

CONFIRMATION OF THE PRESENCE OF *SQUALIUS SQUALUS* (BONAPARTE, 1837) IN SICILY.

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Abstract

The occurrence of the Italian chub *Squalius squalus* (Bonaparte, 1837) in Sicily has always been reported in the literature in a contradictory manner and without certain documentation, being regarded as doubtful by the most recent reviews of the xenodiversity of Sicilian inland waters. Recently, the DNA of the species was detected in an artificial lake. Here we report the first confirmed record of the species in a Sicilian river environment, the Oreto, at two sites close to the mouth sampled by electrofishing in June 2026. The specimens (87–350 mm TL; 7–486 g) were identified as *S. squalus* on the basis of morphometric and meristic characters compared with the reference literature. The two largest individuals were males in reproductive condition. *Anguilla anguilla*, *Cyprinus carpio*, *Sarmarutilus rubilio*, *Salariopsis fluviatilis* and *Chelon labrosus* were also present in the study area. The Italian chub thus joins the list of alien species occurring in Sicilian freshwaters, bringing to 13 the number of alien fish species recorded on the island. Since neither the origin nor the period of introduction is known, a release for recreational fishing purposes is hypothesized, with artificial lakes as likely sources of invasion. The finding a few kilometres from the river mouth testifies to the marked adaptability of the species and to the presence of suitable habitats for this rheophilic cyprinid in the terminal stretch of Oreto. Further investigations are needed to define its distribution in Sicily and its possible interference with native species or species of conservation concern.

Riassunto

CONFERMA DELLA PRESENZA DI *SQUALIUS SQUALUS* (BONAPARTE, 1837) IN SICILIA. - La presenza del cavedano italico *Squalius squalus* (Bonaparte, 1837) in Sicilia è sempre stata riportata in letteratura in modo contraddittorio e senza documentazione certa, essendo considerata dubbia dalle più recenti revisioni sulla xenodiversità delle acque interne siciliane. Recentemente il DNA della specie è stato riscontrato in un lago artificiale. In questo lavoro si riporta il primo dato confermato della presenza della specie in un ambiente fluviale siciliano, l'Oreto, in due siti prossimi alla foce campionati tramite elettropesca nel giugno 2026. Gli esemplari (87–350 mm LT; 7–486 g) sono stati determinati come *S. squalus* sulla base di caratteri morfometrici e meristici confrontati con la letteratura di riferimento. I due individui di maggiori dimensioni erano maschi in attività riproduttiva. Nell'area indagata risultavano inoltre presenti *Anguilla anguilla*, *Cyprinus carpio*, *Sarmarutilus rubilio*, *Salariopsis fluviatilis* e *Chelon labrosus*. Il cavedano italico si aggiunge così all'elenco delle specie ittiche alloctone presenti nelle acque dolci siciliane, portando a 13 il numero di specie aliene segnalate nell'isola. Non essendo nota l'origine né il periodo di introduzione, si ipotizza un'immissione

a fini di pesca sportiva, con i laghi artificiali come probabili fonti di invasione. Il rinvenimento a pochi chilometri dalla foce testimonia la spiccata adattabilità della specie e la presenza di habitat adeguati a questo ciprinide reofilo nel tratto terminale dell'Oreto. Sono necessarie ulteriori indagini per definirne la distribuzione in Sicilia e le possibili interferenze con le specie autoctone o di interesse conservazionistico.

Introduction

According to Kottelat and Freyhof (2007) and AIIAD (2021), there are four species belonging to the genus *Squalius* in Italy: the Creek Chub *Squalius lucumonis* (Bianco, 1983), native to the Tuscan-Lazio district (endemic), the Italian Chub *Squalius squalus* (Bonaparte, 1837), native to peninsular Italy, and the non-native Chub *Squalius cephalus* (Linnaeus, 1758) and Vardar Chub *Squalius vardarensis* Karaman, 1928 (the latter however to be confirmed).

Regarding Sicily, information on the presence of chub is contradictory and not clearly documented: Vinciguerra (1896) e Scotti (1898) do not report it in Sicily; however Kottelat & Freyhof (2007) report its presence, which is instead considered doubtful by Marrone and Naselli-Flores (2015). Indeed, no modern survey on Sicilian fish fauna has reported the chub in rivers or lakes of the island (see for example: Ferrito & Tigano, 1995; Duchi, 2006; Salpietro, 2005; Barresi et al., 2005; Duchi e Milano, 2014; Duchi 2025), although knowledge of freshwater fauna presence in the largest Mediterranean island is still incomplete, especially regarding central-western Sicily (Duchi, 2014; Borghesan et al., 2026) and lacustrine environments (Duchi e Milano, 2014).

Recently, Mauro *et al.* (2025) in their investigation through environmental DNA, reported the presence of *Squalius squalus* DNA in the artificial lake Rosamarina, a certainly interesting datum that needed confirmation. In this paper we report the first verified presence of *Squalius squalus* in a Sicilian river environment: the Oreto River.

Materials and methods

1. Study area

The Oreto River, has a basin of approximately 130 km² and originates between Monte Matassaro, Renna and Cozzo Agliostro to flow into the Tyrrhenian Sea at the Erasmo station near Palermo after about 20 km, crossing along its course the SCZ "Valle del Fiume Oreto".

Specifically regarding fish fauna, the focus of the present investigations were two sites close to the mouth. Both sampled stretches were located in a strongly anthropized environmental context (within the city of Palermo), both regarding land use and the river corridor itself, which appeared rectified and/or banked in various ways, up to complete concreting of the banks and bottom.

A brief description of the main characteristics of the sampled stretches is given below:

Ponte Oreto (38.102435°N, 13.370413°E; Figure 1). Approximately 55 meters of the sampled stretch were concreted. The watercourse in the investigated area had an average wetted channel width of 4.10 m and active channel of 10 meters. The average depth was 31 cm. The dominant mesohabitat was run and the dominant flow was intact waves. The dominant substrate was artificial. The substrate was covered for about 60% by a thick layer of filamentous algae; the organic material was composed of Xylal. Shade in some sections virtually zero, in others about 40%. There was vegetation maintenance activity underway with the presence of mechanical vehicle crossings in the channel which therefore periodically caused the water to become cloudy. Flow was quite significant. Water temperature: 20.7°C; pH 7.88; conductivity 88 mS/cm.



Figura 1. Ponte Oreto sampling site



Figura 2. A monte Foce sampling site

A Monte Foce (38.110026°N, 13.379740°E; Figure 2). In the reach downstream of the previous one, just upstream of the river mouth, the watercourse had an average wetted channel width of 2.7 m and active channel of 3.6 meters. The average depth was 31 cm. The dominant mesohabitat was run (100%), flow: intact waves. The bottom was dominated by artificial, with slight presence of sand, gravel and microlithal. The substrate was almost completely covered with filamentous algae and organic detritus was mainly in the form of CPOM. An intense organic odour was detected. Shade varied between 30 and 60%. No foam or vehicle crossing in the channel were observed. Also in this case the flow was quite significant for the period. Water temperature: 19°C; pH 7.54; conductivity 91 mS/cm.

2.Data collection.

Fish fauna samplings were carried out during the period 8-9/6/2026. A battery-powered backpack electrofisher with DC and continuous pulsed current and modifiable voltage was used. Only wadeable areas were sampled: sampled sites lengths were 130 m in the upstream reach and 100 m in the downstream one. Caught fishes were subjected to anaesthesia with clove essence solution, determined, measured using an ichthyometer (TL, mm), weighed using a portable electronic scale (g) and, after carrying out field investigations, were subsequently released back into the environment following recovery in containers with clean and oxygenated water. Seven specimens were retained and frozen to

117 verify their identification in the laboratory. Subsequent measurements of morphometric characters
 118 (with digital calipers) and counts of meristic characters were performed according to Kottelat &
 119 Freyhof (2007).

121
 122 **Results**

124 Morphological characteristics (Table I) indicate *Squalius squalus* as the chub species found.

125 *Table I. Morphological and meristcal characters of 7 fish sampled in Oreto river; counts: range;*
 126 *measures (mm) and percentages: average (min, max). A: this sudy; B: Squalius squalius in: Kottelat*
 127 *& Freyhof (2007)*

SL	BD/SL %	Branched AR	Branched DR	LL Scales	AF posterior margin	HL/SL %	Mouth	AF & PF colour	HW/HL %	ID/HL %I	PT
130.7 (75.2-173.5)	25.5 (23.8-26.6)	8½- 10½	8½	40+1 41+2	71% straight 29% convex	25.1 (22.6- 27.0)	71% terminal 29% subterm.	71% Hyaline 29% Black	53.1 (46.5-57.9)	38.2 (33.6-43.1)	2 rows
A											
B	22-27	8- 10½	8½	40-45 +2-3	straight or convex	25-28	terminal	Hyaline or Black	43-47	34-39	2 rows

129 SL: Standard Lenght; BD: Body Depth; AR: Anal Rays; DR: Dorsal Rays; LL: Lateral Line; HL: Head Lenght; AF: Anal Fin; PF:
 130 Pelvic Fin; HW: Head Width; ID: Interorbital Distance; PT: Pharingeal Teeth

131 The Italian chub specimens were sampled at both sites, with individuals ranging in size from 87 to 350
 132 mm (TL; Figure 3; Table II)

133 *Table II. Length and weight of Squalius squalius individuals sampled in Oreto River*

N = 16	TL (mm)	W (g)
Average	136,56	51,81
Median	120	18
Min	87	7
Max	350	486



140 The two largest captured individuals (350 and 224 mm LT) were males in reproductive activity
 141 (running).

Other fish species found in the investigated area were: *Anguilla anguilla* L. 1758, *Cyprinus carpio* L. 1758, *Sarmarutilus rubilio* (Bonaparte, 1837), *Salariopsis fluviatilis* Asso, 1801, *Chelon labrosus* (Risso, 1827).

Discussion and conclusions

The Italian chub, LC species according to IUCN (Ford, 2024), adds to the list of alien species present in Sicilian freshwater, following the recent finding of *Abramis brama* (Linnaeus, 1758; Duchi, 2024). Overall therefore the number of alien fish species present in Sicilian freshwater, listed by Marrone and Naselli-Flores (2015), rises to 13 (11 if parautochthonous species and those still doubtful are excluded). As with many other alien fish, unfortunately neither the origin nor the period of introduction of the Italian chub is known, but it is possible to hypothesize release for sport fishing purposes, and imagine artificial lakes as the main sources of invasion, as highlighted by Naselli-Flores and Marrone (2019) and Duchi (2024). Clearly this finding also highlights the lack of information to the population and the lack of controls on the introduction of alien species in Sicilian inland waters. Its finding up to just upstream of the mouth shows the Italian chub marked adaptability, already reported by Gandolfi et al. (1991) as well as the presence of suitable habitats for this rheophilic cyprinid in the terminal stretch of Oreto. Further investigations are needed to verify its complete distribution in Sicily and delineate its biology, with particular attention to possible interference with native species and/or species of conservation interest present in Sicily.

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