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Ecology of the Lasca *Protochondrostoma genei* (Bonaparte 1939) in the Chiarò di Cialla Creek (Northeast Italy): New Insights from a Biodiversity Hotspot Affected by Alien Species

Marco Bertoli [1,*], Matteo Maglitto [1], Andreah Sala [1], Marino Prearo [2], Paolo Pastorino [2,*] and Elisabetta Pizzul [1]

[1] Life Science Department, University of Trieste, Via L. Giorgieri 10, 34127 Trieste, Italy; matteo.maglitto@studenti.units.it (M.M.); andreah.sala@studenti.units.it (A.S.); pizzul@units.it (E.P.)
[2] The Veterinary Medical Research Institute for Piemonte, Liguria and Valle d'Aosta, Via Bologna 148, 10154 Torino, Italy; marino.prearo@izsplv.it
* Correspondence: marbertoli@units.it (M.B.); paolo.pastorino@izsplv.it (P.P.); Tel.: +39-040-558-8830 (M.B.); +39-011-268-6295 (P.P.)

Abstract

The lasca *Protochondrostoma genei* is an endemic freshwater fish of high conservation concern, listed in Annex II of the Habitat Directive and classified as Endangered in Italy. This study investigates the ecology, population structure, and habitat use of *P. genei* in the Chiarò di Cialla Creek (Northeast Italy), a biodiversity hotspot recently designated as a Special Area of Conservation (SAC IT3320041). Particular regard is given to the issue represented by the presence of the common nase *Chondrostoma nasus*, which competes with the lasca for habitats and trophic resources. Fish assemblages were surveyed by electrofishing during 2023 and 2024, coupled with detailed hydromorphological characterization of mesohabitats. Results highlighted that the lasca showed preference for glides and especially pools, characterized by moderate depths, low to moderate current velocities, high shading, and abundant shelters such as boulders, roots, and woody debris. However, *P. genei* extensively overlapped in habitat use with the invasive common nase *C. nasus*, whose density increased markedly during the study period, suggesting ongoing colonization and potential issues for the lasca conservation. Despite moderate river functionality scores and localized anthropogenic pressures, the Chiarò di Cialla Creek remains a key refuge for *P. genei*. These findings provide essential ecological information to support targeted conservation actions, including habitat management and invasive species control, within protected riverine systems.

Keywords: conservation; fish ecology; habitat preferences; invasive species

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1. Introduction

Globally, biodiversity is undergoing a severe decline, whose magnitude led to state that Earth is facing the "sixth mass extinction" [1–5]. This crisis is largely driven by human activities and freshwater ecosystems are among the most vulnerable and heavily impacted environments [1,6–8]. Their susceptibility to biodiversity loss arises from the convergence of multiple pressures, such as overexploitation, water pollution, habitat degradation, flow alteration, and the spread of alien species [9–12], compounded by the high proportion of endemic and rare taxa confined to limited spatial extents [12–14].

In this context, robust knowledge of the distribution and ecology of native species is essential for conservation, restoration, and management of biodiversity hotspots, particularly for species of Community interest sensu the Habitats Directive (92/43/EEC) [15]. Rivers rank among the most impacted ecosystems worldwide, where mitigating multiple interacting stressors on fish communities remains challenging, and where the active involvement of local stakeholders is crucial to ensure the effectiveness of conservation measures within protected areas [16,17], which represent a cornerstone of conservation and restoration strategies [18–20].

Among the most delicate species of the Po Plain district is the South European nase or lasca *Protochondrostoma genei* (Bonaparte, 1839), distributed in freshwater environments of the Adriatic Sea basin of central–northern Italy and the southwestern portion of Slovenia, while it has been introduced by human activity (transfaunation) in the Tyrrhenian side of central Italy (Figure 1a). The species is endemic throughout the Po Plain district and on the Adriatic coast [21–24] and the northeastern limit of the distribution area corresponds to the Isonzo River basin, shared by Italy and Slovenia [21,25–29] (Figure 1b).

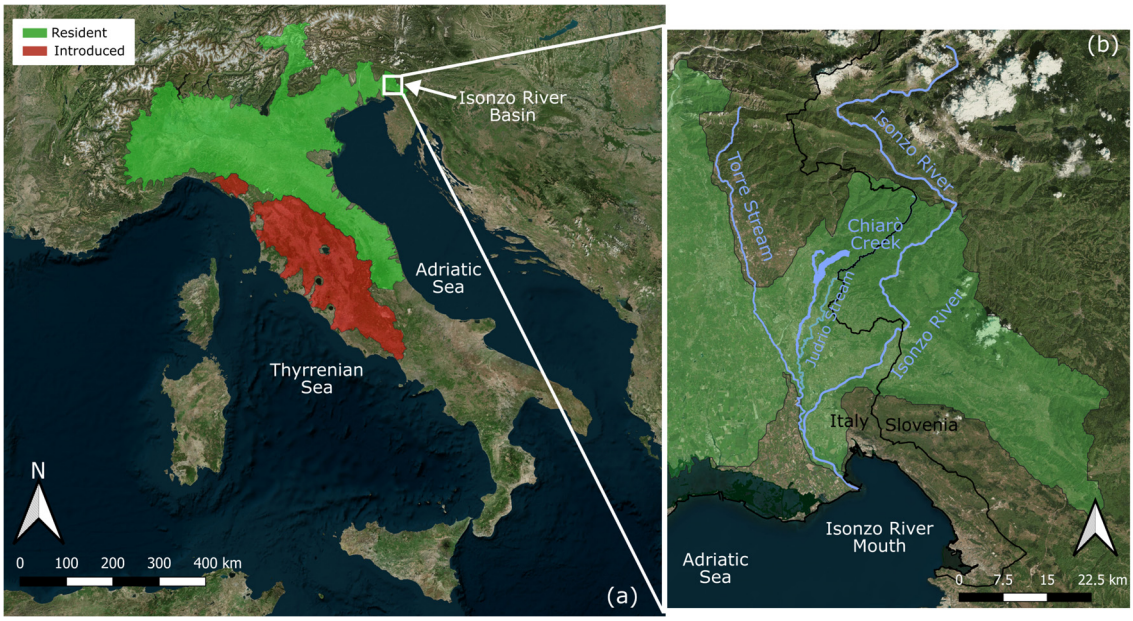

Figure 1. Distribution area of the lasca *P. genei* (**a**) and its eastern limit (**b**), represented by the Isonzo River Basin between Italy and Slovenia; green color indicates the areas where the species is native, while red zones are those where the lasca was introduced due to human activities, via transfaunation (**a**,**b**). The Chiarò di Cialla Creek is reported with a thicker blue line (**b**).

The lasca is a small slender cyprinid, measuring up to 20 cm in length. It is considered a rheophilic species, living in small groups and colonizing middle to lowland stretches of watercourses with fast to moderate flow rates [27]. The lasca usually feeds on aquatic invertebrates, mollusks and epilithic algae [29]. Reproduction occurs from May to June, when water temperatures are approximately 15 °C, and sexual maturity is reached in the third/fourth year of its life [22,27,30].

Degradation, fragmentation and habitat loss are some of the most commonly reported threats and pressures related to the decline of lasca populations [30,31], but *P. genei* is also damaged by the introduction or presence of non-native species, such as Wels catfish (*Silurus glanis*), ide (*Leuciscus idus*), asp (*Aspius aspius*), common roach (*Rutilus rutilus*), channel catfish (*Ictalurus punctatus*), crucian carp (*Carassius carassius*), common bream (*Abramis brama*) and common nase (*Chondrostoma nasus*) due to predation and competition for food

and space [26,31–34]. In particular, *C. nasus* competes with the lasca for trophic resources, habitats and shelters [26,33,34].

Due to these reasons, *P. genei* is listed in Annex II of the Habitats Directive (92/43/EEC) [15] and included in the Bern Convention. It is currently classified as Endangered in the Red List of Italian Vertebrates [35,36] and as Vulnerable in the European Red List [37]. In recent years, *P. genei* has received increasing attention, leading to dedicated protection and recovery initiatives, such as the LIFE for LASCA Project carried out between Italy and Slovenia during 2017–2021 [38]. Despite these efforts, the species is still considered to be in poor conservation status, with highly fragmented populations and a distribution range that has markedly contracted over time. This pattern is particularly evident in marginal areas of its native range, where records are scarce and occurrences are often sporadic [20,31].

One of these areas is represented by the territory of the Friuli–Venezia Giulia Region (Northeast Italy), which hosts a remarkable example of a highly diversified hydrological network, including torrential streams, foothill watercourses, alluvial spring watercourses, and low plain rivers [39–41]. Moreover, the eastern portion of this network can be also considered as a buffer zone between the Balkan and Po plain zoogeographic districts, with special regard for the Isonzo River Basin [42,43]. In this zone, one of the last well-structured (including both juveniles and adult individuals) populations of *P. genei* has been recently observed in the Chiarò di Cialla Creek (Isonzo River Basin). This watercourse is of pivotal importance for the conservation of biodiversity in Friuli–Venezia Giulia, hosting different fish species listed in the Annexes of the Habitat Directive 92/43/EEC [15] such as the Italian barbel *Barbus plebejus*, the Lombardy lamprey *Lampetra zanandreai* (Annexes II, V), the Italian spined loach *Cobitis bilineata*, the Italian riffle dace *Telestes muticellus* and the lasca, *P. genei* (Annex II). Among other species of community interest, white-clawed crayfish *Austropotamobius pallipes* is also widely present in the area (Annexes II, V). Due to this reason, the importance of the Chiarò di Cialla Creek was formally recognized with the proposal to designate it as a Site of Community Importance in the Natura 2000 Network (SAC IT3320041 Rio Chiarò di Cialla) in June 2022 [44] (DGR 816/2022), with the specific aim of protecting/recovering the species; the site was included in the lists of Continental SCIs approved by EU Decision 2024/433 [45] and was finally designed as a Special Area of Conservation in 2025 (DM 20 June 2025) [46].

Despite its importance, the Chiarò Creek is affected by some anthropogenic impacts (including the SAC area), related to scarce urbanization, cutting riverbank vegetation (sometimes left massively in the riverbed) and, above all, intensive agriculture, with the widespread presence of vineyards along the creek. Regarding the alien species, the common nase *C. nasus* has been recorded in the area since 2022. Due to its presence, a control/eradication project started in the same year. Finally, the presence of a well-structured brown trout (*Salmo trutta*) population affects the upstream section of the Chiarò, where it was introduced for fisheries purposes in the early 2000s, as certified by the Regional Authority for the Safeguard of the Fish Heritage of Friuli Venezia Giulia. As an alien species, brown trout was also included in an eradication project, performed between April and September 2024. Results of the eradication campaigns are reported in Figure S1 (Supplementary Materials).

In this context, in agreement with the Regional Authority of Friuli Venezia Giulia, it was deemed of interest to analyze the status of the lasca population inhabiting the SAC IT3320041 Rio Chiarò di Cialla, to obtain information regarding its ecological preferences and to check the level of creek colonization by the common nase, which is recognized as a threat to the lasca [27,29]. In particular, we (i) characterized the fish community within the watercourse stretch included in the SAC, (ii) assessed the hydromorphological features

affecting the community, with particular regard to the lasca population, and (iii) checked the status of the *C. nasus* population within the protected area. The obtained results could be useful for the management of the protected species and its habitat.

2. Materials and Methods

2.1. Study Area

The present study was carried for two years (2023–2024) in the Chiarò di Cialla Creek. This watercourse is located in the eastern portion of the Friuli Venezia Giulia Region, Northeast Italy and is included in the Isonzo River Basin (Figures 1b and 2). The creek originates at 600 m above sea level (a.s.l.) in the municipality of Prepotto, and flows through a foothills landscape. After 9.85 km, the Chiarò Creek joins with the Rug Creek (approximately at 100 m a.s.l.), where the Corno Stream originates. Over a third of the watercourse length (3.84 km) is included in the Special Area of Conservation SAC IT3320041 Rio Chiarò di Cialla.

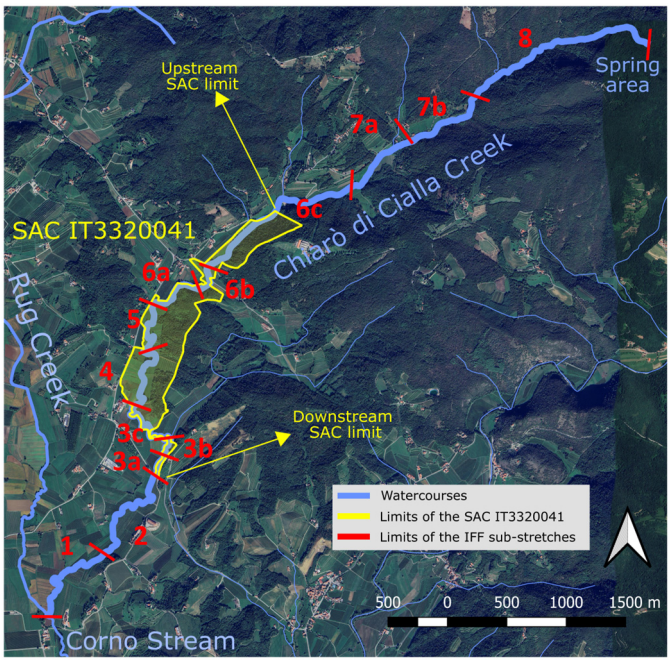

Figure 2. Study area, location in the SAC IT3320041 (yellow line and area; downstream limit 46°02′54.4″ N, 13°27′38.5″ E; upstream limit 46°04′34.2″ N, 13°28′57.1″ E); Chiarò di Cialla and stretches identified by application of the Riverine Functionality Index (IFF).

The use of the Riverine Functionality Index (IFF) [47], applied to the whole creek during June 2024, provides a picture of some issues affecting the watercourse. The IFF index is based on hydromorphological, ecological and biological features [47–49], answering 14 questions related to bank vegetation, land use pressure, extent of riparian area, physical and morphological structure of banks, riverbed structure, and key biological communities (periphyton, macrophytes, macrobenthic invertebrates and fish). For the IFF application, the watercourse was divided into homogeneous stretches based on the characteristics described above [47] (Figure 2). Geographical coordinates for each stretch are reported in Table S1. The obtained overall IFF score, separated for each riverbank, leads to score ranges associated with five classes (High, Good, Moderate, Poor, Bad). As reported in Table S2, riverine functionality seems to be especially compromised in the downstream sections of the Chiarò Creek on the right riverbank (stretches from 1 to 7b). The left bank showed a better condition starting from the most upstream reaches included in the SAC (6a, 6b, 6c) and in the upper sections leading to the spring area.

In the present study, we kept the IFF stretch names. Fish samplings and surveys of hydro morphological features were performed focusing on the stretches included within the SAC area (from 3a to 6c).

Values of the main physicochemical water features measured inside the SAC during 2024 are reported in Table S3.

2.2. Hydromorphological Surveys

Within the SAC area, the presence of individual morphological units or mesohabitats was detected following the MesoHABSIM classification [50,51]. For each mesohabitat, parameters such as water depth, current velocity, biotic/abiotic substrates (microhabitats), and covers/shelters were recorded. These parameters are recognized as the main influences on the patterns of habitat use by freshwater fish in rivers [52–54]. Water depth was measured with a graduated rod, while current velocity was measured with a Flowatch Flowmeter, manufactured by JDC Electronics (Yverdon-les-Bains, Switzerland). Microhabitat composition was expressed in percentage (%) within each mesohabitat, while presence/absence of covers/shelters was recorded. A summary of the parameters considered is reported in Table 1. Data were collected during the summer of 2024.

Table 1. Hydromorphological features recorded during surveys within the SAC IT3320041 Chiarò di Cialla.

Hydromorphological Features	Units	Categories/Description
Mesohabitat		Cascade, rapid, riffle, step, pool, glide, aquatic vegetation, artificial elements, waterfall, backwater
Substrates	%	Gigalithal (rocks), megalithal (>40 cm), macrolithal (20–40 cm), mesolithal (6–20 cm), microlithal (2–6 cm), akal (gravel > 0.2 cm), psammal (sand), pelal (silt and clay), detritus (organic matter), xylal (woody debris, roots), sapropel (dark anoxic mud), phytal (submerged plants).
Cover	Yes/No	Boulders, canopy shading, overhanging vegetation, roots, submerged vegetation, emerging vegetation, undercut banks, woody debris, shallow margins

2.3. Fish Sampling

All activities described in the present study were performed according to European [55], Italian [56] and regional laws and were approved by the Regional Authority for the Safeguard of the Fish Heritage of Friuli–Venezia Giulia, dealing with procedures for the protection of animals used for scientific purposes.

Fish samplings were carried out during summer 2023 and 2024, within the SAC (sections 3a, 3b, 3c, 4, 5, 6a, 6b, and 6c; Figure 2). Backpack electrofishers IG200/2 (24Ah/12V battery, pulsation range 10–100 Hz, output power DC 250W) and ELT62 II 135 GI (pulsation range 25–100 Hz, DC output power 2200 W) manufactured by Hans–Grassl GmbH, Schönau am Königssee, Germany, were used in wadable stretches following the watercourse downstream to upstream, while deep non-wadable areas were sampled using a boat in collaboration with personnel of the Regional Authority for the Safeguard of the Fish Heritage of Friuli–Venezia Giulia. The whole watercourse section included in the SAC area was monitored; sampling activities were carried out proceeding downstream to upstream, from one mesohabitat to another, with a single passage for each morphological unit. Fishing efforts and sampling location were the same in both years.

Collected specimens of all the observed species were taxonomically identified and counted to assess community structure. Specimens were kept in oxygenated tanks during

these operations and then individuals belonging to native species were immediately released downstream of the analyzed mesohabitat, without consequences for their vitality (individuals were able to swim and no spinal injuries and/or hemorrhages were observed). Individuals belonging to alien species were retained, where found.

For *Protochondrostoma genei*, the total length (*TL*, cm) of all specimens was recorded to assess population structure. Measures were carried out as soon as possible to minimize stress on the specimens, which were then immediately released downstream of the sampled mesohabitat (far enough to avoid recaptures), with no consequences for their vitality, as described above. Age was estimated using growth curves previously obtained via scalimetric analysis [57] for the Judrio River sub-basin, which includes the Chiarò di Cialla Creek and is included in the Isonzo River Basin (Figure 1b). This method was chosen to avoid the sacrifice of the lasca specimens. Each individual belonging to the different species was associated with the mesohabitat in which they were captured to identify the preferred habitats for the species, with particular attention to the lasca and the common nase *Chondrostoma nasus*. Regarding the latter alien species, specimens of *C. nasus* were identified and measured for their total length (*TL*, cm). Age was determined as indicated above. These specimens were retained in accordance with the species eradication/containment procedures planned by the Regional Authority. Specimens were also dissected to check for gonadal maturity by visual inspection.

2.4. Statistical Analysis

The data obtained were used to investigate the relationships between the densities of fish species and the characteristics of the different mesohabitats. For this purpose, data collected in 2024 and regarding both fish community and hydromorphological features were used. In detail, substrate composition, presence/absence of cover/refugia, current speed, and flow rate were used. The non-parametric Kruskal–Wallis test was used to detect the presence of significant differences for densities of *P. genei* and *C. nasus* among different mesohabitat types. The Conover–Iman test [58,59] was used as post-hoc test.

The relationships between hydromorphological features and fish community were investigated using Redundancy Analysis (RDA) [60,61]. In this context, abiotic features are considered as affecting the biotic compartment. For the purposes of the present study, the fish community dataset was transformed using the Hellinger transformation [61], while the abiotic data matrix was standardized. Before using the RDA, the axis length was tested using the Detrended Correspondence Analysis (DCA) [62]. To avoid multicollinearity, correlation analysis was performed using the Pearson correlation coefficient, choosing threshold values $r > |0.7|$ and $p < 0.001$ as criteria to exclude variables from the analysis [63]. All analyses were performed with RStudio, version 2021.9.0.351 [64,65], with a 0.05 *p*-level for significance. Figures are produced with RStudio and processed with Inkscape software version 0.92.

3. Results

3.1. Fish Community

Composition of the native fish community observed within the Chiarò SAC IT3320041 area during 2023 and 2024 is shown in Figure 3. In both years, the most abundant species were *Telestes muticellus*, *Padogobius bonelli*, *Squalius squalus*, and *Alburnus arborella*. *Protochondrostoma genei* was less abundant but always present, showing densities between 0.0051 and 0.0128 ind m^{-2} in 2023 and 2024 respectively. *Barbatula barbatula*, *Lampetra zanandreai*, *Gobio benacensis*, and *Phoxinus lumaireul* showed densities lower than 0.0020 ind m^{-2} and represented less than 0.5% of the sampled fish community from both years. The presence

of the European crayfish, *Austropotamobius pallipes*, was noteworthy in the SAC stretches, with a density value equal to 0.011 ind m^{-2} (year 2024).

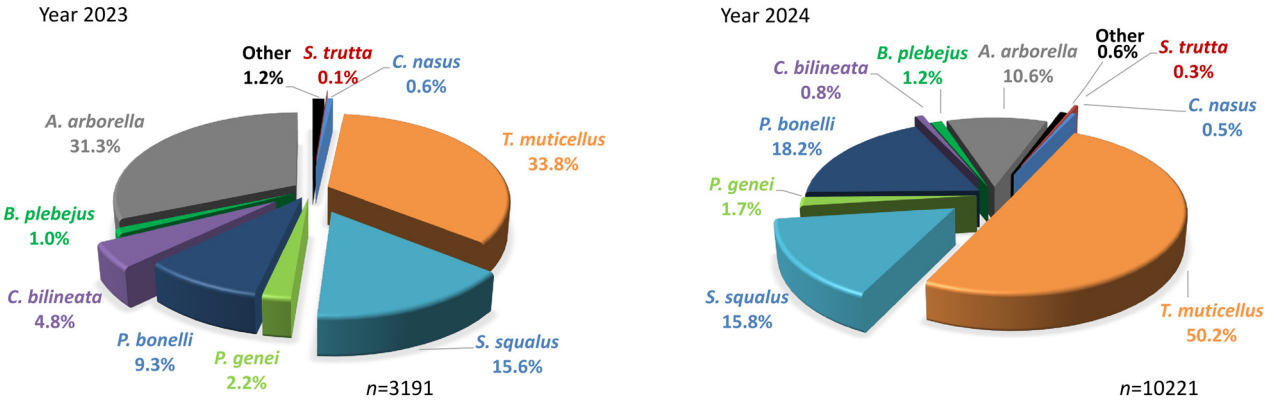

Figure 3. Fish communities observed within the SAC IT3320041 recorded during the monitoring activities carried out in 2023 and 2024. Alien species (*C. nasus* and *S. trutta*) are also included, despite low values, to highlight their presence in the community; "Other" native species observed with percentages lower than 0.3% have been grouped (*B. barbatula*, *L. zanandreai*, *G. benacensis* and *P. lumaireul*).

Regarding the population structure of *P. genei*, in 2023 specimen sizes ranged between 4 and 12 cm, while in 2024 the range was between 3 and 20 cm (Figure 4a,b). It was possible to highlight seven age classes (0+, 1+, 2+, 3+, 4+, 5+, and 6+) (Figure 4c,d). The size for reaching sexual maturity was set at 13 cm, corresponding to age class 2+. Therefore, in 2024, sexually mature individuals were observed within the SAC, albeit in small numbers. No specimens above 12.5 cm in length were observed in 2023, and the number of observed age classes was also smaller than the following year and limited to 0+ and 1+.

As regards non-native species, *Chondrostoma nasus* was detected within the SAC during both years, with density equal to 0.0014 ind m^{-2} to in 2023, which more than doubled in 2024, reaching a value of 0.0034 ind m^{-2}. During 2023, 19 common nase specimens, measuring between 19.1 and 28.2 cm in total length, were observed: 4 individuals were mature males, while 15 individuals were mature females. In 2024, 47 individuals measuring between 7 and 34 cm were captured, and sexually mature individuals were again observed (Figure 4e,f).

3.2. Hydromorphological Characteristics Within the SAC IT3320041 and IFF Index

During the study, with an average flow rate was 0.083 m^3 s^{-1}, 325 mesohabitats belonging to four types were identified within the SAC boundaries (Figure 5). Riffle and glide were the most frequent mesohabitats, ranging between 27.1–44.4% and 22.4–48.1% respectively. Pools were between 5.6 and 40.3% of the observed habitats, with decreasing frequencies from downstream to upstream. Some stretches (especially in the lower watercourse section) were mainly characterized by large pools (i.e., stretch 3b was a single, permanent and non-wadable pool). Backwaters were also present, with lower frequencies than the other mesohabitats (1.9–21.2%).

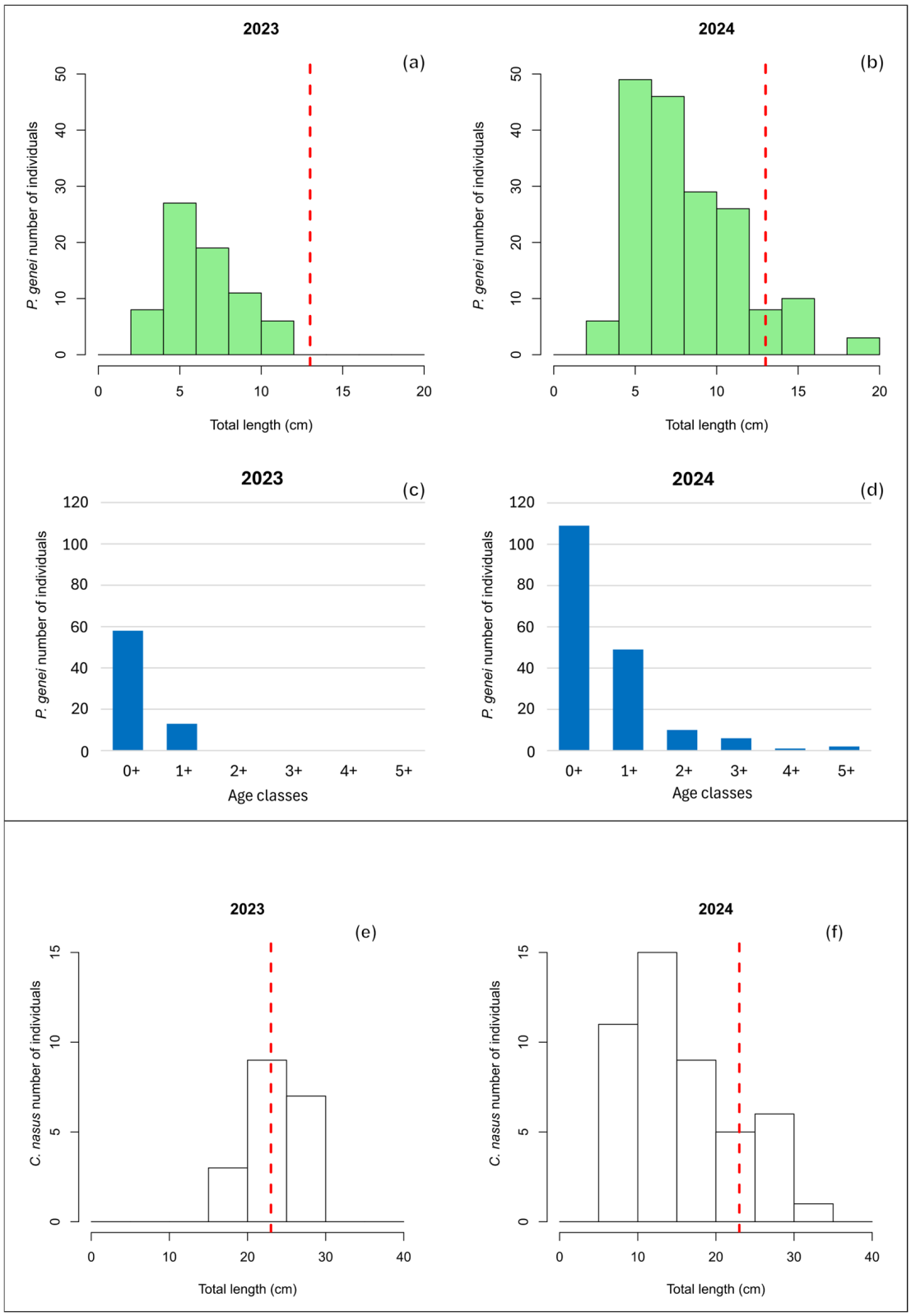

Figure 4. Size class distribution (**a**,**b**) and age classes (**c**,**d**) for *P. genei* specimens and size class distribution (**e**,**f**) for *C. nasus* specimens found within SAC IT3320041 during monitoring carried out in 2023 and 2024. The red line in figures (**a**,**b**,**e**,**f**) indicates the size at which the species reaches sexual maturity.

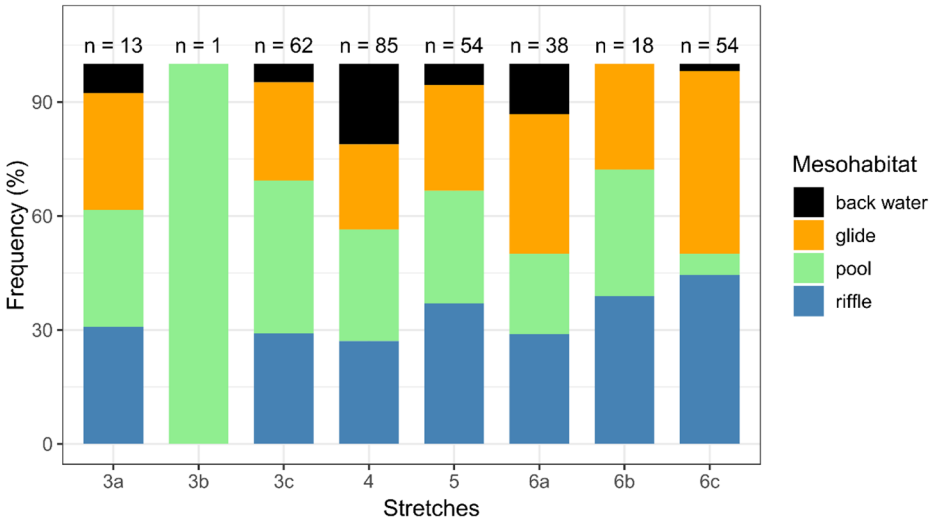

Figure 5. Frequency (%) of the observed mesohabitats in the Chiarò stretches included in the SAC during the study period. The number on the top of each column (n) indicates the number of mesohabitats observed within each watercourse stretch.

3.3. Mesohabitats and Fish Communities

Data regarding the fish community observed in the different mesohabitats were related to their abiotic characteristics via redundancy analysis (RDA), the results of which are shown in Figure 6. The RDA 1 and RDA 2 axes are both significant, explaining 34.9% and 4.2% of the explained variability (Table 2; Figure 6a,b). Most of the pools occurred at the right section of the plot, in association with higher water depth, low water velocity (i.e., ranges were 0.01–0.4 m s^{-1} in pools and 0.1–1.1 m s^{-1} in riffles) and with the presence of organic matter (detritus, woody debris). The lasca is mostly associated with these habitats, showing preferences for zones characterized by shade ("Canopy shad"), moderate depths and moderate current speed. The presence of shelters/covers, such as boulders ("Boulders"), woody debris ("Woody Deb"), eroded banks, and roots, is also noteworthy.

Table 2. Results of the redundancy analysis (RDA) performed on fish community date observed in the Chiarò di Cialla mesohabitats within the SAC boundaries and abiotic features. Significance is highlighted in bold.

	RDA1	RDA2
Eigenvalues	1.053	0.072
Proportion Explained	0.349	0.042
Cumulative Proportion	0.349	0.391
Significance (999 permutations)	***p* < 0.001**	***p* < 0.05**

C. nasus occurred in a more central plot position, but very close to *P. genei*, showing preferences for the same habitats. In fact, considering the analyzed stretches, the two species were always recorded together (Figure 7a), with the exception of stretch 3a. Moreover, both *C. nasus* and *P. genei* were mostly collected in glides and, especially, pools (Figure 7b). The application of the Kruskal–Wallis test highlighted significand differences between the densities observed among different mesohabitats for *P. genei* (H = 46.932, d.f. = 3, $p < 0.001$) and *C. nasus* (H =23.688, d.f. = 3, $p < 0.001$), as both species were more abundant in pools and glides than in other mesohabitats (Conover–Iman test, $p < 0.001$ for all comparisons).

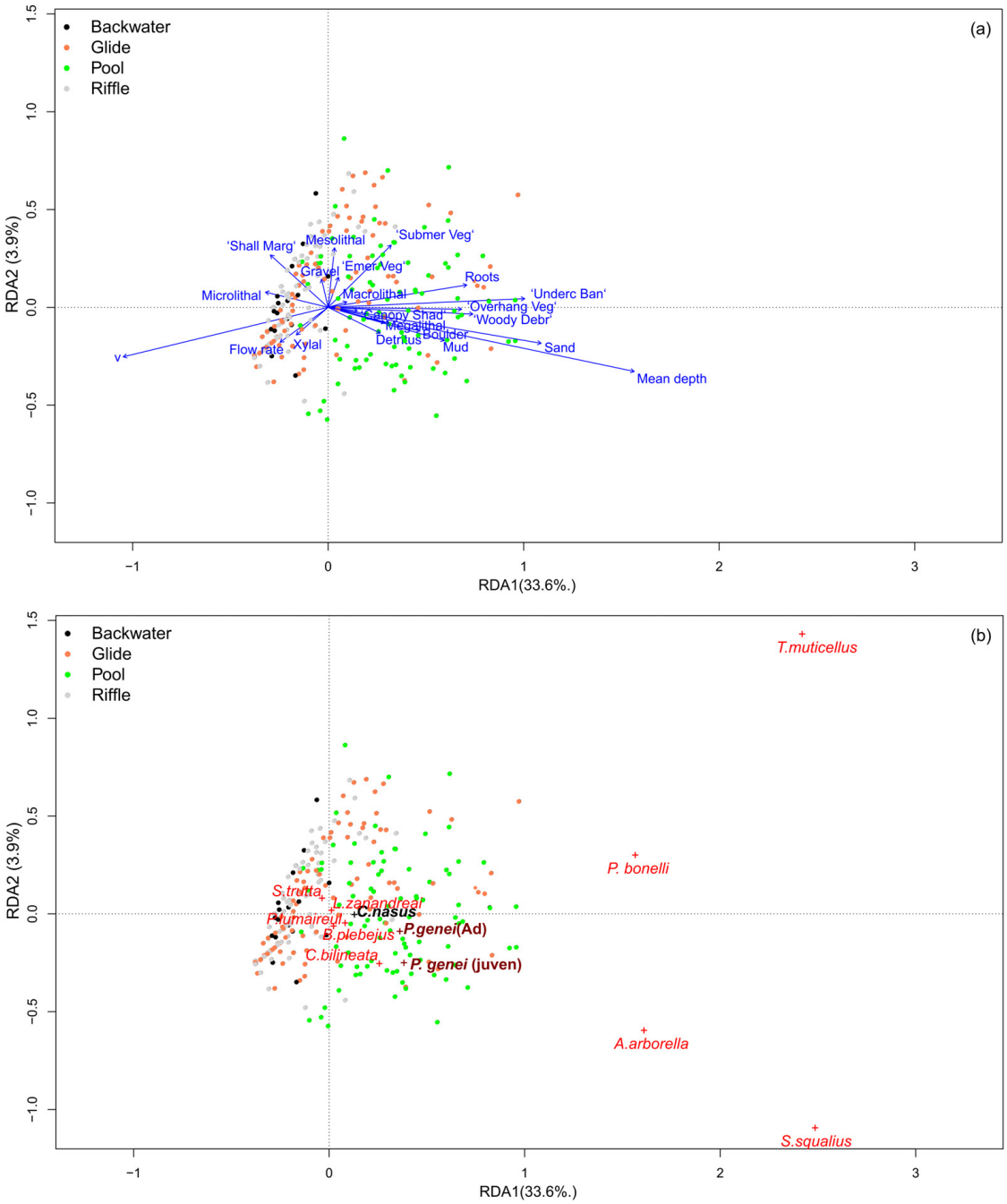

Figure 6. Redundancy analysis (RDA) based on water depth, velocity, flow rate, presence/absence of shelter/cover, and substrate percentages in the mesohabitats examined in the Rio Chiarò. Mesohabitats and abiotic features are reported in (**a**), while mesohabitats and fish species are reported in (**b**). The shelters are indicated with capital letters (Boulder = rocks; Canopy Shad = vegetation along the banks and consequent shading; Overhang Veg = vegetation covering/touching the free water surface along the banks; Roots = presence of roots; Submer Veg = presence of submerged algae/vegetation; Emer Veg = presence of emerged vegetation; Underc Ban = banks eroded by water; Woody Debr = presence of woody debris in the stretch; Shall Marg = conditions of low speed and depth at the edges of the mesohabitat); the substrates are: Megalithal = boulders > 40 cm; Macrolithal = boulders 20–40 cm; Mesolithal = pebbles and boulders 6–20 cm; Microlithal = pebbles and gravel 2–6 cm; Detritus = organic material; xylal = woody debris, roots).

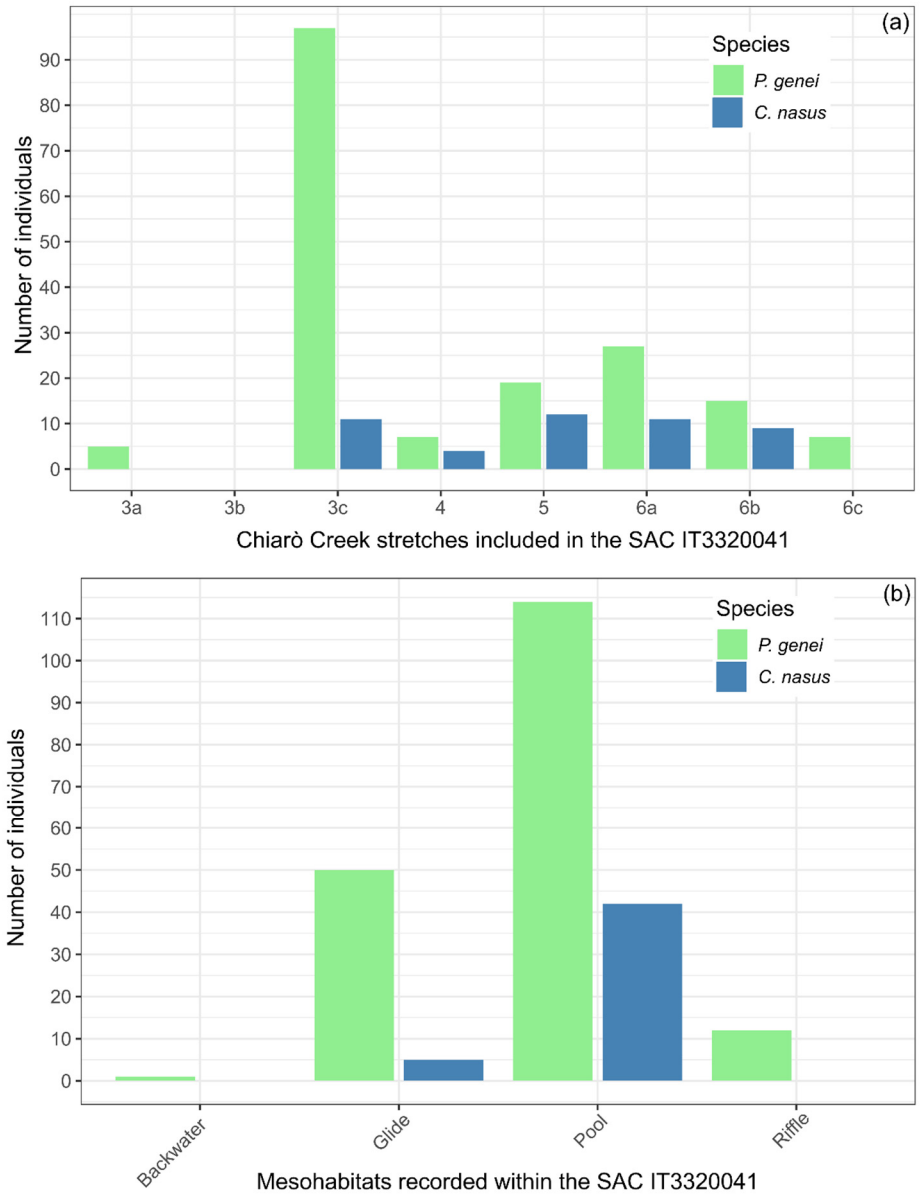

Figure 7. Number of individuals belonging to *P. genei* and *C. nasus* species in the different stretches (**a**) and in the different mesohabitats (**b**) of the Rio Chiarò section included in the SAC IT 3320041.

4. Discussion

4.1. Fish Community and Protochondrostoma genei Population Structure

The fish community is rich in species, and, besides the lasca, other fish included in Annexes of the Habitat Directive 92/32/EEC [15] were observed, such as *Barbus plebejus*, *Lampetra zanandreai*, *Cobitis bilineata* and *Telestes muticellus*. Moreover, the presence of the crayfish *Austropotamobius pallipes* was generally observed within the SAC. These findings confirm that the SAC IT 3320041 Rio Chiarò di Cialla is a valuable biodiversity hotspot.

The lasca population structure was characterized by many juvenile specimens during both monitoring years. A similar population structure was also observed in the Tiber Basin, where the species was introduced, by Carosi et al. [24]. The authors reported that seven age classes (from 0+ to 6+) were identified on 7156 specimens of *Protochondrostoma genei* and individuals belonging to class 1+ (51% of the total sample). The same authors reported frequencies equal to 24% and 20% for classes 2+ and 0+, respectively, while the others were ≤1%. These results could be linked to the growth rate of the species, which is positive allometric [24,66] and very rapid, as the individuals reach around 10 cm in length

at the age of one and a half years [29,67]. However, mature individuals were found (especially in 2024), suggesting the importance of the SAC IT 3320041 Rio Chiarò di Cialla for lasca conservation.

Unfortunately, the increasing presence of *Chondrostoma nasus* was certified within the SAC area, where the invasive species showed a doubling of density and a wider size range in 2024 than in 2023. Available bibliographic data seem to confirm the acclimatization of the species, which is highly invasive [28,33,34]. *C. nasus* lives as a gregarious fish in groups including different age classes with different ecological requirements [65]. According to Kottelat and Freyhof [27], during the breeding season (February–May), mature adults (associated with the middle reaches of moderately to rapidly flowing streams with rocky or gravelly bottoms) migrate upstream (even tens of kilometers) to spawn in habitats often located in the tributaries of their source streams. Breeding migrations for *C. nasus* are reported by Peňáz [68] and Rakowitz et al. [69]. Mature individuals were recorded in the Chiarò Creek in 2023, and the presence of many juveniles in 2024 seems to suggest that colonization is still ongoing.

4.2. Habitat Use and Habitat Overlap Between Protochondrostoma genei and Chondrostoma nasus

Regarding the habitat preferences, the lasca (both juveniles and adults) occurred in the RDA plots where mesohabitats (mostly pools) are characterized by low velocity conditions, higher water depth and the presence of shelters such as boulders, eroded banks, as well as roots and woody debris. These findings agree with Pliberšek and Tavčar [29], who report that *P. genei* shows preferences for various types of shelter, such as eroded banks, roots, large boulders, and vegetation. The lasca also prefers watercourse stretches with a large proportion of shade cover (>80%), such as densely covered overhanging riparian vegetation. Our results seem to agree with this information, as highlighted by the RDA. The availability of refugia represents a key habitat component for *P. genei*, particularly for juvenile stages, which are characterized by limited swimming capacity and low resistance to strong currents. Therefore, individuals rely on sheltered areas to withstand flood events. Following hatching, larvae feed along riverbanks, while juveniles primarily occupy shallow shoreline habitats, progressively shifting towards zones with higher current velocities as they grow. Hauer et al. [70] reported that habitats with low current velocities (<20 cm s^{-1}) and shallow water depths (<60 cm) are critical for juvenile stages, especially for age classes 0+, 1+, and 2+, which show a preference for gravel and silt substrates. This information could be useful for conservation, to keep/restore environmental features that could help/favor the lasca population. Regarding mesohabitat preferences in the Chiarò Creek, the lasca was mainly found in glides and pools. This result agrees with findings obtained during the LIFE FOR LASCA Project activities, as the species was found lingering in pools and glides, often swiftly moving to shallows and riffles [29]. On the other hand, our findings are apparently in contrast with Zerunian [22] and Kottelat and Freyhof [27], who associated *P. genei* with medium-high stretches of watercourses and their tributaries in the piedmont areas, characterized by medium-fast water velocity and gravelly bottoms. However, these riverine types are associated with lasca spawning habitat requirements, corresponding to shallow gravel bottoms with a fast to moderate well-oxygenated current, typical in the riffle zones [29]. Prior to spawning, the lasca migrates in groups searching for faster-flowing stretches of a watercourse or its tributaries, where spawning takes place on shallow gravel beds. *P. genei* is a lithophilic spawner, and females deposit adhesive eggs on substrates with grain size in a range of 2–4 cm [29]. As the lasca individuals collected in this study were mostly juveniles, it is possible that sampled mesohabitats represent growth areas for the species, which could then migrate downstream into higher-flowing watercourses (such as the Corno Stream and the Judrio Stream, belonging to the same

basin). The lasca is a bottom-feeder with an omnivorous diet, including epilithic algae, benthic invertebrates, and mollusks [22,29]. Puzzi et al. [32] reported that juvenile *P. genei* feed on phytoplankton and zooplankton in the early stages of growth, which are likely better developed and concentrated in pools (where water velocity is low and depth is higher than in riffles). Areas with generally moderate flow velocities and shallow margins would be good spots for juveniles to grow. This fact seems to be supported by our data (Figures 7b and S2).

In the investigated watercourse, *C. nasus* and *P. genei* showed an overlapping trend at the mesoscale level, as common nase individuals were consistently recorded in co-occurrence within the same mesohabitats of the lasca (Figure 7b). Although the results presented herein do not yet show clear competition between species, it is well known that, unfortunately, *C. nasus* outcompetes and eliminates *P. genei* in drainages where the common nase was introduced [27]. In fact, activities of the LIFE FOR LASCA Project included the reduction/control of *C. nasus* populations before the reintroduction of *P. genei* in Slovenia [29]. This indicates the potential need for an implementation of eradication/population control activity for the common nase in the Chiarò Creek, to contain/slow the ongoing colonization performed by *C. nasus* and to avoid/slow potential damage to native populations in the SAC. In this context, the findings of the present study seem to suggest the possibility to plan a targeted strategy regarding population control activities for common nase, firstly focusing on pools (and then glides), where the species was most abundant. Due to the harmfulness of *C. nasus*, periodic monitoring activities in all habitats would be also recommended, especially before the reproductive period, when *C. nasus* moves to habitats like riffles and glides. Moreover, hybridization with the lasca is also possible, adding another big conservation issue. In this context, future genetic screening would be strongly recommended.

5. Conclusions

The present work provides new information about *P. genei*, which could be helpful to arrange management actions in the area and in other watercourses. The presence of refugia and microhabitat diversity appears to play a key role in shaping the fish community structure, especially for the lasca. However, the invasive common nase showed the same habitat use. Effects caused by the presence of alien species can also be enhanced by other impacts affecting the area, such as those related to land use and those potentially due to extreme drought events or intense floods, whose frequency increases in relation to climate change effects. In fact, intense flood events could lead to extraordinary flow rate conditions that, due to their intensity, can sweep away gametes, eggs and fry. This point could represent a target for future studies.

The site investigated represents an important biodiversity hotspot, which must be carefully managed in order to protect the lasca and other hosted species. It would be of pivotal importance to continue monitoring activities for *P. genei* in the Chiarò Creek, where several threats to its conservation occur, with particular regard for the presence of the alien *C. nasus*. It would be necessary to implement eradication campaigns for the common nase population, which started in 2022, at least within the SAC. Moreover, it is also necessary to start a genetic screening program to identify possible hybridization between the two species.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/d18020109/s1.

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