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Recent contributions to the distribution of the freshwater ichthyofauna in Greece

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Abstract

In this paper we supplement Greece's recent annotated inventory of freshwater fishes per hydrographic basin with recent distributional data and taxa alteration information, based on field sampling and a literature review up to September 2011. We report on newly documented distributional records of 31 fish species plus one unidentified taxon, within 35 hydrographic river basin units in Greece. These new records include 14 native fish species, seven alien and 12 translocated. Translocated taxa are distinguished from aliens, in order to report species non-indigenous to a basin but native within the same ecoregion. Twelve hydrographic basin units are newly added to the roster of ichthyologically explored river basins following a previous basin-scale inventory method (the total is now 117). This review increases the number of Greece's freshwater fish taxa to 167, since four new species are added to the list (*Carassius langsdorfii, Neogobius fluviatilis, Telestes alfiensis, Millerigobius macrocephalus*) and two are deleted (*Salmo dentex, Barbus rebeli*) due to taxonomic changes. Taxonomic changes will probably continue to alter the national list since phylogenetic research is ongoing on several taxa in many parts of the country.

Keywords: Freshwater ichthyofauna, fish distribution, river basin area, biodiversity, Greece.

Introduction

A baseline requirement for biodiversity conservation and river basin management is a well-documented list of all freshwater fishes per hydrographic basin. In terms of its freshwater ichthyofauna, Greece is one of the most species-rich and endemic-rich countries in Europe (Smith & Darwall, 2006), but baseline aspects of fish species distributions remain poorly studied (Zogaris *et al.,* 2009a). Deficiencies in distributional data as well as taxonomic ambiguities for Greece's freshwater fishes remain, and nomenclature changes are ongoing, especially after the wide acceptance of the Phylogenetic Species Concept (see Economou *et al.,* 2007). Taxonomic challenges have also been augmented by new information from recent distributional surveys. These rapid changes in the taxonomy and the associated distributions have created communication difficulties for conservation authorities and the general public, especially because species nomenclature seems to be in perpetual flux.

According to the most recent reviews of Greece's freshwater ichthyofauna (Economou *et al.,* 2007; Economidis, 2009a) 161 and 154 species are listed as the country's total freshwater ichthyofauna respectively. Part of this discrepancy in total species numbers between these two lists concerns nomenclature and species validity interpretations. For example, Economou et al.'s list includes a few undescribed taxa missing from Economidis' list; such as "*Eudontomyzon* sp. Louros", "*Rutilus* sp. Sperchios", three distinctive taxa of *Squalius* from Aoos, Evia, and Evinos (as presented in Kottelat & Freyhof, 2007), as well as a non-indigenous *Salmo* cf. *trutta*. It is obviously necessary to frequently update the national lists because of the remarkable taxonomic changes that have taken place since the early 1990s (Economidis, 1991). It is likely that Greece's checklist will continue to inspire differing interpretations and controversy since baseline knowledge of native and non-indigenous species status and associated distributions is far from complete.

Similar to Economidis' (1991) popularized annotated checklist, Economou *et al.* (2007) provides a geographic inventory by presenting fish distribution data based on river basins, and more specifically on distinctive hydrographic basin units. The present paper amends the 2007 inventory and reviews selected taxonomic clarifications, specifically focusing on recently surveyed hydrographic

basins. The inventory unit of the river basin area provides a means for consistent documentation and quality control of distributional records at a broad geographic scale. This review compiles new distributional information, supplementing incremental basin-scale knowledge while attempting to screen records for accuracy, in order to contribute to an updating of Greece's freshwater fish checklist.

Materials and Methods

This review provides distributional amendments based on the hydrographic basin as a geographic unit for a species distribution inventory. Hydrographic basin units are defined here as distinctive river basin areas or biogeographically isolated sub-basins usually naturally defined via watershed limits. Some arbitrary defined sub-catchments or semi-isolated basins within greater river basins are also delineated as such inventory units (e.g. semi-isolated lake basins, distinctive plateaus, ancient lake water bodies, unique karstic water features, etc). Small- or medium-sized islands and some parts of peninsulas are also given as hydrographic units although they may contain more than one river basin (although these are considered as partially-surveyed units). This broad-scale survey presents a first screening-level national inventory framework. The framework is open to hydrographic unit revision in the future (i.e. re-defining lakes and smaller island watersheds as distinct units). More detailed aspects of the inventory method are provided in Economou *et al.* (2007), while the regional biogeographical delineations follows Zogaris (2009). Finally, as in the 2007 inventory, new records presented herein do not include euryhaline species or marine transients. Reference to euryhaline species of marine origin should be the objective of another work, the present compilation being necessarily selective, focusing specifically on freshwater areas of river basins that have been well studied through field sampling or reviewed by the author team.

Since the compilation of Economou *et al.* (2007), approximately 150 sites have been newly sampled and new occurrence data at the river basin scale were compiled primarily by members of the Hellenic Center for Marine Research (HCMR). Most of HCMR's sampling involves systematic site-specific sampling using electrofishing gear in lotic freshwaters and often in policy-relevant field monitoring schemes (Chatzinikolaou & Economou, 2009). Furthermore, a literature review compiled data from all available recent ichthyological publications, academic dissertations and technical reports; but only data that have been screened for accuracy (i.e. confirmed via field collections in most cases) were included in this presentation. Some data mentioned in the text were not included in the basin-scale inventory since they await further confirmation. Some undescribed taxa that do not yet have valid species names but have been included in previous accounts (following Kottelat & Freyhof, 2007) are included in this review as was practiced by Economou *et al.* (2007). In this case, the initials cf. (Latin for *confer*) are employed if species identification is not completely certain (e.g. *Squalius* cf. *peloponnensis* means a chub which is almost certainly identified as *S. peloponnensis* but this is not yet confirmed).

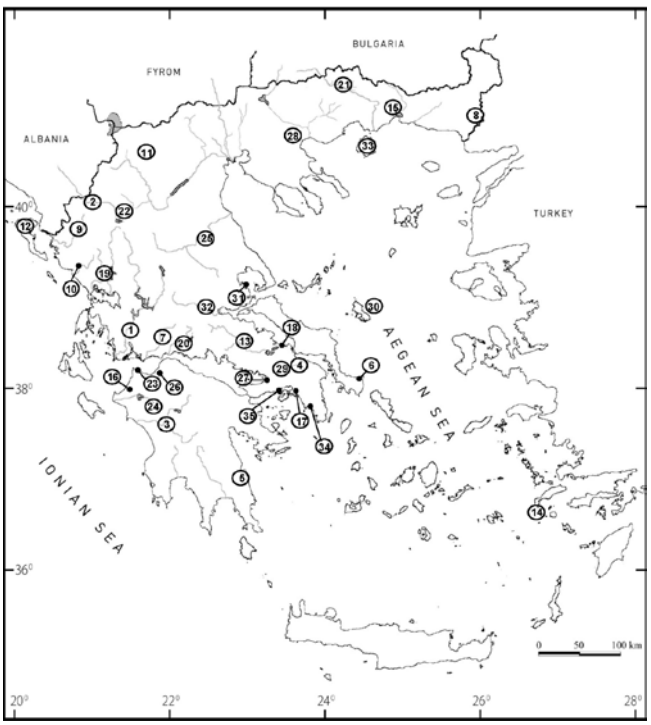

Fig. 1: Map of Greece showing the location of the hydrographic basin areas considered in the ichthyofaunal distributional compilation.

Results and Discussion

New records and hydrographic basin scale coverage

In the current review, 60 new documented records of 31 identified fish species and one unidentified species are reported within Greek river basins. Therefore the distributional compilation of species presented here includes 35 hydrographic basin areas, of which 12 are newly added to the 105 of the 2007 inventory (Table 1). The specific basin locations presented in this review are shown in Figure 1. Among the fish taxa additions to the inventory, 14 are native species, seven alien and 12 non-indigenous translocated (Table 2). One of the translocated species (*Pelasgus marathonicus*) is both recorded as native and translocated in different river basin units. This review, building on the hydrographic basin inventory perspective of Economou *et al.* (2007) has provided documentation to increase the number of Greece's freshwater fish species to 167. A total of four new species are added to

Table 1. Hydrographic basins for which fish data are presented in this study. For each basin the biogeographical region, the basin surface area and the specific references that support the additional geographic occurrence or taxonomic revisions are given. In the references, HCMR expeditions refer to specific projects (see acknowledgements). Basins followed by * are newly added to inventory base of Economou *et al.* (2007).

No	Name Given	Bio-geographical Area	Estimated Area (km^2)	References
1	Acheloos	IONIAN	6329	Tsipas *et al.*, 2009; Takada *et al.,* 2010
2	Aoos	SE ADRIATIC	6710	Markova *et al.,*2010
3	Alfios	IONIAN	3658	Gilles *et al.*, 2010
4	Assopos Beo	W AEGEAN	724	HCMR, 2009, WFD Monitoring - Tachos, V. *et al.* 28.06.2009
5	Dafnonas*	W AEGEAN	386	MIRAGE - Koutsikos, N. & Vardakas, L., 3.03.2010
6	Dimosaris*	W AEGEAN	55	Zogaris, S. & Urbanic, G., 2007
7	Evinos	IONIAN	1112	Giakoumi *et al.*, 2010
8	Evros	THRACE	53000	Zogaris & Apostolou, 2011
9	Kalamas	IONIAN	1831	HCMR, 2009, WFD Monitoring - Tachos,V. *et.al.* 22.07.2009
10	Kalodiki	IONIAN	69	Paschos, I., pers. com. 2009
11	Kastoria	MAC-THES	264	Filos, P. , pers. com. 2010
12	Kerkyra	IONIAN	100	Giakoumi *et al.*, 2010
13	Kifissos Beo	W AEGEAN	1958	HCMR, 2009, WFD Monitoring - Tachos, V. *et al.* 28.06.2009; Zogaris, S. & Sanda, R., 17.09.2011
14	Kos*	E AEGEAN	66	Catsadorakis & Paragamian, 2007; Triantafyllidis *et al.*, 2007
15	Kossinthos	THRACE	435	HCMR, 2009, WFD Monitoring - Chatzinikolaou *et al.* 14.07.09, Zogaris, S. & Sanda, R., 20.09.2011
16	Kotychi	IONIAN	266	Gilles *et al.*, 2010
17	Koumoundourou*	W AEGEAN	39	HCMR, 2011, Koumoundourou - Zogaris, S., Vardakas, L., & Barbieri, R., pers obs. 02.07.11
18	Larymna*	W AEGEAN	23.5	HCMR, 2008, Economou, A. & Koutsikos, N., 18.3.2008
19	Louros	IONIAN	983	Delling, 2010; Renaud & Economidis, 2010
20	Mornos	IONIAN	998	HCMR, 2008, Economou, A., Giakoumi, S. & Vanhove, M., 06.06.2008
21	Nestos	THRACE	6200	Economidis *et al.*, 2009
22	Pamvotis	IONIAN	531	Perdikaris *et al.*, 2010
23	Pappas lagoon*	IONIAN	30	HCMR, 2008, Economou, A., Giakoumi, S. & Vanhove, M., 07.06.2008
24	Pinios Pel	IONIAN	868	Gilles *et al.*, 2010
25	Pinios The	MAC-THES	9500	HCMR, 2009, WFD Monitoring - Tachos, V. *et al.,* 07.01.09; Zogaris, S. & Sanda, R., 16.09.2011.
26	Piros	IONIAN	577	HCMR, 2008,- Economou, A., Giakoumi, S. & Vanhove, M., 05.06.2008
27	Psatha*	IONIAN	15.5	HCMR-HOS, 2010, Zogaris, S. & Kapakos, G., 26.05.2010
28	Rihios	THRACE	300	Petriki, O., pers. com 2011
29	Skourton Plateau*	W AEGEAN	38	HCMR-HOS, 2010, - Zogaris, S. 27.03.2010
30	Skyros*	W AEGEAN	12	HCMR, 2010, Zogaris, S., 25.08.2010
31	Sourporema*	W AEGEAN	173.4	HCMR, 2008, Economou, A. & Koutsikos, N., 13.03.2008
32	Sperchios	W AEGEAN	1828	HCMR, 2010, Zogaris, S. & Petrou, N., 09.07.2010
33	Thassos*	THRACE	384	HCMR, 2011, Zogaris, S., 18.08.2011
34	Vouliagmeni	W AEGEAN	2	HCMR, 2008, Koutsikos, N. & Kommatas, D., 22.05.2008; VANHOVE *et al.*, 2011a
35	Vourkari*	W AEGEAN	120	HCMR-HOS, 2010, Zogaris, S. & Kapakos, G., 01.05.2010

Table 2. Summary of additional records per hydrographic basin. The position of the basins is shown in Figure 1. Basins followed by * are newly added to inventory base of Economou *et al.* (2007).

Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Hydrographic Basin Unit	Acheloos	Aoos	Alfios	Assopos Beo	Dafnonas*	Dimosaris*	Evinos	Evros	Kalamas	Kalodiki	Kastoria	Kerkyra	Kifissos Beo	Kos*	Kossinthos	Kotychi	Koumoun-dourou*	Larymna*	Louros	Mornos	Nestos	Pamvotis	Pappas lagoon*	Pinios Pel	Pinios The	Piros	Psatha*	Rihios	Skourton Pla-teau*	Skyros*	Sourporema*	Sperchios	Thassos*	Vouliagmeni	Vourkari*
Species																																			
Anguilla anguilla						1								1			1						1				1			1			1		
Aphanius fasciatus				1										1			1			1			1												1
Barbus prespensis		1																																	
Carassius gibelio																												2							
Carassius langsdorfii	2																																		
Cyprinus carpio																		3													3				
Economidichthys pygmaeus													3																						
Eudontomyzon graecus																			1																
Gambusia holbrooki				2										2						2					2	2	2		2	2	2		2		
Lepomis gibbosus																									2										
Luciobarbus graecus																		3																	
Millerigobius macrocephalus																																		1[b]	
Neogobius fluviatilis								3[b]																											
Oncorhynchus mykiss					2						2																								
Oreochromis niloticus																						2													
Oxynoemacheilus bureschi															1																				
Pelasgus marathonicus																		1							3										
Pelasgus thesproticus										1																									
Pelasgus stymphalicus																										1									
Poecilia latipinna																																		2	
Rhodeus meridionalis	3																																		
Rutilus ylikiensis																		3																	
Salaria fluviatilis					1	1															1														
Salmo lourosensis																			1																
Salmo sp.																																1			
Scardinius acarnanicus									3																										
Scardinius graecus																		3																	
Silurus aristotelis													3																						
Squalius cf. *peloponnensis*					3																														
Squalius orpheus																																	3		
Telestes alfiensis			1													1[a]								1[a]											
Valencia letourneuxi							1					1																							

1 = Native;
2 = Non-indigenous from outside the country;
3 = Non-indigenous species translocated from within the country;
[a] = Doubtful taxonomic status of population;
[b] = Doubts on native or introduced status.

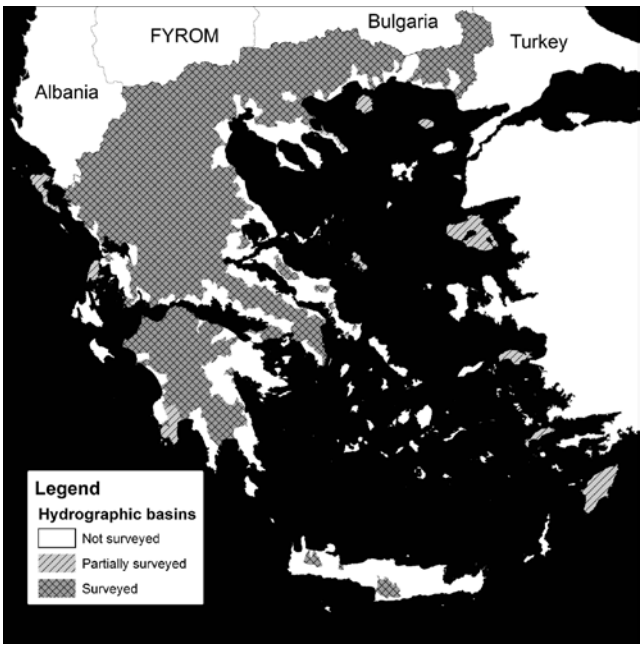

Fig. 2: Hydrographic basins covered in the hydrographic basin scale level, in a combined collective survey effort including ECONOMOU et al. (2007) and the present work. Partially surveyed hydrographic basin areas refer to an arbitrary complex of more than one river basins such as on some islands and peninsulas (see text for details).

the national inland water fish list (*Carassius langsdorfii, Neogobius fluviatilis, Telestes alfiensis, Millerigobius macrocephalus*) and two are subtracted *(Salmo dentex, Barbus rebeli)* due to taxonomic changes. This review may act as a supplement to Economou *et al.* (2007) and shows overall coverage and gaps in that statewide inventory. Figure 2 shows that nearly all of Greece's large river basins are covered by the present inventory in combination with Economou *et al.* (2007), collectively amounting to approximately 64% of the Greek territory. Partially surveyed areas include mostly islands where one or more but not all river basins have been surveyed; these cover about 4.9% of the Greek territory in this survey. Therefore about 31% of the Greek territory is not yet surveyed in terms of its inclusion in HCMR's hydrographic basin inventory. This data-coverage analysis is instructive: large basins attract most research interest and generally have completed basin-specific species lists while many smaller basins, which may have very few freshwater fish species, are lacking completed species inventories. However, our simple coverage map (Fig. 2) does not show the site-by-site coverage within the larger basins, many sub-catchments are obviously poorly explored in several of the large basins which we assume have complete fish lists (Zogaris *et al.,* 2009b). Also certain habitat types (e.g. deep river waters, canals, small lakes) are still very poorly explored even in large basins, such as the Evros basin (Zogaris & Apostolou, 2011).

Translocated and native species

Among the 14 native species included in Table 2, some taxa present particular interest because they may indicate range extensions beyond established biogeographical boundaries. These range expansions may be due to anthropogenic translocations [i.e. non-indigenous occurrences of species within the same country or within the same ecoregion (Economidis *et al.*, 2000)]. In some cases, current knowledge of a region's historical biogeography may reveal that a species is translocated by human actions to adjacent waters within the same country or ecoregion (Perdikaris *et al.*, 2010). For example, the capture of *Scardinius acarnanicus* in the Kalamas River, if not a result of accidental or deliberate introduction, would undoubtedly present remarkable biogeographical interest (Ketmaier *et al.*, 2004). Based on previous records, the northern limit of *S. acarnanicus'* native distribution in the Ionian Freshwater Ecoregion was the River Acheloos basin; yet it has been translocated north to Lake Ziros, near Arta (Economou *et al.*, 2007). This recent finding extends its distribution further north to the Ionian - SE Adriatic Ecoregion boundary, near the Greek-Albanian border. However, we provisionally consider this as an anthropogenic translocation.

In several cases it is difficult to establish if a record represents a species' natural distribution or a recent expansion due to anthropogenic translocation. For example, specimens of *P. marathonicus* were caught for the first time in 2009, within a tributary of the Thessalian Pinios; more specifically, in a canal outflow downstream of the former Lake Xiniada near Smokovo dam (in the extreme southern limit of the Pinios basin). The occurrence of *P. marathonicus* in the Pinios drainage is particularly interesting as it extends the geographic distribution of this species into an adjacent biogeographical region (Macedonia-Thessaly Freshwater Ecoregion). This occurrence is most probably a result of human intervention, since the particular location where the species is found is in close proximity to the Sperchios drainage (and adjacent to a former plateau lake, which may have been stocked with other fish from adjacent basins in the past). Furthermore, this tolerant stagnophil species was not found in any other water body of Pinios, despite detailed surveys of many suitable habitats in the basin in 2009 and 2011. Conversely, native distributions may easily be overlooked. For example, in the case of *Oxynoemacheilus bureschi* in Thrace, although this species survey of Economidis (1974) it is reported for the first time in River Kossynthos (recorded in 2009 and 2011). This species has a patchy distribution in Northern Greece, being absent (or yet undiscovered) in several hydrographic basins within the Thrace Freshwater Ecoregion, while the thriving populations in the Axios are most probably introduced by humans, as suggested by a recent phylogeographic analysis (Šedivá *et al.,* 2010). Even more

difficult is the interpretation of the status of the recently discovered *N. fluviatilis* in the Evros River. This species is recorded as a questionable translocation; it is probably a non-indigenous population although its native range presumably includes the nearby Marmara Sea basin in Turkey, within the wider Thrace Freshwater Ecoregion (Zogaris & Apostolou, 2011). This is a good example of a case for which the ecoregional boundaries may help determine if a fish is alien or translocated since the river is a trans-national waterway.

In other cases, the occurrence of a human-introduced population may be far more obvious, and although historic records may be missing, knowledgeable local inhabitants can give clues to establish proof of translocation and date of introduction. In the springs of the Dafnonas River basin on Mount Parnon (southeastern Peloponnese), *S.* cf. *peloponnensis* has been introduced and there are no such populations of this fish anywhere in the neighboring basins. According to local residents, the chub had been transferred from streams south of Kyparissia region (Messinia hydrographic basin, southwestern Peloponnese) in the mid-1980s and coexist with alien Rainbow Trout at this spring-fed stream. A similar situation exists on the island of Thassos, where *Squalius orpheus* was allegedly introduced to a small reservoir and now also occurs in its stream valley (adjacent to the village of Maries). In the above cases, further genetic studies are required to confirm the species' provenance. In fact, in our present work we have employed mitochondrial DNA analysis to confirm the identification of a newly discovered translocated *Rhodeus meridionalis* population in Lake Trichonis (within the Acheloos basin) in September 2011. Unfortunately, we do not know the taxonomic status of alleged *Rhodeus amarus* in nearby Lake Ozeros (within the same basin), although taxonomic doubt was expressed with respect to this record in Economou *et al.* (2007).

Certain habitat specialists and/or poor dispersers show particularly localized distributions within specific parts of the basins. The critically endangered and highly localized *Valencia letourneuxi* is now recorded in 13 hydrographic basin areas in Greece. This study includes the 2008 discovery of specimens in a new basin (Kryoneri springs within the delta of the Evinos basin) and a rediscovery of the species in Corfu, in an entirely new location (Melissoudi stream in northern Corfu); both records are certainly overlooked native populations within the general realm of the pecies' range (Giakoumi *et al.*, 2010; Kalogianni *et al.,* 2010). The latter record changes the status of the Corfu distribution from "presumably extirpated" (Economou *et al.*, 2007) to "present." The Erassinos stream of Attika is the site of another case in which a small fish was thought to have gone locally extinct at the basin scale and was re-discovered (Economidis, 2009b). Surveys in 2010 discovered a population of *P. marathonicus* near the springs of Pyrgos Vravronas (2 km South of Athens International Airport), yet the species is locally extirpated from the previously known locality of Vravrona Marsh, a few kilometers downstream.

Alien species

Distinctions within non-indigenous species designations have long been a point of much argument (Copp *et al.,* 2005). Here we treat as aliens, those non-indigenous species that are far removed from the constituent ecoregion; that is, originating from faraway basins beyond the country's borders. Aliens are completely foreign in a biogeographical sense and may exhibit invasive behaviour or attributes causing significant ecological changes (Economidis *et al.,* 2000). New occurrences of seven alien species are reported in this review. The new additions to a river basin's ichthyofauna often reveal the poor coverage of some Greek aquatic systems by past surveys. For example, *Gambusia holbrooki* and *Lepomis gibbosus,* both widespread in Northern Greece, were recorded for the first time in the Thessalian Pinios in our study. In fact, these fishes were widespread in the Pinios River in 2009 and 2011, indicating a potentially invasive spreading tendency. The current study reports *G. holbrooki* occurrence in 10 new basins, but the species may also be widespread in many smaller wetlands and artificial reservoirs in insular hydrographic basins (i.e. Aegean islands), few of which are included in this survey.

Taxonomic complications concerning alien taxa may also hide species new to the country's list. A difficult issue concerns the identification of East Asian *Carassius* species; some of the Greek populations in the lowland lakes of the Acheloos basin (i.e. Lysimachia and Trichonis) are shown to belong to the *C. langsdorfii* complex (Tsipas *et al.*, 2009; Takada *et al.,* 2010). *Carassius gibelio, Carassius auratus* and *C. langsdorfii* are morphologically very similar and often a reliable identification on the basis of morphological characters is not possible. Specific genetic work and widespread field sampling is needed to clarify the taxonomic standing, provenance and current distribution of the *C. langsdorfii* populations in Greece and other European countries.

Our review reinforces the need to assess the detailed distribution patterns of all non-indigenous taxa, including the introduction of genetic clones in the natural environment as practiced in aquaculture ventures (Zenetos *et al.*, 2009). The alleged impacts of haphazard stocking and the influence of escapees from fish farms (particularly of salmonids) poses a serious threat to native trout and perhaps to other fishes in Greece's cold waters (Zogaris & Economou, 2009). One problem that is difficult to monitor is the introduction of alien European trout clones, so-called *S.* cf. *trutta* (often marketed as "wild trout"); and the transplanting of hatchery-reared western Greek trout (*Salmo fariodes*) from other catchments where native trout do exist (Zogaris, 2007, 2010). How-

ever, the spread of Rainbow Trout is still rather limited in lotic waters at the river basin scale, evident also from the fact that its presence is documented in only two additional river basin areas in the current study. In fact, it still has not been proven if Rainbow Trout *Oncorhynchus mykiss* reproduce in the wild in Greece (Economidis *et al.*, 2000); although some local residents have mentioned observation of the phenomenon. For example, the Rainbow Trout collected at Dafnonas River (Mount Parnon) were allegedly introduced once to the river, eight to ten years ago; however local reproduction remains unproven in spite of the fact that small fingerlings were observed in this cold-water stream in March 2010.

Fig. 3: Unidentified trout specimen, *Salmo* sp., collected at Gorgopotamos, Sperchios Basin (Photo: N. Petrou, 9.07.2010; ex situ).

Taxonomic considerations

Many unanswered taxonomic challenges concerning the phylogenetic placement and taxa validity of various fish populations still remain in Greece. These are especially acute in particular endemic-rich ecoregions or even specific basins. One such location is the Lake Volvi basin, an ancient lake located at the western edge of the Thrace Freshwater Ecoregion. For example, according to Bryja *et al.* (2010), Lake Volvi's Bitterling *R. amarus* presents divergent mtDNA lineages from all other European Bitterling populations and should be considered a different species. However, Triantafyllidis *et al.* (2011) reported that interspecific distances were lower than expected and consequently this population cannot be assigned separate specific species' status. Therefore, until this phylogenetic issue is completely clarified, the taxonomic status of the *Rhodeus* population in Volvi remains as it was reported in the 2007 inventory. Similarly, another recent complication also from the Lake Volvi basin shows that *Rutilus* specimens from this lake are nearly identical to *Rutilus heckelii*, based on mitochondrial DNA marker (Larmuseau *et al.*, 2009). The considerable genetic distinctiveness of the Lake Volvi and Lake Kerkini *Rutilus* populations, previously determined as *Rutilus rutilus*, were revealed also by Ketmaier *et al.* (2008) and Triantafyllidis *et al.* (2011). Nevertheless more research is needed here to confirm this species presence within Greece, and as such it is not included in this inventory.

Several recent species splits have been recognized in the endemic-rich Ionian Ecoregion in the western part of Greece. The results of the latest taxonomic study of the Greek non-parasitic lamprey *Eudontomyzon* from the Louros River (Renaud & Economidis, 2010) provide sufficient evidence to justify its recognition as a new species, *Eudontomyzon graecus*. Furthermore, *Salmo lourosensis*, another new species was also recently confirmed as a valid taxon from the Louros by Delling (2010). Recent genetic work has also confirmed the splitting of the Peloponnesian populations of *Telestes*; it is now considered valid as *T. alfiensis* (Freyhof *et al.*, 2006; Gilles *et al.*, 2010). However, the populations of *Telestes* immediately north of the Alfios (e.g. the Vergas and Pinios rivers in the Peloponnese) have not been screened and cannot be renamed as such yet; perhaps they should provisionally be cited as *Telestes* aff. *alfiensis* until this is clarified.

There are several important problematic taxa remaining in the Ionian Ecoregion. A prominent issue concerns the status of the *Squalius* populations [namely the alleged different *Squalius* species south of and including the Kalamas and in the Peloponnese (see Economou *et al.*, 2007)]. Kottelat & Freyhof (2007) list five separate *Squalius* taxa (some not yet described) in Western Greece and this urgently needs substantiation since these fish are very difficult to identify in the field. Note that in recent presentations of ichthyofaunal lists of western Greece (e.g. Zogaris *et al.*, 2009a) we have chosen to provisionally lump western Greek chub taxa as *S.* cf. *peloponnesius* in order to practically manage this taxonomic "grey zone" of the chub in the Ionian Freshwater Ecoregion. Obviously, this provisional nomenclature use is based on a precautionary approach to avoid species misidentifications.

Field identification difficulties persist for some genera and in certain cases morphological characters from a few collected specimens cannot be used solely for positive identification, as is the case of endemic trout (Kottelat & Freyhof, 2007). We discovered a population of a self-reproducing trout at the Gorgopotamos Gorge, a tributary of the Sperchios River in 2010; yet without genetic research it is impossible to identify the species. These specimens look similar to western Greek trout (i.e. *Salmo fariodes*, Fig. 3); but since native trout have never before been recorded from the Sperchios basin, they may be either an introduced or a well-hidden native population.

Ongoing genetic and phylogeographic research, along with recent morphological studies, is currently contributing to the clarification of the taxonomic status of several species. For example, a goby species occurring

in Lake Vouliagmeni near Athens was recently positively identified by Vanhove *et al.* (2011a) who employed morphological and molecular analyses to distinguish it as *M. macrocephalus*, although it was previously misidentified as *Zebrus zebrus* (Chintiroglou *et al.*, 2004). Though it is unknown how this marine species entered this unique brackish lake, we provisionally consider it as indigenous. Furthermore, Economou *et al.* (2012, in preparation) positively confirmed Lake Vouliagmeni's introduced Poecilid Molly as *Poecilia latipinna*, based on an analysis of meristic characters used for species differentiation within poeciliid fishes. Incremental distinctions such as these will continue to ameliorate identification problems.

A deeper understanding of the species' phylogenies may create new species delineations, including some «lumping» of populations previously considered valid, thus changing the distribution of presumed endemic taxa. Such taxonomic changes have recently been shown for several fishes in the Aoos basin; for example, Markova *et al.* (2010) insist that the Aoos is in fact inhabited by *Barbus prespensis* which also means that *B. rebeli* should be excluded from the Greek freshwater fish list, since this taxon is now considered endemic to a few river drainages in central western Albania. Furthermore, in the previous Greek checklists, *S. dentex* is noted as possibly inhabiting the Aoos (Kotellat & Freyhof, 2007; Economou *et al.* 2007), yet this fish has been shown not to be a valid species (Snoj *et al.,* 2010). Other serious taxonomic issues include the tiny sand gobies of Western Greece. For example, recent genetic work has provided new evidence that *Knipowitschia* populations from various water bodies of the western coast of Greece may be conspecific with *Knipowitschia milleri*, previously thought to occur only in the lower part of the Acheron River (Vanhove *et al.*, 2011b). Bearing in mind that few Ionian *Knipowitschia* populations are adequately studied morphologically, and that much phenotypic variation is observed in the *Knipowitschia* generally (Kovačić, 2005, 2008), it is uncertain whether the morphological features of the Acheron *K. milleri* represent distinctive identification attributes. This and other issues on goby taxonomy and systematics are still an active area of research.

Amendments and corrections

In state-wide fish inventories such as Economou *et al.* (2007) it is often impossible to avoid isolated errors (e.g. the verification of an old published record); specific corrections to that inventory are provided here. Though with some reservations, the occurrence of *Alburnoides bipunctatus* in the Acheron River was included in Economou *et al.* (2007), since it had been reported by Stephanidis (1939). However, according to P.S. Economidis (per. observations) and HCMR field surveys, this occurrence record appears to be inaccurate. In addition, the occurrence of *Economidichthys pygmaeus,* also erroneously reported in Economou *et al.* 2007 in the same basin, was also not substantiated by recent field data. Furthermore, although doubt was expressed in the 2007 review that *C. gibelio* is native to Northeastern Greece, recent genetic studies provide evidence that this species should be considered as an alien in Greece (Jakovlić & Gui, 2011; Perdikaris *et al.,* 2011). Lastly, the claim that a species is extinct or "presumed extinct" in a system requires particularly careful study before the species is recorded as such with certainty; especially due to the life history and cryptic survival of some fish species. For example, *Acipenser sturio* was presumed "extirpated or possible extirpated" in the Evros (Economou *et al.*, 2007), yet a specimen was located in 2005 that may actually be part of a relic native population (Koutrakis *et al.*, 2011). This and other re-evaluations of "extinct" status (as stated above) reinforce the importance of monitoring to ensure correct and current conservation assessment of populations at the basin-scale.

Conclusions

This study provides new additions of species and distribution records incorporating aspects of a taxonomic review for selected taxa. Distributional data is presented here at a broad geographic scale and this may assist in the delineation of focal species conservation priorities and a thorough fish assemblage natural history for river basins, including the evaluation of non-indigenous species invasions. River basin hydrographic units represent appropriate geographic units suitable for national inventories of freshwater fish since physiographic drainage basin limits are one of the most important factors defining regional freshwater biogeography, and watershed limits have long been used as biogeographic and ecoregional boundaries (Gilbert, 1980; Abell *et al.*, 2008). Obviously finer scale distribution surveys are also critically needed for reach-scale or site-based conservation, restoration and population monitoring but the overall national screening of species assemblages should follow a hydrographic basin scale inventory.

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