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Temporal variations in abundance and biomass of fish species inhabiting the K'sob reservoir (Eastern of Algeria)

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SUMMARY. This study presents data on fish community structure in the K'sob reservoirs (semi arid area) in the East of Algeria. The artisanal fishery was conducted from September 2010 to August 2011. The monthly variations in species composition were analyzed by effort and catch per unit of effort (CPUE) and biomass per unit of effort (BPUE). A total of seven species representing three families was recorded in the investigated reservoir. Cyprinids dominated in this reservoir. *Luciobarbus callensis* is the native species captured in this area, the rest of the fish were introduced. The other Cyprinids are: *Cyprinus carpio carpio*, *Hypophthalmichthys molitrix*, *Hypophthalmichthys nobilis*, *Squalius cephalus*. The Poecilidae were represented by *Gambusia holbrooki*. The third family, Cichlidae, was represeted by *Oreochromis niloticus*. The dominant species in terms of abundance was *L. callensis*, however, *C. carpio carpio* and *H. nobilis* showed higher values in biomass. Several species showed significant temporal variation in monthly samples. The fish assemblage is dominated by invasive species, while predatory species were not detected in the study.

Keywords: abundance, Algeria, biomass, fish assemblage, reservoir

Introduction

Land degradation, long an important environmental issue in arid and semi-arid lands, is now acute in Algeria's high plateaus (Hirche *et al*., 2010). The climate of these regions is subject to the influence of the Sahara and is characterised by wet winters, dry and hot summers and high level of evaporation. The northern Africa Freshwater Biodiversity Assessment is a conservation status review of 128 fish taxa (112 species and 16 subspecies) (García *et al*., 2010). In Algeria, about 27 fish species were introduced and at least 303 introduction events, either intentional or accidental, were

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recorded in the literature (Kara, 2011). The fish fauna of continental waters of North Africa in general and Algeria in particular is little known (Bacha and Amara, 2007). The Algerian ichthyofaunal region is mostly characterized by a low diversity in freshwater fish. The last time the authority and the research is aimed at the domain freshwater fish, we find the work of Zouakh *et al*. (2004), Blanco *et al*. (2006), Bacha and Amara (2007), Kara (2011), Mimeche *et al*. (2013, 2014), Mimeche and Biche (2015) and Mimeche *et al*. (2015). This study presents data on fish community structure in the K'sob reservoirs in the East of Algeria.

Materials and methods

Study area

The K'sob reservoir is one of the oldest reservoirs made in Algeria during the year 1935. It was constructed on the K'sob stream between 1935 and 1940 for agricultural purposes, with the main objective is to irrigate the plain of M'Sila. It is located 10km north of the M'Sila town (Fig. 1). The surface of the Reservoir is 230ha. Its maximum depth is 47m and a capacity to the origin of 30Mm^3; actually its water storage is less than 06mm^3. The area of the study is characterized by semi-arid bioclimatic on the Saharan Atlas National Park (North Algeria, M'Sila). (Mimeche *et al*., 2013).

Sampling methods and statistical analyses

The study was conducted from September 2010 to August 2011. The fishing gear used by the fishermen consisted of two trammels (each approximately 50 m long). The nets were oriented in a transverse direction relative to the edge of the reservoir. Sampling began between 2 and 3 p.m. and ended the following morning, resulting in a minimum soaking time of 18-20 hours. Species composition and abundance of fish were investigated using selective nets of different size mesh (25, 40, 60 mm). Fish were caught monthly in littoral and pelagic zones. The captured specimens were preserved in neutralised formaldehyde solution (07%) and transported into the laboratory for identification to the lowest taxonomic level according to Kottelat and Freyhof (2007). Total length (TL; ±0.1mm) and weight (W; ±0.1g) were recorded.

The total number of individuals caught by the trammels was counted and expressed as catch per unit effort (CPUEs) and biomass per unit of effort (BPUEs), where 1 unit of effort represented a passive trammel in place for 24 h. The data were logarithmically transformed to allow statistical comparisons.

The total relative abundance was expressed as catch per unit of effort (CPUEs) and total relative biomass per unit of effort (BPUEs):

CPUEs = number of specimens /150m²
BPUEs = fish biomass (g)/150m².

To test for significant differences in the abundance (CPUE and BPUE) of species among months, a ANOVA test was employed, levels of probability $p < 0.05$ were accepted as significant. All statistics were performed using the PAST program (Paleontological Statistics) Version 3.05 (1999-2015).

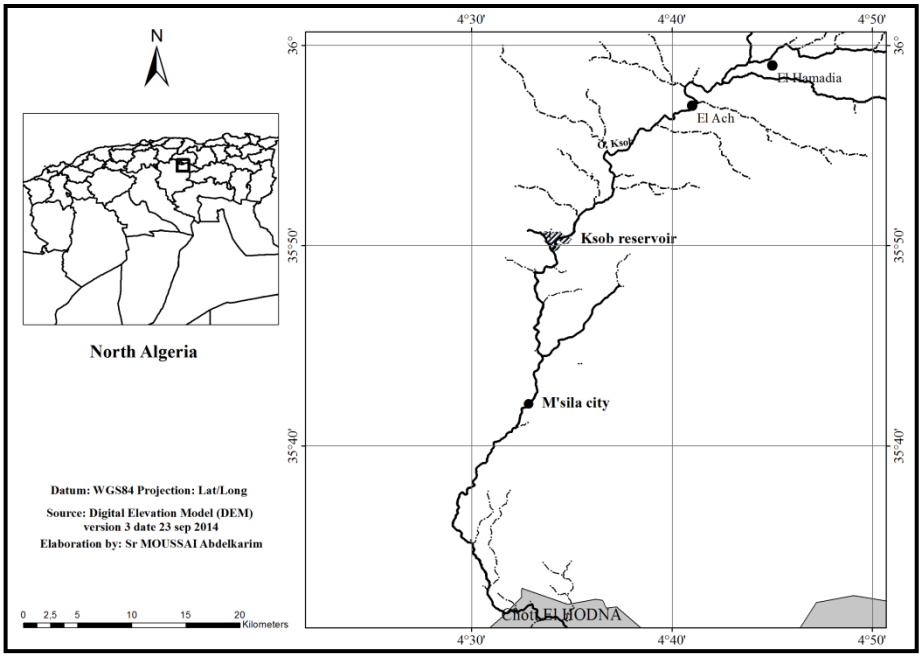

Figure 1. Map of study area

Results

A total of seven species representing three families was recorded (Table 1). Cyprinids represented by *Luciobarbus callensis* (51.1 % of captures during the study period) is the only native species in the reservoir, coexisting with *Cyprinus carpio carpio* (17.3 %), *Hypophthalmichthys nobilis* (9.9%), *Hypophthalmichthys molitrix* (1.5 %) and *Squalius cephalus* (0.2%). The Poecilidae represented by *Gambusia holbrooki* (19.6%) in shallow areas. The third family Cichlidae recorded by *Oreochromis niloticus* (0.4%) .

Overall total CPUEs were 703.33 fishes/m^2 ($F_{(83;6)}$ =28,42, $p<0.0001$) and BPUE were 447291.67kg/ m^2 ($F_{(83;6)}$ = 18.7, $p<0.0001$) during the period of study in Ksob reservoir. The *L. callensis* and *C. carpio carpio* were caught monthly, contributing a total respectively 275.33 fishes/m^2 and 93.33 fishes/m^2 of CPUE (39.15% of a number) with not statistically significant, $p> 0.05$ (Table 2).

Table 1.

List of the taxa collected from 12 sampling events (monthly periodicity) in the M'Sila reservoir. Names are according to FishBase (Froese and Pauly, 2011). (*) Status (n: native; i: invasive) is to the freshwater systems of the ecoregion.

	Taxonomic list	Common name	Status *	Origin	Year of introducion
Cyprinidae	*Luciobarbus callensis* (Valenciennes, 1842)	Algerian barbel	n		
	Cyprinus carpio carpio Linnaeus, 1758	Common carp	i	Hungary	2004
	Hypophthalmichthys molitrix (Valenciennes, 1844)	Silver carp	i	Hungary	2006
	Hypophthalmichthys nobilis (Richardson, 1845)	Bighead carp	i	Hungary	2006
	Squalius cephalus (Linnaeus, 1758)	Chub	i	Europe (France?)	unknown
Cichlidae	*Oreochromis niloticus niloticus* (L., 1758)	Nile tilapia	i	Egypt	2004
Poeciliidae	*Gambusia holbrooki* (Girard, 1859)	Eastern mosquitofish	i	unknown	1986

H. nobilis was captured for 10 months with a CPUE 53.33 fishes/m² (significant difference in catch monthly, $p<0.05$). *G. holbrooki,* caught in littoral area, presents a good place in the fish community composition 105.33 fishes/m^2 (significant difference in catch monthly, $p<0.05$). However, *C. carpio carpio* and *H. nobilis* showed higher values in total BPUE 204420 g/m^2 and 18171.2 g/m^2, respectively (not statistically significant in monthly catch, $p=0.18$ and $p=0.19$) (Table 3). Several species showed significant temporal variation in monthly samples with low caught and value in CPUE and BPUE (Tables 2, 3).

Discussion

Monitoring of CPUE and BPUE provides information on relative changes in the fish populations. The relative abundance of the studied population showed clear monthly variation. The Cyprinid family dominated in the K'sob reservoir; *L. callensis* is known one of the abundant species and to show a certain degree of stability in its seasonal densities (Mimeche *et al*., 2013; Mimeche *et al*., 2014) 2014). It is the only native species captured is this area. This abundance could be an indicator of most variation in the individual size of its population in comparison to other species. The rest of the fish captured were introduced. However the second abundant species in this reservoir is *C. carpio carpio*. Mimeche *et al.* (2015) mentioned the good adaptation and growth in this reservoir.

G. holbrooki introduced in Algeria (Mazafran Oued) since 1926, is considered the most abundant and widespread freshwater fish in the world (Pyke, 2005; 2008).

G. holbrooki presents a clear ability to adapt to lotic systems (Ruiz-Navarro *et al*., 2011), and it is used in the biological control of mosquitoes.

Table 2.

Catch per unit effort (CPUE) (fishes/m²) at monthly sampling of fish community composition in Ksob reservoir, Algeria, between September 2010 to August 2011.

	Lc	*Cc*	*Hm*	*Hn*	*Sp*	*Onn*	*Gh*
Sep	14.00	7.33	0.00	4.00	0.00	0.00	20.00
Oct	12.67	10.00	0.00	5.33	0.00	0.00	16.00
Nov	26.00	15.33	0.00	2.67	0.00	0.00	11.33
Dec	16.67	6.67	0.00	4.67	0.00	0.00	0.00
Jan	16.00	8.67	0.00	0.00	0.00	0.00	0.00
Feb	30.00	4.67	0.00	2.67	0.00	0.00	0.00
Mar	22.00	12.00	1.33	7.33	0.00	0.00	0.00
Apr	23.33	14.67	2.67	10.00	1.33	0.00	12.67
May	16.67	2.67	4.00	12.00	0.00	0.00	15.33
Jun	42.00	6.00	0.00	0.00	0.00	1.33	14.00
Jul	16.67	3.33	0.00	2.00	0.00	0.67	16.00
Agu	39.33	2.00	0.00	2.67	0.00	0.00	0.00
Total	275.34	93.34	8.00	53.34	1.33	2.0	105.33
p	ns	ns	<0.001	ns	<0.001	<0.001	<0.05

Lc: *Luciobarbus callensis, Ccc*: *Cyprinus carpio carpio, Hm* : *Hypophthalmichthys molitrix*, *Hn* : *Hypophthalmichthys nobilis, Sp* : *Squalius cephalus, Onn* : *Oreochromis niloticus, Gh : Gambusia holbrooki,* ns : no significant

The common carp and bighead carp constitute the majority of the fish biomass in these systems (more than 85%). This species presents a wide tolerance range towards the variable environmental conditions in semiarid reservoir, and establishes new viable populations widely dispersed and incorporated in large numbers in the ecosystem (Mimeche and Biche, 2015). The common carp, silver carp and bighead carp represent an important source of protein for the inhabitants of rural communities in this region.

The rarity of the silver carp *H. molitrix* is due perhaps to its unsuccessful reproduction. Bruslé and Quignard (2001) reported that, this fish naturally reproduces in the thermal and hydrological conditions of the average flow of Chinese rivers. It does not seem able to reproduce in Europe, where the spawning is not spontaneous and where the populations must be renewed every year (Pivnicka and Cerny, 1987). The

extinction of *Squalius cephalus* and *Oreochromis niloticus* may be caused by hydrological disturbance, siltation, quality of weirs, mismanagement of the opening and closing of the water distribution channels (Ramdani *et al*., 2001; Kraïem *et al*., 2003), overexploitation, climate change and environmental variability (Brook *et al*., 2008).

Table 3.

Biomass per unit of effort (BPUE) (g/m²) at monthly sampling of fish community composition in Ksob reservoir, Algeria, between September 2010 to August 2011.

	Lc	*Cc*	*Hm*	*Hn*	*Sp*	*Onn*	*Gh*
Sep	1614	17964	0	14582	0	0	30
Oct	1448	25693	0	18020	0	0	22.67
Nov	3613	33744	0	7636	0	0	18.67
Dec	1831	12078	0	14329	0	0	0
Jan	1259	19060	0	0	0	0	0
Feb	3112	8886.7	0	7360	0	0	0
Mar	2495	22447	2103	25287	0	0	0
Apr	2521	29315	4480	35133	200	0	20.67
May	1921	8213.3	6647	40843	0	0	24
Jun	5743	12849	0	0	0	197.3	23.33
Jul	3687	7810.7	0	7373	0	119.3	21.33
Agu	3113	6359.3	0	11149	0	0	0
Total	32357	204420	13230	181712	200	316.6	160.67
p	ns	ns	<0.001	ns	<0.001	<0.001	<0.05

Lc: *Luciobarbus callensis, Ccc*: *Cyprinus carpio carpio, Hm* : *Hypophthalmichthys molitrix*, *Hn* : *Hypophthalmichthys nobilis, Sp* : *Squalius cephalus, Onn* : *Oreochromis niloticus, Gh : Gambusia holbrooki,* ns : no significant

Conclusions

The fish assemblage is dominated by the native species *L. callensis*, which inhabits in the lentic aquatic ecosystem together with invasive species.

Monthly patterns should not necessarily be assumed to be the same for different species or for species in different habitats because differences may exist in (a) recruitment, growth, and mortality within a species, (b) among species and (c) among gears used in sampling. The predatory species were not detected in the study.

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