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Short communication

First record of the western tubenose goby *Proterorhinus semilunaris* (Heckel, 1837) in France

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ABSTRACT

Key-words: Proterorhinus semilunaris, Proterorhinus marmoratus, *France, Rhine, invasive species, first record*

Western tubenose gobies were captured for the first time in France in the Rhine River in September 2007. This species, originating from the Ponto-Caspian basin and considered as invasive in many countries, has colonised the Rhine drainage using the Rhine-Main-Danube canal.

RÉSUMÉ

Première observation du gobie demi-lune *Proterorhinus semilunaris* (Heckel, 1837) en France

Mots-clés : Proterorhinus semilunaris, Proterorhinus marmoratus, *France, Rhin, espèce invasive, première observation*

Des gobies demi-lune ont été capturés pour la première fois en France dans le Rhin en septembre 2007. Cette espèce, originaire du bassin Ponto-Caspien et considérée comme invasive dans plusieurs pays, a colonisé le bassin du Rhin en passant par le canal Rhin-Main-Danube.

The western tubenose goby *Proterorhinus semilunaris* Heckel (1837) was originally described from rivers draining into the Aegean Sea and the Danube River before being considered in synonymy with *Proterorhinus marmoratus* (Pallas, 1814) (Berg, 1949). Following genetic results, Stepien and Tumeo (2006) have validated the existence of the two species, *P. semilunaris* as a freshwater species and *P. marmoratus* as a marine one. *P. semilunaris* is a native of the Black Sea basin and of the Maritza and Struma drainages in the eastern Aegean basin (Figure 1A; Kottelat and Freyhof, 2007). It spread out its native range as far as the Netherlands in Europe in 2002 and in the Great Lakes in North America in 1991. This species is generally considered as invasive because of its rapid colonisation of new habitat (Naseka *et al.*, 2005) where it may become dominant (Prasek and Jurajda, 2005). Its expansion in Western Europe has been facilitated by the digging of the "Rhine-Main-Danube" canal in 1992 (Freyhof, 2003), but also by its use as live bait in the south-eastern

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Czech Republic (Prasek and Jurajda, 2005). Its colonisation of the North American Great Lakes is due to its transport *via* ships' ballasts (Jude and Deboe, 1996).

In August 1997, *P. semilunaris* was observed in the Roth drainage (Germany), which receives water from the Rhine-Main-Danube canal (Von Landwust, 2006). It reached the River Main in 1999 (Reinartz *et al.*, 2000; Schadt, 2000) and then it was reported in the Rhine River in 2000 between the Main confluence and Coblence before being captured in the Netherlands in 2002 (Kottelat and Freyhof, 2007). In 2005, it was found in the downstream part of the Moselle drainage, one of the main Rhine tributaries (Von Landwust, 2006) (Figure 1B).

On the 13th September 2007, a fish sampling done in the Water Framework Directive context was performed on the French (left) bank of the canalised Rhine, 4.5 km downstream of the Gambsheim hydroelectric dam. Electrofishing was performed following the point abundance method (Nelva *et al.*, 1979): a total of 100 points was spread over 2575 m along the bank. Fish were individually measured to the nearest millimetre.

A total of 13 species was captured: *Cottus* sp.*, Chondrostoma nasus* (L., 1758)*, Barbus barbus* (L., 1758)*, Alburnoides bipunctatus* (Bloch, 1782)*, Leuciscus leuciscus* (L., 1758)*, Squalius cephalus* (L., 1758)*, Gymnocephalus cernuus* (L., 1758)*, Perca fluviatilis* (L., 1758)*, Sander lucioperca* (L., 1758)*, Lepomis gibbosus* (L., 1758)*, Anguilla anguilla* (L., 1758)*, Silurus glanis* (L., 1758) and one Gobiid species. The mean total length of the eleven Gobiids captured was 64 ± 8 mm (53–77 mm). Two individuals were preserved in 10% formaldehyde for subsequent identification. Morphometric and meristic features (Kottelat and Freyhof, 2007) indicated that they belonged to the *Proterorhinus semilunaris* species (Figure 2).

The fish community on this site has been surveyed each year since 1987: the finding of *P. semilunaris* in the latest sampling suggests that its arrival is very new. This is congruent with its first occurrence in October 2007 in the downstream part of the Rench River (Germany), flowing into the Rhine near Gambsheim (Künemund, pers. comm.). There is 175 km between the Main confluence, where the species has been signalled since 2000, and the upstream part of the Gambsheim site. This suggests that *P. semilunaris* covered this distance and cleared the Iffezheim hydroelectric dam in less than seven years. Different hypotheses have been proposed to explain Ponto-Caspian Gobiids' dispersal. First, the Rhine River being navigable and the Iffezheim dam equipped with navigation locks, they could travel within ship ballasts or more likely (ballasts being rare in riverine ships in Europe) in the holes of ship hulls (Ahnelt *et al.*, 1998) where eggs or adults could settle. Second, they could also migrate actively by themselves as suggested by Von Landwust (2006) using the locks and/or the fish-pass adapted for small-bodied species of the Iffezheim dam. This last hypothesis would be remarkable for such a fish with *a priori* reduced swimming capacities. However, an invasive bullhead (*Cottus perifretum,* Freyhof, Kottelat & Nolte 2005), displaying a similar morphology (*i.e.* a small benthic fish without a swim bladder), succeeded in colonising the Rhine drainage rapidly (Nolte *et al.*, 2005). Moreover, even though this has not been specifically investigated for western tubenose goby, its adhesive disk (modified pelvic fins present in most of the Gobiidae) could help it, to some extent, to move upstream in high velocity currents (see the extreme case of *Sicyopterus* sp., Voegtle *et al.*, 2002) and to be anchored in the ship hulls' anfractuosities.

P. semilunaris displays a quite large habitat tolerance (Eros *et al.*, 2005); it is found in lakes, estuaries, rivers, lentic streams, canals and in side arms (Kottelat and Freyhof, 2007). It seems to prefer rocks to macrophytes or sandy banks (Jude and Deboe, 1996), which is confirmed here since all the individuals from the Gambsheim site were captured in rocks. *P. semilunaris* is a small-bodied fish reaching its sexual maturity quite early (1–2 years), spawning several times within a season, and the male guards the eggs. Together, the habitat tolerance and these life history traits give to *P. semilunaris* a significant invasive potential (Marchetti *et al.*, 2004; Ruesink, 2005).

If no clear impact was observed in the ecosystems colonised by *P. semilunaris* (Freyhof, 2003), many authors noticed that in some sites where densities dramatically increased, it may compete with the other benthic species (Freyhof, 2003; Von Landwust, 2006). Furthermore, *P. semilunaris* has been identified as a paratenic host of *Anguillicola crassus*,

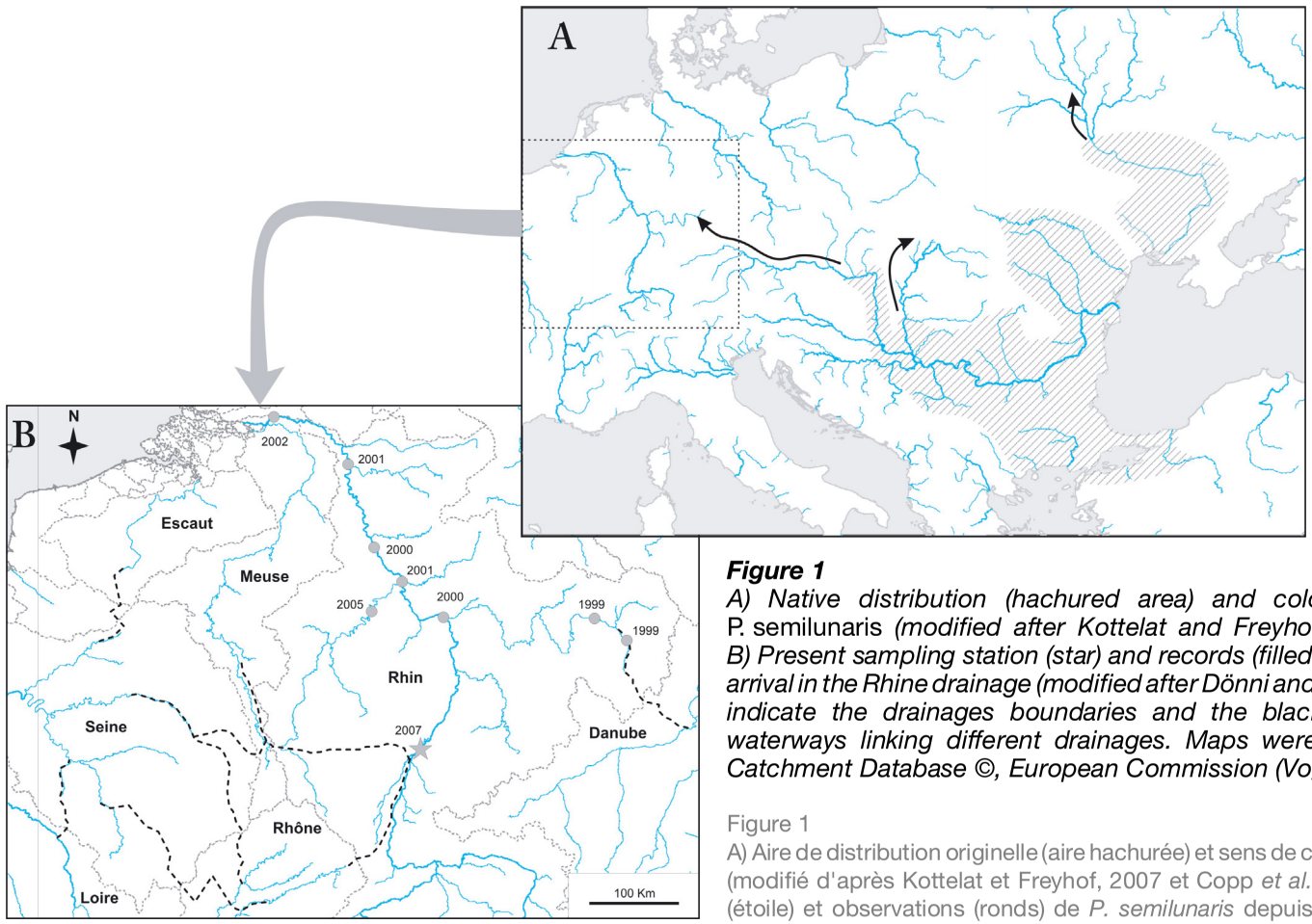

Figure 1

A) Native distribution (hachured area) and colonisation directions (arrows) of P. semilunaris *(modified after Kottelat and Freyhof, 2007 and Copp* et al.*, 2005). B) Present sampling station (star) and records (filled circles) of* P. semilunaris *since its arrival in the Rhine drainage (modified after Dönni and Freyhof, 2002). Grey dashed lines indicate the drainages boundaries and the black dashed lines represent some waterways linking different drainages. Maps were based on the CCM River and Catchment Database ©, European Commission (Vogt* et al.*, 2007).*

Figure 1

A) Aire de distribution originelle (aire hachurée) et sens de colonisation (flèches) de *P. semilunaris* (modifié d'après Kottelat et Freyhof, 2007 et Copp *et al.*, 2005). B) Station d'échantillonnage (étoile) et observations (ronds) de *P. semilunaris* depuis son arrivée dans le bassin du Rhin (modifié d'après Dönni et Freyhof, 2002). Les lignes grises discontinues indiquent les limites des bassins et les lignes noires discontinues représentent des canaux reliant différents bassins. Les cartes ont été dessinées d'après la base de données de caractérisation et modélisation de rivière et bassin ©, Commission Européenne (Vogt *et al.*, 2007).

Figure 2
Picture of a western tubenose goby captured in the Rhine downstream of the Gambsheim hydroelectric dam (credit: S. Manné, ONEMA).

Figure 2
Photo d'un gobie demi-lune capturé dans le Rhin en aval du barrage hydroélectrique de Gambsheim (source : S. Manné, ONEMA).

an eel parasite with severe pathological effects with, nevertheless, a low prevalence (Koubková and Baruš, 2000).

P. semilunaris population in the Rhine River might increase in the future and colonise the other tributaries. Furthermore, due to the canals linking the Rhine to other drainages (Seine and Rhône; Figure 1B), it is very likely that this species will carry on its western colonisation, as other non-native species have done in the recent past (*e.g.* pikeperch). Moreover, two other Ponto-Caspian Gobiids (the round goby *Neogobius melanostomus* (Pallas, 1814), and the bighead goby *N. kessleri* (Günther, 1861)) are already present in the Rhine drainage (Dümpelmann and Freyhof, in press; Freyhof, pers. comm); the round goby is responsible for the decline of two benthic species in the Great Lakes (Corkum *et al.*, 2004). Two others (the monkey goby *Neogobius fluviatilis* (Pallas, 1814) and the racer goby *N. gymnotrachelus* (Kessler, 1857)) should reach it in the near future (Freyhof, 2003).

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