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Intercalibration Report: Fishes as Biological Quality Elements in the Rivers of Cyprus

Submitted to:

WATER DEVELOPMENT DEPARTMENT,
MINISTRY OF AGRICULTURE,
NATURAL RESOURCES AND ENVIRONMENT,
REPUBLIC OF CYPRUS

Specialized Consultancy Services for the Assessment of Fish Assemblages in Cyprus Rivers – Implementation of the Directive 2000/60/EC

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Preamble

The island of Cyprus has a species-poor native fish fauna and largely intermittently-flowing lotic water bodies. There are no completed baseline studies dealing with the inland fishes or their specific distribution or populations on the island. Despite this, it is well known that the fish fauna is almost exclusively dominated by alien fish species primarily introduced through stocking in reservoirs (Stephanou, 1998). In terms of the EU Water Framework Directive (WFD), the Republic of Cyprus considered that it is not possible to base any type of ecological quality assessment solely on fish species due to this unique situation. Consequently, "fish" as a WFD Biological Quality Element (BQE) are not monitored; and Cyprus does not participate in the River-Fish Intercalibration Exercise. However, in order to support this consideration, an investigation is being undertaken in an ongoing research project recently commissioned by the Water Development Department (WDD)[1]. In this project, most significant Cyprus rivers that feature at least some perennial flowing reaches have been investigated in 2011. This note is meant to inform the EU intercalibration process on current progress within this project.

Methodology

Acquisition of information about fish species, populations, population density, reproduction and other attributes relevant to the implementation of the WFD were collected primarily using electrofishing (for technical details please see Economou *et al*., 2007 and Zogaris *et al*., 2011). The electrofishing sampling method is considered a standardized technique for sampling stream fishes for bioassessment (CEN, 2003; Beaumont, 2011). Expert interviews and cooperation with the Cyprus Department of Fisheries and Marine Research and Cyprus Forestry Department as well and structured interviews with knowledgeable local inhabitants also greatly augmented information acquisition and confirmation of fish presence in investigated river sites and associated water bodies.

Study Areas – River sites

This work has provided the WDD with an important database of fish-based knowledge from specific river/reservoir and wetland sites, involving 117 aquatic sites in total in Cyprus (Fig.1 & Fig.2). Currently a quantitative database of ichthyological sampling exists for 81 lotic and wetland sites in Cyprus. During this survey 42 out of 81 sites were found to be fishless during the sampling. During the initial stage of the sampling data on fish presence, knowledge was augmented by interviews. Because of this, there is qualitative knowledge (presence/absence of fish) from a total of 53 sites at this stage in the project. Preliminary data sets and subsets are utilized in the material presented at this stage in the project because comprehensive data analyses are not yet completed.

Sampling has followed approaches and protocols promoted by the FAME project procedure (FAME, 2004) in order to explore the use of fishes as Biological Quality Elements (BQEs). The purpose of BQE indices is to determine the reaction of the ecosystem components to human pressure and concomitantly to the absence of it; and, this has yet to be investigated statistically using fish in Cyprus rivers. It has not yet been concluded if by using the available data-set it will be

[1] The project " Specialized Consultancy Services for the Assessment of Fish Assemblages in Cyprus Rivers – Implementation of the Directive 2000/60/EC, Project Number TAY49/2010" begun in February 2011, is coordinated by the Institute of Inland Waters (HCMR, Greece) and led by Dr. M.T. Ferreira (ISA, Portugal) and Dr. S. Zogaris (HCMR, Greece). The present note presents only portions of the initial survey results of the project.

possible to apply any of the existing indices or to construct a new one. However, in certain river types and/or specific river reaches there is already evidence that fish-based attributes may provide metrics to monitor river continuity, surface water permanence, and other natural attributes of lotic water integrity.

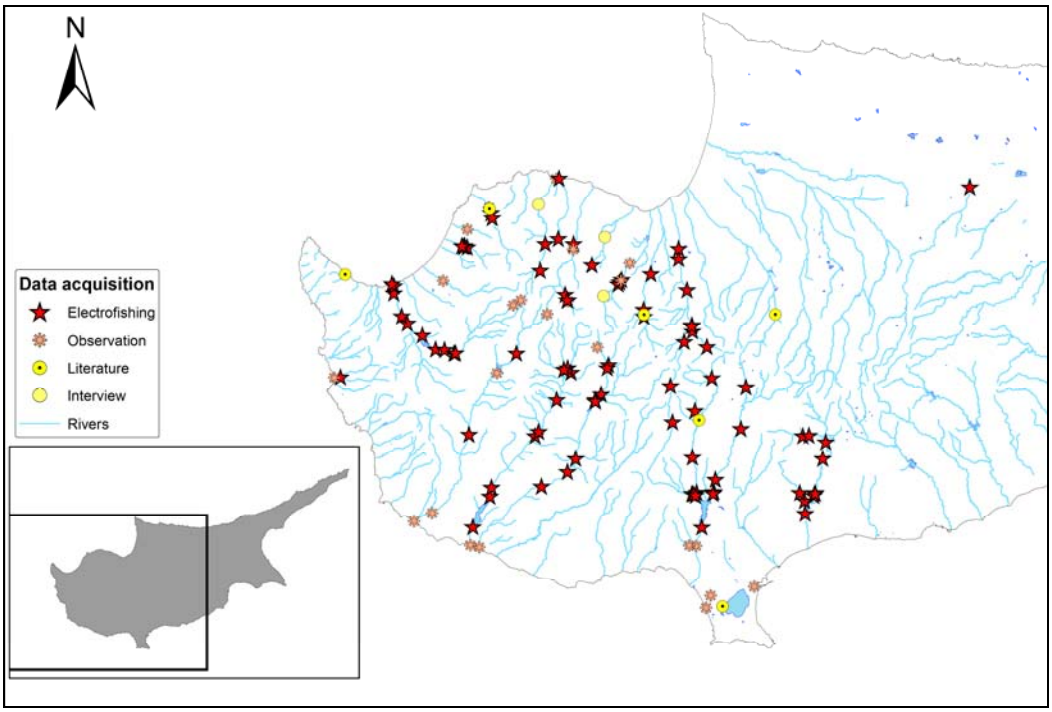

Figure 1. Methods of investigation for ichthyological and environmental data acquisition: star: electrofishing; asterisk: observations or other method other than electrofishing; yellow-circle-with-spot: Literature or report/reference from scientific personnel; yellow-circle-without-spot: interview of local informant (not confirmed by scientific report/literature or specialist).

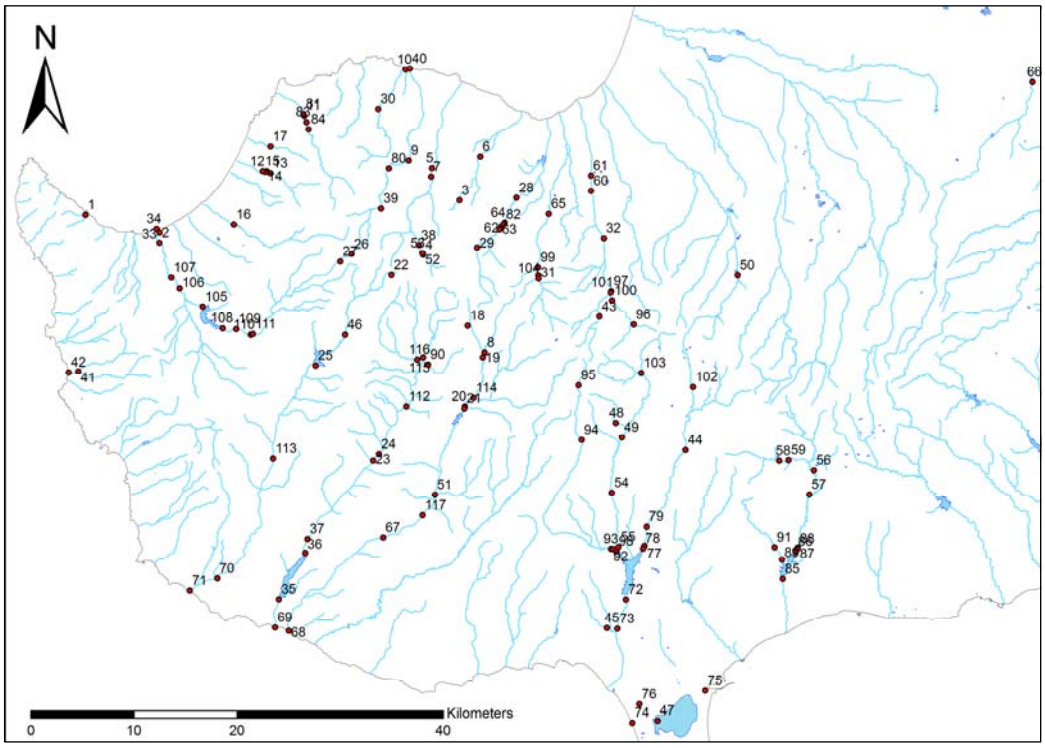

Figure 2. Total number of sites investigated during this project. Site names, sampling details, water body association etc. are provided in the Appendix.

Results (preliminary summary)

1. Eighty one (81) sites where sampled in a quantitative approach using the electrofishing method. Thirty one (31) other sites have been visited and information from optical assessment (direct observations), the literature and local specialists has contributed to base-line knowledge of their ichthyofauna (Fig. 1). This survey represents the first widespread survey using electrofishing on Cyprus. Other sites such as dam reservoirs or wetlands were also visited but information on the fish composition of these water bodies is qualitative and of varying accuracy. All sites are noted on Fig. 2 and presented in detail in the Appendix.

2. The initial sampling work represent a screening-level survey, the first of its kind on the island. There are limits to using only electrofishing in a state-wide fish survey. Electrofishing is not the only recognized method of locating fish presence and in several cases it was not possible to effectively use electrofishing successfully (highly polluted water, high-conductivity or brackish waters, etc). Eels may not react to electricity in dense cover and may not be apparent in turbid water even if they exist in fairly dense populations. So interviews are important to obtaining and supplementing this information at this stage.

3. The cumulative results of fish presence based on electrofishing, literature and interviews give a more comprehensive yet only qualitative image of fish distributions (at present and in the past). A large number of sampled sites had evidence for fish presence, either at the time of sampling or through confirmation by knowledgeable locals, local scientists or the literature in the past. Expert interviews showed that 59 sites had fish, and 15 sites had evidence of only Eels (Fig. 3). This information is the first and only attempt at building biotic reference conditions for the fish-based bioassessment on Cyprus.

4. Wherever there is not enough information from literature (or grey literature), or interviews with experienced scientists to confirm fish presence at a particular site, the site in question is labeled as “fishless”. It should be said that this does not mean that these sites do not have fish at some period of the year or in certain years; and anecdotal evidence of variation in fish distributions among years was given by local knowledgeable informants and local scientists. Forty two (42) sites had no fish present at the time of sampling and it is not confirmed that fish are regularly present there.

5. In terms of water body type and designated condition, the survey investigated 46 river water bodies (covering a total length of 834 km), comprising 32,3% of the river water bodies under control of the Republic of Cyprus. Fish are now known to be present in 32 water bodies (WBs) which cover 6,9% of all the country’s designated water bodies. These water bodies cover 76 km of river network or 4,4% of the water body river network of the country (Table 1). It should be noted that sites that were sampled (electro-fished) immediately upstream of many dams are not subscribed to the upstream river body if they are in close proximity with the dam, so in this case many river bodies that are above the dam and partially maintain some fish populations are not included. Although this analysis is conservative it shows that many of the 463 WBs researched in the project did not have fish populations at the time of sampling. Also, the absence or remarkable scarcity of native species is confirmed.

6. Nineteen (19) rivers - Heavily Modified Water Bodies (covering a total length of 183 km), and comprising 42,2% of the river water bodies under control of the Republic of Cyprus were investigated for fish. One river water body at Risk was investigated for fish (covering a total length of 9 km), and comprising 1,4% of the river water bodies at Risk under control of the Republic of Cyprus. The relative water body distribution of fish in the River Water Bodies, Heavily Modified Water Bodies and the River Water Body at Risk are shown in Table 3.

7. More specifically at this stage of research, three species of fish are provisionally chosen to provide potential bioassessment metrics and the area they cover is expressed here. The Eel is the most important of these, being a native species with specific requirements. The Brown Trout is especially interesting because it maintains naturalized populations that are self-sustaining for at least 50 years (as shown by a historical review and specific expert interviews). Additionally, Rainbow Trout provides evidence of maintaining self-sustaining populations in limited river reaches and it too is treated within this analysis.

8. A museum collection review has established that *Salaria fluviatilis* (River Blenny) did exist in streams of the Lemessos District at the beginning of the 20th Century and was last collected in 1907 (collected material and archived correspondence confirm the species historic presence on the island for the first time). To our knowledge, the species has not been recorded after this period on the island; and it should be considered one of the most threatened vertebrates on the island, if it is not extinct.

9. The Eel (*Anguilla anguilla*) was located during sampling and observations in 2011, in only 9 water bodies, which have a total length of 28 km (1,6% of all water bodies) (Table 2). In contrast, in the expert interviews the presence of the Eel is surprisingly widespread. In fact in certain sites the Eel has been photographed recently and collected by locals although electrofishing failed to locate it at these specific sites.

10. Brown Trout (*Salmo trutta*) was located for certain in only 18 water bodies which have a total length of 38 km (2,2% of all water bodies). The species survives and reproduces within only three catchments/rivers (Table 2). In Cyprus this species is no longer regularly stocked by government authorities (as stated by authorities at the Department of Fisheries and Marine Research (DFMR)).

11. Rainbow Trout (*Oncorhynchus mykiss*) is hypothesized to maintain potentially self-sustaining populations in 5 water bodies, which have a total length of 10 km (0,6% of all water bodies) (Table 2). This potentially naturalized population must be confirmed in the future and our work so provides only evidence not confirmation. It must be noted that distinguishing naturally-hatched trout fry and fingerlings from hatchery-released fish is particularly difficult. Furthermore, this species is regularly stocked by authorities in many reservoirs for recreation angling; but not regularly stocked in rivers. However we do have evidence that escaped fish from fish farms often do enter streams in uncontrolled numbers.

12. Only qualitative ichthyfaunal information was compiled for the dam reservoirs but this includes 12 dams in total during this survey. The influence of dam reservoirs on fish distributions is particularly interesting and important for exploring anthropogenic pressures on fish communities. Dam reservoirs held several times more fish species than rivers. Considering a provisional subset of the data (N=53 sites), the average number of species per site was low: 1,91 (range: 0-8, SD: ±2,04) but dam type sites had an average of 4,23 species (SD: ±2,49) (Fig. 4).

13. The survey inspected sites belonging to nine generic habitat types (dam reservoirs, perennial streams, artificially-intermittent streams, intermittent streams, river mouths, lagoons or coastal wetland pools, inland ponds, spring ponds and spring-fed headwaters (Fig. 4 & 6). The proximity of dams to the sampled sites and the pattern of distribution relative to habitat type and species composition are shown in Fig. 4 & 5. Most species are located very close to the dams, especially those fishes typifying the reservoir lacustrine community (Fig. 5). Typical lacustrine species are rather rare beyond more than 5 km upstream or downstream of reservoirs (Fig. 5).

14. Our work provides the first attempt at depicting fish communities in inland waters for the first time in Cyprus. A cluster analysis (Fig. 6) of selected sites with fish presence clearly separates

fish assemblages between reservoir and non-reservoir groups (cut-off of 20% similarity); and within the non-reservoir group there are distinctive cold-water Rainbow Trout and Brown Trout groups and a large Eel-only cluster (Fig. 6). The reservoirs show a heterogeneous array of assemblages among them, while Trout and Eel-only sites are more similar to each other. The remarkably low number of river-mouth or coastal wetland assemblages is characteristic of a drastic decline in river/wetland connectivity to the sea.

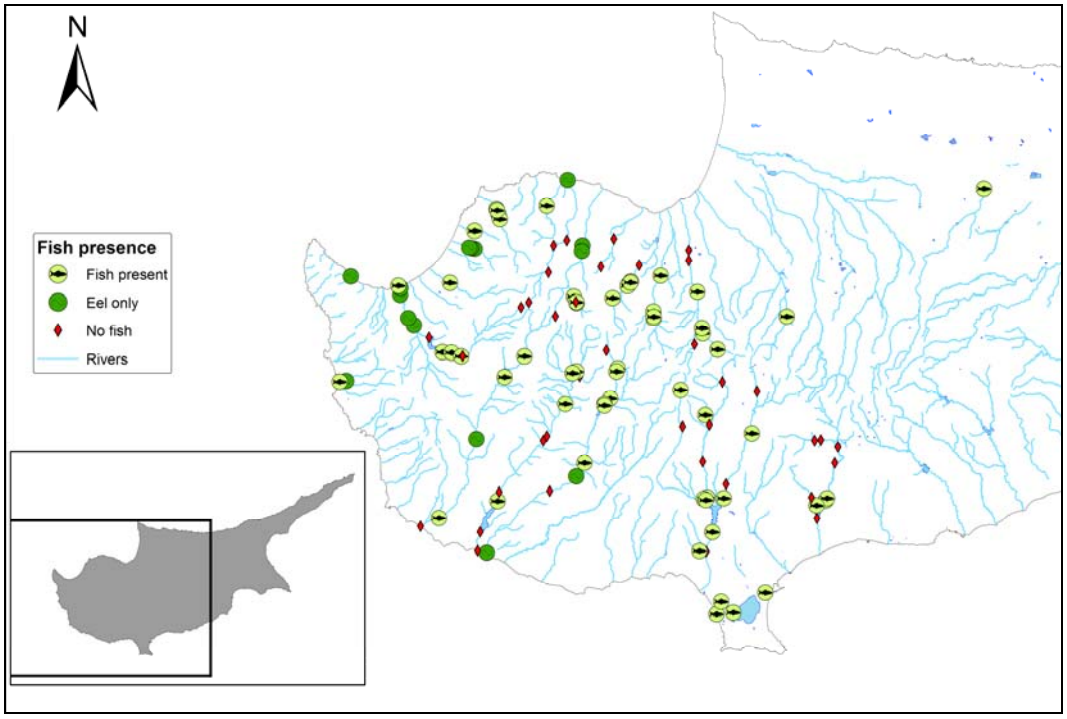

Figure 3. Cumulative results of fish presence survey based on electrofishing, literature and interviews (2011). Sites with more than one fish species or fish other than Eel have the "fish" symbol (light green); sites with only Eel have a dark green "eel" symbol; otherwise sites where no fish were located after complete electrofishing and no further confirmation of fish existed are given with red diamond symbol.

Table 1. Number and length of water bodies (WBs) investigated that hold fish populations.

	Total WBs	Fish Present	Percent of all water bodies (number and length)
Number of water bodies	463	32	6,9%
Length of defined water bodies(km)	1.733	76	4,4%

Table 2. Number and length of water bodies (WBs) investigated that hold populations of three potentially important indicator species.

	WBs	Length (km)	Percent of all water bodies (number and length)
Anguilla anguilla	9	28	1,6%
Salmo trutta	18	38	2,2%
Oncorhynchus mykiss	5	10	0,6%

Table 3. Number and length of water bodies (WBs) investigated in relation to designated type/condition (i.e. River Water bodies, Heavily Modified River Water Bodies and Water Bodies at Risk).

	count	length (km)	% total length	% investigated length
River WBs	216	2.585		
Investigated WBs	46	834	32,3%	
Fish present WBs (Eel + fish)	31	671	26,0%	80,5%
Fish present WBs (Eel only)	3	47	1,8%	5,6%
Heavily Modified River WBs	49	434		
HM investigated WBs	19	183	42,2%	
Fish present HM WBs (fish)	12	130	30,0%	71,0%
Fish present HM WBs (Eel)	0	0	0,0%	0,0%
River WBs at Risk	43	640		
WBs at Risk investigated	1	9	1,4%	
Fish present WBs at Risk (fish)	1	9	1,4%	100,0%
Fish present WBs at Risk (Eel)	0	0	0,0%	0,0%

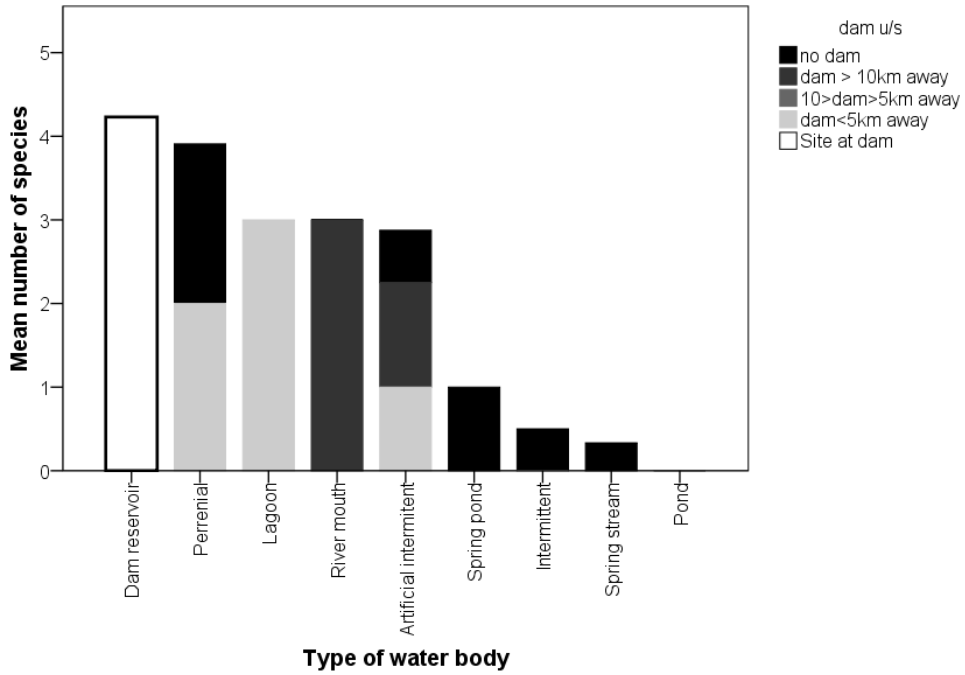

Figure 4. Mean number of species found in Cyprus' water body types, in relation to the proximity of dams (N=53). Most species were documented in dam reservoirs and perennial streams. Very few species where found in isolated spring ponds, intermittent streams, or small spring-fed headwaters or ponds.

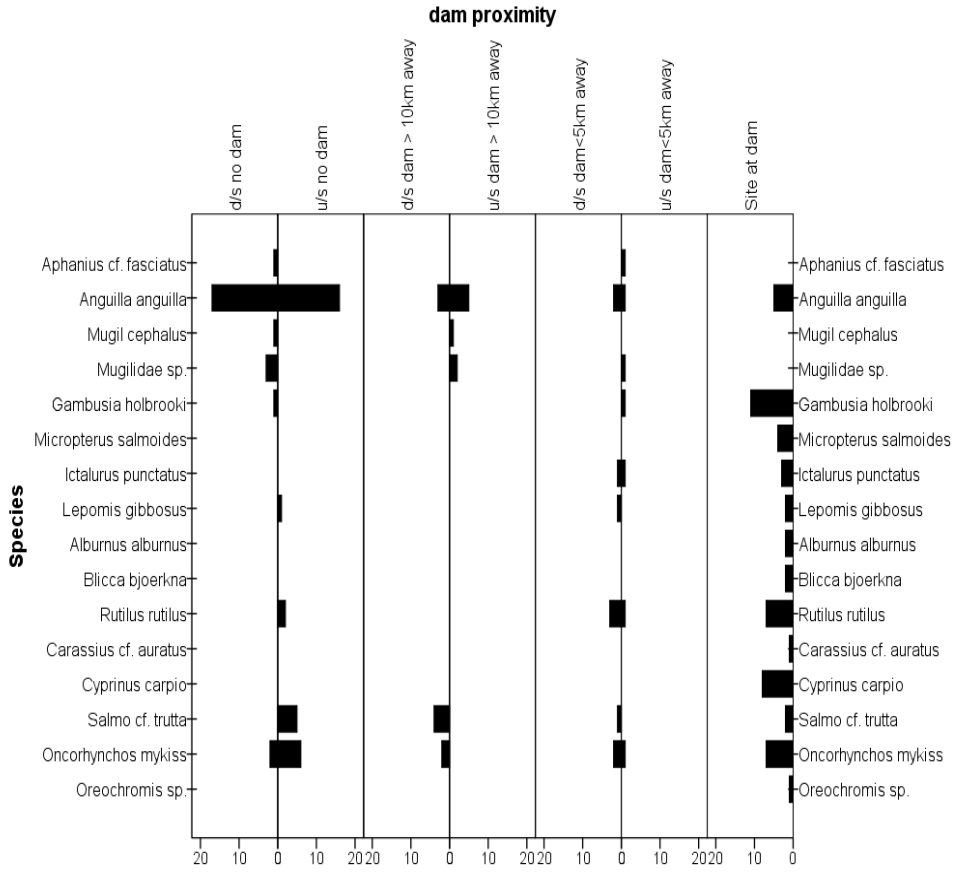

Figure 5. The frequency of occurrence of fish species in sites, in relation to the proximity of dams upstream and downstream of the investigated sites (N=53). Eels and Salmonids (*Salmo cf. trutta, Oncorhynchus mykiss*) seem to shun low-elevation dams. Many of the lacustrine species (i.e. "lake fish") are found primarily or only within dam reservoirs and are not distributed in the river network within the specific system, either upstream or downstream of the dam. The x axis of this plot shows the number of sites where a species was recorded either upstream (u/s) or downstream (d/s) of a dam.

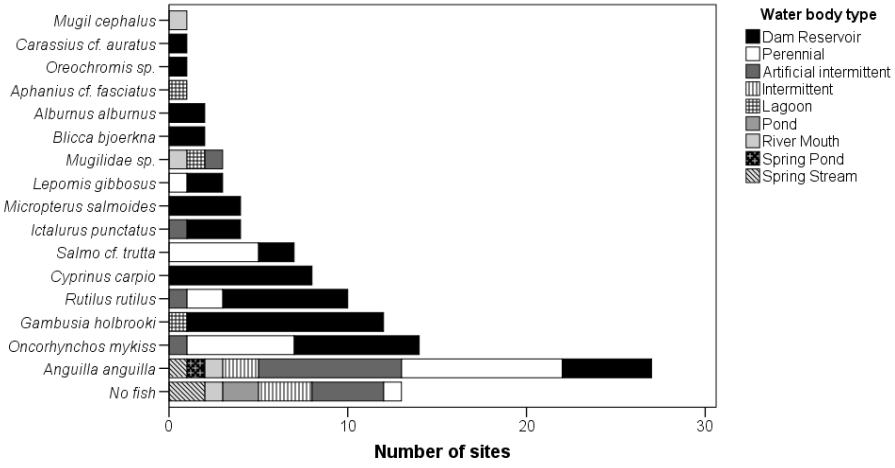

Figure 6. The relative frequency of occurrence of fish species (presence in number of sites), in relation to the water body type. Most species are found within dams and perennial water body types. Eels are found in a large variety of habitat types (and were reported to exist in many different sites) in contrast to other species.

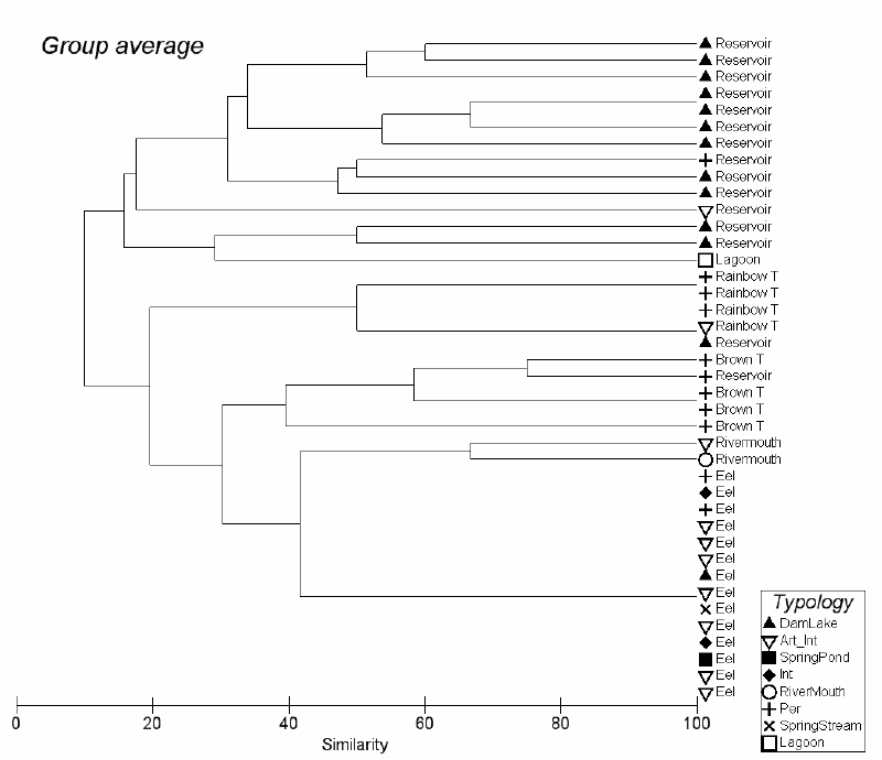

Figure 7. Fish community patterns in Cyprus' inland waters. A classification of sites with fish sites, based on species presence/absence (the dendrogram is produced through a fish composition similarity, Bray-Curtis Similarity Index). The reservoir assemblages (sites labeled) show a very heterogeneous composition among them. Fifty three (53) selected sites with fish presence are thus classified into fish-assemblage categories: Reservoir, Coastal Lagoon, Rainbow Trout, Brown Trout, River-mouth and Eel. Each site's habitat-based typology is also shown.

Discussion

With respect to interpretations made during the first interim report (Zogaris *et al.*, 2011) and an initial analysis of part of the collected data, specific remarks follow:

1. The fish fauna of Cyprus Rivers is depauperate and often exhibit low population densities. This is largely due to the insular character of the catchments and the geological history and position of Cyprus in the extreme eastern end of the Mediterranean. Only five native species are confirmed to inhabit the inland waters of Cyprus: a) Eel (*Anguilla anguilla*); b) River Blenny (*Salaria fluviatilis*) and c) Three euryhaline fish of marine origin that are only found in the lower reaches of rivers or in coastal wetlands (*Mugil cephalus, Atherina boyeri, Aphanius fasciatus*). The River Blenny was not located during the recent survey and may be in danger of extinction since its lowland habitats are highly degraded by anthropogenic alteration and pressures. In addition to the above species, 12 alien species were recorded in the inland stream waters of Cyprus, although most of these inhabited short river sections in the immediate vicinity of artificial reservoirs. A few more alien species are confined exclusively to the reservoirs.

2. Alien warm-water fish are widespread only in dams or in the immediate vicinity of dams. Obviously, fish populations in rivers that are connected to dams originate from stocking or indiscriminate introductions that take place in the dam reservoirs. The commonest aliens within lotic systems are: *Rutilus rutilus, Gambusia holbrooki, Oncorhynchus mykiss, Cyprinus carpio*,

and in some areas *Micropterus salmoides*. Generally predictable patterns in the distributions are not obvious. For example, *Gambusia* is absent from many water bodies although it is said to have been formerly introduced more widely; populations could frequently be exterminated by periodic all-out drying of rivers and wetlands. The survey's database screening will allow the WDD research investigation to construct the final list of widespread alien species and explore aspects of their response to river ecosystem perturbations.

3. There are preliminary indications that some fish-based metrics can possibly be developed, tested and applied and this is perhaps more than of theoretical interest. For example, naturalized Brown Trout was confirmed as spawning in three separate river basins on this survey: the headwater catchments of Xeros (Paphos) and Diarizos rivers and one small headwater tributary of the Kouris river. The populations are of very low density, but the fish have allegedly been surviving in the Troodos for at least six decades (Thirgood, 1986). Work is in progress to investigate the provenance of these populations and historical research should provide data on stocking practices and the confounding complications of fish-farm escapees. Obviously, if a metric based on naturalized alien trout proves to be applicable in the future, any application will not be possible without careful monitoring and, above all, without due metric validation.

4. The native Eel is currently confirmed through our investigation to be distributed in approximately six river catchments on the island (documented in only three catchments during the 2011 field survey). All evidence shows that the species was definitely formerly widespread, as was confirmed by a dedicated questionnaire survey and personal interviews during spring-summer 2011. Its populations are low, and many examples of a declining trend are evident (as ascertained from a questionnaire and local anecdotal evidence). However, within certain water bodies, the presence of the Eel could be singled-out as a useful metric to complement other indicators, as long as the presence is predictable in certain conditions (i.e. good quality lowland situations).

5. Many parts of rivers and their stream tributaries in Cyprus are naturally intermittent and the long-term connection to the sea of most rivers is a very rare situation. In addition, many rivers in the lowlands are "artificially intermittent" due to the presence of dams and widespread water abstractions; so reference conditions cannot easily be constructed in the lowlands. Only two streams with flowing water at their river mouths were located on this survey during June 2011. Therefore, the use of the lower portions of the river segments by marine and euryhaline species is limited.

Preliminary conclusions

Alien fishes in Cyprus are quite widespread in the reservoirs and in some sections of rivers; but native fishes are extremely scarce in the island's inland waters. There is anecdotal evidence that native fish populations, especially that of the Eel, have declined. Very few stretches of the rivers investigated in 2011 had self-reproducing populations of fishes (Fig. 7). The lack of fishes is not wholly natural and in certain cases this is caused by anthropogenic pressures that may degrade the permanence of surface waters or the natural longitudinal connectivity of the river systems. Perennial flowing waters have been altered so much that one of the island's only freshwater fishes (River Blenny) is threatened with extinction, if it still exists. In some respects, the naturalized populations of non-indigenous fishes stand as ecological replacements for species that may have gone extinct in the past. Although stream fish of mostly non-indigenous assemblages were confirmed in isolated parts of some rivers, it is not yet known how predictable and self-enduring they are and if or how they react to specific anthropogenic pressures. However, the potential to use fish in a supplementary

way within biological assessment and water management exists, especially through the localized Eel and naturalized Brown Trout populations. Naturalized trout of the two species present (*Salmo trutta* and *Oncorhynchus mykiss*) are cold-water fish requiring particular natural habitats and stream connectivity in order to survive and reproduce. The presence of these fishes presents interesting theoretical problems in bioasssessment, and further research is needed to explore these fishes' interrelationships with the natural biota. *Oncorhynchus mykiss* is widely stocked or released from fish farms and it may potentially be degrading natural stream biota. Potentially, in the future, fish-based assessment and monitoring could be attempted in certain types or limited stretches of rivers in Cyprus. For example in stretches were the Eel exists the conservation of surface water habitat conditions and connectivity with the sea is an obvious requirement. Although it is not possible to conclusively assess the use of fish for assessment and monitoring in Cyprus at this time, the unique insular and environmental conditions on the island create serious obstacles to the development and practical application of the fish BQE.

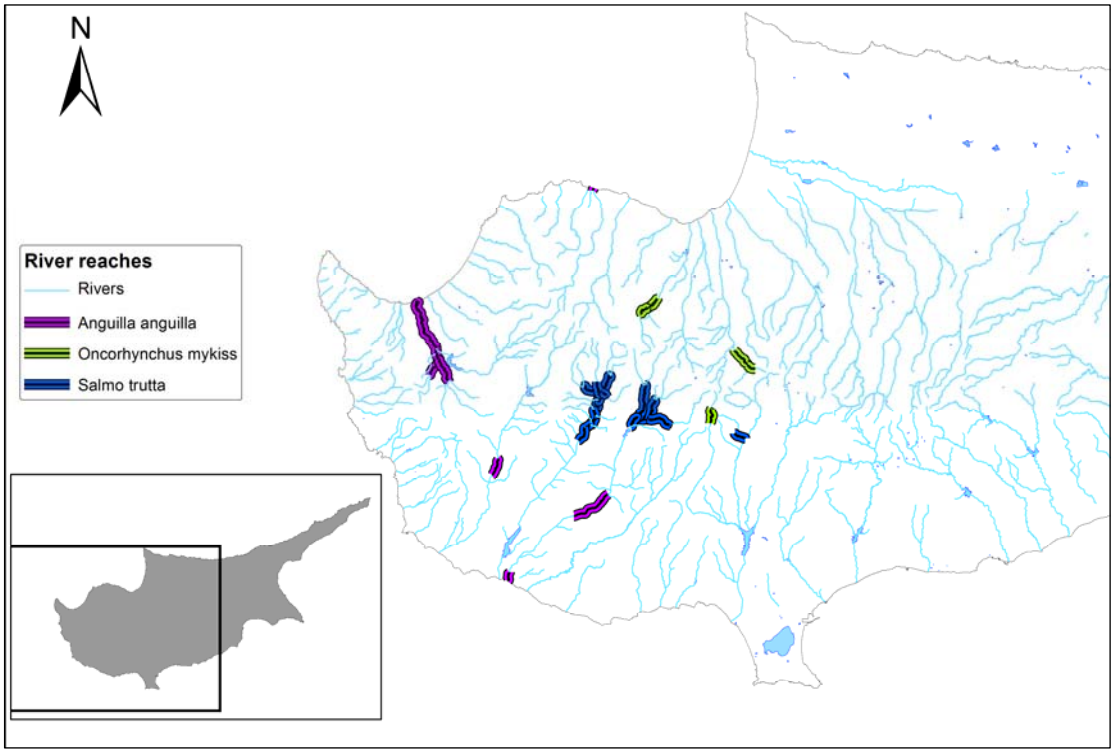

Figure 7. River reaches with the presence of three fish taxa that may potentially provide metrics for the implementation of fish-based indicators in Cyprus (as recorded from electrofishing and observations in 2011). The Eel *Anguilla anguilla* is documented in Diarizos, Chrysochou (=Stavros Psokas), Limnitis rivers (and there are recent observations at Amati on the Ezousa also). Although Eels have been documented by scientists in several other locations in recent times these are not shown here. Reproducing populations of Salmonids include three areas with Brown Trout *Salmo trutta* (Xeros Pafou, Diarizos, Kouris) are shown. Limited areas of suspected reproduction/self sustaining populations of Rainbow Trout *Oncorhynchus mykiss* are also located in three areas (Xeros, Garyllis Kakopetrias, Kalidonia Kryos), although this species is widely stocked.

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Appendix

List of sites table

Note the columns show the following:

1. Site number as shown on map Fig. 2.
2. Site name as given by present research team.
3. Point X (geographic coordinates).
4. Point Y(geographic coordinates).
5. Method of data acquisition (in descending order of reliability): 1 = quantitative electrofishing; 2 = observation of fish at site or recent data from experts; 3 = data from literature and/or experts; 4 = data from literature.
6. Period of investigation of specific site: 2009 = projects of HCMR in Cyprus; 2011 MAY = current project's first sampling trial; 2011 MAY-JU = current project's second sampling trial.
7. Quantitative: 1 = site was sampled in a quantitative way using electrofishing; 0 = only qualitative data (i.e. fish presence/absence or optical assessments made).
8. Fish Presence: 0 = no fish present and no evidence of fish during the 2011 survey; 1 = evidence of Eel only in recent years (as gathered from electrofishing, unstructured interview with experts and questionnaires); 2 = other fish species.
9. WB_Code. Site located within designated Water Body code.
10. Name of watershed which the site belongs to.

1	2	3	4	5	6	7	8	9	10
OBJECTID	SITE	POINT X	POINT Y	METHOD	PERIOD	QUANTITATIVE	FISH PRESENCE	WB_Code	WATERSHED
1	Aphrodites baths	440161,74	3879471,00	3	2009	0	1	CY_2-1-2_R1	East Akamas
2	Polis Mouth 2	447341,80	3876761,21	1	2011MAY	1	1	CY_2-2-6_R3-HM	Chrysochou
3	Kampos 1	476441,38	3880873,97	1	2010	1	0	CY_2-9-1_R1	Kampos
4	Fragma Tsakistras	472920,28	3875592,39	2	2011MAY	0	2	CY_2-8-1_R3	Limnitis
5	Kat Gef Limniti	473771,90	3884006,11	1	2010, 2011MAY_JU	1	1	CY_2-8-1_R3	Limnitis
6	Fragma Galinis	478453,04	3885114,12	4	2010	0	0	CY_2-9-4_R1-HM	Kampos
7	Gef Limniti	473685,56	3883173,89	2	2010	0	1	CY_2-8-1_R3	Limnitis
8	Agios Avvakoum	478886,68	3866158,68	1	2010	1	2	CY_1-2-1_R2	Diarizos
9	Pirgos 1	471519,54	3884741,94	1	2010	1	0	CY_2-7-1_R1	Pyrgos
10	Kato Pirgos	471217,59	3893488,52	2	2011MAY	0	0	CY_2-6-4_R1	Katouris
11	Fragma Pomou	461396,48	3889063,57	3	2010	0	2	CY_2-4-3_R3-HM	Xeros
12	Gialia Seep Pond	457738,80	3883704,35	1	2010	1	0	CY_2-3-8_R3	Makounta
13	Gialia Us Spring	458113,43	3883520,98	1	2010	1	1	CY_2-3-8_R3	Makounta
14	Gialia Spring	457616,55	3883626,42	1	2010	1	1	CY_2-3-8_R3	Makounta
15	Gialia Ds spring	457354,51	3883709,65	1	2010	1	1	CY_2-3-8_R3	Makounta
16	Fragma Argaka	454560,52	3878525,29	2	2011MAY	0	2	CY_2-3-5_R3-HM	Makounta
17	Fragma Ag Marina	458112,45	3886098,90	2	2009	0	2	CY_2-4-2_R3-HM	Xeros
18	Milikouri Spring	477228,42	3868733,36	2	2010	0	0	CY_1-2-1_R2	Diarizos
19	Pareklissoudi	478716,13	3865697,33	1	2010	1	2	CY_1-2-1_R2	Diarizos
20	Us Gef Tzelefou	476960,13	3860969,25	1	2010	1	2	CY_1-2-1_R2	Diarizos

1	2	3	4	5	6	7	8	9	10
OBJECTID	SITE	POINT X	POINT Y	METHOD	PERIOD	QUANTITATIVE	FISH PRESENCE	WB_Code	WATERSHED
21	Ds Gef Tzelefou	476924,72	3860767,23	1	2010, 2011MAY	1	2	CY_1-2-1_R2	Diarizos
22	Spring Dixaloi	469843,51	3873628,34	2	2010	0	0	CY_1-4-1_R3	Ezousa
23	Gef Salamiou Xeros	468081,17	3855699,27	1	2010	1	0	CY_1-3-5_R3	Xeros
24	Perasma Xeros	468626,36	3856313,56	1	2010	1	0	CY_1-3-5_R3	Xeros
25	Fragma Kannaviou	462490,65	3864912,93	2	2009	0	2	CY_1-4-3_R3-HM	Ezousa
26	Stavros kat camping	465988,66	3875664,23	2	2010	0	0	CY_2-2-4_R3	Chrysochou
27	Stavros Psokas 1	464880,05	3874947,44	2	2010	0	0	CY_2-2-4_R3	Chrysochou
28	Gef Xerou Lefkas	481985,53	3881119,62	2	2010	0	0	CY_3-1-2_R3-HM	Xeros
29	Fragma Kamenou Paidiou	478140,95	3876296,33	4	2010	0	2	CY_3-1-1_R3	Xeros
30	Fragma Katouri	468565,96	3889715,91	4	2010	0	2	CY_2-6-3_R1-HM	Katouris
31	Fragma Kalopanagioti	484093,85	3873586,74	3	2010	0	2		Marathasa
32	Gef Evrychou	490445,95	3877193,73	1	2011MAY	1	2	CY_3-3-1_R2	Kargotis
33	Polis Crys 1	447357,37	3877754,73	1	2010	1	1	CY_2-2-6_R3-HM	Chrysochou
34	Polis Mouth 1	447060,07	3878118,45	1	2011MAY	1	2	CY_2-2-6_R3-HM	Chrysochou
35	Asprokremma Ponds	458939,57	3842342,04	1	2011MAY	1	0	CY_1-3-9_R3-HM	Xeros
36	Finikas d/s prodam	461476,01	3846841,79	1	2011MAY	1	2	CY_1-3-5_R3	Xeros
37	Gef Choletria	461696,22	3848151,80	1	2011MAY	1	0	CY_1-3-5_R3	Xeros
38	Gef Mavres Sykies	472510,41	3876528,71	1	2011MAY	1	2	CY_2-8-1_R3	Limnitis
39	Vrondisia	468827,41	3880069,30	1	2011MAY	1	0	CY_2-7-1_R1	Pyrgos
40	Ekv PlatisPyrgoy	471624,33	3893566,73	1	2011MAY, 2011MAY_JU	1	1	CY_2-7-1_R1	Pyrgos
41	Avakas	439479,86	3864356,37	1	2011MAY	1	1	CY_1-8-1_R1	Avgas
42	Avakas Mouth	438542,67	3864247,85	2	2011MAY	0	2	CY_1-8-1_R1	Avgas
43	Us fishfarm Kargotis	490010,14	3869600,61	1	2011MAY	1	0	CY_3-3-1_R2	Kargotis
44	AgMamas Limnatis	498364,06	3856743,97	1	2011MAY	1	2	CY_9-6-5_R2	Kouris
45	Frag Kandou	490749,67	3839562,52	2	2011MAY	0	2	CY_9-6-82_R3	Kouris
46	Panagia Diakou Agia	465351,69	3867856,10	1	2010	1	2	CY_1-4-1_R3	Ezousa
47	Alyki Akrotiri	495655,08	3830566,91	3	2009	0	2		
48	Mesa potamos Kouri	491613,06	3859368,56	1	2011MAY	1	2	CY_9-6-35_R3	Kouris
49	Fragma Trimiklini	492185,48	3857966,04	3	2011MAY	0	0	CY_9-6-31_R3	Kouris
50	Fragma Xiliatos	503418,30	3873600,92	3	2009	0	2	CY_3-5-11_R3	Elias
51	Gefira Yerovassa	474055,59	3852393,71	1	2011MAY	1	2	CY_1-2-4_R3-HM	Diarizos
52	Yperchilistis Tsakistra	472882,85	3875699,31	1	2011MAY	1	2	CY_2-8-1_R3	Limnitis
53	Kat Fragma Tsakistras	472828,62	3875749,34	1	2011MAY	1	0	CY_2-8-1_R3	Limnitis
54	Ag Georgios	491219,57	3852584,09	1	2011MAY_JU	1	0	CY_9-6-4_R3-HM	Kouris
55	U/s Kouris confluence	491864,17	3847406,60	1	2011MAY_JU	1	2	CY_9-6-4_R3-HM	Kouris
56	Dierona	510823,34	3854775,75	1	2011MAY_JU	1	0	CY_9-2-2_R2	Germasogeia
57	Prastio	510372,57	3852405,25	1	2011MAY_JU	1	0	CY_9-2-31_R3	
58	U/s Arakapas dam	507461,58	3855691,89	1	2011MAY_JU	1	0	CY_9-2-11_R2	Germasogeia
59	D/s Arakapas dam	508365,27	3855757,27	1	2011MAY_JU	1	0	CY_9-2-1_R2-HM	Germasogeia
60	Katydata	489210,59	3881794,28	1	2011MAY_JU	1	0	CY_3-3-4_R3	Kargotis

1	2	3	4	5	6	7	8	9	10
OBJECTID	SITE	POINT X	POINT Y	METHOD	PERIOD	QUANTITATIVE	FISH PRESENCE	WB_Code	WATERSHED
61	Skouriotisa	489189,67	3883279,75	1	2011MAY_JU	1	0	CY_3-3-4_R3	Kargotis
62	U/s Kafizides dam	480530,21	3878357,27	1	2011MAY_JU	1	2	CY_3-1-1_R3	Xeros
63	D/s Kamenopaidi	480331,55	3878059,85	1	2011MAY_JU	1	2	CY_3-1-1_R3	Xeros
64	D/s Kafizides dam	480818,84	3878699,20	1	2011MAY_JU	1	2	CY_3-1-2_R3-HM	Xeros
65	U/s Lefka dam	485104,04	3879569,17	1	2011MAY_JU	1	2	CY_3-2-2_R3-HM	Marathasa
66	Pediaos Lefk	532016,17	3892279,45	1	2011MAY_JU	1	2	CY_6-1-2_R3-HM	Pediaios
67	D/s Life pond	469043,43	3848294,08	1	2011MAY_JU	1	0	CY_1-2-4_R3-HM	Diarizos
68	Ekvoles Diarizos	459880,19	3839293,28	2	2011MAY_JU	0	1	CY_1-2-4_R3-HM	Diarizos
69	Ekvoles Xeros	458560,78	3839604,18	2	2011MAY_JU	0	0	CY_1-3-9_R3-HM	Xeros
70	Achelia canal	452951,94	3844363,72	2	2011MAY_JU	0	2	CY_1-4-3_R3-HM	Ezousa
71	Ekvoles Ezousas	450282,96	3843184,10	2	2011MAY_JU	0	0	CY_1-4-3_R3-HM	Ezousa
72	D/s Kouris dam	492593,41	3842307,45	1	2011MAY_JU	1	2	CY_9-6-9_R3-HM	Kouris
73	D/s Kouris dam 2	491754,11	3839494,22	2	2011MAY_JU	0	0	CY_9-6-9_R3-HM	Kouris
74	Phassouri pits	493205,56	3830364,86	2	2011MAY_JU	0	2	N/A	“Akrotiri”
75	Zakaki	500286,30	3833470,47	2	2011MAY_JU	0	2	N/A	“Akrotiri”
76	Phassouri reeds	493902,77	3832151,93	2	2011MAY_JU	0	2	N/A	“Akrotiri”
77	Alassa above bridge	494386,44	3847527,20	1	2011MAY_JU	1	0	CY_9-6-72_R3	Kouris
78	Alassa below bridge	494251,65	3847245,04	1	2011MAY_JU	1	2	CY_9-6-72_R3	Kouris
79	Limnatis flowmeter	494595,61	3849331,17	1	2011MAY_JU	1	0	CY_9-6-72_R3	Kouris
80	Fleva	469604,76	3883977,36	1	2011MAY_JU	1	0	CY_2-7-1_R1	Pyrgos
81	Livadi dam	461307,30	3889239,52	2	2011MAY_JU	1	2	CY_2-4-3_R3-HM	Xeros
82	Kafizides dam	480731,40	3878542,41	2	2011MAY_JU	0	2	CY_3-1-2_R3-HM	Xeros
83	Livadi u/s dam	461616,26	3888456,32	1	2011MAY_JU	1	2	CY_2-4-4_R3	Xeros
84	Livadi u/s dam 2	461799,13	3887759,37	1	2011MAY_JU	1	2	CY_2-4-4_R3	Xeros
85	Germasogia d/s dam	507789,69	3844321,29	1	2011MAY_JU	1	0	CY_9-2-5_R3-HM	Germasogeia
86	Germasogia u/s dam	509061,85	3846962,91	1	2011MAY_JU	1	2	CY_9-2-31_R3	Germasogeia
87	Germasogia u/s flowmeter	509236,60	3847357,08	1	2011MAY_JU	1	0	CY_9-2-31_R3	Germasogeia
88	Germasogia d/s flowmeter	509241,39	3847238,81	1	2011MAY_JU	1	2	CY_9-2-31_R3	Germasogeia
89	Akrounta confluence	507733,93	3846189,95	1	2011MAY_JU	1	2	CY_9-2-4_R3-HM	Germasogeia
90	Lazarides 1	473394,47	3865015,58	1	2011MAY_JU	1	0	CY_1-3-1_R2	Xeros
91	Akrounta village	507000,75	3847361,09	1	2011MAY_JU	1	0	CY_9-2-4_R3-HM	Germasogeia
92	Kouris flowmeter	491136,14	3847228,21	1	2011MAY_JU	1	0	CY_9-6-1_R3-HM	Kouris
93	Kouris d/s flowmeter	491362,33	3847195,23	1	2011MAY_JU	1	2	CY_9-6-1_R3-HM	Kouris
94	Perapedi u/s bridge	488287,48	3857715,88	1	2011MAY_JU	1	0	CY_9-6-1_R2-HM	Kouris
95	Kalidonia trailhead	488001,58	3863019,31	1	2011MAY_JU	1	2	CY_9-6-1_R2	Kouris
96	Spilia	493346,35	3868835,57	1	2011MAY_JU	1	2	CY_3-3-1_R2	Kargotis
97	Kargotis confluence	491163,85	3872075,18	1	2011MAY_JU	1	0	CY_3-3-1_R2	Kargotis
98	Kouris u/s dam	491666,63	3846986,06	1	2011MAY_JU	1	2	CY_9-6-1_R3-HM	Kouris
99	Marathasa d/s fisheries	484061,03	3874359,02	1	2011MAY_JU	1	2	CY_3-2-2_R3-HM	Marathasa
100	Kakopetria Garillis	491238,90	3871154,29	1	2011MAY_JU	1	2	CY_3-3-1_R2	Kargotis
101	Garillis confluence	491123,36	3871938,59	1	2011MAY_JU	1	2	CY_3-3-1_R2	Kargotis

1	2	3	4	5	6	7	8	9	10
OBJECTID	SITE	POINT X	POINT Y	METHOD	PERIOD	QUANTITATIVE	FISH PRESENCE	WB_Code	WATERSHED
102	Potamitissa bridge	499098,41	3862849,37	1	2011MAY_JU	1	0	CY_9-6-5_R2	Kouris
103	Amiantos	494064,99	3864202,45	1	2011MAY_JU	1	0	CY_9-6-31_R3	Kouris
104	Marathasa u/s dam	484102,28	3873299,62	1	2011MAY_JU	1	2	CY_3-2-1_R2	Marathasa
105	D/s dam Evretou	451536,83	3870558,54	1	2011MAY_JU	1	0	CY_2-2-6_R3-HM	Chrysochou
106	Goudi bridge	449304,76	3872324,52	1	2011MAY_JU	1	1	CY_2-2-6_R3-HM	Chrysochou
107	Gef Skouli	448494,21	3873379,01	1	2011MAY_JU	1	1	CY_2-2-6_R3-HM	Chrysochou
108	Stavros Psokas u/s dam E	453465,52	3868478,29	1	2011MAY_JU	1	2	CY_2-2-4_R3	Chrysochou
109	U/s evretou dam 2	454779,87	3868405,29	1	2011MAY_JU	1	2	CY_2-2-4_R3	Chrysochou
110	D/s gef watermills Arama	456194,63	3867867,71	1	2011MAY_JU	1	2	CY_2-2-4_R3	Chrysochou
111	U/s gef watermills Arama	456399,43	3867926,51	1	2011MAY_JU	1	0	CY_2-2-4_R3	Chrysochou
112	Gef Roudias	471289,42	3860966,64	1	2011MAY_JU	1	2	CY_1-3-5_R3	Xeros
113	Amati	458373,74	3855907,15	1	2011MAY_JU	1	1	CY_1-4-3_R3-HM	Ezousa
114	Two bridges	477809,56	3861796,24	1	2011MAY_JU	1	2	CY_1-2-1_R2	Diarizos
115	Alonoui	472907,58	3865692,85	1	2011MAY_JU	1	2	CY_1-3-1_R2	Xeros
116	Stenoi	472336,36	3865481,06	1	2011MAY_JU	1	2	CY_1-3-1_R2	Xeros
117	Kisdasi	472860,15	3850436,24	1	2011MAY_JU	1	1	CY_1-2-4_R3-HM	Diarizos