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DELLA LOMBARDIA

The Freshwater Crayfish.

Austropotamobius pallipes, an endangered species

WITH THE CONTRIBUTION OF

Regione Lombardia

LIFE GESTIRE 2020 - Nature Integrated Management to 2020.
Integrated strategy for Natura 2000 and biodiversity in Lombardy

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I^ Revision 2014 as part of project LIFE NAT/IT/000352 CRAINat “Conservation and Recovery of *Austropotamobius pallipes* in Italian Natura 2000 Sites”.
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An endangered species

The native crayfish, *Austropotamobius pallipes*, is a species protected at the European level, and it requires concrete interventions for its conservation due to numerous threats menacing its survival. The species is registered in the International Union for Conservation of Nature and Natural Resources (IUCN) Red List, in which it has been classified since 2010 as “endangered” (at risk of extinction, the same level of threat as the Giant Panda!). The EEC Directive 92/43 qualifies *A. pallipes* as a “species of community interest for which special conservation areas must be identified” (Annex II) and as a “species subject to exploitation consistent with specific management plans” (Annex V). The directive was implemented by Italy with DPR 357/97 and DPR 120/2003. In Lombardy *A. pallipes* has been safeguarded since 1977 with the prohibition of capture, transport and trade (LR n. 33 of 27/07/1977). Then, since 2008, the Regional Law n. 10 (“Provision for the protection and conservation of small fauna, of flora and spontaneous vegetation“) officially protects the two species *A. pallipes* and *A. italicus*, belonging to the species complex (*A. pallipes* complex). The law also prohibits the alteration and destruction of their habitat.

The interest in the protection and conservation of native crayfish arises within the context of previous LIFE projects:

- LIFE03NAT / IT / 000147 “Redevelopment of the biocoenosis in Valvestino and Corno della Marogna 2” (2004-2007) envisaged, among the various actions, the study of the local crayfish populations and their habitat level of conservation. ERSAF, with the Inland Water Laboratory of the University of Pavia, started experimentally the reproduction and breeding of crayfish in captivity, aimed at subsequent release into the wild.

- LIFE NAT / IT / 000352 CRAINat “Conservation and Recovery of *Austropotamobius pallipes* in Italian Natura 2000 Sites” (2010-2014), specifically dedicated to crayfish, involved, in addition to Lombardy, significant realities of central Italy, including another Region (Abruzzo), two Provinces (Chieti and Isernia), a National Park (Gran Sasso and Monti della Laga), and a Research Centre (Mario Negri Sud Consortium).

In this context, the LIFE IP GESTIRE 2020 project stands as an element of continuity with previous experiences: some of its actions are dedicated to the protection and conservation of the native crayfish, through monitoring activities in its natural environment and conservation interventions inside Natura 2000 areas.

The LIFE IP GESTIRE 2020 project

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LIFE Integrated Project (IP) GESTIRE 2020 is an 8-year (2016 - 2023) innovative and integrated project about conservation of biodiversity in Lombardy. It is co-financed by the European Commission under the LIFE + Program.
The project implements a cohomprensive management of the **Natura 2000 Network** in Lombardy, through 64 actions aimed:

- **To improve the governance and management models of Natura 2000 in Lombardy**, on behalf of the European Habitat Directive;
- **To maintain and improve the conservation status of habitats and species**, through direct and concrete interventions;
- **To increase awareness** of the value of the Natura 2000 areas in Lombardy;
- **To monitor the environmental and socio-economic impact** of the project actions, in order to better understand their effectiveness and better target them in the future.

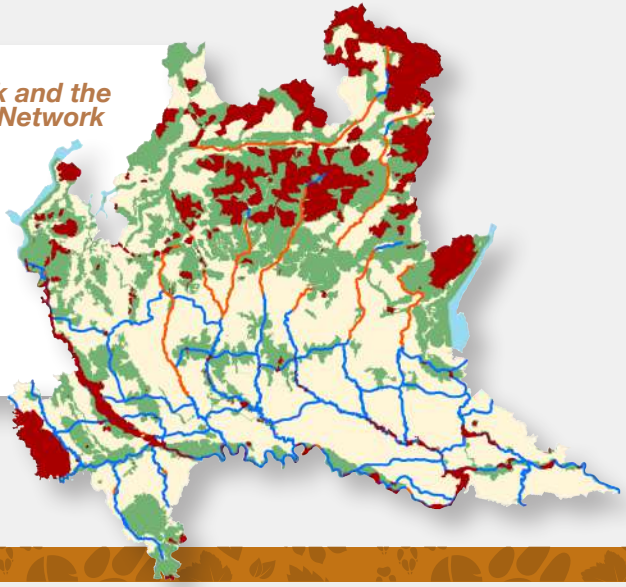
LIFE IP GESTIRE 2020 presents a budget of 17 million euros, provided by the partners and the European Commission, with the aim of involving an additional 83 million euros, coming from potential sources of Natura 2000 funding, represented by public and private funds and referred to as **“complementary funds”**.

NATURA 2000 is the name that the European Union has assigned to the network of areas (Sites of Community Importance, Special Conservation Areas and Special Protection Areas) intended for the conservation of biodiversity in its territory. It can therefore be said that it represents the Natural Park of the European Union.Natura 2000 was born thanks to two Directives that defined the purposes and methods of its constitution and functioning: the **"Habitat" Directive** 92/43/EEC aimed at the protection of habitats and animal and plant species, indicated in Annexes I and II, while the **"Birds" Directive** 79/409/EEC, later on codified in the "Birds" Directive 2009/147/EC, aimed at the protection of the bird species listed in its Annex I.

The **LIFE Program** was born in 1992 as an European funding tool to contribute to the development and implementation of the Union legislation and policy on the environment. It is managed directly by the European Commission which defines the rules for the access to contributions. Thus, it issues calls for tenders, evaluates and approves the projects deemed most valid and monitors them during the course of their activities.

In addition to the concrete activities planned for the conservation of species and habitats, LIFE IP GESTIRE 2020 is important as a framework for discussion, collaboration and sharing of choices and responsibilities between the project partners, all committed to the protection of biodiversity.

Natura 2000 Network and the Regional Ecological Network



The complementary funds

In the context of the LIFE IP GESTIRE 2020 project, the so-called "complementary funds" play a fundamental role. They are sources of financing that do not necessarily ascend to the conservation of nature and the protection of biodiversity, but which can contribute to obtain important results in such a perspective, if used with the help of experts in environmental matters and on the basis of a strategic vision.

The LIFE IP GESTIRE 2020 project provides support to the territory, thanks to figures called "technical facilitators", to access funds with projects aimed at the protection of species and habitats, and at the same time the project plays a leading role for the achievement of significant results in the long term. The main complementary funds, which can integrate LIFE funds and be used for the protection of crayfish, are:

1) The Rural Development Program (RDP), and especially measures 4 and 10, which allow agro-environmental interventions for the protection and restoration of habitats such as, for example, wetlands, pools and springs.
   Other useful measures are 1 (training and information) and 8 (interventions against hydrogeological instability).
2) The calls of the CARIPLO Foundation - Environment Area, which over the years have allowed the realization of numerous interventions for the restoration of habitats.
3) The "Green Areas" regional fund, created to compensate for the consumption of agricultural land, and the funds linked to Forestry Compensation.
4) The European INTERREG program, which makes it possible to carry out projects on a international scale.

The use of additional and multiple sources of funding on a local, regional, national or European scale is also envisaged.

Who it is and where it lives

The autochthonous crayfish, also known as “white-clawed crayfish”, is one of the largest freshwater invertebrates present in our area. Its scientific name is *Austropotamobius pallipes* and it belongs to the only genus of native crayfish in Italy.

Distribution

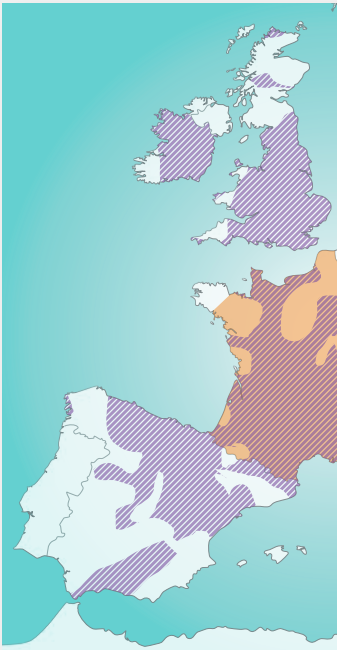
Austropotamobius pallipes (Lereboullet, 1858) is distributed in the southern part of Western Europe: Spain, France, Switzerland, Italy and the states of the Balkan Peninsula overlooking the Adriatic Sea. It is also found in Ireland and the United Kingdom, but in these North Atlantic islands it was moved in medieval times by French monks, who greatly appreciated the crayfish meat! The knowledge about the distribution of *Austropotamobius pallipes* in Italian freshwater is incomplete and limited to specific studies located only in some provinces or regions.

The Freshwater Crayfish

Phylum:	Artropoda
Class:	Crustacea
Order:	Decapoda
Family:	Astacidae
Genus:	*Austropotamobius*
Species:	*A. pallipes*

Identity card

The taxonomic position is still controversial and not fully defined. Genetic investigations show that the Italian populations of the freshwater crayfish genus *Austropotamobius* belong to two different species: *A. pallipes* in the north-western area and *A. italicus* in the rest of mainland and peninsular Italy.
In all the protected areas involved in the LIFE IP GESTIRE 2020 project the presence of *A. italicus* has been ascertained, but the European legislation only protects *A. pallipes* which, on the field, corresponds however to a complex of species all seriously threatened.
A. italicus has four subspecies, two of which can be found in Lombardy: *carinthiacus* in the western part and *carsicus* in the eastern one.
The distinction between *A. italicus* and *A. pallipes*, given that the morphological differences between the species have not yet been identified, must be made with the appropriate genetic analyses, which allow the correct management of the species and the related reintroduction and repopulation actions.



From: Atlas of Crayfish in Europe

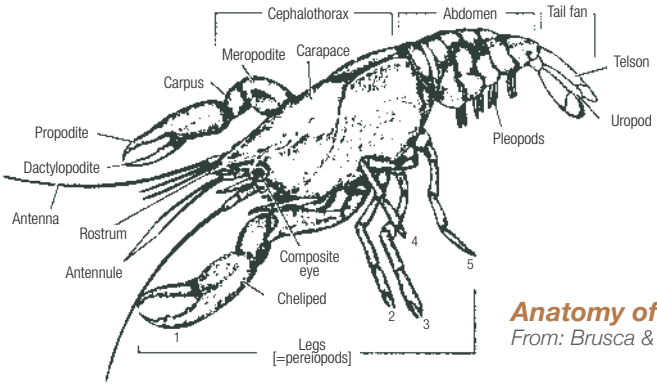
A bit of history

In the Middle Ages the crayfish was a very popular animal due to its nutritional and economic importance. Due to the periodic renewal of its outer shell, it assumed the symbolic meaning of “death and resurrection” in the religious context. The alchemists, on the other hand, used the symbol of the crayfish in an alchemical procedures to indicate the device “that makes one go back” (called καρκινος = crayfish). The crayfish were then deprived of any religious symbolism, but continued to be the object of intense harvesting and trade. This activity contributed to the rapid spreading throughout Europe of an

epidemic disease of American origin (**the crayfish plague**), which appeared for the first time in 1859 in the Po river basin.

Anatomy

Like all crustaceans, its body is covered with an "exoskeleton", which is a very robust and solid external protective cover. This is hornlike in texture and consists of abundantly calcified chitin.
The color varies from greenish-gray to dark brown (some specimens are completely blue): this makes the animal barely visible and camouflaged with the bottom of the streams in which it lives.
The body is divided into two easily distinguishable parts: cephalothorax and abdomen.
The **cephalothorax**, which ends at the front with a triangular structure called "rostrum", has two pairs of antennae, a complex mouth apparatus, a pair of claws (chelipeds: used for defense, predation and mating) and four pairs of legs (pereiopods: used for walking, forward!). The **abdomen** is segmented and ends with the **"telson"** (a paddle tail), which is used by the animal for the characteristic "swimming backward" as an escape reaction in case



Anatomy of the Crayfish
From: Brusca & Brusca, 2003

Color variations

Male (left) and female (right) crayfish specimen

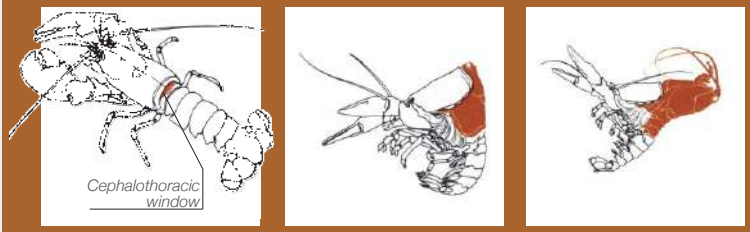
of danger. The females fold it up to protect the eggs.
For each segment of the abdomen there is a pair of appendages (pleopods); these, in the female, are all the same, while in the male the first two pairs are modified into appendages (gonopods) used for reproduction. The distinction between males and females is therefore simple and immediate even in younger individuals.

Moulting

The rigidity of the exoskeleton does not allow the gradual growth of the crayfish, which is therefore forced to replace the old shell with a new one, carrying out the process called **moulting** or **ecdysis**. The crayfish, in this delicate moment of the life cycle, abandons its refuge in search of more open spaces, in order to have greater freedom of movement during the repeated contractions with which it comes out and frees itself from the old exoskeleton (exuvia). After this laborious operation, the crayfish has the opportunity to grow before the new shell hardens definitively. In this period the animal is soft and therefore more exposed to the risks of predation. Moulting is divided into several phases:

- **Pre-moulting**: lasts a few days and leads to the thinning of the carapace and the accumulation of calcium in gastroliths.
- **Moulting**: lasts from a few minutes to a few hours in which the crayfish comes out of the old exoskeleton through the cephalothoracic window between the cephalothorax and the abdomen.

Moulting phases



- **Post-moulting**: lasts about three / four days and leads to hardening of the tegument thanks to the substances (calcium carbonate) accumulated in gastroliths.
- **Inter-moulting**: in this phase the crayfish feeds and accumulates the essential reserves until the next pre-moulting.

During the moulting, the crayfish has the opportunity to repair any damage to the exoskeleton and to regenerate limbs and appendages. This explains why sometimes it happens to see limbs and claws of different sizes in the same crayfish. In older animals, with less frequent moulting, the regenerated limbs remain smaller, but still functional. Sometimes the crayfish can also amputate itself (autotomy): for example, in case of a claw immobilized by a predator or in a cleft, in order to free itself.

Post-moulting crayfish with the old exoskeleton (exuvia)

The ecology of Crayfish

Habitat

Austropotamobius pallipes loves clear, flowing, fresh, well oxygenated waters (also known as “salmonid waters”), of good physico-chemical quality, with rocky, gravel and sand substrates. It inhabits the canals, streams and waterways of the hills and pre-Alpine belt which are also characterized by pebbles, mud, silt, organic matter of vegetal origin (leaves and branches), submerged roots and aquatic vegetation, which constitute its potential refuges. Once it was also found in the pre-alpine lakes, in the large rivers of the plain, as well as in its springs. These environments are now completely colonized by exotic crayfish species and for this reason they are no longer suitable for the life of *A. pallipes* (especially due to the presence of the aforementioned “crayfish plague”).

Water. A good water oxygenation (> 60%) is essential. The pH must be between 6 and 9 and the favorable calcium concentration values between 200 and 350 ppm.

Temperature. Since crayfish are heterothermic animals (organisms in which the body temperature is not constant, but similar to the environmental one), the water temperature is a particularly important factor in their life. They have a good resistance, with optimal summer values between 15 and 18 °C; at 22° C physiological disturbances would occur and values close to 25° C would be tolerated only for short periods. They resist in winter to temperatures close to zero.

Altitude. Defining precisely which are the optimal altitudes for this crustacean is not easy, since other factors such as latitude affect the water temperature. Generally in Northern Italy it is found up to 800 m above sea level ; even up to 1200 m a.s.l. in Central/ Southern Italy, when the thermal conditions allow it.
Light. It prefers well-shaded streams, with a good riparian vegetation cover, which prevents the sun from direct radiation of the water surface. The crayfish activity is substantially crepuscular and nocturnal, coinciding with the transition from a mosaic vision (like that of insects) to a continuous one (like that of man).

Food

The diet of *A. pallipes* varies according to the type of water course; it includes living preys, sought after among aquatic macroinvertebrates (insect larvae, crustaceans, molluscs, etc.), plant pieces (algae and macrophytes), seeds and fruit remains (chestnuts, cherries, etc.). However, the carnivorous component in the nourishment prevails (small insects, corpses of fish and other animals). The food is grasped with the small claws (second and third pair of pereiopods) and brought to the mouth, where all the mouth appendages, rich in bristles with a tactile and olfactory function, select it and the mandibles grind it.

Reproduction

Sexual maturity is generally reached in the third-fourth summer of life, when the males have a total length (from the tip of the rostrum to the telson) of 60-70 mm and the females of 55-60 mm.
Mating takes place in autumn in the months of October and November, generally when the water temperature approaches 10°C. The females prepare for reproduction a few weeks before mating, with the formation of the so-called “Glair Gland”, whitish structures visible ventrally on the abdomen, which represent glands dedicated

to the release of a mucous and sticky substance used to anchor the eggs to the pleopods.
The male, after a sort of “courtship”, overturns the female on the back and places the spermatophores (white cylinders containing the spermatozoa) on the ventral plate (sternitis).
After about a week, the eggs are released through the genital papillae (small orifices in correspondence with the 3rd pair of thoracic limbs of the female) and fertilized by the spermatozoa.
The eggs (from 50 to 100 approximately - the number depending on the female size) remain attached to the abdominal appendages (pleopods) and are protected under the abdomen for the whole winter and spring. During this period the female has reduced mobility and keeps the eggs clean of any debris and well oxygenated.
Hatching takes place after an incubation period that can vary from four to seven months, depending on the thermal conditions of the watercourse.
The newly hatched **larvae** are less than a centimeter long, but already similar to adults. The first year of life is the riskiest when small crayfish have the highest mortality rate.

Female crayfish with ready-to-open eggs

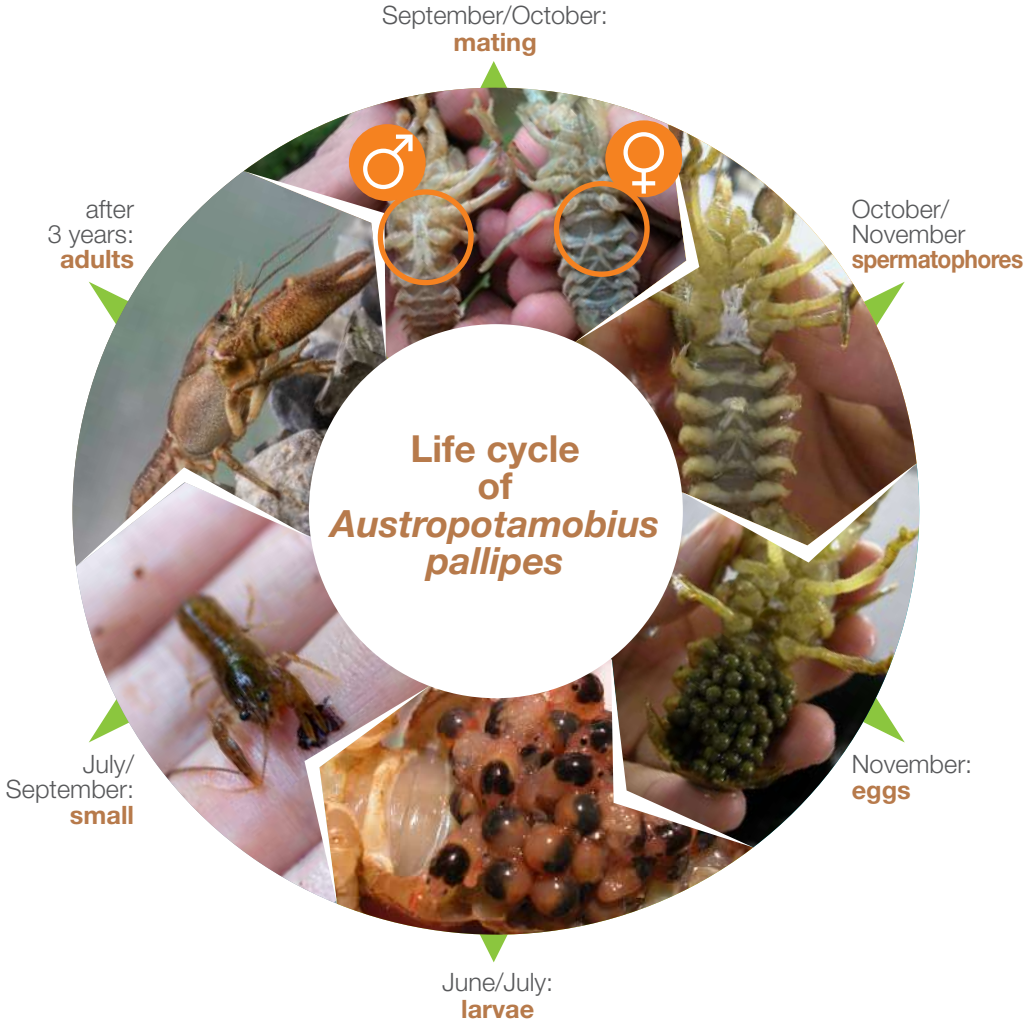
Time to grow up!

The **moulting events**, which allow the body to grow, occur at **different frequencies**: they occur more often in young specimen and are concentrated during the summer. Over the years the crayfish can reach dimensions even greater than 120 mm, with a weight of 70-80 g. Females are smaller, but proportionally have a wider abdomen to contain and protect the eggs.

In the first days of life and after the first moulting, the **larva** hangs with its hooked claws on the maternal abdomen and has a cephalothorax swollen with food reserves. After about a week the first moulting takes place: the larvae begin to feed and move independently, but the mother in case of danger calls them back with alarm pheromones.

A juvenile after first moulting

Newborn larvae protected under their mother's abdomen


September/October:
mating
October/
November
spermatophores
November:
eggs
June/July:
larvae
July/
September:
small
after
3 years:
adults
Life cycle
of
Austropotamobius
pallipes

Who are its enemies

The threats to the crayfish can derive from various factors, and concern for example the quality of its living environment, competition and conflict with other species and the onset of often deadly diseases.

Allochthonous crayfish

The introduction of allochthonous species into a given environment is now recognized as one of the greatest threats to biodiversity globally. In the case of the native crayfish, the introduction and diffusion in water bodies of exotic species is the most important problem. The most widespread allochthonous crayfish species in our territory are the Red Swamp (Louisiana) crayfish *(Procambarus clarkii)* and the spinycheek (American) crayfish *(Orconectes limosus)*, which are progressively replacing the native populations. So far localized in some areas of Italy, *Pacifastacus leniusculus* is another very invasive species, which comes from North America and has already invaded the rivers of much of northern Europe. Its predilection for cold waters makes it potentially very dangerous, because it could colonize those environments still populated by our crayfish and less suitable for other species of allochthonous crayfish.

All the North American crayfish species that can be found in Lombardy are considered invasive alien species of Union interest targeted by EU Reg. 1143/2014 and Legislative Decree 230/2017:

Crayfish distribution in Lombardy

- *Austropotamobius pallipes*
- *Procambarus clarkii*
- *Orconectes limosus*

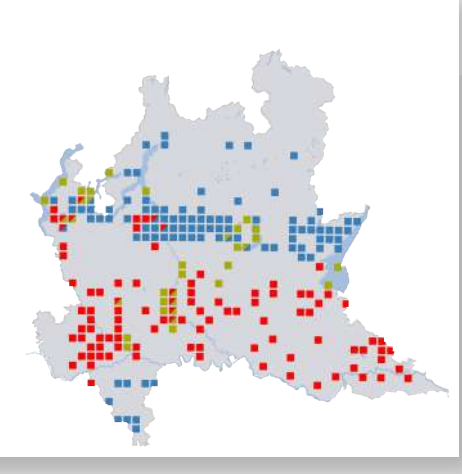
(data from Inland Water Laboratory, University of Pavia)

their marketing, possession and movement are therefore prohibited. The Turkish crayfish *Astacus leptodactylus*, on the contrary, is a European species, but alien to the Italian territory. In Italy at the moment is still not very widespread in nature, while it is widely bred for food.

Among the alien species mentioned above, those that are threatening the future of the indigenous crayfish in Italy are mainly three: *Procambarus clarkii, Orconectes limosus* and *Pacifastacus leniusculus*.

Procambarus clarkii (Girard, 1852), the Louisiana crayfish, is native to the central-southern United States and is the most widespread allochthonous species in Italy, having acclimatized in much of the Northern and Central Italy. The species has rapid growth and high fecundity. These crayfish become sexually mature just a few months after birth; an adult female can produce up to 600 eggs, even twice in the same year and embryonic development, at 22° C, lasts about 2-3 weeks. It prefers warm waters, resisting over 40° C, but also adapts to low winter

P. clarkii, adult specimen, recognizable by its red color



temperatures, taking refuge in the deep holes (40-90 cm) that it digs in the banks and riverbed. It is able to adapt to the most diverse environments and can live in conditions of low dissolved oxygen, breathing with its gills out of the water for several days. Thanks to this characteristic it is able to move from one water body to another. It is an asymptomatic carrier of the “crayfish plague” and, for this reason, is the main vehicle for the spread of the disease.

Orconectes limosus (Rafinesque, 1817), commonly called the American crayfish, is native to the east coast of the United States. It was introduced in Europe in the second half of the 1800s and has spread throughout most of the continent and in several Italian regions. It is a very active and aggressive species: in fact, when captured, it assumes a characteristic attitude with the abdomen folded and the claws extended to touch the tip of the telson. It can live in waters of poor quality, it colonizes streams and canals with medium-low current speed, lakes and ponds, even if heavily polluted. However, its ideal habitat is made up of environments that have a muddy or sandy substratum in which to dig shelters. It is

O. limosus, red spots on the upper part of the abdomen are evident

now found in almost all the lakes, major and minor, of northern Italy. It is an asymptomatic carrier of the “crayfish plague”.

Pacifastacus leniusculus (Dana,1852), the California crayfish, is a species originally distributed between southwestern Canada and the northwestern United States. It is a species that populates different types of environments with running water, and is much more suitable for creating large populations in running and relatively cold waters than other species of alien crayfish.

In Europe it is widespread throughout the territory, while in Italy populations are currently known only between Piedmont and Liguria. In 2017 the species was reported in Switzerland in Lake Maggiore, in the locality of Rivapiana di Minusio. This species is an asymptomatic carrier of the “crayfish plague”, too.

Diseases

Afanomycosis, or **“crayfish plague”**, is the main threat to the native crayfish in Italy. Caused by the oomycete *Aphanomyces astaci*, this pathology is lethal.

The spores penetrate through the exoskeleton and encyst, while the subsequent formation of hyphae causes the death of the crayfish.

P. leniusculus, the lower part of the claws is reddish

A large number of new spores are released from the animal into the water, which remain viable for weeks and can be transported by exotic crayfish, other animals or objects that have come into direct contact with infected water.
The main vector of afanomycosis are the American allochthonous crayfish, whose spread can lead to the extinction of entire populations of *A. pallipes* in a very short time. Another mycosis is the **"crayfish rust"**, caused by a fungus of the genus Fusarium, which causes damage to the gills and muscles. On the outside, the points of infection appear as black-reddish spots, which can degenerate into real lacerations. It has a long course and leads to a fairly modest mortality.
The endoparasitic microsporid protozoan *Thelohania contejeani* is responsible for the **"porcelain disease"**, which causes a degeneration of muscle tissues and a white porcelain color in the ventral part of the abdomen.
Finally, in conditions of poor water quality, the ectoparasites of the genus *Branchiobdella* (leeches) weaken the crayfish, making them more vulnerable to epidemic diseases.

On the right, an A. pallipes specimen affected by the "porcelain disease"

Good practices against the Crayfish Plague

It is essential to:

1) avoid the movement of potentially infected live or dead animals, or contaminated water or equipment;
2) avoid the movement and release of fish and / or water from environments populated by alien crayfish;
3) avoid the release in nature of alien crayfish;
4) carry out a correct disinfection of equipment (nets, buckets, etc.), boots, boats and vehicles in case of subsequent visits to different streams.

The “Guidelines for the containment of alien crayfish species in Lombardy” have useful information for the knowledge of these issues.

Climate change / drought

Small streams in hill areas, which represent the ideal habitat also because they generally present good water quality, are often particularly sensitive due to their low water flow, which decreases greatly in summer. Dry sections or very low flows reduce the vital environments and produce stress to the populations of our crayfish. In addition, the crayfish cannot survive in water courses subject to long periods of drought.

A small stream with low water flow

Reduced flow downstream of a dam

Environment degradation

The native crayfish is particularly sensitive to heavy metal **pollution**, herbicides, pesticides and synthetic fertilizers used in agriculture. The organic pollution caused by urban settlements and livestock farms, in addition to weakening the crayfish, making them more susceptible to diseases, seriously modifies the habitat, because it impoverishes the water of dissolved oxygen and causes the alteration of the macroinvertebrate communities.
Particularly harmful are the **interventions** that modify the morphology of the water bodies: riverbed excavations, rectifications, artificiality of the banks, and dams. In addition to the direct mechanical impact, these interventions lead to variations in the section, depth, current speed and substrate; the result is a drastic decrease of environmental diversity and the disappearance of the refuges, essential for crayfish.

Poaching

Although the native crayfish is protected by European, national and regional regulations, there are still frequent episodes of illegal fishing, which put the last remaining populations at risk of extinction, even in protected areas.

Conservation and monitoring

The activities of LIFE IP GESTIRE 2020 have been developed according to multiple tasks, contributing both directly and indirectly to the conservation of native crayfish. Technical aspects concern, e.g., the assessment of existing populations to verify their consistency, health and conservation status; the breeding of crayfish in reproductive centers; reintroduction or restocking; habitat restoration. There are also activities to raise awareness and disseminate knowledge about the species and its problems, through the training for qualified operators, educational activities dedicated to schools and the organization of meetings for the public. For a greater dissemination of the activities, the project involved 12 management bodies of Natura 2000 sites (listed on page 34), of which 7 were already involved in the previous CRAINat LIFE project.

Crayfish monitoring

The scientific support of LIFE IP GESTIRE 2020 allowed the characterization of the populations and habitats found in the Natura 2000 sites involved in the project. For each of them, the distribution of the native crayfish in the water bodies has been defined, verifying the health of populations and quantifying their consistency using the *Catch per Unit Effort* (CPUE) technique.
Habitat assessment was conducted by analyzing the water physico-chemical parameters and the quality of biological

communities of the watercourses, comparing the characteristics of the environment with the ecological needs of the species, and applying for the former the *"Habitat Assessment"* and *"River Function Index (IFF)"* methods.
Assessment of the species and its habitat is periodically repeated to detect any variations that may highlight risks and threats in the various areas investigated. Aim of the monitoring is also to assess which factors may be decisive in the crayfish density drops.
The environmental investigation allowed on the one hand to identify streams suitable for recolonization and, on the other, degraded streams for which it was possible to define interventions for environmental restoration.
To support repopulation and restocking, genetic characterization of the populations is performed, to allow the activities to be conducted in compliance with the genetic profile already present in the release zones.

Environmental Flow for the crayfish

The LIFE IP GESTIRE 2020 project includes an action to determine the **Ecological Flow** that must be left in rivers and streams in order to protect species of particular conservation interest, such as crayfish. This water quantity varies according to the time of the year, the hydrology of the basin, morphology and habitats, as well as the ecology and life cycles of the target species. The identified flows will be used by Lombardy to regulate dams that operate on water courses with crayfish populations in protected areas.

Reproduction centers in Lombardy

Reproduction center in Tignale

Prabione di Tignale (BS)

ERSAF activated the first reproductive center in Prabione during the LIFE project “Redevelopment of the biocoenosis in Valvestino Corno della Marogna 2” (2004-2007).
It was then expanded and renewed during LIFE project CRAINat, with the construction of the **new hatchery** and a second external pond.
These external structures recreate the habitat of the large pools in streams, so that the crayfish can complete their entire reproductive cycle in a “natural” environment. In this hatchery *Austropotamobius italicus* clade *carsicus* is bred, and used for repopulation of streams in Natura 2000 sites in the eastern part of Lombardy. The water, coming from Rio Acquasinega in the western Gardesana “Forest of

Hatchery inside the reproduction center, Tignale

Lombardy" and from a small adjacent spring, flows continuously to ensure the high oxygenation needed by the crayfish.
Perforated bricks serve as a refuge, while leaves and wood are used to naturalize the ponds and, thus, increase the shelters. At the beginning of the reproductive period, the center hosts a total of about two hundred adult crayfish (140 females and 60 males).

Prim'Alpe di Canzo (CO)

Near Prim'Alpe, in the Corni di Canzo "Forest of Lombardy", the **second breeding center** is active. It is dedicated to the clade carinthiacus of *Austropotamobius italicus*, widespread in the streams of western Lombardy.
The CRAINat project has converted two disused pods which now, used for breeding, house a total of about ninety breeding crayfish (60 females and 30 males) at the beginning of the cycle.
A semi-natural environment has been recreated for the crayfish using branches and leaves.

Reproduction center in Prim'Alpe, Canzo

The release of the new born

Thanks to the information obtained from the monitoring of populations and environments, it is possible to identify suitable sites in which to release the young born, to increase the number of populations (reintroduction) or to strengthen those, already existing, that show critical densities that may be insufficient to guarantee their survival *(restocking)*.

At the chosen site, at least for three consecutive years, the release of **several hundred young crayfish** of about three months of age, born in the reproductive centers, is carried out. This is the best age for release into natural environment, as their dimension allows, compared to younger and smaller subjects, an easier adaptation to the new environment and therefore a greater chance of survival.

The young crayfish, in the years following their release, are then monitored and controlled to follow the adaptation and the state of health - up to the stages of reproductive activity, which indicates the success of the reintroduction.

September: reintroduction of young crayfish in streams

Other project activities

Multifunctional pond

Environmental restoration

It has the aim of improving the habitat status of the native crayfish, thus adequately hosting its populations.
Some examples are the **restoration** of small streams with the **consolidation of the banks**, the removal of debris in some existing **pools** and the creation of new ones, the adaptation or **removal of barriers** that make it difficult crayfish passage, the **planting** of trees and shrubs to increase shading, the construction of **fences** to prevent grazing cattle from entering uncontrolledly in streams or to prevent access to areas where shelters are present.
There are also plans to **eradicate** alien crayfish if their presence is close to and represents a danger for the survival of native crayfish populations.

The multifunctional ponds

These **semi-natural pools**, which host small populations of *A. pallipes*, have numerous functions: they favor the observation of crayfish during environmental education activities, they constitute an excellent refuge to temporarily accommodate crayfish collected from dry streams, pending reintroduction in nature, and represent a potential reserve of juveniles.
Such ponds were created during the LIFE CRAINat project in the WWF Oasis Nature Reserve of Valpredina, in the Montevecchia and

Curone Valley Regional Park and in the Campo dei Fiori Regional Park. An additional pond was built at the Colli di Bergamo Regional Park as part of the LIFE IP GESTIRE 2020.

Crayfish Recovery Groups (GReG)

The crayfish recovery groups are composed by competent people, formed by the LIFE IP GESTIRE 2020 project. They intervene during **emergencies**, such as prolonged periods of drought, or in case of pollutant spills.

In Lombardy there are nine active GReGs managed directly by the managing bodies of the Natura 2000 sites. When necessary, the GReGs are activated according to a rigorous **intervention protocol**, collecting crayfish in difficulty and transferring them to safer contexts for their survival, such as multifunctional ponds, reproduction centers or structures set up for temporary housing. When the environmental conditions have improved, the crayfish can be brought back to the streams of origin or released into other suitable water courses.

Containment of exotic crayfish

Invasive alien species are among the main threats to the survival of the native crayfish, in particular in the lowland area and the foothills of Lombardy.

The exotic species are asymptomatic carriers of the *Aphanomyces astaci* fungus, agent of the “crayfish plague”, which is able to cause, in a short time, the death of entire populations of native crayfish along the contaminated rivers. At the first signs of colonization, it is vital to act promptly, trying to implement the eradication of alien species. If the invasive populations are already firmly established and widespread, it is necessary to intervene with containment actions in the contact areas, limiting as much as possible the loss of suitable environments for the native crayfish.

Trap for P. clarkii

LIFE IP GESTIRE 2020 has created for this purpose a technical tool for operators, the **"Guidelines for the containment of alien crayfish species in Lombardy"** which, together with the **"Action Plan for the conservation of *A. pallipes* in Italy"**, created by previous LIFE CRAINat project, offers a valid support to the management of the conservation activities for the crayfish.
The Guidelines collect the most effective techniques and types of intervention for the Lombardy territory, illustrating the strategies for monitoring and intervention – including the management of alien populations.

Environmental education and dissemination

LIFE IP GESTIRE 2020, for a greater awareness and knowledge about the crayfish, supported the Natura 2000 managing bodies in the drafting of **12 communication plans**, articulated to develop an effective dissemination campaign in each territory, with environmental education proposals aimed at schools and with events, seminars, meetings aimed at the public and visitors to the protected areas.
Supporting the dissemination activities, the project makes available some products in paper format or downloadable from the web.

Educational activity with a primary school

The Protected Areas involved

Adamello Regional Park (BS)

www.parcoadamello.it

The Regional Park, established in 1983, extends from the Tonale Pass to the Crocedomini Pass. The managing body is the Mountain Community of Valle Camonica.

Mountain Community Parco Alto Garda Bresciano (BS)

www.parcoaltogarda.eu

The Park, established in 1989, includes the "Forest of Lombardy" Gardesana occidentale (ERSAF Gargnano - BS, www.ersaf.lombardia.it). Since 2006, the ERSAF center for the reproduction and breeding of crayfish has been active in Prabione di Tignale (BS), consisting of two large external ponds and a hatchery with 12 tanks inside.

Campo dei Fiori Regional Park (VA)

www.parcocampodeifiori.it

Located a few kilometers north of the city of Varese, the Park was established in 1984 and expanded in 2009. It covers about 6,300 hectares on the territory of 17 municipalities and 2 Mountain Communities in the Province of Varese.

Regional Park of the Bergamo Hills (BG)

www.parcocollibergamo.it

The Park, established in 1977, covers an area of about 4,700 hectares and involves 10 municipalities in the Bergamo province.

Monte Barro Regional Park (LC)

www.parcobarro.lombardia.it

The Park, established in 1983, falls within the province of Lecco and has an extension of 665 hectares.

Montevecchia and Curone Valley Regional Park (LC)

www.parcocurone.it

Established in 1983, the Park has an area of approximately 2,350 hectares and falls within the territory of 10 municipalities.

Regional Park of the Orobie Valtellinesi (SO)

www.parcorobievalt.com

Established in 1989, it covers over 44,000 hectares along the Orobic Alps side of the Valtellina.

Spina Verde Regional Park (CO)

www.spinaverde.it

Recognized in 2006 as a natural park, the protected area extends along the hilly area of Como.

Valli del Verbano Mountain Community (VA)

www.vallidelverbano.va.it

Mountain community in the province of Varese, born in 2009 from the merging of the Valcuvia mountain community and the Valli del Luinese mountain community. Several Natura 2000 sites fall within its territory.

Sasso Malascarpa Nature Reserve (CO-LC)

www.parks.it/riserva.sasso.malascarpa • www.ersaf.lombardia.it

The Nature Reserve, managed by ERSAF, extends for 137 hectares and falls partly in the Corni di Canzo “Forest of Lombardy”. The ERSAF crayfish reproduction and breeding center in Prim’Alpe, Canzo (CO) has been active since 2010, equipped with two outdoor ponds.

Funtanì Spring Nature Reserve (BS)

www.sorgentefuntani.eu

The Reserve, located in the Municipality of Vobarno, was established in 1985 and has an extension of 66 hectares.

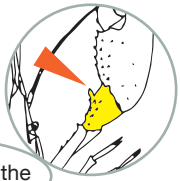
WWF Valpredina Nature Reserve (BG)

www.oasivalpredina.it

It was born in 1983, thanks to a legacy in favor of WWF Italy. It is classified as a partial Natural Reserve of forest and landscape interest and extends over 90 hectares.

Identification key

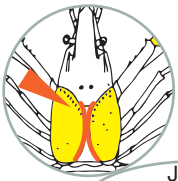
for the crayfish species found in Italy

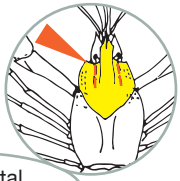


Spur at the inner side of the carpopodite

YES

NO





Joined ridges on the back of the carapace

Post-orbital ridges

YES

NO

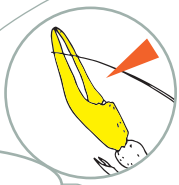
1 pair

2 pairs

Procambarus clarkii

Orconectes limosus

Austropotamobius pallipes

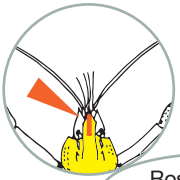


Elongated claws

YES

NO

Astacus leptodactylus



Rostrum with smooth keel

YES

NO

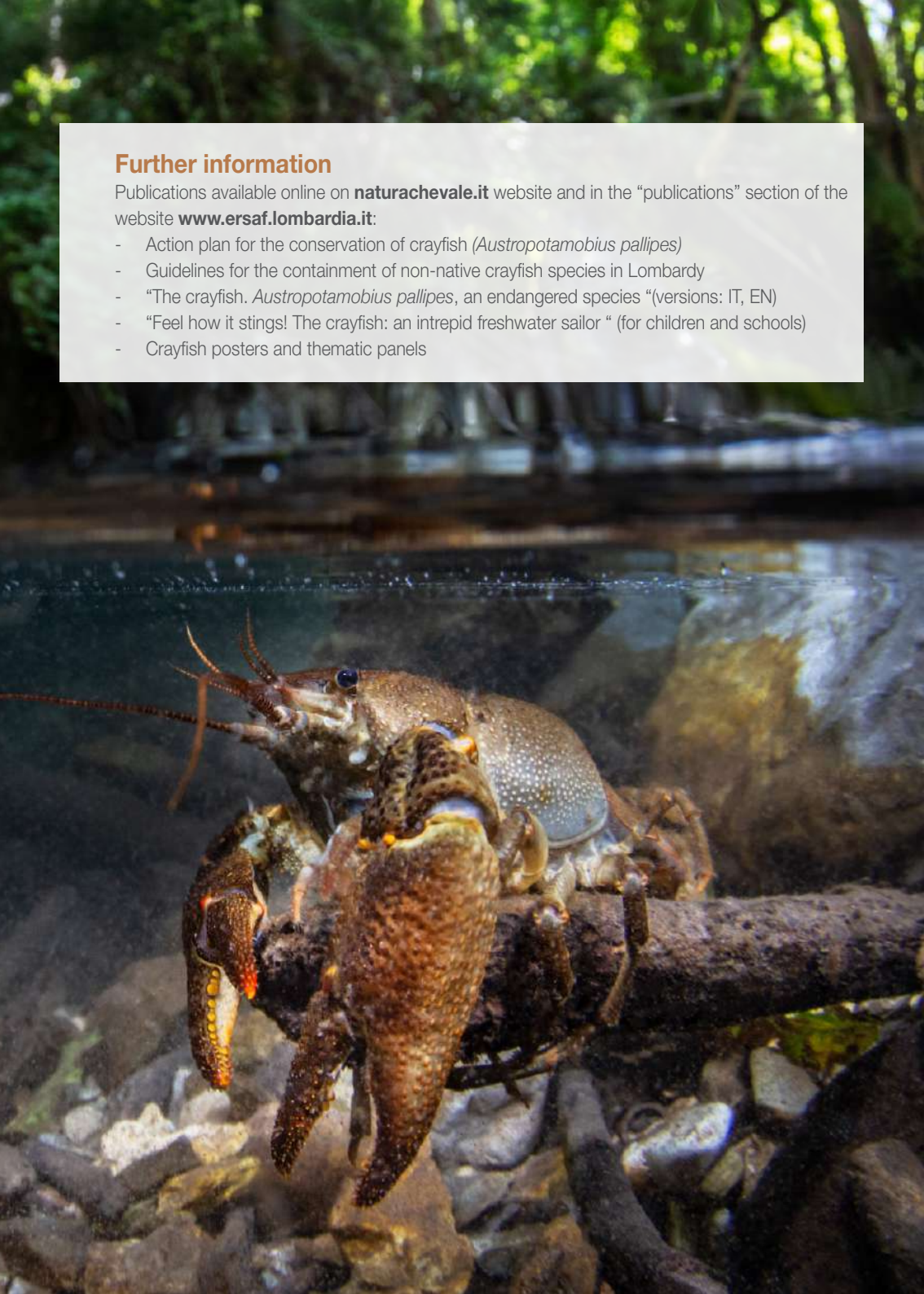
Pacifastacus leniusculus

Astacus astacus

Further information

Publications available online on **naturachevale.it** website and in the “publications” section of the website **www.ersaf.lombardia.it**:

- Action plan for the conservation of crayfish *(Austropotamobius pallipes)*
- Guidelines for the containment of non-native crayfish species in Lombardy
- “The crayfish. *Austropotamobius pallipes*, an endangered species “(versions: IT, EN)
- “Feel how it stings! The crayfish: an intrepid freshwater sailor “ (for children and schools)
- Crayfish posters and thematic panels



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LIFE CRAINat (LIFE08 NAT/IT/000352)

LIFE RARITY (LIFE10 NAT/IT/000239)

LIFE+ TEN (LIFE11NAT/IT/000187)

LIFE CLAW (LIFE18 NAT/IT/000806)

LIFE IP GESTIRE 2020 is an innovative and ambitious European project dedicated **to the long-term conservation of habitats and threatened or rare species in Lombardy.** It contributes to the regional strategy on biodiversity by improving the management of the Natura 2000 sites.

Lombardy Region, project leader, together with partners, ERSAF (Regional Agency for Agricultural and Forest Services), Carabinieri Forestali, FLA (Lombardy Foundation for the Environment), LIPU, WWF, Comunità Ambiente Srl and the co-funder Cariplo Foundation, works with all the managing bodies of the Natura 2000 Network to improve biodiversity in Lombardy. The project's lines of action include the conservation and management of the native crayfish *Austropotamobius pallipes*.

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Integrated strategy for Natura 2000 and biodiversity in Lombardy