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## Short communication

# Record of two established populations of Nile tilapia, *Oreochromis niloticus*, in freshwaters of northern Italy

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### Introduction

The African Nile tilapia, *Oreochromis niloticus* (L.), is a cichlid fish native to the large lakes and rivers of Africa. About six subspecies were recognised by Trewavas (1983); a subspecies, *O. niloticus tana,* was described for Lake Tana by Seyoum and Kornfield (1992). More recent molecular studies have revealed several differences between eastern and western African populations, which are in disagreement with Trewavas (1983) subspecific classification (Rognon and Guyomard, 1997). From our preliminary diagnosis the species found to be established in the Venetian Region is *O. niloticus niloticus* (*sensu* Trewavas, 1983), but we report this taxon as *O. niloticus* whilst awaiting further taxonomic revision of this subspecies complex.

The first observation of Nile tilapia in freshwaters of Italy was in 2001, when the species was found in a small stretch of a

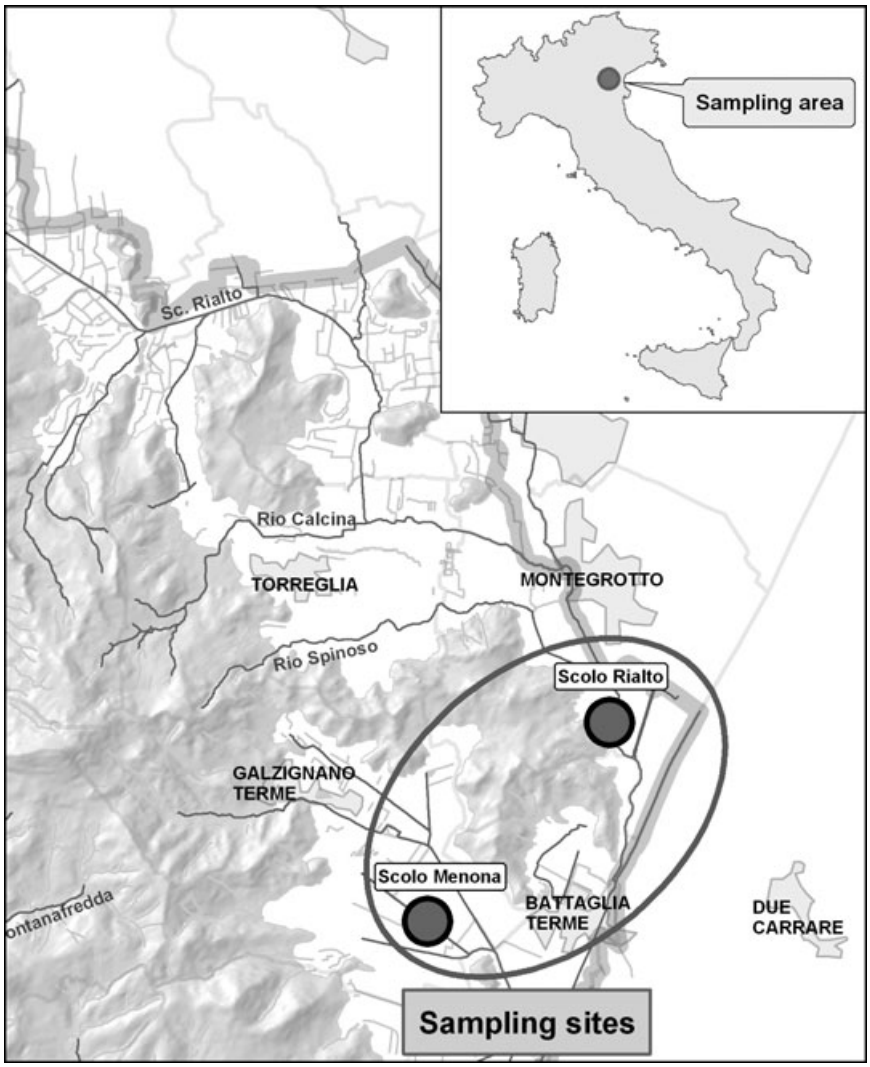


Fig. 1. Nile tilapia collecting sites in Veneto Region, Italy

thermal stream, 'scolo Rialto', which is part of the Montegrotto Terme thermal area of the Venetian Region (Turin, 2004; Bianco, 2005) (Fig. 1). At that time, the population already had a moderately natural size structure and the presence of fish ranging from 60 to 220 mm total length (TL). This was preceded by the absence of the species in a fish survey of the area in 1995 (Turin et al., 1995), which suggested that the species had been introduced in the interim period.

During extensive recent surveys (April and October 2007) on fish composition in rivers with large areas (the River Bacchiglione drainage, north-eastern Italy), the Nile tilapia was found to have established itself in the scolo Rialto as well as in another thermal stream, the 'scolo Menona'. In all cases due to the large number of some 150 collecting sites, the investigated transect lengths were 50–60 m; these length limitations provided only a rough indication of the Nile tilapia population structure, but at least confirmed its establishment in the two streams. The source of the introduction is unknown, but was probably a release from an unwanted aquarium or private pond (reared for angling or commercial purposes), similar to what possibly occurred in Lago di Lesina, a coastal salty lagoon in south-eastern Italy where the species was also recorded (Scordella et al., 2003).

## Materials and methods

The fishes were caught by electrofishing using an electroshocker regulated at 40 pulsations in CC per second, and 50 KW of power, with a quite high conductibility: 5005 $\mu$s cm$^{-1}$ in the Rialto and 1600 $\mu$s cm$^{-1}$ in the Menona streams. The range of efficiency to attract fish was about 3 m in diameter. All fishes in each transect were collected; the population size and biomass estimations of each species were calculated according to the Moran–Zippin method (Seber and Le Cren, 1967) using the removal sampling method (Zippin, 1958). All tilapia species collected were also analysed simultaneously to estimate densities and compare the local fish biocenosis. With regard to tilapia, about 172 specimens, 58–265 mm TL, were estimated on 28 April 2007 from a 7 m wide, 50 m stretch of the scolo Rialto; 244 specimens, 25–220 TL, were estimated on 5 October 2007 from a 2.5 m wide, 60 m stretch of the scolo Menona. Both streams belong to the River Bacchiglione drainage, Venetian Region (Fig. 1). At the time of sampling, water temperatures were 30°C (37°C in July) in the scolo Rialto and 27°C (30°C in July) in the Menona stream. Each specimen was measured (nearest mm) and weighed (nearest g) and then released into the wild because the area of study belonged specifically to the Regional Park 'Colli Euganei' where fauna preservation – also for alien species – is mandatory. A few specimens were preserved for morphological analyses.

## Results and discussion

Nile tilapia dominated the fish community structure by biomass, representing 51% of the total biomass in the Menona stream and 77% in the Rialto stream (Table 1). Goldfish (*Carassius auratus*), another invasive species, was the second most important species present, contributing 35 and 14% of the biomass, respectively. The size distribution of Nile tilapia at the two locations differs (Fig. 2), with the population structure in the scolo Menona stream including a considerable

Table 1
Density (ind m$^{-2}$ = number of individuals per area) and biomass (g m$^{-2}$) of Nile tilapia compared to all species collected simultaneously (combined sexes): 350 m$^2$ in scolo Menona, and 150 m$^2$ in scolo Rialto

| Species | Common names | Menona stream | | Rialto stream | |
|---|---|---|---|---|---|
| | | Density (ind m$^{-2}$) | Biomass (g m$^{-2}$) | Density (ind m$^{-2}$) | Biomass (g m$^{-2}$) |
| *Alburnus arborella* (Bonaparte) | Italian bleak | 0.01 | 0.02 | 1.07 | 2.02 |
| *Carassius auratus* | Golden fish | 1.14 | 36.2 | 0.14 | 4.54 |
| *Cyprinius carpio* | Common carp | 0.01 | 1.79 | 0 | 0 |
| *Squalius squalus (*Bonaparte) | Italian chub | 0.06 | 8.84 | 0 | 0 |
| *Gambusia holbrooki* (Girard) | Mosquitofish | 0.14 | 0.03 | 0 | 0 |
| *Pseudorasbora parva* (Temminck) | Topmouth gudgeon | 0.34 | 1.47 | 0.02 | 0.11 |
| *Scardinius esperidicus* (Bonaparte) | Alpinie rudd | 0.12 | 1.79 | 0 | 0 |
| *Oreochromis niloticus* | Nile tilapia | 2.01 | 51.91 | 0.57 | 23.3 |
| *Rutilus aula* (Bonaparte) | Alpinie roach | 0.03 | 0.23 | 0.01 | 0.19 |
| *Anguilla anguilla* (L.) | European eel | 0 | 0 | 0.01 | 0.24 |

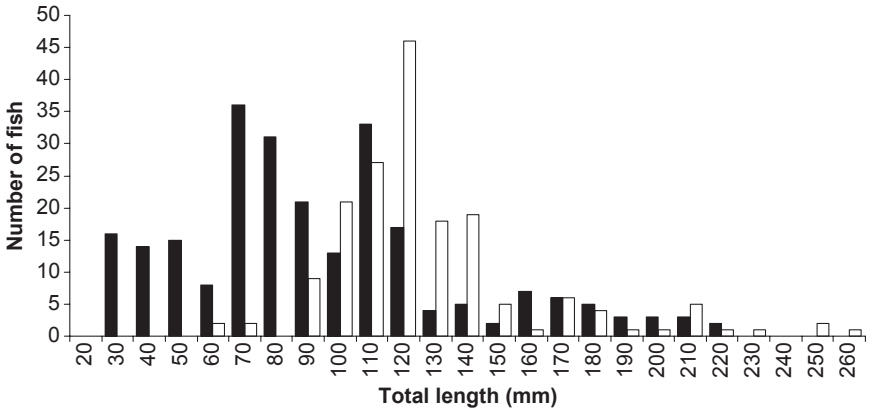


Fig. 2. Distribution of total length classes for combined sexes of Nile tilapia from Menola (n = 244) (■) and Rialto (n = 172) (□) thermal streams collected in 2007

proportion of young-of-the-year specimens and the possibility of at least 4 year-classes. We can thus consider Nile tilapia to be a newly-established alien in Italy.

Nile tilapia has been introduced into some 102 countries, and ranks amongst the most introduced commercial species that are most involved in pan-world fish transfers (Bianco, 2005; Froese and Pauly, 2008): common carp *Cyprinius carpio* L. (157 countries); rainbow trout *Oncoryhnchus mykiss* (Walbaum) (116 countries), and Mozambique tilapia *Oreochromis mossambicus* (L.) (117 countries).

Nile tilapia is a very resistant species and able to survive in extreme environmental conditions such as high temperatures (up to 43°C; Bezault et al., 2007), high salinity (up to 57 ppm; Mateo et al., 2004), and elevated concentrations of toxicants such as ammonia and cadmium (El-Shafai et al., 2003; Garcia-Santo et al., 2006). All of these factors explain its successful, sometimes invasive, establishment in critical or polluted environmental conditions (Khallaf et al., 2003), although it is sensitive to cold waters. The lowest lethal thermal limit is between 9.6 and 13.6°C, depending on the environmental conditions and genetic origin of the fish stock (Charo-Karisa et al., 2005); however, the species shows an adaptive selection to low temperatures (Peterson et al., 2005). We can predict a gradual adaptation to low temperatures and a progressive expansion of the species into non-thermal waters of temperate regions. The record in Italy also represents the first documented breeding population of this species in a natural freshwater environment in Europe.

With this species and the recently documented establishment of *Ictalurus punctatus* (Rafinesque, 1818) (Ligas, 2008), the number of aliens established in Italian freshwaters rises to 41, corresponding to 50% of the entire freshwater fish–fauna in Italy. For alien introductions Italy is the most affected country in continental freshwaters of the world, followed by France (39%) and Spain (36%) (Bianco, 2005; Copp et al., 2005).

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