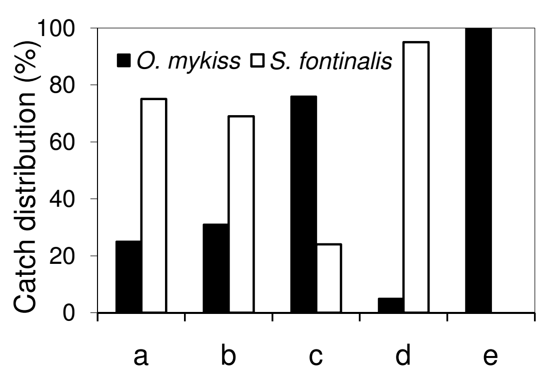

Figure 1. Catch distribution by species, habitat and fishing system: a) littoral perpendicular net catches, b) littoral parallel net catches, c) littoral fisher catches, d) epibenthic net catches, and e) pelagic net catches.

Figura 1. Distribución de capturas por especie, hábitat y sistema de pesca: a) red litoral y perpendicular a la costa, b) red litoral y paralela a la costa, c) captura litoral de los pescadores deportivos, d) red epibéntónica, y e) red pelágica.

Table 2. Sex ratio by species and year. Asterisk indicates significant difference.

Tabla 2. Distribución de sexos por especies y por año. El asterisco indica diferencias significativas.

	O.mykiss		*S. fontinalis*	
	1997	1998	1997	1998
χ^2	0.258	1.280	8.881	0.108
Female	29	21	87	72
Male	33	33	131	77
Significance	0.611	0.258	0.003*	0.742

Brook trout numbers caught by gill nets were greater than rainbow trout, comprising more than 76% of the catches in both years. Proportions of species caught did not differ significantly from one year to the next (*P*>0.001). Sex ratios differed significantly for brook trout in 1997 (Table 2), with a higher catch of males in the autumn of that year. This was the only season during the study when a difference in sex ratio was observed.

CPUEs were low. Only autumn of 1997 showed an exceptionally high catch of both species. Thus, because no general seasonal pattern was apparent and partitioning of the data between habitats greatly reduced sample size values, comparisons were not made within habitats at a seasonal level.

The pelagic habitat gave the smallest catches (see supplementary information*), with only rainbow trout caught, and in very low numbers, during spring, summer and autumn months. Catches were made generally in the PEL0 depth stratum. The littoral habitat always showed the highest number of catches of both species. Between 50-60% of the specimens were caught in its deepest portion (10 m). When comparing catches between depth strata of the same fishing system we found that parallel nets set in the littoral habitat at the 0 m (EPI0) and 10 m (EPI10) depths did not show significant differences in either year. However, shallow perpendicular nets (PCS) showed significant differences compared with the deep ones (PCD) in 1997 but not in 1998. This was also the case when the EPI0 epibenthic net was compared with the shallow perpendicular one (PCS), but not when the EPI10 net was compared with the deep perpendicular (PCD) one. Overall comparison of net systems in the littoral habitat did not yield significant differences. In summary, even when we found a significant difference between the numbers caught by the EPI0 parallel net and the shallow perpendicular (SL) nets in 1997, catches in the littoral habitat did not vary regardless of the gill netting system used.

In this habitat brook trout was the main gill net catch, and catches were not compared between depths due to low numbers. When comparing pooled catches in any year between the littoral and epibenthic habitats it can be seen that brook trout is the most abundant species in both habitats, proportions of both species differing significantly, (see supplementary information*).

Due to type of gear and casting range, fisher catches corresponded to the littoral habitat. A total of 141 rainbow trout and 43 brook trout were caught. Of these, fishers were able to externally sex 44 female, 43 male rainbow trout, as well as 14 female and 21 male brook trout. The high incidence of undetermined specimens prevented sex ratio estimations from their catches. For both species most of the specimens were caught during winter and spring (Figure 2).

The annual mean TL of rainbow trout caught with nets differed between years, 1997 TL means being higher than those of 1998. Size range and general distribution were

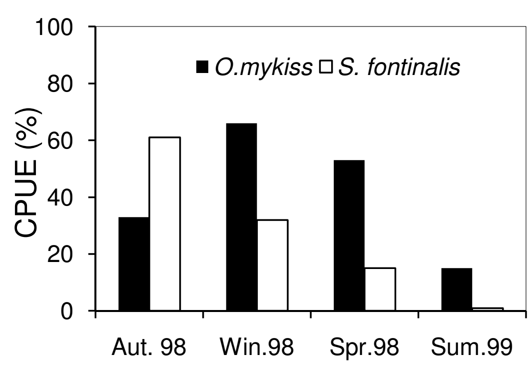

Figure 2. Fishers catch per unit effort (CPUE) distribution by species and season of the year.

Figura 2. Distribución por unidad de esfuerzo (CPUE) de las capturas por especie y estación del año de los pescadores deportivos.

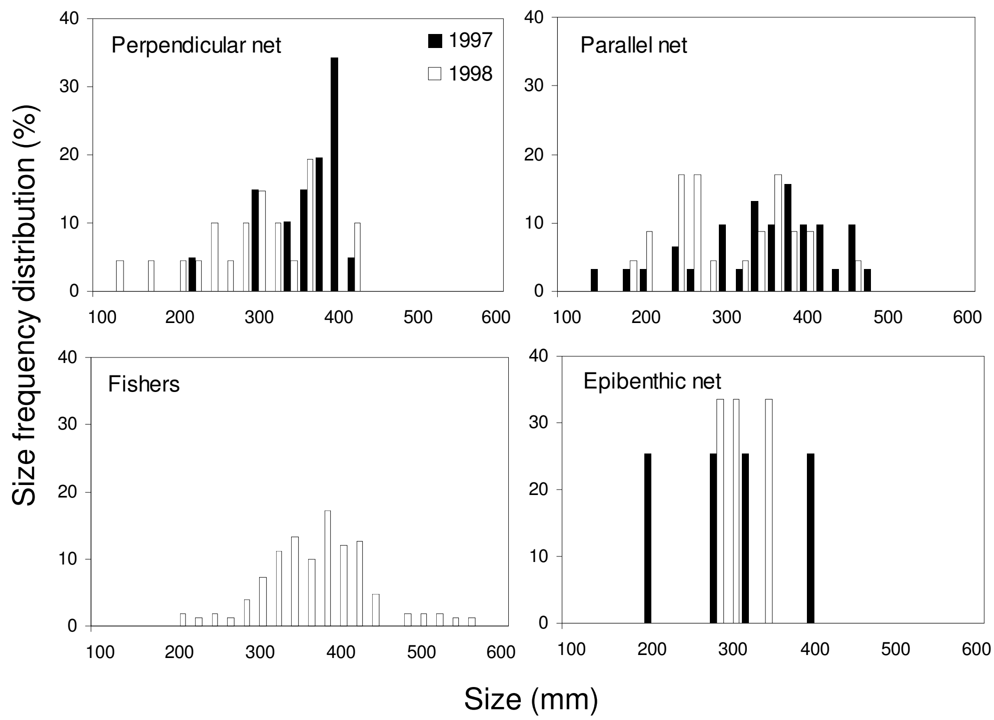

Figure 3. Size frequency distribution of *O. mykiss* by year, habitat and gill net fishing system.
Figura 3. Distribución de frecuencia de tallas de *O. mykiss* por año, hábitat y arte de pesca.

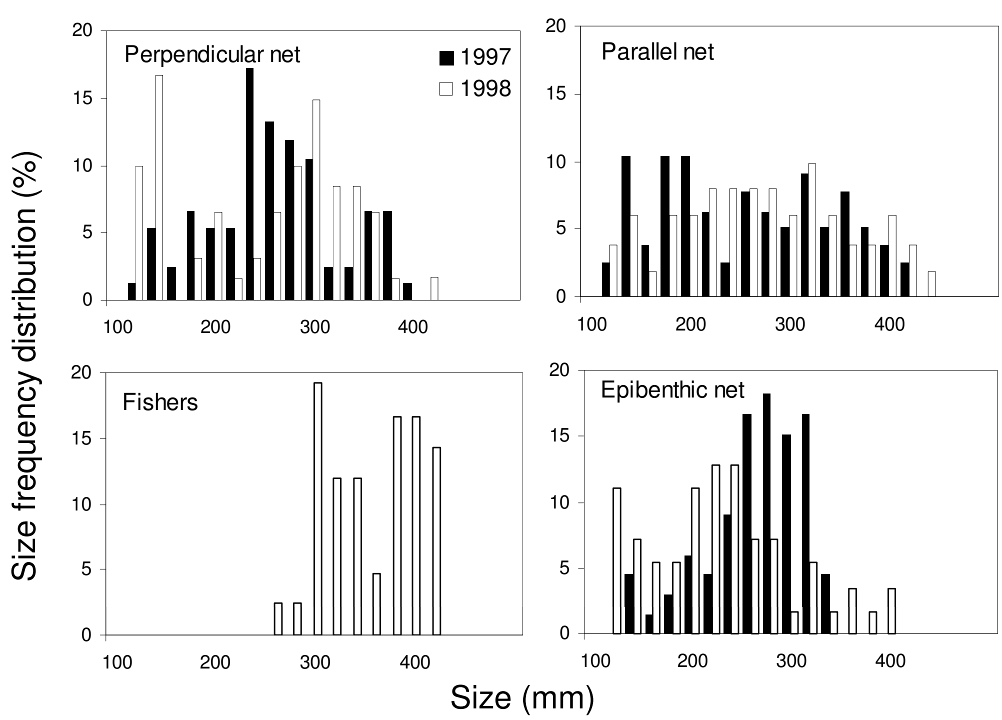

Figure 4. Size frequency distribution of *S. fontinalis* by year, habitat and gill net fishing system.
Figura 4. Distribución de frecuencia de tallas de *S. fontinalis* por año, hábitat y arte de pesca.

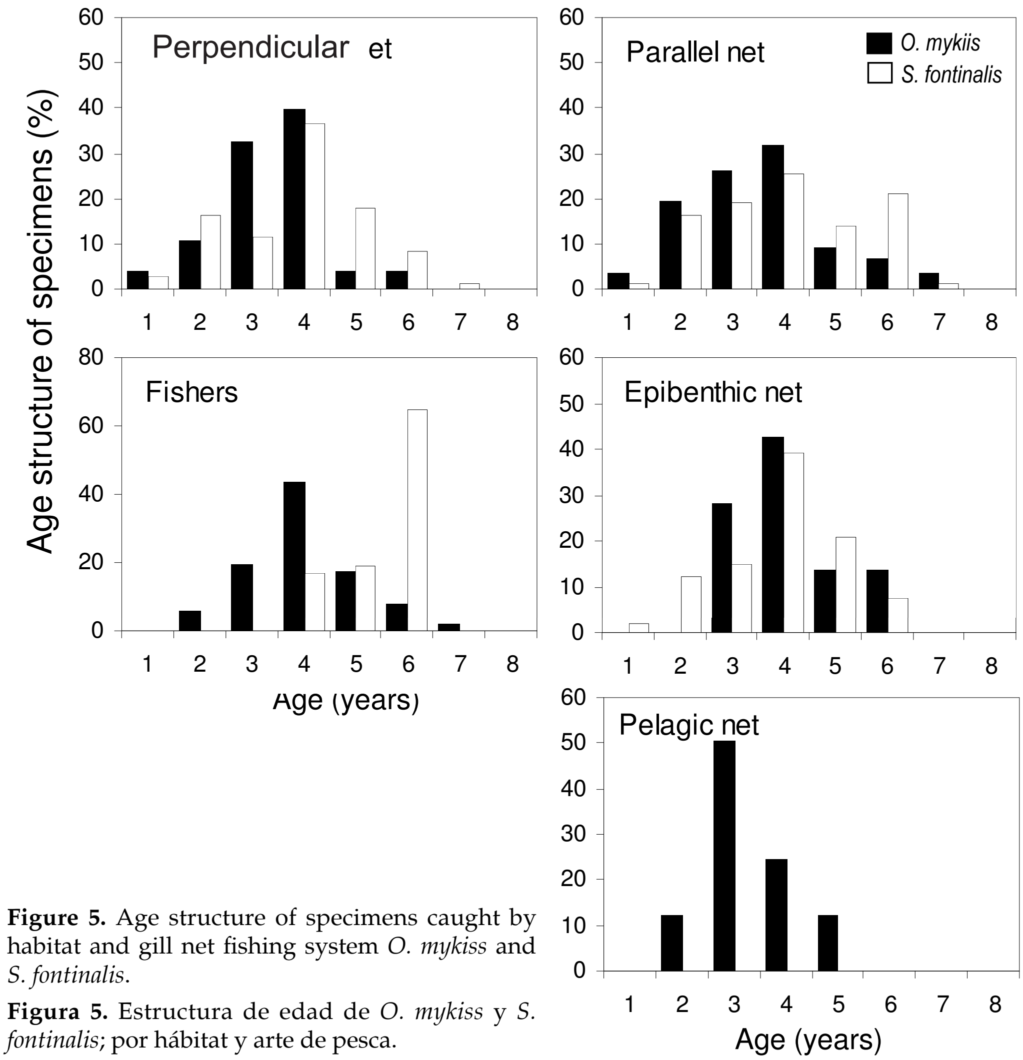

Figure 5. Age structure of specimens caught by habitat and gill net fishing system *O. mykiss* and *S. fontinalis*.

Figura 5. Estructura de edad de *O. mykiss* y *S. fontinalis*; por hábitat y arte de pesca.

consistent in both studied years (Figures 3 and 4). When TL means were compared between gill net fishing methodologies in each year no significant differences were found between littoral and perpendicular nets regardless of the sampling year (Figure 3).

In the case of brook trout, TL means did not differ significantly between years (P>0.001). Significant differences were found only for the TL means in 1998 between the littoral (EPI0-EPI10), perpendicular (PCS-PCD) and the epibenthic nets (EPI 30-EPI 50 strata) (P>0.001), (Figure 4).

When comparing mean sizes of gill net catches in the littoral habitat with those of the fishers, significant differences were found for both species (rainbow and brook trout P>0.001), size distribution of fish caught by fishers being skewed to higher sizes (Figures 3 and 4). In addition fisher-caught specimens showed a unimodal distribution, whereas those caught with nets were bimodal. Length weight relationships according to gill net catches showed good fits with no apparent differences between years (see supplementary information).

Age structure analysis (Figure 5) showed specimens for both species no older than 7 years. Differences were observed with regards to the distribution of age groups in relation to fishing system by habitat. In the littoral habitat, 4-year-old and younger rainbow trout were more abundant in catches of all three gill net fishing systems, whereas 3-year-old fish were more abundant in the epibenthic and pelagic habitats. This was not the case for brook trout, for which littoral, perpendicular gill nets and epibenthic nets showed a more even distribution around the four-year mode. Age structure of fisher catches corresponds to the littoral. Whereas rainbow trout distribution was unimodal and centered on the 4-year-old age class, that of brook trout was dominated by 6-year-old specimens.

DISCUSSION

Catch results between methodologies showed significant differences in terms of species proportions, habitat use and population structure. Brook trout was the more numerous species in all net systems (77%) in relation to rainbow trout. In fisher catches rainbow trout (76%) were more abundant than brook trout. Fisher casting acted upon a small portion of the lake, namely the littoral zone, and so does not provide catch information regarding open waters and the deeper parts of the lake. Whilst both gill netting and sport fishing caught rainbow and brook trout in the littoral habitat, catch proportions by species were reversed. Whereas fishers caught mainly rainbow trout, gill nets showed dominant brook trout catches for this habitat. The gill net sampling design used in this zone makes us believe that gill nets reflected better fish community composition than sport fishing. This implies that fisher catches were highly selective towards rainbow trout. This could be brought about by two causes, differential distribution of species in the water column and/or gear selectivity. Overall distribution of fish by age group and depth showed that older brook trout were located in deeper strata, coincidentally with observations in the northern hemisphere (Mac Crimmon et al. 1968). On the contrary, rainbow trout of older ages were associated with shallower depths. In both cases, perhaps, this could be related to water temperature and dissolved oxygen concentrations. Brook trout have been found to require higher oxygen concentrations than rainbow trout and tend to be found in deeper, colder waters of lakes or at stream discharge points (Vincent & Miller 1969), whereas rainbow trout tolerate a wider range of temperatures (Mc Cormick et al. 1972).

Differential distribution could also probably be related to food availability; brook trout is known to be very selective in terms of food items caught. According to Griffith (1974) and Webster (1975) in lakes of the northern hemisphere brook trout age 0+ eat Ephemeroptera and Diptera larvae, age 1+ specimens eat Tricoptera larvae and adults, and the biggest specimens are seasonal opportunists, incorporating macro invertebrates like crustaceans in cold times and fish in warmer times. On the other hand, Carlander (1969) stated that 50% of juvenile rainbow trout consume terrestrial insects in superficial waters, complementing their diet with zooplankton and aquatic insects. Adult are generally opportunistic feeders and consume a great variety of organisms depending on environmental conditions, such as quality of water, season, temperature, etc. (Scott & Crosman 1973). This is coincidental with feeding patterns for these species in Guillelmo Lake (Macchi 2004).

Fisher selectivity is usually brought about by fishing techniques, type and construction of lures and fisher expertise. For this study fishers resorted to fly fishing, most of them used only floating lines, with a wide variety of fly types and sizes. Because of this, we have to consider that fishers acted upon a restricted part of the environment, namely the shallower littoral areas leaving out the deeper parts of the lake and the open waters. This undoubtedly gives biased images of fish distribution and assemblages.

Another aspect to be considered is that while fisher catches did not allow analysis of fish distribution within the littoral zone, the gill net systems did. Perpendicular gill nets gave higher catches in the shallow littoral habitat (PCS) with regards to the net set parallel to the coast in the same area (EPI0) and to the deep littoral perpendicular nets (PCD). This latter net system did not show significant differences in catches with regards to the parallel nets set in the same depth range (EPI10). The described catch pattern could be brought about by two factors, higher fish densities in the shallower littoral area (0-5 m) and a higher probability of interception by perpendicular gill nets with regards to swimming direction of fish, which for this zone is mainly parallel to the coastline. In the deeper littoral (5-10 m), density might be lower and fish would not swim strictly parallel to the coast line making catches between both systems similar. This would imply that numbers of fish in the shallower littoral area would be underrepresented by parallel gill nets. Gill nets also allowed us to determine that both fish species were present in the littoral and epibenthic habitats, but the pelagic habitat was used only occasionally by rainbow trout.

Another factor to be considered in future studies is that sport fishing shows size selectivity in relation to hook size and shape. In gill nets, smaller brook trout were caught in the shallow littoral habitat (0-5 m depths), whereas a wider size range of rainbow trout were caught in this habitat. Smaller sizes of both species were caught by fishers, probably due to gear selectivity. Both species showed specimens up to 7 years of age: fisher catches presented almost all age groups for rainbow trout but only the higher age classes for brook trout. This could have implications in terms of interpreting population size and age structure. This problem is more readily corrected with gill net fishing techniques and appropriate selectivity studies.

Weight length relationships derived from gill net catches were similar despite the net setting. However, this relationship showed a low fit in fisher catches. Rechencq (2003) showed that voluntary fishers on the Limay River were not consistent in the way they collected and recorded catch data, even when they had been specifically trained to do so. This seems also to be the case for fishers in this study were data inconsistencies attributable to lack of compliance with procedures set for weight scale calibration, length measurement and recording precluded the use of their data to analyze growth, length weight relationships and sex ratios.

The study clearly shows that for deep lakes, fishers have proven highly unreliable in terms of following data recording protocols and that their catches are extremely biased in relation to fish distribution. It could be argued that fisher bias could be dealt with through a tailored sampling design, but this would mean taking into consideration not only fishing mode, but also subdivisions within each fishing mode, each type of lure and each size and shape of hook in use. This would make any sampling design highly impractical. Fishers in Argentina have had a great deal of influence in the setting and implementation of management policies and strategies. Fisher demands for specific management action for Guillelmo lake are based on the derived catch perception that the fish community is dominated by a growth stunted rainbow trout population. As revealed by stratified gillnetting, the community is composed of two stunted populations where brook trout dominate. Fisher catch data are important because they describe actual fisheries occurring throughout the Patagonian Andean range. Specific fishery issues such as analyses of size limit regulations and catch quotas require information on fisher catches. If possible biases are accounted for, fisher logbooks may provide historical records of species-specific catch trends of particular environments, which could help to detect and analyze community or specific population structure changes (Vigliano et al. 1998).

While stratified gill net sampling may give a more representative image of fish communities and populations, it does not provide data on the actual fishery. It is also worth considering that as with any other sampling methodology gill net sampling is as representative as the sampling design allows. Studies of diverse structurally complex environments require complex stratified designs, which must take into account water body size, habitats, depth and season. This implies that adequate gill net sampling designs entail high logistic and human resource costs, which are not readily available in the region.

In the broad context of environments in the Patagonian Andean Range, where differing interest groups coexist (Vigliano & Alonso 2007) and economic resources for evaluation and monitoring studies are scarce. A strategic plan to manage fish resources in Patagonia should identify regional and local priorities in terms of sport fishery development and conservation issues and categorize environments in terms of existing knowledge. Specific objectives for environments, sub-basins or basins could be contrived and appropriate research and management programs that take economic constraints into consideration could be developed. Within this context those environments for which knowledge is null or scarce could initially be evaluated through gill net sampling and creel census and designs tailored to different ecological and management questions. The initial gill net evaluation could also be used to establish a schedule and sampling design for follow-up surveys, whereas creel census could be used to develop catch logbook programs that would provide actual fishery information. The most difficult part would be convincing fishers and their organizations that no single method provides the necessary information for sound management and that properly kept, standardized catch logbooks are essential for successful management.

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SUPPLEMENTARY INFORMATION

Gill net catches in the pelagic depth strata. Numbers, total weight (in kg) of catch and CPUE data: *Oncorhynchus mykiss.* Unit effort: 100 m^2 net/24 h fishing.

Captura por unidad de esfuerzo en número y en peso para el sistema de redes agalleras de los estratos pelágicos. *Oncorhynchus mykiss.* Unidad de esfuerzo: 100 m^2 de red/24 h de pesca.

Season	Strata	N	Weight	CPUEN	CPUEW
AUT97	PEL0	1	0.83	0.65	0.54
	PEL10	0	0	0	0
	PEL20	0	0	0	0
WIN97	PEL0	0	0	0	0
	PEL10	0	0	0	0
	PEL20	0	0	0	0
SPR97	PEL0	1	0.23	1.27	0.29
	PEL10	0	0	0	0
	PEL20	0	0	0	0
SUM98	PEL0	0	0	0	0
	PEL10	2	0.75	2.5	0.94
	PEL20	0	0	0	0
AUT98	PEL0	2	0.39	2.45	0.48
	PEL10	0	0	0	0
	PEL20	0	0	0	0
WIN98	PEL0	0	0	0	0
	PEL10	0	0	0	0
	PEL20	0	0	0	0
SPR98	PEL0	0	0	0	0
	PEL10	0	0	0	0
	PEL20	0	0	0	0
SUM99	PEL0	2	0.66	2.50	0.83
	PEL10	0	0	0	0
	PEL20	0	0	0	0

Gill net catches in the epibenthic depth strata. Numbers, total weight (in kg) of catch and CPUE by species, date and strata for Depth Strata System. *S.f*: *Salvelinus fontinalis*; *O.m*: *Oncorhynchus mykiss.* Unit effort: 100 m^2 net/24 h fishing.

Captura por unidad de esfuerzo en número y en peso del sistema de redes agalleras para el estrato epibentónico, por especies y estación del año. *S.f*: *Salvelinus fontinalis*; *O.m*: *Oncorhynchus mykiss.* Unidad de esfuerzo: 100 m^2 de red/24 h de pesca.

		S.f:		*O.m.*		*S.f:.*		*O.m.*	
Season	Strata	N	Weight	N	Weight	CPUEN	CPUEW	CPUEN	CPUEW
AUT97	EPI0	14	3.01	4	1.54	9.02	1.94	2.58	0.99
	EPI10	8	1.78	9	5.20	5.45	1.21	6.14	3.55
	EPI30	27	5.76	0	0	19.30	4.12	0	0
	EPI50	15	2.63	3	1.21	5.63	0.99	1.13	0.45
	Total	64	13.2	16	7.95	39.4	8.26	9.85	4.99
WIN97	EPI0	0	0	3	2.31	0	0	3.68	2.83
	EPI10	13	2.62	2	0.77	15.51	3.13	2.39	0.92
	EPI30	6	1.23	0	0	7.51	1.54	0	0
	EPI50	0	0	0	0	0	0	0	0
	Total	19	3.85	5	3.08	23.02	4.67	6.07	3.75
SPR97	EPI0	4	1.04	3	1.23	5.04	1.31	3.78	1.55
	EPI10	11	5.23	4	1.63	13.73	6.53	4.99	2.03
	EPI30	2	0.31	0	0	2.50	0.39	0	0
	EPI50	6	1.39	0	0	3.75	0.87	0	0
	Total	23	7.97	7	2.86	25.02	9.28	8.77	3.58
SUM98	EPI0	16	0.915	4	2.01	20.17	1.15	5.04	2.53
	EPI10	11	2.85	4	1.91	13.64	3.53	4.96	2.37
	EPI30	1	0.115	0	0	1.25	0.14	0	0
	EPI50	9	1.99	1	0.08	5.63	1.25	0.63	0.05
	Total	37	5.87	9	4.00	40.69	6.07	10.65	4.95
AUT98	EPI0	3	0.75	1	0.55	3.53	0.88	1.18	0.65
	EPI10	9	4.01	5	2.06	10.71	4.77	5.95	2.45
	EPI30	7	2.15	0	0	8.64	2.65	0	0
	EPI50	6	1.14	0	0	3.60	0.68	0	0
	Total	25	8.05	6	2.61	26.48	8.98	7.13	3.10
WIN98	EPI0	1	0.82	1	0.62	1.12	0.92	1.12	0.69
	EPI10	6	1.53	3	0.92	6.67	1.71	3.33	1.02
	EPI30	4	0.36	0	0	4.53	0.41	0	0
	EPI50	4	1.25	0	0	2.26	0.71	0	0
	Total	15	3.96	4	1.54	14.68	3.75	4.45	1.71
SPR98	EPI0	12	1.50	4	1.07	14.52	1.82	4.84	1.29
	EPI10	6	1.52	2	0.40	6.67	1.74	2.22	0.44
	EPI30	9	0.47	0	0	10.21	0.53	0	0
	EPI50	10	1.23	0	0	5.68	0.70	0	0
	Total	37	4.72	6	1.47	37.08	4.79	7.06	1.73
SUM99	EPI0	1	0.55	2	0.71	1.26	0.68	2.52	0.88
	EPI10	11	3.50	6	2.07	13.75	4.37	7.50	2.58
	EPI30	9	1.20	3	1.04	11.26	1.50	3.75	1.30
	EPI50	5	1.01	0	0	6.27	1.26	0	0
	Total	26	6.26	11	3.82	32.54	7.81	13.77	4.76

Number, total weight (kg) of gill net catches perpendicular to the coast line and CPUE by species, season and surface and deep strata. *S.f*: *Salvelinus fontinalis*; *O.m*: *Oncorhynchus mykiss.*

Captura por unidad de esfuerzo en número y en peso (kg) por especie, estación del año y sistema de redes agalleras perpendicular a la costa en el estrato superficial y en profundidad. *S.f*: *Salvelinus fontinalis*; *O.m*: *Oncorhynchus mykiss.*

		S.f.		O.m.		S.f.		O.m.	
Season	Strata	N	Weight	N	Weight	CPUEN	CPUEW	CPUEN	CPUEW
AUT97	PCS	32	5.05	1	0.622	41.56	6.57	1.30	0.45
	PCD	13	6.92	5	2.48	16.88	8.99	6.49	0.81
	Total	45	11.97	6	3.10	58.44	15.56	7.79	1.26
WIN97	PCS	2	0.33	0	0.00	4.76	0.79	0	0
	PCD	0	0.00	1	0.295	0	0	2.70	0.80
	Total	2	0.33	1	0.295	4.76	0.79	2.7	0.8
SPR97	PCS	5	1.37	4	1.99	11.23	3.09	8.98	4.48
	PCD	3	0.125	2	0.46	8.31	0.35	5.54	1.29
	Total	8	1.49	6	2.45	19.54	3.44	14.52	5.77
SUM98	PCS	9	0.69	1	0.60	22.5	1.73	2.50	1.50
	PCD	11	3.70	6	2.90	27.5	9.25	15.0	7.25
	Total	20	4.49	7	3.50	50	10.98	17.5	8.75
AUT98	PCS	18	3.92	1	0.01	49.85	10.86	2.77	0.12
	PCD	2	0.64	4	2.09	4.49	1.45	8.98	4.70
	Total	20	4.56	5	2.10	54.34	12.31	11.75	4.82
WIN98	PCS	3	0.59	2	0.30	7.50	1.46	5.00	0.74
	PCD	2	0.63	0	0	4.05	1.28	0	0
	Total	5	1.22	2	0.30	11.55	2.74	5.00	0.74
SPR98	PCS	16	2.14	3	1.28	42.00	5.60	7.88	3.36
	PCD	9	2.12	3	0.79	16.78	3.94	5.59	1.46
	Total	25	2.26	6	2.07	58.78	9.54	13.47	4.82
SUM99	PCS	1	0.01	1	0.16	2.76	0.01	2.76	0.43
	PCD	8	3.05	7	2.08	17.96	6.86	15.71	4.67
	Total	9	3.06	8	2.24	20.72	6.87	18.47	5.10

Total length (TL) and weight (TW) by species,depth stratum and season according to gill net catches. Standard deviations between parentheses. *S.f*: *Salvelinus fontinalis*; *O.m*: *Oncorhynchus mykiss*

Largo total (TL) y peso (TW) por especies, capturadas por las redes agalleras según estrato de profundidad y estación del año. *S.f*: *Salvelinus fontinalis*; *O.m*: *Oncorhynchus mykiss*. Desviación estándar entre paréntesis.

		S.f.		O.m.	
Season	STRATA	TL	TW	TL	TW
AUT97	EPI0	263.6 (70.1)	214.8 (164.7)	326.2 (58.9)	385.5 (191.9)
	EPI10	268.6 (76.1)	223.2 (181.6)	369.4 (74.5)	579.9 (320.7)
	EPI30	272.9 (46.0)	213.5 (99.4)		
	EPI50	258.8 (40.9)	175.7 (77.1)	340.0 (45.4)	403.3 (146.6)
	PEL0			456.0 (0)	838.0 (0)
	PCS	245.5 (44.9)	158.0 (71.0)	378.0 (0.0)	622.0 (0)
	PCD	358.0 (55.8)	532.6 (187.3)	346.0 (40.5/0	496.0 (196.3)
WIN97	EPI0			363.3 (129.6)	770.0 (495.6)
	EPI10	261.5 (58.8)	201.9 (124.1)	320.0 (65.0)	385.0 (195.0)
	EPI30	274.2 (44.1)	205.0 (83.1)		
	PCS	255.0 (5.0)	165.0 (5.0)		
	PCD			310.0 (0)	295.0 (0)
SPR97	EPI0	272.5 (87.0)	260.7 (266.5)	344.7 (46.3)	410.7 (144.0)
	EPI10	363.5 (30.2)	475.9 (87.2)	347.2 (56.6)	407.5 (132.9)
	EPI30	220.0 (80.0)	155.5 (130.5)		
	EPI50	286.5 (32.4)	231.8 (61.8)		
	PEL0			275.0 (0)	230.0 (0)
	PCS	294.8 (20.1)	275.0 (55.7)	374.7 (21.5)	498.7 (28.1)
	PCD	156.3 (21.2)	41.67 (17.0)	281.5 (58.5)	233.0 (137.0)
SUM98	EPI0	172.2 (35.5)	57.2 (41.8)	351.2 (128.9)	502.5 (382.7)
	EPI10	281.8 (101.4)	259.1 (212.2)	377.5 (28.83)	477.5 (80.3)
	EPI30	225.0 (0)	115.0 (0)		
	EPI50	270.0 (66.8)	221.7 (119.1)	210.0 (0)	75.0 (0)
	PEL10			332.5 (17.5)	372.5 (87.5)
AUT98	EPI0	174.0 (60.9)	58.3 (54.2)	390.0 (0)	555.0 (0)
	EPI10	341.0 (90.5)	445.0 (244.1)	324 (95.9)	413.0 (355.6)
	EPI30	305.7 (64.5)	306.1 (166.9)		
	EPI50	251.2 (57.6)	189.2 (149.3)		
	PEL0			270.0 (15)	192.5 (32.5)
WIN98	EPI0	430.0 (0)	820.0 (0)	400.0 (0)	615.0 (0)
	EPI10	299.7 (52.4)	255.8 (125.4)	311.7 (62.5)	305.0 (180.3)
	EPI30	218.5 (10.6)	90.0 (15.4)		
	EPI50	300.2 (102.8)	312.5 (215.8)		
SPR98	EPI0	217.9 (54.9)	125.4 (91.8)	275.0 (51.4)	267.5 (77.7)
	EPI10	267.5 (86.6)	254.2 (185.6)	260.0 (10.0)	210.0 (35.0)
	EPI30	153.9 (43.7)	52.22 (51.1)		
	EPI50	208.0 (60.4)	122.5 (96.8)		
SUM99	EPI0	350.0 (0)	545.0 (0)	310.0 (60.0)	352.5 (177.5)
	EPI10	290.0 (48.5)	318.2 (146.8)	310.8 (69.5)	345.0 (159.0)
	EPI30	221.1 (33.4)	133.3 (7037)	315.0 (35.6)	346.7 (94.3)
	EPI50	271.0 (62.6)	201.0 (93.7)		
	PEL0			322.5 (22.5)	327.5 (32.5)