Update technical report

Subject:	TECHNICAL UPDATE ON *DELIVERABLE* N. 2– MONITORING AND ACTION PLAN FOR *MICROPTERUS SALMOIDES* LACÉPÈDE, 1802
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Realized by:	ERSE *Ecological Research and Services for the Environment* soc. coop. s.t.p. Via Aurelia sud 291, 55 049 Viareggio (LU) – www.erseambiente.it
activities:	Technical report: specific monitoring protocol and relative action plan towards the IAS *Micropterus salmoides,* aimed at the "evaluation of the threats to biodiversity caused by the IAS and relative action plan for the protection of biodiversity", inside BEST project- *Addressing joint Agro-and Aqua-Biodiversity pressures Enhancing SuSTainable Rural Development*").

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Premise

The present report aims at realizing a management plan concerning the Invasive Alien Species *Micropterus salmoides*, also known as largemouth bass, inside the Natural Regional Park "Fiume Ofanto". This plan is composed by two sections: a monitoring plan, whose goal is to characterize the spatial and quantitative patterns of the distribution of the species on the territory, and a relative action plan. The latter will be strictly related to the monitoring plan, proposing different management strategies depending on the different outcomes

Chapter 1. Introduction

Protecting biodiversity is one of the main and most ambitious goals of our times, requiring a strong cooperation among institutions and local managers. Many anthropic factors represent a great menace in this regard, including the introduction of Invasive Alien Species (IAS), which is considered one of the main threats to biodiversity around the world.

1.1 The Invasive Alien Species

According to Kolar & Lodge (2001), ecologically speaking a species is defined as invasive when able to quickly spread from the introduction point throughout the territory, becoming abundant and eventually dominant in this new area. This is possible thanks to the following characteristics (Life ASAP Project):

1. Resistance to parasites and diseases
2. Adaptation to different environmental conditions, including highly anthropized ones
3. Higher competitiveness in exploiting the resources, compared to the native species (sometimes producing allelopathic substances)
4. Quick growth
5. Short life cycle
6. High reproductive potential
7. High diffusion capabilities, eventual asexual reproduction
8. Adaptation of the life cycle depending on the invaded environments
9. Consociation with human activities
10. Resistance to predators/competitors in the new area

From a regulatory point of view, IAS are defined as those species threating biodiversity and related ecosystem services (CDB 2000, 2002), with negative impacts on economic activities and human health. It is thus important to

distinguish between alien species and invasive species, as a new introduced species may not necessarily be related to a menace for local biodiversity.

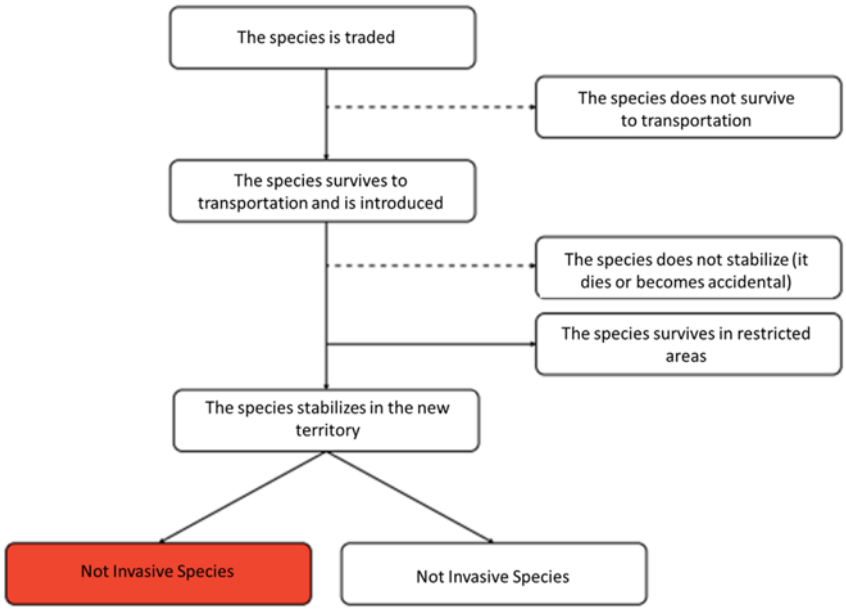

Figure 1: introduction and potential invasion process of an alien species (from lifeasap.eu).

According to the tens rule (Williamson, 1996), around 10% of introduced species survive to the transportation, and 10% of these species stabilize in the new environment. Again, a 10% of these stabilized species may become invasive, giving an overall 0,001% probability of invasion of a new introduced species. Obviously, this "rule" represents an estimation, but still remains a reference point in the study of biological invasions.

1.2 The species *Micropterus salmoides* as an invasive species inside the Natural Regional Park "Fiume Ofanto".

The largemouth bass (*Micropterus salmoides* LACÉPÈDE, 1802) is a freshwater fish belonging to the family of Centrarchidae, native of North America and later introduced in many continents due to farming and fishing activities. The species has a compact body, with a terminal large mouth with many teeth. *M. salmoides* live in freshwater habitats with slow water flow and aquatic plants. Reproduction occurs from march to July, in shallow water, the male digging a depression where the female will lay its eggs, from 1'000 to 10'000. Diet is strictly carnivorous, including fishes, amphibians, reptiles and small mammals, and the species is listed among the 100 worst invasive alien species in the world (Lowe *et al.,* 2000) because of its capability of altering the native biological community.

The Natural Regional Park "Fiume Ofanto" is a protected area since 2007, characterized by the river Ofanto and its valley, strongly marked by the agricultural component. The river basin represents the major source of biodiversity and is the most important river course of the Region, both in terms of length and flow magnitude. Within the boundaries of the Park it is included the Special Area of Conservation (SAC) IT9120011 "Valle Ofanto – Lago di Capacciotti", Protected Area part of the Natura 2000 network according to the Directive 92/43CEE "Habitat". Specifically, the most represented

habitats of the area are the 6220 “Pseudo-steppe with grasses and annuals (Thero-Brachypodietea)” and the 92A0 “*Salix alba* and *Populus alba* galleries”, with typical wetlands plant communities. Also, the Park hosts many faunal species of conservational interest, like the otter (*Lutra lutra*) for the mammals, the european pond turtle (*Emys orbicularis*) and the four-lined snake (*Elaphe quatorlineata*) among the reptiles, the Apennine yellow-bellied toad (*Bombina pachypus*) for the amphibians and many bird species like the moustached warbler (*Acrocephalus melanopogon*), the ferruginous duck (*Aythya nyroca*), or the bittern (*Botaurus stellaris*). Also, there are many native protected species like the Italian bleak (*Alburnus albidus*), the rovella (*Rutilus rubilio,* native to the river basins of Arno and Tevere but declining in all the rest of the country) and introduced invasive species like the common carp (*Ciprinus carpio*), the goldfish (*Carassius auratus*), the black bullhead (*Ameiurus melas*), the pumpkinseed (*Lepomis gibbosus*) and, among the others, the largemouth bass (*Micropterus salmoides*).

In Apulia the largemouth bass has a wide provincial distribution, mostly present in confined basins due to its introduction by anglers, with the major risk of an expansion of its actual range and an increase of its populations. The main objectives of the present plan are the realization of a monitoring and containment plant of the species inside the Natural Regional Park “Fiume Ofanto”, mostly based on **prevention actions** aiming at precluding the expansion of the population of the species inside the Ofanto river basin, as well in other river systems, for which eventual management plans could have non-significant effects.

Table 1: Characterization of invasiveness of *Micropterus salmoides*.

Invasiveness characteristics	Evaluation
Velocity of dispersal	Dispersive
Tendency of prevalence	Medium
Level of threat to biodiversity	Highly competitive
Regional distribution	Distributed at a regional level

Chapter 2. Characteristics of the species

2.1 Morphological description

TAXONOMY

Phylum: Chordata
Class: Actinopterygii
Order: Perciformes
Family: Centrarchidae
Genus: *Micropterus*
Species: *Micropterus salmoides*

Figure 2: taxonomical framework of the largemouth bass (*Micropterus salmoides*): adult (left) and young (right) individual. Within the same species there can be differences in terms of colour, depending on habitat and age. Source: www.cabi.org

The largemouth bass (*Micropterus salmoides* LACÉPÈDE, 1802) is a freshwater fish of the family of Centrarchidae. The body is streamline and robust, covered by small ctenoid scales. The mouth is big, marginal, with many teeth on the jaws, the vomer and the palatine. The lower jaw is longer than the upper one, reaching the rear margin of the eye. The dorsal fin is composed of two sections, with soft or hard rays, the caudal fin is homocercal, with rounded lobes. The colour depends on environmental conditions and on the physiological status of the individual, green on the back and yellow on the abdomen. The lateral sides have a dark, scattered stripe, and the fins vary in colour from brown to yellow/white. The species does not show sexual dimorphism, the adult measuring on average 20-40 cm and rarely reaching 60 cm for 3-4 kg.

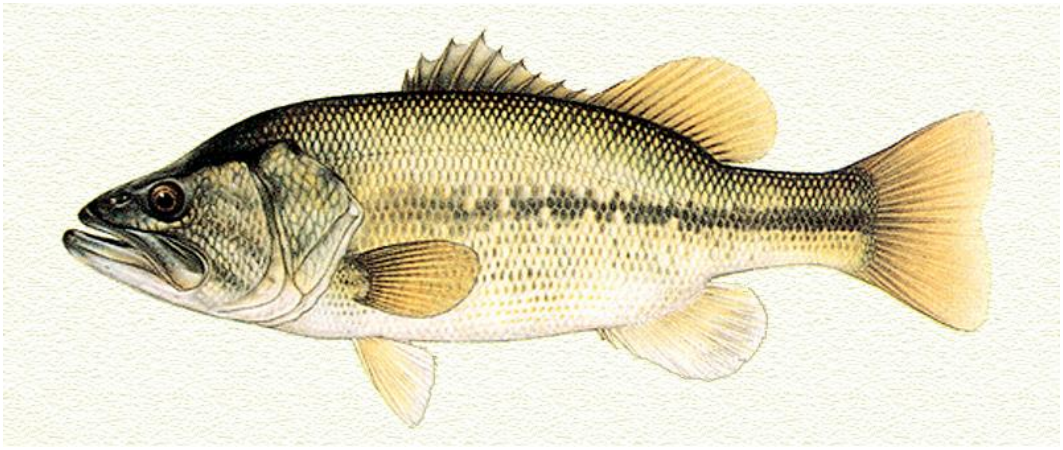

Figure 3: representation of an adult individual of *Micropterus salmoides.* With the dark lateral stripe.

We hereby provide a dichotomous key to easily identify the largemouth bass from other similar species of fish, by non-technical staff

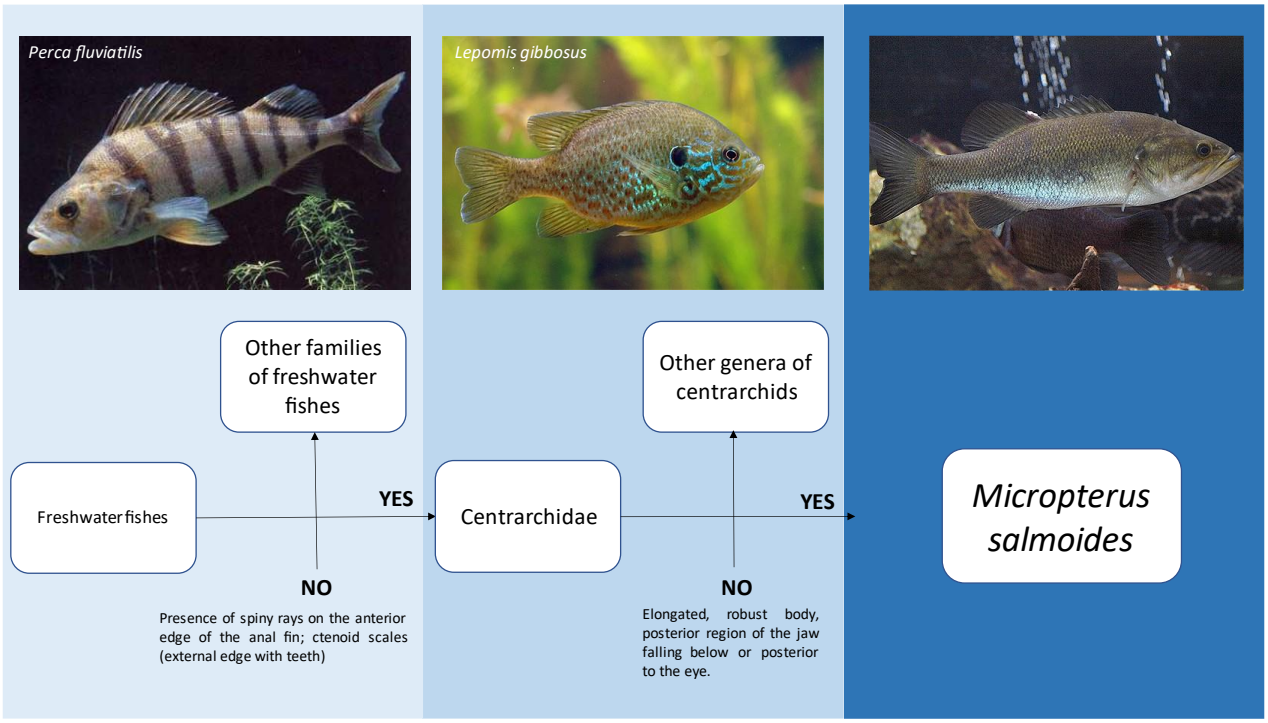

Figure 4: streamlined dichotomous key to the identification of *Micropterus salmoides* (source photos: www.ittiofauna.org).

2.2 Ecological features

The largemouth bass primarily lives in slow flowing waters, usually in parts of the river close to submerged trees or roots. It can colonize lakes, ponds, rivers and channels, preferring the edges along reed beds. Temperature plays a key role for its behaviour, as the species tends to live in deeper waters during the coldest months of the year, migrating upwards during spring. In the warmest moths it lives close to the surface, in shallow waters, close to the vegetation.

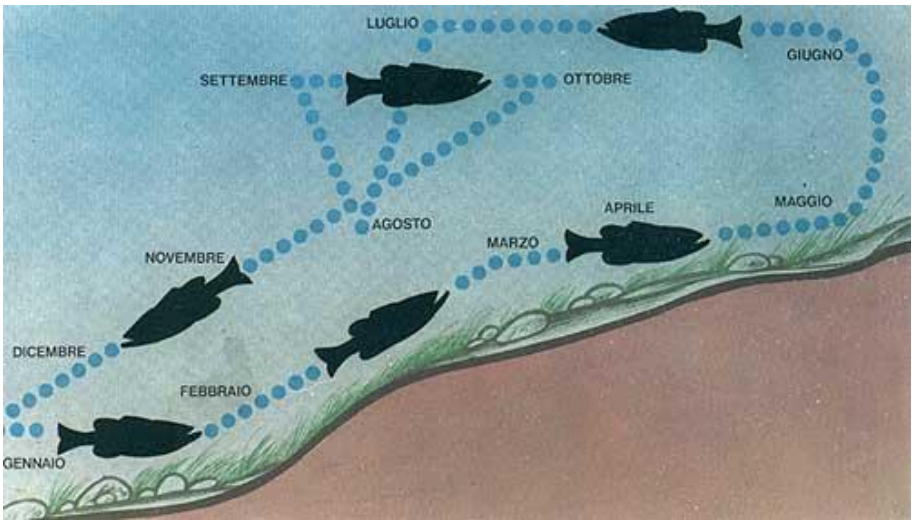

Figure 5: vertical migration of *M. salmoides,* depending on the season.

The species is carnivorous, with an extremely variable diet, feeding on crustaceans, insects, and even vertebrates. Conversely, the species is preyed upon other vertebrates like pond turtles, snakes and fishes, the juveniles also eaten by aquatic insects and other invertebrates, like crustaceans and leeches.

The species may suffer from microbial and viral diseases, and it hosts different species of parasites like *Myxobolus cerebralis.*

2.3 Reproduction and development

The reproductive season spans from early spring to mid-summer, with a peak of activity usually happening in the month of June. Male starts building up the nest when temperature reaches 15-16°C, and eggs deposition will occur between 16-20°C. Spawning occurs in shallow water with muddy bottom, where the male digs a depression (up to 90 cm in diameter. In this depression the female will lay their eggs, in a variable number from 1'000 to 10'000. Eggs and juveniles will be guarded by the male until the abandonment of the nest.

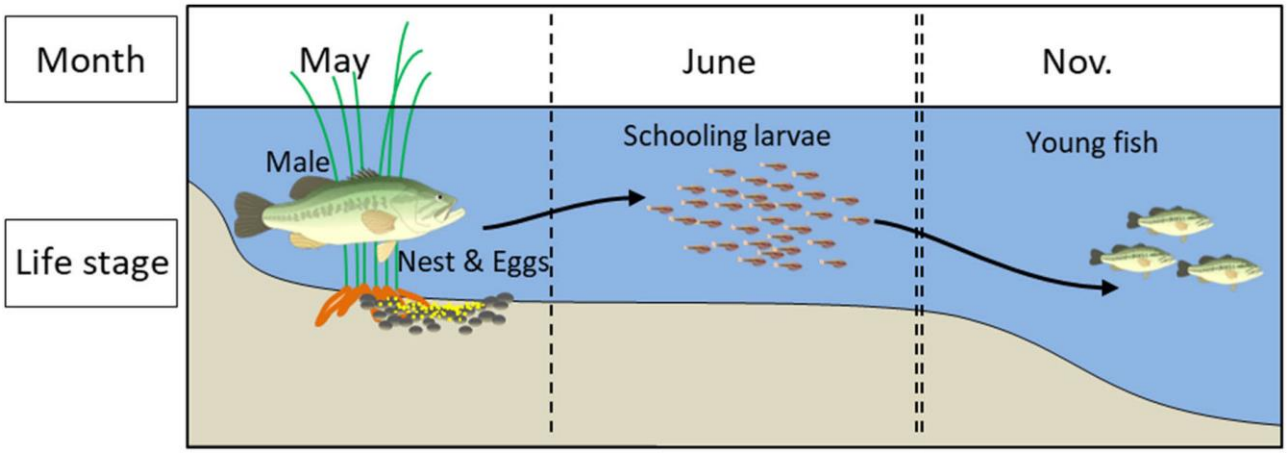

Figure 6: main steps of development of *Micropterus salmoides*, from nest construction till the development of the juvenile fishes. From *Fujimoto et al.*, 2021.

Chapter 3. Distribution and pathways of introduction

3.1 Distribution

The largemouth bass is native to the north American continent, with a range extending from the Great Lakes basins till the Gulf of Mexico, and from the Atlantic ocean till Arizona. Starting from the XIX century, the species has been voluntarily introduced in many other countries by anglers, for fishing activities, and by aquaculture industries, for farming. In the following decades the range of the species has deeply expanded, and now it includes other countries of North America, Europe, Asia, Indonesia, South America, Africa and some Pacific islands.

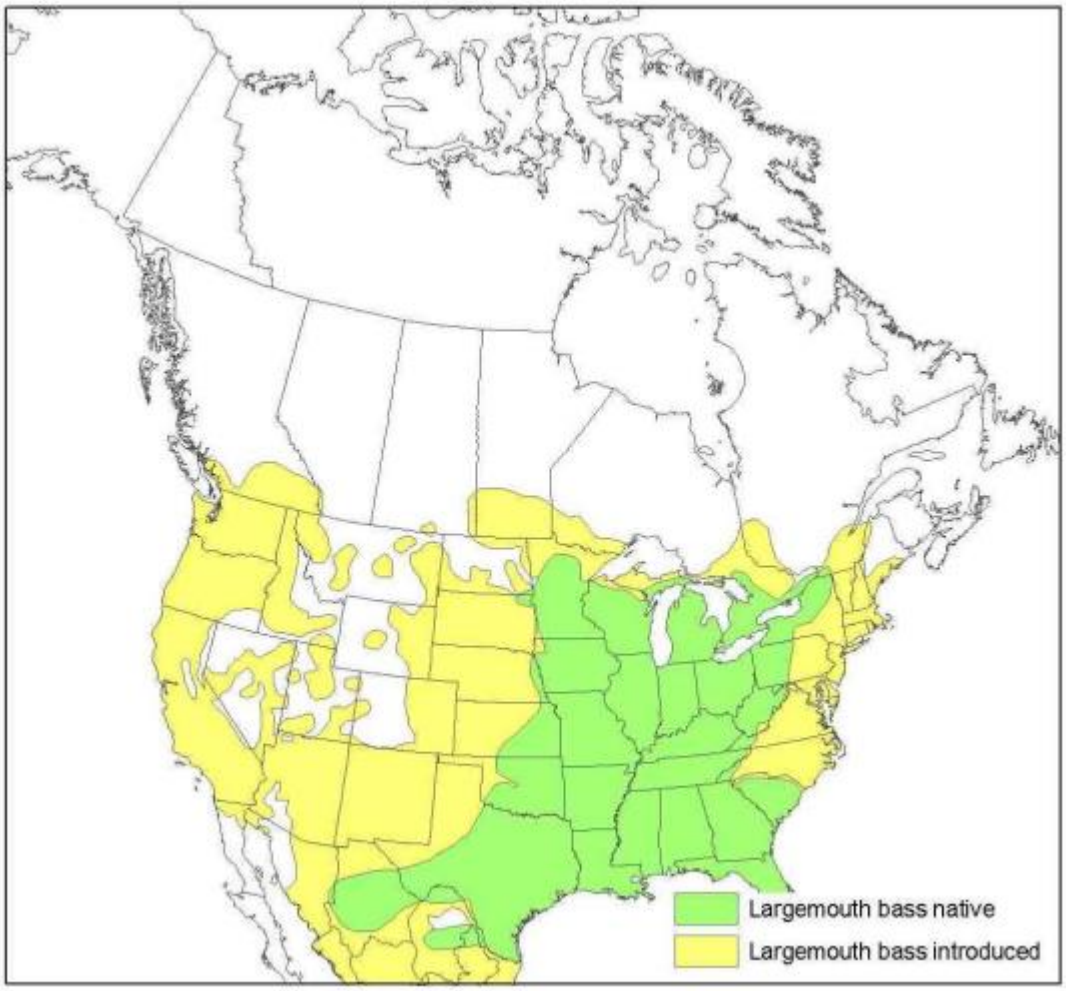

Figure 7: native and introduced range of *Micropterus inside the* North American continent.Source: Brown, T. G., *et al.* 2009.

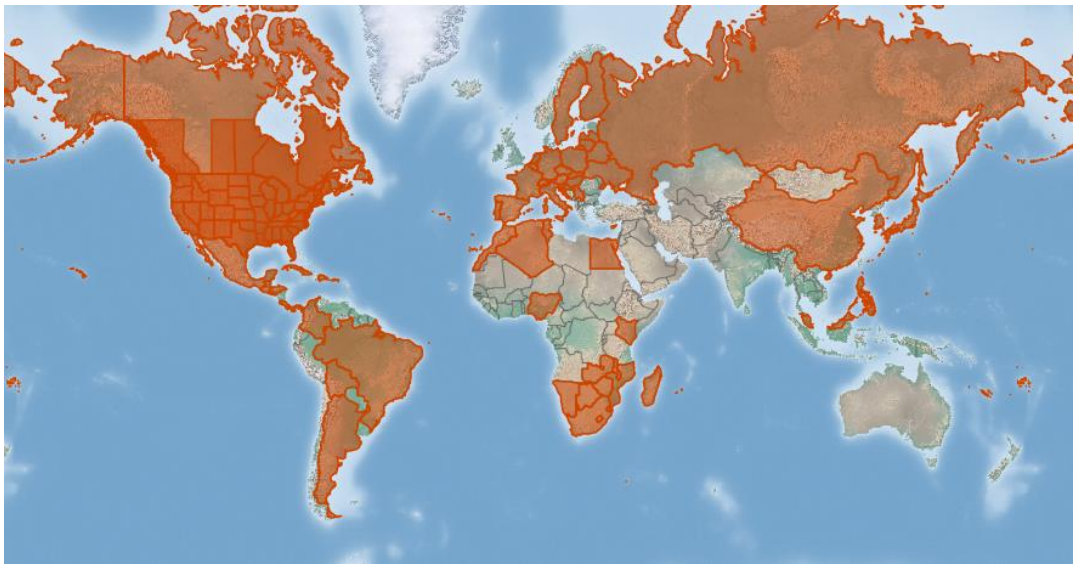

Figure 8: global range of *Micropterus salmoides*. Source: www.cabi.org

In Europe, the first introduction dates back to 1877 in France and Belgium, from native populations of North America, and quickly expanding in the other countries. In Italy the first reported sighting dates to 1897.

Concerning the species range in the Apulian Region, nowadays the presence of *Micropterus salmoides* appears to be well distributed throughout the provinces but semi-confined in artificial ponds and dams, where it has been introduced by anglers. In addition, a specific survey has been proposed to the managers of the local protected areas concerning the presence and distribution of IAS (available at the end of the document, annex A, produced by Puglia Region and ERSE soc. coop. s.t.p.), with no presence of the species in areas of high naturalistic value. Concerning the Natural Regional Park "Fiume Ofanto", the presence of the species has been reported in Locone Lake and Capacciotti Lake, two artificial basins produced by the upstream dams. Given the connection of these basins with the Ofanto river, it appears to be crucial to activate a prevention system aiming at stopping a potential future expansion and colonization of the target species.

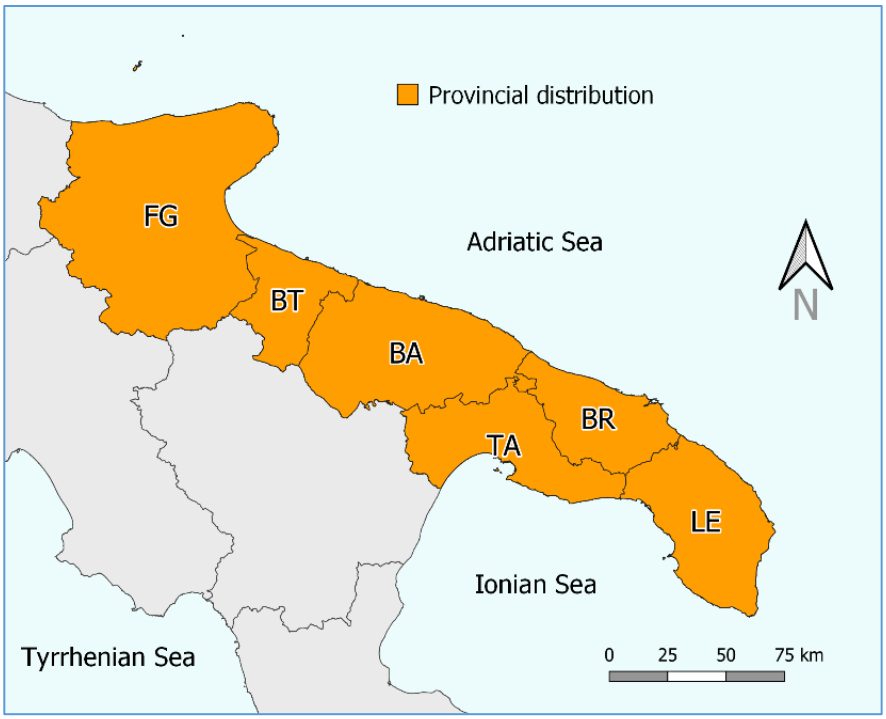

Figure 9: regional distribution of the largemouth bass *Micropterus salmoides,* showing in orange the provincial distribution.

3.2 Pathways of introduction

The current distribution of the largemouth bass has been caused mainly by introductions by anglers, for sport fishing, with the first reports dating back at the end of the XIX century. In other cases, the species has been farmed and commercialized by fish farming facilities, representing in some countries an important fishery resource, like in China.

In addition, the species has been accidentally or voluntarily released by privates, even if the legislation strictly forbids these introductions.

Chapter 4. Impacts

4.1 Ecological impact

The largemouth bass is an extremely ecologically adaptable species, with a broad-spectrum carnivorous diet that negatively impacts the native biological community. Once settled in a new environment, the species may produce a significant impact on the ecosystem and on the other species. In fact, it has been observed that in presence of *M. salmoides* the fish community was composed of younger and smaller individuals, both effects of the destructuration of the local populations. More generally, the presence of the largemouth bass is correlated with a decrease in terms of richness and abundance of native species in the areas of introduction, mainly because of its predatory burden. In some cases, these effects have led towards the local extinction of some species, or towards the change in behaviour of other species, like for *Galaxias zebratus* in South Africa, which shifted its average feeding depth.

Similarly, the presence of the species may alter the composition of the biological community in terms of relative abundance of the species. In Japan, for example, it has been observed a significant decrease of the populations of crustaceans, dragonflies and fishes, correlated with an increase of the macrophytes and of allochthonous crayfish. These effects may occur also in migrating populations, like it happened in South Africa.

More generally, the ecological impact of the largemouth bass may be categorized as highly significant, with effects on the plant and animal communities and through both direct and indirect effects, causing a deep change in terms of richness and abundance of the species, sometimes leading towards local species extinctions. Because of these reasons, the largemouth bass has been listed among the worst 100 alien species in the world.

4.2 Other impacts

There appears to be no negative effect on human health from *Micropterus salmoides*. Economically speaking, on the contrary, there can be some positive impacts on the local community, being the species subjected to fishing and by eventually producing a monetary income for the anglers community (gear purchase, fishing licences, boats rental, etc.) These represents a serious threat, as the eventual removal/containment of the species must overcome the local opposition of the stakeholders, for which the largemouth bass may represent an economic income. It is nevertheless of fundamental importance to communicate the value of this kinds of actions, also due to the fact that ecological impacts will lead to greater economic impacts than those produced by the presence of the species.

Chapter 5. Regulatory aspects

The cornerstone of European legislation, and subsequently the Italian and Regional legislation, is Regulation (EU) n. 1143/2014 of the European Parliament and the Council, of 22 October 2014, laying down provisions to prevent and manage the introduction and spread of invasive alien species. It requires, inter alia, the rapid eradication or control of those species by the Member States.

This decree introduces the prohibition of "introduction, transport, detention (even in confinement), exchange, breeding, reproduction, trade and release into the environment" of the species, for public and private subjects (including individual citizens), and requires eradication, where possible, and control or containment of populations of naturally occurring invasive alien species to prevent further dissemination and mitigate adverse impacts on biodiversity. MiTE (Ministero della Transizione Ecologica) may grant derogations from the prohibitions, subject to authorisation, to botanical and zoological gardens, research institutes and other entities carrying out research or conservation activities ex situ. In exceptional cases, derogation shall be granted on grounds of overriding public interest, including those of an economic or social nature. No derogation shall be granted for trade and release into the environment of species listed in the relative Annexes.

The allochthonous species to which the aforementioned regulations apply were subsequently identified through the establishment of lists of invasive alien species of Union relevance or IAS (Invasive Alien Species), through the Implementing Regulation (EU) of 13 July 2016, Commission Implementing Regulation (EU) 2017/1263 of 12 July 2016, Commission Implementing Regulation (EU) 2019/1262 of 25 July 2016.

Italian legislation transposes Regulation (EU) No. 1143/2014 of the European Parliament and of the Council by means of Legislative Decree 230/2017 of 15 December 2017. The measure establishes rules to prevent, minimize and mitigate the adverse effects on biodiversity caused by the introduction and spread, both deliberate and accidental, of invasive alien species within the European Union, and to minimise and mitigate the impact that these species may have on human health or the economy in Italy. The Ministry of the Environment and the Protection of the Territory and the Sea has moreover published two decrees directly connected to the D.Lgs. 230/2017, that is the Ministerial Decree of 6 March 2020, that regulates the institution and the compilation of the register of the exotic species, and the Ministerial Decree of 29 April 2021, which regulates tariffs for activities provided for by Legislative Decree no. 230/2017.

The Apulia Region, in addition to the provisions of Community and Italian legislation on the problem of alien species, establishes a regional coordination table for the control of invasive alien species, through the Decree 815/2019, of 2 May 2019.

Micropterus salmoides is not listed as an IAS of Union Concern. It is, nevertheless recognized as a deeply impacting species by IUCN, thus listed among the 100 worst invasive species in the world (*Invasive Species Specialist Group*" (ISSG) from IUCN).

Chapter 6. Monitoring plan

Considering the regulatory aspects of the European Union, the monitoring step appears to be a key tool to determine the status of the species, by individuating the essential parameters to determine its presence, distribution, abundance, habitats and future trends.

Data must be collected through standardized methodologies, and these must be combined with information collected through previous monitoring campaigns, scientific literature, sightings, and so on. This chapter will then focus on the monitoring techniques required to reach the aforementioned goals.

6.1 Data collection

Collecting the data through bibliography represents a crucial step, as a high-quality information allows to correctly set up the monitoring protocol, together with regards to the techniques and the time scale. This information itself cannot substitute the direct data collection on the field, but it can optimize the sampling effort, with a positive impact on the economy of the project.

The information is collected from three sources:

- Scientific papers
- *on-line databases*
- Protected area manager survey.

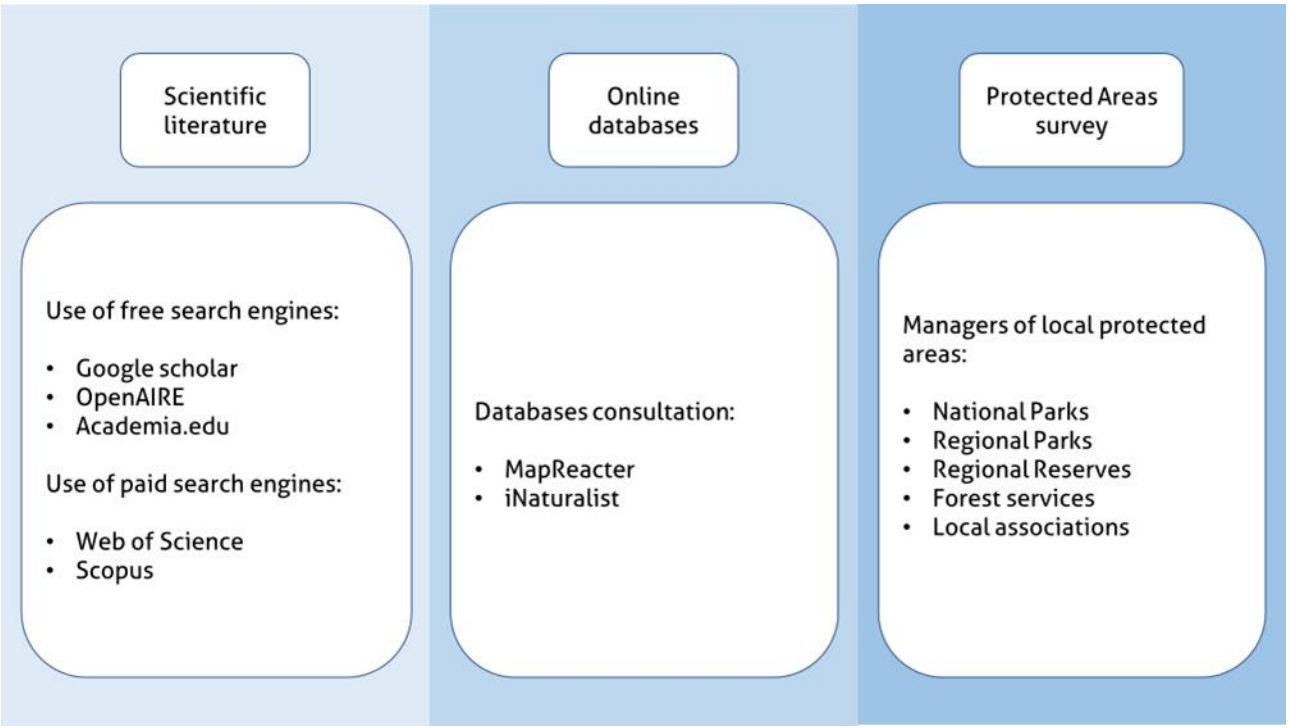

Figure 10: diagram of the sources of the data.

6.1.1 Scientific literature

This source is represented by highly specific scientific journals or technical/informative material, with a major attention to the most authoritative papers (high-impact periodicals, subjected to peer-review; local journals, with high attention to the small-scale patterns). This source may give us information about distribution and abundance of the species. For the present project dedicated search engines have been consulted, as for example *Google Scholar, OpenAIRE, Academia.edu, Web of Science, Scopus*.

6.1.2 Consultation of online databases

This source is represented by online data collectors, like for geographical information (from which we can determine part of the spatial distribution of a species). There may be some biases due to the upload of incomplete/wrong data, especially by people participating to citizen science projects; specific databases periodically review by experts or technical staff. This tool has the advantage of being continuously updated, avoiding the usual gap between the writing of scientific papers and their publication.

For the present project two main databases have been used: *Mapreacter* from ISPRA and *iNaturalist*.

6.1.3 Surveys

Many projects rely on the contribution of citizen science protocols, by gathering information from citizens or stakeholders. For the present project, a specific survey has been proposed to the managers of the local protected areas concerning the presence and distribution of IAS (available at the end of the document, annex A, produced by Puglia Region and ERSE soc. coop. s.t.p.). This tool aimed at evaluating the critical points about the impacts of these species on the habitats and on the other species, together with gathering information on existing projects for this issue.

6.2 Description of the monitoring plan

This chapter defines the specific modalities for carrying out the *Micropterus salmoides* Monitoring Plan within the Ofanto River and the main affluents in the territory of the Regional Natural Park “Ofanto River”.

In order to carry out the monitoring protocol it is appropriate to use a method that makes the most accurate census as possible of the local fish fauna. Methods that have catch limitations due to the size of the animals are not applicable, such as net trapping or line fishing. Therefore, the most effective method is monitoring by electric fishing, or electrofishing. Because of the limited literature available, it is not possible to identify preferential areas in which to carry out activities, and this method must be applied equally both to the main course and to the major affluents of the Ofanto River.

6.2.1 Monitoring through electrofishing

This phase is necessary for the identification and assessment of the presence of *Micropterus salmoides* within the Ofanto River and its main affluents in Apulia, as well as for the assessment of the presence of additional alien fish species. The practice of electrofishing requires adequate preparation both in the technical-scientific field, both in the field of

safety and first aid. This technique acts through the placement of a negative pole or anode (usually consisting of a metal ring applied to a rod) and a positive pole or cathode (usually consisting of an elongated wire with an uncovered tail "mouse tail" or a wire mesh) the development of an electric current in water, and a consequential electric field. Through a positive electroplating phenomenon, the fish are attracted towards the anode. The attracted fish is collected by the operators by means of a hand net. The electric current is produced by a portable generator usually powered by gasoline or other fuels, through a backpack harness and weighing about 25 kg (or eventually fixed to be used from the ground or from a boat, weighing about 80 kg). The generator with harness, the cathode, the anode and the safety system are called in its entirety electrostunner.

This technique, if not carried out with care and knowledge, can be dangerous for both the fauna and operators. The development of an electric current can cause damage to the operators, therefore all clothing and instrumentation must not be conductive, except for the conductive parts of the anode and cathode of the electrostunner itself. Further security measures will be discussed in detail in par. 6.3.

This procedure involves the use of a minimum of four operators with different tasks, which cannot be performed simultaneously for practical and safety reasons. The four main roles to be played during the electrofishing activities of the wadable rivers are explained here:

- Electrostunner transport operator: the task of this operator is to transport the electrostunner with backpack harness. It is also responsible for regulating the activity of the combustion engine according to the need for the development of current, to observe that all activities are carried out safely and to immediately switch off the engine in case of dangerous situations. It is also responsible for the cathode positioning.
- Anode operator: it is responsible for attracting fish through the anode by going to probe the course of the river. On the new generation devices on the anode rod there is a button that opens the electrical circuit; therefore, it is also the one who safely directs the flow of the river current.
- Fish catcher operator: it has the main task of quickly collecting the fishes attracted by the anode. In particularly rich rivers, the presence of two operators may be necessary.
- Transporter and nursering of the fish: the fourth operator has the task of recovering the captured fishes from the net, placing them in buckets and then transporting them in larger tanks or tubs on the site prepared for subsequent analysis. A further task is to take care of the health of the captured fishes by changing and oxygenating the water in the tubs (also by using the portable oxygenator), shading of the containment tanks to prevent any suffering, etc.

Fundamental in this method is the choice of the current. This can be in fact direct current or alternating current. The first is recommended as it causes less damage to the fishes, but requires more powerful and heavy generators to be developed. The current can also be generated by impulses, in fact, if the conductivity of the water is not optimal, this technique can use higher voltages, however causing minor damage to the animals, precisely because of the pulsed nature of the current. Modern electrostunners can adjust the type of current between DC and AC, pulsed or not (with the possibility of adjusting the frequency), voltage and current amperage. Depending on the conductivity of the water, which must be properly measured, all the various parameters of the current must be properly adjusted, to allow optimal sampling without risking to harm the health of the fishes. The current can also be controlled by adjusting the distance between the anode and the cathode.

In the case of electric fishing by boat, the methodologies and the roles of the operators are similar with the appropriate exceptions: the electrostunner is heavier and generates more current, therefore it is fixed and has no harness, the anode is often provided with additional rings or other structures to maximize the development of an electric field capable of attracting fish.

In order to carry out all the catch activities described above, the necessary material is as follows:

- electrostunner complete with cathode, anode and harness, if any
- hand net or screen with insulating material handle
- insulating latex gloves
- boots of rubber or other insulating material
- life jacket
- protective helmet
- buckets or other plastic containers
- GPS device
- plastic tubs or other suitably sized material
- first aid equipment
- probe for physical water parameters
- boat (in the case of non-wadable rivers)
- fire extinguisher (in case of non-wadable rivers).

After the allocation of the captured fishes in special tanks of sufficient size, it is then necessary to proceed to the identification and measurement of the individuals, which must be also photographed. The fishes must be previously narcotized by placing them in a tank with a narcotizing solution. There are several types on the market such as solutions of MS-222, two-methoxyethanol or eugenol. The fish must therefore be weighed with a precision balance, measured on a special instrument called ichthyometer, photographed and then left to recovery in a net placed inside the river, where the current is low. This operation must be repeated for each captured individual. It is reported that the temperature of the fish is much lower than the human one, so the individuals must never be touched with bare hands and all the instrumentation used must be continuously wet to be refreshed. Operations must also be carried out as quickly as possible. The identification can be done in the field or later thanks to the photos, so they must be accurate and detailed. After the capture and collection of biometric data, specimens of *Micropterus salmoides* or other exotic species shall be retained and subsequently killed, while specimens of native fauna shall be released from the pot once they have recovered. In order to avoid spreading of zoonoses, all the material must be disinfected at the end and at the beginning of the activity, and immediately after the use of tools by obviously infected individuals.

In order to carry out all the biometric identification and measurement activities described above, the necessary material is as follows:

- tanks or other containers made of plastic or other material of suitable size
- net with anchorage system to the bank
- fish handling nets
- latex or vinyl gloves for handling fish
- anaesthetic solution
- disinfectant solution
- electronic balance
- ichthyometer
- digital camera

According to ISPRA directives, the monitoring of large rivers must be carried out with a transept every 5-10 km, reason for which the Ofanto river has been divided into sectors of 10 km length, for each of which a transept must be provided. The transepts should be placed roughly in the middle of the sector to avoid overlapping sampling between two successive sectors. Concerning the main affluents of the Ofanto river, one transept for each affluents must be carried out, to be placed preferably within the territory of the Regional Park. In any case, the transept must be positioned at most at a distance of 10 km upstream of the confluence with the Ofanto River. Table 2 shows the entry coordinates of the main affluents of Apulia and their length. As for the Locone and Capacciotti streams, the length of the river branch emissary of the lakes formed by their dams is indicated.

Table 2: main Apulian affluents of the Ofanto River, immigration coordinates and length

Affluents	Coordinate (Lat., Long.)	Type of stream	Name	Length (km)
1	41.05597 N, 15.54373 E	Torrent	Osento	5
2	41.07361 N, 15.54276 E	Walloon	Capo Diavolo	2,5
3	41.09909 N, 15.61202 E	Rio	Salso	3
4	41.11193 N, 15.80072 E	Ditch	Fontana Cerasa	8,5
5	41.16173 N, 15.89988 E	Ditch	Capacciotti	7,5
6	41.19216 N, 15.98189 E	Torrent	Locone	11,5
7	41.19790 N, 15.98046 E	Ditch	Fontanafigura	25
8	41.22873 N, 16.02026 E	Canal	Cavallaro	9,5

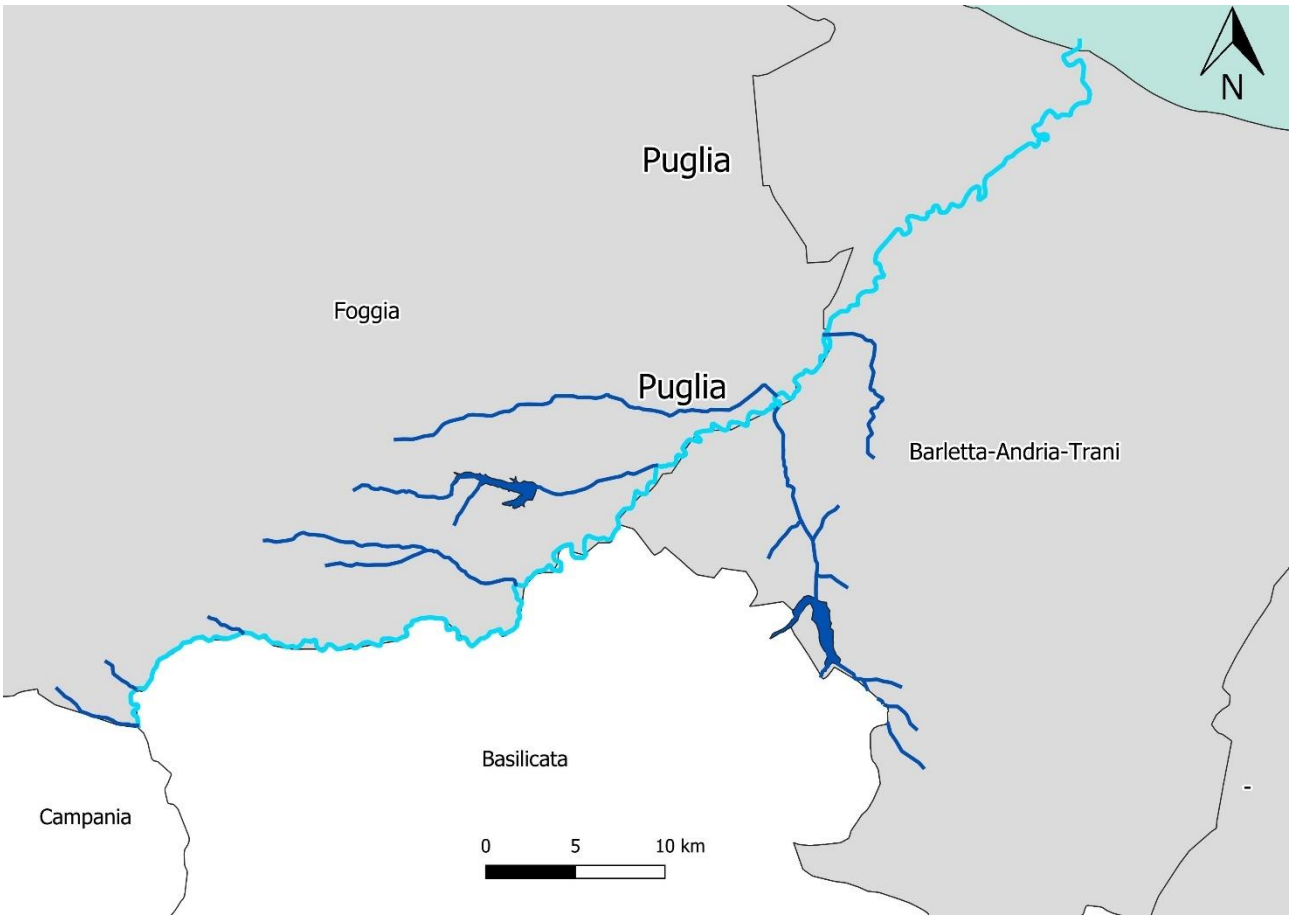

Figure 11: course of the Ofanto river and its main affluents.

The length of the transept must be at least 20 times the width of the river for a minimum of 100 m, if the width is greater than 30 m it may be sufficient to consider transepts of length equal to 10 times the width of the river. This methodology must be applied according to the average width of the river analysed in the corresponding section. The transept must have a zigzag pattern, to contact as many individuals as possible within the river. In case of division into branches of the river, all branches of the river must be monitored. Possible resting or feeding areas, such as shaded areas, areas with vegetation, or generally deeper areas or with slower current, should be monitored more carefully. The trace of the transept must be recorded by means of a special GPS device.

The period to carry out this monitoring must take into account the needs of the native fauna, avoiding the peak of the spawning season or later, when there is a large presence of fry. It is also important to bear in mind that the best time to carry out electrofishing is when the river is lean, since the smaller flow facilitates the activities. Considering these two factors, monitoring should be carried out in late summer-autumn, in the months from July to October. The identification of monitoring sites may be carried out in the preceding months, from January to June.

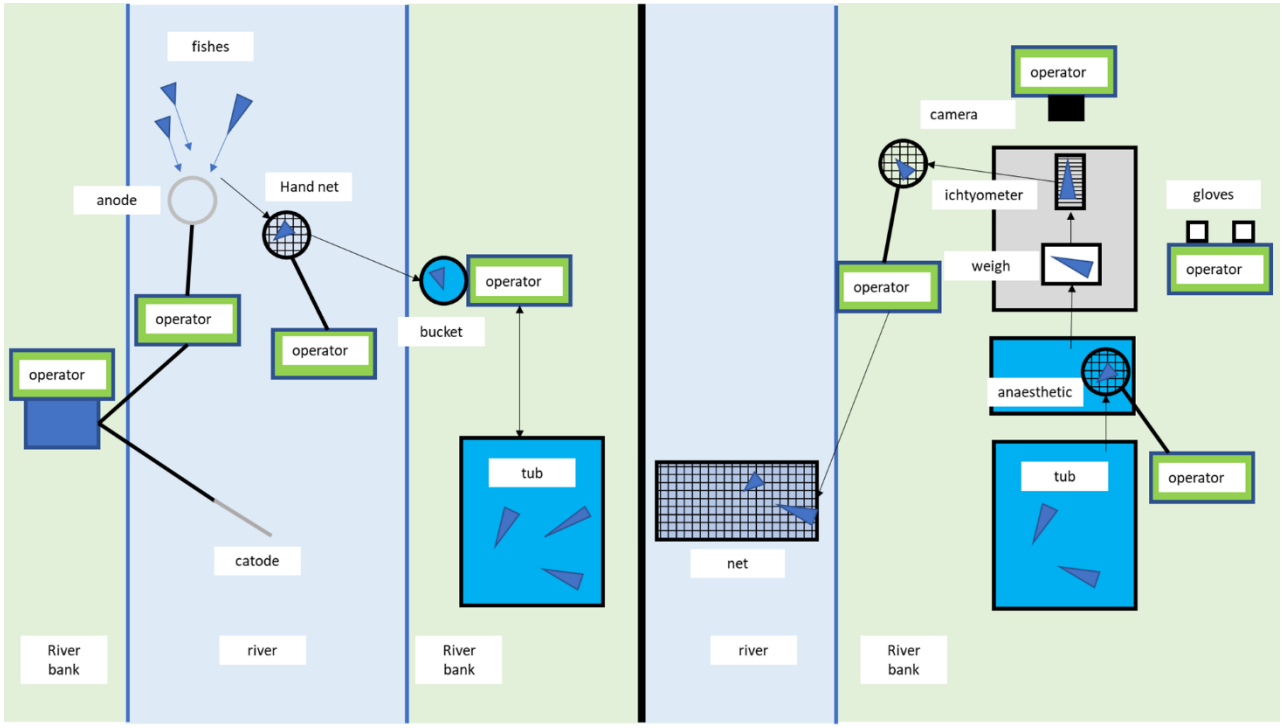

Figure 12: diagram of electrofishing activity, catch phase (right), identification and measurement (left).

6.2.2 Period, frequency of monitoring and intensity of monitoring

- *MONITORING PERIOD* - The monitoring period of *Micropterus salmoides* by electric fishing should take place in the months from July to October (see par. 6.5 on the monitoring time structure), a period established taking into account the ecological needs of native species and the optimal period of river flow, that is, the lean period. The identification of monitoring sites may be carried out in the preceding months from January to June.
- *FREQUENCY OF MONITORING* - The monitoring stretches over a period of 4 months. The monitoring frequency will be functional to the number of transepts, which will be monitored from July to October.
- *MONITORING INTENSITY* - For each of the monitoring areas identified in par. 6.2.1 the following number of transects is identified:
    - Linear transepts within 10 km of the Ofanto river - 11
    - Linear transepts within main affluents of the Ofanto River - 8

Summing up, 19 transepts will be covered over a period of 4 months from July to October.

6.2.3 Data collection by survey cards

For the monitoring protocol, the "Monitoring and Management Protocol" survey card available in Annex B must be filled, in order to carry out an accurate inventory of the presence and the consistency of the population of alien and native fish caught during the sampling activities. The card is divided in two parts, one about the information of the station and

the activities to carry out, and one where to report the biometric data of the captured fish. The card must specifically contain the following information:

Data station:

- River
- Site (also municipality and province)
- Station (GPS track code name)
- Station coordinates (at start point)
- Foreman (name and telephone number)
- Date
- Weather:
    - T (air) (°C)
    - Cloudiness
    - Rain
    - Wind
- Brand-Model Electrostunner
- AN. (shape and diameter)
- CAT. (shape and diameter)
- Active Streambed width (m)
- Wet Streambed width (m)
- Length of section (m)
- Dissolved oxygen (mg/l)
- pH
- Water Temperature (°C)
- Conductivity (µs/cm)
- Visibility of the bottom (yes/no)
- Electrostunner settings:
    - Voltage (V)
    - Amperage (A)
    - Maximum power (Kw peak)
    - Frequency (Hz)
- Start time
- End time
- Mesohabitat (%):
    - Puddles
    - Laminar
    - Streams
    - Scrapers
    - Rapids
    - Hops
    - Waterfall
    - Bars/Islands
- Depth (%):
    - <20 cm
    - 21-40 cm
    - 41-60 cm
    - 61-80 cm
    - > 80 cm
- Shading (percentage)

- Foams/hydrocarbons (yes/no)
- Means in streambed recent (yes/no)
- Means in streambed passed (yes/no)
- Type of substrate (%):
    - Rock
    - Megalithal (>40 cm)
    - Macrolithal (20-40 cm)
    - Mesolithal (6-20 cm)
    - Microlithal (2-6 cm)
    - Gravel (0.2-2 cm)
    - Sand (0.2 cm-6 µm)
    - Clay (<6 µm)
- Type of FLow (%):
    - Waterfall
    - Slides
    - Broken waves
    - Intact waves
    - Chaotic flow
    - Rippled
    - Bubble rise
    - Laminar
    - Still
    - Dry
- Vegetation (% coverage):
    - Filamentous algae
    - Felt algae
    - Submerged macrophytes
    - Emerging macrophytes
    - Live root
- Organic deposit (%):
    - Xylal (large woods)
    - CPOM (rough organic deposit)
    - FPOM (fine organic deposit)
- Non distinguishable end of origin deposit (%)
- Notes

Biometric parameters of captured specimens:

- Species
- Length (cm)
- Weight (g)

Notes

6.2.4 Mapping of monitoring points via GIS

Spatial mapping is an important phase of data collection, in which the information found must be standardized in order to analyse it through GIS spatial processing software. Therefore, the data to be collected during the mapping phase, necessary for the production and processing of spatial geometries, are provided:

- **Location of monitoring sites**: collection of individual linear data representing localized transects at monitoring sites. It will be enough to take via GPS track the site of the transept.

Concerning the information to be included in the table of attributes of the geometries described above, it will be necessary to record the following data:

- **Location** (site).
- **Site ID** (e.g. Micropterus 1).
- **Number of individuals of *Micropterus salmoides***
- **Number of individuals of *Ameiurus Melas***
- **Number of individuals of *Carassius auratus***
- **Number of individuals of *Cyprinus carpio***
- **Number of individuals of *Lepomis gibbosus***
- **Year of sampling.**

Table 3: Example of an attribute table for linear geometries referring to the sampling sites of *Micropterus salmoides*.

ID	Site	ID site	N_Mic	N_Ame	N_Car	N_Cyp	N_Lep	Year
1	Ofanto 1	Micropterus 1	0	8	1	8	10	2022
2	Locone	Micropterus 14	2	5	2	0	2	2022

6.3 Possible risks

Electric fishing, if not done with due care, can be a potentially dangerous practice for both operators and aquatic fauna.

As far as operators are concerned, they should be warned about the risks of electric shock, drowning, falling and breathing of the generator's exhaust gases. For this reason, the clothing must be waterproof and insulating. Moreover, in case of punctures of clothing or accidental embarkation of water, the operator must immediately notify the supervisor and get out of the water. In order to avoid falls or drownings, it is prohibited to carry out electrofishing activities during the floods, as well as it is forbidden to carry it out when raining. The material must always be stored in dry and clean places and must be checked before each electrofishing session, paying particular attention to connections with electrical equipment. As for carriable electrostunners, the operator must always ensure that this does not risk falling into the water or getting wet; therefore, it must always be in a stable position and preferably working from the shore. It is always recommended not to put the hands in the water, and this can only be done in the event of a green light from the supervisor (anode), who verifies the absence of power in the water. Preparation of the operators (at least for those in charge under the national law) on the techniques of cardiac and pulmonary resuscitation (CPR) is required.

On boats used for electric fishing, all metal surfaces, including fuel tanks, tool boxes, generator chassis etc. must be electrically connected together, both in the case of metal hulls and in non-conducting material. In non-metallic hull boats, the whole "energy production unit" shall be protected to avoid contact with appropriate protections. All equipment shall be specially secured to prevent its movement.

Regarding fish stocks, the following procedures shall be implemented:

- the catching of fish by fishing net must be as rapid as possible
- avoid keeping the fish too close to the anode for a long time, especially if in a state of galvanonarcosis (fainting due to electric shock)
- properly regulate the current developed by checking the conductivity of the water with a special probe and observing the behaviour of the fauna, if the fish enter galvanonarcosis even very far from the anode
- use, if effective, direct current
- allocate the fish in suitably large tanks in as cool places as possible, if the operations are particularly long, re-oxygenation may be necessary either with special instruments or with water change
- Do not over-fill the fish transport buckets which need to be emptied frequently
- check the anaesthetic proportions carefully, the fish can suffer damage both from excess substance, both for damage due to movements during measurements
- Do not release fish before a complete recovery

It is also recalled that before carrying out a session of electrofishing the necessary authorizations issued by the competent Regional Administration are required, and the utmost care shall be taken to prevent personnel not involved in the sampling operations from approaching or entering the area under investigation for the duration of the activity.

6.4 Evaluation of the monitoring results

The monitoring of *Micropterus salmoides* within the Regional Natural Park “Ofanto River” will have the main purpose of defining the presence of the species and at the same time to remove individuals from the water body as the first containment action. The results of this extended monitoring protocol will therefore have the function of defining spatial and temporal changes in terms of abundance, age and sex distribution of largemouth bass and other exotic species present in the river, providing a case study for the retrieval of crucial information for the application of management interventions as defined in the next chapter. The Monitoring Plan will also indicate the locations where the management protocol is to be applied, that is, the sections of the Ofanto River or the main affluents where the presence of *Micropterus salmoides* has been found, regardless of the size of the population. The protocol should therefore be repeated over the years on the basis of the results of the evaluation phase, in order to obtain a set of reliable and statistically valid data.

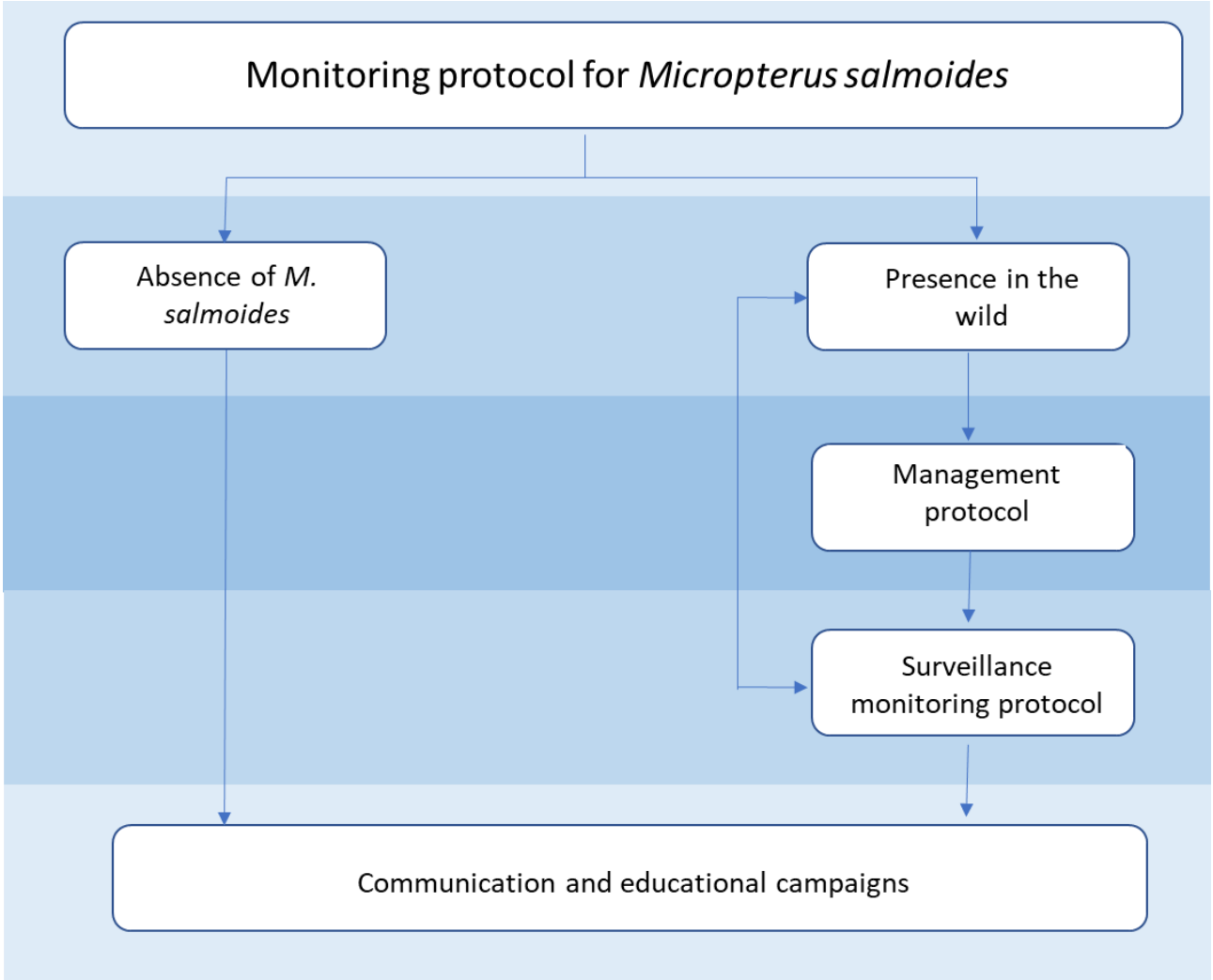

Figure 13: block diagram of evaluation of monitoring outcomes.

6.5 Time structure of monitoring

The diagram on the following page outlines the time sequence in which monitoring is to be carried out for the purposes described above. The proposed time scale is 36 months, for a total of 3 years: based on the results of the final evaluation phase, it is possible to revise the monitoring plan as specified in the previous paragraph for the years following the one under consideration.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Year 1	identification of monitoring sites											
							I monitoring campaign					
											Evaluation	
Year 2	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
							II monitoring campaign					
											Evaluation	
Year 3	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
							III monitoring campaign					
											Evaluation	

Chapter 7. Management plan

7.1 Objective of the management plan

The management of alien species can basically involve two types of action: control or eradication.

The control of an exotic species provides for the periodic removal of individuals of this species from a certain territory, without ever leading to its complete absence. This type of action is effective as long as management activities continue and is therefore recommended for long-term management practices. This type of action can also be carried out in a preventive way, not knowing the degree of invasiveness of the species or the consistency of the exotic population within the identified area.

The eradication of an exotic species from a territory requires the complete removal of all individuals of that species in a single solution (even several times in time, but still included in a single intervention plan). This type of action usually involves time-limited management activities and is therefore recommended where possible. The main limits to eradication activities consist in the difficulties of realization, both in practical and economic terms; therefore, they can be carried out more easily on limited and isolated territories and are strongly correlated with the biology of the species.

In the present case, the Ofanto River basin is too large to plan any likely eradication plans. *Micropterus salmoides* may, however, be subjected to a control protocol, which may be even more effective as a preventive management action. The presence of largemouth bass, in fact, has not been reported directly within the Ofanto River but only in affluent basins of the same. The diffusion of this species within the waters of the Park must therefore be checked before the situation can worsen. The plan also, through its management activities, has the additional objective of controlling and monitoring the main exotic species of fish fauna within the Ofanto River, as well as *Micropterus salmoides*. These species include the European carp (*Cyprinus carpio*). The goldfish (*Carassius auratus*), the black bullhead (*Ameiurus melas*) and the pumpkinseed (*Lepomis gibbosus*). All these species, although occupying different ecological niches, are strongly competitive with the native species of fishes. Thanks to a medium-long term monitoring activity, it is possible to broaden the knowledge of these species within the territory of the Park. In the light of these considerations, the objective of this plan, namely to control the species *Micropterus salmoides*, from the Ofanto river basin, is achievable. It is also possible to control and monitor other exotic fish species within the same territory.

7.2 Preliminary phase

After the capture and collection of biometric data, specimens of *Micropterus salmoides* will have to be subsequently killed, as well as the individuals of other exotic species. The carcasses will then have to be removed as required by EC Regulation No. 1069/2009, in compliance with current health and hygiene regulations. Measures for the removal of such carcases should therefore be organised in advance.

7.3 Containment phase

Similarly to the monitoring phase, the containment phase will involve the direct capture of individuals by electric fishing, as described in par. 6.2.2. The main difference with the first phase will be the sampling effort, which will be intensified by the capture of as many of the target species as possible. Whenever one individual of *Micropterus salmoides* will be identified within a river section, the construction of four more transects will be planned, each placed in a further division of the section every 2 km. The new transepts shall be positioned as far as possible in the centre of the 2 km section, to avoid any overlap of sampling.

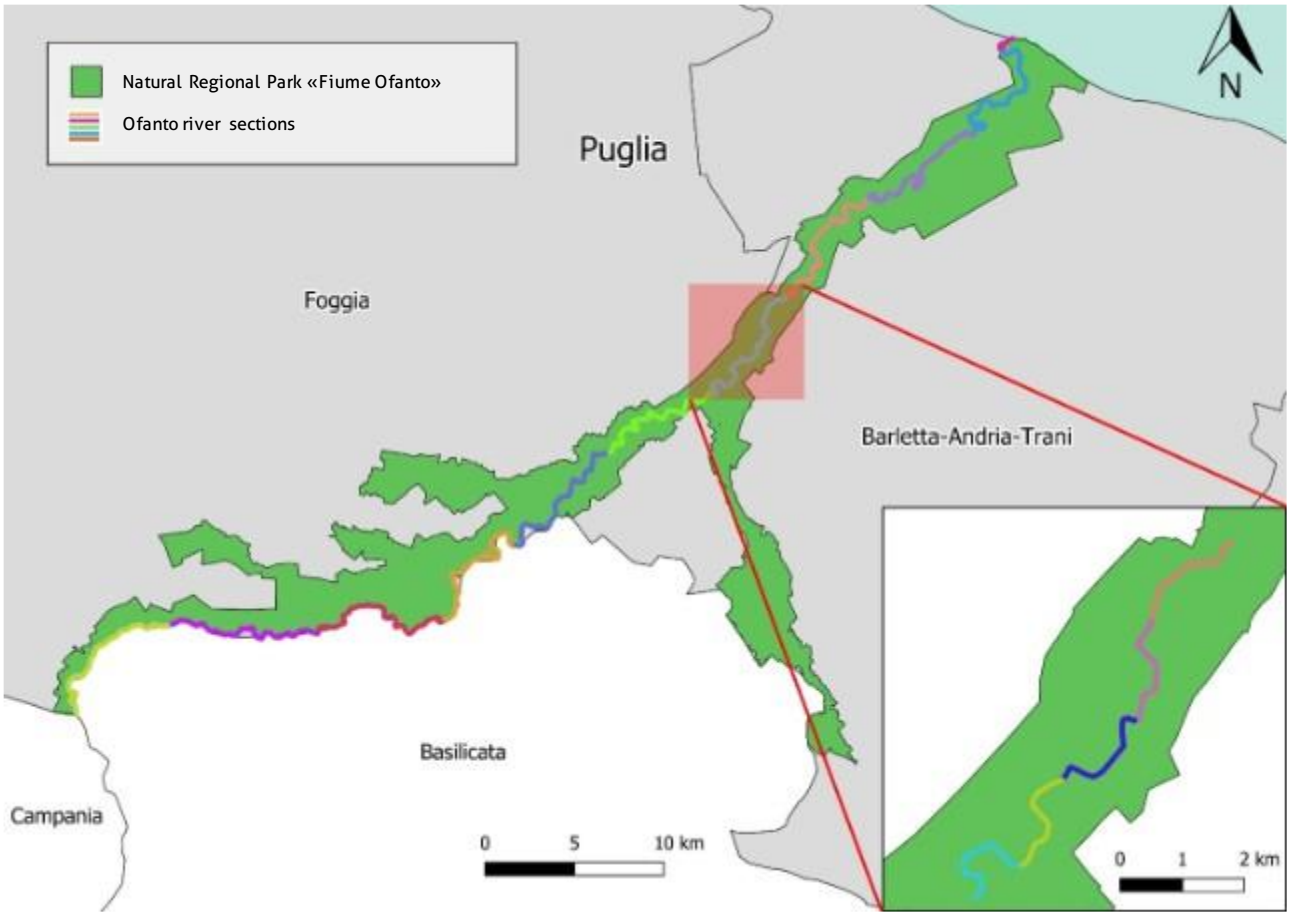

Figure 14: example of dividing sections of the Ofanto River into sections of 10 km and further subdividing into sections of 2 km for implementation of the management plan.

In case of contact of individuals of largemouth bass inside the affluents, further transects proportional to the length of river courses will be carried out, always maintaining the proportion of a transept of electrofishing every 2 km. In the case of affluents longer than 10 km there will be considered only the 10 km stretch prior to the introduction of the branch into the river Ofanto. Table 4 shows the number of additional transepts for each affluent.

Table 4: additional transepts for each branch of the Ofanto River.

Affluents	Type of stream	Name	Additional Transept
1	Torrent	Osento	2
2	Walloon	Capo Diavolo	1
3	Rio	Salso	1
4	Ditch	Fontana Cerasa	4
5	Ditch	Capacciotti	3
6	Torrent	Locone	4
7	Ditch	Fontanafigura	4
8	Canal	Cavallaro	4

All the modalities in terms of safety and good practice of electrofishing are valid also in this situation, therefore also the period of implementation of the management protocol is overlapping, and that is from July to October. The identification of monitoring sites should be carried out in advance, in order to avoid technical problems due to the difficulty of finding the transepts. Being consequential to the monitoring plan, it is therefore advisable not to delay the activities in order not to risk problems of timing of the management plan. It is therefore recommended to begin management activities immediately after the discovery of individuals of *Micropterus salmoides*.

7.3.1 Period, working frequency of containment actions and sampling effort

- *MONITORING PERIOD* - as for the monitoring protocol, the management activities of Micropterus salmoides by electofishing should take place in the months from July to October (see section 7.4 on the monitoring time structure), a period established taking into account the ecological needs of native species and the optimal period of river flow, that is, the lean period. The identification of monitoring sites may be carried out in the preceding months from January to June.
- *MONITORING FREQUENCY* - The monitoring aims at developing the activities over a period of 4 months. The monitoring frequency will be functional to the number of transepts, which will be monitored overall in the months from July to October.
- *MONITORING INTENSITY* - The number of transepts varies according to the number of sites where there is the presence of *Micropterus salmoides*. As for the 10 km stretches of the Ofanto River, there will eventually be produced four further transects for the management of the species. As for the various affluents of Ofanto river, further transects are planned according to Table 4.

Summing up, in total there will be a maximum of 78 transepts, to be covered over 4 months from July to October. Not being documented such a wide diffusion of the species, this number is however widely overestimated. The exact number of transepts in which to apply the protocol is determined by the results of the monitoring referred to in the previous section; given the incipient status of the colonization of the species in the Ofanto basin, it is likely that these transepts represent only a fraction of the total indicated.

7.3.2 Data collection by survey cards

As for the monitoring protocol, the survey card "Monitoring and Management Protocol" must be filled in, available in Annex B, in order to contribute to an accurate inventory of the presence and size of the alien and native fish populations captured during the sampling activities. The data to be entered in the form are the same as described in par. 6.2.3.

7.3.3 Mapping of monitoring points via GIS

Spatial mapping is an important phase of data collection, in which the information found must be standardized in order to be able to analyse it through GIS spatial processing software. Therefore, the data to be collected during the mapping phase, necessary for the production and processing of spatial geometries, are provided:

- **Location of monitoring sites**: collection of individual linear data representing localized transects at monitoring sites. It will be enough to take via GPS track the site of the transept.

Concerning the information to be included in the table of attributes of the geometries described above, it will be necessary to record the following data:

- **Location** (site/is expected to add a letter to the section of the Ofanto river or affluents).
- **Site ID** (e.g. Micropterus 1).
- **Number of individuals of *Micropterus salmoides***
- **Number of individuals of *Ameiurus Melas***
- **Number of individuals of *Carassius auratus***
- **Number of individuals of *Cyprinus carpio***
- **Number of individuals of *Lepomis gibbosus***
- **Year of sampling.**

Table 5: example of an attribute table for linear geometries referring to the sampling sites of *Micropterus salmoides*.

ID	Site	ID site	N_Mic	N_Ame	N_Car	N_Cyp	N_Lep	Anno
1	Ofanto 2c	Micropterus 2c	3	2	0	5	0	2022
2	Ofanto 3a	Micropterus 3a	2	5	0	1	9	2022

7.4 Temporal structure of the containment plan

The following diagram shows the time sequence in which the containment campaigns are to be carried out for the purposes described above. The proposed time scale is 36 months, for a total of 3 years: at the end of each year, depending on the results of the final evaluation phase of the monitoring plan (winter months: see the relevant paragraph for more details) the need to continue with the containment plan for the following year should be assessed (see paragraphs below). This schematization represents a structured calendar on a catch frequency on a monthly basis.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Year 1	identification of monitoring sites											
							I management campaign					
											Evaluation	
Year 2	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
							II management campaign					
											Evaluation	
Year 3	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
							III management campaign					
											Evaluation	

By overlapping the monitoring phase with the containment phase, the timing of the activities can be summarized through the following Gantt diagram (in yellow the containment campaigns, in orange the monitoring campaigns):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dic
Year 1	identification of monitoring sites											
							I monitoring campaign					
							I management campaign					
											Evaluation	
Year 2	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dic
							II monitoring campaign					
							II management campaign					
											Evaluation	
Year 3	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dic
							III monitoring campaign					
							III management campaign					
											Evaluation	

7.5 Management of captured individuals and disposal of carcasses

In the case of capture of individuals of *Micropterus salmoides* or other exotic species, euthanasia and carcass disposal should be used. In the latter case, the carcasses must be removed as required by EC Regulation No. 1069/2009, in compliance with current health and hygiene regulations. These operations should be carried out by veterinary medical staff, through the implementation of techniques aimed at minimising the suffering of animals.

In particular, arrangements for the most sensitive steps in the disposal of carcasses should be agreed with the local health authorities, such as transport, holding at any temporary storage site and identifying the most appropriate methods of disposal.

7.6 Personnel employed

The implementation of this management plan requires the presence of an appropriately trained technical and operational staff, who can carry out the functions of coordination, control and performance of activities on the ground.

7.6.1 Coordination team

The first phase will be the technical-operational coordination regarding the organization of work, the timing of activities, the acquisition and management of equipment and support for field activities, both for the monitoring plan and the management actions. We recommend a staff of at least two people, whose main tasks can be summarized as below:

- Planning the detailed calendar of activities.
- Research and organization of personnel involved during the operational phase (see next paragraph).
- Identification of sampling sites.
- Equipment set-up and retrieval (electrofishing equipment, see par. 6.2.3).
- Data collection and analysis of the monitoring and management phases through capture.

7.6.2 Operations team

In this second phase, the staff involved will have the main task of dealing with the operational phase in the field, both regarding the monitoring plan and the management interventions. There should be an adequate number of operators to ensure that monitoring and management actions are carried out in order to cover all the necessary shifts in the planned monitoring and containment campaigns.

The monitoring phase will include a campaign to be held between July and October, which will involve 19 electro-fishing transepts. As already specified electrofishing activities must be carried out by a team of at least four people, adequately trained in the recognition of fish species and the activities and risks of electric fishing, therefore highly professional staff is required. Therefore, 10 working days are estimated to prevent an activity of two transects per day.

During the management phase a number of transects proportional to the number of traits with the presence of *Micropterus salmoides* will be generated; therefore an exhaustive quantification is currently not calculable. The staff

assigned to the monitoring activities will have the skills to carry out the management activities, so it is possible that the activities of the two phases are carried out by the same team.

It is also reported that a team should be deployed, both during the monitoring and during the management phase, to remove the carcasses of the captured alien species. A technical external company can eventually carry out this activity.

7.7 Estimates of implementation costs

This paragraph provides estimates of implementation costs, divided by year and by operational phase, which refer to the modalities described in the previous paragraphs. The estimated fees and costs shall include operators' costs, expenses related to the use of vehicles and the cost of the material to be purchased, and shall be based on median values derived from national market analysis; it is therefore likely that they will reveal to be cheaper during the implementation phase of the design, where there will be the acquisition of actual cost estimates formulated by local operators and/ or selected through appropriate administrative procedures (which may include, among the selection criteria, a reduction in the estimated cost base). In addition, the expected costs will be optimised according to the further refining of the monitoring/management plan in the light of the actual territorial conditions at the time of application of the plan (e.g. the possibility of reducing the number of operators and/or exits because of a more easily practicable environmental context than the one estimated in this policy document). In order to facilitate such revisions, the unit cost (day/man, daily expenditure, etc.) is provided for each cost item, which can be used in recalculating the expenditure balance against the new planned effort.

The estimates provided here are to be considered inclusive of all the estimated expenses for the implementation of the Plan, not taking into account any coverage of these by the Managing Authorities, with resources already at their disposal (internal staff, agreements/contracts with local businesses, economic operations, etc.). These resources may, if necessary, be budgeted as co-financed components of the project, in order to request specific funds to carry out the project.

The effort required to carry out the containment phase of *Micropterus salmoides* is closely linked to the results derived from the monitoring phase of the specimens of *Micropterus salmoides*, thus making also the implementation costs highly variable. The table shows the estimated maximum and minimum costs, taking into account this variability.

As for the disposal of carcasses, it is estimated a cost of 123.97 € plus VAT up to 10kg of material, adding 8.50 € /kg for each additional kilogram (source: Protected Marine Area “Torre Guaceto”).

	Team	Type of work	Cost operators (per day)	Means	Cost per day	Minimum days	Maximum days	Estimated minimum	Estimated maximum
Year 1	coordination team	coordination	500 €	/	500 €	15	15	7.500 €	7.500 €
							TOT. TEAM	**7.500 €**	**7.500 €**
	coordination team	Monitoring phase	1.100 €	/	1.100 €	6	6	6.600 €	6.600 €
	coordination team	Phase of monitoring	1.300 €	200 €	1.500 €	4	4	6.000 €	6.000 €
	coordination team	Containment phase	1.100 €	/	1.100 €	3	2	3.300 €	2.200 €
	coordination team	Phase of containment	1.300 €	200 €	1.500 €	2	1	3.000 €	1.500 €
							TOT. TEAM	**18.900 €**	**16.300 €**
							TOT. ANNUAL	**26.400 €**	**23.800 €**
Year 2	Team	Type of work	Cost operators (per day)	Means	Cost per day	Minimum days	Maximum days	Estimated minimum	Estimated maximum
	coordination team	coordination	500 €		500 €		10	5.000 €	5.000 €
							TOT. TEAM	**5.000 €**	**5.000 €**
	coordination team	Monitoring phase	1.100 €	/	1.100 €	6	6	6.600 €	6.600 €
	coordination team	Phase of monitoring	1.300 €	200 €	1.500 €	4	4	6.000 €	6.000 €
	coordination team	Containment phase	1.100 €	/	1.100 €	4	2	4.400 €	2.200 €
	coordination team	Phase of containment	1.300 €	200 €	1.500 €	3	1	4.500 €	1.500 €
							TOT. TEAM	**21.500 €**	**16.300 €**
							TOT. ANNUAL	**26.500 €**	**21.300 €**
Year 3	Team	Type of work	Cost operators (per day)	Means	Cost per day	Minimum days	Maximum days	Estimated minimum	Estimated maximum
	coordination team	coordination	500 €		500 €		15	7.500 €	7.500 €
							TOT. TEAM	**7.500 €**	**7.500 €**
	coordination team	Monitoring phase	1.100 €	/	1.100 €	6	6	6.600 €	6.600 €
	coordination team	Phase of monitoring	1.300 €	200 €	1.500 €	4	4	6.000 €	6.000 €
	coordination team	Containment phase	1.100 €	/	1.100 €	5	2	5.500 €	2.200 €
	coordination team	Phase of containment	1.300 €	200 €	1.500 €	3	2	4.500 €	3.000 €
							TOT. TEAM	**22.600 €**	**17.800 €**
							TOT. ANNUAL	**30.100 €**	**25.300 €**
							TOT. PROJECT	**83.000 €**	**70.400 €**

7.8 Possible risks

As already mentioned, the activity of electric fishing if not carried out with due attention can be a potentially dangerous practice both for operators and for the aquatic fauna.

See Section 6.3 for details of this issue and best practices to mitigate these risks.

7.9 Monitoring the progress of the intervention and future actions

The management plan, if correctly applied, should keep the number of individuals of *Micropterus salmoides* below the guard values, ensuring the existence of a population whose impact is significantly lower or zero than the current situation and preventing its further expansion.

Depending on the outcome of this plan, there are two possible scenarios, summarised below:

- The population is not found within the Regional Natural Park "Ofanto River". Being a preventive monitoring plan of largemouth bass, this situation is possible and desirable. By maintaining the monitoring protocol, it will be possible to identify a possible ingression within the river and then act promptly before the further spread of the species may cause damage to local biodiversity.
- Population abundance decreases significantly over the years: The catch effort applied for the plan is functional to its objectives and must be maintained as an effective containment strategy to limit the impacts of the species on the local ecosystem and biodiversity. The individuals or the carcasses must be disposed of in accordance with the regulations in force, as described in par. 7.5.
- The population remains constant or even undergoes a demographic increase: the catch effort applied to the plan is not sufficient and is poorly or not significant in its objective of reducing the number of individuals. It will therefore be necessary to increase the catch effort until a significant decrease in the population is observed. Individuals or carcasses must be redirected/disposed of in accordance with current legislation, as described in par. 7.5.

It is important to remember how such variations of the populations can be found also for the other exotic species captured during the monitoring and management activities, that is the European carp (*Ciprinus carpio*), the goldfish (*Carassius auratus*), the black bullhead (*Ameiurus melas*) and the pumpkinseed (*Lepomis gibbosus*). Depending on the size of the populations of these species or the fluctuations of concern for native fish fauna, additional specific management plans may be promoted. In any case, the communication to the regional authorities of the presence and consistency of these populations is essential for a larger scale management.

These actions must be related to prevention and communication strategies described in the next chapter.

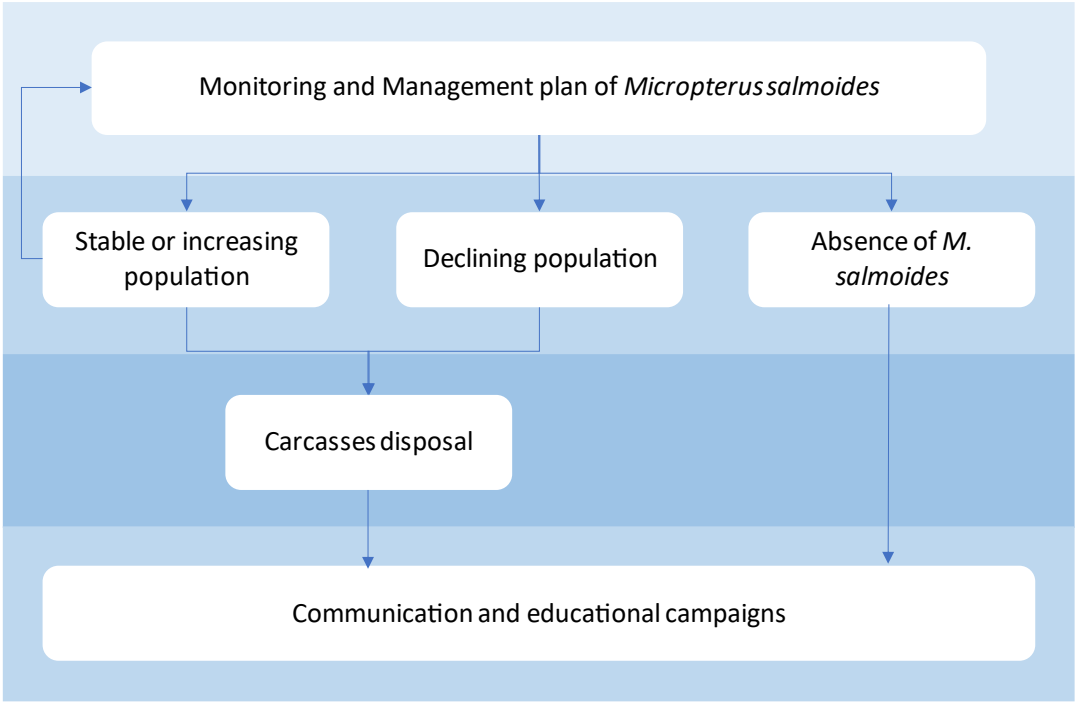

Figure 15: Block diagram of future actions.

Chapter 8. Prevention and communication strategies

This chapter contains the main prevention and communication strategies to be adopted regarding the invasiveness of the species *Micropterus salmoides* and which are considered scientifically effective to prevent its expansion. Specifically, for this Plan, the actions are targeted for the Ofanto river basin, but the measures identified can be extended in different spatial contexts where necessary. Prevention and communication strategies include several fronts of action, represented in the following chapters:

8.1 Prevention as a strategy to contrast invasive species

The introduction of alien species is one of the main causes of global biodiversity loss. In the European Union alone, 12,000 alien species have been identified, of which 10-15% are invasive. The cost in ecological and economic terms is constantly increasing, with hundreds of species extinct globally due to the introduction of exotic species and many other endangered species. Once an invasive species is introduced into a new territory, its possible containment requires a constant effort from the point of view of human and economic resources that the authorities and administrations can hardly take charge of. In addition, eradication projects are often not feasible and, where possible (usually in small contexts), the effort is even more costly and requires constant monitoring to avoid future recolonisation. From this point of view, prevention is a crucial tool that is too often underestimated, as it aims to avoid future spill overs of present populations as a result of specific containment or eradication projects. By adapting the concept of prevention in medicine, we can identify three types of prevention depending on the presence of the invasive species on the territory and the manifestation of its impacts:

- *PRIMARY PREVENTION* - absence of species, absence of impacts. The species is not yet present in the territory, and consequently there are no impacts attributable to this. This phase represents the optimal condition, in which, however, it is essential to activate those general alert systems aimed at monitoring the presence of the species in the surrounding areas and potential vectors for future introduction.
- *SECONDARY PREVENTION* - presence of the species, absence of impacts. The species is detected on the territory, but the impacts are not yet visible or measurable. This may be the case of the presence of a non-invasive alien species, whose abundance on the territory will decrease or will be linked to continuous introduction by man (e.g. cultivated species) or, worse, may be the case of the presence of an invasive species in its incipient colonization phase. This phase represents the condition in which it is necessary to activate quickly all those management actions aimed at the rapid eradication or containment of the species, where possible.
- *TERTIARY PREVENTION* - presence of the species, presence of impacts. The invasive species has settled, colonization is ongoing or stable and impacts are tangible and measurable. This phase represents the most critical condition, in which the presence of the species is responsible for impacts of ecological, economic and/or sanitary nature. The prevention in this phase consists in avoiding future introductions of the species and is aimed at the containment of the species where possible (considering possibly eradication actions in spatially restricted contexts and/or with high naturalistic value).

		PRESENCE OF THE SPECIES ON TERRITORY	
		ABSENT	**PRESENT**
IMPACTS OF THE SPECIES	**ABSENT**	PRIMARY PREVENTION (Species absent, no impacts)	SECONDARY PREVENTION (Species present, no impacts)
	PRESENT		TERTIARY PREVENTION (Species present, present impacts)

The purpose of this document is therefore to operate in the first phase, adopting a Primary Prevention Plan to avoid the settlement of the species *Micropterus salmoides* within the Ofanto basin (for which the presence is already ascertained in the nearby basins such as Locone and Capacciotti lakes), through monitoring actions aimed at its early detection (chap. 6), its possible management in case of presence (chap. 7) and the implementation of all those preventive actions aimed at avoiding its future introduction into the basin.

In this regard, the cornerstone of European legislation, and subsequently of Italian and regional legislation, is Regulation (EU) No. 1143/2014 of the European Parliament and the Council, of 22 October 2014, laying down provisions to prevent and manage the introduction and spread of invasive alien species, which shall indicate how "*as soon as an invasive alien species is introduced, it is essential to have early detection and rapid eradication measures in place to prevent its establishment and spread." in order to avoid ecological and economic repercussions, as "the most effective and cost-efficient response often consists in eradicating the population as soon as possible, when the number of specimens is still limited."*

According to the Guidelines for the prevention of biodiversity loss caused by alien species, drawn up by the IUCN (2000), there are four macro-categories of action based on which to set up the Prevention Plan: Communication and Awareness, Management, Legal and Institutional Support, Development and Research.

8.1.1 Communication and awareness

Knowledge is the basis of any prevention path. Concepts such as alien species, biodiversity, introduction, etc. must be clear to the population and stakeholders, together with awareness of the various impacts that may ensue. Better education and information for all sectors of society is essential to prevent or reduce the risk of accidental or unauthorised introduction, and any monitoring and management plans, once local communities have been informed, will be more likely to succeed. The main actions can be summarised as follows:

- identification of the main categories of stakeholders, with the aim of addressing these categories with targeted and specific information. Concerning the largemouth bass, the world of sport fishing and the aquaculture sector are among the most problematic categories.

- **Quick and easy access to information.** Digital platforms, databases, manuals, brochures, etc. The dissemination of information should be promoted and simplified, so that information about the species and the campaigns against as many subjects as possible is easily accessible.
- **Building communication strategies during the planning phases of the Plan**, to minimize misunderstandings in the roles of individual actors and solve them in advance.
- **Involvement of schools,** through specific projects and through the production of *ad hoc* informative materials, intended for the construction of specific educational paths.
- **Involvement of the companies involved in the transport of the individuals of the species** in question. Aquariums, farms, sport fisheries, etc. in order to make them understand the importance of their role in prevention and the adoption of possible solutions.
- **Inform travellers**, who may be the first to be responsible for the voluntary or involuntary transport of alien species from one territory to another. Increase awareness of how human travel contributes to the spread of alien species.
- **Involvement of tourism operators in the promotion of eco-sustainable tourism**, which takes into account the problem of invasive alien species, especially in areas of high naturalistic value. In particular, the actions must be focused on sport fishing tourism, in order to raise awareness among users and direct them towards more sustainable alternatives.
- **Preparation of guidelines in the field of transport and controls**. Control of goods, customs, stations, airports, etc. These sectors must be better informed about the control and prevention of the introduction of alien species.

8.1.2 Management actions

Management actions shall consist of active measures to prevent the introduction or expansion of invasive species, which may be part of the monitoring, containment or eradication phases. Prevention against the introduction of alien species is the cheapest and most efficient measure to fight the spread of alien species, regardless of the uncertainty of the scientific world about the long-term outcome of a potential invasion. Some measures aimed at contrasting accidental introduction and not alien species on the territory are:

- **Prioritise controls on areas of high naturalistic value**, especially the most isolated and therefore most vulnerable ecosystems such as islands, freshwater basins, mountains and coastal habitats. In this case, the main affluents of the Ofanto River and the main reservoirs connected to it, such as the lakes of Locone and Capacciotti, must be monitored.
- **Identify the most common routes of introduction of exotic species**, where management actions such as goods, tourism, ballast water, livestock, agriculture and trade in animals/plants can be concentrated.
- **Take economic measures to discourage trade in animals,** such as sanctions, higher taxes, subsidies to other sources, etc.
- **Regulate voluntary introductions**, where legal, by setting up teams of experts to evaluate the introduced species and their potential impacts on the territory.
- **Set up constant monitoring programs,** especially against the most sensitive matrices (e.g. aquatic environment) and with specific target species of which we already know the invasiveness but which are not yet widespread in the territory.

- **In the case of incipient colonization, act quickly through eradication actions.** Eradication of newly introduced species is preferable to long-term control, with managerial and economic advantages.
- **Carefully evaluate eradication projects,** acting only when they appear to be ecologically feasible and if sure of available human and economic resources, in order to avoid unnecessary waste with inefficient results.
- **Produce information material on the importance of species control,** in order to address ethical public debates with a solid scientific basis and with arguments to emphasize the importance of such actions for the protection and safeguarding of the environment.

8.1.3 Legal and institutional support

Forward-looking and interdisciplinary policies are a fundamental prerequisite for preserving biodiversity from alien species, whether promoted globally, nationally or locally. An immediate response is in fact highly dependent on the legislation in force and above all on its proper application on the territory. Specifically, the management of alien species must inevitably pass from confrontation with other neighbouring political realities, regardless of the scale in which you are operating. Cooperation is a key element in managing the transport of species from one territory to another. Recommended actions include:

- **Give high priority to the development of national management plans** and strategies to respond to threats or potential given by alien species
- **Ensure the application of pre-existing laws**, as often there are measures of actions that do not find a real application
- **Develop *ad hoc* strategies with specialized departments** for the control and prevention of alien species, wherever possible. The establishment of targeted guidelines, together with the creation of individual authorities or departments, aimed at the implementation of laws and the adoption of prevention and control measures in the sector, has a higher effectiveness of action than a fragmentary and dispersive control mechanism. We can cite as an example the Regional Strategy for the contrast to invasive alien species (2021-2026) of the Friuli-Venezia Giulia Region.
- **Periodically update existing legislation** to ensure that all aspects related to the problem of invasive species are analysed in the light of new discoveries and with the latest material available.

8.1.4 Development and research

An essential and common element to all campaigns against the spread of invasive species at all scales (global, national, local) is the up-to-date collection of all relevant information and experience, able to provide constant elements to the world of research and better manage the present problem. The following actions are recommended for this purpose:

- **Make available all relevant information** in this regard, before undertaking management actions, as often the information is present but difficult to find and fragmented.
- **Develop specific databases.** The development of digital platforms relating to invasive species, their invasiveness, diffusion, identification characteristics, etc., is crucial. These databases must be provided at the

same time as the data entry service by citizens, who can expand the data within them following reports made (which will be validated by experts). Applications such as iNaturalist are an excellent tool already available that can be used as a species monitoring tool, as indicated in par. 8.2.

- **Allocate funds to the study of the impacts of invasive species.** Often only a limited component of the impacts that invasive species can cause on the territory is known and, while the precautionary principle remains valid, the introduction of exotic species must be anticipated regardless of the impacts. A deep knowledge of potential new invasive species is the basis for successful rapid management in the event of a future introduction.
- **Study new methodologies for the elimination of any invasive species** at the time of their introduction. Reference is made to involuntary introductions linked to trade in risky material, such as timber, agricultural equipment, ballast water, personal luggage, etc.
- **Develop new, more efficient and cost-effective monitoring techniques,** to externally enforce the applicability and make possible a continuous monitoring plan against the introduction of new invasive species.

Table 6: schematic description of the main macrocategories of prevention action with related description

Macrocategories	Activities	Description
communication and awareness	Identification and communication with *stakeholders*	Planning of communication activities for different *target*
	Building *ad hoc* communication strategies	Simplification of access to information, preparation of differentiated digital and paper information material for different *targets* (see Tab. 7 for details)
	Planning activities with schools	Meetings and educational courses to be held at local schools
	Technical personal training	Training and drafting of guidelines for technical staff involved in drawing up and implementing management plans
management actions	Priority controls on areas of high naturalistic value	Identification of the naturalistically most vulnerable areas to the introduction of invasive alien species
	Identification of the main introduction vectors	Identification of the most common vectors of introduction of invasive alien species on which management actions should focus
	Adoption of *ad hoc* economic measures	Introduction of economic measures to discourage trade and transport of these species
	Technical personal training	Training of qualified personnel to assess the status of introduced species and any dedicated management plans
	Preparation of early monitoring and eradication plans	Drawing up of preventive plans for monitoring and rapid eradication of the most threatening invasive alien species
Legal and institutional support	Updating and application of existing legislation	Update of legislation based on the most recent data and enforcement of existing legislation where it is not effectively applied.

	Prioritise the development of national management plans and strategies	Development of management plans/national strategies for the implementation of updated and coordinated Plans with other territorial realities (e.g. Regions)
	Establishment of *ad hoc* guidelines and specialised departments	Drafting of guidelines aimed at the prevention of introduction of alien species and establishment of specialized departments dedicated to the study and monitoring of these species on the territory
development and research	Organisation of available data and information	Collection of the most up-to-date information and creation of appropriate consultation and data entry tools, such as specific databases
	Allocation of specific funds to the world of research	Investments dedicated to research and study of invasive alien species
	Development of new monitoring and eradication techniques	Study of innovative methodologies increasingly targeted and efficient in the control of invasive alien species

8.2 Early detection by alerts

The presence of an allochthonous species represents a threat not always easy and quick to detect. Therefore, a widespread early detection on the territory represents a key resource in the definition of the distribution range of the species and the role of citizenship should not be underestimated. Through a special awareness campaign aimed at spreading the problems related to the species and its rapid identification, citizens must be able to acquire the tools to sight, recognize and report individuals of *Micropterus salmoides* on the territory. Reports must then be uploaded to databases created for this purpose, or with existing services (e.g. iNaturalist), with the aim of quickly collecting and analysing (and possibly confirming) the collected data. The possibility of taking photographs with modern mobile phones must be encouraged in order to be able to validate the data more securely.

Obviously, while non-technical citizens represent an important portion of the population, which is the primary target of the production of clear and usable information material from different categories, this early detection and signalling service should also be accessible to technical staff. This, represented by organizations managing Protected Areas, Regional Territorial Offices, Park personnel, Foresters, environmental or hunting and fishing associations, etc. will be able to provide more detailed and reliable information, in order to obtain a more complete picture of the situation at local level and at the same time to create a network of contacts that can actively provide information on further sightings on the territory. This information can be channelled to specific areas of coordination, as proposed in par. 8.1.3, in which dedicated technical staff is responsible for controlling the expansion of endangered species in the territory, as in the case of *M. salmoides*.

The role of social networks in this regard is an appropriate tool for the dissemination of this type of information, being able to directly advertise the platforms for uploading data to be downloaded quickly on their electronic devices.

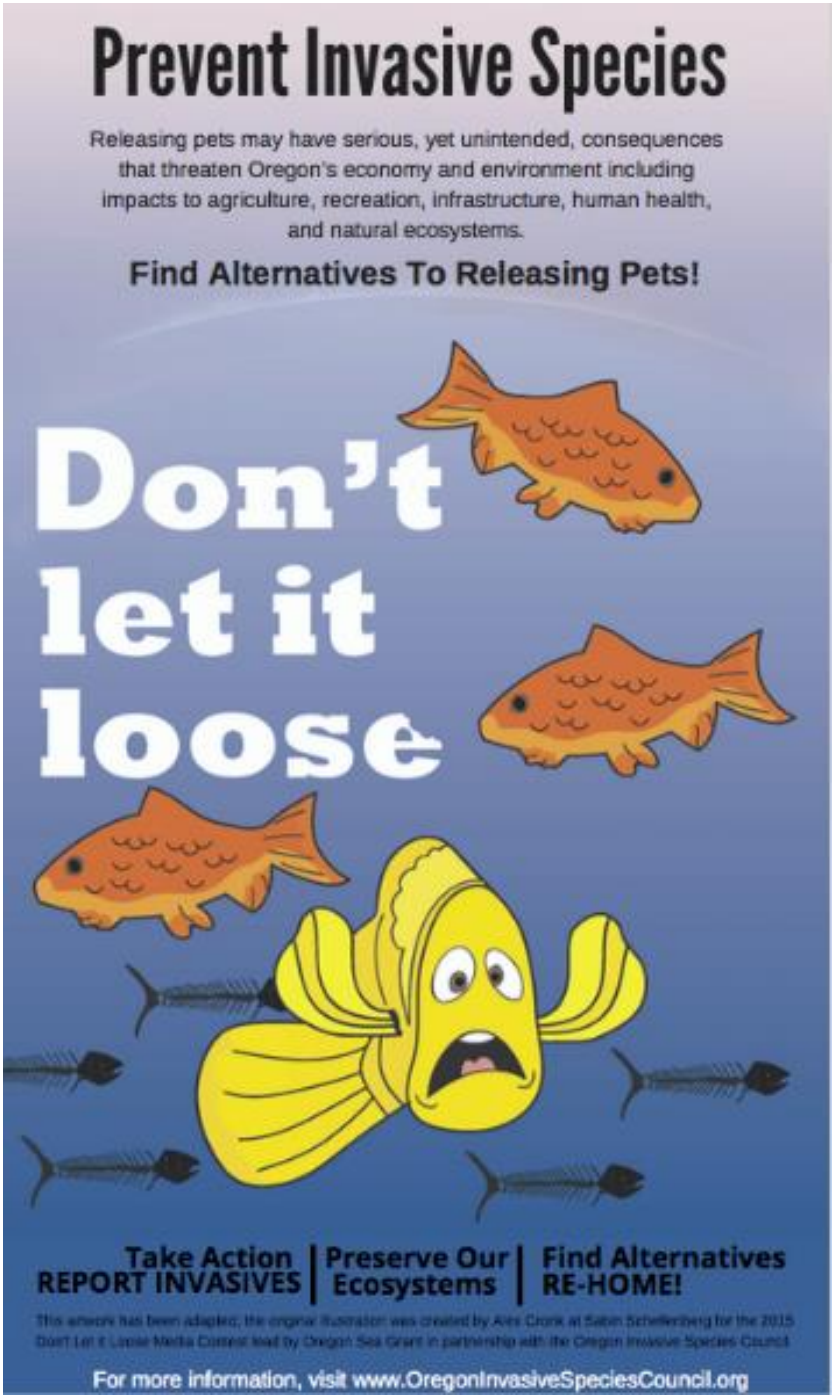

Figure 16: Example of information panel for population involvement (source: https://www.oregoninvasivespeciescouncil.org/dont-let-it-loose).

8.3 Advertising of management activities

In conclusion, a correct dissemination of information and awareness of the involved parties, the so-called stakeholders, is a very important part of the management plans, which otherwise risks to remain an exclusive activity of the world of technicians, without producing significant effects on the rest of the population.

In this phase, it is therefore important to communicate the achievements of the management activities. It is essential to produce a report dedicated to the main stakeholders contacted in the initial stages of the Management Plan (veterinarians, hunters, technicians, wildlife operators, fishermen, etc.) and the data contained in the report should be communicated to the local population, through one or more final seminars describing the phases covered and the successes achieved.

Specifically, we can identify the following categories of actions, each intended or declined to one or more specific targets:

- **Educational seminars**: awareness-raising sessions will be organised on environmental issues related to the state of conservation of aquatic environments, their main issues with a focus on invasive alien species and largemouth bass. These seminars may be differentiated according to the different targets. Educational seminars will be mainly directed to citizens and fishermen, the main carriers of introduction of the species. More technical-managerial seminars may be addressed to the world of research or to technicians, perhaps reporting the activities carried out for this Plan among the contents of the seminar itself (as specified in the following points). Regarding the commercial sector, which is mainly involved in the breeding of fish species, it is not excluded that there will be moments of debate through specific meetings aimed at raising awareness of this component with regard to the negative impacts of the traded animals. Despite differing interests, communication remains one of the most effective and direct instruments in the field of prevention.
- **Information flyers**: paper material will be produced and distributed by the Park Authority, directed mainly to individual citizens and sport fishermen. This material will have the function of informing the reader about the possible presence of *M. salmoides* in the Ofanto river basin, to highlight its impacts and to signal its sighting through an emergency number or with a dedicated smartphone application.
- **Multimedia material and use of social networks:** it will be possible to make an audio-visual documentary during the implementation phases of the Plan that illustrates, together with the naturalistic values of the site, the activities in progress for the monitoring of the fish fauna of the Ofanto River, in order to show the importance of active protection actions on the territory and the necessary effort for the proper management of an area with high naturalistic value as a wetland. The realization of such product will have the function to promote the plan through media of great impact. Similarly, the use of the main social networking platforms is of fundamental importance in order to reach as many users as possible.
- **Information panels:** information panels can be created to be placed inside the Park, dedicated to the presence and impact of invasive alien species, with guidelines to limit their dissemination in a manner similar to those contained in the above information leaflets.
- **Classroom activities:** schools are a key node in the network of information and awareness actions. Training days, lectures and school visits can be dedicated to the theme of invasive alien species, in order to involve young people and encourage greater awareness of these issues and work on prevention against future introduction of new invasive species.

Table 7: Outline of the main communication and awareness-raising activities addressed in this chapter.

Activities	*Target*	Frequency	Location
Educational seminars	Citizens, professional and amateur fishermen	Half-yearly	Municipal offices, fishing clubs, squares or public parks
Technical management seminars	Researchers, operators in biodiversity management	Yearly	Municipal offices, headquarters of the Park, Universities
Meetings with the commercial sector	Fish farmers	Yearly	Municipal offices of the municipalities having territorial competence on the areas affected by the project
information flyers	Citizens, professional and amateur fishermen	To be distributed throughout the year	Municipal and park information centres, fishing clubs, sport fishing grounds
Audio-visual documentary	Citizens, young people	Yearly	Municipal offices, film clubs, squares or public parks
Social networks	Citizens, young people, professional and amateur fishermen	To be updated weekly	Communication channels of the public bodies involved in the project
information panels	Citizens, tourists, amateur fishermen	To be installed in the first year of operation	Information centres, equipped tourist areas of the Park
classroom activities	Children, adolescents, teachers	Annual for each class for at least 12 hours	Primary schools, lower and upper secondary schools
Periodic information report	Aquarium operators, operators in biodiversity management, hunting and fishing	Annual	Communication channels of the Public Authorities involved in the project; print in paper format at the Park's offices

Chapter 9. Conclusions

The application of the Monitoring and Action Plan for the largemouth bass inside the Natural Regional Park "Fiume Ofanto", if conducted in accordance with the prescribed protocols, will provide the following outcomes:

- **Characterization of the presence of *Micropterus salmoides* and other fish species**: This step aims at monitoring the presence of *Micropterus salmoides* inside the Park territory, and it will be necessary to plan the subsequent management interventions. Through this monitoring step it will be possible to characterize the populations of fish species inside the river basin, focusing on the IAS. This job may serve as a pilot study to develop further management plans on different species. The main issue of this step is the requirement of a highly qualified team to deal with electrofishing, and it can be worked out by contracting proper professional staff.
- **Physical removal of the captured individuals during the containment phase:** through the monitoring and management activities the exotic species will be captured and removed, in order to minimize their effect on the local fish community inside the Ofanto river system. This protocol is not only valid for *M. salmoides,* as it is applicable to other species as well. The main issue of this step is represented by the correct identification of the captured species, in order not to accidentally remove not target species. As before, this can be worked out by contracting proper professional staff. We underline how the aim of the present plan, i.e. preventive containment and management, is not the eradication of the species, but only focuses on containing the population from further expansions; Subsequently, it is of fundamental importance to properly undertake the monitoring actions, which will be continued in the following years.
- **Execution of communication strategies to prevent further colonisations of exotic species.** The importance of prevention on new expansions of populations of *M. salmoides* and other species is crucial for the correct execution of the plan. Therefore, all the prevention activities must be communicated to the stakeholders, through customized actions. The local authorities must be encouraged to produce proper legislation aiming at reducing the risk of the IAS, and the citizenship must be contacted and properly informed about those risks, eventually through the use of social medias, social platforms and mobile phones applications. To carry out a proper communication strategy it will be necessary to organize seminars, webpages and proper signage, in order to inform the local population, the scientific world, tourists and generally all the stakeholders present in the territory.

The activities are in accordance with the objectives of the action plan, i.e. preventive control of the populations of *M. salmoides* inside the Natural Regional Park "Fiume Ofanto". Specifically, constant monitoring activities of the Ofanto River system, together with the activation of an intensive management plan, appears to be an efficient method against biological invasions, when the populations are not at a critical level. This is further promoted by a proper communication strategy, aiming at involving the citizenship and the local authorities through seminars, proper signage and workshops. This method also ensures a continuous flow of information on further exotic species, enlarging the knowledge on current populations and reducing their number.

It is finally fundamental to underline how these activities are part of a bigger framework of projects involved in the control of the fish species in the inland waters (*Life Ecotone, Life IdroLife, Life Proyecto Estany*), supporting the necessity of this kind of activities. In addition, the proposed protocols, with specific precautions, may be applied to the management of other IAS, or to different territories.

We finally underline, however, although it is much easier and convenient to act in the control of the species before their expansion, there still are few projects focusing on prevention on IAS in areas where these are not still present (i.e. *Life Rarity)* or focusing on communication activities on IAS (*Life Asap*). Therefore, the present project may be a virtuous example concerning the IAS control and prevention.

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Life Asap https://lifeasap.eu/index.php/it/

Life IdroLIfe: https://idrolife.eu/

Life Proyecto Estany: http://www.consorcidelestany.org/

Life Sun Life Umbria: http://www.life-sun.eu/

MapReachter ISPRA – Istituto Superiore per la Protezione e la Ricerca Ambientale: http://geoviewer.nnb.isprambiente.it/

Nobanis – European Network of Invasive Alien Species: https://www.nobanis.org/

Oregon Invasive Species Council: https://www.oregoninvasivespeciescouncil.org

Puglia.con – conoscenza condivisa per il governo del territorio: http://sit.puglia.it/

Scopus: https://www.scopus.com/home.uri

Web of Science: https://www.webofknowledge.com

Annex A

The following survey is part of the "BEST Project - Addressing joint Agro- and Aqua-Biodiversity pressures Enhancing SuSTainable Rural Development - Interreg Programme V-A Greece-Italy 2014/2020" (www.interregbest.eu), aiming to elaborate a monitoring protocol for evaluating threats to biodiversity caused by the presence of invasive alien species, together with a dedicated action plan for biodiversity conservation. We need to obtain a simple and clear information from the institutions directly involved in managing local flora and fauna about the most-pressing invasive alien species on the territory, ultimately looking for a monitoring protocol for the management of the 5 priority target species.

We are presently asking you a few minutes of your time to answer the following questions.

Full name

Name of the institution

E-mail contact

Which are the terrestrial plant invasive alien species that cause major threats within your territory/protected area? (Write at least one species up to a maximum of 5, or write "not relevant")

Which are the terrestrial animal invasive alien species that cause major threats within your territory/protected area? (Write at least one species up to a maximum of 5, or write "not relevant")

Which are the aquatic plant invasive alien species that cause major threats within your territory/protected area? (Write at least one species up to a maximum of 5, or write "not relevant")

Which are the aquatic animal invasive alien species that cause major threats within your territory/protected area? (Write at least one species up to a maximum of 5, or write "not relevant")

List the biotic and abiotic features (habitats and ecosystems, vulnerable species/populations) most affected by the species mentioned above.

Define the area where the effects of the alien species take place.

Are there already ongoing monitoring protocols or action plans (eradication/containment) with respect to these species (i.e. LIFE+ Projects)? If available, share the link to the project

Within your territory of competence, are there any prevention programs with respect to future introductions of alien species? If so, which ones? If available, share the link to the program/project

Annex B - Monitoring and Management Protocol Survey Card for *Micropterus salmoides*

RIVER				SITE (also Municipality and Province)				DATE
STATION (name and GPS track code)				STATION COORDINATES (at the starting point)				WEATHER
								T (air)
FOREMAN (name, surname and tel.)				TEAM COMPOSITION (N. operators)				
				ELECTRO.	ANODE	HAND NET	BUCKETS	Cloudiness
BRAND- MODEL ELECTROSTUNNER				Active Streambed Width		Wet Streambed Width		Rain
				Stroke length				Wind
AN. (shape and Ø)		CAT. (type, length and Ø)						
				O_2	pH	T (water)	Conduct.	Bottom visib.

SETTINGS ELETTROST.				Start time	End time	NOTES
V	A	Kw peak	Freq. (Hz)			

MESOHABITAT							Bars/ Islands	NOTES
Puddles	Laminar	Streams	Scarpers	Rapids	Hops	Waterfa.		

DEPTH					SHAD.	HYDROCARBON /FOAMS	MEANS IN STREAMBED	
≤20	21-40	41-60	61-80	>80			RECENT	PASSED

SUBSTRATE								
ROCK	$MGL_{>40cm}$	$MAC_{20-40cm}$	MES_{6-20cm}	MIC_{2-6cm}	GRAVEL 0,2-2cm	SAND $_{6\mu-2mm}$	$CLAY_{<6\mu}$	ARTIFIC.

TYPES OF FLOW									
Waterfall	Slides	B. waves	I. waves	Chaotic f.	RIppled	Bubble rise	Laminar	Still	Dry

VEGETATION					ORGANIC MATERIAL			Fine deposit
Filam. algae	Felt algae	Subm. Macro.	Emerg. Macro.	Live root	Xylal	CPOM	FPOM	

RIVER	STATION (NAME and CODE)	DATE	CARD N.

NOTES

ID	SP.	L (cm)	W (g)	ID	SP.	L (cm)	W (g)	ID/NOTES
1				25				
2				26				
3				27				
4				28				
5				29				
6				30				
7				31				
8				32				
9				33				
10				34				
11				35				
12				36				
13				37				
14				38				
15				39				
16				40				
17				41				
18				42				
19				43				
20				44				
21				45				
22				46				
23				47				
24				48				

RIVER			STATION (NAME and CODE)				DATE	CARD N.
ID	SP./SEG./PASS.	L	P	ID	SP./SEG./PASS.	L	P	ID/NOTE
49				75				
50				76				
51				77				
52				78				
53				79				
54				80				
55				81				
56				82				
57				83				
58				84				
59				85				
60				86				
61				87				
62				88				
63				89				
64				90				
65				91				
66				92				
67				93				
68				94				
69				95				
70				96				
71				97				
72				98				
73				99				
74				100				