

Freshwater fish fauna of Algeria. The fish fauna of inland waters of Great-Kabylia.

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ABSTRACT

In Algeria, there has been little research on fish communities. In a first part, we presented a synthesis of the bibliographic data of the fishes of the Algerian continental waters. The established list includes 67 species belonging to 22 families and 46 genera. 37 are native of which 6 endemic and 28 introduced. Among the native species, three are on the IUCN red list of endangered or near-threatened species (*Aphanius iberus*, *Aphanius saouensis* and *Haplochromis desfontainii*). The results of a study on the ichthyofauna of Great Kabylia are also presented. The established inventory consists of 16 species belonging to 7 families and 14 genera. They represent 24.61% of all the known species of Algeria. Samples were collected from 12 sites in may-june 2012 and may-june 2013. Height sites were selected at river level and four at dams. The examined sampling of fish was performed by using many techniques: electric fishing, gill net fishery, fish traps, fishing rod. The spatial distribution of the species was specified by a factorial correspondence analysis (AFC) and the affinity between species and stations were investigated by the hierarchical classification method. Three groups of species and stations have been recognized: a first grouping of homogeneous species characteristic of lowland rivers, the second, rather heterogeneous, composed of species common to rivers and dam lakes, and the third is composed of the most common species which colonize all types of habitats (rivers and dams) with no particular ecological requirements.

KEYWORDS: Freshwater fish - Diversity - Introduced species - Inventory - Great-Kabylia – Algeria.

INTRODUCTION

Algeria, by its geographical position in the west of the Mediterranean, between the southwest of Europe and the Ethiopian region, is confers it a special interest for fauna and biogeographic studies. The great diversity of its relief and the importance of its river system explain the diversity and endemism of its fauna in general and of freshwater fish in particular.

The fish fauna of Algerian continental waters forms one part of the sum that constitutes the Maghrebi ichthyologic province. The latter forming a hinge zone between the African and Eurasian tectonic plates is recognized as having played an important role in the dispersion of this fauna [47, 34]. This region, compared to Mediterranean Europe and sub-Saharan Africa, has a relatively poor biological diversity. Its fish fauna is characterized by the predominance of Cyprinidae with nearly half of indigenous species of Algerian aquatic continental environments [39].

Studies on fish fauna of inland waters in Algeria have not boomed as is the case for marine ecosystems. The works available, typically limited in space and time, are devoted mostly to systematics and rarely to ecology and biogeography [46, 43, 48, 49, 14, 15, 19, 20, 21, 22, 13, 1, 45, 10, 25, 11].

The most recent ichthyological studies in the Algerian territory are those of [53] on fish fauna of Hoggar and Tassili, [16] on fish fauna of the Mellah lagoon, [9] on genus *Aphanius*, [6] on fish fauna of Soummam, [30] on fish fauna of Algerian inland waters, [38, 39] on the distribution of Algerian freshwater fish, [17] on the fish fauna of inland waters in the region of the Aures and northern Sahara, [24] on the upper Cheliff dam lakes. As a consequence, more than 70 species are reported or described in the literature concerning the Algerian freshwater fish. However, it should be noted that their taxonomy is questionable, their determination is without doubt inaccurate or should at least be confirmed, and their distribution and status are often inaccurate. Moreover, the current situation of this wildlife is precarious and weakened by the growing economic activities, destruction and fragmentation of habitat, population pressure and drought. That is why, to adopt adequate measures to preserve fishery resources in Algeria, it is important to update the data on systematic, distribution and ecology of the species, and to assess the factors responsible for the decline of this fish fauna.

The aim of this study was to (1) achieve a synthesis of knowledge on the overall composition of ichthyologic population of Algerian inland waters, (2) an inventory of freshwater fish species in Great Kabylia.

This work done on aquatic continental environments of Great Kabylia is original to the extent that no study has been made there before. It seemed interesting to focus on the investigations of the abiotic components to determine their influence on the composition and structure of the ichthyologic population.

Study sites and methods:

Study sites:

The work has been conducted in the area of Great Kabylia: the Sebaou basin. The latter occupies a central location in the Tell Atlas between $36^{\circ}54'$ and $36^{\circ}53'$ north latitude and between $3^{\circ}50'$ and $4^{\circ}25'$ east longitude. The Sebaou basin is part of the périmediterranean alpine orogeny. It occupies an area of approximately 4000 km². It starts in the north side of the massif of Djurdjura (alt. 2308 m) and the southern slopes of the Coast Range (alt. 800m) and extends to its mouth which is Takdemt near the town of Dellys ($36^{\circ}54'43.5''$ N – $3^{\circ}50'39.2''$ E), on the Mediterranean coast.

The Sebaou basin is drained by a dense river network (Fig. 1). Its main tributaries are on the left bank and the east, Boubhir Wadi * that drains runoff from the massif of Akfadou (Akfadou col alt. 1574m, Chelata col alt. 1421m) and the eastern ridge of the Djurdjura (Tirourda col alt. 1960m) in the center of wadi Aissi that collects runoff from the Djurdjura median dorsal (Tizi-N'Kouilal col alt. 1531m, Azrou N'Chira alt. 1289m), west of Bougdoura wadi that drains runoff of western ridge of Djurdjura (Thala Guiléf alt. 1680 m, Jebel Haizer alt. 2093m). The tributaries of the right bank are relatively short (about ten km long): Diss wadi, Tamda wadi, Stita wadi, and have smaller flows. They collect all south side flows of the Coast Range. The study area has, in addition to the temporary standing water (small dams, bogs), four dams (Tab. 1).

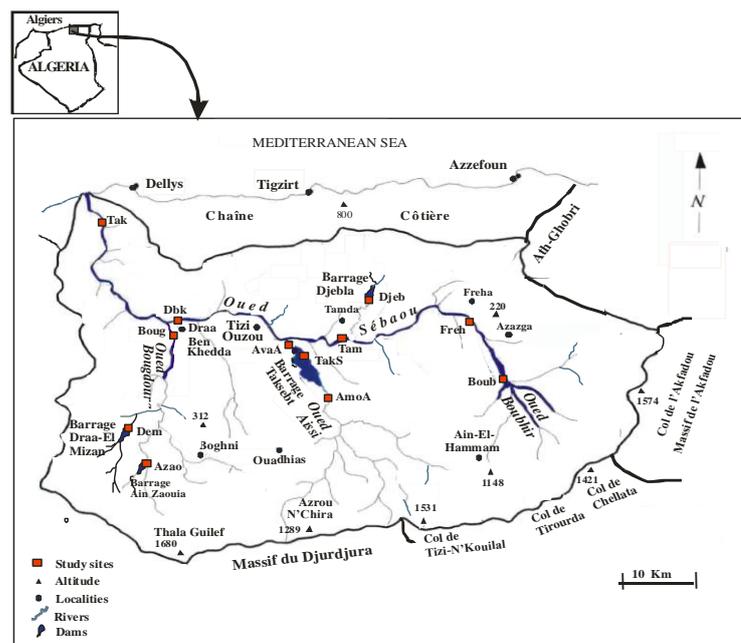


Fig. 1: Map of the Sebaou catchment showing the location of the sampling sites

* Wadi = Arabic word for a temporary watercourse.

Table 1: The dams of Great-Kabylia

locality	Capacity (x 10 ⁶ m ³)	geographical coordinates	Installation date	maximum depth (m)
Ain Zaouia	1.4	36°32'18.5'' N / 3°52'18.8''E	1985	26
Draa El Mizan	1.52	36°33'48.8''N / 3°50'15.7''E	1974	23
Taksebt	180	36°40'25.8''N /4°07'18.6''E	2002	72
Djebbla	3	36°46'27.7''N / 4°12'31.3''E	1969	19

The Sebaou basin is characterized by a fluctuating hydrologic cycle. Periods of low water levels are between June and October, while the maximum flow occurs in December, January and/or February for winter regime, and in March-April for spring. In the massif of Djurdjura and Akfadou (Alt. > 1000 m), the annual averages of rain full range from 1200 mm and around 800 mm in the Sebaou valley [36, 37]. The temperature variations are influenced mainly by altitude. In the middle and lower flows of rivers, the maximum water temperature is high (25-30° C) and annual thermal amplitudes oscillate around 20°C. In the upper parts, the maximum temperature does not exceed 20°C.

The hydrographic Sebaou basin network is disrupted by various anthropogenic attacks. The urban and industrial wastes are the main pollutants of rivers outside agricultural activities and sand extractions. These downgrades have led to the fragmentation of the environmental and threaten aquatic life.

Methods:

The examined sampling of fish was performed by using two techniques:

- Electric fishing whose effectiveness depends on the characteristics of the current used, mineralization and water temperature, and depth. Its implementation to deep and turbid areas seemed quite delicate.

- The gill net fishery, efficient method for sampling average or waterways large sizes waterways. It permits to fish closer to the banks of dams. However, this technique is particularly selective in relation to the size and species of fish. The net used is a trammel net of 50 m long and 1,5 m high. It consists of three superimposed layers: two layers large mesh (270 mm) surrounding a central web to a smaller mesh size (50 mm). The set has a head rope equipped with floats and a lower lead line.

Other means of capture were implemented to obtain other samples. So, we used fish traps (80 cm long and 15 mm mesh) and fishing rods to capture living individuals.

Sampling was carried out in 12 stations (Fig. 1). Four were chosen at Sebaou Wadi (main course): Fréha, Tamada, Draa Ben Khedda, Takdamt), four in the major tributaries (boubhir Wadi 1, Aïssi Wadi 2, Bougdoura Wadi 1) and four at dams (Djebbla, Taksebt, Draa El Mizan, Ain Zaouia). The environmental characteristics of the 12 sampling stations are listed in Appendix 1. In order to achieve the most exhaustive inventory, some sites have undergone several samples: May-June 2012 and May-June 2013. In addition, we collected information of samples donor (anglers) on capture performed (quality and quantity). The fish caught were identified through usually used morphological and morphometric characters, reported in the literature [43, 44, 1, 2, 40, 4].

To analyze the structure and fish assemblages, factorial correspondence analysis (AFC) [7, 23] were performed with the software Statistica 6.0, departing from presence-absence data. The research cores affinity between variables or between observations is made possible through the hierarchical classification method [50] used from the coordinates of variables and observations along the axes of the AFC. This method is to gather, in the same group, the data that have a significant degree of similarity.

Results:

Bibliographic inventory of the fish fauna of inland waters in Algeria:

The established inventory of Algerian fish fauna consists of 65 species split into 22 families and 46 kinds (Appendix 2). Thirty-seven are natives among whose six are endemic and 28 are introduced. The fish fauna is characterized by the predominance of Cyprinidae family members with 14 kinds and 20 species and in a lesser extent Cichlidae (5 kinds, 8 species), Mugilidae (3 kinds, 5 species), and Cyprinodontidae (1 kinds, 4 species). The rest of the families are represented by only one or two species. Some dominance in the generic qualitative level detach from the community. It is the *Barbus* genus that is the most diversified with six species among which *Barbus deserti* and *Barbus biscarensis* are Saharan endemics. However, it should be noted that the systematic and specific status of North African barbels require firstly taxonomic revision [51] despite the fact that morphologically we can easily distinguish these taxa [26]. Among the native species, three are on the red list of endangered or near-threatened by IUCN [52] (*Aphanius iberus*, *Aphanius saourensis* and *Haplochromis desfontainii*).

Concerning the introduced species in Algeria, today there are 28 species: carp as a whole, zander, catfish, black bass for aquaculture purposes, mosquito fish for biological control or to reduce eutrophication in dams. These species seem to be well acclimatized, but can be an ecological threat to the rest of the local fish fauna in certain habitats. As for the unintentional introduction of *Pseudorasbora parva*, it gradually colonizes the wadis and can be considered potentially harmful.

The ichthyofauna of Great-Kabylia:

The fish fauna of inland waters of Great Kabylia has remarkably attracted little attention. The only previous data we have are those of [45] which identified two species in Wadi Sebaou (*Barbus callensis* and *Anguilla Anguilla*).

The study carried out in the Sebaou basin has resulted in the identification of 16 species belonging to 7 families and 14 genera (Tab. 2). The Cyprinidae with 9 species (56.25% of the stand), are the most important part of this settlement. The other families are represented by only one or two species. Seven species are observed in lentic environment (*Micropterus salmoides*, *Aristichtys nobilis*, *Carassius auratus*, *Ctenopharyngodon idella*, *Cyprinus carpio specularis*, *Hypophthalmichthys molitrix*, *Sander lucioperca*), four in lotic environment (*Alosa Alosa*, *Alosa fallax*, *Mugil cephalus*, *Petromyzon marinus*) and five are common to both environments (*Anguilla Anguilla*, *Barbus setivimensis*, *Cyprinus carpio carpio*, *Rutilus rutilus*, *Alburnus alburnus*). Representatives of the freshwater fish fauna are 12 in number; only two are natives (*Anguilla Anguilla*, *Barbus setivimensis*). The other ten are rather introduced species for aquaculture purposes and the fight against eutrophication of dams. Regarding water euryhaline species, they are four in number: *Alosa Alosa*, *Alosa fallax*, *Mugil cephalus*, *Petromyzon marinus*. They go up the rivers to search for food.

Table 2: List of freshwater fish of Great-Kabylia (1: present, empty box: absent)

	Species code	Stady sites											
		Water courses							Dams				
		Takdemt (Tak)	Draa Ben Khedda (Dbk)	Tamda (Tam)	Frehha (Freh)	Bouhbir (Boub)	Oued Aissi Aval (AvAA)	Oued Aissi Amont (AmoA)	Bougdoura (Boug)	Djebha (Djeb)	Taksebt (Taks)	Draa-El-Mizame (Dem)	Ain Zaouia (Azou)
Anguillidae													
<i>Anguilla anguilla</i>	Aang	1	1	1	1	1	1	1	1	1	1	1	1
Centrarchidae													
<i>Micropterus salmoides</i>	Msal										1		
lupeiidae													
<i>Alosa alosa</i>	Aalo	1	1		1	1							
<i>Alosa fallax</i>	Afal	1	1			1							
Cyprinidae													
<i>Alburnus alburnus</i>	Aalb						1			1			
<i>Aristichtys nobilis</i>	Anob									1			
<i>Barbus setivimensis</i>	Bset		1	1	1	1	1	1	1	1	1	1	1
<i>Carassius auratus</i>	Caur									1			
<i>Ctenopharyngodon idella</i>	Cide									1	1		
<i>Cyprinus carpio var. communis</i>	Ccco		1	1		1	1	1	1	1	1	1	1
<i>Cyprinus carpio var. specularis</i>	Ccsp									1			
<i>Hypophthalmichthys molitrix</i>	Hmol									1			
<i>Rutilus rutilus</i>	Rrut						1			1			
Mugilidae													
<i>Mugil cephalus</i>	Mcep	1	1			1	1						
Percidae													
<i>Sander lucioperca</i>	Sluc									1	1	1	
Petromyzontidae													
<i>Petromyzon marinus</i>	Pmar						1						

Considering the complexity of the relations between the biological and ecological characteristics and stand structure, a multivariate analysis of a contingency table crossing stations and species was performed by means of an AFC. Then, an hierarchical ascending classification calculated from coordinates readings on the factorial axes allowed to know at what level the frequently associated species are connected. The results obtained with this classification and simultaneous examination of the positions of faunal surveys on F1-F2 Plans (Fig. 2 and 3) allowed to highlight three successive groups of species along the structure. The F1-F2 AFC factorial is the one which extracts the maximum faunal information. These first two axes account for over 57% of the total inertia (F1: 36.69%, F2: 20.96%). However, considering the objectives of this study, it was not essential to determine the exact meaning of each axis, but rather to distinguish species groups in terms consistent with their distribution.

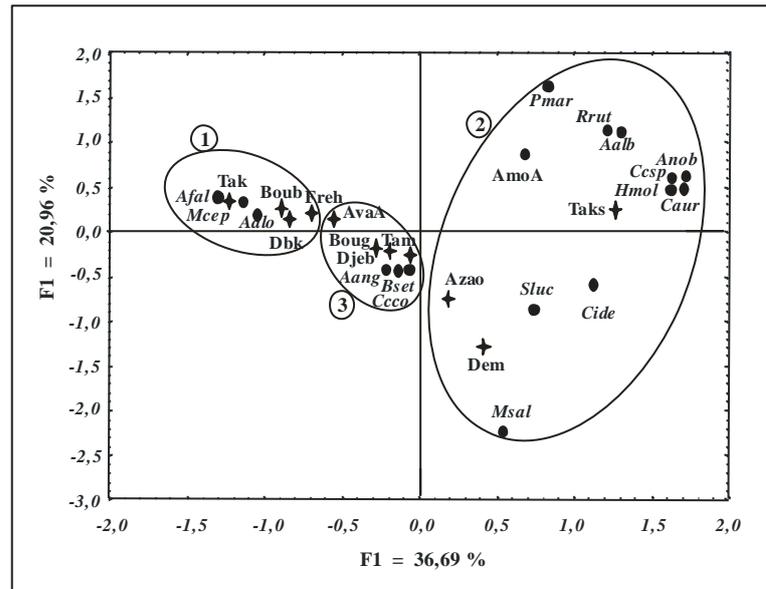


Fig. 2: F1 x F2 plane of the correspondence analysis run with species presence-absence data. Stations (in bold) and species (in italic) are indicate in table 2.

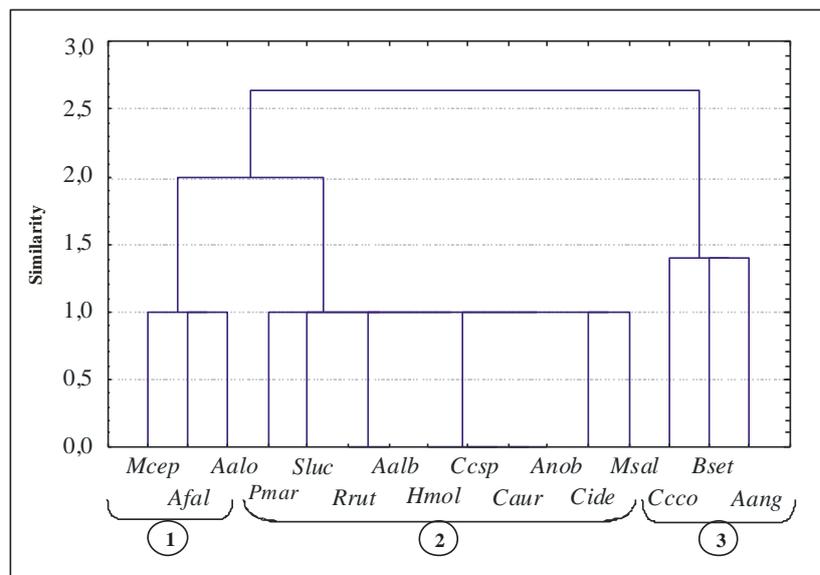


Fig. 3: Cluster analysis of the 2 first axis coordinates of the correspondence analysis showing the 3 species groups.

The distribution of fish and stations is performed according to a gradient roughly oriented along F1 axis. The most common species, with wide ecological amplitude, representative of bodies of water taken together (group 3), occupy the center of the graph (*Barbus setivimensis*, *Cyprinus carpio carpio*, *Anguilla Anguilla*). At the negative end of F1 axis, amphihaline species known for their great euryhalinity, i.e. group 1 which is constituted of *Alosa Alosa*, *Alosa fallax*, *Mugil cephalus*, are clearly marginalized. This group of species is the settlement characteristic of lowland rivers (stations Tak, Dbk, Freh, Boub). It is characterized by a certain homogeneity of the fauna structure and biological characteristics. This group of species is markedly different from settlement Taks, Dem, Azao and AmoA stations in positive position of axis 1 which also shows strong heterogeneity (group 2). This group is composed of *Petromyzon marinus*, species characteristic of the upstream of Aissi wadi (AmoA), *Rutilus rutilus* and *Albirtus albirtus*, common species to AmoA station (up stream of Aissi wadi) and Taks (Taksebt dam), and *Aristichtys nobilis*, *Hypoptalmichthys molitrix*, *Carassius auratus*, *Cyprinus carpio* var. *specularis*, *Sander lucioperca*, *Ctenopharyngodon idella*, *Micropterus salmoides*, species introduced and frequently dumped into artificial reservoirs (stations: Taks, Azao, Dem, Djeb).

Discussion:

Ichthyofauna from Algeria:

Until recently, very few studies have been devoted to the ichthyofauna of the continental waters of Algeria. [42] was the author of the first monograph of the Algerian freshwater fish. Then, apart from attempts of recent bibliographical compilations [38, 39, 6, 30] and some partial studies [1, 2, 25, 11], no updated distribution catalog of Algerian freshwater fish has been developed. More recently, in the context of biodiversity projects in continental aquatic environments, regional inventories of fish fauna have been carried out [53, 6, 17, 24] and allowed a first view of the ichthyofaunal diversity of the continental waters of Algeria.

The freshwater fish fauna of Algeria is composed of 65 species belonging to 22 families and 46 genera. Thirty seven species were found to be autochthonous and twenty eight have been introduced (Appendix 2). In accordance to the fish fauna of the rest of the Mediterranean basin, Cyprinidae species now predominate [33, 27, 8, 5]. In Algeria, this family represents 30.77% of the recorded species. However, the autochthonous fish species were mostly Cichlidae (8 species), Cyprinidae (20 species) especially the genus *Barbus* (6 species), and Cyprinodontidae of the genus *Aphanius* (4 species). Among autochthonous species, six are endemic: *Barbus deserti*, *Barbus biscarensis*, *Aphanius saourensis*, *Aphanius apodus*, *Pseudophoxinus callensis*, and *Haplochromis desfontainii*. The latter has the status of endangered species in the red list of IUCN [52].

On a systematic level, several studies have reported the difficulties encountered in distinguishing between *Barbus*, *Aphanius* and *Gambusia* species by referring to morphological characteristics, given their great similarities and many hybrids and local varieties [25, 5]. Traditionally, studies on freshwater fishes in North Africa have focused on the description of diversity based on morphological characters. However, morphological characters used in classical works [12, 43, 44] such as meristic characters and body measurements, did not provide reliable keys for species identifications [1] results obtained often overlap, and a correct identification becomes difficult if not impossible. Consequently, most authors considered the number of taxa described for some genera unreasonably high. i.e. in the genus *Barbus*, 12 nominal species and 6 varieties have been described in North Africa [35]. The main problem is that the descriptions are often based on a small number of preserved specimens which usually constrains adequate study of intraspecific variation. As a result, the biogeography based on the results of these classical studies is apparently not correct. i.e. a recent study of molecular polymorphism [41] showed that the species *Barbus callensis* Valenciennes, 1842, actually comprises two species: *Barbus callensis* Pellegrin, 1921 whose range is limited to the region of El-Kala (North-East of Algeria) and *Barbus setivimensis* Pellegrin, 1939 which occupies the rest of northern Algeria. Considering these divergences, the systematic and the specific status of North African barbels in general and of Algeria in particular, require a more systematic revision.

Specific diversity in Algerian continental waters is comparable to that found around the Mediterranean basin: 70 species in France [32], 36 in Portugal [3], 40 in Spain [27], 71 in Italy [8], 46 in Morocco [5] and 9 species in the northern Tunisian rivers [33].

Scientific knowledge of the ichthyofauna of Algeria is recent and is still a field insufficiently explored. Many watersheds, lakes, chotts and other water points (fountains, foggaras, wells...) are not yet explored and have not yet been the subject of a systematic ichthyological inventory. Twenty two fish families, belonging to 65 species and 46 genera, are currently listed [39]. It is likely that this list is not yet complete and the ichthyofauna specific to each river basin is still poorly known.

The ichthyofauna of Great-Kabylia:

The fish inventory carried out in this study resulted in the identification of 16 species belonging to 7 families and 14 genera. It represents 24.61% of all the known species of Algeria. It is characterized by the predominance of Cyprinidae: 9 species, or 56.25% of the stand. The other families are represented by only one or two species. This study provides the first qualitative inventory of the fish fauna of the continental waters of Great-Kabylia. All the species listed here have already been described in the literature.

The specific wealth encountered is similar to that observed in the Soummam: 19 species, 11 families, 17 genera [6], in the Aures region: 14 species, 5 families, 13 genera [17] and in the upper Cheliff: 10 species, 4 families, 9 genera [24].

Among the 16 species caught, five are amphihaline migratory species (*Alosa alosa*, *Alosa fallax*, *Mugil cephalus*, *Petromyzon marinus*, *Anguilla anguilla*) and 11 exclusively freshwater species, 10 of which have been introduced as part of water body replanting programs. For the needs of aquaculture and the fight against the eutrophication of dams, and only one species (*Barbus setivimensis*) is indigenous.

The analysis of the qualitative data based on the presence-absence of the species highlights the faunistic richness of the stations and the faunistic affinity between the stations. The results reveal some similarities in stand structure, but also associations of significantly different species. The most common species (*Barbus setivimensis*, *Cyprinus carpio carpio*, *Anguilla anguilla*) colonize all types of habitats (rivers and dams) with no particular ecological requirements. The amphihaline species (*Alosa alosa*, *Alosa fallax*, *Mugil cephalus*) are typical of lowland streams, and the rest of the species show a strong heterogeneity of structure. The presence of

Petromyzon marinus observed at the station AmoA (upstream of Aissi Wadi) and *Rutilus rutilus* - *Alburnus alburnus*, identified in two types of environments (Watercourse and dam), typical of watercourses in particular Aissi Wadi, can be interpreted as a residue of the species initially present in the rivers before the construction of the Taksebt dam.

The water bodies of Great-Kabylia have known the introduction of several species: *Cyprinus carpio*, *Aristichthys nobilis*, *Ctenopharyngodon idella* and *Hypophthalmichthys molitrix*. The purpose of these introductions was aquaculture and reducing the eutrophication of dams. Three other species were recently found in the Taksebt reservoir: *Alburnus alburnus*, *Carassius auratus* and *Rutilus rutilus*. These species are probably part of the 2005 and 2006 introduction of carps. These introductions, without prior studies of their possible impacts on indigenous species, may lead to the regression or even disappearance of indigenous species. As in the rest of the world, the introduction of fish has many consequences that affect biodiversity: competition phenomena [18, 31], predation [42], hybridization [34], disease transmission [29] and habitat modification [40].

The current situation of the ichthyofauna of Algeria in general and of Great-Kabylia in particular is precarious and fragilized by the increasing economic activities, destruction of natural environments, population pressure and drought. In fact, continental aquatic ecosystems have become receptacles of all forms of pollution. The main impacts are on rivers, which are the main collectors of urban and / or industrial sewage. This pollution is one of the factors of decline and / or extinction of indigenous fish. Moreover, the development (dam construction, diversion of watercourses, removal of gravel) on the wadis jeopardizes the diversity of fish fauna; they are also responsible for this decline. This species is very sensitive to the risks of extinction due to the decrease in the area and the quality of its habitat [28]. The exclusive presence of indigenous species in natural habitats, particularly in watercourses, emphasizes the importance of these habitats in the conservation of rare and/or special species.

Conclusion:

This study provides the first qualitative inventory of the fish fauna of the continental waters of Great-Kabylia. However, as conservation efforts in Algerian continental aquatic environments are constrained by a variety of factors including lack of ecological information, much more work is needed on the life histories and distributional ecology of freshwater fish. In this way we could better understand the consequences of land degradation and its effects on the integrity and conservation of running waters in Algerian rivers.

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Appendix 1 : Abiotic characteristics of the 12 studied sampling stations.

alt: elevation (m), Dist : distance to the sea (km), Larg: river and dam width (m), Prof : maximum water depth (m), GG: pebbles and gravels (%), SLMO: sand, silt and organic matter covering the botom (%), Poll: human impact (3 classes from absente (0) to high (2)), Vb: riparian cover (absente (0), present (1)), Tmoy: Average temperature (°C), Ass: Drought (permanent water (0), drying (1)).

	geographical coordinates	Alt	Dist	Larg	Prof	GG	SLMO	Poll	Vb	Tmoy	Ass
Tak	36°53'49.6'' N / 3°51'13.7'' E	20	5	30	1	50	50	2	1	23	0
Dbk	36°46'20.9'' N / 3°53'19.9'' E	60	36	20	0,5	50	50	2	0	22	1
Tam	36°42'19.4'' N / 4°3'11'13.1'' E	100	55	20	1	50	50	2	0	21	1
Freh	36°44'30.1'' N / 4°17'49.2'' E	160	60	10	0,5	40	60	1	1	21	1
Boub	36°38'32.8'' N / 4°23'04.2'' E	220	75	4	0,5	50	50	0	1	20	1
AvaA	36°40'15.4'' N / 4°07'22.9'' E	100	56	10	0,5	70	30	1	1	19	1
AmoA	36°38'49.0'' N / 4°07'51.6'' E	140	61	7	1	40	60	0	2	18	0
Boug	36°30'55.8'' N / 3°56'51.2'' E	120	37	15	0,5	60	40	2	0	22	1
Djeb	36°46'27.7'' N / 4°12'31.3'' E	170	66	50	19	20	80	1	2	22	0
Taks	36°40'25.8'' N / 4°07'18.6'' E	120	56	500	70	20	80	0	2	21	0
Dem	36°33'48.8'' N / 3°50'15.7'' E	260	70	100	23	20	80	1	1	21	0
Azaa	36°32'18.5'' N / 3°52'18.8'' E	320	75	50	26	20	80	1	1	22	0

Appendix 2: Bibliographic inventory of the fish fauna of inland waters of Algeria.

(Stat: status, Nat: autochthonous species, Int: introduced species, End: endemic species.)

Freshwater fish			
Families / Species	Stat.		
Anguillidae		Percidae	
<i>Anguilla anguilla</i> (Linnaeus, 1758)	Nat	<i>Perca fluviatilis</i> (Linnaeus, 1758)	Int
Centrarchidae		<i>Sander lucioperca</i> (Linnaeus, 1758)	Int
<i>Micropterus salmoides</i> (Lacépède, 1802)	Int	Poeciliidae	
<i>Lepomis gibbosus</i> (Linnaeus, 1758)	Int	<i>Gambusia affinis</i> (Baird et Girard 1853)	Int
Cichlidae		<i>Gambusia holbrooki</i> (Girard, 1859)	Int
<i>Haplochromis desfontainii</i> (Lacépède, 1802)	End	<i>Poecilia reticulata</i> (Peters, 1859)	Int
<i>Hemichromis bimaculatus</i> Gill, 1862	Nat	Salmonidae	
<i>Hemichromis letourneuxi</i> sauvage, 1880	Nat	<i>Oncorhynchus mykiss</i> (Walbaum, 1792)	Int
<i>Oreochromis macrochir macrochir</i> (Boulenger, 1912)	Int	<i>Salmo trutta trutta</i> (Linnaeus, 1758)	Int
<i>Oreochromis mossambicus</i> (Peters, 1852)	Int	Siluridae	
<i>Oreochromis niloticus</i> (Linnaeus, 1758)	Int	<i>Silurus glanis</i> Linnaeus, 1758	Int
<i>Sarotherodon galilaeus borkuanus</i> (Linnaeus, 1758)	Nat		
<i>Tilapia zillii</i> (Gervais, 1848)	Int		
Clariidae		Amphihaline species	
<i>Clarias anguillaris</i> (Linnaeus, 1758)	Nat	Families / Species	Stat.

<i>Clarias gariepinus</i> (Burchell, 1822)	Nat	Acipenseridae	
Cyprinidae		<i>Acipenser sturio</i> Linnaeus, 1758	Nat
<i>Abramis brama</i> (Linnaeus, 1758)	Int	Alestiidae	
<i>Alburnus alburnus</i> (Linnaeus, 1758)	Int	<i>Brycinus macrolepidotus</i> Valenciennes, 1850	Nat
<i>Aristichthys nobilis</i> (Richardson, 1845)	Int	Atherinidae	
<i>Aspius aspius</i> (Linnaeus, 1758)	Int	<i>Atherina boyeri</i> Risso, 1810	Nat
<i>Barbus amguidensis</i> Pellegrin, 1934	Nat	<i>Atherina presbyter</i> Cuvier, 1829	Nat
<i>Barbus biscarensis</i> Boulenger, 1911	End	Blenniidae	
<i>Barbus callensis</i> Valenciennes, 1842	Nat	<i>Salaria fluviatilis</i> (Asso, 1801)	Nat
<i>Barbus deserti</i> Pellegrin, 1909	End	Clupeidae	
<i>Barbus moulouyensis</i> Pellegrin, 1924	Nat	<i>Alosa alosa</i> (Linnaeus, 1758)	Nat
<i>Barbus setivimensis</i> Valenciennes, 1842	Nat	<i>Alosa fallax</i> (Lacepède, 1803)	Nat
<i>Carassius auratus</i> (Linnaeus, 1758)	Int	Gobiidae	
<i>Carassius carassius</i> (Linnaeus, 1758)	Int	<i>gobius paganellus</i> Linnaeus, 1758	Nat
<i>Ctenopharyngodon idella</i> (Valenciennes, 1844)	Int	<i>Pomatoschistus marmoratus</i> (Risso, 1810)	Nat
<i>Cyprinus carpio carpio</i> Linnaeus, 1758	Int	Moronidae	
<i>Hypophthalmichthys molitrix</i> (Valenciennes, 1844)	Int	<i>Dicentrarchus labrax</i> (Linnaeus, 1758)	Nat
<i>Pseudorasbora parva</i> (Schlegel, 1842)	Int	<i>Dicentrarchus punctatus</i> (Bloch, 1792)	Nat
<i>Pseudophoxinus callensis</i> (Guichenot, 1850)	End	Mugilidae	
<i>Rutilus rutilus</i> (Linnaeus, 1758)	Int	<i>Chelon labrosus</i> (Risso, 1827)	Nat
<i>Scardinius erythrophthalmus</i> (Linnaeus, 1758)	Int	<i>Liza aurata</i> (Risso, 1810)	Nat
<i>Tinca tinca</i> (Linnaeus, 1758)	Int	<i>Liza ramada</i> (Risso, 1810)	Nat
Cyprinodontidae		<i>Liza saliens</i> (Risso, 1810)	Nat
<i>Aphanius apodus</i> (Gervais, 1853)	End	<i>Mugil cephalus</i> Linnaeus, 1758	Nat
<i>Aphanius fasciatus</i> (Valenciennes, 1821)	Nat	Petromyzontidae	
<i>Aphanius iberus</i> (Valenciennes, 1846)	Nat	<i>Petromyzon marinus</i> Linnaeus, 1758	Nat
<i>Aphanius saourensis</i> Blanco, Hrbek & Doadrio, 2006	End	Syngnathidae	
Esocidae		<i>Syngnathus abaster</i> Risso, 1827	Nat
<i>Esox lucius</i> Linnaeus, 1758	Int		
Gasterosteidae			
<i>Gasterosteus aculeatus aculeatus</i> Linnaeus, 1758	Nat		