

Recent changes in fish assemblages of a lentic-lotic system in Central Italy (Lake Posta Fibreno, Latium), with remarks on salmonids situation

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SUMMARY - *Cambiamenti recenti delle comunità ittiche di un sistema lentic-lotico dell'Italia centrale (Lago di Posta Fibreno, Lazio), con osservazioni sui salmonidi* - Fish assemblages of a lentic-lotic hydrographic system in Central Italy (Latium), undergoing alterations in streams riparian canopy and lake submerged vegetation, were investigated from September 2004 to December 2007. Changes in the composition of ichthyofauna of the system were highlighted, providing original information on presence and distribution of taxa within the water system. Qualitative data were collected by means of electrofishing in the water courses and by frequent fishermen's gears control, day and night scuba-diving and snorkeling *visual census* in the lake area. Quantitative data on salmonids derived from 1-2 electrofishing catches in the four streams of the system. An increase of six taxa emerged from the comparison with previous available data, with a total number of 17 taxa recorded. All recently appeared taxa are cyprinids or poecilids, indicating a warm-water species invasion of this hydrographic basin in the last two decades. Noteworthy is the occurrence of five species of European interest (Habitat Directive 1992/43/CEE), plus the endemic taxon *S. fibreni* (astoundingly not included in the Directive), making this small system a relevant conservation challenge to deal with. Our data outline a changing process in the fish assemblages of this system with significant qualitative alterations. Quantitative investigations showed low numbers of salmonids (*Salmo trutta macrostigma* and *Salmo fibreni*), with marked differences among streams. Thus, further essential observations, in progress at present, are needed.

RIASSUNTO - *Recent changes in fish assemblages of a lentic-lotic system in Central Italy (Lake Posta fibreno, Latium), with remarks on salmonids* - Tra settembre 2004 e dicembre 2007 è stata condotta un'indagine sui popolamenti ittici di un sistema idrografico lentic-lotico dell'Italia centrale (Lazio), sottoposto ad alterazioni della vegetazione riparia dei corsi d'acqua e di quella lacustre sommersa. L'indagine evidenzia i cambiamenti occorsi recentemente nella composizione dell'ittiofauna del sistema, fornendo informazioni originali sulla sua presenza e distribuzione. I dati qualitativi sono stati raccolti tramite campagne di pesca elettrica nei corsi d'acqua, frequenti controlli degli attrezzi da pesca e osservazioni subacquee (*visual census*) diurne e notturne. I dati quantitativi sui salmonidi derivano da uno-due pescate con elettrostorditore nei quattro torrenti dell'area. Dal confronto con i dati pregressi disponibili emerge un incremento di 6 taxa, con un totale di 17 taxa osservati. I taxa apparsi di recente sono ciprinidi o pecilidi, ad indicare nei due decenni passati una invasione del sistema da parte di specie termofile. Si nota la presenza di 5 specie in Direttiva Habitat (1992/43/CEE), oltre al salmonide endemico *S. fibreni* (incredibilmente non incluso in Direttiva), che rendono questo sistema una interessante sfida per la conservazione. Le nostre osservazioni testimoniano un cambiamento in atto nei popolamenti ittici del sistema, e i dati quantitativi sui salmonidi indicano basse densità delle specie presenti (*Salmo trutta macrostigma* e *Salmo fibreni*), con marcate differenze tra i corsi d'acqua. Si ritengono necessari, se non essenziali, altri approfondimenti sul tema.

Keywords: Fibreno water system, fish assemblages, changes monitoring, endemic species

Parole chiave: Sistema del Fibreno, popolamento ittico, monitoraggio dei cambiamenti, specie endemiche

1. INTRODUCTION

Central and Southern Italy show many hydrological basins in which diversity and ecology of fish assemblages is still quite unknown, or represented by very few and old data. The general overwhelming environmental changes, involving surficial water systems as a whole, impose the difficult task of deepening and updating this knowledge, with the goal of starting and maintaining routinary scientific monitoring as a base for correct managing practices.

This work is aimed to contribute to the above general purpose, dealing with the present composition of fish assemblages of a little lentic-lotic water system in Central

Italy: the Lake Posta Fibreno, the River Fibreno, and their tributaries. This cold water system is very interesting for the occurrence of some fish taxa, including salmonids, of high conservation relevance with respect to the European Community Habitat Directive (1992/43/CEE) and for the presence of the endemic species *Salmo fibreni* (Zerunian & Gandolfi 1990) whose populations urgently need preservation efforts (Zerunian 1990, 2002). The perception of an existing worsening of the present environmental conditions of these waters, and of an intensification of human impact on fish communities and on single species in this area, prompted us to investigate on the current composition of fish assemblages of the Lake Fibreno system, to update

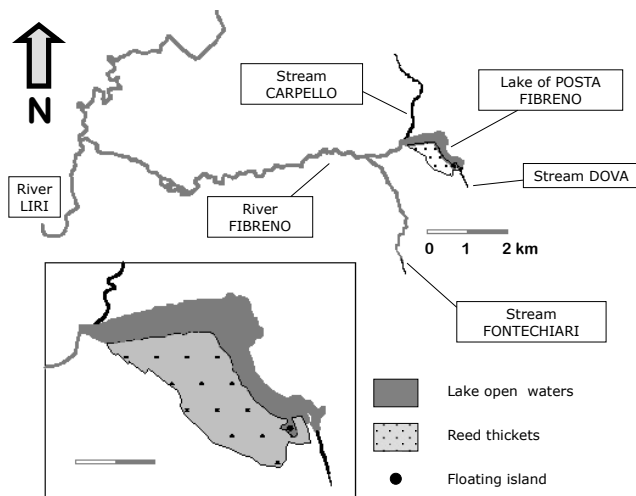


Fig. 1 - Sketch map of the Fibreno water system, including the Lake Posta Fibreno, the Streams Dova, Carpello and Fontechiari, and the River Fibreno. The portions of lake area characterized by open waters and reed thicket are evidenced.

Fig. 1 - Mappa schematica del sistema idrologico del Fibreno, comprendente il Lago di Posta Fibreno, i torrenti Dova, Carpello e Fontechiari, il Fiume Fibreno. Le porzioni di superficie lacustre caratterizzata da acque libere e da canneto sono evidenziate.

our scarce knowledge on this subject, and to provide a reference term for future monitoring in this field. In particular, some quantitative aspects of salmonid populations in the lentic-lotic system were also investigated, with the aim to start a reference evaluation of their abundance, useful in future managing activities.

2. STUDY AREA AND METHODS

The karstic hydrographic system of Lake Posta Fibreno (285 m a.s.l.) is originated by a complex of cold freshwater resurgence springs (about 10-11 °C all over the year), which create and feed a unique lake basin (1.9 km length and 0.1-0.3 km width, total surface area about 0.3 km², maximum depth about 15 m, mean depth 2.7 m). The mean estimated water outflow of Fibreno is about 10 m³ sec⁻¹ (Carbone 1965): even if this outflow has recently reduced, a lake water renewal time of less than 1 day results from a simple calculation. The elongated shape of the lake and the constant water supply give it a lotic character, with slow running water in the longitudinal axis of the lake, and still waters along the shores, especially in the first half of the western side, covered by dense reed thicket which are crossed by narrow channels, these last not represented in the sketch map (Fig. 1). The deeper parts of the lake have a muddy bottom, often covered by submerged macrophytes. Some little tributaries enter directly the lake (Dova and Carpello), while the River Fibreno outflows from the lake, then receiving the waters of Fontechiari stream (see Fig. 1). A Regional Natural Reserve including the lake, streams Dova and (partly) Carpello and Fibreno was instituted on January the 29th 1983, but it has been effectively working since a few years.

Observations and samplings were carried out from September 2004 up to December 2007, in order to collect ecological and ichthyological information about Dova, Carpello, Fontechiari and Fibreno streams, and the Lake of Posta Fibreno. A field data sheet was compiled for all the streams to describe stream bed, riparian and submerged vegetation, anthropogenic interventions along the stream course (such as weirs, water uptakes, canalization, discharges, human residence proximity, etc.). The lake water main characteristics derived from reference data (LIMNO Project 2004, Mastrantuono & Di Vito, 2007).

Fish catches in the four streams were performed by electrofishing (one or two catches per stream, along a 100 m transect, all conducted avoiding the salmonids reproductive period), applying the *removal method* (Zippin 1956, Peterson *et al.* 2004) to obtain an evaluation of the trout populations density. The annual catches of breeding specimens of *Salmo (trutta) macrostigma* Duméril 1858, aimed at the restocking of the Lake of Posta Fibreno and its tributaries, also provided further qualitative information. Due to the difficulties of electrofishing and to the need of keeping the populations of *S. (trutta) macrostigma* and *S. fibreni* as undisturbed as possible by avoiding any risk to specimens, the observations were performed in the lake by snorkeling and scuba diving *visual census* (see Bresse *et al.* 2001); observations were made monthly from September 2006 to July 2007, both during day and night, with the aid of an artificial light during the latter. All the zones of the lake which are accessible to snorkeling and scuba diving are called "open waters" hereafter. The information about fish presence in much vegetated zones and channels in reed thicket were obtained by the repeated controls of local fishermen gears, called "bertavelli" and "martavellini". These sort of net traps (pots) have different size (respectively, max. opening diameter = 80 cm, max. length = 180 cm, mesh size = 15 mm; max. opening diameter = 40 cm, max. length = 60 cm, mesh size = 7 mm), and the first are commonly used to catch cyprinids, eels and trouts, while the second for three-spined stickleback. The presence of larvae of European brook lamprey (*Lampetra planeri* Bloch 1784) was investigated by sieving portions of suitable sediments both in stream beds and in lake littoral bottom.

3. RESULTS

Recent lake water physico-chemical characteristics are reported in Table 1.

3.1. Qualitative aspects

The temperature of spring waters is constant at about 10 °C and many underwater springs are distributed all along the east side and the centre of lake bottom, which is mainly constituted of mud, once mostly covered by submerged macrophytes (about 80% of surface, Zerunian 1988) which are now dramatically reduced (about 20-25% of surface, D'Orsi, pers. comm.).

The analysis of the compiled field data sheet evidenced some relevant changes in the originary morphology and structure of the main stream courses of the hydrographic basin, consisting of:

- strong reduction of primary vegetation in the floo-

Tab. 1 - Annual mean values of chemical and physical main characteristics of Lake Posta Fibreno waters in 1998 (LIMNO Project) and 2004 (from Mastrantuono & Di Vito 2007).

Tab. 1 - Valori medi annui delle principali caratteristiche chimico-fisiche delle acque del Lago di Posta Fibreno nel 1998 (Progetto LIMNO) e nel 2004 (da Mastrantuono & Di Vito 2007).

Year	pH	Conductivity ($\mu\text{S cm}^{-1}$)	Total Dissolved Solids (mg l^{-1})	Temperature ($^{\circ}\text{C}$)	Dissolved oxygen (mg l^{-1})	NO_3 (mg l^{-1})	PO_4^{3-} ($\mu\text{g l}^{-1}$)
1998	7.04	407	-	-	9.25	3.2	30
2004	7.13	613	349.2	10.6	11.1	0.2	109

- dplain of all the streams;
- substitution of natural vegetation with cultivated areas;
- extension of cultivated soils up to the riparian edge of the streams;
- strong reduction of riparian canopy;
- substitution of riparian plant species (if present) with secondary, or cultivated, or domestic ones;
- dirt roads running close to the edge of water, or on the top of river banks.

Modifications of lacustrine environment are mainly related to:

- increased water captation from both springs and lake;
- unauthorized domestic discharges;
- increased agricultural impact;
- changes in the traditional water vegetation management (no further harvesting since 1970);
- filling of channels with sediments in the reed thicket;
- damages to riparian and submerged vegetation and to shore banks of rivers and lake exerted by a recently settled population of coypus (*Myocastor coypus*) and a strongly increasing winter occurrence of coots (*Fulica atra*).

From the analysis of data collected during the sampling period, a total of 17 fish species were identified in the lake and streams as a whole (Table 2).

The fish assemblage of River Fibreno showed the highest number of taxa ($n = 13$) in respect to the other stream environments sampled (n from 5 to 9). This is probably due to substantially larger dimensions of the water course, to its higher environmental patchiness and to the direct connection to the much larger hydrographic basin of the River Liri-Garigliano. The higher number of fish taxa ($n = 9$) in the streams Carpello and Fontechiari (directly connected to the River Fibreno) compared to Dova, mainly depends on the absence in this stream of reophilic (*R. rubilio*, *L. cephalus*, *L. souffia*, *Barbus plebejus*) and still water (*Carassius auratus*, *Scardinius erythrophthalmus*) cyprinid taxa, and on the presence of *Lampetra planeri*. The lowest number of taxa was thus recorded in stream Dova ($n = 5$), located at the upstream side of Lake Fibreno (cfr. Fig. 1); the short length, smaller size and the constantly low temperatures probably prevented it from being colonized by the cyprinid taxa occurring in the sy-

stem, which are more thermophylic.

The lacustrine habitats resulted to host up to 11 fish taxa, 6 of which diffused in the open waters and in the more lotic part of this environment; 8 taxa resulted to be present in the channels of the reed thicket and in the more vegetated areas of the lake. Apparently, *Anguilla anguilla* and *Gasterosteus aculeatus* occurred in both the open waters and the reed habitats with no depth limitation, while *Gambusia holbrooki* showed to be confined to densely vegetated, shallow coastal waters.

On the whole, the stream habitats share with the lacustrine ones only 6 taxa, the most diffused species as to their presence in the entire lentic-lotic environments being the three-spined stickleback *Gasterosteus aculeatus*, the mediterranean trout *Salmo (trutta) macrostigma* and the ubiquitous european eel, *Anguilla anguilla*.

The small lentic-lotic system of Fibreno was found to harbour five species of EC interest (including Cyclostomata): *Lampetra planeri*, *Barbus plebejus*, *Leuciscus souffia*, *Rutilus rubilio*, *Salmo (trutta) macrostigma*. This last species is considered priority at an european level. Another very important presence in the Lake Posta Fibreno and in Dova stream only, is the small salmonid *Salmo fibreni*, an endemism of this unique site with a still unknown biology and ecology (Zerunian & Gandolfi 1990). Astoundingly, neither it is included in the taxa list of Habitat Directive, nor in the IUCN red list, as it should be highly recommendable.

Comparing the results of the present work with previous information on the Posta Fibreno system ichthyofauna (Chiappi 1924, Carbone 1965, Bruno 1985) an increase in the number of taxa apparently occurred up to now. As the information about the fishing methods used in the above cited previous literature is critically revised and integrated by Zerunian (1988), and this last constituted our method reference in the comparison (Table 3), it seems the present higher taxa richness in not an effect of a more intense sampling effort, but an actual increase. In particular, this increase was due to the appearance of three more or less rheophylic cyprinid species (*R. rubilio*, *Gobio gobio* and *L. cephalus*), the littoral phytophilyc species *Scardinius erythrophthalmus*, and an introduced exotic species, *Gambusia holbrooki*. The occurrence of *Oncorhynchus mykiss*, sporadically found, derived from rare events of adult fish stocking with this species, nowadays no longer introduced.

Tab. 2 - List of fish taxa and Cyclostomata taxa collected/observed in the system of Posta Fibreno during the period 2004-2007, with their occurrence (⊕) in the different habitats investigated. Boldface highlights species listed in the Habitat Directive (92/43/CEE).

Tab. 2 - Lista delle specie ittiche e dei ciclostomi raccolti/osservati nel sistema di Posta Fibreno nel periodo 2004-2007, con la presenza (⊕) nei vari habitat indagati. In grassetto le specie elencate in Direttiva Habitat (92/43/CEE).

Species	Lake of Posta Fibreno					
	Dova	Open waters	Channels and shores	Carpello	Fibreno	Fontechiari
1 <i>Lampetra planeri</i> Bloch 1784				⊕*		
2 <i>Anguilla anguilla</i> (Linn. 1758)	⊕	⊕	⊕	⊕	⊕	⊕
3 <i>Rutilus rubilio</i> (Bonaparte 1837)				⊕	⊕	⊕
4 <i>Leuciscus cephalus</i> (Linn. 1758)			⊕	⊕	⊕	⊕
5 <i>Leuciscus souffia</i> Risso 1826				⊕	⊕	⊕
6 <i>Tinca tinca</i> (Linn. 1758)			⊕			
7 <i>Scardinius erythrophthalmus</i> (Linn. 1758)			⊕	⊕	⊕	⊕
8 <i>Gobio gobio</i> (Linn. 1758)					⊕	
9 <i>Barbus plebejus</i> (Bonaparte 1839)					⊕	⊕
10 <i>Carassius auratus</i> (Linn. 1758)			⊕		⊕	⊕
11 <i>Cyprinus carpio</i> Linn. 1758			⊕		⊕	
12 <i>Salmo (trutta) trutta</i> Linn. 1758	⊕	⊕		⊕	⊕	
13 <i>Salmo (trutta) macrostigma</i> Duméril 1858	⊕	⊕		⊕	⊕	⊕
14 <i>Salmo fibreni</i> Zerunian & Gandolfi 1990	⊕	⊕				
15 <i>Oncorhynchus mykiss</i> Walbaum 1792					⊕	
16 <i>Gambusia holbrooki</i> Girard 1859		⊕	⊕			
17 <i>Gasterosteus aculeatus</i> Linn. 1758	⊕	⊕	⊕	⊕	⊕	⊕
Total number of taxa	5	6	8	9	13	9

11

* = Only adults collected by electrofishing.

3.2. Quantitative aspects

Most of the recent information coming from fishermen reported a general, sharp decrease of fish abundances occurred during at least the last two decades, especially in the numbers of *Salmo (trutta) macrostigma*, *Salmo fibreni* and *Gasterosteus aculeatus*, traditional targets of local fishing activities. With the aim to quantitatively describe the local populations of salmonids, we performed one electrofishing sampling in each stream of the system in 2007, and repeated the sampling in 2008, with the exception of Stream Dova and Carpello (due to technical problems). In table 4 some data referring to the quantitative samplings are reported. During 2007 Carpello and Fibreno showed the highest numbers of catches, followed by Dova (contemporary catches of *Salmo (trutta) macrostigma* and *Salmo fibreni*) and Fontechiari with very few specimens. The mean total length of specimens in 2007 is very similar in Fibreno and Dova for *S. (t.) macrostigma* but quite lower in Fontechiari and Carpello. In 2008

catches decreased in the river Fibreno and increased in the Stream Fontechiari, so they appeared substantially similar as regards to the number of catches, standing stock (following Zippin 1956) and density of population. However, the very different weight of trouts in the two water courses underline the substantial riverine character of River Fibreno, with much higher water flow and habitat availability with respect to Fontechiari stream. Stream Carpello shows intermediate mean values of total length and weight, while stream Dova, harbouring the two species *Salmo (trutta) macrostigma* and *Salmo fibreni*, shows surprisingly high mean size values (both of length and weight) for its small dimensions, and relative densities as high as the ones observed in the stream Carpello.

In figure 2 length-weight relationships are shown of the same sampling dates we referred to in table 4. Trout population of stream Carpello appear to have the most regular distribution of individuals, and perhaps also the Fibreno population, although scarce in smaller sizes, does have one. The Fontechiari population seems to be poor and lacking

Tab. 3 - Comparison between the lists of fish taxa and Cyclostomata deriving from previous studies and from the present work. Letters (indicating methods of capture/observation) as follows: E = Electrofishing; N = Nets traps; V = Visual census. Boldface highlights species listed in the Habitat Directive (92/43/CEE).

Tab. 3 - Comparazione tra la lista delle specie ittiche e dei ciclostomi risultante da studi precedenti e quella derivante dal presente studio. Le lettere indicano come segue i metodi di cattura/osservazione: E = Pesca elettrica; N = Pesca con nasse; V = Visual census. In grassetto le specie elencate in Direttiva Habitat (92/43/CEE).

Species	Up to 1988	2004 2007	Methods
1 Lampetra planeri Bloch 1784	⊕	⊕	E
2 <i>Anguilla anguilla</i> (Linn. 1758)	⊕	⊕	E-N-V
3 Rutilus rubilio (Bonaparte 1837)		⊕	E
4 <i>Leuciscus cephalus</i> (Linn. 1758)		⊕	E-V
5 Leuciscus souffia Risso 1826	⊕	⊕	E
6 <i>Tinca tinca</i> (Linn. 1758)	⊕	⊕	N
7 <i>Scardinius erythrophthalmus</i> (Linn. 1758)		⊕	E
8 <i>Gobio gobio</i> (Linn. 1758)		⊕	E
9 Barbus plebejus (Bonaparte 1839)	⊕	⊕	E
10 <i>Carassius auratus</i> (Linn. 1758)	⊕	⊕	N-E
11 <i>Cyprinus carpio</i> Linn. 1758	⊕	⊕	E-N-V
12 <i>Salmo (trutta) trutta</i> Linn. 1758	⊕	⊕	E
13 Salmo (trutta) macrostigma Duméril 1858	⊕	⊕	E-V
14 <i>Salmo fibreni</i> Zerunian & Gandolfi 1990	⊕	⊕	E-N-V
15 <i>Oncorhynchus mykiss</i> Walbaum 1792		⊕	E
16 <i>Gambusia holbrooki</i> Girard 1859		⊕	V
17 <i>Gasterosteus aculeatus</i> Linn. 1758	⊕	⊕	E-N-V
Total number of taxa	11	17	

(especially in the mean-large sizes), showing a possible small size recruitment in 2008. In stream Dova, especially *S. fibreni* shows a quite even distribution, with a clear lack in the smaller sizes.

4. DISCUSSION AND CONCLUSIONS

From the results above emerges the remarkably high number of EC interest taxa observed in the Posta Fibreno system ($n = 5$), if compared to the total number of fish taxa recorded ($n = 17$) and to the really small surface area considered, a quite exceptional situation in Central Italy hydrographic systems, and elsewhere, too. Moreover, it has to be considered that streams Dova, Carpello and Fontechiari are all short fifth order streams, while the river Fibreno is only a fourth order water course. The increase in the number of taxa registered in 2004-2007 (six species added) included one more species of community interest, *Rutilus rubilio*, endemic of the Central-Southern Italian ichthyogeographic

district (Gandolfi *et al.* 1991), already commonly recorded in the hydrographic system of Liri-Garigliano, and only two allochthonous exotic species, *Oncorhynchus mykiss* and *G. holbrooki*. On this respect, the Posta Fibreno system seems to have resisted to the generalized invasion by exotic (alien) taxa occurred in Italy in the last decades (Zerunian 2002; Gelosi & Colombari 2004). In our opinion, this can be explained by the strong character of salmonid streams of these water courses (relevant discharge and constantly cold water temperatures all over the year), and by the low trophic level of the lake, maintained by its very fast water renewal time in spite of the high concentration of reactive phosphorous in the waters. Moreover, since some weirs exist across the Rivers Fibreno (near Carnello village) and Liri (in which River Fibreno flows) which cannot be easily overcome (> 1 m high), these probably prevented the less rheophilic ciprinids by autonomously moving up to the upper Fibreno system. These observations seem to outline a still good condition of the water system studied in respect to the past. Nevertheless, it is evident the lake and

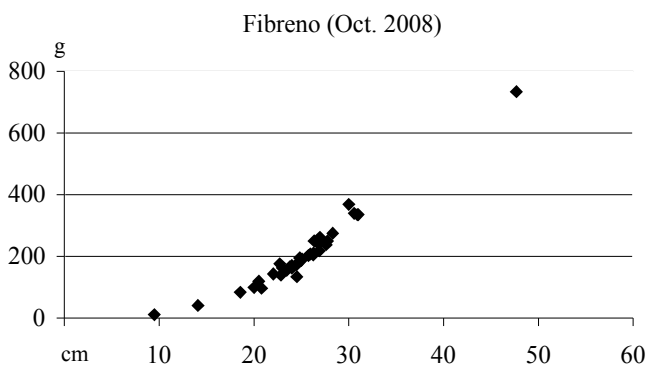
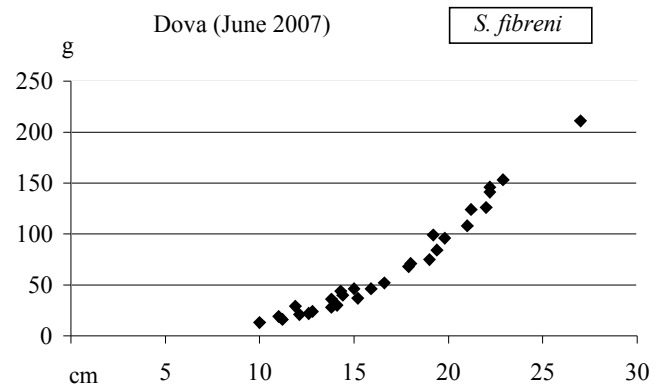
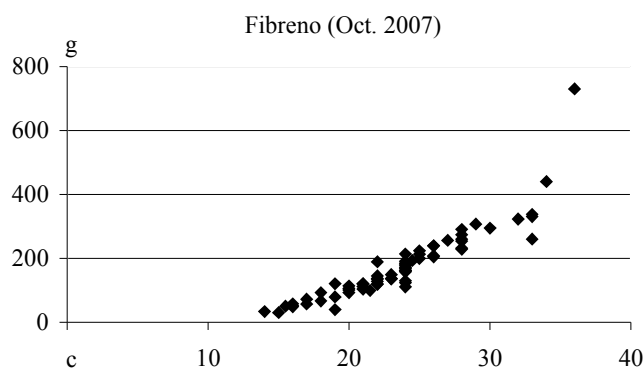
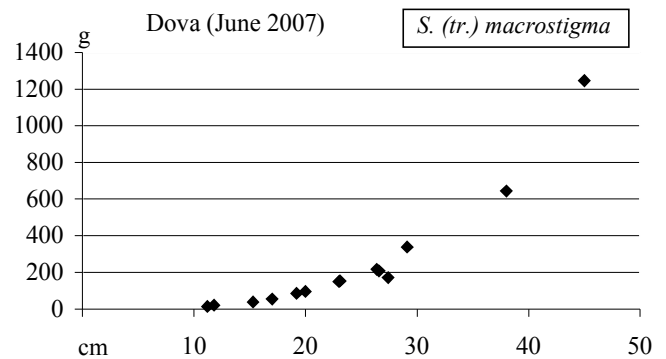
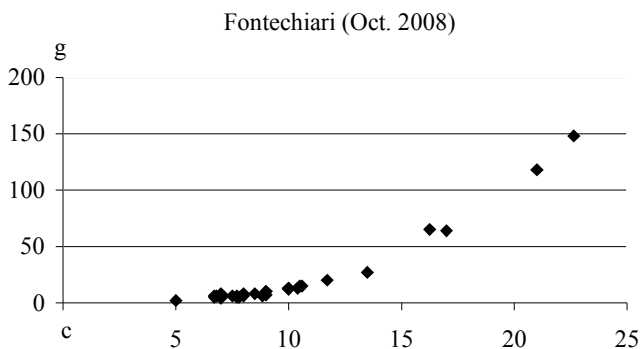
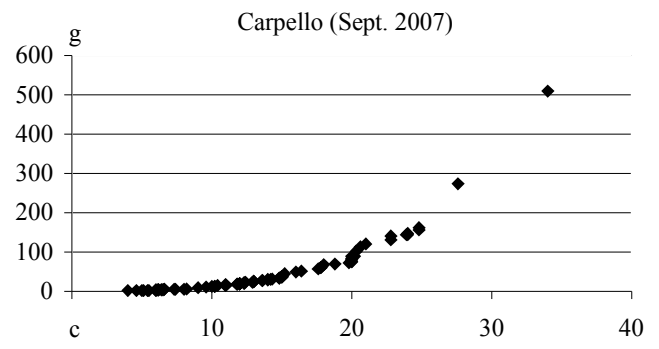
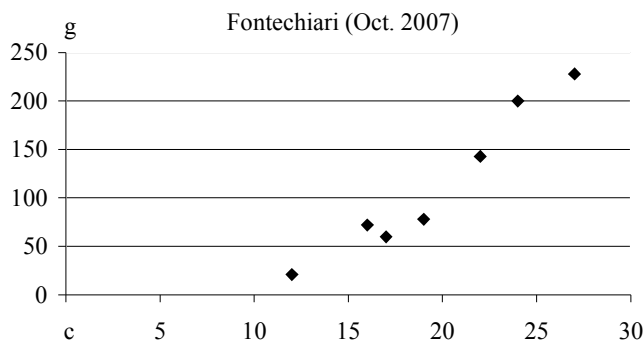


Fig. 2 - Length-weight relationships of *Salmo (trutta) macrostigma* and *Salmo fibreni* sampled in the different streams of Fibreno system. Only in the stream Dova both species occur.

Fig. 2 - Relazioni lunghezza-peso per *Salmo (trutta) macrostigma* e *Salmo fibreni* campionate nei vari torrenti del sistema del Fibreno. Solo nel torrente Dova le due specie sono entrambe presenti.

its tributaries have suffered a process affecting the mean temperatures (especially of some traits of the streams and the lake littoral) probably through the reduction of riparian canopy, with consequent increased exposure of shallow waters to the sun radiation. This phenomenon favoured the colonization and settlement by cyprinid species which are

not properly cold water fishes, or salmonids-accompanying taxa (i.e. *Leuciscus cephalus*, *Rutilus rubilio*, *Scardinius erythrophthalmus*), and the occurrence of the thermophilic, exotic *Gambusia holbrooki*, probably introduced directly by man in the lacustrine environment.

The warning signals coming from local fishermen

Tab. 4 - Length, weight, numbers of caught individuals and estimated densities of salmonids from streams of Posta Fibreno system.
 Tab. 4 - Peso, lunghezza, numero di individui catturati e densità stimate dei salmonidi presenti nei corsi d'acqua del sistema di Posta Fibreno.

		Dova 2007 <i>S. macrost.</i>	Dova 2007 <i>S. fibreni</i>	Carpello 2007	Fibreno 2007	Fibreno 2008	Fontechiari 2007	Fontechiari 2008
Total length (cm)	min.	11.2	10	4	14	9.5	12	5
	mean	23.8	16.8	13.8	23.5	25	19.6	9.7
	max	45	27	34	36	47.7	27	22.6
Weight (g)	min.	14	13	2	31	11	21	2
	mean	245.7	69.1	49.3	174	205.9	107.1	19.5
	max	1247	211	510	730	733	228	148
Number of catches	(ind)	14	29	82	69	37	7	34
Standing stock*	(ind)	32	58	123	77	41	8	41
Density	(ind m ⁻²)	0.09	0.16	0.25	0.19	0.1	0.03	0.16

* Following Zippin (1956).

about the reduction of target species such as *Salmo (trutta) macrostigma* is to be carefully considered in the view of managing intervention: we have numerical evidence of this in the reduction of catches reported by anglers, and in the low densities showed by preliminary data we collected on salmonids of the water courses of Posta Fibreno system. The shift of the local fish assemblages toward a community in which cyprinids get more represented, prompt us to think salmonids are exposed to increasing competitive pressure, probably produced both by a single, direct competitor as well as by a set of environmental modifications. In the stream Fontechiari, where at the end of 2007 a selective eradication of about 1000 individuals of *Leuciscus cephalus* was performed (D'Orsi, pers. comm.), the apparent recruitment of young *S. (trutta) macrostigma* (see Fig. 2) clearly demonstrate the predator-prey relationship existing between the first and the last species. The quantitative observations carried out in the lake by means of *visual census* allowed us to partially confirm the fishermen statements of salmonids decrease, with particular reference to *Salmo fibreni*, which occurred in very low numbers all over the period of study (D'Orsi & Seminara 2010).

An additional concern relates to this same taxon. During our work emerged a clear preference of *S. fibreni* for nocturnal vs. diurnal movements, a more sedentary behaviour compared to *S. (trutta) macrostigma*, a close proximity to rocky refuges (already reported by Zerunian & Gandolfi 1990), cobblestone bottom (even artificial), spring bottom resurgences: this behaviour probably tends to relegate *S. fibreni* to more "upstream" and/or localized habitats, thus reducing its spatial distribution in the whole environment and enhancing the risk of extinction. The presence of a recently settled colony of wintering great cormorant (*Phalacrocorax carbo sinensis*, Brunelli *et al.* 2004), grown up to about 100 individuals (Celauro, pers. comm.), is to be added to the risk factors affecting salmonid species in the lake, and increases the need for a careful evaluation of specific intervention.

In conclusion, our data outline an existing change process in the fish assemblages of the Posta Fibreno lentic-lotic system, which already produced significant qualitative alterations in this community and seems to cause also quantitative modifications in fish numbers we are trying to quantify at present. Further studies aimed at the quantitative monitoring of salmonids, at their reproductive biology, life history, trophic preferences and role in the lake food web, are certainly needed to deepen our knowledge about this precious habitat and to develop rigorous and sustainable management policies.

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