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Epiplatys bifasciatus (Steindachner, 1881) (Nothobranchiidae) and *Hemichromis fasciatus* Peters, 1852 (Cichlidae), two relict fish species in the Sahara desert

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Abstract. Two tropical fish species, *Epiplatys bifasciatus* and *Hemichromis fasciatus*, are recorded for the first time from the Sahara desert, in Lake Boukou and Lake Djara respectively, two of the seven Ounianga Serir lakes in northern Chad. The nearest known populations of these two species are located 900 km to the southwest in Lake Chad. The Ounianga Serir lakes, which resisted the increasing aridity of Sahara since the Holocene by virtue of subsurface inflow of fresh groundwater from a large fossil aquifer, present the richest relict fish fauna of the Sahara, with at least eight species, including also *Hemichromis* cf. *letourneuxi*, *Sarotherodon galilaeus borkuanus*, *Coptodon zillii*, *Astatotilapia tchadensis*, *Polypterus senegalus* and *Poropanchax normani*.

Key words. Biogeography, relict fish hotspot, climate change, killifish, cichlids, Ounianga, Chad.

INTRODUCTION

Relict fish populations are known in several perennial bodies of waters of the Sahara desert, most of them located in mountainous massifs of central Sahara: the Adrar mountains in Mauritania, the Ahaggar, Tassili n'Ajjer and Mouydir in Algeria, and the Tibesti and Ennedi in Chad (Lévêque 1990, 2006; Trape 2009). Fish diversity is low, only two dozen of species have been recorded for the whole Sahara, and most species are known from a very low number of permanent water bodies, often from a single spring, guelta, pound or lake (Trape 2009). The number of species sharing the same water body usually ranges from one to three, with a maximum of four species in Molomhar guelta in Mauritania, and seven species in Totous guelta in Tibesti in Chad (Daget 1959, Lévêque 1990, Monod 1951, Trape 2009).

Fig. 1. Satellite view of the Sahara with location of Ounianga lakes (Chad).

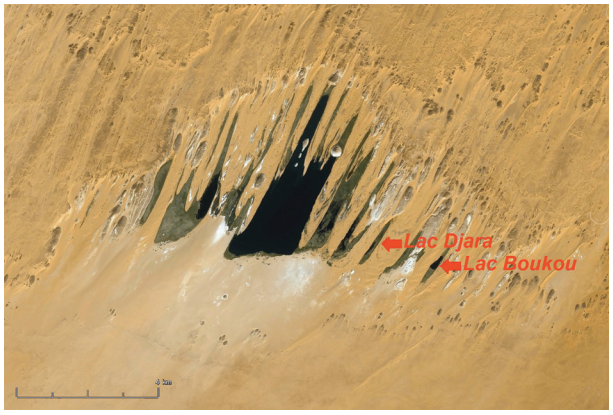

Fig. 2. Satellite view of Ounianga Serir lakes, with location of Lake Djara and Lake Boukou.

During zoological surveys in northern Chad in 2013 and 2014, fishes, reptiles, amphibians, and invertebrates were collected in various areas of Borkou, Ennedi and Tibesti (Brancelj 2015, Dumont 2014, Trape 2013, 2015, 2016). Among fishes collected in Ounianga Serir Lakes in 2013 and 2014 (Figs 1–2), several specimens belonged to three species never reported before from northern Chad nor from other areas of the Sahara desert, namely *Poropanchax normani* (Ahl, 1928) (Poeciliidae), *Polypterus senegalus* Cuvier, 1829 (Polypteridae), and the previ-

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ously undescribed *Astatotilapia tchadensis* Trape, 2016 (Cichlidae) (Trape 2013, 2016). Other species reported from Ounianga Serir lakes included *Sarotherodon galilaeus borkuanus* (Pellegrin, 1919), *Hemichromis* cf. *letourneuxi* Sauvage, 1880 (erroneously reported as *Hemichromis bimaculatus* Gill, 1862), and *Coptodon zillii* (Gervais, 1848) (Daget 1959, Lévêque 1990, Trape 2013). Here I report the occurrence of two additional species collected in these lakes in 2016, both representing remarkable additions to the known relict fish fauna of the Sahara.

MATERIAL & METHODS

Measurements, counts and diagnosis were made as described in Paugy et al. (2003), Wildekamp & Van der Zee (2003) and Teugels & Thys Van den Audenaerde (2003). Measurements were made with a digital calliper, and counts partly under a dissecting microscope. Species keys of Teugels & Thys Van den Audenaerde (2003) and Wildekamp & Van der Zee (2003) were used for the species diagnosis of *Hemichromis fasciatus* and *Epiplatys bifasciatus*, respectively. Preserved specimens are deposited in the Museum national d'Histoire naturelle (MNHN) at Paris.

RESULTS

***Hemichromis fasciatus* Peters, 1852**
(Fig. 3)

Material examined. MNHN 2016.0272, previously IRD TR.4515, collected in Lake Boukou (18°54'54''N, 20°54'40"E, elev. 363 m) (Fig. 4) on April 4th 2016 in the evening using a fishing rod by Jacques Robin.

Description. Two lateral lines. Scales cycloid. No pharyngeal hanging pad between gills. Outer jaw teeth monocuspid. Upper profile of snout concave. Premaxilla extremely protrusible. Lower jaw distinctly prominent. Dorsal fin with 14 spines and 12 soft rays. Anal fin with 3 spines and 9 soft rays. Number of lateral-line scales: 29. Five dark blotches on sides, the first blotch confluent with the opercular spot, the fifth on caudal-fin base. Standard length 180 mm.

Fig. 3. *Hemichromis fasciatus* from Lake Boukou in life.

Fig. 4. View of Lake Boukou.

***Epiplatys bifasciatus* (Steindachner, 1881)**
(Fig. 5)

Material examined. MNHN 2016.0273, 5 specimens collected in Lake Djara (18°55'09''N, 20°53'39"E, elev. 355 m) (Fig. 6) on April 9th 2016 by Jean-François Trape. Specimens were collected at night on the shore of the lake using a dipnet.

Fig. 5. Two specimens of *Epiplatys bifasciatus* from Lake Djara in life.

Fig. 6. View of Lake Djara.

Description. A tubular pre-ocular system with five pores. A frontal supra-orbital neuromast system consisting of one pit with two neuromasts. Dorsal fin 8–9 rays, anal fin 14–18 rays. Scales on mid-lateral series 26–27. Life colours of males (Fig. 5) are typical of this species (see Wildekamp & Van der Zee 2003) with in particular oblique red stripes on the opercle, a large number of oblique red bars on the sides and the back, a wide dark grey longitudinal band extending from the opercle to the caudal peduncle, and a number of red spots on the anal, dorsal and caudal fins. Standard length 37–39 mm.

DISCUSSION

Hemichromis fasciatus is a well-known afrotropical cichlid, abundant and widespread in most hydrographic basins of West and Central Africa, in particular in Lake Chad and the Senegal and Niger rivers basins (Lévêque et al. 1991; Teugels & Thys van den Audenaerde 2003). *Hemichromis fasciatus* has never been reported before in the Sahara, contrary to its widespread congener *Hemichromis bimaculatus,* a complex of species with unresolved taxonomy which is probably represented by *H. letourneuxi* in Ounianga Serir, Ounianga Kebir, and some other bodies of water in the Sahara (Fig. 7) (Lévêque 1990, Lévêque et al. 1991, Loiselle 1979, Sauvage 1880, Trape 2013, Teugels & Van den Audenaerde 2003).

Epiplatys bifasciatus is a killifish with a large distribution from Senegal in West Africa to Sudan in East Africa, both in weedy parts of rivers, swamps, small brooks and rivulets in the Guinean and Sudanese savanna, and in coastal lagoons on the shore of the Atlantic Ocean (Wildekamp & Van der Zee 2003). The two other known populations of killifish that survived the increasing aridity of the Sahara since the Holocene are both located in northern Chad in a single body of water: *Epiplatys spilargyreius* (Duméril, 1861) in Tigui pool (Borkou) (Estève 1952, Lévêque 1990), and *Poropanchax normani* in Lake Boukou (Trape 2013). The nearest current populations of these three species are located 900 km to the southwest in Lake Chad (Blache 1964).

According to Grenier et al. (2009) the Ounianga Serir lakes were connected to Megalake Chad in the Holocene. Despite the current extreme aridity in this area – average annual rainfall is less than 5 mm and annual evaporation exceeds 6000 mm – these lakes persist by virtue of subsurface inflow of fresh groundwater from a large fossil aquifer (Kröpelin 2007). The remarkable biodiversity of these lakes has remained poorly investigated and until recently only the two fish species collected during the Thilo expedition (1912–1917) in northern Chad - *Sarotherodon galilaleus borkuanus* and *Hemichromis* cf. *letourneuxi* – were known from Ounianga Serir lakes (Pellegrin 1919). In fact, with at least eight species, these lakes present the richest fish fauna of the Sahara desert.

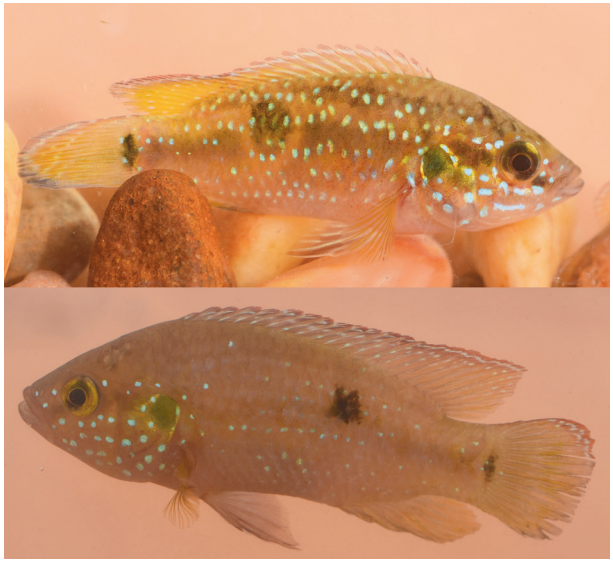

Fig. 7. *Hemichromis* cf. *letourneuxi* from Lake Djara (top) and Ounianga Kebir (bottom) in life.

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