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Assessment Report of the IAS study list

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1. Introduction

The first signs of the introduction of non-native species into the European sector have existed since antiquity. Recent data, however, show that in Europe, as well as in the rest of the world, the number of non-native species has increased considerably in the last 200 years. This is due to the development of trade, tourism and other disruptive economic activities. The ever-increasing number of naturalized non-native species is seen as an important indicator of global uniformity. It is proven that changes in the distribution of a species are natural phenomena in which the range can spread or decrease. Thus, species can colonize new regions outside the natural space of existence.
If, in the past, the introduction of non-native species into natural habitats meant only immediate economic benefits, now the recognition of the impact created by these species on biodiversity, the economic system and human health is unanimously accepted.

The distribution of plant and animal species outside their natural distribution is a common phenomenon in a large number of countries all over the world. In the past, the human kind has greatly benefited from the introduction of alien species (e.g. potatoes and maize in Europe, etc.) and this trend is likely to continue. Among these species, a large number has been naturalized and now can be found in natural habitats. However, some of them have become invasive, having multiple ecological, economic and human health impacts. The distribution of invasive alien species (IAS) is mainly climate driven and this is why they can be found in a number of countries that are far from their native distribution range. Specifically, regarding the impacts that IAS can cause, they not only represent a threat to native species of fauna and flora (IAS are globally considered as the second major threat to biodiversity) but can also result in major disruption to ecosystem health, with resulting damage and loss of goods and services. Increasing pressures on ecosystems, caused mainly by destruction of habitats, spread of IAS, over-exploitation and pollution, are weakening ecosystem resilience and ability to adapt to new conditions under climate change and thus continuously declining capacity for providing ecosystem services.
Under a global changing environment, the Black Sea is found in between the European and Asian crossroad and in the transition between the Mediterranean and North. A great number of stakeholders have developed economic activities around the Black Sea coastline, especially at the deltas, which are known for their density in population and growth potential (such as fishing, fisheries and aquacultures, tourism and recreation, farming etc). Historically, the Black Sea was under the invasion of alien species from the Indian Ocean and the Mediterranean Sea due to various reasons. Invasive Alien Species (IAS) is the central point on which this proposal makes focus, because if not sufficiently monitored and assessed they may alter dramatically not only the ecosystem balance but also a range of already well-established socio-economic activities. The overall objective of the project is to establish and perform joint monitoring actions on IAS in Black Sea deltaic ecosystems of five countries (Georgia,

Greece, Ukraine, Romania and Turkey) and assess their response under current and predicted climatic conditions.

The specific objectives of the project are to:

- To develop and implement joint monitoring and risk assessment procedures on IAS in the project's nature protected areas and motivate and assist countries in creating their IAS inventories.
- To improve long-term cross-border collaboration, information and research capacity through using innovative technologies on IAS monitoring.
- To improve cooperation on IAS monitoring through the involvement of the public at various levels of the project.

1.1. IAS - defining the concept, specific terms (glossary)

A – IAS - defining the concept

The **Convention on Biological Diversity** (CBD) entered into force on 29 December 1993. It has 3 main objectives:

1. The conservation of biological diversity
2. The sustainable use of the components of biological diversity
3. The fair and equitable sharing of the benefits arising out of the utilization of genetic resources

According **CBD** (https://www.cbd.int/idb/2009/about/what/):
Invasive alien species are plants, animals, pathogens and other organisms that are non-native to an ecosystem, and which may cause economic or environmental harm or adversely affect human health. In particular, they impact adversely upon biodiversity, including decline or elimination of native species - through competition, predation, or transmission of pathogens - and the disruption of local ecosystems and ecosystem functions.
Invasive alien species, introduced and/or spread outside their natural habitats, have affected native biodiversity in almost every ecosystem type on earth and are one of the greatest threats to biodiversity. Since the 17th century, invasive alien species have contributed to nearly 40% of all animal extinctions for which the cause is known (CBD, 2006).
The problem continues to grow at great socio-economic, health and ecological cost around the world. Invasive alien species exacerbate poverty and threaten development through their impact on agriculture, forestry, fisheries and natural systems, which are an important basis of peoples' livelihoods in developing countries. This damage is aggravated by climate change, pollution, habitat loss and human-induced disturbance.

IUCN provides technical and scientific support to the European Commission for the implementation of the Invasive Alien Species (IAS) regulation (EU regulation No. 1143/2014) in collaboration with the IUCN Invasive Species Specieslist Group.

According **IUCN** (https://www.iucn.org/regions/europe/our-work/biodiversity-conservation/invasive-alien-species):
Invasive alien species are species that are introduced, accidentally or intentionally, outside of their natural geographic range and that become problematic. They are often introduced as a result of the globalization of economies through the movement of people and goods, for instance via shipping, consignments of wood products carrying insects, or the transport of ornamental plants to new areas. The EU has developed Regulation (EU) 1143/2014 to actively deal with the problem of invasive alien species.

Invasive alien species (IAS) can have severe ecological effects on the invaded environments. They may lack natural predators in their new environments, allowing them to quickly increase their abundance and spread. They can carry diseases, outcompete or prey on native species, alter food chains, and even change ecosystems by, for example, altering soil composition or creating habitats that encourage wildfires. These impacts can lead to local or global extinctions of native species and eventual ecological devastation.
IAS can also have marked socio-economic impacts. The European Union (EU) experiences annual damages worth EUR 12 billion as a result of IAS effects on human health, damaged infrastructure, and agricultural losses.
In Europe, there are over 12,000 alien species, 15% of which are invasive. IAS are the third most severe threat to European threatened species. According to a report from 2015, 354 threatened species (229 animals, 124 plants and 1 fungus) are specifically affected by IAS, which accounts for 19% of all threatened species in Europe. The newly adopted EU Biodiversity Strategy reiterates the importance of tackling this threat by proposing to 'manage established invasive alien species and decrease the number of Red List species they threaten by 50%' by 2030.
In 2013, the European Commission (EC) put forward a proposal for legislation in the form of an EU Regulation on IAS, focusing on the prevention of their entry, early warning/rapid response, and effective and coordinated management. IUCN, through a series of service contracts with the EC and in collaboration with the IUCN Invasive Species Specieslist Group (ISSG), has been providing technical and scientific support for the implementation of the EU IAS Regulation since 2016.

According **European Commission** (EC)
(https://ec.europa.eu/environment/nature/invasivealien/index_en.htm):
Invasive Alien Species (IAS) are animals and plants that are introduced accidentally or deliberately into a natural environment where they are not normally found, with serious negative consequences for their new environment. They represent a major threat to native plants and animals in Europe, causing damage worth billions of Euros to the European economy every year. As invasive alien species do not respect borders, coordinated action at the European level will be more effective than individual actions at the Member State level.

EU Regulation 1143/2014 on Invasive Alien Species
Regulation (EU) 1143/2014 on invasive alien species (the IAS Regulation) entered into force on 1 January 2015, fulfilling Action 16 of Target 5 of the EU 2020 Biodiversity Strategy, as well as Aichi Target 9 of the Strategic Plan for Biodiversity 2011-2020 under the Convention of Biological Diversity.
The core of the IAS Regulation is the list of Invasive Alien Species of Union concern (the Union list). For information about the species currently included on this list, click here.
The IAS Regulation provides for a set of measures to be taken across the EU in relation to invasive alien species included on the Union list. Three distinct types of

measures are envisaged, which follow an internationally agreed hierarchical approach to combatting IAS:

- Prevention: a number of robust measures aimed at preventing the intentional or unintentional introduction of IAS of Union concern into the EU.
- Early detection and rapid eradication: Member States must put in place a surveillance system to detect the presence of IAS of Union concern as early as possible and take rapid eradication measures to prevent them from establishing.
- Management: some IAS of Union concern are already established in certain Member States. Concerted management action is needed to prevent them from spreading any further and to minimize the harm they cause.

History of the EU IAS Policy

Preparation of the Regulation

Two public consultations were held on the IAS policy in 2008 and 2012.

Preparatory studies towards Regulation (EU) 1143/2014. They should not be considered to represent the views of the European Commission.

- Policy options to minimize the negative impacts of IAS on biodiversity in Europe and the EU, with annexes - 2008
- Recommendations on policy options to minimize the negative impacts of invasive alien species on biodiversity in Europe and the EU - 2009
- Assessment of the impacts of invasive alien species in Europe and the EU - 2009
- Analysis of the impacts of policy options/measures to address IAS, with Annexes - 2009
- Assessment to support continued development of the EU strategy to combat invasive alien species – 2010
- Assessment of existing policies on invasive alien species in EU Member States and selected OECD countries, with country assessments and background information - 2011

On 3 December 2008 the European Commission adopted a Communication "Towards an EU Strategy on Invasive Species":

- Communication
- Impact Assessment
- Impact Assessment – Executive Summary
- Press Release: Commission presents policy options for EU Strategy on Invasive Species

The EU 2020 Biodiversity Strategy adopted in May 2011 announced a dedicated legislative instrument on invasive alien species, hence the new proposal.

Preparation of the Union list

Preparatory studies towards the first list of IAS of Union concern. They should not be considered to represent the views of the European Commission.

- Framework for the identification of invasive alien species of EU concern – October 2014
- Ad hoc scientific workshop to complete IAS risk assessments – February 2015

Studies on ragweed, they should not be considered to represent the views of the European Commission.

- Assessing and controlling the spread and the effects of common ragweed in Europe, with background information, including maps - 2012
- Complex research on methods to halt the Ambrosia invasion in Europe, with background reports – 2014

B – Specific terms (glossary)

Explanation:
Term (Source) – Definition

Terms:

Alien invasive species (IUCN) - means an alien species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity.

Alien species (CBD*) - A species, subspecies or lower taxon, introduced outside its natural past or present distribution; includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce.

Alien species (IUCN) - (non-native, non-indigenous, foreign, exotic) means a species, subspecies, or lower taxa occurring outside of its natural range (past or present) and dispersal potential (i.e., outside the range it occupies naturally or could not occupy without direct or indirect introduction or care by humans) and includes any part, gametes or propagule of such species that might survive and subsequently reproduce.

Alien species (UNEP-WCMC) - A species occurring in an area outside of its historically known natural range as a result of intentional or accidental dispersal by human activities (also known as an exotic or introduced species).

Biocontrol species (ICES) - The intentional release of an organism that is intended to consume, infect, or debilitate a selected species to decrease its population size. Note: The possible limited specificity of biocontrol species is of concern as native species might be negatively affected.

Biological control agent (IPPC) - A natural enemy, antagonist or competitor, and other self-replicating biotic entities

Biological control (biocontrol) (IPPC) - Pest control strategy making use of living natural enemies, antagonists or competitors and other self-replicating biotic entities.

Ecosystem (CBD*) - A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.

Endangered area (IPPC) - An area where ecological factors favor the establishment of a pest whose presence in the area will result in economically important loss.

Establishment (CBD*) - The process of an alien species in a new habitat successfully producing viable offspring with the likelihood of continued survival .

Exotic species (UNEP-WCMC) - An organism that exists in the free state in an area but is not native to that area. Also refers to animals from outside the country in which they are held in captive or free-ranging populations.

Foreign species (IUCN) - See definition for 'alien species'

Harmful aquatic organisms and pathogens (IMO) - "Harmful aquatic organisms and pathogens" means aquatic organisms or pathogens which, if introduced into the sea including estuaries, or into fresh water courses, may create hazards to the environment, human health, property or resources, impair biological diversity or interfere with other legitimate uses of such areas. (Article 1.8 of the Ballast Water Management Convention)

Hazard (OIE Terrestrial Animal Health Code) - A biological, chemical or physical agent in, or a condition of, an animal or animal product with the potential to cause an adverse health effect.

Indigenous species (ICES) - Indigenous (=native) species: a species or lower taxon living within its natural range (past or present) including the area which it can reach and occupy using its natural dispersal systems (modified after CBD, GISP).

Intentional introduction (CBD*) - The deliberate movement and/or release by humans of an alien species outside its natural range.

Intentional introduction (IUCN) - An introduction made deliberately by humans, involving the purposeful movement of a species outside of its natural range and dispersal potential. (Such introductions may be authorized or unauthorized).

Introduced species (ICES) - Introduced species (= non-indigenous species, = exotic species): Any species transported intentionally or accidentally by a human-mediated vector into aquatic habitats outside its native range. Note: Secondary introductions can be transported by human-mediated or natural vectors.

Introduction (Bern Convention) - "introduction" means deliberate or accidental release, into the environment of a given territory, of an organism belonging to a non-native taxa (species or lower taxa that has not been observed as a naturally occurring and self-sustaining population in this territory in historical times)" .

Introduction (of a biological control agent) (IPPC) - The release of a biological control agent into an ecosystem where it did not exist previously.

Introduction (CBD*) - the movement by human agency, indirect or direct, of an alien species outside of its natural range (past or present). This movement can be either within a country or between countries or areas beyond national jurisdiction.

Introduction (IUCN) - means the movement, by human agency, of a species, subspecies, or lower taxon (including any part, gametes or propagule that might survive and subsequently reproduce) outside its natural range (past or present). This movement can be either within a country or between countries.

Invasive alien species (CBD*) - "An alien species whose introduction and/or spread threaten biological diversity (For the purposes of the present guiding principles, the term ""invasive alien species"" shall be deemed the same as ""alien invasive species"" in decision V/8 of the Conference of the Parties to the Convention on Biological Diversity)."

Native species (Bern Convention) - "… species native to a given territory means a species that has been observed in the form of a naturally occurring and self-sustaining population in historical times; ""species"" in the sense of this Recommendation refers both to species and to lower taxonomic categories, subspecies, varieties, etc. (thus, for instance, the release of a different non-native subspecies into a given territory should also be considered as an introduction)"

Native species (ICES) - See definition of ‘indigenous species’.

Native species (IUCN) - (indigenous) means a species, subspecies, or lower taxon, occurring within its natural range (past or present) and dispersal potential (i.e. within the range it occupies naturally or could occupy without direct or indirect introduction or care by humans.)

Native species (UNEP-WCMC) - Plants, animals, fungi, and microorganisms that occur naturally in a given area or region

New introduction (ICES) - The human-mediated movement of a species outside its present distribution.

Non-target species (ICES) - Any species inadvertently accompanying in, on, or with the species intended for introduction or transfer

Release (into the environment) (IPPC) - Intentional liberation of an organism into the environment

Risk analysis (CBD*) - "(1) the assessment of the consequences of the introduction and of the likelihood of establishment of an alien species using science-based information (i.e., risk assessment), and (2) to the identification of measures that can be implemented to reduce or manage these risks (i.e., risk management), taking into account socio-economic and cultural considerations.

Risk analysis (OIE Aquatic Animal Health Code) - "Risk communication: the interactive exchange of information among risk assessors, risk managers and other interested parties

Risk analysis (OIE Terrestrial Animal Health Code) - "The process composed of hazard identification, risk assessment, risk management and risk communication

Risk assessment (WTO) - The evaluation of the likelihood of entry, establishment or spread of a pest or disease within the territory of an importing Member according to the sanitary or phytosanitary measures which might be applied, and of the associated potential biological and economic consequences; or the evaluation of the potential for adverse effects on human or animal health arising from the presence of additives, contaminants, toxins or disease-causing organisms in food, beverages or feedstuffs.

Risk (OIE Aquatic Animal Health Code) - The likelihood of the occurrence and the likely magnitude of the consequences of an adverse event to public, aquatic animal or terrestrial animal health in the importing country during a specified time period.

Risk (OIE Terrestrial Animal Health Code) - The likelihood of the occurrence and the likely magnitude of the consequences of an adverse event to animal or human health in the importing country during a specified time period, as a result of a hazard.

Sanitary measure (OIE Terrestrial Animal Health Code) - Any measure applied to protect animal or human health or life within the territory of the Member Country from risks arising from the entry, establishment or spread of a hazard.

Sanitary or phytosanitary measure (WTO) - "Any measure applied: (a) to protect animal or plant life or health within the territory of the Member from risks arising from the entry, establishment or spread of pests, diseases, disease-carrying organisms or disease-causing organisms; (b) to protect human or animal life or health within the territory of the Member from risks arising from additives, contaminants, toxins or disease-causing organisms in foods, beverages or feedstuffs;(c) to protect human life or health within the territory of the Member from risks arising from diseases carried by animals, plants or products thereof, or from the entry, establishment or spread of pests; or(d) to prevent or limit other damage within the territory of the Member from the entry, establishment or spread of pests.

Spread (IPPC) - Expansion of the geographical distribution of a pest within an area.

Surveillance IPPC An official process which collects and records data on pest.

Transferred species (ICES) - Transferred species (= transplanted species): Any species intentionally or accidentally transported and released within areas of established populations, and continuing genetic flow where it occurs.

Unintentional introduction (CBD*) - All other introductions which are not intentional.

Unintentional introduction (IUCN) - An unintended introduction made as a result of a species utilizing humans or human delivery systems as vectors for dispersal outside its natural range.

Vector (ICES) - Any living or non-living carrier that transports living organisms intentionally or unintentionally.

Sources used:

CBD - Decision VI/23* of the Conference of the Parties to the CBD, Annex, footnote to the Introduction.
IPPC - International Plant Protection Convention. International Standard for Phytosanitary Measure #5 (Glossary of Phytosanitary Terms), 2006.
OIE - Terrestrial animal health code (2005)
Aquatic animal health code (2005)
Manual of Diagnostic Tests for Tests fir Aquatic Animals (2003)
Manual of Standards for Diagnostic Tests and Vaccines (2000)
IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species (2000). Approved by the IUCN Council, Feb 2000.
WTO World Trade Organization. Agreement on the Application of Sanitary and Phytosanitary Measures
IMO International Convention for the Control and Management of Ships' Ballast Water and Sediments (2004)

ICES International Council for the Exploration of the Sea. Code of Practice on the Introduction and Transfer of Marine Organisms (2005)

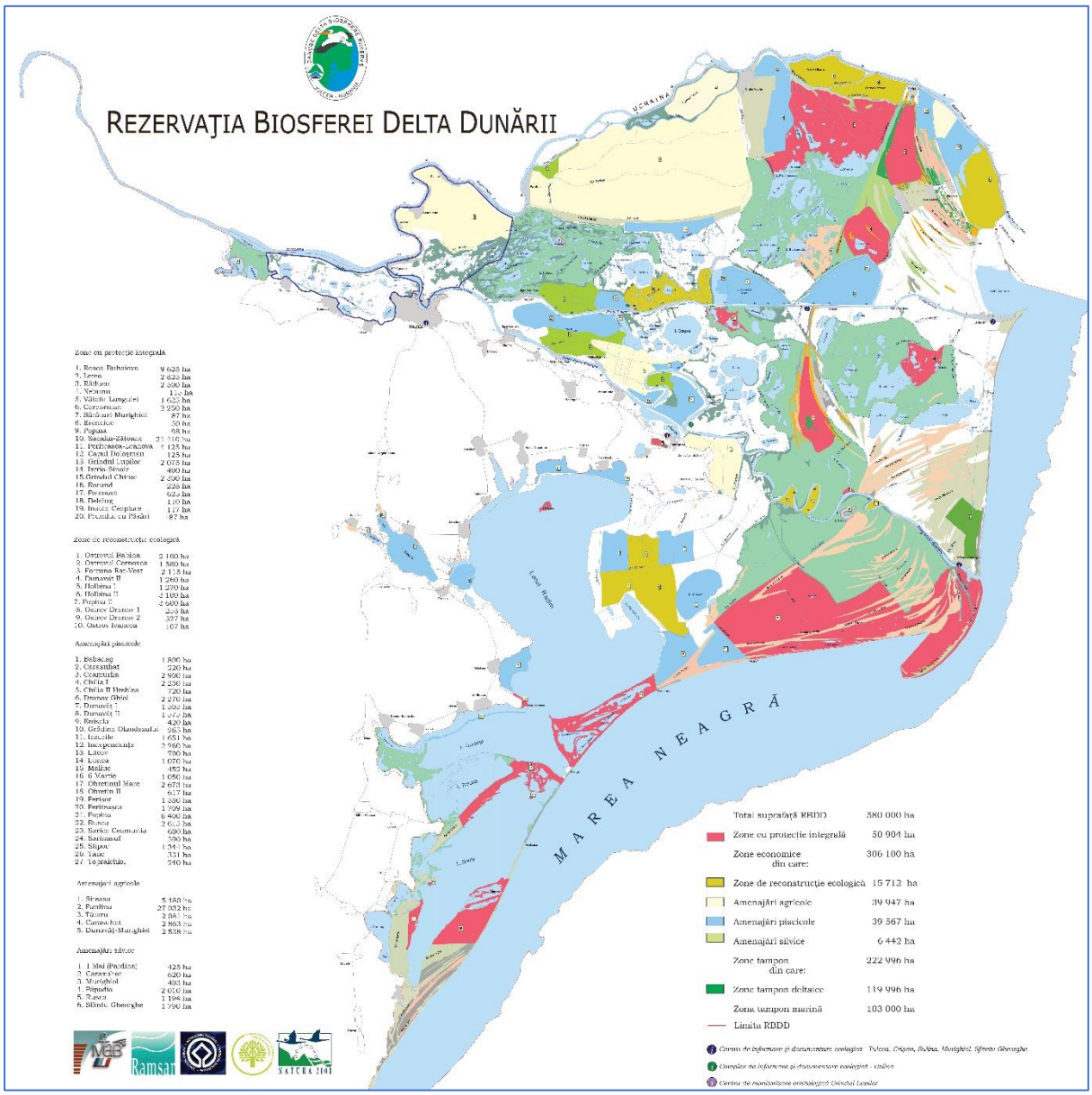
UNEP-WCMC UNEP World Conservation Monitoring Centre – Glossary of Biodiversity Terms (http://www.unep-wcmc.org/reception/glossary)

Bern Convention Recommendations No. 57 and 99 of the Standing Committee of the Convention on the Conservation of European Wildlife and Natural Habitats.

1.2. General characterization of Black Sea Deltaic Protected Areas monitored in the IASON Project (ecological and socio-economic framework)

1.2.1 - Danube Delta - Romania (DDNI & DDBRA)

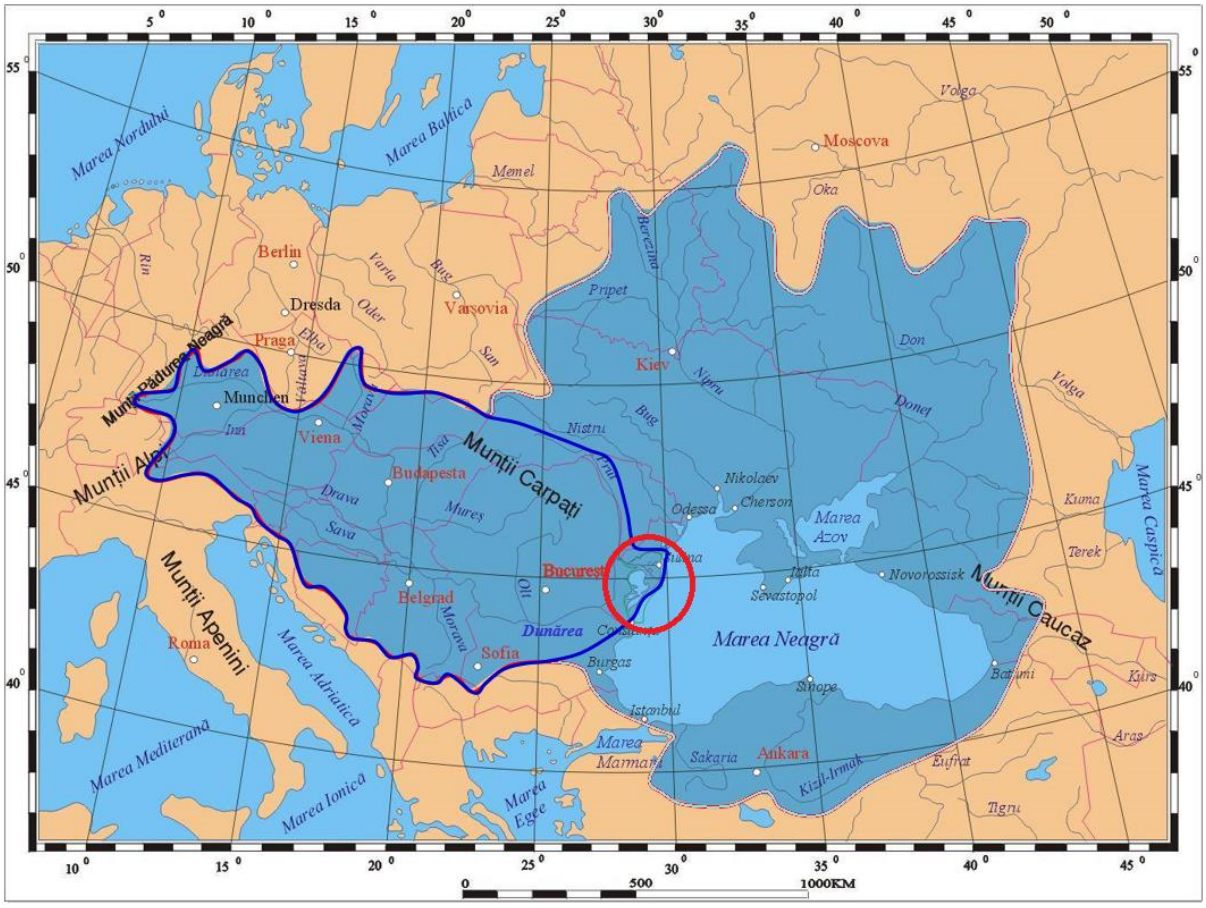
The Danube Delta is a unique environment in Europe, even and in the world due to its peculiar landscape in permanent evolution and change, and its rich biodiversity specific to the wetland zone. From Ancient Times to the present-day, the interest for this area has remained constant. Books and lots of articles are devoted to the genesis, evolution, natural landscape, flora, fauna, settlements and the population of the Danube Delta



The Danube Delta is:

- The only delta in the world declared BIOSPHERE RESERVE by Romanian Government in 1990.
- part of UNESCO WORLD NETWORK
- UNESCO Program - “MAN and BIOSPHERE” - 15 February 1993;
- RAMSAR Site - Wetland of International importance eSpecieslly for aquatic birds’ habitat
- 13 May 1991;
- Cultural and Natural World Heritage List - December 1990.

Geographic position and area. The Romanian Danube Delta Biosphere Reserve (DDBR) is situated in the eastern part of Europe and lies at the intersection of 45º N (parallel of latitude) with 29º E (longitude). The total area of DDBR is of about 5,800 km2 more than half of which (3,510 km^2) belong to what is commonly called the “Danube Delta” while the remaining area is shared between the upstream Danube flood plain (Isaccea-Tulcea sector 102 km^2), the Razim-Sinoie lagoon complex (1,145 km^2), the neighboring strip from the Black Sea (1,030 km^2) up to the 20 m isobath, and the Danube river between Cotul Pisicii and Isaccea (13 km^2) (Gâștescu, Știucă, 2008).



Danube River Basin
(817,000 sq.km catchment basin – 8% of Europe surface)

Genesis and hypothesis. The genesis of the Danube Delta was favoured by the existence of a large continental shelf, a liman-type gulf between the Dobrogean horst and the Bugeac Platform, the big volume of alluvia deposited by the Danube, the configuration of the littoral sea currents, the low tides (7 – 11 cm) in the north-east of the Black Sea, together with the major climatic conditions which triggered the Black Sea level oscillations, and the tectonic (epirogenetic) movements suffered by the neighboring areas. All the hypotheses on the genesis and evolution of the Danube Delta river sector fall into two large categories: one admitting the existence of a liman enclosed by littoral bars, pierced through in several points, and later evolving into the fluviatile delta (Murgoci, Antipa, Vâlsan, Panin); the other admitting the formation of the delta by the gradual advance of the river levees as far as the littoral sea current, fact that led to the formation of the coastal bar (Brătescu).

The Romanian coast of the Black Sea. The Romanian seacoast is like a submerged field, with very few morphological irregularities. The continental platform decreases in width from 170 km in the north to 130 km in the south. The gradient of 1 - in the north increases to 2 – in the south. Since the Black Sea is almost totally landlocked, tidal oscillations of 7 – 11 cm have a minimal effect on the shoreline of the delta. The effects of wave action are highly significant, but these vary according to exposure and the distance of wind fetch across the Black Sea. Wave action and the seiche effect vary according to wind direction and speed. Waves of up to 2.5 – 4 meters in height are normal but waves of 7 meters in height were measured. Steady winds also cause drift up or down the coast and the currents generated are capable of eroding existing coasts and of depositing materials. It has been calculated that 60 km of the shoreline of the Biosphere Reserve is in retreat (about 50 ha/annum), whereas the coastline is advancing into the sea along a 50 km length (adding some 10 ha/annum). The level of the Black Sea is rising as a response to global warming. The most changes in shoreline morphology can be observed in the way and the rate at which the Chilia arm of the delta is accumulating new land at the rate of around 2 hectares per annum. This length of this branch of the river increased by 7 km, between 1870 to 1992. The Sulina arm has been developed since 1862, to provide a major navigation route to Tulcea, Galaţi and Brăila. New sections of channel were cut between Tulcea and Sulina to reduce the distance by some 28 km. The natural formation of Sacalin Island on offshore sandbanks, to the south of Sfântu Gheorghe dates back to 1897. A catastrophic flood deposited most of the material and the island had grown to 10 km in length by 1924 and 17 km by 1992. The „island" has now virtually joined up with the mainland, the Gârla de Mijloc mouth has been blocked and the channel is becoming narrower and narrower (Gâștescu, Știucă, 2008).

Hypsometry. The Danube Delta is a very low flat plain, lying 0.52 m above Mean Black Sea Level (MBSL) with a general gradient of 0,006 m/km. Being close to the Black Sea level, in the case of the Danube Delta, the hypsometry is limited to very narrow range of value. The maximum difference in altitude is 15 m and is given by the highest point (+12,4 m) of the Letea dunes and the lowest lake bottom (-3 m) from the marine part of the delta. Compared to the Black Sea level, only 20.5 % of the delta

area is below 0m. The rest (79.5 %) is above 0m the most of which (54.6 %) is in the range 0 – 1 m above MBSL. If, the 1 – 2 range (18.2 %) and that of below 0 m are added to this range, more than 93 % of the delta area is within the 3 m range of hypsometry (Gâștescu, Știucă, 2008).

Climate. The climate of the land that surrounds the Danube Delta is continental, with hot dry summers and very cold winters. Clear-sky days average 66 days/annum in Tulcea, while Sfântu Gheorghe enjoys an average of 80 such days each year. Tulcea has some 2,260 hours of sunshine and Sfântu Gheorghe averages 2,502 hours of sunshine each year. The influence of cyclonic weather from the Mediterranean tends to result in sudden changes in weather and intensive rainfall, eSpecieslly is summer. Anticyclonic conditions derive from the Azores and Eastern Europe and Russia. Both have a stabilizing effect on the climate, but the latter often brings arctic and polar winds. Temperatures can go below - 27˚C, though close proximity to the Black Sea reduces the chill factor. The average annual temperature in Tulcea is 11˚C, max 39.7˚C min – 27˚C. Similar measurements for Sfântu Gheorghe show an average of 11.4˚C, with maxima of 36.3˚C and minima or –21.5˚C. The first date for autumn freezing in Tulcea is around the 31st October, while Sfântu Gheorghe remains frost free until about the 12th November. Average rainfall is higher in Tulcea, with 438.4 mm whereas Sfântu Gheorghe receives 403.6 mm. Average humidity is higher in Sfântu Gheorghe at 86 % compared to Tulcea's 80 %. The Biosphere Reserve is one of the windiest zones in Romania (Gâștescu, Știucă, 2008).

Waters. *The hydrological regime* basically the water circulation, represents the vital component of the very existence of the delta space. Since the water volume transported by the Danube to Ceatal Chilia is 205 km3/year at a multiannual mean of 6,515 m3/sec (1921 – 2000) and with it a quantity of alluvia of 58.75 million t/year (the average for the same period), and 90 million tons of salts/year corresponding to a mineralization of 350 mg/l and 2,576.1 * 1012 Kcal. This sub-system is undoubtedly playing a basic role within the configuration and evolution of the delta space. Of the matter and energy transported by the Danube, 95 % reaches the three arms and flows into the sea, and only 5 % is taken over by the network of backwaters and canals (Gâștescu, Știucă, 2008).

Chemistry of the Danube's waters within the delta. The chemical composition of waters within the delta is relatively homogenous. The mean value for dissolved minerals varies between 300 – 500 mg/litre, according to seasonal changes and dilution factors. The Danube drains many mountainous areas where limestone is the main geological component. Not surprising, the waters of the river are high in dissolved bicarbonates, calcium and magnesium. Sodium, potassium, sulphates and chlorides are also present. Bearing in mind the influx of calcium rich floodwaters into the delta in early summer, the fate of calcium and bicarbonates in open waters in the delta is interesting. Both show high values in spring and autumn when the pH of the water is lower. Warm weather brings about a partial transformation, as a result of intense

photosynthetic activity. The pH of the water entering the delta tends to range between 7.7 – 8.5.
The amount of inorganic nitrogen varies between 0.7 – 3,6 mg/L and the organic phosphorous range from 0.02 – 0.2 mg/L. It has been estimated that the amount of inorganic nitrogen flowing into the delta system in 1961 was 113,000 tons to 176,000 tons in 2003. Organic phosphorous entering the delta in 1961 was estimated to be 5,500 tons and this had increased to 44,000 tons in 2003. Nevertheless, the amounts of organic, nitrogen and phosphorus recorded in coastal waters in the Black Sea increased significantly between 1983 – 1988 (Gâștescu, Știucă, 2008).

Biodiversity and ecosystems within the Biosphere Reserve (Gâștescu, Știucă, 2008). The Danube Delta maintains its enormous biodiversity in a better state than most other deltas in Europe, even in the world. It contains a greater range of habitat types, lower and higher plants, invertebrates and vertebrates than all other deltas in Europe. Many of the species that live within the delta are unique to it, these include plants and animals. The static freshwater ecosystems provide the base for the food chain in much of the delta. The contribution they make „spills over" in canals, rivers and other moving waters. Protozoa, Micro-algae, algae and macrophytes are the primary producers, on which zooplankton, oligochaetes, molluscs, insects, fish, amphibia, reptiles, birds and mammals feed in ascending order within the food chain. Imbalances in some seasons have allowed some components like blue/green algae to thrive, to the detriment of macrophytes and many of the animals that depend on plant life. Inevitably, the more adaptable fish species (roach, crucian carp and perch) have survived then thrived, at the expense of species like pike, zander and common carp (*Cyprinus carpio*). Terrestrial ecosystems have suffered less than aquatic ones, because they are less easy to pollute and over fish. Exploitation by grazing, arable cropping, forestry, reed cutting is limited to areas where this is possible and in much of the delta these potentially damaging activities are impossible.
***Flora*.** The Dobrogea region that adjoins the Danube Delta provides habitats for 50 % of the 3,800 plant species recorded in Romania. Compared with this, the delta itself and the Razim-Sinoie lake complex supports 779 species (20 % of the National species list). Their distribution is as follows: euroasiatic (30 %), continental asiatic (15 %), cosmopolitan (10 %).
Fish. They represent the fauna of the delta, more than any other type of animal. Birdwatchers may not agree, but fish are economically more important and angling is a major leisure pursuit for many local people and visitors. Of the 300 fish species recorded in Europe, 185 species occur within Romania. Of these 134 species have been recorded within the Biosphere Reserve. The sturgeons are the most primitive type of fish caught in the delta and three species run into the river to spawn. There are 31 species of fish that are able to live in both seawater and freshwater. They come into the rivers and canals to spawn and they include the Danube herring (*Alosa pontica*), Black Sea Salmon (*Salmo trutta labrax*) shad, and a small clupeoid herring (*Clupeonella cultriventris*). Some of the carp, perch, zander and Danube catfish are able to withstand small dilutions of salt water. There are 44 fish species that live exclusively in the freshwaters of the delta. These include pike, tench, rudd, orfe, barbel

and bream. Many of these fish are very important commercially and they provide the main source of income for people who live in the delta.

Amphibia there are two species of newts, seven species of frogs and four species of toad. The lake, pool and edible frogs are particularly abundant in the delta throughout the year and unlike the common frog (*Rana temporaria*) they tend to stay in lakes, canal and riversides all year. There are two species of spadefoot or digger frogs, the brown earth frog and the sireaca earth frog – the second being found in sandy shore zones. The green' frogs are an important food source for many birds like the white stork, herons and egrets. Tree frogs (*Hyla arborea*) are also common in the delta, as are fire-bellied toads (*Bombina bombina*). Common toads are less common in the delta, but green toads are very common in settlements.

Reptiles are well represented in the delta with terrapins (*Emys orbicularis*) and tortoise (*Testudo graeca ibera*). The latter is more common in the south-western sector of the Biosphere Reserve. Four species of lizard are found, as are five species of snake. There are two species of 'grass' snake (*Natrix natrix* and *Natrix tesselata*) and also the smooth snake, steppe viper and *Coluber caspius*. The Berne Convention protects all species of reptile.

***Birds*.** There is no other place in Europe where such a great diversity of land and water birds can be found. 375 bird species are recorded in Romania and, of these, 325 live in the delta or migrate to it in the summer or the winter. 166 species nest in the Biosphere Reserve and most of these are summer migrants, which spend the winter in Africa or the Mediterranean. Many of the birds that live or visit the delta are strictly protected or given some measure of protection by the Berne Convention. Of the 325 species recorded within the DDBR, 224 species are currently given strictly protected status. There are some introduced species, like the pheasant, but these do not pose a threat to any native Phasianids. The spread of the ornamental ruddy duck North American across Europe is a threat to the white-headed duck.

Mammals. Among the 110 species that are native to Romania, 44 have been recorded within the DDBR. There are large numbers of native rodents, but the muskrat was introduced from North America in 1954 and it has established itself as one of the delta's most plentiful mammals. Rabbits are commonplace in Letea and Caraorman forests and in the farmed area of Pardina. The otter and European mink are both protected, due to over trapping for their pelts. Ferrets and stoats are found occasionally in the DDBR, but badgers are very rare in this territory. Hoofed mammals, the „ungulates", are represented in the delta, by forest loving roe deer and swamp dwelling wild boar. Amongst the larger predators the wolf is now extinct as a breeding species within the delta, though individuals have been known to move into the territory from Ukraine in particularly cold winters when they are able to cross the ice – this is not a usual event. Foxes maintain a stable population, but over-trapping has reduced the racoon dog's numbers. Originally, this species migrated into the DDBR from eastern Siberia, being recorded in the delta since 1953. Another member of the dog family, the golden jackal has moved into the territory from Asia Minor, via Bulgaria. The wild cat is present, but very rarely encountered in the forests of the delta. Three species of dolphin are recorded in the Black Sea and of these, the common dolphin is

the most frequent. A combination of hunting and reductions in the numbers of fish available to them has resulted in a decline in their numbers.

Soils. The soils found in the delta are largely of riverine origin. However, wind-blown loess soils are present in areas like Grindul Stipoc and Câmpul Chiliei, but they were probably deposited by the northern arm of the river, following erosion of loess deposits. Alluvial soils are typically young soils that make up the sandbanks in the delta and which receive fresh alluvia during times of flood. Some of these banks are high enough 2 – 5 meters MBSL to be well drained and aerobic. These soils are important in farming districts, but they tend to break down to form dusts – leading to the formation of surface crusts. Limnosols include lake and lagoon deposits. They consist of fine sediments, organic material and calcium carbonate deposited during the summer. These soils are often associated with high organic histosoils, like turbars or peats. Gleyed soils are the most important component within the soil cover of land between 0 – 0.5 meters MBSL. Most develop on alluvial soils but they have also formed on loess deposits (Câmpul Chiliei). The gley soils within the delta tend to be very productive in the summer months, when the water table is low and the soils are both warm and well aerated. Psamosols or sandy soils are associated with sandbanks and dunes in the marine sectors of the delta. They tend not to have well defined soil profiles and they may overly 4-13 meters of similar deposits. They are ecologically very important, because of the plant communities they support. Soloneac soils occur in zones typified by salty groundwater and they are particularly well developed in dune slacks in areas like south Letea, eastern Caraorman, western Sărăturile, and lacustrine areas within Chituc, Istria, Lupilor. Solonet soils are very restricted in distribution to areas in the eastern part of Câmpul Chiliei. These loess-based soils are better drained than soloneac soils, in that salty water lies at 2 – 2-5 meters and not at or just below the soil surface. Grey soils characteristic calcium-rich steppe soils, that have developed within dry continental climate areas on Câmpul Chiliei and Stipoc. They are well drained and the highest areas are used for arable cultivation, whereas those closer to the water table are used for grazing. Chernozems are spread on thick deposits of loess in the southern Câmpul Chiliei and Stipoc dune areas. They tend to be gleyed and the land they overly is used mainly for grazing. Histosoils are the most abundant in the delta and they tend to have depths of more than 0.5 metres of organic material, usually unhumified (non oxidised). They are formed when undecomposed roots, rhizomes, stems and leaves of sedges, reeds, reedmace and Salix spp. build up under anaerobic conditions. These soils are also referred to as turbars or peats and they have the capacity to hold water and to act as physical and microbiological filters. Anthroposoils are primarily those that owe their location to mans' activities, like the creation of soil banks during dredging operations. They consist mostly of alluvial deposits, mixed with organic material and plant remains. All tend to be rich in lime, so they degrade rapidly (Gâștescu, Știucă, 2008).

Economic activities (Gâștescu, Știucă, 2008). The Danube Delta land-use structure is the following: 58.2 % of the area is in a natural state (river and marine levees with forests and pastures, canals, lakes, swamps - part of them protected) and 41.8 %

agricultural polders (400 km^2), fish ponds (365 km^2), forest plantations (64 km^2). Noteworthy, the Danube Delta is to undergo some ecological management. Since ancient times, fishing has been the main occupation of the Danube Delta inhabitants and although today the supply of fish has diminished and changed in quality, it continues to be basic trade. A second major occupation has been (and still is) sheep and cattle breeding. Traditional agriculture has been practiced successfully by the inhabitants of the settlements situated on the riverine levees at low risk from flooding. After 1960, these traditional occupations were drastically modified by the extension of reed exploitation (later abandoned), fish ponds, large agricultural polders (also partly abandoned) and forest plantations. The introduction and spread of non-native species have also put pressure on less adaptable fish.

Agricultural activities are the split responsibility of the Judeţ of Tulcea, town councils and the Central Board of Agriculture, while the ARBDD monitors effects of farming activities on ecosystems.

Bee keeping is not as important as it is within the neighbouring Dobrogea, due to a shortage of suitable flowering plants.

Reeds (Phragmites australis) are ecologically and economically very important in the delta.

Forestry within the delta has enjoyed a rather chequered history, mainly due to the use of inappropriate species to create plantations. Natural woodlands do not tend to suffer from the same problems, since they have evolved in balance with nature.

Navigation. The Danube Delta and its mouths have been used for navigation since the Antiquity.

Tourism. The Danube Delta is an area with a high reputation in Europe and elsewhere in the world; the number of foreign visitors is very limited and the level of accommodation is still low.

Mineral resources have been exploited in the past, in the form of sand for use in the construction industry.

Heavy industry is located on the margins of the delta, particularly on the western side of Tulcea.

The administration and management of DDBR is a complex process, distinct from, but linked to local government structures that operate within the reserve. They comprise DDBR lands under national control, lands under local government control, and lands privately owned, distributed among seven communes and the town of Sulina. According to Law No. 69/1991, the local communal councils include elected bodies that make all decisions relating to land under their control, including development planning and control, public works, conservation of historical monuments, recreation facilities and protection and improvement of the environment in order to better the quality of life. The next level of government is Tulcea County, which coordinates various communal services on behalf of the communal councils, and takes responsibility for land under its own control, town planning, maintaining and improving the infrastructure (roads and water supply). Within the DDBR, the county controls fish areas, agricultural polders and forest plantations (about 860 km^2) used by companies in which the state holds a majority share.

1.2.2 - Danube Delta – Ukraine (IMB)

The Danube Biosphere Reserve was founded by the Decree of the President of Ukraine #861 at August 10, 1998, on the base of Natural Reserve "Danube Wetlands". At this time its area (including of the parts joined the reserve in 2004) consists of 50253 ha. By the decision of the International Coordinating Committee of the UNESCO 'Man and the Biosphere' Programme from December 9, 1998, the reserve was included in the global network of biosphere reserves as part of the bilateral Romanian-Ukrainian biosphere reserve "Danube Delta".
The climate in the delta is temperate continental with relatively short warm winter and long hot summer. Its typical landscape is formed by reed and willows. The hydrological regime of the territory is almost entirely determined by the hydrology of the Danube. Among the large rivers of the north-western Black Sea region, only the Danube forms a deltaic forefront because of the great turbidity of the Danube water. Tens of millions of tons of silt are deposited in the shallow waters of the reserve every year. Some years its area has increased by 30-40 hectares.
However, now the biggest environmental problem for the Ukrainian Danube Delta continues to be the large-scale redistribution of the Kiliia Branch in direction of the Saint George Branch – from 72% in 1910 to 47.5% in 2020, which arose due to a number of primarily anthropogenic and natural factors. For the Kiliia Branch, the loss of runoff averages about 40 km^3 per year (for comparison, it is about 5 annual inflows of a river such as the Dniester River or about the entire annual inflow of the Dnieper River). The affect of this redistribution is visible along whole Ukrainian part of the Danube River: the condition of all Danube lakes (80 thousands ha) are worsened, entire riverine branches died, threat to threat to the water supply of settlements, the saline water intrusion reached the town of Vylkove (20 km from the sea).
The presence inside the Natural reserve of the sea ecosystems, mixed
Waters and totally freshwaters, as well as various types of landscapes, lead to rich biodiversity. The total number of flora species consists of 1571, but fauna – 1660. It includes 1 187 invertebrate species and 473 vertebrates (113 species included in the Red Data Book of Ukraine). Among the vertebrates, 108 species are fishes, 11 - amphibians, 6 – reptiles, 302 - birds, and 46 - mammals.
The area of the Danube delta almost lack of industrial factories which could source of pollution of the protected area. The Danube Biosphere Reserve is almost totally placed inside the territory of the Vylkove municipality (hromada) (see Fig. 1). The area of the delta part of the reserve is 46,403 ha, but one of the municipality is 55380 ha. Only the Yermakov Island (area of 2334 ha) is related to the Kiliia municipality. Thus, 80% of the Vylkove municipality is related to the Natural Reserve. A specific unique resource of the municipality is its geographical location on the border with the Romania (a member of EU), in the Danube Delta and on the Black Sea coast, which, combined with the extremely high share of the protected area, provides significant potential for tourism and recreation.

The population of the municipality (the Town of Vylkove and four villages) consists of 13460 people and has high trend to decrease.

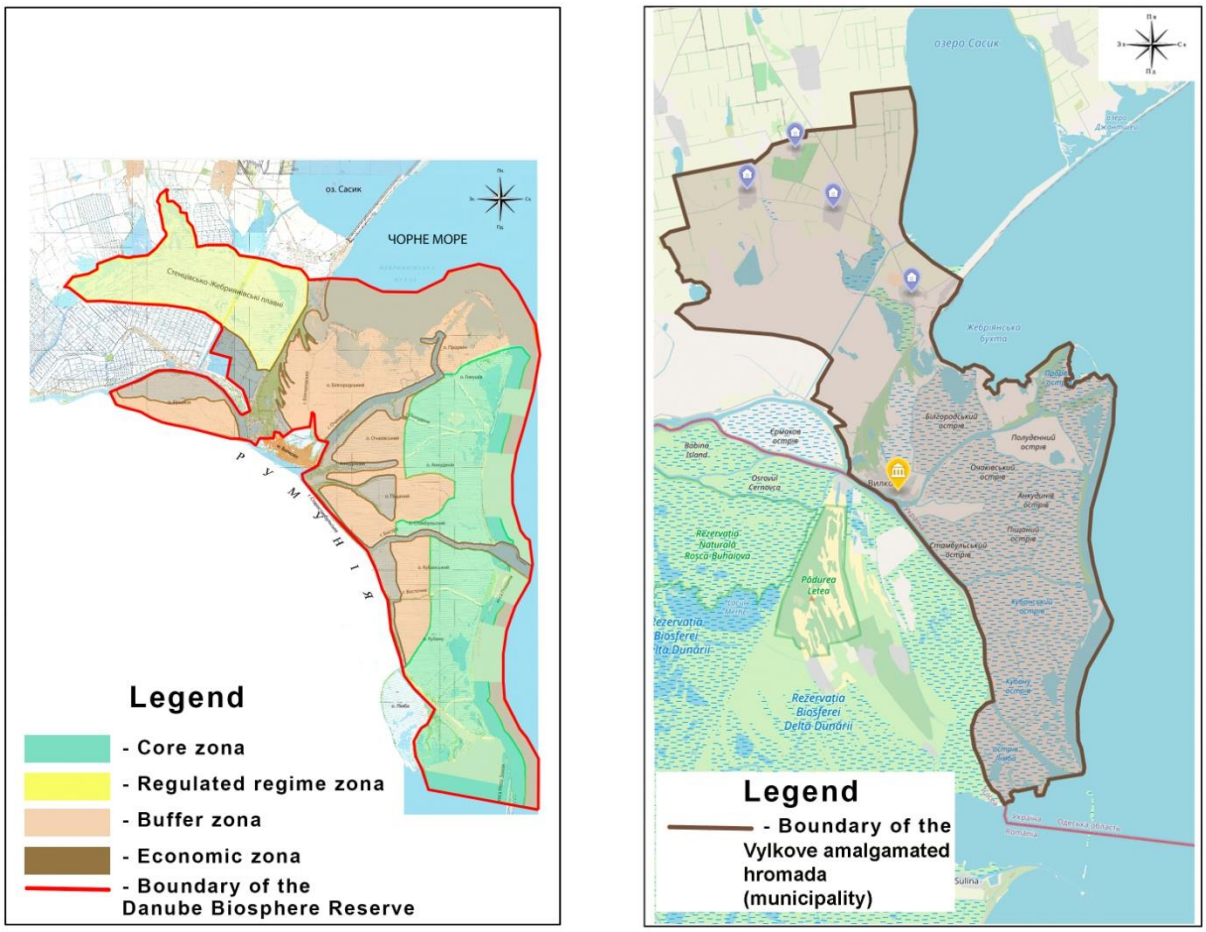


Fig. 1. The maps of the Danube Biosphere Reserve (left) and Vylkove municipality (right).

The main type of nature management in the reserve is commercial fisheries (up to 730 fishermen in period of the Pontic shad migration). Winter harvesting of reeds, which is exported for the installation of roofs, provided up to 1,000 jobs places. In addition, up to 300 people were involved into processing and sorting of reed in summer. Nevertheless, because of low water level in Danube and climatic changes the reed did not grown enough for commercial usage in last two years. Therefore, the winter harvesting did not provided in this period.

About 350-380 families in the municipality are consistently engaged in horticulture and gardening. The number of cattle that pasture free in the delta varies from year to year and consists of 340-450 heads.

After the establishing of the Biosphere Reserve, the tourism industry is significantly developed in the municipality. Now, 17 companies are engaged in tourism and about 60-70 thousands of tourists are visited the municipality. In general, about half of the adult population of the municipality engaged works in the reserve.

Among the industrial factories, only a sand quarry and the Danube-Black Sea waterway operate on the territory of the reserve. There was a lot of discussion about its impact on the delta ecosystem at one time, but its operation and, accordingly, the depth and volume of deepening stopped at the first stage of construction. A new reconstruction project begins to be developed only in 2020, which is under public discussion and cross-border evaluation, primarily with the Romanian side.

Also, the Vylkove forestry (11,575 ha) operates in the deltaic area and the reserve. It includes little less than 1 thousand hectares of artificial plantations of the Crimean pine, the same area of natural riparian forest, but all other areas are covered by the solid reed thickets.

The cultivation of strawberries, grapes, vegetables and cereals, as well as beekeeping are well developed in the dammed territories of the former Danube delta and adjacent steppe areas. At the same time, the climate changes and desertification in the south of Ukraine, the dominance of various alien species, makes these activities more and more risky.

1.2.3 - Nestos Delta – Greece (IHU)

Nestos River is one of the most important rivers in Greece. It originates from Mount Rila (2716 m) in southern Bulgaria between the mountainous ranges of Aimos and Rodopi. Its Bulgarian name is Mesta. It is 234 km in length and its basin covers an area of 5749 km^2, of which 130 km and 2280 km^2 lie in Greek territory (Samaras & Koutitas 2008). Before it reaches the sea, the main river spreads over the coastal plain of Chrysoupolis and expands as a deltaic system with freshwater lakes and ponds forming the Nestos Delta.

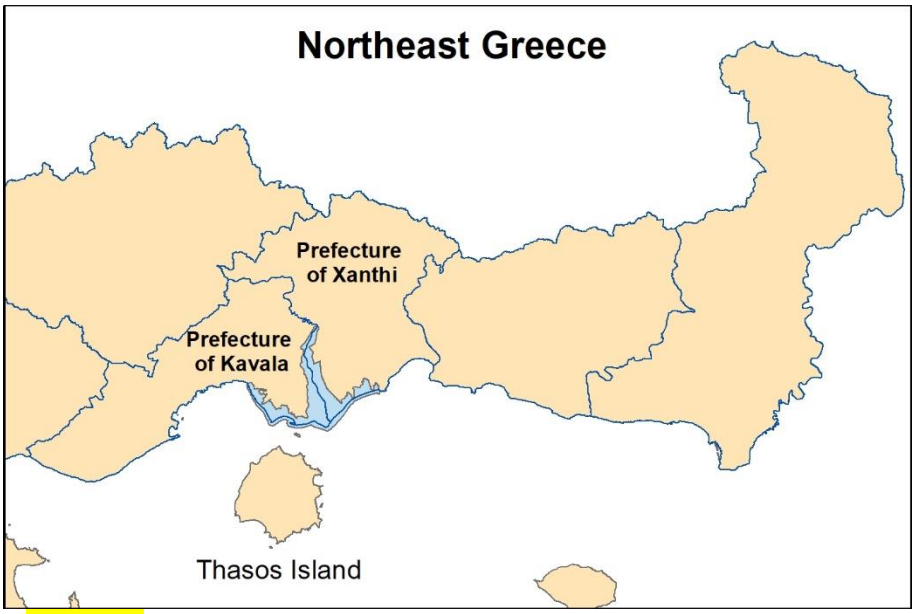


Figure 1. Map of East Macedonia showing Nestos Delta area

From an administrative point of view, the Nestos Delta, is divided between two Prefectures, the Prefecture of Kavala and the Prefecture of Xanthi in Northern Greece, whereas its largest part is found on the territory of the Prefecture of Kavala (Fig. 1). Each Prefecture is represented by one municipality; Municipality of Nestos is located in the western part of the area, whereas on the eastern part, Municipality of Topeiros is located. The majority of the population (56%) in the greater Nestos Delta area lives in urban and semi-urban areas, while 44% in rural areas. Although the general population trend in both Prefectures, that is the Prefecture of Kavala and the Prefecture of Xanthi, where the Nestos Delta study area is located appears decreasing over the past few decades, the urban population shows an increasing trend. In terms of the age class distribution of the local population in the greater Nestos Delta area just 12% is over 65 years of age. Almost 70% of the population belongs to the economically active age groups, that is, from 15 up to 65 years of age. Almost 1/3 of the economically active population of the area is occupied in agriculture (30%), 23% of the local population is occupied in services, 17% in manufacture, 11% in commerce and only 4% in the tourism sector (Hellenic Statistical Authority).

According to Mallinis et al. (2011), the plain area of the two Municipalities, was changed after the second world war. Specifically, in 1945, the entire area of Nestos Delta was almost totally dominated by forests and wetlands, covering a total of 3750 ha (63.0% of the Delta), whereas rangelands occupied 16.1% of the landscape followed by agricultural areas (4.2%). On the contrary to these natural landscapes, no built-up areas were evident in the landscape. However, in 1960, a significant landscape transformation was observed. Specifically, agricultural areas occupied approximately 34.4% of the Delta, whereas forested areas were declined at a 76.5% as a result of the intensified agriculture. A major decline of the wetland covered areas (-62.8%) was also noticed due to its conversion mainly to rangelands. The alluvial areas along the coastline increased by 127.1% compared to 1945, leading to a decrease of the extent of the sea. Due to this transformation, residential areas were recorded for the first time, despite that these occupied only a small portion of the delta (0.1%, 4.3 ha). In 1992, agricultural areas increased by 35.0% compared to 1960, replacing rangelands. A significant increase from 1960 to 1992 (61.0%) was also observed in wetlands at the expense of rangelands and inland waters. Alluvial areas also experienced loss of coverage (57.8%). Additionally, a 1472.1% increase of built-up areas was observed compared to 1960 (1.2% coverage; 68 ha).
Despite the extensive decline in the natural landscapes of the wider area, the region has still the most extensive riparian forest in Greece (Vasilopoulos 2005). Thus, the Nestos Delta is of high ecological significance because it hosts a high number of important habitats, and because it hosts a large number of bird species (307 different bird species have been recorded so far), several of which are endangered and strictly protected raptors. Based on this fact, the Nestos Delta has been classified as a wetland of international importance and in 1971 it was included in the Ramsar Convention. The area is also protected by the Bern Convention, the EC Directives, and is considered a protected area by Greek legislation. Finally, it belongs to the Natura 2000 Network, a designation which includes regions of special environmental interest (Dafis et al. 1997).
The Nestos Delta is significantly rich in habitat types. According to the Monitoring Report for Terrestrial Habitats in the Nestos area, 31 categories of habitat types are present which can be shown in Table 1 and Fig. 2. Most of the habitat categories that are presented in Fig. 2, are natural formations corresponding to habitat types of good conservation status. Moreover, some of these habitats form also types of priority. It is worth mentioning the riparian forest of Kotza Orman, with its distinct physiognomy, which requires specific management attention, as this is the forest which has been substantially diminished over the past several years.

Despite the complex mosaic of habitat types of the region and their good conservation status, many of these face major problems, which are directly related to the lack of water resource management, the expansion of agricultural activities, species disturbance by various human activities, the degradation of key habitats, such as breeding islands in the lagoons, and various illegal activities, such as poaching or use of poisoned baits.

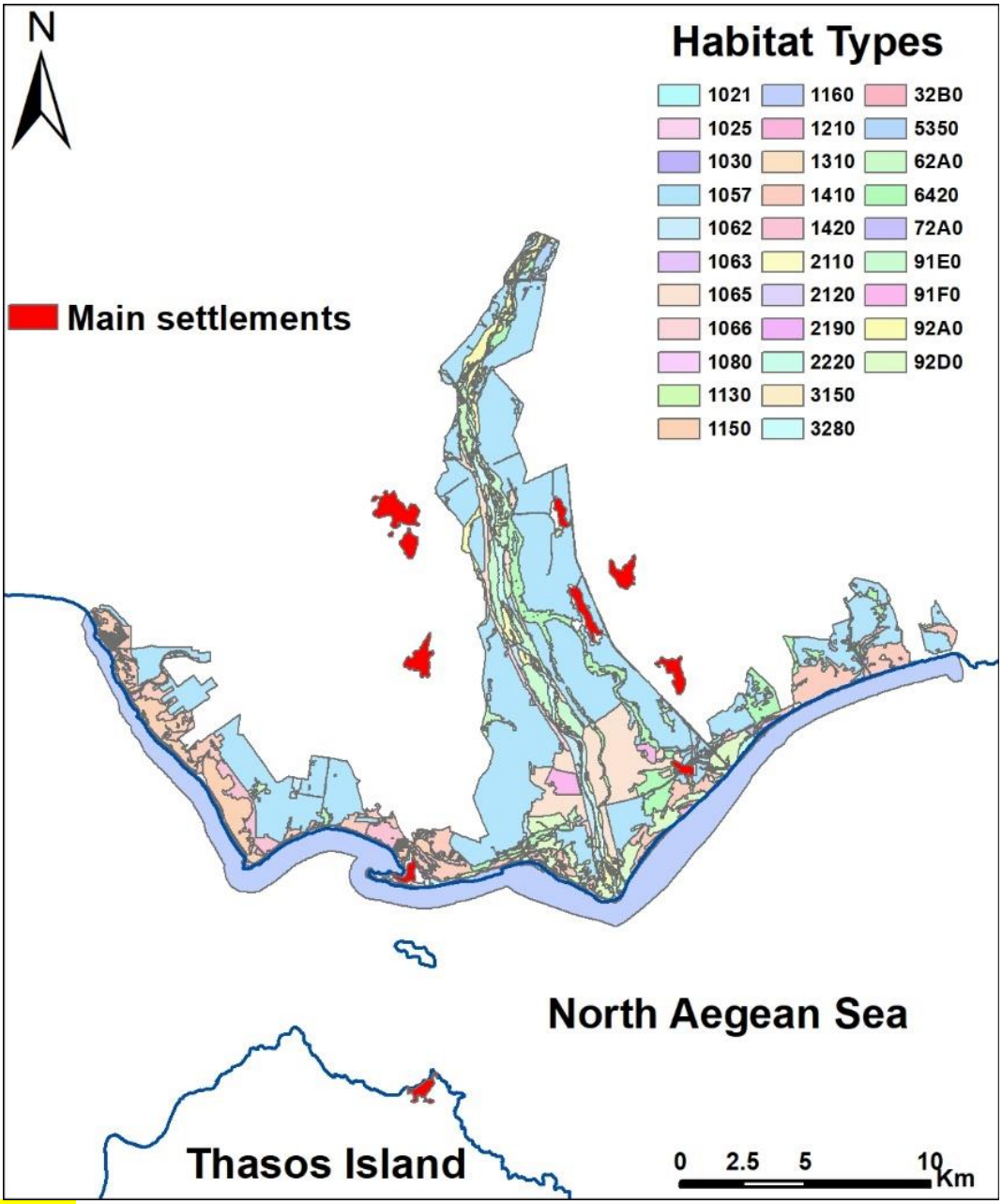


Figure 2. Map of the Nestos Delta area showing the habitat types (Ministry of the Environement and Energy)

Table 1. Habitats that have been recorded so far.

Code	Description
1021	Concentrations of agricultural / processing units
1025	Roads
1030	Areas of extraction / processing of minerals, aggregates, etc.
1057	Arable cultivated land
1062	Abandoned crops
1063	Rivers

1065	Plantations with forest trees
1066	Fruit trees & plantations
1080	Water collections
1130	Estuaries
1150	Coastal lagoons
1160	Large shallow inlets and bays
1210	Annual vegetation of drift lines
1310	*Salicornia* and other annuals colonising mud and sand
1410	Mediterranean salt meadows (Juncetalia maritimi)
1420	Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi)
2110	Embryonic shifting dunes
2120	Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)
2190	Humid dune slacks
2220	Dunes with *Euphorbia terracina*
3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation
3170	Mediterranean temporary ponds
3280	Constantly flowing Mediterranean rivers with PaspaloAgrostidion species and hanging curtains of *Salix* and *Populus alba*
32B0	32B0 Euro-Siberian annual communities of muddy river banks
5350	Pseudomaquis
62A0	Eastern sub-mediteranean dry grasslands (Scorzoneratalia villosae)
6420	Mediterranean tall humid herb grasslands of the Molinio-Holoschoenion
72A0	Reed thickets
91E0	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)
91F0	Riparian mixed forests of *Quercus robur, Ulmus laevis* and *Ulmus minor, Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (Ulmenion minoris)
92A0	*Salix alba* and *Populus alba* galleries
92D0	Southern riparian galleries and thickets (NerioTamaricetea and ecurinegion tinctoriae)

Some of the most significant habitat types or vegetation formations that can be found in the Nestos Delta area are the following:

- Riparian mixed forests of *Quercus robur, Ulmus laevis* and *Ulmus minor, Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (Ulmenion minoris) (habitat 91F0). They are one of the most important vegetation types covering some 66 ha. They occur on the embankments, in the fenced part of the riparian forest. They develop on soils with low moisture, rarely flooding and very fertile. This vegetation type is characterized by a profusion of climbing plants.

- Riparian curtain-like forests with willows-poplars. Such formations can be seen from the Toxotes barrage to the estuary, on sandy or sandy-clay soils along the riverbanks. They are formed of *Populus alba* and *Salix alba* with *Typha* stands and cover c. 690 ha.

- Galleries with *Salix alba* and *Populus alba*, dominated by *Salix alba*, *S. fragilis* and *Populus* sp., with *Fraxinus* sp. in areas not waterlogged throughout the year. Apart from these tree species, the specific formation also includes many climbing plants. It is tolerant to inundation by running water and occupies around 470 ha.

- Mediterranean riparian gallery and thickets. This type of vegetation appears inland of the low halophytic vegetation. It is poor in species due to the adverse soil conditions (high water level or permanent inundation and high soil salinity), and dominated by *Nerium oleander*, *Vitex agnus-castus* and *Tamarix* sp.

- Annual vegetation on silty riverbanks. Annual herbs growing on muddy substrate rich in nitrogen (Isoeto-Nanojuncetea) appear in patches and cover a very small area.

- Reedbeds. Beds of *Arundo* and *Typha* develop on standing or slow-flowing waters, and also on very wet soils, covering an area of some 2.7 ha.

- Xeric meadows of Eastern Mediterranean. Festuco-Brometalia meadows develop on sandy islets mostly in the northern part of the river and in former riverbeds (c. 60 ha).

- Mediterranean meadows with high grass and bulrush. Wet meadows with herbaceous plants, characterized by the occurrence of *Erianthus ravennae*. They appear on clay or sandy-clay soils created by river sedimentation, covering some 170 ha, mostly along former riverbeds where salinity is high.

- Mediterranean temporary ponds. The cover a very small area.

1.2.4 - Kızılırmak Delta – Turkey (KTU-MSF)

The Kızılırmak Delta is cover 56.000km^2 and 11.600 km^2 of it's wetland areas which are consisted of natural and semi-natural wetlands areas. 11,580 hectares of these areas are open water surfaces, fresh and salt water swamps, wet meadows, and pasture areas, 2,330 hectares of beaches and coastal dunes, 1,850 hectares of the 3,100 hectares of forest area are flooded forest, 1,250 hectares of broad-leaved forest areas. The combination of different habitats (habitats) such as sea, rivers, lakes, reeds, swamps, meadows, pastures, forests, sand dunes, and agricultural areas have provided the delta to have an uniquely important biological diversity. On the coastal part of the delta there are dunes reaching 200-300 meters in length and 7–8 m in height. It is the only wetland on the Black Sea coast that has not lost its delta feature. 22,000 hectares of the area was declared Ramsar area in 1998. 5,174 hectares of land have been declared as a wildlife development area. It was determined to be a habitat for waterfowl in 1994 (SIÇDR, 2014).

The Kızılırmak Delatic area has many small lakes such as; Lake Balık (1389 ha), Lake Çernek (589 ha), Lake Uzun (293 ha), Lake Liman (322 ha), Lake Gıcı (125 ha), Lake Tatlı (52 ha), and Lake Karaboğaz (295 ha). These lakes spread parallel to the sea on both sides of the Kızılırmak Delta, which was formed with the embrace of River Kızılırmak with the sea, in the area within the borders of 19 Mayıs, Bafra, and Alaçam districts in Samsun province. A number of small and transitory water basins among these lakes that have a lagoon character dry out in summer. Connection of lakes with the sea is through a narrow strait, except for Tatlı and Gıcı. Thirtyfive fish species were identified in the Kızılırmak Delta, seven of which are considered as "Critical-CR" (critically endangered) according to the IUCN category. Among the identified species, *Cyprinus carpio* (carp) and *Aphanius dandrofii* (sailton pupfish) are local species. The species *Anguilla Anguilla* and *Acipenser nudiventris*, which were specified to be endangered in the Fish Species List, are pointed in the publications as not available in recent studies (Zengin et al., 2008 and 2013).

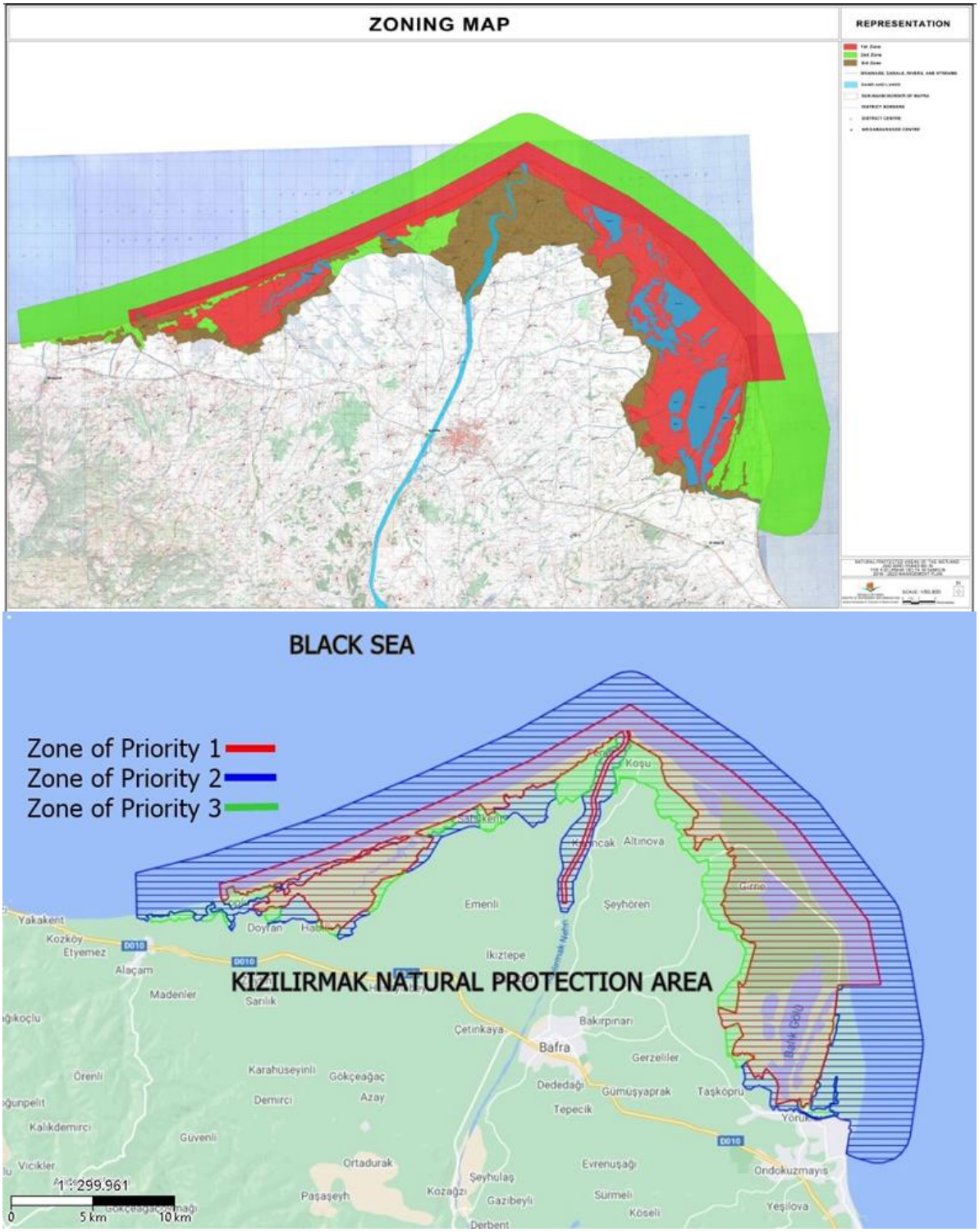


Fig 1. Protection zones of the Kızırmak Natural Protected Area (http://tvksays.csb.gov.tr/citizen).

Red zone : Natural Protected Area of Priority 1: According to the Leading Decision concerning the Requirements of Conservation and Utilization, an area must be

protected for public interest because of having outstanding features and beauties, which must be protected in-situ, where no activity is feasible other than any scientific study for the purpose of protection. Blue zone: Natural Protected Area of Priority 2: An area which might be put into service considering the public interest, along with protection and improvement of the natural structure. In such areas, no building is allowed other than touristic facilities with a tourism investment and tourism management certificate and service purpose buildings. Green zone: Natural Protected Area of Priority 3: An area which might be put into service for house building, considering the potential and utilization of the locality, for the purpose of protecting and improving the natural structure. Any village complexes within a natural protected area of priority 1 and 2 will be considered as a natural protected area of priority 3.

The wetlands of the Kızılırmak Delta, as a Ramsar area, are a part of the ecological structure and the fishing activities have been gone on for years in the area, fishery may not be ignored as an embodiment of the relationship between mankind and ecosystem. It is distinguished as a living, breeding, feeding, and protection area for many fish species such as sturgeon, eel, sailton pupfish, shad, etc. However, there is insufficient data about the structure, improvement, regression, threats, species, and size composition of the fish populations, trends over the years, and efficiency, number, etc. of the fishing gears in the delta, which causes uncertainty about evaluating the impacts of fishing on the ecosystem and management of fishing, thus shortcomings and failures. Although there is not any structure that continuously prevents the entry of migratory species into the river or the lakes in the delta, it appears that there are problems about the advancement of sturgeons in particular within the Kızılırmak. Both the sills made in the main bed of the river for the purpose of flood control and absence of fish gateways in Derbent and Altınkaya Dam Reservoirs prevent migration in the spring-river mouth-spring route. Hence, while sturgeons, shads, and eels (3 sturgeon species, 2 shad species, and European Eel) are encountered in the Black Sea on the coastal zone of the delta, no records were reported about these species at least in the section of Kızılırmak upto the outlet of Derbent Dam Reservoir. In addition, closing up of the canals or transitory water canals that connect the lakes to the sea at certain times to prevent ingress of water back from the sea or to avoid drop of the water level in the lake interrupts the connection of sea-fresh water and therefore passage of the fish and other aquatic creatures between the sea and fresh water.
The most important problem for the fishery in the delta's lakes are the impacts of the Prussian carp, *Carassius gibelio*, (Israel carp in fisher's terminology), which was introduced to the habitat later. This species is known to adapt to ecological changes and unsuitable water quality conditions better than other species and to have a strong competition in terms of food, breeding, and feeding area of the fry. In landing points of Doğanca and Yörükler S.S. Fishing cooperatives, it was seen that about 75% of the catch obtained by the fishers consisted of the Prussian carp, and the remaining 25% consisted of Common Carp (*C. carpio*), grey mullet (Mugil sp.), and pike perch (*S. lucioperca*), which all are commercially important. As stated by the fishermen, majority of the captured Prussian carp are females. Fishermen do not want to catch this species as it does not have any economical value, they spend too much effort to take the fish

from the net, and waste time on it. These factors increase the power of invasion of the Prussian carp further. It is stated that the rudd (*Scardinus eryophtalmus*) species that was captured in the delta lakes in previous years and which had an economical value have not been found on the nets any more after invasion of the Prussian carp.

Sea Level Changes: A rise of about 1 meter is expected in sea level within the next 100 years, due to the climate change. This rise in sea levels will first impact the coastal areas. The risen sea will advance towards the interior lands and impact the floodplain forests, lakes, and reeds around them.
The rise in sea levels due to climate change will not happen immediately but will occur progressively through years. In this case, as the process of the delta's being over-flooded by the sea will progress at a slow pace, position of the existing habitat types will change as well, and probably reeds and forests will regress back to the further hinterland.
This transgression process may gain speed after unification of the lakes with the sea. Raising awareness of the local people should be considered, beginning from the places to be impacted by the rise in the first place. The right agricultural practices to be applied consciously and nature-friendly will minimize the damage to be suffered by the delta due to the rise of sea levels.

Socio-Economic Evaluation: Existence of more than one protection status and therefore more than one public institution being authorized in the Kızılırmak Delta cause confusion of powers in the area. With the impact of the protection status of the delta being constituted of protected areas of priority one, activities carried out in the area such as agriculture, animal husbandry, fish farming, fishing have been attempted to be solved sometimes through legal means and sometimes verbally. Just at this point, adaptation of the local people to the new structure to be formed with the re-setting of the protected areas should be cared for. Accordingly, a common language should be formed with public entities and institutions.
The local people have a sense of belonging. Any person who has identified themselves in the area would have an improved sense of protection. However, there are shortcomings about what is included and excluded by the content of protection. Accordingly, awareness raising studies should be carried out without impairing the sense of belonging of the local people.

Fishery: According to the current status and site observations regarding fishery in the Coastal Area adjacent to the delta and in the Derbent Dam Reservoir (DBG) located on the upper basin of the Kızılırmak Delta (KD), the coast of the Black Sea, Karaboğaz Lake, Liman Lake, Cernek Lake, Balık Lake, Tatlı Lake, Gıcı Lake, and Uzun Lake in the Kızılırmak Delta are areas where fishing/fish farming products are carried out. This area direct and indirect relates to the wetland complex in the Kızılırmak Delta (Table 1 and Table 2).

Table 1. Fish farming facilities and their capacities in the Derbent Dam Reservoir located in the upper basin of the Kızılırmak Delta (Source: Records of GTHB, Samsun Provincial Directorate, 2017)

Sequence No.	Name	Capacity (Tons/year)	Species
1	Dostlar Aquaculture Products Production Pant	240	Trout
2	Kıyak Kardeşler Trout Production Prj	490	Trout
3	Furkan Aquaculture Products	250	Trout
4	Boğazkaya Trout Aquaculture Products	240	Trout
5	Orhan Orta Trout Production Plant	200	Trout
6	Kaya-4 Trout Aquaculture Products	480	Trout
7	Parlak	480	Trout
8	Türköz	29	Trout
9	Kaya-2	900	Trout
10	Kuzey Aquaculture Products Breeding Plant	922	Trout
11	Kuzey-2	960	Trout
12	Samsun Balıkçılık-6	950	Trout
13	Trout Breeding Prj. In Floating Net Cages	29	Trout
14	İskele Aquaculture Products Production	900	Trout
15	Doğanca Köyü Carp Production	No production	Carp
	TOTAL	**6970**	

Table 2. Limited Aquaculture Fishery Cooperatives that are engaged in trade purpose fishing in the ponds in the Kızılırmak Delta and in the Derbent Dam Reservoir, number of members, and location of operations. Yörükler are registered in the Ondokuzmayıs Town, and others are registered in the Bafra Town (Source: GTHB Samsun Bafra District Directorate Records, 2017)

Sequence No.	Name	Capacity (Tons/year)	Species
1	Sarıköy Aquaculture Products Cooperative	138	Fish ponds
2	Doğanca Aquaculture Products Cooperative	200	Fish ponds
3	Yeşilyazı and Altınova Aquaculture Products Cooperative	37	Fish ponds
4	Emenli, Şirinköy, Habilli and Surrounding Villages Aquaculture Products Cooperative	46	Lake Karaboğaz
5	YörüklerAquaculture Products Cooperative	385	Fish ponds
	TOTAL	796	

Fishing, fresh water lobster (crayfish) harvesting, snail and medicinal leech collecting have been practiced in the lakes in the Kızılırmak Delta for a long time. Fishing is an integral part of the delta and wetlands. Six fishing cooperatives were established in the area, some of which are not active for the time being. There are about 769 fishers registered to these cooperatives, according to the data of 2017. Site observations have revealed that fishers basically catch carp, grey mullet, pike perch, common carp, and

crayfish in the lakes on the right part of the delta. In addition, cage fishing is practiced in the wetlands of the delta.
In coastal areas of the delta, adjacent to the sea, the fish are captured from the sea, where no discrimination was made as an area. 19Mayıs District Dereköy Fishing Port (S.S. Dereköy Fisheries Cooperative), Alaçam Toplu Göçkün Doyran Fishing Port (S.S. Toplu, Göçkün Doyran Fisheries Coopertive), and Yakakent Fishing Port (S.S. Küplüağzı Fisheries Coopertive) are in operation on the sea part of the delta. The fishery products were listed in Table 3 along the Samsun Province.

Table 3. Fishery production data across Samsun province for the year 2016 (Kg) (Source: Records of GTHB, Samsun Provincial Directorate, 2017)

Capture Fishing			**Culture Fishing**			**Total**
Sea	**Inland**	**Total**	**Sea**	**Inland**	**Total**	
54709,68	125,53	54835,21	3600,00	1984,69	5584,69	60419,90

Although known to be caught in the Kızılırmak Delta (especially in Lake Cernek), no up-to-date catch data could be accessed about *Astacus leptodactylus* (crayfish) and collected medicinal leeches, frogs, and snails.
According to the records of the Local Directorate of Food, Agriculture, and Stockbreeding of Bafra, it was reported for the year 2016 (except for the Yörükler Cooperative) that 16 tons of carps, 24 tons of grey mullets, and 3.5 tons of pike perche were captured. There are 385 members registered to the Yörükler Cooperative (Source: Ondokuzmayıs District Directorate, 2017) 6,482 tons of carps, ,231 tons of grey mullets, and 1,386 tons of pike perches were caught by the members of this cooperative in 2016. The data about the Prussian carp cannot be accessed, which were hunted and taken to the shore by fishers. According to the site observations (landing points in lakes Cernek and Balık), catch rate of common Carp was at least 3 times higher than the other species. When these data are taken together the majority of the catch is considered to have been obtained from the lakes in the Kızılırmak Delta with a total amount of 125,53 tons.

Legal And Administrative Evaluation: There are Natural Protected Areas of Priority 1, 2, and 3, Wildlife Improvement Area, and Ramsar Site statue within the Kızılırmak Delta for the protection of the natural life. Considering the protection statuses and current uses of the area, there are many public entities and institutions in action. The main designated authorities are the Ministry of Environment and Urbanization, Ministry of Agriculture and Forestry, Ministry of Culture and Tourism, and local units under these entities. In addition, district governor's offices, metropolitan municipalities, district municipalities, and town municipalities are in action in the area. As the area accommodates Natural Protected Areas of Priority 1, 2, and 3, the General Directorate for Protection of Natural Assets and the Ministry of Agriculture and Forestry being responsible for activities in the wetland and Ramsar site, may be considered as the most efficient authorities in management of the wetland.

Establishment and Duties of the Field Management and the Council of Monuments and Management Areas, as published in the Official Gazette dated 27.11.2005 and no. 26006, the 1st article “The purpose of this communiqué is to regulate the procedures and principles for determining the duties, powers, and responsibilities of the advisory board, presidency of the area, coordination and supervision committee, the auditing unit, and the council of monuments that will take charge to provide protection and evaluation of ruins, protected areas, and interaction fields and connection points within framework of a sustainable management plan with coordination of the public entities and institutions and non-governmental organizations, to set and improve management areas, to prepare, approve, implement, and monitor the management plans, and to perform management of the area.”

Within this context, for the purpose of providing sustainable management of the area, namely as the Wetland and Bird Paradise in the Kızılırmak Delta, enlisted in “UNESCO’s World Heritage Tentative List” on 13th April 2016 in field of “Natural Heritage”, Approval of the Ministry no. 10655 and dated 15.09.2017 approved establishment of the Presidency of Area and employment of one president of the area, an urban planner, a biologist, a geological engineer, an official, a secretary, a driver, and two nature protection attendants under such presidency.

1.2.5 - Chorokhi and Kolkheti – Georgia (IBEDC)

The Colchic area has a warm-temperate and very humid climate. The climatic conditions and bio-geographical setting of the Colchis enables the existence of various chariacteristic forest and wetland ecosystems, including extensive temperate rainforests (Nakhutsrishvili et al. 2010) and peatlands of a globally unique functional type (Krebs et al. 2017).
Within the wider Caucasus ecoregion, the Colchic Forests and Wetlands comprise humid pleiocene/pleistocene refuge areas and among the ecosystem complexes with the longest uninterrupted existence in temperate Eurasia (Tarkhnishvili 2014). These forests and wetlands are considered not only a global Centre of Plant Diversity (Davis et al. 1994, 1995), but also a centre of plant endemism in the Caucasus (Zazanashvili et al. 2012), preserving plant associations from the Tertiary period.
The Colchic Forests and Wetlands also overlap with various types of key biodiversity areas, including Important Plant Areas (e.g. Batsatsashvili 2011), nine Important Bird Areas (BirdLife International 2017a), an Endemic Bird Area (BirdLife International 2017b), the most important hotspot of autumn raptor migration in the western Palearctic (Harris 2013), and areas of exceptional invertebrate species richness (e.g. Pokryszko et al. 2011).
The Colchic Forests and Wetlands are part of the Caucasus ecoregion (in the sense of Williams et al. 2006) and of the Black Sea basin. According to Udvardy (1975), they form part of the provinces Mediterranean Sclerophyll and Caucaso-Iranian Highlands of the Palaearctic Realm. However, neither of these provinces accurately reflects the ecological, faunistic or floristic peculiarities of the Colchic region.
In the classification of terrestrial ecosystems of Olson et al. (2001), the Colchic forests are part of the neighbouring ecoregions of Euxine-Colchic broadleaf forests and Caucasus mixed forests within the Temperate Broadleaf and Mixed Forests biom of the Palaearctic Realm. The delineation between the two ecoregions appears somewhat arbitrary, as typical Colchic forests also occur within the areas mapped as Caucasus mixed forests by Olson et al. (2001). Olson & Dinerstein (2002) include them in the Global 200 priority ecoregion Caucasus-Anatolian-Hyrcanian Temperate Forests.
The Colchic wetlands fall into the freshwater ecoregion of Western Transcaucasia as identified by Abell et al. (2008), and do not coincide with any freshwater priority ecoregion as listed by Olson & Dinerstein (2002).
The Colchic zone has a warm temperate climate. Summers are moderately warm (24-25 °C) and winters cool (4-6 °C) (Nakhutsrishvili et al. 2010). The location and topography of the Colchic triangle result in very high average annual precipitation of 1,800-2,200 mm, and exceptionally high local precipitation averages such as on Mount Mtirala, Adjara Autonomous Republic of Georgia (4,500 mm). Precipitation is distributed relatively evenly throughout the year (Nakhutsrishvili et al. 2010), with maxima in December (303 mm in Batumi) and minima in May (84 mm) (Climate-Data.Org 2017).

The Colchic climate should be considered warm temperate not subtropical: Air temperatures are lower compared with subtropical areas, and the seasonality of precipitation is not as pronounced, with significant rainfall throughout the year. This is reflected in the Colchic forest vegetation, which lacks deciduous broadleaf forest with evergrenn understory and is more appropriately described as hygro-thermophilous temperate broadleaf forest (Dolukhanov 1980), or temperate rainforest (Nakhutsrishvili et al. 2015).
Extensive parts of the Colchis Lowlands are wetlands, owing to the warm and wet climate and numerous rivers flowing from the Caucasus Mountains to the Black Sea. In particular vast areas are paludified adjacent to the Black Sea due to the continuous subsidence of the lowland in combination with high precipitation and backwater of the rivers flowing into the Sea. Hence, the main habitats/ecosystems in the Colchis lowland are peatlands, relict Colchic riparian forest, wet meadows, coastal sand dunes, and open freshwater areas.
Flora: The Colchis region is one of the most important refugia of the flora and vegetation of the Tertiary and centre of biodiversity in western Eurasia, along with the Hyrcan region located in the southern coastal area of the Caspian Sea (Knapp 2005). The Colchis region contain more than 1200 species of vascular plants and bryophytes in total. About 220 of them are listed as Caucasus endemics by Solomon et al. (2014).
Vertebrates: Almost 500 vertebrate species have been recorded within the Colchic areas. By far most of them are birds (327), followed by mammals (70), fish (63), reptiles (20) and amphibians (11). The most noteworthy vertebrate species of the series are either threatened or endemic. Only 123 of the 327 bird species recorded within the series breed there; the majority visits during migration and/ or winter only. The contribution of the component areas to the species richness of other groups of the Colchic Forests and Wetlands also differs strongly: The wetlands and lagoons of Kolkheti National Park support the great majority of ichthyofauna, whereas the forest PAs are more important for herpetofauna and mammals. The terrestrial vertebrate faunas of the forest and wetland areas are generally rather different, and complement each other. The Colchic region is one of the very last areas in the world where Ponto-Caspian sturgeons are still regularly spawning. The Rioni, which borders the potential property, is one of four still active spawning rivers for Ponto-Caspian sturgeons in the world (together with the Danube, the Volga and the Ural). It is the last active sturgeon river in Georgia: four species of sturgeons that are critically endangered globally spawn in the Rioni, and two additional species might still occur - Beluga Huso huso, Russian Sturgeon Acipenser gueldenstaedtii, Stellate Sturgeon Acipenser stellatus, Ship Sturgeon Acipenser nudiventris, Atlantic Sturgeon Acipenser sturio and Colchic Sturgeon Acipenser colchicus. After its extirpation in Russia and Turkey - the Colchic Sturgeon is now endemic to the rivers of Kolkheti. However, only small numbers of sturgeon juveniles (Colchic Sturgeon and Stellate Sturgeon) visit Paliastomi Lake within Kolkheti National Park for feeding purposes - but not for breeding - nowadays (Guchmanidze, 2009; 2012; 2013; 2014; 2015; 2016; Ninua & Guchmanidze, 2012). In addition, the critically endangered European Eel Anguilla anguilla and the vulnerable Common Carp Cyprinus carpio occur in the Paliastomi lake, which belongs to the buffer zone of the property.

Invertebrates: The overall species richness of the invertebrate fauna of the Colchic Forests and Wetlands cannot be estimated currently, due to a lack of sufficient data. However, some well-studied groups show both high species richness – particularly if calculated in relation to the study area, and high endemism. A number of invertebrate species occurring in western Georgia are threatened and included in the IUCN Red List. However, all of these species are known from pan-Europe, and Georgian populations were not considered (or only at limited extent) during the assessment of their conservations status. At the same time, Georgian populations of each these species are of particular importance as they represent either marginal or well-preserved and abundant populations. More than 90% of globally threatened species occurring in Georgia are represented in western Georgia including the site cluster only. The conservation status of the great majority of local or regional endemic invertebrates has not been assessed. Nevertheless, all the invertebrate species included in international or national red lists are mostly occurring in western Georgia. These include the globally vulnerable Noble Crayfish Astacus astacus and Apollo butterfly Parnassius apollo, as well as the globally endangered freshwater snail Belgrandiella adsharica.
Chorokhi Delta: The Chorokhi Delta is an integral part of Adjara (southern Kolkheti), located in the southwestern part of Georgia, its area is 80 km2, the hypsometric boundaries of the territory are 0-200 m.MSL (Nizharadze, 1961). The territory of the Chorokhi Delta includes the Black Sea coast from the Georgian-Turkish state border to the confluence of the Korolistskali River. (https://ka.wikipedia.org/wiki/Delta). The relief of the Chorokhi Delta is represented by the Kakhaberi lowlands and nearby hills.The Chorokhi Delta relief formationwas impacted by the Chorokhi River, the Black Sea, coastal winds and someerosion processes (Maruashvili 1964). Due to its direct proximity to the Black Sea, the Chorokhi Delta is characterized by a humid subtropical cli-mate, abundance of atmospheric precipitation, humidityand the prevalence of sea winds (Mge-ladze 2018). We can find 4 types of soils in the Chorokhi Delta: lowland marshy soils, alluvial soils, red soils and yellow loam soils (Palavandishvili 2004).

There are 9 habitats spread in the Chorokhi Delta: seaside sand, coastal sand dunes, freshwater swamps, swamps, woodlands, grassy slopes, cliffs, rocky slopes, roadside. The habitats of the Chorokhi Delta are distinguished by the special diversity and originality of the flora, which is due to its historical past and geographical location. Seaside Adjara, which consists of the Chorokhi Delta, is separated from highland Adjara by the Kobuleti-Chakvi ridge. Due to its close proximity to the Black Sea, which is a kind of thermoregulator of the heat, the flora of the Chorokhi Delta was not affect-ed by the Tertiary and Quaternary glaciation, that is why we can still find the plant groups formed in the Tertiary, floristic complexes rich in relict and endemic species, Colchian elements of vegetation with valuable wood resources, medicinal and other valuable plant resources, many of which were lost as a result of the extraction of plant resources and the arrangement of infrastructure (Man-velidze 2008). There are 271 plant species in 9 habitats of the Chorokhi Delta, which are united in 157 genera of 77 families. Among them3 species belong to horsetails, 12 species belong to ferns; 254 species to angiosperms, among them 217 species are dicotyledonous, 40 species are

monocot-yledonous. There are 244 species of grasses, including 23 annuals and 221 perennials. There are 19 species of timber, including 9 species of trees, 10 species of shrubsand6 species of lianas (Beridze et. al. 2020). 4 species are invasive: *Pueraria hirsuta, Robinia pseudoacacia, Ambrosia artimisiifolia, Xantium* occidentale (Davitadze 2001).

The Chorokhi Delta is important during migration and also for wintering birds. Over 20,000 Water birds migrate and winter there annually, and about 40,000 migrating passerines have been ringed in the Chorokhi delta since 2010. 300 bird species have been recorded in the Chorokhi Delta.

1.3 DAISIE – first pan-European inventory of Invasive Alien Species

Delivering Alien Invasive Species Inventories for Europe – **DAISIE**

According **DAISIE - Inventory of alien invasive species in Europe** – official site (https://www.gbif.org/dataset/39f36f10-559b-427f-8c86-2d28afff68ca): The DAISIE - inventory of alien invasive species in Europe is a species checklist dataset published by the Research Institute for Nature and Forest (INBO) and the Centre for Ecology and Hydrology (CEH). It contains information on 12,104 taxa (mostly species and mostly introduced) occurring in the wild in Europe since 1500. It covers a broad taxonomic spectrum of terrestrial and aquatic free living and parasitic organisms. The collation of the alien species list is the result of the efforts of the DAISIE (http://www.europe-aliens.org/) project partners and more than 300 collaborators from Europe and neighboring countries, involved in different fields of expertise and organizations. Here the DAISIE checklist is published as a standardized Darwin Core Archive and includes for each species: the scientific name, higher classification, and stable taxon identifier (in the taxon core), the vernacular names (in the vernacular names extension), the presence in a specific region, the year of the first introduction (first collection) and/or last assessment/observation in that region, as well as extra information (in the distribution extension), and the habitat, native range, and ecofunctional group (in the description extension). The DAISIE dataset is no longer maintained, but can be used as a historical archive for researching and managing alien plants or compiling regional and national registries of alien species. Issues with the dataset can be reported at https://github.com/trias-project/daisie-checklist

We have released this dataset under a Creative Commons Attribution license (CC-BY 4.0). We would appreciate it if you follow the GBIF citation guidelines (https://www.gbif.org/citation-guidelines) when using the data. If you have any questions regarding this dataset, don't hesitate to contact us via the contact information provided in the metadata or via https://twitter.com/trias_project.

The publication of the checklist to GBIF was supported by the European Cooperation in Science and Technology (COST) action Alien CSI "CA17122 - Increasing understanding of alien species through citizen science" as a Short-Term Scientific Mission "Publishing alien species checklist data for Europe through repeatable, open workflows", with technical support provided by the Research Institute for Nature and Forest (INBO).

Geographic scope
This checklist contains documented introduction records of the alien taxa for 71 terrestrial and nine marine regions of Europe, the Levantine Basin and the North African coast of the Mediterranean Sea. These regions mostly match political borders of countries as they are known today. Where data were available at a finer political or

biogeographic level, these are also presented e.g., the administrative regions of the United Kingdom (Wales, Scotland, England, Northern Ireland) or islands such as Corsica, Sicily, Crete, Greenland or Svalbard.

Taxonomic scope
In total, this dataset includes taxa from 5 kingdoms and 53 phyla recorded in the database. The phyla of Spermatophyta, Arthropoda and Chordata contain the highest numbers of the alien species: 56, 24 and 5 %, respectively. Many phyla (32 out of 53) contain less than 10 recorded species, and 12 phyla are represented by only one recorded alien species.

According **European Environment Agency** (https://www.eea.europa.eu/data-and-maps/data-providers-and-partners/delivering-alien-invasive-species-inventories): The website was developed as part of the Delivering Alien Invasive Species In Europe (DAISIE) project funded by the sixth framework programme of the European Commission (Contract Number: SSPI-CT-2003-511202). It provides a 'one-stop-shop' for information on biological invasions in Europe, delivered via an international team of leading experts in the field of biological invasions, latest technological developments in database design and display, and an extensive network of European collaborators and stakeholders.

According **CREAF** - public research center dedicated to terrestrial ecology and territorial analysis, producing knowledge and methodologies for conservation, management, and adaptation of the environment to global change (http://www.creaf.cat/delivering-alien-invasive-species-europe): DAISIE is a pivotal instrument in developing a Europe-wide strategy that encompasses both the geographical scale of the problem and unites the study of different taxa in marine, freshwater and terrestrial environments. With direct access to national knowledge bases throughout Europe, those addressing the invasive alien species challenge will easily obtain data on which species are invasive or potentially invasive in particular habitats, and use this information in their planning efforts. Data has been collated for vertebrates, invertebrates, marine and inland aquatic organisms as well as plants from up to 97 countries/regions (including islands) in the wider Europe. Over 248 datasets have been assembled and verified by experts, representing the largest database on invasive species in the world. Access to this resource is provided through three main search facilities:

- Search for information on one of the alien species occurring in Europe;
- Search for one of the 835 experts on biological invasions in Europe;
- Search regions to explore the alien species threats across Europe, for 81 countries/regions (including islands) and 57 coastal and marine areas.

2. Methodological approaches to the IAS inventory

2.1 - Danube Delta – Romania (DDNI & DDBRA)

Motivation
Pursuant to Article 13 (1) of European Union Regulation 1143/2014, Member States shall, within 18 months of the adoption of the Union list (December 2017), conduct a comprehensive analysis of the ways of unintentional introduction and spread of invasive alien species concern for the Union, at least in their territory and in their marine waters, as defined in Article 3 (1) of Directive 2008/56 / EC, and identifies those introduction routes that require priority action ("introduction routes priority ") due to the volume of species or potential damage caused by species that are introduced into the European Union in those ways.

Equipment and materials required:
- Topographic and satellite maps of the areas where the inventory is to be made;
- GPS receiver;
- Phone and GPS Essentials application downloaded. It is available for the Android operating system. Other telephone applications can be used to record GPS points;
- Camera, ideal with GPS function installed;
- Means of travel (vehicle / bicycle), fuel;
- Field sheets, pen / pencil, tape recorder for faster data recording;
- Animal / plant determinant, preferably illustrated for faster identification;
- Botanical press / materials needed for plant sampling and herbalization (plastic or paper bags, newspaper or blotter, labels, planter, etc.);
- Biological material collection containers;
- Biological sample fixatives;
- Binoculars for observing trees or shrubs at a greater distance;
- Polarized sunglasses for inventory in aquatic ecosystems;
- Waterproof boots in case of inventory in aquatic ecosystems.

General data on inventory and mapping with low effort
The selection of test areas (10 × 10 km grids, projection similar to the one used for mandatory reporting for Natura 2000 species and habitats) will be made so as to cover the Danube Delta territory in a balanced way. The number of test areas (transects) will be determined so as to ensure a high degree of reliability in the data.
To take data from the selected sample areas, the experts will follow the established protocol.
After collecting the data in the field, the action manager will check the quality of the records and the observance of the inventory protocols. The data obtained will be transferred to the database organized for alien species, will be archived in electronic format and will be downloaded to distribution maps. Following the initial mapping, in years 2 and 3, new field steps will be made to complete the data set and monitor the dynamics of invasive species.

The data collected according to the established protocol can be supplemented with data obtained by opportunistic sampling and through reports from local environmental authorities and custodians / administrators of protected natural areas. At this stage, the data collected opportunistically by experts (species identified without following the systematic sampling protocol), as well as those reported from environmental authorities and custodians / administrators of protected natural areas will be recorded. Opportunistic sampling will be done without prior preparation, but respecting the data structure required by the standard inventory protocol, and data collection from local environmental authorities and custodians / administrators of protected natural areas will be done by sending a questionnaire that will be completed online each year of study.
The field phase will be followed by the laboratory phase. During this, checks will be made of the collected herbarium materials in order to establish the correct identity of some taxa. For the same purpose, the photographic images taken in the field will be analyzed. The data collected with the help of the classic files, printed on paper, or with the help of the tape recorder will be entered in the electronic files and transferred to the activity manager.
After receiving the data from the experts, the action manager will check the quality of the records and the observance of the inventory protocols. The data obtained will be transferred to the database, archived in electronic format and downloaded to GIS distribution maps.

VARIANT 1 - Sampling and data collection protocol for terrestrial species.
For animal and herbaceous terrestrial plants, the main places to be targeted in the inventory actions are the following:
- habitats associated with transport and commercial infrastructure: roadsides (roads, paths), railways, etc.;
- rural and urban habitats: abandoned land, rubble, ruins, landfills, courtyards of houses or public institutions, cemeteries, land affected by recent urban works (excavations, gravel and sand deposits, road construction, foundations), the surroundings of the botanical and public gardens;
- riparian habitats: banks and major riverbeds (rivers, streams), lake shores, meadow forest edges;
- cultivated lands: agricultural and horticultural fields, nurseries, forest plantations, horticultural or anti-erosion, ornamental arrangements;
- abandoned lands: agricultural huts, abandoned plantations;
- cleared or cleared land;
- secondary meadows (eSpecieslly overgrown or trailed);
- naturally disturbed lands: recent alluviums, lands disturbed by animals (wild boars, etc.), ravines, ravines, recent landslides, etc.;
- territories of protected natural areas likely to be invaded (frequently disturbed by natural or anthropogenic factors).

The inventory will be made by 1-2 experts and will be done on transects with a length of 100 - 500 m, depending on the difficulty of the area where the activity is performed and the number of alien species encountered. During the transect, stops will be made

to mark the coordinates and other data in the terrain sheet. Such stops are also necessary for the observation of smaller alien plants, which cannot be easily noticed or for taller plants, but which requires verification for correct identification.
In the case of protected natural areas, inventories will be made along the access roads, also on a maximum width of 50 m.
For each transect / route traveled, a field sheet will be completed, which will include the following information:

1) Identification data: file number, name of the expert who completes it, date, transect number, description of the transect, GPS coordinates of the point of departure (initial) and of the point of arrival (final), county, localities along the transect. Data on the management of alien species will also be noted on the sheet, insofar as they are observed or information can be obtained from owners, custodians, administrators, etc.
2) Coordinates: northern latitude. It is preferable to use decimal degrees in the WGS84 system. For any other system used, the appropriate details shall be given in the comments section.
3) Coordinates: eastern longitude. It is preferable to use decimal degrees in the WGS84 system. For any other system used, the appropriate details shall be given in the comments section.
4) Transect / route code. It consists of three letters and four digits. The letters represent, in order: the initial of the name, the first two letters of the first name. Example, for the expert Georgescu Teodora, the three letters of the code will be: GTE. The figures represent, in order, the route number and the year. Example, for the second route, performed in 2019, by Georgescu Teodora, the code will be: GTE0219, where 02 is the route number and 19, the last two digits of the year in which the inventory is made.
5) County (the two-letter county code will be used). If the form is completed in digital format, the corresponding code will be chosen from the list displayed when we select the cell in which the information is to be entered.
6) Locality - a free text will be written, corresponding to the locality where the alien plant was observed.
7) Local toponym - is used in the case of larger localities, but also in the case of relief units or areas where the assignment of a locality is more difficult.
8) Taxon. The valid name of the plant taxon will be noted according to the website www.theplantlist.com
9) Population size. A five-step ladder will be used as follows:
    1. 1-10 individuals
    2. 11-50 individuals
    3. 51-100 individuals
    4. 101-500 individuals
    5. Over 500 individuals.

For the situation of completing the sheet in digital format, there is the option to select the appropriate step from a list of five steps. First click on the cell in which you want to enter the information, then click on the arrow that appears to the right of the cell and one last click on the corresponding step.

In the case of plants that form bushes, each bush is considered an individual. In herbaceous plants with rhizomes or underground shoots, each individualized strain is considered a separate specimen. In the case of plants with creeping stems, in which it is difficult to establish well-individualized specimens, the shoots found on the test surface are counted, regardless of whether or not they have a root in that surface.
Alternatively, the DAFOR scale can be used:

D = dominant,
A = abundant,
F = frequent,
O = occasional,
R = rare.

10) Phenophase. A system with four phenophases will be used:

V = vegetative (sprouting, sprouting, leaf formation, stem growth stage and covering them with leaves);

A = flowering or anthesis (appearance of buds, domination of bud stage, domination of open flowers, wilting of flowers);

F = fruiting (young fruits, ripe fruits);

D = dissemination (seed spread). If the plants are dry and dead, the letter U will be recorded in the file.

11) The habitat type will be initially marked with simple terms such as: railway embankment, roadside, pasture, hayfield, river meadow, etc. Subsequently, an attempt will be made to correlate it with the appropriate habitat type according to the EUNIS classification.

12) Observations. Any incidental comments will be noted in this section. Of particular interest is the presence of Natura 2000 species or other rare / threatened species in the habitat where an alien species has been identified. Also, in this column, of the observations, it will be noted if the distribution data are collected from owners, custodians, administrators, authorities, etc.

The plants will then be photographed. It is ideal to take at least 3-4 photos of which at least two with details of the organs of the plant (a size scale will be used).
A photo of the population of the species or of the area where the plant was found would be very useful, as it provides information about the density of the species, its coverage, etc.
Plants should be identified in the field whenever possible. Any plant that cannot be identified will be collected, herbarized and identified in the laboratory. The GPS coordinates, location, date and name of the collector will be written on the label.
The data listed above can be collected on a classic file, printed on paper, directly in the electronic file (more difficult to do in the field) or can be done using the GPS Essentials application available for the Android operating system, or any other application that can record and display GPS coordinates.

VARIANT 2 - Sampling and data collection protocol for trees and shrubs
For terrestrial woody plants, be they trees or shrubs, the main places that must be targeted in the inventory actions are the following:

- habitats associated with transport and commercial infrastructure: roadsides (roads, paths), railways; - rural and urban habitats: abandoned land, rubble, ruins, landfills, courtyards of houses or public institutions, cemeteries, land affected by recent urban works (excavations, gravel and sand deposits, road construction, foundations), the surroundings of the botanical and public gardens;
- riparian habitats: banks and major riverbeds (rivers, streams), lake shores, meadow forest edges;
- cultivated lands: agricultural and horticultural fields, nurseries, forest plantations, horticultural or anti-erosion, ornamental arrangements;
- abandoned lands: agricultural huts, abandoned plantations;
- cleared or cleared land;
- secondary meadows (eSpecieslly overgrown or trailed);
- naturally disturbed lands: recent alluviums, lands disturbed by animals (wild boars, etc.), ravines, ravines, recent landslides, etc .;
- territories of protected natural areas likely to be invaded (frequently disturbed by natural or anthropogenic factors).

We point out that almost all woody species can be observed and even easily recognized even from 25-50 m: *Acer negundo, Ailanthus altissima, Amorpha fruticosa, Prunus serotina, Robinia pseudoacacia*. Of course, for better observation, binoculars can be used. Please note that some woody plants may require collection and verification (eg, *Fraxinus species*).

For each transect / route a field sheet will be completed which will include the following information:

1) Identification data: file number, name of the expert who completes it, date, transect number, description of the transect, GPS coordinates of the point of departure (initial) and of the point of arrival (final), county, localities along the transect. Data on the management of alien species will also be noted on the sheet, insofar as information is observed or can be obtained from owners, custodians, administrators, etc.
2) Coordinates: northern latitude. It is preferable to use decimal degrees in the WGS84 system. For any other system used, the appropriate details shall be given in the comments section.
3) Coordinates: eastern longitude. It is preferable to use decimal degrees in the WGS84 system. For any other system used, the appropriate details shall be given in the comments section.
4) Transect / route code. It consists of three letters and four digits. The letters represent, in order: the initial of the name, the first two letters of the first name. The figures represent, in order, the route number and the year.
5) County (the two-letter county code will be used). If the form is completed in digital format, the corresponding code will be chosen from the displayed list when we select the appropriate cell for entering the information.
6) Locality - a free text will be written, corresponding to the locality where the alien plant was observed.
7) Local toponym - is used in the case of larger localities, but also in the case of relief units or areas where the assignment of a locality is more difficult.

8) Taxon. The valid name of the plant taxon will be noted according to the site www.theplantlist.com.

9) Population size. A five-step ladder will be used, as follows:

1. 1-10 individuals
2. 11-50 individuals
3. 51-100 individuals
4. 101-500 individuals
5. Over 500 individuals.

For the situation of completing the sheet in digital format, there is the option to select the appropriate step from a list of five steps. You will first click on the cell in which you want the information to be entered, then again click on the arrow that appears to the right of the cell and one last click on the corresponding step.

In the case of woody plants that form shrubs (eg, Amorpha fruticosa), each shrub is considered an individual. For those that have rooting stems, each rooted plant is considered an isolated specimen, regardless of whether or not it still maintains contact with the mother plant.

For those who form suckers (shoots of a plant grown from the root), the information regarding their presence or absence in the observations section will be filled in.

Alternatively, the DAFOR scale can be used:

D = dominant,
A = abundant,
F = frequent,
O = occasional,
R = rare.

10) Phenophase. A system with four phenophases will be used:

V = vegetative (sprouting, sprouting, leaf formation, stem growth stage and covering them with leaves);

A = flowering or anthesis (appearance of buds, domination of bud stage, domination of open flowers, wilting of flowers);

F = fruiting (young fruits, ripe fruits);

D = dissemination (seed spread). If the plants are dry and dead, the letter U will be recorded in the file.

11) The habitat type will be initially marked with simple terms such as: railway embankment, roadside, pasture, hayfield, river meadow, etc. Subsequently, an attempt will be made to correlate it with the appropriate habitat type according to the EUNIS classification.

12) Observations. Any incidental comments will be noted in this section. Of particular interest is the presence of Natura 2000 species or other rare / threatened species in the habitat where an alien species has been identified. Also, in this column, of the observations, it will be noted if the distribution data are collected from owners, custodians, administrators, authorities, etc.

The plants will then be photographed. Ideally, at least 3-4 photos should be taken, of which at least 2 with details of the plant's organs: rhytidome, young shoots, leaves on both sides, flowers, fruits. We recommend using a size scale.

A photo of the population of the species or of the area where the plant was found would be very useful, as it provides information about the density of the species, its abundance, etc.
Woody plants will be identified in the field whenever possible. Any plant that cannot be identified will be collected, herbarized and identified in the laboratory. As far as possible, branches with leaves, flowers and / or fruit will be collected, often the leaves alone will not be enough. The GPS coordinates, location, date and name of the collector will be written on the label.

VARIANT 3 - Sampling and data collection protocol for aquatic and marsh species
For aquatic and marsh plants, the main places to be considered in the inventory actions are the following:
- aquatic habitats: running waters (rivers, streams) and stagnant (lakes, ponds, ponds), ditches, irrigation or drainage channels, including those located on the territory of protected natural areas.

Emphasis can be placed on nutrient-rich waters, but also on habitats with conservative value.
The sampling method in the case of aquatic plants consists in moving on transects that cover the width of the Phyto-littoral area (from the shore to the maximum depth of colonization), on either side of the chosen point. The length of the transect varies depending on the size of the water body. In the case of the Danube Delta, the inventory can be done by boat, on canals or other wetlands. In the case of lakes, sampling will be done along their entire length, and in the case of rivers, transects of 100 - 500 m will be made, depending on the means of transport chosen for the activity.
Both waterborne and submerged or submerged plants will be examined. To more easily observe submerged plants, it is recommended to use polarized sunglasses. The inventory will take place between July and September, when the plants can be easily identified. The trips will be made on clear and calm days, these conditions making the submerged plants more easily visible. Early in the morning the conditions are often ideal because the water is calm and the reflection on the water surface is minimal. It will be difficult to conduct an effective study in windy conditions.
For each transect / route a field sheet will be completed which will include the following information:
1) Identification data: file number, name of the expert who completes it, date, transect number, description of the transect, GPS coordinates of the point of departure (initial) and of the point of arrival (final), county, localities along the transect. Data on the management of alien species will also be noted on the sheet, insofar as they are observed or information can be obtained from owners, custodians, administrators, etc.
2) Coordinates: northern latitude. It is preferable to use decimal degrees in the WGS84 system. For any other system used, the appropriate details shall be given in the comments section.
3) Coordinates: eastern longitude. It is preferable to use decimal degrees in the WGS84 system. For any other system used, the appropriate details shall be given in the comments section.

4) Transect / route code. It consists of three letters and four digits. The letters represent, in order: the initial of the name, the first two letters of the first name. Example, for the expert Georgescu Teodora, the three letters of the code will be: GTE. The numbers represent, in order, the route number and the year. Example, for the second route, performed in 2019, by Georgescu Teodora, the code will be: GTE0219, where 02 is the route number and 19, the last two digits of the year in which the inventory is made.
5) County (the two-letter county code will be used). If the form is completed in digital format, the corresponding code will be chosen from the list displayed when we select the cell in which we must enter the information.
6) Locality - a free text will be written, corresponding to the locality where the alien plant was observed.
7) Local toponym - is used in the case of larger localities, but also in the case of relief units or areas where the assignment of a locality is more difficult.
8) Taxon. The valid name of the plant taxon will be noted according to the website www.theplantlist.com.
9) Population size. A five-step ladder will be used as follows:
   1. 1-10 individuals
   2. 11-50 individuals
   3. 51-100 individuals
   4. 101-500 individuals
   5. Over 500 individuals.

For the situation of completing the sheet in digital format, there is the option to select the appropriate step from a list of five steps. First click on the cell in which you want to enter the information, then click on the arrow that appears to the right of the cell and one last click on the corresponding step.
In the case of plants that form bushes, each bush is considered an individual. In herbaceous plants with rhizomes or underground shoots, each individualized strain is considered a separate specimen. In the case of plants with creeping stems, in which it is difficult to establish well-individualized specimens, the shoots found on the test surface are counted, regardless of whether or not they have a root in that surface.
Alternatively, the DAFOR scale can be used:
   D = dominant,
   A = abundant,
   F = frequent,
   O = occasional,
   R = rare.
10) Phenophase. A system with four phenophases will be used:
   V = vegetative (sprouting, sprouting, leaf formation, stem growth stage and covering them with leaves);
   A = flowering or anthesis (appearance of buds, domination of bud stage, domination of open flowers, wilting of flowers);
   F = fruiting (young fruits, ripe fruits);

D = dissemination (seed spread). If the plants are dry and dead, the letter U will be recorded in the file.

11) The habitat type will be initially marked with simple terms such as: railway embankment, roadside, pasture, hayfield, river meadow, etc. Subsequently, an attempt will be made to correlate it with the appropriate habitat type according to the EUNIS classification.

12) Observations. Any incidental comments will be noted in this section. Of particular interest is the presence of Natura 2000 species or other rare / threatened species in the habitat where an alien species has been identified. Also in this column, of the observations, it will be noted if the distribution data are collected from owners, custodians, administrators, authorities, etc.

The plants will then be photographed. A white-bottomed container will be used for shooting.

A photo of the population of the species or of the area where the plant was found would be very useful, as it provides information about the density of the species, its abundance, etc.

Plants should be identified in the field whenever possible. Any plant that cannot be identified will be collected, herbarized and identified in the laboratory. The GPS coordinates, location, date and name of the collector will be written on the label.

The field fact-sheet for the alien species inventory whit low effort can be found the annex 2.

Intensive inventory and mapping of hot spots and a possible priority routes for alien invasive plant species to enter consist from another set of 3 variants separated as the previous described ones for: terrestrial herbaceous plant species, trees and bushes and for aquatic / marsh(palustrine) plant species.

The difference of intensive inventory protocols consists in:

- Particular attention will be paid to inventory and mapping along the Danube, from entry into the sea to discharge into the sea, known on the one hand the importance of this river in the dispersal of invasive and potentially invasive species, and on the other hand the importance of environmental protection. along it. In particular, the presence of aquatic taxa and already invasive marshmallows in Europe (eg Ludwigia grandiflora, Ludwigia peploides, etc.) will be monitored, as well as the species Elodea nuttallii, recently introduced in the list of species of concern to the EU.
- The field factsheet for intensive investigation includes mostly the same information categories from the factsheet of the low effort investigation and some extra categories such:

o *Abundance* - dominance. The Braun-Blanquet scale will be used (r = one or several individuals; + = few individuals, with very low coverage; 1 = fairly abundant individuals, but with a degree of coverage below 1/20 of the sample area; 2 = very individuals abundant or covering at least 1/20 of the sample area, 3 = coverage ranges from 1/4 to 1/2 of the sample area, regardless of the number of individuals, 4 = coverage ranges from 1/2 to 3/4 of the sample area, regardless of the number of individuals; 5 = coverage of more than% of the sample area delimited, regardless of the number of individuals). In the spreadsheet, these classes can be selected from a

list that will appear as soon as you click on the arrow to the right of each cell in the column.

- *Multiplication*. Note the type of propagation observed: V (vegetative: rhizomes, bulbs, tubers, shoots, cuttings, etc.) or G (generative: seeds).
- *Accompanying species*. All native species in the stationary / test area will be listed.
- *The Source* column should provide information on the possible source of introduction of each alien plant into the analyzed area. It was classified into 3 classes: anthropic, natural, unknown. In the electronic file, these classes can be selected from a list that will appear as soon as you click on the arrow below it.

The field fact-sheet for the alien species intensive inventory has the same format and fields of information as the one for the low effort inventory.

2.2 - Danube Delta – Ukraine (IMB)

Shallow water, high mosaicity, formed by thickets of higher wetland vegetation, a large difference in temperature and hydrodynamics, which causes different rates of accumulation and transformation of organic material, create in floodplain ecosystems the maximum possible natural heterogeneity of conditions. Differences in the floristic structure of aquatic vegetation, which for marine ecosystems can be recorded at a distance of 10 km or in a few decades, in floodplain ecosystems can be observed simultaneously at a distance of 10 m. on the original empirical material of the mechanisms of formation of biodiversity of aquatic vegetation.
Surveys of plant groups of fouling are care out on a boat with an outboard motor. For quantitative analysis in sampling should use special equipment - frames, scrapers. Frames can have a size (10x10), (20x20) cm. The type of substrate will determine the choice of frame size. Smaller frames should be use on solid substrates (stones, surfaces of hydraulic structures, etc.). Frame size (20x20) cm is used for quantitative sampling on a soft substrate (silt, sand), which usually develops thickets of seaweed, which have significant dimensions.
The material will be collected at integrated monitoring stations using the main hydrobiological methods in a system for quantifying bottom vegetation. In addition to the generally accepted phytocoenological methods for assessing aquatic vegetation (Petrov, 1962; Eremenko, 1980; Kalugina-Gutnik, 1969), which determine the floristic composition, the percentage of projective bottom cover by macrophytes, and the biomass of thickets, a set of indicators based on the active surface of aquatic vegetation was also used (Minicheva, 1989). Determination of a complex of morphological and functional indicators, in particular, the specific surface area of the population (S/Wp) of flower macrophytes, unicellular and multicellular algae, allows one to quantitatively assess the functional activity of species as elements that form the structure of a group (Minicheva, 1999).
For practical application of the morphofunctional approach when studying aquatic vegetation, the estimation algorithms of the indices based on parameters of the active surface of unicellular and multicellular algae have been elaborated (Minicheva et al., 2003). The main indices are:
- Population specific surface (S/W)p – gives the area of the surface through which the population to carry out metabolism with the aquatic environment (m2.kg-1), used for estimating the EA of species with a difference morphological structure;
- Community surface index SIcm– reflects the area of the vegetation developing per square meter of bottom aquatic ecosystems or under the surface of 1m2 water mirror (unit), used for estimating the intensity of the production process in ecosystems of different trophic status.
Morphofunctional indicators of macrophytes are propose to be used for monitoring IASs, since they characterize the possible barriers of the species' metabolic activity for settling in new biotopes and ecosystems. The (S/W)p indicator characterizes the level of individual ecological activity of a species and limits the species when introduced into ecosystems with a high level of trophicity. The SIcm indicator

characterizes the intensity of IASs development in a new ecosystem and, accordingly, the degree of impact on local communities.

The monitoring of the terrestrial flora will be provided using the common geobotanical methods. The transects will be planned in different types of terrestrial habitats and the occurred plants will be calculated. The photofixation of the observed plants will be carried out.

Zooplankton species should be collected using a standard Juday plankton net with the mouth area of 0.1 m^2 and mesh size 150 μ. Samples should be fixed with buffered formaldehyde solution (4% final concentration). The samples should be processed under binocular microscope according the standard methodology for zooplankton studies in the Black Sea (Alexandrov et al., 2015, 2016). Individuals of aquatic insects should be collected using standard methods for collecting aquatic insects: Balfour-Browne hydrobilogical hand-net and drag, aquatic traps, attraction to the light (Golub et al., 2012).

At each station, benthic samples will be taken in all microhabitats that covered more than 5%. A kick-net will be dragged along the coast to a distance of 5 m. The collector will move in zigzags to cover depths from the water edge to one meter during 15 minutes, with 3 replicates (AQEM Consortium 2002).

At all stations, soft bottom samples will be taken with a benthic frame (20 x 20 cm), with 3 replicates. The bottom sediments will be washed through laboratory sieves for granulometry of sediments with a metal wire mesh (mesh diameter = 1 mm). The collected macroinvertebrates will immediately be preserved in 70% ethanol in the field, and later in the laboratory the samples will be sorted, the taxa of macroinvertebrates will be counted and identified to the level of the species. The abundance and biomass of each species in each sample will be determined. The abundance and biomass of each species at the station will be calculated as the average over all replicates (Todorova & Konsulova 2005).

The fish sampling will be provided in different types of habitats, e.g. artificial canals, main Danube flow, lakes, artificial reservoirs, sea delta forefront. To evaluate the species composition of the fish assemblage, size parameters of the AIS, the standard 'EN 14757:2015 Water quality – Sampling of fish with multimesh gill nets' will be used. The fish abundance will be calculated as the species number per standard multimesh net. In small and shallow waterbodies, a dipnet (1 x 0.5 m, 5 mm mesh size) will be used.

The method of route reckoning will be used for registration of the reptiles and mammals. For aquatic routes the same methods will be used onboard (Novikov, 1949; Romanov & Maltsev, 2005; Gulik et al., 2019). For the transects establishing the most common habitats will be used, e.g. sandy-silt spits and islands in the sea forefront, shrubs overgrowth, thickets of reeds and other surface vegetation, wet meadows, river-bank forest, artificial forests on sands, dams and embankments, branches of the Danube, straits, bays in the delta, urban areas (fish ponds, sand quarries), etc. The routes will be planned in the way to cover all types of habitats.

On each route transect the individuals of the target species will be registered, as well as their vital activity products (traces, excrements, storages, vocalization, etc.) (Romanov & Maltsev, 2005; Rizun, 2017; Gulik et al., 2019). Mammals registrations

will be provided in day and night periods in different seasons. The reptile registration will be provided only in day period from May to November. The target species and their vital products will be cartographed using the GIS-apps. In each locality we will register next data: species observed (or type of vital product), sex (if possible), age (if possible), generative stage (if possible), date of the registration, time of the registration, circumstances of registration, geographical coordinates of the locality, habitat, number at the place of registration (if possible), weather conditions. Except of this, the same information will be collected for the target species observed outside the transects. The phototraps will be installed on the transects and the drone used. The mirror photocameras will be used for the photoregistration of the target species. The 10*42 binoculars and 20-60 altering telescopes will be used as well. For the slider *Trachemys scripta* registration, the survey method will be used (Rizun, 2017). To evaluate the relative abundance of the brown rat *Rattus norvegicus* the method of the silt sites will be used (Korneev et al., 2001). Thus, the presence/absence of a target species will be evaluated for each habitat type. For the abundance evaluation the scale will be used: 0 – species in listed by the previous observations only, 1 – accidental observations (once or several times per decade), 2 – rare species (difficult to find), 3 – common species (register during few days observation), 4 – numerous species (prevail in all target localities), 5 – background species (mass reproduction) (Zagorodniuk et al., 2002).

2.3 - Nestos Delta – Greece (IHU)

In general, two categories of IAS can be created for each one of the studied areas. The first list of invasive alien species is composed of those species that already have been recorded, whereas the other one consists of those species that potentially could be found in the study area. Although the second list could provide information about the potential threats that each area could face in the future, here, in this deliverable we will be focused on the first of the two categories.
Regarding Nestos area, as also was written in the literature review (D.T.1.1.1), 11 alien species have been reported so far and based on other sources, these species have been characterized as invasive species in Greece. The list of these species is presented in Table 2.

Table 2. Invasive Alien Species that have been recorded close to Nestos river area.

Taxon	Family	Chorology
Acer negundo L.	Sapindaceae	N American
Amaranthus deflexus L.	Amaranthaceae	S American
Amorpha fruticosa L.	Fabaceae	N American
Datura stramonium L.	Solanaceae	Cosmopolitan
Eleusine indica (L.) Gaertn.	Poaceae	Cosmopolitan
Medicago sativa L. subsp. *sativa*	Fabaceae	Paleotemperate
Paspalum distichum L.	Poaceae	Neotropical
Phytolacca americana L.	Phytolaccaceae	N American
Robinia pseudoacacia L.	Fabaceae	N American
Solanum elaeagnifolium Cav.	Solanaceae	S American
Xanthium spinosum L.	Asteraceae	S American

According to Streftaris & Zenetos (2006), a list of invasive marine species should be compiled by selecting those alien species that are rapidly expanding, and those which are locally or regionally abundant and are reported to have some impact (negative or positive). Another option would be to compile a list on the basis of expert knowledge, which was also applied in the case of Zenetos et al. (2010). Specifically, Zenetos et al. (2010) compiled their list of invasive species using expert knowledge and literature searching. In this case the compilation of the list was totally subjected, as it was exclusively based on personal points of view of scientists. It is of crucial importance to state that different alien species act in a different way in ecosystems and their impacts on total biodiversity vary. Thus, among any list of alien or invasive species recorded in an area, methodological approaches should be mainly focused on those species that is expected to affect in a negative way biodiversity.
Based on the above, we will identify those invasive species that have been already recorded in Nestos area and that are expected to cause serious problems in biodiversity and the habitat types of the area. The degree of the negative impacts that these species will cause is mainly determined by their likelihood of spread and their interactions with other species of ecological processes (e.g. vegetation succession) (Roy et al. 2015).

2.4 - Kızılırmak Delta – Turkey (KTU-MSF)

Methodology for determining of the situation of the IAS in Black Sea coastal area and also Kızılırmak Deltaic Area is directly related to the common sampling strategy. Phytoplankton, zooplankton, mollusks, bivalve, crustacean, and fish sampling methodologies were given below shortly. These methodologies were standardized by national project supported by Ministry of Environment and Urbanisation and Ministry of Agriculture and Rural Affairs. Scientists were studied together to produce a standard methods for marine samplings (ÇŞB, 2017).

Fish; Trawl, bottom seines, gillnets, fyke-net, traps, dredge, and electro fishing equipment are the catching/fishing tools for fish in the marine environment of the deltaic area (FAO, 1980). Gill nets and cast nets will be used to samples fish within the deltaic area (lakes, lake sea corridor and water reservoirs. Scales, measuring ruler, digital caliper, knife, scissors, scalpel, plastic bags, ice box, and tags will be used to sample for further evaluation of reproduction biology and population biology of each species. The last part of the trawl sac mesh width is defined as 20mm. The trawl and dredge towing speed (2,5 miles) and time (15-30 min) were also defined. The speed and time were changed according to the sampling depths.

Sampling stations were determined according to the transitional water where the deltaic area (small lakes, and lake-sea corridor) belongs to it, and marine water in the Kızılırmak Deltaic area. There is no specific strategy for IAS sampling and evaluation. These species catch together with biodiversity studies and samplings and then evaluate either in the biodiversity studies and /or IAS scope.

The coordinates of the sampling stations and the localisaition in the map was demonstrated in the Table 4 and Figure 2.

Table 4: Sea water, benthic and fish sampling stations and their specifications

Station name	Coordinates	Station specification	Water and sediment specification
Station-1	41°41'5.31"N 35°46'18.93"E	Coastal water	Salty water; Sandy/muddy sediment
Station-2	41°44'56.19"N 35°57'39.96"E	Coastal water	Salty water, Sandy/muddy sediment
Station-3	41°39'47.73"N 36° 6'10.14"E	Coastal water	Salty water, Sandy/muddy sediment
Station-4	41°40'14.11"N 35°47'43.63"E	Karaboğaz Lake Fresh/brackish water	Fresh/brackish water Sandy/muddy sediment
Station-5	41°41'55.71"N 36° 1'9.81"E	Liman Lake Fresh/brackish water	Fresh/brackish water Sandy/muddy sediment

Station name	Coordinates	Station specification	Water and sediment specification
Station-6	41°38'31.26"N 36°04'12.97"E	Cernek Lake Fresh/brackish water	Fresh/brackish water Sandy/muddy sediment
Station-7	41°42'50.32"N ,35°56'34.24"E	Kızılırmak Fresh water	Fresh water Sandy/muddy sediment

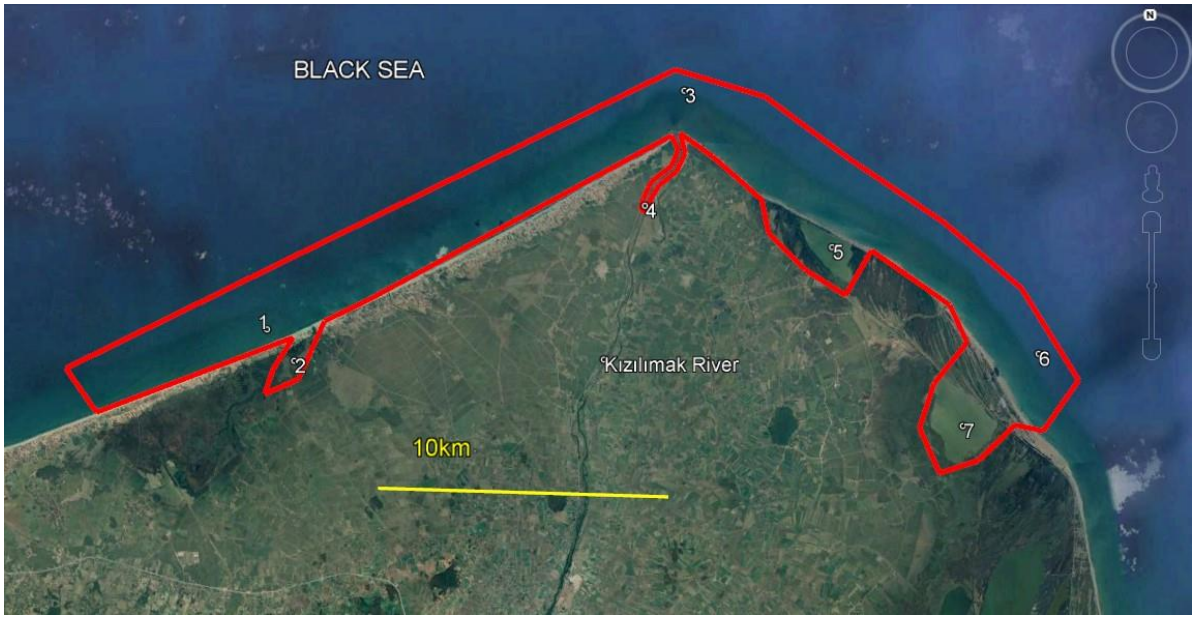


Fig 2: Kızılırmak Deltaic region, protected coastal sea, Lake and River sampling stations and locations.

Benthos: The sampling tools for the benthos are box core and grab. But box core is a heavy and large tool. Besides, shallow area and small boats are not suitable for this tool. A grab is a good tool for soft sediment sampling. The standard size of Van Veen Grab is 0,1 m^2 and that is the most common type of grab for coastal benthic studies. Selected species as an IAS in this project will be caught with Van Veen Grab and Dredge which is explained in the fish sampling methodology section above. Dredge will be used for sampling of mollusk and bivalves.
The coordinate and name and specification of the sampling station for the benthic studies were listed in the Table 4 Figure 2.

Crustacean: Dredge will be used for sampling crustaceans in the marine environment of deltaic area. Traps and gill nets will be used to sample crustaceans within the deltaic area. Scales, measuring ruler, digital caliper, plastic bags, ice box, and tags will be used to sample for further evaluation of reproduction biology and population biology of each species.
The coordinate and name and specification of the sampling station for the benthic studies were listed in the Table 4 and Figure 2.

Fitoplankton and Zooplankton:

Phytoplankton: For quantitative sampling, sampling of phytoplankton, sampling bottles such as Niskin and Nansen bottles will be closed at the desired depth. A litter of samples will be transferred to bottle and 5 ml acidic lugol solution for 100 ml sample will be added for fixation the cell. Sample collection location, sampling depth and date will be written on the sample bottles.
Sampling with the plankton net will only be used for biodiversity studies. Phytoplankton net sampling will be made from the point where quantitative sampling depth is made in vertical direction to the surface. 20 µm net mesh size will be used for phytoplankton sampling.

Zooplankton: Plankton nets will be used for qualitative and quantitative purposes for meso and macrozooplankton sampling. The plankton net mesh size will be 100 and 200 µm for mesozooplankton and 300-500 µm for macrozooplankton. Towing speed will not exceed 1m / sec in large mesh size net. After finishing collection procedure net will be wash carefully and samples in the collector will be transferred to plastic jar. 60 ml Natural Formalin (%37) for each liter of sample will be added to the sample for fixation.
After concentration procedure in the laboratory, the samples will be observed under Nikon E 600 binocular microscopy and Zeiss SMZ 508 dissection microscopy.
The coordinate and name and specification of the sampling station for the benthic studies were listed in the Table 4 Figure 2.

2.5 - Chorokhi and Kolkheti – Georgia (IBEDC)

The methodology of the research include desk works, field works, interviews and laboratory processing of obtained material.
Phytoplankton samples is take with BETA type bathometer, with the volume of 4.6 liters. The volume of each sample is 1 litter. 3 phytoplankton samples is take at each station – at different depths.
Zooplankton samples is take with Apstein net: ⌀- 40 sm., L-100 sm., 55 µm. Macroplankton and ichthyoplankton is take with above mentioned net, by tugs on upper layers of the sea. 3 zooplankton samples is take at each station, on different depths. One macro plankton and one ichthyoplankton samples also take at every station.
Benthos and the bottom sediments is take by Van Veen Grab Sampler - 0.1 m2. Conservation of hydro biologic samples is done by formalin (4%) solution. The bottom samples is take with two or three times repetition (according to the ground type).
Definition of transparency is using the Secchi disk marine style ⌀- 30 sm.
Main physical – chemical parameters of the water is determined by portable Multiparameter analyzers on all stations.
The ichthyological research implement by the fishing vessel. For fishing use universal trawl, with parameters - horizontal spread – 20 meters, vertical spread – 10 meters, mesh size (Knot to knot) in the bag – 12mm. Trawling is done with active contact with the bottom, and with random contacts the bottom in the layer along the bottom and going through upper layers of the sea. The speed of trolling is maximum 3.5 knots. Each attempt of trolling is exposition for not more than 30 minutes, which excluded traumatization of fish and provided the opportunity for returning them into safe environment. Major part of obtained fish is released safely to the environment, after visual observation and measurement (catch – release principle). Just small number of industrial objects is removed from the environment with purpose of study of their sex compositionand stadion og maturity, food composition in gastro -floor and age. which is essential for the research.

Ichthyological researches also included the following:
1. Monitoring of fish sale points (Batumi, Tskhaltsminda, Poti);
2. Monitoring of dislocation places of traditional fishers Gonio, Batumi, Kobuleti, Ureki, Grigoleti, Poti, Anaklia, Tikori, Nabada, Maltakva etc.);
3. Interviews – local fishemanrs is interviewed with purpose of presenting complete picture. For this purpose is selected the fishers with at least 10 years' experience. Th program of interviewing is developed for detecting the falsification (exaggeration, invention, hiding) by the fishers. Besides, the information is considered as reliable only in case of being confirmed by more than three fishers;
4. Joint fishing with traditional fishemans in coastal and estuarine areas.

While taking samples, the marine meteorological information (tiding, direction and velocity of flow and so on) was obtained on the following EU marine environment telemetering monitoring portals:

- http://marine.copernicus.eu (COPERNICUS - MARINE ENVIRONMENT MONITORING SER-VICE);
- http://poseidon.hcmr.gr (POSEIDON system – Monitoring, Forecasting and Information System for the Greek Seas);
- https://podaac.jpl.nasa.gov https://podaac-tools.jpl.nasa.gov/soto (State of the Ocean (SOTO)).

Used Determinants (keys):

Fishes:

1. World Register of Marine Species (WoRMS): http://www.marinespecies.org.
2. European Register of Marine Species (ERMS): http://www.marbef.org/data/erms.php.
3. Marine Species Identification Portal: http://species-identification.org.
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Т. 3. Паукообразные. Низшие насекомые. СПб., 1997
Т. 4. Двукрылые насекомые. СПб., 2000
Т. 5. Высшие насекомые. СПб., 2001

Т. 6. Моллюски, Полихеты, Немертины. СПб., 2004

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2. пределитель пресноводных водорослей СССР (12 выпусков) - 1951-1983.
3. Nordic Microalgae and aquatic protozoa: http://nordicmicroalgae.org.

Methods and guidelines:
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3. List of IAS identified for Black Sea Deltaic Protected Areas monitored in IASON Project

3.1 - Danube Delta – Romania (DDNI & DDBRA)

Analysis of non-native plant species from Danube Delta - Romania

List of non-native woody plant species identified in Danube Delta Bisphere Reserve – Romania (Doroftei and Covaliov, 2009):

Family Species	**Origin**	**Presence in Danube Delta Romania**
Aceraceae Durande, 1782		
Acer ginnala Maxim.	China	Ornamentally cultivated in households in Chilia and Sulina. Identify a few individuals.
Acer negundo L.	N. Am.	Ornamentally cultivated in and around localities. The species is also cultivated in forest plantations where it has spread to the rest of the canals in Danube Delta.
Acer saccharinum L.	N. Am.	Some specimens grown ornamentally in Sulina and Maliuc.
Anacardiaceae Lindley, 1830		
Rhus hirta (L.) Sudworth	N. Am.	Ornamental species cultivated in Sulina, Sf. Gheorghe, Maliuc, Crişan, Chilia, Gorgova and Pardina. Also, the species was identified as subspontaneous outside the localities
Aquifoliaceae Bartling, 1830		
Ilex aquifolium L.	Atl.-medit.	The species was identified in Maliuc and Sf. Gheorghe.
Berberidaceae Durande, 1782		
Berberis thunbergii D.C.	Japonia	The species was identified in Sulina.
Bignoniaceae Durande, 1782		
Campsis radicans (L.) Seemann	N. Am.	Ornamental species identified in the gardens of Sulina, Periprava and Chilia
Catalpa bignonioides Walter.	N. Am.	Ornamental tree cultivated in Crişan, Maliuc and Sulina. Species identified in several specimens, without having impressive dimensions.
Buxaceae Dumortier, 1822		
Buxus sempervirens L.	Medit.	Ornamental species identified in Crişan, Sulina, Maliuc, Gorgova, Sf. Gheorghe,

Family Species	Origin	Presence in Danube Delta Romania
		Periprava, Chilia. Quite common species in localities.
Caesalpiniaceae R. Brown, 1814		
Cercis siliquastrum L.	Medit	Ornamental tree cultivated in the dendrological park from Maliuc (one specimen) and in Mila 23, where, given the small size of the specimen reported, the species was probably introduced relatively recently
Gleditsia triacanthos L.	N. Am.	Ornamentally cultivated species in Mila 23, Sulina, Chilia, Gorgova, Sf. Gheorghe, Pardina and Periprava. It is also cultivated in forest plantations where it has spread subspontaneously in areas where droughts have occurred.
Caprifoliaceae A.L. de Jussieu, 1789		
Lonicera japonica Thunb.	E Asia	Ornamental liana cultivated in the gardens of Mila 23, Sulina, Periprava, Chilia, Gorgova, Sf. Gheorghe and Crişan
Lonicera tatarica L.	Asia de V	Arbust ornamental identificat la Sulina.
Symphoricarpos albus (L.) S.F.Blake	N. Am.	Ornamental shrub cultivated in Sulina and Maliuc.
Viburnum macrocephalum Fort.	China	Ornamental shrub cultivated in the gardens of Sf. Gheorghe, Sulina, Gorgova, Crişan, Mila 23, Chilia and Letea.
Cornaceae (Dumortier, 1827) Dumortier, 1829		
Cornus sericea L.	N. Am.	Ornamental cultivated shrub in Maliuc and Sulina for hedges.
Cupressaceae Richard ex Bartling, 1830		
Juniperus virginiana L.	N. Am.	Ornamental cultivated shrub in Maliuc and Sulina for hedges.
Thuja occidentalis L.	N. Am.	Ornamental species identified in Crişan, Sf. Gheorghe, Chilia and Pardina in several specimens.
Thuja orientalis L.	China	Ornamental tree cultivated in Crişan, Gorgova, Sf. Gheorghe, Sulina and in the dendrological park from Maliuc
Elaeagnaceae Adans., 1763		
Elaeagnus angustifolia L.	W and Central Asia	Species introduced in forest crops, cultivated in the area of the coastal cordon and on ridges for fixing sands. It has been

Family Species	**Origin**	**Presence in Danube Delta Romania**
		identified mainly in the river-maritime delta, in all localities in the Danube Delta, as well as in the river delta, but with a lower frequency. It is also found on the island of Popina, Capul Doloşman, Iancina and Taşburun. It is currently considered a subspontaneous species. We consider that it has the potential to extend and eliminate the species *Hippophaë rhamnoides* L
Fabaceae Lindley, 1836		
Amorpha fruticosa L.	N. Am.	Shrub cultivated, in the past, along the modified / dredged canals in the Danube Delta; Currently, a species considered subspontaneous, having an invasive character. It is a species present in all types of habitats, eSpecieslly in the river delta sector where it is very common. In the poplar forest plantations it develops very well, occupying the shrub layer and thus, causing damage to these crops.
Robinia hispida L.	N. Am.	Arbore ornamental întâlnit în câteva exemplare în localitatea Chilia.
Robinia pseudoacacia L.	E Asia	Tree grown in forest plantations. It is frequently found in the localities of the Danube Delta. In places like Pardina and Periprava, the landscape dominates. Species considered subspontaneous, invasive, found in most habitat types in the Danube Delta
Robinia viscosa Vent	N. Am.	Species cultivated in the gardens of Chilia
Sophora japonica L.	E Asia	Species cultivated in Maliuc in the dendrological park and in Sulina.
Wisteria sinensis (Sims) Sweet	N. Am.	Ornamental liana found in Sulina and Sf. Gheorghe.
Fagaceae Dumortier, 1829		
Quercus rubra L.	N. Am.	Ornamental tree cultivated in Maliuc and Sulina.
Grossulariaceae A.P. de Candolle, 1805		

Family Species	Origin	Presence in Danube Delta Romania
Ribes aureum Pursh.	N. Am.	Shrub cultivated in the gardens of Crişan, Sf. Gheorghe, Chilia, Sulina and Periprava.
Hydrangeaceae Dumortier, 1829		
Philadelphus coronarius L.	W Europe, Caucaz	Cultivated as an ornamental plant in most settlements in the Danube Delta. The species was not identified in Mile 23, it may have been omitted.
Hydrangea arborescens L.	N. Am.	Ornamental shrub cultivated in Mila 23, Sulina, Crişan and Sf. Gheorghe
Hippocastanaceae A.P. de Candolle, 1824		
Aesculus hippocastanum L.	Balcans	Ornamental tree found in Mila 23, Sf. Gheorghe and Sulina in a few specimens up to 3-4 meters.
Juglandaceae A. Richard ex Kunth, 1824		
Juglans nigra L.	N. Am.	The species was found in the gardens of Crişan and Sulina.
Malvaceae Adans., 1763		
Hibiscus syriacus L.	S and E Asia	Shrub quite common, found in the gardens of Crişan, Maliuc, Sf. Gheorghe, Sulina, Chilia, Periprava, Letea and Caraorman.
Mimosaceae R. Brown, 1814		
Albizia julibrissin Durazz.	W Asia	Ornamental tree cultivated in Sulina, Sf. Gheorghe and Chilia, in the school yard.
Moraceae Link, 1831		
Ficus carica L.	Medit.	Shrub from crops, today it is common in St. George. In Sulina, Chilia, Letea, Caraorman, Mila 23, Crişan, Gorgova and Periprava, it has a lower frequency.
Maclura pomifera (Raffin.) C.K. Scheneid.	N. Am.	Tree cultivated in the dendrological park from Maliuc.
Morus alba L.	China	Species cultivated in forest plantations and localities where it was wilded throughout the Danube Delta. The species is considered subspontaneous, being susceptible to being invasive
Morus nigra L.	Medit.	Species cultivated in or around localities.
Oleaceae Hoffmannsegg şi Link, 1813-1820		
Forsythia suspensa (Thunb.) Vahl.	China	Ornamental shrub found in the gardens of Sulina and Crişan.
Fraxinus pennsylvanica Marsh.	N. Am.	Tree frequently cultivated in forest plantations as a substitute for the species Amorpha fruticosa. It is frequently found in

Family Species	**Origin**	**Presence in Danube Delta Romania**
		the localities of the Danube Delta. Currently, it is considered subspontaneous, being widespread in floodplains. We consider it to be a species that needs attention in terms of its invasive character
Jasminum officinale L.	W Asia	Shrub of small height, cultivated for its flowers; it is found in Sulina, Sf. Gheorghe, Crişan, Caraorman and Chilia.
Pinaceae Lindley, 1836		
Picea pungens Engelm	N. Am.	Shrub of small height, cultivated for its flowers; it is found in Sulina, Sf. Gheorghe, Crişan, Caraorman and Chilia.
Pseudotsuga menziesii (Mirbel) Franco	N. Am.	Species found in the dendrological park from Maliuc
Platanaceae Lestiboudois ex Dumortier, 1829		
Platanus occidentalis L.	N. Am.	Cultivated in localities, in arranged places, in Maliuc and Sulina.
Rosaceae Adans., 1763		
Armeniaca vulgaris Lam.	W Asia	Orchard species cultivated in Crişan, Sulina, Chilia and Periprava.
Chaenomeles japonica (Thunb.) Spach	Asia	Ornamental shrub found in several specimens in Crişan.
Cydonia oblonga Miller	S Asia	Small tree, grown in gardens in all localities of the Danube Delta and in micro-plantations in Tatanir.
Physocarpus opulifolius (L.) Maxim.	N. Am.	Shrub found in St. George.
Prunus cerasifera Ehrh. *var. pissardi* (Carriere) C.K.Schneid.	Pont. balcanic	Ornamental tree cultivated in most localities in the Danube Delta. The species was found to be planted outside the localities, in the temporary settlements of fishermen, without spreading naturally.
Prunus domestica L.	V Asia	Species cultivated in the gardens of most localities for its fruits. Like the previous species, it was found in temporary fishermen's settlements, without expanding later.
Prunus vulgaris Miller	China	Tree cultivated in the gardens of St. George, Gorgova and Sulina for its fruits.
Rosa rugosa Thunb.	Asia	Ornamental species cultivated in Maliuc, Sf. Gheorghe and Chilia.

Family Species	Origin	Presence in Danube Delta Romania
Sorbaria sorbifolia (L.) A.Br.	Asia	Shrub found in the gardens of Periprava, Sf. Gheorghe, Caraorman, Sulina, Maliuc and Chilia.
Spirea vanhouttei (Briot) Zabel	Asia	Shrub up to 2 m tall, found in the gardens of Crişan, Maliuc, Sf. Gheorghe, Sulina and Chilia.
Rutaceae Durande, 1782		
Ptelea trifoliata L.	N. Am.	Shrub present at St. George in several individuals
Salicaceae Mirbel, 1815		
Populus x canadensis Moench	hybrid	Hybrid species, currently preferred in forest crops. The current management of the exploitation of the poplar forest plantations favors the development of the *Amorpha fruticosa* shrub layer. Maintaining a high-water level in these enclosures for a longer period of time can be a solution in eliminating the species *Amorpha fruticosa.*
Salix babylonica L.	E Asia	Ornamental tree found in or near the localities of Mila 23, Crişan, Gorgova, Maliuc, Sf. Gheorghe and Sulina.
Salix matsudana Koidz.f.tortuosa Vilm.	Asia	Species found in the dendrological park from Maliuc.
Sapindaceae A.L. de Jussieu, 1789		
Koelreuteria paniculata Laxm.	Asia	Ornamental tree found in Maliuc and Sulina.
Scrophulariaceae Durande, 1782		
Paulownia tomentosa (Thunb.) Siebold and Zucc. ex Steud.	Japan	Ornamental tree found in the dendrological park from Maliuc.
Simaroubaceae A.P. de Candolle, 1811		
Ailanthus altissima (Mill.) Swingle	China	Frequently cultivated in most localities. It is considered a subspontaneous species, being found near the localities, in the forest cultures, on Popina Island, Capul Doloşman, Iancina, Taşburun and, sometimes, along the canals. We consider it a species that needs attention due to its high spread potential. It is currently classified as an invasive species
Solanaceae Adans., 1763		

Family Species	Origin	Presence in Danube Delta Romania
Lycium barbarum L.	China	Species used in the past to fix the soil. Currently, on the territory of the Danube Delta, the species was found in the wild near Sulina, Sf. Gheorghe, Maliuc, Crişan, Gorgova, Caraorman, Letea and Chilia. Other areas where the species was encountered during the study are the Portita area, Grindul Lupilor, Taşburun and Periteaşca
Taxodiaceae Warming, 1884		
Taxodium distichum (L.) L.C.M. Rich.	N. Am.	Ornamentally cultivated tree in the dendrological park from Maliuc and in Uzlina, in the forest arrangement.
Vitaceae Durande, 1782		
Parthenocissus quinquefolia (L.) Planchon	N. Am.	Liana cultivated as an ornamental plant in the gardens of Sf. Gheorghe, Sulina and Crişan.
Parthenocisus inserta (A.Kerner) Fritsch	N. Am.	Species identified in Sf. Gheorghe, Maliuc and Sulina

List of non-native herbaceous plant species identified in Danube Delta - Romania

Crt. No.	Identified species	Status in DD	Occurrence	Origin
1	*Acorus calamus*	rare	Delta	SE As
2	*Aegilops crassa*	sporadically	Letea	As.centr
3	*Agropyron pycnanthum*	rare	Delta	Atl-medit.
4	*Amaranthus albus*	rare	Delta	N. Am.
5	*Amaranthus blitoides*	rare	Delta	N. Am.
6	*Amaranthus crispus*	rare	Delta	N. Am.
7	*Amaranthus hybridus*	sporadically	Delta	N. Am.
8	*Amaranthus powelii*	sporadically	Delta	N. Am.
9	*Amaranthus retroflexus*	sporadically	Delta	N. Am.
10	*Ambrosia coronopifolia*	rare	Sf.Gheorghe	N. Am.
11	*Ammophila arenaria*	rare	Delta	Medit.
12	*Apium graveolens*	common	Delta	Atl-medit.
13	*Apium nodiflorum*		Delta	Atl-medit.
14	*Argenteo marginatum*		Delta	
15	*Aristolochia clematitis*	rare	Delta	Medit.
16	*Armoracia lapathifolia*	sporadically	Delta	S-W Eur. and W. As.
17	*Asperula taurina*	rare	Delta	Medit.
18	*Azolla filiculoides*		Delta	N. Am.
19	*Bidens connata*	very rare	Caraorman	N. Am.

Crt. No.	Identified species	Status in DD	Occurrence	Origin
20	*Bidens frondosa*	common	.	N. Am.
21	*Bifora radians*	very rare	Chilia Veche	Medit.
22	*Bilderdykkia balchuanicum*			
23	*Blackstonia acuminata*	very rare	Sf.Gheorghe	Medit.
24	*Brachyactis ciliata*	rare	Sacalin	As.
25	*Brassica rapa*	.	Delta	Medit.
26	*Buddleja davidii*		Delta	Asia
27	*Bupleurum tenuissimum*	very rare	Chilia Veche	Atl-medit.
28	*Cardaria draba*	sporadically	Delta	Medit.
29	*Carex extensa*	rare	Delta	Atl-medit.
30	*Carex flava*	common	Delta	N. Am.
31	*Chenopodium ambrosioides*	sporadically	Delta	Am.trop
32	*Chenopodium botrys*	sporadically	Delta	Am.trop
33	*Chenopodium chenopodioides*	very rare	Periteasca	Atl-centr-eur.
34	*Chenopodium pumilio*	rare	Partizani	Australia
35	*Chenopodium vulvaria*	rare	Delta	Medit.
36	*Conyza canadensis*	common	Delta	N. Am.
37	*Coronopus didymus*	rare	Sulina	S. Am.
38	*Corynephorus canescens*	very rare	Sulina	Atl-centr-eur.
39	*Crambe maritima*	rare	litoral	Atl.
40	*Cuscuta approximata*	rare	Cardon	Medit.
41	*Cuscuta campestris*	common	.	N. Am.
42	*Cyperus hamulosus*	very rare	Caraorman	Medit.
43	*Cyperus odoratus*	very rare	Letea, Sulina, Sf. Gheorghe	N. Am.
44	*Dasypyrum villosum*	sporadically	Sulina	Medit.
45	*Datura stramonium*	rare	Delta	N. Am.
46	*Daucus brotteri*	.	Cardon	Medit.
47	*Diplotaxis erucoides*	.	Sulina	S-W Eur.
48	*Ecballium elaterium*	rare	Delta	Medit.
49	*Eleocharis parvula*	rare	Sacalin, Sulina	Atl-medit.
50	*Elodea canadensis*	sporadically	Delta	N. Am.
51	*Elodea nuttallii*	sporadically	Delta	N. Am.
52	*Eruca sativa*	.	Delta	medit.
53	*Eryngium maritimum*	sporadically	litoral	Atl-medit.
54	*Euphorbia maculata*	sporadically	Delta	N. Am.
55	*Euphorbia paralias*	very rare	Delta	Atl.-medit.
56	*Euphorbia peplis*	very rare	Sf.Gheorghe	Atl-medit.
57	*Fimbristylis bisumbellata*	rare	Sulina, Cardon	Medit.
58	*Galingsoga parviflora*	sporadically	Delta.	S Am.

Crt. No.	Identified species	Status in DD	Occurrence	Origin
59	*Glaucium flavum*	rare	Cordon litoral	Atl-medit.
60	*Groenlandia densa*	sporadically	Buhaz	Atl-centr.eur.
61	*Heliotropium curassavicum*	rare	Sulina	N. Am.
62	*Heliotropium suaveolens*	.	Delta	Medit.
63	*Hordeum bulbosum*	rare	Delta	Medit.
64	*Hordeum jubatum*	rare	Delta,Letea Perisor.	N. Am., E As.
65	*Hordeum murinum*	sporadically	Letea, Sulina.	Atl-medit.
66	*Juncus hybridus*	rare	Sulina	Medit.
67	*Juncus subnodulosus*	sporadically	Delta	Atl.centr-eur-medit.
68	*Kohlrauschia prolifera*	rare	Letea	Atl-medit.
69	*Lolium multiflorum*	rare	Delta	Medit.
70	*Lolium rigidum*	very rare	Sulina	Medit.
71	*Lythrum scabrum*		Delta	N. Am.
72	*Lythrum thymifolia*	rare	Letea	Medit.
73	*Medicago rigidula*	.	Chilia Veche	Medit.
74	*Myagrum perfoliatum*	rare	Delta	Medit.
75	*Myrroides nodosa*	rare	Letea	Medit.
76	*Oenothera biennis*	sporadically	Delta	N. Am.
77	*Oenothera parviflora*	rare	Delta	N. Am.
78	*Orchis coriophora*	common	Letea	Medit.
79	*Oxalis corniculata*	.	Sulina	medit.
80	*Panicum capillare*	subspont.	Delta	N. Am.
81	*Papaver dubium*	rare	Delta	Medit.
82	*Paspalum paspalodes*	common	Letea	tropic
83	*Petasites spurius*	sporadically	Delta	Atl-pont.
84	*Petunia parviflora*	rare	Sf.Gheorghe	N. Am.
85	*Phytolacca americana*	.	Chilia Veche	Am.de N.
86	*Plantago coronopus*	rare	Delta	Atl-medit.
87	*Polygomum maritimum*	rare	Sf.Gheorghe	Medit.
88	*Polypogon monspeliensis*	sporadically	Delta	Medit.
89	*Potentilla pedata*	very rare	Perişor	Medit.
90	*Psilurus incurvus*	rare	Delta	Medit.
91	*Ranunculus baudotii*	.	Sulina	Atl-centr-eur-medit.
92	*Saccharum ravennae*	rare	Delta	Adv.(medit.)
93	*Sagina maritima*	.	Letea	Atl-medit.
94	*Salicornia ramossisima*	very rare	Sf.Gheorghe	Atl-medit.
95	*Schoenoplectus litoralis*	rare	Delta	Medit.
96	*Sclerochoa dura*	rare	localităţi	Medit.
97	*Scolymus hispanicus*	rare	Sulina	Medit.
98	*Solanum retroflexum*	.	Delta	S. Afr.
99	*Sonchus asper*	sporadically	Delta	Medit.
100	*Sorghum halepense*	sporadically	Delta	Medit.
101	*Suaeda splendens*	very rare	Chilia Veche	Medit.

Crt. No.	Identified species	Status in DD	Occurrence	Origin
102	*Teucrium scordium*	sporadically	Delta	Medit.
103	*Tragus racemosus*	rare	Delta	Medit.
104	*Trifolium filiforme*	.	Delta	Atl.-medit.
105	*Trifolium ornithopodioides*	.	Delta	Atl.-medit.
106	*Trifolium pallidum*	.	Delta	Medit.
107	*Trifolium resuapinatum*	.	Delta	Medit.
108	*Trifolium striatum*	.	Delta	Atl.-medit.
109	*Trifolium suffocatum*	.	Letea	Medit.
110	*Trigonella gladiata*	.	Sulina	Medit.
111	*Valerianella coronata*	rare	Delta	Medit.
112	*Vallisneria spiralis*	sporadically	Delta	tropic
113	*Veronica persica*	rare	Delta	S-W As.
114	*Viola odorata*	common	Letea	Antl-medit.
115	*Xanthium italicum*	common	Delta	N. Am.
116	*Xanthium spinosum*	sporadically	Delta	S. Am.

Mollusk (Bivalvia Class)
Kingdom: Animalia Linnaeus, 1758
Phylum: Mollusca (Linnaeus, 1758) Cuvier, 1795
Class: Bivalvia Linnaeus 1758

Order: Unionoida
Family: Unionidae s.s.
Genus: *Sinanodonta* Modell, 1945
Species: *woodiana* (Lea, 1834)

Order: Veneroida H. Adams and A. Adams, 1856
Family: Corbiculidae Gray, 1847
Genus: *Corbicula* Megerle von Mühlfeld, 1811
Species: *fluminea* (O. F. Müller, 1774)

Order: Veneroida H. Adams and A. Adams, 1856
Family: Dreissenidae Gray, 1840
Genus: *Dreissena* Beneden, 1835
Species: *rostriformis* Andrusov 1890
SubSpecies: *bugensis* (Andrusov, 1897)

Order: Veneroida H. Adams and A. Adams, 1856
Family: Dreissenidae Gray, 1840
Genus: *Dreissena* Beneden, 1835
Species: *polymorpha* (Pallas, 1771)

Arthropoda (Insect Class)
Kingdom: Animalia Linnaeus, 1758

Phylum: Arthropoda Latreille, 1829
Class: Insecta Linnaeus, 1758

Order: Hymenoptera Linnaeus, 1758
Family: Encyrtidae Walker, 1837
Genus: *Ageniaspis* Dahlbom, 1857
Species: *fuscicollis* Dalm.

Order: Lepidoptera Linnaeus, 1758
Family: Gracillariidae
Genus: *Cameraria* Chapman, 1902
Species: *ohridella*

Order: Lepidoptera Linnaeus, 1758
Family: Arctiini
Genus: *Hyphantria* Harris, 1841
Species: *cunea* (Drury, 1773)

Order: Lepidoptera Linnaeus, 1758
Family: Gracillariidae
Genus: *Phyllonorycter* Hübner, 1822
Species: *robiniella*

Order: Coleoptera Linnaeus 1758
Family: Chrysomelidae
Genus: *Leptinotarsa* Stål, 1858
Species: *decemlineata* (Say, 1824)

Order: Coleoptera Linnaeus 1758
SuperFamily: Curculionoidea
Family: Curculionidae
Genus: *Bothynoderes*
Species: *punctiventris*

Chordata (Class Actinopterygii)
Kingdom: Animalia Linnaeus, 1758
Phylum: Chordata Bateson, 1885
Class: Actinopterygii
Order: Cypriniformes
Family: Cyprinidae
Genus: *Carassius*
Species: *gibelio* Bloch 1782

Order: Cypriniformes
Family: Cyprinidae

Genus: *Ctenopharyngodon*
Species: *idella* Valenciennes 1844

Order: Cypriniformes
Family: Cyprinidae
Genus: Hypophthalmichthys
Species: molitrix Valenciennes 1844

Order: Cypriniformes
Family: Cyprinidae
Genus: *Hypophthalmichthys*
Species: *nobilis* Richardson 1845

Order: Perciformes
Family: Centrarchidae
Genus: *Lepomis*
Species: *gibbosus* Linnaeus, 1758

Order: Mugiliformes
Family: Mugilidae
Genus: *Mugil*
Species: *soiuy* Temminck & Schlegel, 1845

Order: Cypriniformes
Family: Cyprinidae
Genus: *Mylopharyngodon*
Species: *piceus* Richardson 1846

Order: Perciformes
Family: Percidae
Genus: *Percarina*
Species: *demidoffi* Nordmann 1840

Order: Perciformes
Family: Odontobutidae
Genus: *Perccottus*
Species: *glenii* Dybowski, 1877

Order: Cypriniformes
Family: Cyprinidae
Genus: *Pseudorasbora*
Species: *parva* Temminck & Schlegel, 1842

Chordata (Aves Class)
Kingdom: Animalia Linnaeus, 1758

Phylum: Chordata Bateson, 1885
Class: Sauropsida
Order: Galliformes Temminck, 1820
Family: Phasianidae Vigors, 1825
Genus: *Phasianus* Linnaeus, 1758
Species: *colchicus* Linnaeus, 1758

Chordata (Mammalia Class)
Kingdom: Animalia Linnaeus, 1758
Phylum: Chordata Bateson, 1885
Class: Mammalia Linnaeus, 1758
Order: Rodentia Bowdich, 1821
Family: Muridae (Illiger, 1811) Gray, 1821
Genus: *Ondatra* Link, 1795
Species: *zibethica* Linnaeus 1766

Order: Carnivora Bowdich, 1821
Family: Canidae (Fischer de Waldheim, 1817) Gray, 1821
Genus: *Nyctereutes* Temminck, 1838
Species: *procynoides* Gray 1834

3.2 - Danube Delta – Ukraine (IMB)

Algae

Florideophyceae
Thoreales
Thoreaceae
1. *Thorea hispida* (Thore) Desvaux - likelihood of arrival

Phaeophyceae
Desmarestiales
Desmarestiaceae
2. *Desmarestia viridis* (O.F.Müller) J.V.Lamouroux - likelihood of arrival

Stschapoviales
Halosiphonaceae
3. *Halosiphon tomentosus* (Lyngbye) Jaasund - likelihood of arrival

Charophyceae
Charales
Characeae
4. *Chara rudis* (A.Braun) Leonhardi – likelihood of arrival

Plants

Polypodiopsida
Salviniales
Azollaceae
5. *Azolla caroliniana* Willd. – likelihood of spread post invasion

Magnoliopsida
Fabales
Fabaceae
6. *Amorpha fruticosa* L., 1753 – potential impact on biodiversity
7. *Robinia pseudoacacia* L., 1753 – potential impact on biodiversity
8. *Gleditsia triacanthos* L. (1753) – potential impact on biodiversity

Asterales
Asteraceae
9. *Ambrosia artemisifolia* L., 1753 – potential impact on biodiversity
10. *Erigeron canadensis* L, 1753 – potential impact on biodiversity

Sapindales
Sapindaceae
11. *Acer negundo* L., 1753 – potential impact on biodiversity

Cucurbitales
Cucurbitaceae
12. *Sicyos angulatus* L. – potential impact on biodiversity

Liliopsida
Poales
Poaceae
13. *Hordeum murinum leporinum* (Link) Arcangeli 1753 – potential impact on biodiversity

Alismatales
Hydrocharitaceae
14. *Elodea canadensis* Michx. – likelihood of spread post invasion
15. *Elodea nuttallii* (Planch.) H.St.John – likelihood of arrival
16. *Egeria densa* Planch. – likelihood of arrival
17. *Vallisneria spiralis* L. – likelihood of spread post invasion

Araceae
18. *Pistia stratiotes* L. – likelihood of arrival, likelihood of establishment

Arales
Lemnaceae
19. *Lemna turionifera* Landolt – likelihood of arrival, potential impact on biodiversity

Animals

Phylactolaemata
Plumatellida
Pectinatellidae
20. *Pectinatella magnifica* (Leidy, 1851) – potential impact on biodiversity

Hydrozoa
Limnomedusae
Olindiidae
21. *Craspedacus tasowerbii* Lankester, 1880 – likelihood of arrival

Tentaculata
Lobata
Bolinopsidae
22. *Mnemiopsis leidyi* Agassiz, 1865 – potential impact on biodiversity

Nuda
Beroida
Beroidae

23. *Beroe ovata* Bruguière, 1789 – potential impact on biodiversity

Polychaeta
Spionida
Spionidae
24. *Streblospio gynobranchiata* Rice & Levin, 1998 – likelihood of spread post invasion, potential impact on biodiversity

Polychaeta
Spionida
Spionidae
25. *Polydora cornuta* Bosc, 1802 – potential impact on biodiversity

Hexanauplia
Calanoida
Acartiidae
26. *Acartia tonsa* Dana, 1849 – potential impact on biodiversity

Pseudodiaptomidae
27. *Pseudodiaptomus marinus* Sato, 1913 – likelihood of arrival

Cyclopoida
Oithonidae
28. *Oithona davisae* Ferrari & Orsi, 1984 – potential impact on biodiversity

Malacostraca
Decapoda
Cambaridae
29. *Faxonius limosus* (Rafinesque, 1817) – likelihood of arrival

Xanthidae
30. *Rhithropanopeus harrisi* (Gould, 1841) – potential impact on biodiversity

Insecta
Heteroptera
Belostomatidae
31. *Lethocerus patruelis* (Stal, 1854) – likelihood of arrival

Gastropoda
Hypsogastropoda
Tateidae
32. *Potamopyrgus antipodarum* J. E. Gray, 1843 – potential impact on biodiversity

Pulmonata
Physidae

33. *Physella acuta* (Draparnaud, 1805) – likelihood of spread post invasion, potential impact on biodiversity

Bivalvia
Unionoida
Unionidea
34. *Sinanodonta woodiana* (I. Lea, 1834) – likelihood of spread post invasion, potential impact on biodiversity

Venerida
Cyrenidae
35. *Corbicula fluminea* (O. F. Müller, 1774) – likelihood of spread post invasion, potential impact on biodiversity

Arcida
Arcidae
36. *Anadara kagoshimensis* (Tokunaga, 1906) – potential impact on biodiversity

Myida
Myidae
37. *Mya arenaria* Linnaeus, 1758 – potential impact on biodiversity

Actinopterygii
Cypriniformes
Cyprinidae
38. *Carassius gibelio* (Bloch, 1782) – potential impact on biodiversity
39. *Pseudorasbora parva* (Temminck & Schlegel, 1846) – potential impact on biodiversity

Siluriformes
Ictaluridae
40. *Ameiurus melas* (Rafinesque, 1820) – likelihood of arrival
41. *Ameiurus nebulosus* (Lesueur, 1819) – likelihood of arrival

Mugiliformes
Mugilidae
42. *Planiliza haematocheila* (Temminck & Schlegel , 1845) – potential impact on biodiversity

Gobiiformes
Odontobutidae
43. *Perccottus glenii* Dybowski, 1877 – likelihood of spread post invasion

Centrarchiformes
Centrarchidae

44. *Lepomis gibbosus* (Linnaeus, 1758) – potential impact on biodiversity

Reptilia
Testudines
Emydidae
45. *Trachemys scripta* Thunberg, 1831 – likelihood of arrival, likelihood of establishment

Mammalia
Rodentia
Muridae
46. *Rattus norvegicus* Berkenhout, 1769 – likelihood of spread post invasion, potential impact on biodiversity

Cricetidae
47. *Ondatra zibethicus* Linnaeus, 1766 – likelihood of spread post invasion, potential impact on biodiversity

Myocastoridae
48. *Myocastor coypus* Molina, 1782 – likelihood of spread post invasion, potential impact on biodiversity

Carnivora
Mustelidae
49. *Neovison vison* Schreber, 1777 – likelihood of spread post invasion, potential impact on biodiversity

Canidae
50. *Canis aureus* Linnaeus, 1758 – likelihood of spread post invasion, potential impact on biodiversity
51. *Nyctereutes procyonoides* Gray, 1834 – likelihood of spread post invasion, potential impact on biodiversity

3.3 - Nestos Delta – Greece (IHU)

Based on the proposed methodology stated in paragraph 2.3, the proposed invasive alien species that will be monitored in Nestos area are the following:

- *Amorpha fruticosa* L. (Fabaceae)
- *Robinia pseudoacacia* L. (Fabaceae)
- *Acer negundo* L. (Sapindaceae)

The selection of the above three IAS was based on their effects on biodiversity and habitat types. Although *Amorpha fruticosa* was recorded for the first time a few years ago, it is rapidly expanded forming dense thickets and consequently directly affects plant species richness and distribution patterns. *Robinia pseudoacacia* was introduced in the specific area in the past in a way that natural vegetation was replaced by plantations of fast-growing trees. Among those trees, *R. pseudoacacia* was selected and planted in several sites and now it can spread and replace natural vegetation formations (Vasilopoulos, 2005). On the other hand, *Acer negundo* was found within 91E0 habitat type [Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)] either in the understory or even in the overstorey. Although the consequences of the existence of *A. negundo* are not extensive now, it is expected to affect the specific habitat type after several years through vegetation succession.

3.4 - Kızılırmak Delta – Turkey (KTU-MSF)

Cyprinus carpio:

Common carp, is one of the most cosmopolitan benthivores freshwater fish that introduced to almost every part of the world from Europe. The native population was traced back to the inland deltas of the Danube River. *Cyprinus carpio* have been intentionally released most of the inland water sources of Turkey to improve inland fisheries, aquaculture, and angling. Reproductive population of the species can be easily found most of the inland water sources of Turkey including Kızılırmak Delta. *C. carpio* has been implicated in the environmental degradation of aquatic ecosystems and considered as an ecologically harmful invasive species (Kloskowski, 2011). Most of the clear water sources are turned into phytoplankton rich waters after the population density of carp reaches high density (Zamnbrano et al. 2001). *C. carpio* populations can be found in Kızılırmak delta and it is one of the targeted fish species for fishermen for being economically valuable.

Carassius gibelio:

Prussian carp is one of the highly invasive freshwater fish species. They produce thousands of eggs and can tolerate low dissolved oxygen. *Carassius gibelio* cause environmental damage by leading quantitative changes in the communities. In most of the invaded water sources they became the dominant species and shifted food chain by altering physicochemical properties of the environment and by altering available food sources. In Kızılırmak Delta case for instance, total landed *C. gibelio* is at least three times more than any other fish species. Moreover, *C. gibelio* is threatening local fish species. Some of the native fish species in the Delta such as the rudd (*Scardinius erythrophthalmus*) is eradicated after *C. gibelio* invasion. Even though *C. gibelio* is edible, it is not preferred as a food sources in Turkey for being small in size and for being bony which makes it harder to control their invasion.

Mosquito fish species *Gambusia holbrooki* and *Gambusia affinis:*

These species are native to Central and North America. The main diet of these species are pelagic eggs and larvae including insect eggs and larvae. Thus, this species have been introduced worldwide mainly as biocontrol agents against mosquitos and have become an invasive species in many places including Kızılırmak river and Kızılırmak Delta (Ugurlu ve Polat, 2007; Kurtul and Sarı, 2019). These species are mainly aggregated in slow-flowing vegetated shallow waters where most of the insect species choose to lay eggs. Mosquito fish can tolerate temperature, pH, and chemical stressors far beyond most of the other fish species (Pyke, 2005). Invasion of the mosquito fish species dates back almost a hundred years ago and believed to be one of the earliest introduced exotic fish species in Turkey (İnnal and Erk'akan, 2006; Kurtul ve Sarı, 2019). Mosquito fish have the ability to produce swiftly under different environmental conditions. Despite being only couple cm long, it is listed under 100 worst invasive species. They pose great threat to existence of various aquatic organisms that produce pelagic eggs and larvae.

Lithognathus mormyrus:

Striped seabream or sand steenbras is a demersal saltwater fish species of the Mediterranean Sea. *L. mormyrus* believed to be reached to the Black Sea through straits and formed adaptive populations (Aydin, 2017). Striped seabream was first recorded in the Black Sea in 2014 (Satılmış, 2014) and rarely considered as invasive species ever since due to being economically valuable. *L. mormyrus* is a carnivorous fish species and feeds on mostly aquatic invertebrates in shallow waters. Invasion of the species is not considered previously in

Kızılırmak Delta or any other region but possible negative effects and pressure on benthic organisms is obvious.

Parablennius incognitus:

It was traditionally believed that the Black Sea fauna of blennies (Blenniidae) included eight species but after the description of *Parablennius incognitus* (Bath, 1968) from the Mediterranean Sea, this species also included in this group in the Black Sea (Bogorodsky, 2006). The mystery blenny (Parablennius incognitus) is an omnivorous species (Wilson, 2009) of combtooth blenny found in the eastern Atlantic Ocean and the Mediterranean Sea (Froese and Pauly, 2021). Adults inhabit rocky shores of coastal waters. They feed on bottom invertebrates, especially gammarids and occasionally feed on algae (Bath, 1990). P. incognitus is a shallow water dwelling species. The species is mainly found at a depth from 0.5 to 2.5 meters according to the data of underwater observations (Bogorodsky, 2006).

Syngnathus acus:

Pipefish are a member of the Syngnathidae family and an important component of the fish fauna, due to their tolerance to high temperature and salinity (Kornienko 2001) in estuarine areas and shallow coastal waters. Pipefish belong to the same family as seahorses and are widely used species in many parts of the world, mainly in aquariums, ornamental items, and as a raw material in the traditional Chinese medicine in the Far East (Gurkan and Innal, 2018). *Syngnathus acus* can be found in sandy-muddy and densely vegetated habitats of continental and estuarine areas (Dawson 1986). These species are included in the Least Concern (LC) category of the Red Data Book (IUCN 2016) and they are important ecological examples, because of their sex-role reversal, parental care, single or multiple spawning seasons (Franzoi et al. 1993). Light greenish to dark brown in color with variable markings. Snout cylindrical, equal to or less than eye diameter (Dawson, 1986) with 18 - 19 body rings between head and dorsal fin (Muus and Nielsen, 1999). They are almost square in each segment of the body and known to feel rigid when handled. The greater pipefish has distinctive body rings which are a sandy brown with darker bars covering his body in between (Yıldız at al., 2015). The Mediterranean basin has 9 species that belong to the genus Syngnathus (Dawson, 1986); 6 species are distributed in the Black Sea (Taskavak et al., 2010). They inhabit vegetated coastal and estuarine habitats and may constitute an important part of the ichthyofauna of estuarine and shallow coastal waters. Analysis of the stomach contents indicates that they feed mainly on epibenthic and pelagic crustaceans such as calanoid copepods and gammarids (Taskavak et al., 2010).

Oncorhynchus mykiss:

Rainbow trout, *Oncorhynchus mykiss*, have been artificially propagated in fish hatcheries to restock streams and to introduce them into non-native waters. Rainbow trout are commercially farmed in many countries throughout the world including the Black Sea coast of Turkey. The practice began in the late 19th century, and since the 1950s commercial production has grown dramatically. In freshwater, they prefer cool water but have been known to tolerate water temperatures up to 24°C (native climates have water temperatures around 12°C in the summer). It is found in all fresh water sources where trout farming is carried out. Since it disperses by escaping from cages and pools, it is easily distributed to other secondary water sources. It has been reported in the studies that it is also in the Kızılırmak Delta. Insects remain their dominant food source throughout life, although they are opportunistic piscivores. Analysis of the contents of these stomachs revealed that rainbow trouts competing with each other for food. Aquatic insects and fish made up the greater part of the diet of trout. The fish portion of the diet consisted largely of other small fish and larvae species. Rainbow trout have been

introduced throughout the world, negatively impacting species of native freshwater fishes and, therefore, native fisheries.

Liza haematocheila:

Mugil so–iuy, *Liza haematocheila*, is a freshwater fish living in Amu Darya River Basin, Far East Asia. It was first introduced to the area around the Sea of Azov for fish farming but, then migrated to the Black Sea, and from there to the Sea of Marmara. The So-iuy mullet found a suitable environment on the eastern Black Sea coast of Turkey, after leaving the Sea of Azov and following the northeastern coast of the Black Sea. Although this species is known to migrate towards rivers in winter, no such migration was observed on the eastern Black Sea coasts of Turkey (Kaya at al., 1998). Mugil so-iuy, which is known locally named as "Pelingas" or "Russian grey mullet" by Turkish fishermen (Kaya at al., 1998). In the 1990's it cultured and naturalized into the Black Sea and the Sea of Azov (Pianova, 2004). Adults inhabit shallow coastal waters as well as freshwater regions of rivers (Unsal, 1992). Its major foods are benthic algae, aquatic invertebrates, and other organic material such as dead fish etc. M. so-iuy is an eurybiontic, eurythermal and euryhaline species. It grows very rapidly (Sabodash at all., 1996). In Azov Sea, it is now the most abundant mugilid species. Along shores of Black Sea, its expansion corresponds to a sharp decline of native species of Mugilidae, which it apparently replaces (Kottelat and Freyhof, 2007).

Gobius cruenttus:

Gobius cruenttus (Gmelin, 1789), is an eastern Atlantic goby, occurring from the southwest Ireland to Senegal coasts of the Atlantic Ocean and the Mediterranean Sea. It is a common species on the inshore rocky habitats, sand with stones and boulders and on the sea-grass meadows in this area (Miller, 1986). The red-mouthed goby is a frequent and abundant benthic species in its characteristic habitat. The most eastern records of this species were from the Anatolian coast of the Aegean Sea and the Sea of Marmara (Engin at al., 2007). The red-mouth goby is usually found among rock and boulders in sheltered inlets at depths between 10-20 m. In the Mediterranean it is often found in eel-grass beds (Picton and Morrow, 2016). The feeds on a wide variety of prey items, gammarids, shrimp, mussels, squid, scales, and fish (Miller, 1990).

Callinectes sapidus:

Blue crab is a commercially valuable swimmer crab species native to the Western Atlantic Ocean. *C. sapidus* invaded the Mediterranean Sea in 1930s and the Black Sea in 1968 (Bulgurkov, 1968). While early incidence was rare, encounter incidence with the species become more and more frequent by day (Öztürk et al., 2020). In one of the latest studies, Gül vd. (2021) captured a single gravid blue crab specimen in the Black Sea, a close location to Kızılırmak Delta which revealed reproductive capability of the blue crab in the Black Sea. Furthermore, this study officially represents the *C. sapidus* as being an invasive species. Blue crabs rely on brackish waters, especially estuaries for spawning (Sümer et al., 2013) and Kızılırmak Delta is one of the most suitable places in the region. The blue crab is an opportunistic benthic omnivore that feeds on whatever is available in the habitat (Mancinelli et al., 2017). Presence or establishment of this species in Kızılırmak Delta would surely affect the benthic community structure.

Pseudosolenia calcar-avis:

The invasive marine phytoplanktonic diatom *Pseudosolenia calcar-avis* (Schultze) (Sundström, 1986) was first observed in the Black Sea between 1924–1926 which were

introduced by ships' ballast water (Kaiser et al., 2018). It is the largest planktonic diatom of the Black Sea, its length may exceed 1 mm. Sharp curved ends of the frustule prompted botanists to give this algae its species name: bird's spur - calcar-avis. *P. calcar-avis* distributes warm water region, occasionally in temperate waters. In mid-1990s microphytoplankton population reached to maximum biomass so far and *Pseudosolenia calcar*-avis was the dominant diatom species in this bloom period (Feyzioğlu and Şahin, 2017). Eker-Develi and Kideys (2003) reported that this species was found high abundance in the southern coast of the Black Sea. Agirbas et al. (2014)'s microscopic observations revealed that *Pseudosolenia calcar-avis* was the most abundant and prominent species from February to December 2009 along the southeastern coasts of the Black Sea. It became dominant in phytoplankton species at last two decades. Although ecological effect of the species is not clearly known in the Black Sea Coast ecosystem, *P. calca-virus* caused a decline in the zooplankton production and an increase in the zoobenthos production in The Caspian Sea. So, it considers as both useful and harmful impacts on the ecosystem (Karpinsky, 2010).

Thalassiosira nordenskioeldii:

T. nordenskioeldii is a typical cold-water species described from Arctic waters. In the current warming period, this taxon is restricted to the colder Mediterranean sub-basins such as Gulf of Lions (Travers, 1975) and the Adriatic Sea (Revelante et al., 1984; Vilicˆic´ et al., 2002). This taxon may have had wider distributions during the last glacial periods. The occurrence of *T. nordenskioeldii* in the colder waters of the Black Sea is not unexpected. Although *Thalassiosira nordenskioeldii* rarely observed in the Black Sea coastal ecosystem. Effects of species is considered as Harmful Agae Bloom (HAM) along the coastal ecosystem (Polat *et al*, 2006).

***Alexandrium minutum*:**

Examination of the presence of *Alexandrium spp*. by scanning electron microscopy in the Black Sea revealed presence of *A. minutum.* Member of the genus Alexandrium constitute a considerable portion of the total phytoplankton community (25% by cell number). *A. tamarense*, *A. minutum* and *A. acatenella* are all known to inhabit the neighboring Mediterranean Sea (Vershinin et al., 2006). *A. minutum* is a photosynthetic dinoflagellate and many species in this genus are responsible for outbreaks of Paralytic Shellfish Poisoning (PSP). This phytoplankton species can also form extremely dense blooms that have the capacity to kill finfish, in addition to their PSP toxin production. As this species forms a tough resting cyst, it is easily transport by ballast water and in translocated shellfish, and it has been reported from most continents and every ocean. Control appears to be impossible. This species is primarily an inhabitant of environments with a high terrestrial influence, such as lagoons and estuaries where nutrient levels are high, the water column is stratified, and mechanical disturbance low (Cabi, 2021).

Oxyphysis oxytoxsoides

O. oxytoxsoides is a non-indigenous plankton species in the Black Sea. Moncheva and Kamburska (2002) reported that possible origin of *Oxyphysis oxytoxoides* is western coast of the North America. However, this species was reported from the Mediterranean (Gómez, 2003), recently from the Marmara Sea (Balkis, 2000). *Oxyphysis oxytoxsoides* rarely observed in the Black Sea coastal ecosystem. It is mostly observed from late spring to Late summer (Lok, et al, 2010).

***Scrippsiella trochoide*:**

S.trochoide was first recorded in Bulgarian waters of the Black Sea in 1989 with maximal abundance of 1.9×10^6 cells l^{-1}. Later, *Scrippsiella trochoidea* was noted in 1991 and 1994 and has been referred to as an invasive species by mistake (Moncheva and Krastev, 1997; Velikova et al., 1999). This species is a common harmful bloom forming species in coastal waters. *Scrippsiella trochoide* being dominant in the western Black Sea in comparison to the eastern side (both species formed 25% of total abundance and 51% of the total biomass) (Eker et al., 1999). The species was found to cause red tides along Trabzon's coast line between 1991 and 2001 (Feyzioğlu and Öğüt, 2006).

Ulva lactuca = Ulva fasciata:

U. lactuca is a thin flat green algae growing from a discoid holdfast. The margin is somewhat ruffled and often torn. It may reach 18 centimetres. They are widely distributed in the ocean and seas, ranging from tide level to considerable depths or attached to substrates such as sand, mud, rocks, shells, and coral inter alia (Apaydın et al., 2010). It is particularly prolific in areas where nutrients are abundant.This has been the case off the coast of Sea where a high level of nitrates, from the intensive farming there, washes out to sea. Large quantities of *Ulva lactuca* decay produces methane, hydrogen sulfide, and other gases on beaches (Geert-Hansen et al., 1993; Nedergaard et al., 2002). Fast growing and opportunistic characters of the species can cause covering the water surface, decreasing the biodiversity even for other algae species (Dominguez and Loret, 2019).

***Mnemiopsis leidyi* (Scyphozoa:Ctenophora):**

The entry of the invasive comb jellyfish species *Mnemiopsis leidyi* from the East coast of the North America into the Black Sea ecosystem is considered one of the most disastrous invasions ever known. First seen in the Black Sea ecosystem in 1982, *M. leidyi* has spread to the whole ecosystem as of 1988 (Vinogradov et al. 1989). *Mnemiopsis leidyi* was accidentally introduced to the Black Sea in the early 1980s; within 10 years, it had destroyed the fishing industry in the entire region, outcompeting native planktonic fishes and disrupting the food chain (Shiganova, 1998; Kideys et. al., 2004). This species has caused dramatic changes on copepoda group and plankton biodiversity. The feeding ecology and the lack of predator combined with the special oceanographic conditions of the Black Sea have become this species quickly dominant species in pelagic zone. Between the effects of its penetration and adaptation in the Black Sea can be said the extreme reduction of pelagic fish populations. Also *M. leidyi* heavily affect the main components of the pelagic community; mesozooplankton, ichthyoplankton, and fish resources (Shiganova, 1998). This species has started to spread throughout the Black Sea (Vinogradov et al., 1989) and has been in Kızılırmak Delta coastal water.

Beroe ovate:

B. ovate is another comb jellyfish, naturally inhabits the Atlantic Ocean and coastal waters near both the United States and Canada as well as in the Gulf of Mexico and European waters. *B. ovata*, in the summer of 1987, a predator feeding on planktivorous comb jellies and *M. leidyi* above all, entered the Black Sea with ballast waters (Shiganova et al., 2003). *Beroe ovata* is a pelagic marine organism that swims freely in the water column and has been found at depths ranging from just below the surface at 0.5 meters to deeper than the surface. It can inhabit areas of varying temperatures including polar, temperate, and tropical regions (Finenko et al., 2003). It is emphasized in the literature that the yearly dynamics of both species are in control of temperature and food (zooplankton for *M. leidyi* and *M. leidyi* for *B. ovata*) (Shiganova et al. 2018). The appearance of a new invader ctenophore *B. ovata*, a known feeder on *Mnemiopsis* in native waters (Kremer, 1976), at the end of the 1990s in the Black Sea caused further

improvements in the planktonic community. The consequence of this new invasion was positive for the recovery of the Black Sea ecosystem (Finenko et al., 2003).

Acartia tonsa:

Presence of A.tonsa, copepod, was reported in the Black Sea for the first time in 1990 (Belmonte et al., 1994). However, the examination of historical zooplankton samples showed that this species had appeared there in the early 70s (Gubanova, 2000). Probably it was transferred to the Black Sea with ship's ballast water from some other region of the World Ocean (Gubanova et al. 2014). It is commonly found in coastal waters, including brackish estuaries. *A. tonsa* is found year-round in estuaries and coastal waters which are warm throughout the year. It is frequently the dominant zooplankton in the spring and summer samplings. Individuals spend most of the day in deeper waters in order to avoid predators, rising into shallower waters at night (Mauchline, 1998). *Acartia tonsa* is translucent and is usually between about 0.8 and 1.5 mm in length in females, and from about 0.8 to 1.3 mm in males. *A. tonsa* nauplii and adults feed on phytoplankton as well as planktonic ciliates and rotifers (Razouls et al., 2018). *A. tonsa* species are an important food source for many commercial fish species.

Balanus improvises:

B.improvises is the invasive species with the highest ecological success among the crustaceans. It is arrived in the Black Sea in the second half of the 19th century. Almost all these barnacles have proven to be successful invasive species (Skolka and Preda, 2010). It developed large populations on all types of hard substrate. A possible collateral effect of its successful establishment could be the inability of other species of barnacles to install on the rocky littoral of the Black Sea. While barnacles are observed in the water column during planktonic stage, adult individuals survive by holding on to hard ground at the bottom.

Oithona davisae:

O.davisae, new invader, was first observed as *Oithona brevicornis* in Sevastopol Bay, Crimea, Black Sea since 2001 (Zagorodnyaya 2002; Gubanova and Altukhov, 2007). Then, Temnykh and Nishida (2012) re-assessed the taxonomic status of this species and concluded that the species is actually *Oithona davisae* (Ferrari and Orsi, 1984). The species *O. davisae*, which is a new immigrant in the Black Sea and a representative of Cyclopoida: Copepoda, is indigenous to Japan and the China Seas. The occurrences of *O. davisae* in the northern Black Sea match very well with the main shipping routes, indicating that they were probably introduced though the ballast water transport. During the regular monitoring programme, *O. davisae* was first discovered in the Anatolian continental shelf area (Black Sea) in 2010. Since then, it has been observed regularly (Yıldız et. al., 2017). The studies show that *O. davisae* has successfully invaded the southern Black Sea and may replace *Oithona nana*, which was regularly observed in coastal areas (Shiganova et. al., 2012; Temnykh et. al., 2012). Its high abundances also indicate that it may become a key species in the food web of the southern Black Sea. Species of genus Oithona are omnivorous with preferences for ciliates and dinoflagellates (Atkinson, 1995; Saiz et. al., 2014). Furthermore, they are an important prey for fish larvae in the Black Sea (Tkach et. al., 1998). Hence, *O. davisae* would be a key species in the energy transfer from the microbial loop to higher trophic levels, which is very important in the Black Sea (Shiganova et. al., 2012; Temnykh et. al., 2012).

Rapana venosa:

R. venosa, Rapa whelk, is a voracious predator with a preference for mussels, oysters and other bivalves. It affects ecosystem services primarily through its negative impacts on mussel

and oyster beds. The consumption of *R. venosa* may cause a potential risk for human health due to the high Cd and Pb levels in case of increased serving sizes and portions (Gedik, 2017).

Rapa whelk is a commercially important invasive species in the Black Sea. Rapana fishery has developed and the revenue is €15 million. The indirect ecologic impact of Rapana on benthic ecosystem is rapana fishery. Rapa whelk is harvested by dredge and beam trawls in Turkey. Dredges are harmful to the bottom habitat and the biodiversity due to high by-catch rates (Saglam and Duzgunes, 2014).

Rapa whelk is a successful invader because of high fecundity, early sexual maturity, fast growth rate, and broad tolerance to salinity and temperatures. This invasive species distributed to the waters of 16 different countries due to the high ecological fitness. The Rapa whelk is native to the Sea of Japan, Yellow Sea, East China Sea and the Bohai Sea. It was accidentally introduced into the Black Sea in 1946 with the first record from Novorossiysk Bay (Drapkin, 1963) and within a decade spread along the Caucasian and Crimean coasts and to the Sea of Azov. It may also be introduced to Black Sea with oysters imported for culture. Its distribution range extended to the northwest Black Sea to the coastlines of Romania, Bulgaria, and Turkey from 1959 to 1972 (Chukhchin, 1984; Bilecik, 1990; Zolotarev, 1996). Its bio-geographical range has extended towards Europe (Mediterranean, Adriatic and Aegean Sea) and America (South and North America) due to marine trade traffic (Bombace et al., 1996; Pastorio et al., 2000; Harding & Mann 1999).

Extended pelagic larval development is facilitated local dispersal (Saglam and Duzgunes, 2014). Its establishment in the Black Sea appeared to be facilitated by the general lack of competition from other predatory gastropods and an abundance of potential prey species.

Rapana venosa has broad ecological tolerances of temperature, low salinity, oxygen depletion and pollution (Zolotarev, 1996). In its native range it tolerates temperatures between 4°C and 27°C, and in the Black Sea between 7°C and 24°C. In the Sea of Azov it is absent from those parts that are ice-covered during winter, but survives continuous salinity below 12 ‰ (ICES, 2004). In Chesapeake Bay, R. venosa occurs at salinities from 18 to 28 ‰, in the Black Sea from 25 to 32 ‰ (Mann and Harding, 2000). It seems to prefer sandy or sandy-muddy bottoms in the introduced areas (Koutsoubas and Voultsiadou-Koukoura, 1991; Harding and Mann, 1999). Rapa whelks are active burrowers and may remain completely buried in the sediment with only the tip of the siphon sticking out (Harding and Mann, 1999).

The ecological impacts of Rapa whelk in the Black Sea have been severe. Rapa whelk caused a significant damage to native benthos due to no predator in the Black Sea.

Establishment of Rapa whelk in Black Sea is facilitated a lack of competition, a lack of predator and the presence of abundance preys. The abundance of rapa whelk in the Black Sea coast of Turkey increased from 42 thousands in 1991 to 204 thousands indv./km^2 in 2000 (Duzgunes et. al., 1992; Saglam, 2003; ICES, 2004).

Rapa whelk has high fecundity and it has facilitated to establish in the Black Sea. The total number of egg capsules per adult female ranged from 197 to 999 with a mean of 575 and each capsule contains 555 eggs. The fecundity ranged from 106 thousands to 872 thousands eggs per whelk (Saglam and Duzgunes, 2007).

This invasive species is generalist predator and usually feeds on bivalves of economic interest like oysters, mussels and clams (Harding and Mann, 1999; Savini et. al., 2004). It is responsible for the collapse of mussels and oysters beds in the Black Sea (Drapkin, 1963; Zolotarev, 1996). Diet preference of Rapa whelk is bivalve mollusk including Ch*amelea gallina*, *Gouldia minima*, and *Pitar rudis* (Zolotarev, 1996). Some native bivalve species including *Ostrea edulis*, *Pecten ponticus*, and *Mytilus galloprovincialis*, on the Gudaut, were near extinction due to predation by Rapa whelk (Chukhchin, 1984).

The indirect impact of Rapana on benthic ecosystem is Rapana fishery. Rapa whelk is harvested by dredge and beam trawls in Turkey. Dredges are harmful to the bottom habitat and the biodiversity due to high by-catch rates. 13 different by-catch species are caught by dredge. These are turbot, dragonet, goby fish, seahorse, sole, stargazer, scorpion fish, flounder, shore crab, harbor crab, striped venus clam, needle whelk and blood cockle (Celik and Samsun, 1996; Duzgunes, 2001; Saglam et. al., 2008).

Despite all impacts there are positive effects of this invasive species in socio-economical life of the fishermen communities. For artisanal fisheries it is an important income source. Many whelk fishing vessels, transporters and processing plants provide employment in the region.

Rapa whelk is commercially an important species and started to catch by dredge and get important revenue for the small scale fisheries in this region since the 1980s. There are eight whelk processing plants and most of them are located in Samsun and Sinop. The number of licensed fishing boats to harvest Rapa whelk increased from 121 to 596 between 2000 and 2005 (Saglam et. al., 2008; Aydin et. al., 2016). Forty percent of Rapa whelk fishermen are from Samsun province where the most productive region by the deltas of the Kızılırmak and Yeşilırmak rivers and has the largest continental shelf in Turkish Black Sea. Rapa whelk landing is 11.6 thousand tons in 2019 according to national statistics (TUIK, 2021).

Due to no domestic consumption in Turkey, all the production is exported as frozen meat to Asian countries. It is provided foreign currency about 15 million euro in 2013. Not only exported meat of rapa whelk but also its shell and operculum are exported to foreign countries especially Japan, Kore, China, Thailand, US, France etc (Saglam et al., 2008).

Anadara kagoshimensis:

The arc clam in the Black Sea is considered to have a high export potential, like Rapa whelk. Although marine bivalve mollusks have no substantial demand in domestic market, there is

high demand from European and the Far East markets (Sahin, 1995). There is no fishing activity and no domestic consumption for this species in the Black Sea of Turkey.

The arc clam, *S. inaequivalvis* (Syn. *Anadara inaequivalvis*), being of Indo-Pacific origin was transferred to the Adriatic Sea via ballast water, and then found in the Aegean and Black Seas (Sahin et. al., 2009). The first record in the Black Sea was made from Bulgaria. The member of Arcidae, *Scapharca inaequivalvis*, has been introduced into Black Sea accidentally and found in the Black Sea in 1968, almost at the same time as in the Adriatic Sea, and has spread to the whole basin, often becoming the dominant species, especially along the Bulgarian sector (Sahin, 1995; Zolotarev, 1996; Sahin et. al., 1999).

A.kagishimensis in the Black Sea is considered to have a high export potential, like Rapa whelk. Although marine bivalve mollusks have no substantial demand in domestic market, there is high demand from European and the Far East markets (Sahin, 1995).

The arc clam is eurytherm and euryhaline species. They are found near coasts and river mounts and can survive very shallow waters and even when sea water withdraws in tide. In the Black Sea they rarely found in the waters less than 3 m depths. The growth rate is better in the Black Sea than in other coastal waters. It's opportunistic species, resistant to a broad range of conditions (CIESM, 2003). Minimum spawning size was found as 20 mm and spawning season covers the period from June to September (Sahin et. al., 2006).

Arc clam is an indicator for eutrophic waters, very resistant to hypoxia; due to these features it rapidly spread on sedimentary bottoms (sand and mud) (Abaza et. al., 2010). There is no fishing activity and no domestic consumption for this species in the Black Sea.

This species has a potential for commercial harvesting in Turkey (Sahin et. al., 2006).

Potamopyrgus antipodarum:

The New Zealand mud snail is generally regarded as a competitor with native snails and a threat to biodiversity. It may establish very dense populations, consume large amounts of primary production, alter ecosystem dynamics, compete with and displace native invertebrates, and negatively influence higher trophic levels.
Competition with native snails and other invertebrates, habitat impacts, and food web and nutrient impacts have been reported in freshwater systems. It has the potential to alter habitats by reducing algal cover. At high snail densities, heavy deposition of shells could have an effect on sediment quality. This invasive species is also a potential prey for fishes, birds, and invertebrates. However, it is poorly digested by most fishes and birds. *P. antipodarum* and its impacts are similar to that of the extremely problematic invasive Zebra Mussel (GISD 2021).

New Zealand mud snail is native to New Zealand. It has been introduced to Europe, North America, Australia, Iraq, Turkey, and Japan. *P. antipodarum* was first recorded in Turkey in 1980 (Bilgin, 1980). In the Delice River (a branch of the River Kızılırmak), the invasive mud snail predominated over the other mollusca taxa. In several ecosystems it is considered invasive because it becomes highly abundant, impacting the structure and function of the invaded ecosystems (Odabası et. al., 2019).

The freshwater snail *P. antipodarum* is parthenogenic and ovoviparous cold water living species (ESENIAS, 2015). Females are parthenogenetic, meaning they can reproduce without males, so a population can be founded by a single female. Most the non-native populations

are female. There can be up to six generations per year, with an average number of 230 offspring per adult per year. In theory only one female need arrive at a new ecosystem for a new population to establish (CABI, 2019). It has fast growth, high reproductive potential and reproduces asexually.

The mud snail can also tolerate desiccation for several days, which allows for rapid spread (such as by birds and fishing tools) throughout different aquatic ecosystems. In several countries, including Spain, USA and Australia, it is considered as an invasive species. This invasive species has a wide range of tolerance to different environmental parameters (such as salinity and water temperature). It can tolerate water temperature from 31ºC to near 0ºC, but cannot tolerate freezing or sub-zero temperatures It has a high tolerance to the toxicity of nitrogen compounds (ammonia, nitrate and nitrite) (CABI, 2019).

Several studies have shown high densities of up to 500.000,0 snails/m^2 in some streams in the USA, or even up to 800 thousands in a lake in Switzerland. Population sizes change throughout the year, with higher densities in summer and very low densities in winter, especially at temperatures near freezing (CABI, 2019).

P. antipodarum alter the overall nitrogen fixation rate of an ecosystem by consuming a high proportion of green algae, which causes an increase of nitrogen-fixing diatoms. Some studies show domination of mollusk communities by this species and also a reduction in the growth of native mollusk due to competition for space and food. Because *P. antipodarum* can survive travelling through the digestive tract of fish, fish that eat lots of *P. antipodarum* tend to lose weight compared to those which do not (CABI 2019).

Some predators (such as rainbow trout *Oncorhynchus mykiss*) and parasites (such as the digenetic trematode *Microphallus sp*.) have been reported for *P. antipodarum*. A high proportion of *P. antipodarum* are able to survive the passage through the digestive tracts of fish such as rainbow trout, although the endangered tidewater goby (*Eucyclogobius newberryi*) may digest it more effectively (CABI 2019).

The main impacts of this invasive species are altered trophic level, damaged ecosystem services, ecosystem change/ habitat alteration, modification of nutrient regime, reduced native biodiversity and threat to/ loss of native species.

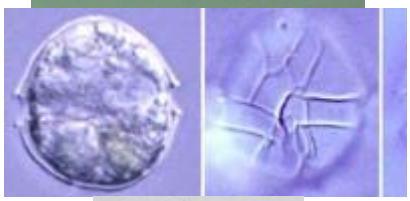
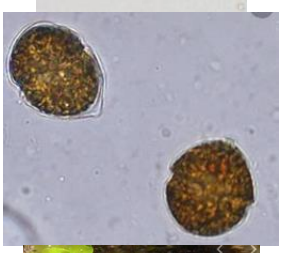
There is no information about economic impacts of this species.

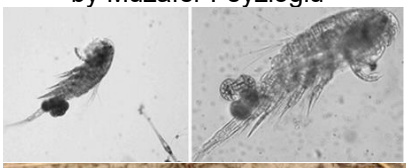
Under this project, 26 species were identified for the IAS in the Kızılırmak Deltaic area. The specifications and their impacts on the environment and economy were analysed. The latin name, common name, vernacular name and pictures were respresent in the Table 8.

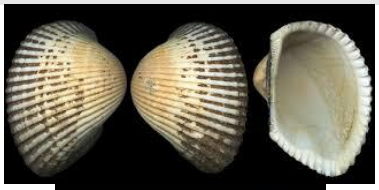
Table 5: Selected IAS in Kızılırmak Deltaic area

No	Latin Name	Common Name	Classification	Picture
1	*Cyprinus carpio* (Linnaeus, 1758)	Mirror carp	Fish	

No	Latin Name	Common Name	Classification	Picture
2	*Carassius gibelio* (Bloch, 1782)	Prussian carp Israil sazanı	Fish	
3	*Gambusia holbrooki* (Girard, 1859)	Eastern Mosquitofish	Fish	
4	*Gambusia affinis* (S. F. Baird and Girard, 1853)	Mosquitofish	Fish	
5	*Lithognathus mormyrus* (Linnaeus, 1758)	Striped seabream or Sand steenbras mırmır	Fish	
6	*Mugil soiuy= Liza haematocheila* (Temminck & Schlegel, 1845)	Mugil, Haarder	Fish	
7	*Parablennius incognitus* (Bath, 1968)	Mystery blenny	Fish	
8	*Syngnathus acus* (Linnaeus, 1758)	Greater pipefish	Fish	
9	*Oncorhynchus mykiss* (Walbaum, 1792)	Rainbow trout	Fish	
10	*Gobius cruentatus* (Gmelin, 1789)	Red-mouthed goby	Fish	
11	*Callinectes sapidus* (Rathbun, 1896)	Blue crab	Crustacea	

No	Latin Name	Common Name	Classification	Picture
12	*Pseudosolenia calcar-avis (Schultze) B.G.Sundström 1986*		Diatom	
13	*Thalassiosira nordenskioeldii* (Cleve, 1873)		Diatom	
14	*Alexandrium minutum* (Halim, 1960)		Dinophylagellate	
15	*Oxyphysis oxytoksoides (*Kofoid 1926*)*		Dinophylagellate	
16	*Scrippsiella trochoide*		Dinophylagellate	
17	*Ulva lactuca Linnaeus, 1753 = Ulva fasciata (*Delile, 1813)		*Choloroph yta*	
18	*Mnemiopsis leidyi* (Agassiz, 1865)		*Ctenophor a*	

No	Latin Name	Common Name	Classification	Picture
19	*Beroe ovata (*Mayer 1912)		*Ctenophora*	  *by M. Feyzioğlu*
20	*Acartia tonsa (Dana, 1849) (*)*		*Arthropoda*	
21	*Balanus improvisus* (Darvin 1854)		Arthropoda	  by Muzafer Feyzioğlu
22	*Oithona davisae* (Ferrari F.D. and Orsi, 1984)		Arthropoda	
23	*Rapana venosa* (Valenciennes, 1846)	Veined rapa whelk	Gastropoda	

No	Latin Name	Common Name	Classification	Picture
24	*Anadara kagishimensis* (Tokunaga, 1906)	Blood cockle	Bivalve	
25	*Potamopyrgus antipodarum* (J. E. Gray, 1843)	New Zealand mud snail	Gastropoda	
26	Astacus leptodactylus (Eschscholtz, 1823)	Freshwater crayfish	Crustacea	

3.5 - Chorokhi and Kolkheti – Georgia (IBEDC)

Chorokhi Delta

FLORA (Davitadze 2001; Beridze et. al. 2020):

Clade: Angiospermae

Order: Fabales
Family: Fabaceae
Species: *Pueraria hirsute*;

Order: Fabales
Family: Fabaceae
Species: *Robinia pseudoacacia*;

Order: Asterales
Family: Asteraceae
Species: *Ambrosia artimisiifolia*;

Order: Asterales
Family: Asteraceae
Species: *Xantium occidentale*.

FAUNA (Georgian Biodiversity Database http://biodiversity-georgia.net/; Ninua et. al. 2013, Japoshvili et. Al. 2013, Guchmanidze2016):
Phylum: Chordata
Class: Mammalia
Order: Rodentia
Family: Echimyidae
Species: Coypu or Nutria - *Myocastor coypus*

Phylum: Chordata
Class: Actinopterygii
Order: Cyprinodontiformes
Family: Poeciliidae
Species: western mosquitofish - *Gambusia affinis*

Phylum: Chordata
Class: Actinopterygii
Order: Cypriniformes
Family: Cyprinidae
Species: Prussian carp - *Carassius gibelio*

Phylum: Chordata
Class: Actinopterygii
Order: Mugiliformes
Family: Mugilidae
Species: Pacific mullet - *Liza haematocheila*

Kolkheti Area

FLORA (Kolkheti National Park Management Plan, 2006):

Clade: Angiospermae

Order: Caryophyllales
Family: Polygonaceae
Species: *Polygonum thunbergii*

Order: Asterales
Family: Asteraceae
Species: *Ambrosia artimisiifolia*;

Order: Poales
Family: Poaceae
Species: Paspalum paspalodes

Order: Poales
Family: Poaceae
Species: *Oplismenus undulatifolius*

Order: Fabales
Family: Fabaceae
Species: *Robinia pseudoacacia*;

Order: Gentianales
Family: Apocynaceae
Species: Gomphocarpus fruticosus

Order: Malpighiales
Family: Hypericaceae
Species: *Hypericum mutilum*

FAUNA (Kolkheti National Park Management Plan, 2006; Georgian Biodiversity Database http://biodiversity-georgia.net/; Guchmanidze 2015; Ninua et. al. 2013, Japoshvili et. Al. 2013 Guchmanidze, 2012 (b); Guchmanidze, Mikashavidze, 2010;

Varshanidze, Guchmanidze, 2004; Komakhidze, Mazmanidi, 1998; Phalavandishvili, 2006; Mikashavidze, 2008; National Pilot Monitoring Studies and Joint Open Sea Surveys in Georgia, Russian Federation and Ukraine, 2016; National Pilot Monitoring Studies and Joint Open Sea Surveys in Georgia, Russian Federation and Ukraine, 2017; Biodiversity Monitoring Reports on the Georgian Black Sea Coast. 2008-2019; Gvarishvili, 2010; Aleksandrov at. al. 2013):

Phylum: Chordata
Class: Mammalia
Order: Rodentia
Family: Echimyidae
Species: Coypu or Nutria - *Myocastor coypus*

Phylum: Chordata
Class: Actinopterygii
Order: Cyprinodontiformes
Family: Poeciliidae
Species: western mosquitofish - *Gambusia affinis*

Phylum: Chordata
Class: Actinopterygii
Order: Cypriniformes
Family: Cyprinidae
Species: Prussian carp - *Carassius gibelio*

Phylum: Chordata
Class: Actinopterygii
Order: Cypriniformes
Family: Cyprinidae
Species: Stone moroko - *Pseudorasbora parva*

Phylum: Chordata
Class: Actinopterygii
Order: Mugiliformes
Family: Mugilidae
Species: Pacific mullet - *Liza haematocheila*

Phylum: Ctenopohora
Class: Tentaculata
Order: Lobata
Family: Bolinopsidae
Species: Warty comb jelly - *Mnemiopsis leidyi*

Phylum: Ctenopohora
Class: Nuda

Order: Beroida
Family: Boroidae
Species: Comb jelly - *Beroe ovata*

Phylum: Mollusca
Class: Gastropoda
Order: Neogastropoda
Family: Muricidae
Species: Rapa whelk - *Rapana venosa*

Phylum: Mollusca
Class: Bivalvia
Order: Arcida
Family: Arcidae
Species: Blood cockle – *Anadara inaequivalvis*.

4. Summary of different impacts caused by IAS

4.1 - Danube Delta – Romania (DDNI & DDBRA)

In the following, a review will be made of the forms of impact generated by the IAS selected for monitoring in the Danube Delta - Romania.

1. *Amorpha fruticosa* L.

Is a fast-growing, deciduous shrub that grows in wetlands and disturbed habitats. It is native to North America but has spread across Asia and Europe, likely through its use as an ornamental plant. It is now generally accepted to be among the most invasive alien species in Europe. It has a high reproductive capacity, forms dense thickets and outcompetes native flora, changing successional patterns and reducing biodiversity. Repeated cutting and mowing can help to control populations of this species and in disturbed habitats, some herbicides have been successful in controlling its spread.
Its use as an ornamental, means that there is a risk of further spread to other countries in Europe and Asia and also potentially to other continents, such as Africa and Central America.
Szigetvári (2002) describes *A. fruticosa* as a transformer species that colonizes disturbed areas, particularly floodplain pastures and meadows. Through rapid growth, it forms dense thickets and outcompetes native flora, changing successional patterns and reducing biodiversity (Szigetvári, 2002). It is known to be particularly invasive in riparian and alluvial habitats and is generally accepted to be among the most invasive alien species in Europe (Protopopova et al., 2006; Kozuharova et al., 2017). Allelopathic effects of *A. fruticosa* have also been reported (Csiszár, 2009).
Brigić et al. (2014) demonstrated that changes to the vegetation structure and microclimate of habitats, caused by the invasion of *A. fruticosa*, have a significant effect on the composition of soil invertebrates.

2. *Xanthium strumarium* L.

Rapidly forms large stands, displacing other plant species. *X. strumarium* is a major weed of row crops such as soybeans, cotton, maize and groundnuts in many parts of the world, including North America, southern Europe, the Middle East, South Africa, India and Japan. It also has a damaging impact on rice production in Southeast Asia. Cocklebur is also an alternative host for a number of crop pests. *X. strumarium* burrs lodge in animal hair and in sheep's wool, reducing the quality and increasing treatment costs. The plants are toxic to livestock and can lead to death if eaten.
X. strumarium is a major weed of row crops such as soyabeans, cotton, maize and groundnuts in many parts of the world, including North America, southern Europe, the Middle East, South Africa, India and Japan. In 1995, it ranked as the fourth, fifth, sixth and seventh most troublesome weed in soyabean, cotton, maize and groundnut, respectively, across 10 southern states in the USA.

X. strumarium also has an economic impact in pastures, where cattle, sheep and pigs may be poisoned by eating young plants. The cotyledons contain a toxic compound, carboxyatractyloside, which is absent in older plants (Weaver and Lechowicz, 1982; Hocking and Liddle, 1986; Martin et al., 1992). Symptoms include vomiting, muscular spasms, liver degeneration and occasionally death.
The *Xanthium* genus is closely related to the Ambrosia (ragweed) genus, and *X. strumarium* produces large amounts of highly antigenic pollen (Reddi et al., 1980). The glandular hairs on the leaves and stem secrete a substance which causes contact dermititis in allergic individuals (King, 1966).

3. *Elodea nuttallii* (Planch.) H. St. John, 1920

Is a perennial submerged aquatic plant native to North America. It was introduced as an aquarium plant into Europe, reported for the first time in Belgium in 1939 (Simpson, 1984; Cook and Urmi-König, 1985), and in Japan, circa 1960 (Ikushima and Kabaya, 1965), where it is commonly considered a weed (GCW, 2007). Several traits of the species are typical of successful invaders: rapid growth, vegetative reproduction through fragments and easily dispersed by waterfowl and currents (Cook and Urmi-König, 1985; Nichols and Shaw, 1986; Cook, 1987).
The spread of *E. nuttallii* has resulted in displacement of *E. canadensis* (itself an invasive alien from N. America) from many localities where the latter had previously become well established in Europe (Simpson, 1990; Thiébaut et al., 1997; Barrat-Segretain, 2001; Larson, 2007). *E. nuttallii* is itself being replaced by Lagarosiphon major. Where it establishes it can form exceptionally dense monocultures, excluding native species through competition, and it can cause major problems by blocking pipes; strongly invaded waters may become less attractive and safe for recreation. Flooding may be caused by heavy infestations choking drainage systems and sluices. It is not known as a weed species in its native range, and in the US states of Kentucky and Tennessee it is listed a threatened species (USDA-NRCS, 2009). It is included in the list of invasive alien plants in EPPO region (EPPO, 2009).
E. nuttallii has been unintentionally introduced outside its natural range via the trade in live aquarium plants, and has spread by escaping from garden ponds and during the disposal of garden waste near waterways. As this species is sold commercially as an aquarium or garden plant, there is a high risk of unintentional introduction. Different studies have established that *E. nuttallii* is probably in an expansion phase in Europe and is likely to spread to new areas (Simpson, 1984; Thiébaut et al., 1997; Barrat-Segretain, 2001; Larson, 2007), and it should be regarded as having a high risk of being invasive and must be strongly recommended as a priority target for eradication or control in new sites (Thiébaut et al., 1997; Barrat-Segretain, 2001). *E. nuttallii* is included in the black list in Belgium (Branquart, 2007) and Switzerland (CPS-SKEW, 2008) because of its high environmental risk, so further introductions, at least in these regions, are unlikely.

4. *Leptinotarsa decemlineata* Say, 1824

Invaded North America, and then Europe and Western Asia, in a classic pattern of regular geographical spread, hardly impeded by measures taken against it. However,

this spread could not be called invasive because it occurred in an introduced crop planted over large areas as a monoculture. Though *L. decemlineata* attacks other Solanaceae, there are no indications that it affects wild plants in the natural environment to any significant extent. Control of the pest leads to the use of insecticides in potato crops, which most probably would not require such treatment in its absence. So, to a certain degree *L. decemlineata* is responsible for an increased pesticide load in the environment.

The Colorado beetle, is one of the most economically damaging insect pests of potato in the many countries where it now occurs (Hare, 1990). L. decemlineata adults and larvae indirectly reduce potato tuber yields by devouring foliage. If plants become entirely defoliated prior to tuber initiation, total crop loss will result. L. decemlineata will also attack tomato and aubergine. In many areas, it is the only pest of ware potato crops against which insecticides have to be applied.

Perhaps the greatest economic impact that *L. decemlineata* has had on agriculture has been since its development of resistance to insecticides. *L. decemlineata* has become resistant to >25 insecticides belonging to the traditional chemical classes (Forgash, 1981, 1985; Gauthier et al., 1981; Heim et al., 1990; Roush et al., 1990; Tisler and Zehnder, 1990; Bishop and Grafius, 1991; Georgiou and Lagunes-Tejeda, 1991).

Economic injury levels and economic thresholds are major components in the decision-making process of pest management (Pedigo and Higley, 1992). Developing economic injury levels and thresholds requires knowledge of the market value of the crop, the cost of managing the pest and the crop yield response to pest density or damage. Since the late 1970s, considerable effort has been made in identifying tuber yield responses of potato to defoliation and density of *L. decemlineata* adults and larvae. Fewer studies have examined the yield/damage relationship in aubergine and tomato.

5. *Perccottus glenii* Dybowski, 1877

The Amur sleeper is considered as one of the most widespread (Reshetnikov, 2010) and successful fish invaders in European inland waters of the last decades (Copp et al., 2005). Since 1916 when the species was introduced outside its native range of distribution for the first time, it expanded to 15 countries in Eurasia (almost the whole of Russia, Mongolia, Belarus, Ukraine, Lithuania, Latvia, Estonia, Poland, Hungary, Romania, Slovakia, Serbia, Bulgaria, Moldova and Croatia) where it has been recorded from the rivers Volga, Ural, Don, Dnieper, Dniestr, Vistula, Danube, Pregolya, Nemen, Daugava, Velikaya, Neva, Onega, North Dvina, Ob and Enisey (Reshetnikov, 2010). The rate of the Amur sleeper expansion is impressive - the rate of its expansion in the Vistula River ranged from an initial 44 km per year, up to 197 km per year thereafter (mean ~ 88 km per year). The Amur sleeper is voracious predator that forages on a wide range of prey from small planktonic invertebrates (Cladocera, Copepoda consumed by juveniles), through macroinvertebrates (larvae of Insecta, Oligochaeta, Mollusca, Crustacea) to vertebrates (fish and amphibian larvae: Triturus sp., Rana sp.). Its impact on the environment in invaded areas is sometimes described as deteriorative as it is able to exhaust the entire food supplies,

and also can compete with native species for the same food resources (Spanovskaya et al., 1964; Litvinov and O'Gorman, 1996; Reshetnikov, 2001; 2003). Thus, it can considerably affect the tropic structure of some water bodies and even lead to local extinction of some species or, at least, decrease of their abundance. The Amur sleeper was brought intentionally to European part of Russia and later released to open waters, from where it naturally penetrated farther. The species was also kept in aquaria and used as live bait - such activities could be additional reasons for uncontrolled introductions. It was also accidentally introduced several times to many distant localities as contamination of stocking material of Asian herbivorous cyprinids (Reshetnikov, 2004, 2010; Reshetnikov and Ficetola, 2011).
Considering its widespread and rapid invasion in Eurasia and its potential impact on native biota it was placed on the list of the top 27 animal alien species introduced into Europe for aquaculture and related activities. This list includes species that could cause serious thread to biodiversity if they escaped to open water bodies (Savini et al., 2010).

4.2 - Danube Delta – Ukraine (IMB)

A feature of IAS of plant species is that they not only affect the floristic diversity and can change the structure of vegetation, but they can also significantly change the level of autotrophic process in the aquatic ecosystem. These changes, first, are associated with the trophicity of the ecosystems. Changes in the trophic status of an aquatic ecosystem are already reflect not only on vegetation, but also on the structural and functional organization of other biological communities of higher trophic levels. Thus, a change in the base of the trophic pyramid of aquatic ecosystems, due to the IAS of macrophytes, can significantly disrupt all connections in the ecosystem and lead to general negative consequences. The main factors influencing the aquatic vegetation:

1. Photosenetically active radiation;
2. Nutrients;
3. Salinity;
4. Temperature.

Correspond to the inventory list of the IAS macrophytes to planning monitoring in the Danube Delta the 11 species of floating and submerged vegetation, on the transit marine waters and river, ponds and wetland biotopes of the area of Danube Biosphere Reserve (see Table).Some of them lead to changes in habitat conditions: they reduce the transparency of the water content, affect its temperature, oxygen and acidity. Often they displaces native species, forming single-species communities over large areas (for example Elodea canadensis, Elodea nuttallii, Lemna turionifera). Egeria densa is an ecological weed that can affect agriculture by blocking irrigation canals. Pistia stratiotes is a vicious weed. In a short period of time, it can completely cover the surface of a small reservoir, dooming it to disappearance. The cover from the Pistia significantly increases the water consumption from the reservoir, since incomparably more water is consume for its transpiration than for evaporation from the open surface of the reservoir.Currently, it is very widespread in the Dnieper River basin and leads to serious disturbances in the structure of aquatic vegetation (Kuzemko & Pashkevych, 2020). Excessive growth aquatic fern – Azolla caroliniana creates an anaerobic environment, which inhibits the development of other species and has a negative effect on aquatic ecosystems.

There is also a danger of changing the structure of vegetation fouling in the avandelta (the marine part of the DBR), due to the penetration of new arctorabial invaders of seaweeds into the Black Sea. At present, the Desmarestia viridis is the dominant of phytocenoses of benthic vegetation along the entire coastal part to a depth of 10 m of the Danube-Dnieper inter-riverine. At present Halosiphon tomentosus fills the places in cold (up to 10°C) and deep (below 5 m) phytocoenoses dominated by Desmarestia viridis and Ceramium diaphanum var. elegans. Species feature of Halosiphon tomentosus, connected with dense pubescence of quite coarse tubular thalli with thin fibrils, determines the intensity of metabolic processes and enables this species to use optimally the nutrients of its new area and conditions of the winter season with low temperatures.

Among the terrestrial flora of the Danube delta 5 species are listed in Union concern list [European Commission, 2017]: Amorpha fruticosa, Robinia pseudoacacia, Ailanthus altissima, Gleditsia triacanthos, Ambrosia artemisifolia.
Of the above, xenophyte (unintentionally introduced) is only ragweed A. artemisifolia, all other species were deliberately brought at different times, mainly for botanical gardens and landscaping. In the European list, most species of aquatic plants- from aquariums, terrestrial ones were bought in stores and planted on plots, and then they "escaped" from the culture. The plants that threat to the ecosystem are Acer negundo, Erigeron canadensis, Hordeum murinum leporinum, Sicyos angulatus.
The Black Sea pelagic ecosystem was extremely degraded from blooms of invasive ctenophore Mnemiopsis leidyi since the end of 1980s. After invasion of its predator Beroe ovata ecosystem began gradually to recover (Shiganova et al., 2014; 2019).So, these species play leading role in the functioning of the pelagic ecosystem. Invasive copepods Acartia tonsa and Oithona davisae reproduce and established self-sustaining populations in the Black Sea (Polischuk & Nastenko, 2006, Mihneva & Stefanova, 2013). They form a significant part of the forage zooplankton and are useful for planktophagous commercial fish species.
Craspedacus tasowerbii currently is not known in the Danube delta (Protasov & Babariga, 2009). If it will invade to the delta it probably can affect the forage zooplankton due to its predation on mesozooplankton. Pseudodiaptomus marinus currently is not known in the Danube delta as well as in the North-Western part of the Black Sea in general. It was reported from the Crimean waters (Garbasey et al., 2016) and probably can invade into the Danube region. In that case this species can compete with other Copepoda and produce some changes in the zooplankton community structure. It also belongs to the forage zooplankton for fish and thus can play any positive role in the ecosystem. Lethocerus patruelis currently is not known in the Danube delta. It is a large predacious aquatic bug (up to 80 mm in length) with wide trophic spectrum, that includes crustaceans, insects, small fishes and amphibian larvae. It also can form a part of large fish and wetland birds diet. The range of this species in Europe is currently expanding and at present time it is known in Bulgaria (Gozeva et al., 2013), thus, can probably invade into to the Danube delta. In such case this species can have a serious ecosystem impact.
In zoobenthos, Sinanodonta woodiana quickly spreads over fresh water bodies, forming stable populations, often dominating in abundance and biomass in benthic communities. The question of the influence of the invader on local species remains unstudied; attention was paid to the qualitative and quantitative simplification of mollusks assemblages. Corbicula fluminea is registered in the fauna of the Danube delta; the species is characterized by high ecological plasticity; for its fixation in dispersion under new conditions, there are enough single individuals capable of eventually forming new populations. Physella acuta is widespread, coexists successfully with other invasive species, and can promote the invasion of macrophytes. Species affect changes in the diversity and structure of macrozoobenthos communities (Lyashenko et al., 2005; Panov et al., 2009; Son, 2007, 2009, 2010). Pectinatella magnifcam can significantly influence the structure of the community, increase the transparency of water, and promote the development of

local species. Colonies can settle on fishing nets and pipes of municipal water treatment systems and clog them (Alexandrov et al., 2014).
Rhithropanopeus harrisi is a component of macrozoobenthos communities developing on sandy and sandy-silty bottoms (Vorobyova et al., 2017), can destroy the natural structure of the community, and carry viruses (Payen & Bonami, 1979).The successful naturalization of P. cornuta significantly influenced the benthic fauna of the northwestern shelf and, especially, the estuaries of the Black Sea region. In the areas of interfluves, this species has become a characteristic form of biocenoses of Mytilus galloprovincialis Lamarck, 1819 and Alita succinea; it is massively developing on the coast of the Danube River (Losovskaya & Zolotarev, 2003; Alexandrov, 2005; Bondarenko, 2011). Mya arenaria and Anadara kagoshimensis successfully acclimatized in the estuaries of the NWBS, in its coastal and estuarine areas, including in the near-mouth seashore of the Danube River. Their introduction significantly affected biodiversity, entailed serious restructuring of benthic communities and the formation of new biocenoses for the region (Aleksandrov et al., 1998, Zaitsev et al, 2006, Vorobyova et al, 2017).
The American crayfish, Faxonius limosus, was registered in the Lower Danube upper from the Delta (Kudriashov, 2020). It is known both as an affecting biodiversity omnivorous species; burrower, which can destabilize riverbanks and modify other habitats (Holdich et al. 2009) and the principal carrier of crayfish plague, caused by the fungus-like pathogen Aphanomyces astaci, which present in the rivers of the Northwestern Black Sea basin (Panteleit et al.,2018; Ungureanu et al., 2020).
In total of 12 alien fish species are registered in the Danube delta and adjacent areas. Among them, only 5 species have high abundance and potentially could increase in number in nearest time. Part of the fish have commercial importance and used in fisheries. All known fish species have established populations. Among the main influence on the ecosystem are competition with local species for food sources, predation on local species, competition for reproduction space. Two species, Ameiurus melas and A. nebulosus, became invasive in western and northern parts of Ukraine (Kutsokon et al., 2018), also in the Lower Danube (Pehlivanov et al. 2016; Yankova et al. 2016), and could arrive to the delta in nearest time.
The modern terrestrial vertebrate fauna of the Danube Natural reserve consists of 11 amphibian species, 6 reptiles, 302 birds and 47 mammals (Chronicle of nature…, 2019; unpublished data). Three AIS are listed in the Union concern list, i.e.
Ondatra zibethicus, Myocastor coypus and Nyctereutes procyonoides (European Commission, 2017). Among the negative consequences of the introduction of these species are predatory impact, excavation, which leads to degradation of river banks, irrigation systems, etc., the transfer of parasites and pathogens, which has a major impact on ecosystems and agriculture (European Commission, 2017).
One of the most common reproducing invasive bird species in the Danube delta is Phasianus colchicus L., 1758. Also, the cases of occurrence of Anser caerulescens, which is commonly hold in zoos and private husbandries, were registered here. Also, some species, which spread their ranges in last decades are registered in the Ukrainian Danube delta, e.g. Bubulcus ibis, Streptopelia decaocto, Phoenicurus ochruros, Passer hispaniolensis (Puzanov & Nazarenko, 1962; Korzukov & Redinov,

1999; Korzukov et al., 2015; our unpublished data). But, the negative impact on ecosystem and agriculture was not registered.

There are two invasive reptile species registered in the Danube delta: Podarcis muralis and Trachemys scripta (Matvyeyev et al., 2013; Chronicle of nature…, 2018). The lizard Podarcis muralis might be introduced via the Reni marine port, and now established a local population, spreading to the west shore of Lake Kahul and Kohylnyk River (Matvyeyev et al., 2013). But, the species has now negative impact on the ecosystem. The pond slider T. scripta was registered in the Kohylnik River mouth, north of the Sasyk Lagoon, to be caught by local fishermen (Chronicle of nature…, 2018). Because the Sasyk Lagoon is connected with the Danube delta via the Danube-Sasyk canal, the species could spread into the Danube protected area in nearest time. Trachemys scripta has threat for the populations of the European terrapin Emys orbicularis, because of competition for the nesting (European Commission, 2017).

The mammal species, which has negative impact on the local fauna of the Danube Natural Reserve, are Rattus norvegicus, Neovison vison, Canis aureus. The brown rat R. norvegicus was first registered in Ukraine probably at the end of 19th century (Mezhzherin, Lashkova, 2013). Now it is common in whole the Danube delta, having negative impact on the local rodents and birds, also to be a vector of dangerous diseases.

Neovison vison was intencialy introduced to Europe at the end of 20th century, then started to establish the wild populations (Pavlov et al., 1977; Ternovsky, 1977; Sidorovich, 1995; Zagorodniuk, 2006). It established populations in all regions of Ukraine in 1960s–80s (Volokh, 2004; Zagorodniuk, 2006). In 1987 its number reached 350 thousands individuals, which is the source of new wild populations. Now in Ukraine are registered about 8–10 thousands ind. of this species (Panov, 2002; Zagorodniuk, 2006). In the Danube region of Ukraine is was found near the City of Izmail and in the Romanian part of the delta, but the status of its population in the Ukrainian delta needs confirmation (Youngman, 1982; Cuzic et al., 2003; Marinov et al., 2012). Having similar biology with a local species, Mustela lutreola, N. vison compete with it, therefore brings high threat to its population (Mezhzherin, Lashkova, 2013).

Canis aureus occurred in Ukraine in 1997–1998 to be found in deltas of Danube and Dniester (Volokhetall., 1998; Rozhenko, Volokh,1999; Zagorodniuk, 2006). After the expansion it established the numerous local populations. Because of predation, it has threat impact on the local fauna of the Danube delta, being a competitor for forage with local carnivores, pray on local mammals and birds, also to be a vector of diseases.

4.3 - Nestos Delta – Greece (IHU)

As was also stated in paragraph 2.3, the invasive alien species that have been recorded in Nestos area so far are 11. Among them, 3 taxa are trees or shrubs whereas the remaining are herbaceous. Taking into consideration the ecological requirements of all these species, as well as their ability to invade in an ecosystem and threaten natural vegetation and/or plant species, we concluded that only those three species can have significant negative consequences in the area of Nestos. Specific information about the three species are given below:

Amorpha fruticosa was reported for the first time in Greece in 2000, where it was found along Strymonas river and its delta (NE Greece) (Karagiannakidou-Iatropoulou et al. 2000). Since that time, *A. fruticosa* expanded its distribution range and now it is found in 7 out of the 13 phytogeographical areas of Greece. According to the CABI database (https://www.cabi.org/isc/datasheet/5001#tosummaryOfInvasiveness), *A. fruticosa* is a fast-growing, deciduous shrub that grows in wetlands and disturbed habitats. It is native to North America but has spread across Asia and Europe where it is found in several European countries. It is believed that it was introduced in specific countries as an ornamental plant. Due to its high reproductive capacity, it is classified among the most invasive alien species in Europe as it usually forms dense thickets and, in that way, it outcompetes native flora, changing successional patterns and reducing biodiversity. Despite the negative impacts that it may cause, the foliage of this shrub constitutes a valuable forage for grazing animals occurring in the area of Nestos, whereas moreover, it has been proposed as a good beekeeping plant similar to *Robinia pseudoacacia*.

Robinia pseudoacacia is widely distributed all around Greece as it was formerly used to stabilize land masses and to prevent soil erosion. For several years, croplands, especially those that were not in the lowlands, were degraded due to the increased soil surface runoff and soil erosion. In many cases, the soil depth of such croplands was restricted and the decreased crop yields led to the abandonment of cultivation. Thus, a large portion of these areas, was restored with *R. pseudoacacia* followed rules of the European Agricultural Fund for Rural Development (EAFRD) (Papaioannou et al. 2016). In the area of Nestos, during the last century, it was selected among the tree species used to replace natural vegetation formations. The criteria used for its selection were mainly the ability of that species to grow fast and produce timber. However, *R. pseudoacacia* is able to spread and invade in natural habitats and affect biodiversity and based on this, it causes specific problem in Nestos area (Vasilopoulos 2005). The conflict between the numerous uses by humans and the negative environmental impacts that can it cause, forced European authorities to list it among the most invasive species in Europe (Sádlo et al. 2017).

Acer negundo is another tree species that has been widely used in cities and parks all around Greece. It is being selected because it is resilient in conditions of increased atmospheric pollution, whereas it can also tolerate heat and water stress. However, its seeds are able for long distance dispersal and now it can be found in areas far away from places where it was planted. As a result, it has become one of the most

invasive plant species occurring in riparian forests all around Europe (Sikorska et al. 2019). In Nestos area, *Acer negundo* was found within 91E0 habitat type [Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)] either in the understorey or even in the overstorey. Although the consequences of the existence of *A. negundo* are not extensive now, it is expected to affect the specific habitat type after several years through vegetation succession. For a comprehensive description about its negative impacts in riparian forests see Sikorska et al. (2019).

4.4 - Kızılırmak Delta – Turkey (KTU-MSF)

Selected IAS impact was explained in the Table 6.

Table 6: Selected IAS in Kızılırmak Deltaic area

No	Latin Name	Impacts
1	*Cyprinus carpio* (Linnaeus, 1758)	*C. carpio* has been caused environmental degradation of aquatic ecosystems and considered as an ecologically harmful invasive species. Clear water sources are turned into phytoplankton rich waters after the population density of carp reaches high density. *C. carpio* is one of the economically valuable target fish species in the Kızılırmak Delta.
2	*Carassius gibelio* (Bloch, 1782)	This species have very high invasition capabilities. They became the dominant species and shifted food chain by altering physicochemical properties of the environment and by altering available food sources. *C. gibelio* is threatening local fish species. Some of the native fish species in the Delta such as the rudd (*Scardinius erythrophthalmus*) is eradicated after *C. gibelio* invasion.
3	*Gambusia holbrooki (Girard, 1859)*	Invasion of this species in Turkish waters was almost took place hundred years ago and believed to be one of the earliest introduced exotic species. Despite being only couple cm long, it is listed under 100 worst invasive species. They pose great threat to existence of various aquatic organisms that produce pelagic eggs and larvae.
4	*Gambusia affinis (S. F. Baird and Girard, 1853)*	Invasion of this species in Turkish waters was almost hundred years ago and believed to be one of the earliest introduced exotic species. Despite being only couple cm long, it is listed under 100 worst invasive species. They pose great threat to existence of various aquatic organisms that produce pelagic eggs and larvae.
5	*Lithognathus mormyrus (Linnaeus, 1758)*	*L. mormyrus* reached to the Black Sea through straits and formed adaptive populations. The first recorded in 2014 in the Black Sea. The species is rarely considered as invasive species ever since due to being economically valuable. *L. mormyrus* is a carnivorous fish species and feeds on mostly aquatic invertebrates in shallow waters. Invasion of the species is not considered previously in Kızılırmak Delta or any other region but possible negative effects and pressure on benthic organisms is obvious.
6	*Mugil soiuy= Liza haematocheila (Temminck & Schlegel, 1845)*	*Liza haematocheila* was first introduced to the Sea of Azov for its aquaculture potential. Escapees and released individuals migrated to the Turkish Black Sea coast. Negative effects of the fish remain unknown.
7	*Parablennius incognitus (Bath, 1968)*	*Parablennius incognitus* is a blenny species and mainly distributed in the coastal waters of the Black Sea at a depth from 0.5-2.5 meters. P. Incognitus mainly feed on

No	Latin Name	Impacts
		invertebrates which forms an extra pressure on especially gammarids.
8	*Syngnathus acus (Linnaeus, 1758)*	*Syngnathus acus*, inhabit vegetated coastal and estuarine habitats and may constitute an important part of the ichthyofauna of estuarine and shallow coastal waters. Analysis of the stomach contents indicates that they feed mainly on epibenthic and pelagic crustaceans such as calanoid copepods and gammarids. *S. acus* forms extra pressure on their prey species.
9	*Oncorhynchus mykiss (Walbaum, 1792)*	*Oncorhynchus mykiss* is an economically important trout species introduced to Turkey for its culture potential. There are plenty of inland farms and sea cages culturin rainbow trout. Escapees from the aquaculture facinities lead to the invasion of species. Food competition with local species, putting pressure on invertebrates are the main negative effects of the species.
10	*Gobius cruentatus (Gmelin, 1789)*	The most eastern records of this species were from the Anatolian coast of the Aegean Sea and the Sea of Marmara (Engin at. al., 2007). Latest studies indicate presence of G. Cruentatus in the Black Sea. Their negative impacts are not assessed. Howeer, possible negative effect of the species would be on benthic communities.
11	*Callinectes sapidus (Rathbun, 1896)*	*C. sapidus* invaded the Black Sea in 1968. While early incidence was rare, encounter incidence with the species become more and more frequent by day. The blue crab is an opportunistic benthic omnivore that feeds on whatever is available in the habitat (Mancinelli et al., 2017). Presence or establishment of this species in Kızılırmak Delta would surely affect the benthic community structure.
12	*Pseudosolenia calcar-avis (Schultze) B.G.Sundström 1986*	The invasive marine phytoplanktonic diatom *Pseudosolenia calcar-avis* was first observed in the Black Sea 1924–1926 after its introduction by ships' ballast water. In mid-90s microphytoplankton population reached to maximum biomass so far and Pseudosolenia calcar-avis was the dominant diatom species along the southern Turkish coast of the Black Sea since 2003. The species has positive and negative impact on the ecosystem.
13	*Thalassiosira nordenskioeldii (Cleve, 1873)*	The occurrence of *T. nordenskioeldii* in the colder waters of the Black Sea is not unexpected. Although Thalassiosira nordenskioeldii rarely observed in the black sea coastal ecosystem. Effects of species is considered as Harmful Agae Bloom (HAM) along the coastal ecosystem
14	*Alexandrium minutum (Halim, 1960)*	This species has a tough resting cyst, it is easily transport by ballast water and in translocated shellfish, and it has been reported from most continents and every ocean. Control appears to be impossible. This species is primarily an inhabitant of environments with a high

No	Latin Name	Impacts
		terrestrial influence, such as lagoons and estuaries where nutrient levels are high.
15	*Oxyphysis oxytoksoides (Kofoid 1926)*	*Oxyphysis oxytoxsoides* rarely observed in the Black Sea coastal ecosystem. It is mostly observer from late spring to Late summer.
16	*Scrippsiella trochoide*	This species is a common harmful bloom forming species in coastal waters. *Scrippsiella trochoide* being dominant in the western Black Sea in comparison to the eastern side (both species formed 25% of total abundance and 51% of the total biomass). The species was found to cause red tides along Trabzon's coast line between 1991 and 2001
17	*Ulva lactuca Linnaeus, 1753 = Ulva fasciata (Delile, 1813)*	Fast growing and opportunistic characters of the species can cause covering the water surface, decreasing the biodiversity even for other algae species
18	*Mnemiopsis leidyi (Agassiz, 1865)*	This species is one of the most disastrous invasions ever known. *Mnemiopsis leidyi* was accidentally introduced to the Black Sea in the early 1980s; within 10 years, it had destroyed the fishing industry in the entire region, outcompeting native planktonic fishes and disrupting the food chain. This species has caused dramatic changes on copepoda group and plankton biodiversity.
19	*Beroe ovata (Mayer 1912)*	This species entered in the Black Sea with ballast waters. The appearance of a new invader ctenophore *B. Ovata* is known Mnemiopsis feeder in native waters. After the 1990's in the Black Sea caused further improvements in the planktonic community. The consequence of this new invasion was positive for the recovery of the Black Sea ecosystem.
20	*Acartia tonsa (Dana, 1849)*	*A.tonsa*, copepod, was found in the Black Sea for the first time in 1990, however, the examination of historical zooplankton samples showed that this species had appeared there in the early 70s. A. tonsa species are an important food source for many commercial fish species
21	*Balanus improvisus (Darvin 1854)*	*B.improvises* is the invasive species with the highest ecological success among the crustaceans. It is arrived in the Black Sea in the second half of the 19th century.
22	*Oithona davisae (Ferrari F.D. and Orsi, 1984)*	*O.davisae*, new invader, was first observed as Oithona brevicornis in Sevastopol Bay, Crimea, Black Sea since 2001. Its high abundances also indicate that it may become a key species in the food web of the southern Black Sea.
23	*Rapana venosa (Valenciennes, 1846)*	It was accidentally introduced into the Black Sea in 1946 with the first record for Novorossiysk Bay. Its establishment in the Black Sea appeared to be facilitated by the general lack of competition from other predatory gastropods and an abundance of potential prey species. The ecological impacts of Rapa whelk in the Black Sea have been severe. Rapa whelk caused a significant

No	Latin Name	Impacts
		damage to native benthos due to no predator in the Black Sea.
24	*Anadara kagishimensis (Tokunaga, 1906)*	The arc clam is eurytherm and euryhaline species. It's opportunistic species, resistant to a broad range of conditions. Arc clam is an indicator for eutrophic waters, very resistant to hypoxia; due to these features it rapidly spread on sedimentary bottoms (sand and mud).
25	*Potamopyrgus antipodarum (J. E. Gray, 1843)*	This species was first recorded in Turkey in 1980 (Bilgin 1980). In the Delice River (a branch of the River Kızılırmak), the invasive mud snail predominated over the other mollusca taxa. In several ecosystems it is considered invasive because it becomes highly abundant, impacting the structure and function of the invaded ecosystems (Odabası et al., 2019).
26	*Astacus leptodactylus (Eschscholtz, 1823)*	*Astacus leptodactylus* is a native crayfish species of Turkey. A. Leptodactylus have been domestically transfered to different rivers, lakes and damns including the Kızılırmak Delta to form a economically important local fishing resource. Introduction of this species reported to have negative effect onnative crayfish species. Transfer of diseases (crayfish plague), consumption of fish eggs, reduction of fish stocks and consumption of large amounts of macrophyes are indirect and direct effects of the species.

4.5 - Chorokhi and Kolkheti – Georgia (IBEDC)

1. Reduction of total fish populations in the Marine, wetlands and freshwater ecosystems as predation, food competition and major destruction in the foods web: Prussian carp - Carassius gibelio, by its high reproduction capacity by means of gynogenesis and tolerance to environmental changes, considered as asuccessfull invasive. It can become the dominant species in new habitat in a short time with the help of these attributes. The stone moroko - Pseudorasbora parva is an undesirable invasive animal that often generates numerous populations, has no commercial value, and reduces nutritional re-serve of native species. After the introduction of pacific mullet - Liza haematocheila the population of native mullet (Mugil cephalus, Liza ramada, L. saliens, L. aurata and Chelon labrosus) declined to high level food competition. Its growth rate is considerably higher than the native mullet species. Fishermen also were obliged to change their gill nets to catch bigger sized Pacific mullet. Pacific mullet is a euryhaline species, which regularly enter the brackish and fresh waters of the black sea basin - therefore spread a negative effect on these waters.
2. Impact on some of the unique grassland and forest ecosystems and threats to the indigenous species diversity, agriculture and human health: The alien flora of Georgia is still insufficiently studied. Current knowledge clearly indicates that invasive plants will deteriorate some of the unique natural ecosystems of the country and pose threats to the indigenous species diversity, agriculture and human health.
3. Destruction of native Bivalve populations – Benthic Biofilter of the Black Sea: There are no major predators of adult Rapa whelk - Rapana venosa in the Black Sea and the population has become very abundant and destructive to native marine life: it has been responsible for the destruction of native bivalve populations i.e. oysters, scallops, and mussels.
4. Predation on pelagic fish eggs and larvae, feeding on the food of pelagic larvae and adult small pelagic fishes (Anchovy, Sprat, Horse mackerel etc.), accelerating of ongoing ecological change due to eutrophication: After invasion into Black Sea in the early 1980s Warty comb jelly - Mnemiopsis leidyi was well adopted the Black Sea conditions and its population has increased sharply due to lack of predators and abundant preys. Their prey is the eggs and larvae of zooplankton-eating fish. After the invasion of another predacious Comb jelly - Beroe ovata in 1997, the abundance of M. leidyi declined sharply and was maintained at a level more than four times lower than during the late 1980s. Introduction ways of Beroe ovata is not clear whether it was introduced with ballast waters or naturally transferred from the Mediterranean Sea. However, there are signs that the ecosystem of the Black Sea began to recover due to sharp decreases in Mnemiopsis population. Investigations in the Black Sea have shown that Beroe almost exclusively feeds on Mnemiopsis and very effective in controlling its levels.

5. List of species that will be used in the IAS monitoring in Black Sea Deltaic Protected Areas

5.1 - Danube Delta – Romania (DDNI & DDBRA)

In Romania, the national strategy for monitoring non-native plant species is currently being developed within a national monitoring project, so far only sectoral management measures have been developed, which have not reached the desired objective. An example in this sense is the forest management at the level of the National Forests Authority, which includes a set of measures to control invasive non-native wood species. According to current European trends, these measures aim to replace non - invasive non - invasive, habitat - specific or other non - invasive, but economically valuable non - invasive non - invasive species. This compromise, at least in the Danube Delta, is proving to be unviable. In the European poplar forest plantations (*Populus x canadensis*), in the tree layer, the invasive species *Amorpha fruticosa* settles very well in an extremely compact thicket. This phenomenon causes significant economic losses.
The management plan of the Danube Delta Biosphere Reserve for the objective of stopping the decline of biodiversity provides for the action of inventory of invasive species and the elaboration of precautionary measures for their management. So far, at the level of the Danube Delta Biosphere Reserve Administration, there is no blacklist of invasive species or an observation list of non-native species, much less relevant data to determine the development of prevention and control measures.
The problem of invasive non-native species has not generally been made known nationally. Proof is that there is no national center of specialists to represent the authority in this field, an example that could be taken from countries like the US, Australia, Germany, the Czech Republic or France. On the one hand, the actions started through research projects within the profile institutions show that there are human resources to support a general framework specific to Romania. On the other hand, institutional decision-making support cannot ensure the success of an action centrally, due to the poor policy involved in this direction.

List of IAS that will be used in monitoring in DDBR (Danube Delta Biosphere Reserve – Romania)

A. Plant species:

Plant species:

1. Kingdom	Plantae – Vegetal, plants
Subkingdom	Viridiplantae – green plants
Infrakingdom	Streptophyta – land plants
Superdivision	Embryophyta
Division	Tracheophyta – vascular plants, tracheophytes
Subdivision	Spermatophytina – spermatophytes, seed plants

Class	Magnoliopsida – dicotyledons
Superorder	Rosanae
Order	Fabales
Family	Fabaceae – peas, legumes
Genus	Amorpha L. – false indigo, indigobush
Species	***Amorpha fruticosa*** L. (desert false indigo, dullleaf indigo, false indigobush, leadplant, desert indigobush, indigobush, false indigo)

General characterization:
Amorpha fruticosa L. (family Fabaceae, indigo bush) is widely distributed in North America, southern Canada and northern Mexico. Populations of *Amorpha fruticosa* in Europe were introduced as ornamental plants. It presents as a shrub with a stem of 1-3 m, with imparipinnate compound leaves with stipules. The purple flowers are clustered in racemes. The fruit is an indehiscent pod of 8-9 mm with 1(2) seeds. (Alexan et al., 1991). Indigo bush has been used as a Chinese folk medicine for hypertension, hematomas and contusions. Various organs of the species (seeds, root, leaves) contain rotenoid compounds, known for their insecticide activity, but also with antimicrobial and anticancer properties (Fang and Casida, 1998; Gao et al., 2003; Sangthong et al., 2011). Flavanones and rotenoids from roots of indigo bush also manifest antibacterial activity by inhibition of bacterial neuraminidase (Kim et al., 2011). Only few data are available regarding the volatile oil of *Amorpha fruticosa* fruits (Lis and Gora, 2001; Popescu et al., 1973) and none referring to its antimicrobial activity. Therefore, the aim of present study was to investigate the in vitro antibacterial and antifungal activities of the essential oil isolated from the fruits of *Amorpha fruticosa*, collected from Romania, in relation to its chemical compositions.

Known relative distribution:
Shrub cultivated, in the past, along the modified / dredged canals in the Danube Delta. It is a species present in all types of habitats, especially in the river delta sector where it is very common. In the poplar forest plantations, it develops very well, occupying the shrub layer and thus, causing damage to these crops.

2. Kingdom	Plantae – plants
Subkingdom	Tracheobionta – vascular plants
Superdivision	Spermatophyta – seed plants
Division	Magnoliophyta – flowering plants
Class	Magnoliopsida – dicotyledons
Subclass	Asteridae
Order	Asterales
Family	Asteraceae
Genus	Xanthium L. – ash
Species	***Xanthium strumarium ssp. Italicum*** Moretti (common cocklebur)

General characterization:
X. strumarium is a coarse, erect, branching, annual herb which reproduces solely by seed; stems 30 to 150 cm tall, tough, with short dark streaks or spots and covered with short hairs which give a coarse texture; leaves alternate, triangular-ovate to broadly ovate in shape, 2 to 12 cm long, base often cordate, petiole 2 to 8 cm long, margins irregularly toothed or lobed, both surfaces rough-pubescent; flowers monoecious, male flowers inconspicuous, many-flowered heads 5 to 8 mm across, clustered at the tips of branches or axillaries above the female flowers, female flower heads axillary, greenish, two flowers in the head enclosed by the involucre; fruit, a hard brown, ovoid bur, 1.5 to 2.5 cm long, covered with hooked spines 2 to 4 mm long, and with two terminal beaks, fruits readily stick to clothing and fur, and thus are easily spread; seeds (achenes) black, two in each bur, one above the other (from Holm et al., 1977).
Seed germination and emergence of *X. strumarium* generally occurs in late spring or early summer. The two seeds within each bur often differ in size and dormancy status, with the larger seed germinating in the spring following production, and the smaller seed germinating a year later (Kaul, 1965). Light is not required for germination and seedlings seldom emerge from seeds lying on the soil surface or from those buried 15 cm or more below the soil surface (Stoller and Wax, 1974). Seed production is strongly correlated with above-ground biomass at the time of floral initiation. Vigorous, open-grown plants can produce from 500 to 2300 burs per plant (Weaver and Lechowicz, 1983). The spiny burs are readily dispersed by adhering to animals, human clothing or other materials, as a contaminant of wool, and by water. Viability of seeds buried in the soil does not generally exceed five years (Weaver and Lechowicz, 1983).
X. strumarium is a short-day plant which generally will not flower under photoperiods longer than 14 hours, although populations vary in critical night length with latitude of origin (Ray and Alexander, 1966; McMillan, 1975). *X. strumarium* has the C3 pathway of photosynthesis. It is self-compatible and primarily wind-pollinated.

Known relative distribution:
The geographic distribution of *X. strumarium* extends from latitude 53°N to 33°S (Holm et al., 1977). It is most often found in the temperate zone, but also occurs in subtropical and Mediterranean climates. Love and Dansereau (1959) identified the center of origin of *X. strumarium* as Central or South America. The native North American *Xanthium* taxa originally grew along shores and rivers and the fruits were dispersed by water or occasionally by animals.

3. Kingdom	Plantae – plants
Subkingdom	Tracheobionta – vascular plants
Superdivision	Spermatophyta – seed plants
Division	Magnoliophyta – flowering plants
Class	Liliopsida – monocotyledons
Subclass	Alismatidae
Order	Hydrocharitales
Family	Hydrocharitaceae – tape-grass family
Genus	Elodea Michx. – waterweed

Species ***Elodea nuttallii*** (Planch.) H. St. John (western waterweed)

General characterization:
Western waterweed (*Elodea nuttallii* (Planch.) H. St. John, Hydrocharitaceae) is a tetraploid, dioecious, submerged freshwater macrophyte native to North America that is invasive in Europe and Japan. In its invasive range, almost exclusively female plants have been found and the reproduction is primarily vegetative (Cook and Urmi-König, 1985). Because it can form dense dominant stands, *E. nuttallii* constrains water flow in rivers and the recreational use of lakes. Furthermore, the aggressive growth of this species may influence abiotic factors, outcompete native plants, change the makeup of the aquatic vegetation, and thus impact fish occurrence (Carey et al., 2016). Because no effective, species-specific management options are known (Zehnsdorf et al., 2015), more information about the species' biology and population structure is urgently needed. The analysis of genetic variation and population structure can give insights into reproduction mode, dispersal patterns, and the invasion process in general and may allow the identification of source regions in the native range (e.g., Durka et al., 2005; Voss et al., 2012).

Known relative distribution:
E. nuttallii is native to temperate North America common throughout most of the USA and south Canada and has a similar distribution to E. canadensis (eFloras, 2009; USDA-ARS, 2009; USDA-NRCS, 2009). In its non-native distribution, it is found in central and western Europe and Japan (Cook and Urmi-König, 1985).

B. Animal species

Insects

4. Kingdom	Animalia – animals
Subkingdom	Bilateria
Infrakingdom	Protostomia
Superphylum	Ecdysozoa
Phylum	Arthropoda – arthropods
Subphylum	Hexapoda – hexapods
Class	Insecta – hexapoda, insectes
Subclass	Pterygota – winged insects
Infraclass	Neoptera – modern, wing-folding insects
Superorder	Holometabola
Order	Coleoptera Linnaeus, 1758 – beetles
Suborder	Polyphaga Emery, 1886
Infraorder	Cucujiformia Lameere, 1938
Superfamily	Chrysomeloidea Latreille, 1802
Family	Chrysomelidae Latreille, 1802 – leaf beetles
Subfamily	Chrysomelinae Latreille, 1802
Tribe	Chrysomelini Latreille, 1802

Genus Leptinotarsa Chevrolat in Dejean, 1836
Species ***Leptinotarsa decemlineata*** Say, 1824 (Colorado potato beetle)

General characterization:
L. decemlineata attacks potatoes and various other cultivated crops including tomatoes and aubergines. It also attacks wild solanaceous plants, which occur widely and can act as a reservoir for infestation. The adults feed on the tubers of host plants in addition to the leaves, stems and growing points. Adults and larvae feed on the edges of leaves and may quickly defoliate young plants. They eventually strip all leaves from the haulm; exceptionally, tubers exposed at the soil surface are also eaten. Characteristic black and sticky excrement is left on the stem and leaves by the larvae and adults.
The number of complete generations varies between one, near the colder extremes, to about four, in the warmest areas where development from egg to adult is completed in 30 days. The minimum requirements for completion of one full generation are at least 60 days during summer when the temperatures exceed 15°C and winter temperatures that remain above -8°C. There are some cold areas in which only a partial generation is produced and the beetles cannot permanently become established. In general, sunny weather with a mean daily temperature of 17-20°C results in growth and spread of populations, but if temperatures do not exceed 11-14°C and humidity is high, the populations may actually decrease (Svikle, 1976).

Known relative distribution:
Currently, *Leptinotarsa decemlineata*, the Colorado potato beetle, is distributed widely throughout North America east of the Rockies as well as some of Europe and Asia. Its distribution covers about 8 million km² in the Nearctic Region and about 6 million km² in the Palearctic and Oriental regions. Originally, *Leptinotarsa decemlineata* was found in the southwestern United States into Mexico. As potatoes were extensively planted for agriculture, the species spread into agricultural areas throughout North America, Europe, and Asia. It is predicted that *Leptinotarsa decemlineata* could occupy other regions including Korea, Japan, parts of Africa, and most of the temperate Southern Hemisphere. (Alyokhin, et al., 2008; Alyokhin, 2008; Jolivet, 1991; Vlasova, 1978; Worner, 1988).

Fish:
5. Kingdom Animalia – animals
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata – chordates
Subphylum Vertebrata – vertebrates
Infraphylum Gnathostomata
Superclass Actinopterygii – ray-finned fishes, spiny rayed fishes
Class Teleostei
Superorder Acanthopterygii

Order	Perciformes – perch-like fishes
Suborder	Gobioidei – gobies
Family	Odontobutidae
Genus	Perccottus Dybowski, 1877
Species	***Perccottus glenii*** Dybowski, 1877 (Amur sleeper)

General characterization:

Amur sleeper is a small/medium fish up to 20-25 cm total length. The shape of the body is typically streamlined like a perch. The body is robust, the depth at pelvic origin being about 30% of standard length. The mouth is large, the angle of the jaws is below the rear half of eye, the lower jaw is in advance of the upper jaw; the upper lip more or less uniform in width; the teeth are caniform. As with all fish from the Perciformes it has two dorsal fins. The pectoral fin tip is below the origin of the second dorsal fin. The pelvic fins are relatively short, less than 1/2 to 3/4 the length of the abdomen and about 3/5 to 3/4 of pectoral fin length. The caudal fin is rounded (Miller and Vasil'eva, 2003). Its coloration is rather dark and varies from greenish-olive to brownish-grey or dark green depending on water body character and colour of substrate. On the dorsal and lateral sides of the body it has dark, irregular spots and blotches with numerous small pale yellow to blue-green flecks; the belly speckled. A dark streak runs from the tip of snout to edge of opercula and from eye to angle of jaws.

The age of maturation observed in its natural range is 2+ and 3+ (Kirpichnikov, 1945; Nikolski, 1956) while in most introduced areas fish matured at the age 2+, although specimens maturing in the second year of life were also found (Spanovskaya et al., 1964; Litvinov and O'Gorman, 1996). The growth rates of Amur sleeper vary considerably in its geographic range (see for review Grabowska et al., 2011). Amur sleeper is a multiple spawner (at least two batches); however, large females spawn longer during the breeding season and deposit more batches of eggs. The spawning starts when water temperatures exceed 15°C and in the Amur River (native area) last from May to June (Kirpichnikov, 1945).

Eggs are deposited on the lower surface of submerged objects: plants, stones, roots, etc. (litho-phitophilous species). Embryonic development lasts for 10-12 days at a water temperature of 19°C. Larvae on the day of hatching are 4.5-5.0 mm. After three days they can swim freely in the water column and start external feeding. The Amur sleeper provides parental care, as males guard their eggs until they hatch, as well as fanning the clutch with their pectoral fins and defending the nest aggressively (Bogutskaya and Naseka, 2002; Miller and Vasil'eva, 2003).

The Amur sleeper has naturally dispersed from several locations since its initial introduction. Reshetnikov and Ficetola (2011) distinguished 13 such dispersal centres for the present non-native distribution range. It is a rather bad swimmer and avoids main river courses; however, large rivers serve as long distance transport corridors downstream during high water levels and especially floods, when they are washed from adjacent oxbow lakes and flood plains, which they often inhabit (Košco et al., 2003a; Reshetnikov, 2010; Reshetnikov and Ficetola, 2011).

Known relative distribution:

The Amur sleeper is a limnophilic species, inhabiting freshwater canals, gravel pits, natural and fish ponds. It lives in the littoral zone of these waterbodies. It prefers rather stagnant waters with dense aquatic vegetation and muddy substrate; in rivers it avoids the main current and is common in flood plains and oxbow lakes. It tolerates low oxygenation of water, so it can be found also in drying, shallow waterbodies. It usually co-occurs with gibel carp (*Carassius gibelio*), crucian carp (*Carassius carassius*) and mud loach (*Misgurnus fossilis*).

The natural area of distribution of one of the most invasive freshwater fish species in Europe, Amur sleeper, Rotan Perccottus glenii Dybowski 1877 (Osteichthyes, Odontobutidae), is located in the Far East of Russia, north-east China, and northern North Korea (Reshetnikov 2009). At present, Perccottus glenii is distributed in many European countries: Belarus, Bulgaria, Estonia, Finland, Germany, Hungary, Italy, Latvia, Lithuania, Moldavia, Poland, Romania, Serbia, Slovakia, Ukraine (Kosco et al. 2003, Nalbant et al. 2004, Reshetnikov 2004, 2008, 2010.

5.2 - Danube Delta – Ukraine (IMB)

Among 51 invasive or potencially invasive species, which occurred in the Danube delta, or may established in nearest time, 7 species are chosen for the standard protocol description, as most common and invasive in the monitoring area.

Elodea canadensis Michx.
IAS name vernacular name: American or Canadian Waterweed, or Pondweed, Елодея канадська (ukr.)
Taxonomy

Kingdom:	Division:	Ordo:	Family:
Plantae	Magnoliophyta	Hydrocharitales	Hydrocharitaceae

Description:
Elodea canadensis is a dioecious, perennial, submerged aquatic macrophyte with elongated flexuous stems and long internodes which are clothed with whorls of sessile, minutely-serrate leaves and rooted from their nodes, typically in mud substrates. The middle and upper leaves, typically three per whorl, are elliptic, approximately 2-5 mm wide; leaves in the upper whorls grow closely together. Male flowers are pedunculate by the elongate, filiform base of the floral tube, not released from the plant at anthesis; sepals 3.5-5.0 mm long, petals 5 mm long. The staminate spathe has a pedunculate base, inflated, 7 mm long, 4 mm wide. The female flower stalk is approximately 15 cm long; sepals and petals 2-3 mm long. Petals white. Pistillate spathe cylindrical.

Amorpha fruticosa L.

IAS name vernacular name: Desert false indigo, False indigo-bush, Bastard indigo-bush, Аморфа кущова (ukr.)
Taxonomy

Kingdom:	Division:	Subphylum:	Family:
Plantae	Spermatophyta	Angiospermae	Fabaceae

Description:
Amorpha fruticosa is a fast-growing, deciduous shrub that grows in wetlands and disturbed habitats. It is native to North America but has spread across Asia and Europe, likely through its use as an ornamental plant. It is now generally accepted to be among the most invasive alien species in Europe. It has a high reproductive capacity, forms dense thickets and outcompetes native flora, changing successional patterns and reducing biodiversity. Repeated cutting and mowing can help to control populations of this species and in disturbed habitats, some herbicides have been successful in controlling its spread. *A. fruticosa* is a fast growing shrub, that produces a high number of viable seeds. Pollination is performed by insects (mainly bees, belonging to the genus Andrena). Pollen is small (10-25 µm), isopolar, oblate, with

three colporous apertures (PalDat, 2000). *A. fruticosa* also spreads vegetatively by sprouting, and stems can root at the nodes (Szigetvári, 2002). *A. fruticosa* is associated with species that form coastal or riparian communities. Amorpha fruticosa L. is a species which is found in the riparian forests of Ukraine. Rivers as waterways for the transport of genetic material help and often accelerate the spread of invasive species to surrounding ecosystems. It grows in medium to wet, well-drained soils and is tolerant of partial shade and occasional flooding. Although it prefers to grow along river banks, it can tolerate dry soils. Its well-developed root system means it is relatively wind tolerant (Kozuharova et al., 2017). Szigetvári (2002) describes *A. fruticosa* as a transformer species that colonizes disturbed areas, particularly floodplain pastures and meadows. Through rapid growth, it forms dense thickets and outcompetes native flora, changing successional patterns and reducing biodiversity (Szigetvári, 2002). It is known to be particularly invasive in riparian and alluvial habitats and is generally accepted to be among the most invasive alien species in Europe (Protopopova et al., 2006; Kozuharova et al., 2017). Allelopathic effects of *A. fruticosa* have also been reported (Csiszár, 2009).Brigić et al. (2014) demonstrated that changes to the vegetation structure and microclimate of habitats, caused by the invasion of *A. fruticosa*, have a significant effect on the composition of soil invertebrates.

Oithona davisae Ferrari F.D. & Orsi, 1984

IAS name vernacular name: -

Taxonomy

Kingdom:	Phylum:	Ordo:	Family:
Animalia	Arthropoda	Cyclopoida	Oithonidae

Description:

Oithona davisae has a shield-shaped prosome and four tapering thoracic segments. The final (5th) thoracic segment is conical and truncated, bearing much reduced P5 swimming legs (pereiopods). The urosome is slender, consisting of five segments (Ferrari and Orsi 1984). Adult females have a rostrum, which is pointed ventrally. The forehead is rounded dorsally. On the 1st urosome segment, there is a knob near the genital opening with one long and one short seta. The caudal rami have a length 3X the width, and are armed with one outward seta near the base and five seta at the tip. From the outward side inward, setae 2 and 3 are longer, with 2 being the longest. All the caudal setae are plumed and the antennules have 13 segments. The female, like other Oithonidae, often carries two symmetrical egg masses attached to the genital segment. The adult male lacks a rostrum, and the forehead is somewhat squared off. The posterior-lateral edges of the cephalon are drawn into fingerlike projections. The length of the caudal rami is 2X the width, with setae like a female's. Both antennules are symmetrical and digeniculate (having two hinged joints), with 13 segments, and end in a thick subterminal projection (called an aesthete). The swimming legs (pereiopods) P1-P5 are slightly reduced in size relative to a female's.

Corbicula leana O.F. Muller, 1774

IAS name vernacular name: Asian clam, Japanese clam
Taxonomy

Kingdom:	Phylum:	Ordo:	Family:
Animalia	Mollusca	Venerida	Cyrenidae

Description:
Externally shells are mostly asymmetrical (the posterior vs. anterior margin), and their length visibly exceeds their height giving an oval appearance. Species had coarse, widely and irregularly spaced ribs. Shell hinge has long lateral and closely spaced cardinal teeth. The color of the outer side of the shell has a wide range of transitions from greenish yellow to olive. The internal coloration of an adult shell is purple, however, this may differ in juvenile shells. Fresh shells clearly show adductor muscle and pallial line. In the Danube Delta, adult specimens have length 2-4 cm. Frequently misidentified in European literature as *C. fluminea*.
Diagnostic signs: coarse, widely and irregularly spaced ribs vs. regular, closely-spaced ribs of *C. fluminalis*; asymmetrical oval shell (adult specimens) vs. symmetrical round shell of *C. fluminea* (additionally, last species in Europe has mostly light-milk internal coloration).

Perccottus glenii Dybowski, 1877

IAS name vernacular name: Chinese sleeper, Amur sleeper, ротань-головешка (ukr.)
Taxonomy:

Kingdom:	Phylum:	Ordo:	Family:
Animalia	Chordata	Centrarchidae	Odontobutidae

Description:
Dorsal spines (total): 6 - 8; Dorsal soft rays (total): 9-11; Anal spines: 1-3; Anal soft rays: 7 - 10. Distinguished from other European freshwater species by the following characters: 2 dorsals with the first with 6-8 simple rays, and the second with 2-3 simple and 8-12 branched rays; no spines on first dorsal; no barbels; pelvics not fused into a disc; no lateral line canals; males during spawning period, develop a hump on nape and become black with bright green spots on body and unpaired fins (Kottelat and Freyhof, 2007).

Canis aureus Linnaeus, 1758

IAS name vernacular name: Golden jackal, Шакал звичайний (ukr.)
Taxonomy:

Kingdom:	Phylum:	Ordo:	Family:
Animalia	Chordata	Carnivora	Canidae

Description:
The body length of the golden jackal is 70 to 85 cm., with a tail length of about 25 cm. Its standing height is approximately 40 cm. The fur is generally coarse and not very long. Its coat is usually yellow to pale gold and brown-tipped, but the color can vary with season and region. On the Serengeti Plain in Northern Tanzania, golden jackals are brown-tipped yellow in the rainy season (December-January), changing to pale gold in the dry season (September-October) (Jhala & Moehlman, 2004)

5.3 - Nestos Delta – Greece (IHU)

Up to now only limited and small scaled consequences of the IAS occurring in Nestos area have been observed. Specifically, the only negative impact is owned to the species *Amorpha ftuticosa* whose invasion is very aggresive. *Amorpha fruticosa* was observed in specific grassland areas along Nestos river during July 2018. Although at that time we observed only very small shrubs, there are now bushes 2-3 metres high and quite dense, with a lot of new growth of small size extending towards the river. It is believed that if the rate of expansion remain unchecked, large meadows that are close to the river will be fully covered in the next couple of years. Similar problems have been identified in other European countries as well (e.g. Romania: Kucsicsa et al. 2018), and this is why that species is classified among the most invasive species in Europe. Although the present situation is not very bad, this species is expected to alter the physiognomy of the natural grasslands in the near future.

Amorpha fruticosa is native to North America and introduced in a large number of countries outside USA (Asia and Europe). In Europe, it was introduced in 1724 as an ornamental plant (Karmyzova 2014), and since that time it spread all over Europe. It is a fast growing shrub, occurring in a wide range of habitats, including riparian and alluvial habitats, sandy banks of ravines, coastal areas, dunes and disturbed land, such as plantations, orchards, meadows and urban areas. It produces a large number of seeds, characterized by a high viability rate, whereas moreover, it can also spread vegetatively by sprouting, as stems can root at their nodes (Szigetvári 2002). It grows in medium to wet, well-drained soils and is tolerant of partial shade and occasional flooding. Although it prefers to grow along river banks, it can tolerate dry soils. Its well-developed root system means it is relatively wind tolerant (Kozuharova et al. 2017).
It should be noted that *A. fruticosa* presents the most aggressive invasion compared to all other alien species that have been recorded in the wider area of Nestos river so far. Apart from this, it is excepted that both *Acer negundo* and *Robinia pseudoacacia* will negatively affect natural habitats. Unfortunately, it is not possible to predict the invasiveness of these two species (*A. negundo, R. pseudoacacia*) as both species are trees and vegetation succession is a very slow process. However, specific actions should be taken to reduce the consequences of such invasiveness. What we know comes from other countries where *A. negundo* has been identified as a major threat to the riparian forests, where it can alter species dynamics (e.g. *Salix* spp., *Populus* spp.) (Sikorska et al. 2019).

Acer negundo is distributed from southern Canada to the mountains of Mexico and as far as Guatemala, is absent from western North America but occurs along the Atlantic coast (Rosario 1988). However, its range has greatly expanded in North America through planting and subsequent natural regeneration and is spreading in the western USA. *A. negundo* was introduced in Europe as a horticultural plant before centuries. Now, it is known that it invaded European ecosystems, and among them some very rare ones, e.g. Bialowieza in Poland (Adamowski et al. 2002).

Acer negundo is a fast growing tree species, although short-lived, which can tolerate a wide range of environmental conditions. It can tolerate temporary or permanently logged areas (Howell and Benson 2000) and it is very sensitive to water stress (Ward et al. 2002). However, once it is established in an area, it is drought-tolerant (Rosario 1988). Thus, once established in a riparian area, it is believed that it will affect other dominant tree species and will alter vegetation composition.

Robinia pseudoacacia is native to eastern North America but it was widely used as an ornamental plant or for its ability to produce timber or stabilize soils. These uses made it a valuable tree species which is now naturalized in a large number of countries in which it might appear an invasive character. It invades a wide range of habitats (e.g. disturbed woodlands, urban and rural landscapes, riparian areas, disturbed or cleared sites). Specificaly as regards Europe, it is commonly seen as a roadside tree, and forming thorny, stands from root suckers along roads, rivers and field margins (CABI database).
R. pseudoacacia is a fast growing tree which flowers for the first time at the age of three years, whereas it is able to produce a very large quantity of seeds which can be dispersed in quite large distances. Dry seeds are viable even after 10 years. However, *R. pseudoacacia* can sprout from both stump and roots, especially after being cut or damaged. Although this species is able to produce both seedlings and sprouts, the root suckers are most prevalent in natural reproduction. These characteristics make *R. pseudoacacia* a species which can easily colonize bare areas, whereas moreover, it is very difficult to remove it from areas that has already been established.

5.4 - Kızılırmak Delta – Turkey (KTU-MSF)

Selected IAS for the monitoring in the Kızılırmak Deltaic area:

IAS scientific name	***Cyprinus carpio*** (Linnaeus, 1758)			
IAS name vernacular name [optimal]	Mirror carp, Common carp, European Carp, Bayağı sazan (Turkish)			
Taxonomy	Kingdom: Animalia	Phylum: Chordota	Ordo: Cypriniformes	Family: Cyprinidae
Description	25-36 cm average length (120 cm maximum recorded) Diagnostic characters:2 pairs of barbels; dorsal fin with 15-20% branched rays; caudal fin deeply Emarginated (Kottelat and Freyhof, 2007). Large and thick scales.			

IAS scientific name	***Carassius gibelio*** (Bloch, 1782)			
IAS name vernacular name [optimal]	Prussian carp, silver carp, gibel carp, İsrail sazanı (Turkish)			
Taxonomy	Kingdom: Animalia	Phylum: Chordota	Ordo: Cypriniformes	Family: Cyprinidae
Description	body in silvery-brownish color; last simple anal and dorsal rays strongly serrated; 37-52 gill rakers; lateral line with 29-33 scales; freed edge of dorsal concave or straight; anal fin with 5½ branched rays; and peritoneum black (Kottelat and Freyhof, 2007).			

IAS scientific name	***Gambusia holbrooki*** (Girard, 1859)			
IAS name vernacular name [optimal]	Eastern mosquitofish, Sivrisinek balığı (Turkish)			
Taxonomy	Kingdom: Animalia	Phylum: Chordota	Ordo: Cyprinodontiformes	Family: Poeciliidae
Description	Semi-transparent fins, superior mouth shape, small size (avergage size of males 3,8 cm and females 6.4 cm), black stripe near eye area. 7-8 dorsal and 10-11 anal fins.			

IAS scientific name	***Gambusia affinis*** (Baird and Girard, 1853)			
IAS name vernacular name [optimal]	Western mosquitofish, Sivrisinek balığı (Turkish)			
Taxonomy	Kingdom: Animalia	Phylum: Chordota	Ordo: Cyprinodontiformes	Family: Poeciliidae
Description	Semi-transparent fins, superior mouth shape, small size (avergage size of males 3.9 cm and females 6.2 cm), 6-7 dorsal and 9-10 anal fins.			

Length of anal nase much less than half distance from caudal fin. 8 horizontal scale rows.

IAS scientific name	***Lithognathus mormyrus*** (Linnaeus, 1758)
IAS name vernacular name [optimal]	Sand steenbras, Streaped seabream, Mırmır Balığı (Turkish)
Taxonomy	Kingdom: Animalia; Phylum: Chordota; Ordo: Perciformes; Family: Sparidae
Description	The species have moderately deep body that can grow up to 55 cm and weight around 1 kg. Eleven spines in dorsal fin, twelve to thirteen soft rays. The anal fin has three spines and 10-11 soft rays. Body marked with vertical dark bands.

IAS scientific name	***Liza haematocheila*** (Temminck & Schlegel, 1845)
IAS name vernacular name [optimal]	So-iuy mullet,Rus Kefali (Turkish)
Taxonomy	Kingdom: Animalia; Phylum: Chordata; Ordo: Mugiliaformes; Family: Mugilidae
Description	Distinguished from other species of Liza in Europe, posterior extremity of upper jaw reaching beyond anterior rim of eye, predorsal scales with longitudinal groove 41–42 lateral line scales (not including scales on caudal base), 24 circumpeduncular scale rows.

IAS scientific name	***Parablennius incognitus*** (Bath, 1968)
IAS name vernacular name [optimal]	Mystery blenny, Horozbina (Turkish)
Taxonomy	Kingdom: Animalia; Phylum: Chordata; Ordo: Perciformes; Family: Blenniidae
Description	The coloration of the body and head is olive-green, the territorial males are darker. On the upper part of the body there are 8–9 dark brown transverse unevenly outlined X-shaped stripes in the form of dumb-bells, with the first of them on the level of III–IV spinal ray; the last three stripes are usually blurred. Body dense, naked. Dorsal fin with well notched between spiny and soft parts (length of last spiny ray equal to 1/3–1/4 length of first soft ray). Beginning of dorsal fin just behind head in front of insertion of pectoral fin and on the level of insertion of ventral fin. Head big, length 3.4–3.8 in SL. Branchiostegal membranes connected by fold along the lower surface of head. The rear edge of upper jaw is at the level of rear edge of eye. Upper lip is big, it hangs out over lower jaw. Eye big, oval; its upper profile coincides with front contour of head. Horizontal diameter of eye 4.0– 4.5 times length of head.

IAS scientific name	***Syngnathus acus*** (Linnaeus, 1758)

IAS name vernacular name [optimal]	Greater pipefish, Deniz iğnesi (Turkish)			
Taxonomy	Kingdom: Animalia	Phylum: Chrdata	Ordo: Syngnathiformes	Family: Syngnathidae
Description	The greater pipefish has a long segmented armoured body, angular in cross section and stiff appearance. It ranges a color brown to green in with broad alternating light and dark hue along it. Its customized by a long snout with mouth on end and a slight hump on the top of the body just behind the eyes.			
IAS scientific name	***Oncorhynchus mykiss*** (Walbaum , 1792)			
IAS name vernacular name [optimal]	Rainbow trout, Gökkuşağı alabalığı (Turkish)			
Taxonomy	Kingdom: Animalia	Phylum: Chordata	Ordo: Salmoniformes	Family: Salmonidae
Description	Coloration varies widely between regions and subspecies. Adult freshwater forms are generally blue-green or olive green with heavy black spotting over the length of the body. Adult fish have a broad reddish stripe along the lateral line, from gills to the tail, which is most pronounced in breeding males. The caudal finis squarish and only mildly forked. Lake-dwelling and anadromous forms are usually more silvery in color with the reddish stripe almost completely gone. Juvenile rainbow trout display parr marks (dark vertical bars) typical of most salmonid juveniles. In some red band and golden trout forms parr marks are typically retained into adulthood.			
IAS scientific name	***Gobius cruentatus*** (Gmelin, 1789)			
IAS name vernacular name [optimal]	Red-mouthed goby, Kaya balığı (Turkish), Kırmızı yanaklı kaya balığı (Turkish)			
Taxonomy	Kingdom: Animalia	Phylum: Chordata	Ordo: Perciformes	Family: Gobiidae
Description	This is a relatively large and stout bodied goby which is easily recognized by its distinctive coloration. The body is reddish-brown with lighter and darker blotches and the lips and cheeks have vivid red markings, hence its common name. Lines of black sensory papillae are visible on the head. Adult fish can be up to 18cm in length.			
IAS scientific name	***Callinectes sapidus*** (Rathbun, 1896)			
IAS name vernacular name [optimal]	Blue crab, Atlantic blue crab, Chesapeake blue crab, Mavi Yengeç (Turkish)			
Taxonomy	Kingdom: Animalia	Phylum: Arthropoda	Ordo: Decapoda	Family: Portunidae

Description	Carapace more than twice as broad as long. 9 blunt to acuminate teeth, front bearing 2 obtyse to acuminate. Fifth length flattened in form of paddles Greyish, bluish or brownish color.
IAS scientific name	***Pseudosolenia calcar-avis*** (Schultze) B.G.Sundström 1986
IAS name vernacular name [optimal]	*Pseudosolenia calcar-avis*
Taxonomy	Kingdom: Chromista; Phylum: Bacillariophyta; Ordo: Rhizosoleniales; Family: Rhizosoleniaceae
Description	Diameter, 4.5-190 µm; process, 28-52 µm; areolae onbands 28-32 in 10 µm measured with TEM. Remarks: The shape of the valve and the external as well as the internalparts of process and the poroid areolae distinguish the genus from*Rbizosolenia sensu stricto*. How to identify: Most of the *Rbizosolenia* species as well as *Proboscia* and *Pseudosolenia* may be identified in girdle view in water mounts. In criticalcases in which information on the otaria is urgent, valves cleaned of organicmatter and mounted in a medium of a high refractive index may beexamined in valve view.A portion of the frustule of *Pseudosolenia calcar-avis*, the largest planktonic diatom in the Black Sea.
IAS scientific name	***Thalassiosira nordenskioeldii*** (Cleve 1873)
IAS name vernacular name [optimal]	*Thalassiosira nordenskioeldii*
Taxonomy	Kingdom: Chromista; Phylum: Bacillariophyta; Ordo: Thalassiosirales; Family: Thalassiosiraceae
Description	This species come in a variety of shapes, from box-shaped to cylindrical, discoid or spherical. Some Thalassiosira cells are found alone while others form chains. This genus harbor several discoid plastids and a circular valve, which contains pores arranged in rows or arcs, opening outwards. The valve's mantle edge is pattered with a series of bands. Different species of Thalassiosira can be identified by the morphological characteristics of their areolae and the processes on the valve.
IAS scientific name	***Alexandrium minutum*** (Halim, 1960)
IAS name vernacular name [optimal]	*Alexandrium minutum*
Taxonomy	Kingdom: Protista; Phylum: Protozoa; Ordo: Gonyaulacales; Family: Pyrophacaceae
Description	Small species, somewhat irregularly oval, sometimes a little longer than wide. Neither spines nor horns present. Cingulum deeply excavated, its right end displaced posteriorly one cingular width. Apical pore plate (Po) large, with a central foramen shaped like a comma. Rhomboidal

	first apical plate in direct or indirect contact (by a thread-like process of variable length) with Po. Sixth precingular narrow. Sulcus shallow. Posterior sulcal plate (S.p.) wider than long. Thin thecal walls. A very faint, irregular and incomplete reticulum is often seen in some plates, especially in the S.p. and the 1. Length: usually 17-29 µm (Balech, 1989).
IAS scientific name	***Oxyphysis oxytoxoides*** (Kofoid, 1926)
IAS name vernacular name [optimal]	*Oxyphysis oxytoxoides*
Taxonomy	Kingdom: Chromista; Phylum: Miozoa; Ordo: Dinophysales; Family: Oxyphysaceae
Description	Among all the species of Dinophysidae family, Oxyphysis is the only genus having a strongly elongated left ventral epithecal plate. The cell is 49-54 µm long and 15-19 µm wide,the body being fusiform. The epitheca is an asymmetrical cone with different concave sides. The girdle displacement is similar to the one observed in some species of Oxytoxtim. Two hyaline membranes can be seen on the margins of the girdle. The sulcus containsa flagellar pore situated immediately behind girdle and includes the area between the twosulcal lists. SEM observations revealed subpolygonal reticulations all over the surface. Alongthe right and left ipothecal margins scattered pores are regularly distributed.
IAS scientific name	***Scrippsiella trochoide*** ((Stein) Loeblich)
IAS name vernacular name [optimal]	*Scrippsiella trochoide*
Taxonomy	Kingdom: Chromista; Phylum: Miozoa; Ordo: Thoracosphaerales; Family: Thoracosphaeraceae
Description	*Scrippsiella trochoide*is pear-shaped, length 16 - 36 µm, width 20 - 23 µm, reddish-green, solitary, covering cellulose theca, two unequal flagella, several discoid chloroplast.
IAS scientific name	***Ulva lactuca*** *Linnaeus, 1753 = Ulva fasciata Delile, 1813*
IAS name vernacular name [optimal]	Sea lettuce, Deniz Marulu (Turkish)
Taxonomy	Kingdom: Plantae; Phylum: Chlorophyta; Ordo: Ulvales; Family: Ulvaceae
Description	Thallus sheet-like, light green, rather delicate and translucent, to 250 mm long. Persists throughout the year.
IAS scientific name	***Mnemiopsis leidyi*** (A. Agassiz, 1865)

IAS name vernacular name [optimal]	American comb jelly, comb jelly, comb jellyfish (English), Rippenqualle (German), sea gooseberry, sea walnut (English), Venus' girdle, warty comb jelly, Deniz cevizi (Turkish)			
Taxonomy	Kingdom: Animalia	Phylum: Ctenophora	Ordo: Lobata	Family: Bolinopsidae
Description	*Mnemiopsis ledyi* is a comb jelly with a length up to 100mm. The body is laterally compressed, with large lobes arising near the stomodaeum, generating 4 deep, noticeable furrows that characterize the genus. It has four rows of small, but numerous, ciliated combs which are iridescent by day and may glow green by night. The color is usually transparent or slightly milky, translucent (Shiganova 2003).			

IAS scientific name	***Beroe ovate*** (Bruguière, 1789)			
IAS name vernacular name [optimal]	Brown comb jelly, Pink comb-jelly, Hıyar Medüsü and Medüz (Turkish)			
Taxonomy	Kingdom: Animalia	Phylum: Ctenophora	Ordo: Beroida	Family: Beroidae
Description	Body mitten-shaped. Lateral compression very marked. Four meridional canals of each broad side connected orally by oral forks of paragastric canal. Eight meridional canals interconnected by loose network of numerous diverticulae, with a few anastomoses forming a wide meshwork. Color dull milky, pink or reddish brown. Height: up to 115 mm, usually 60-70 mm.			

IAS scientific name	***Acartia tonsa*** (Dana, 1849)			
IAS name vernacular name [optimal]	*Acartia tonsa*			
Taxonomy	Kingdom: Animalia	Phylum: Arthropoda	Ordo: Calanoida	Family: Acartiidae
Description	*Acartia tonsa* is translucent, and is usually between about 0.8 and 1.5 mm in length in females, and from about 0.8 to 1.3 mm in males. It can be differentiated from closely related species by their long first antennae (at least half the length of their bodies) and biramous (branched) second antennae, as well as the presence of a joint between their fifth and sixth body segments (Gonzales, 2013).			

IAS scientific name	***Oithona davisae*** Ferrari F.D.&Orsi, 1984			
IAS name vernacular name [optimal]	*Oithona davisae*			
Taxonomy	Kingdom: Animalia	Phylum: Arthropoda	Ordo: Cyclopoida	Family: Oithonidae
Description	*Oithona davisae* has a shield-shaped prosome and four tapering thoracic segments. The final (5th) thoracic segment is conical and			

truncated, bearing much reduced P5 swimming legs (pereiopods). The urosome is slender, consisting of five segments (Ferrari and Orsi 1984). Adult females have a rostrum, which is pointed ventrally. The forehead is rounded dorsally. On the 1st urosome segment, there is a knob near the genital opening with one long and one short seta. The caudal rami have a length 3X the width, and are armed with one outward seta near the base and five seta at the tip. From the outward side inward, setae 2 and 3 are longer, with 2 being the longest. All the caudal setae are plumed and the antennules have 13 segments. The female, like other Oithonidae, often carries two symmetrical egg masses attached to the genital segment. The adult male lacks a rostrum, and the forehead is somewhat squared off. The posterior-lateral edges of the cephalon are drawn into fingerlike projections. The length of the caudal rami is 2X the width, with setae like a female's. Both antennules are symmetrical and digeniculate (having two hinged joints), with 13 segments, and end in a thick subterminal projection (called an aesthete). The swimming legs (pereiopods) P1-P5 are slightly reduced in size relative to a female's.

IAS scientific name	***Balanus improvisus*** (Darwin, 1854)
IAS name vernacular name [optimal]	Bay barnacle, Barnacle, Balanus (Turkish)

Taxonomy	Kingdom:	Phylum:	Ordo:	Family:
	Metazoa	Arthropoda	Sessilia	Balanidae

Description

B. improvisus has a low, cone-shaped or semi-globe shape. It may be cylinder-shaped in crowded populations. The calcareous shell is made up of white to greyish plates. Walls never ribbed or folded longitudinally. Uneroded calcareous shells have a smooth surface and may be covered by a thin yellowish epidermis, which is often more resilient on the radii. The radii are narrow and oblique and do not completely cover the alae that is nearly horizontal. The carina is lower than the rostrum. The operculum situated off centre, so that terga are close to the carina. The operculum is rounded at the rostral end. In water the opening is narrow and diamond shaped with partly- erect tergoscutal flaps.Base of the shell calcareous, flat and thin. Canals inside run radially to the place (approximately centre of the basal plate) where cyprid antennas were attachedforming a star-like pattern. *B. improvisus* normally grows to around 10 mm in diameter.

IAS scientific name	***Astacus leptodactylus***(Rathbun, 1896)
IAS name vernacular name [optimal]	Turkish crayfish, Danube crayfish, Galician cray fish, narrow-clawed crayfish, Kerevit (Turkish)

Taxonomy	Kingdom:	Phylum:	Ordo:	Family:
	Animalia	Arthropoda	Decapoda	Astacidae

Description

Can grow up to 30 cm in length. Pale yellow and pale green in color. 2 pairs, long claws, two pairs of post-orbital ridges.

5.5 - Chorokhi and Kolkheti – Georgia (IBEDC)

Prussian carp - *Carassius gibelio*

Carassius carps have been a popular freshwater fish from ancient times as a valuable food source and as the basis of sport fisheries. The goldfish, Carassius auratus (Linnaeus, 1758) is also likely the most popular aquarium fish species in the world. Because of its popularity and ability to deal with a wide range of aquatic conditions, species of the genus Carassius have also become one of the most successful invader fish species of the last century, which makes it a group for ecological concern as well. In Georgia, crucian carp Carassius carassius (Linnaeus, 1758) was known from only one locality after Kessler's record (1877–1878) with no new findings until 1985. Since then C. carassius rapidly and simultaneously invaded almost all water bodies of Georgia. In 2004, it was for the first time noted that this invasive Carassius sp. could not be a C. Carassius, but was a form of Carassius gibelio (Bloch, 1792). However no further data is available about this invasive species in Georgia. Prussian carp Carassius gibelio (Bloch,1782), by its high reproduction capacity by means of gynogenesis and tolerance to environmental changes, considered as asuccessfull invasive. It can become the dominant species in new habitat in a short time with the help of these attributes. After the first spread report of Carassius gibelio from in 80's, Carassius gibelio became to be a problem in inland waters of Georgia as it is in some countries of Europe. By now Prussian carp is massive species in Chorokhi delta and kolkheti area and have significant commercial importan.

Pacific mullet - *Liza haematocheila*

The pacific mullet, Liza haematocheila (Temminck & Schlegal 1845) (=Mugil so-iuy Basilewsky, 1855) native to the Armur river estuary and Japan Sea. Pacific mullet is one of the new introduced species in the eastern Black Sea. It was intentionally introduced in the Black Sea in the period 1972-1980 (Zaitsev 1991). Another view about the introduction is it had been escaped from the rearing cages in the Azov Sea. The Pacific mullet well adapted to the Black Sea since 1980 - has established a self-sustaining multiple-age population in the Black Sea. Spawning and fishing both take place from May to August. There are five native mullet species in the Black Sea, namely; Mugil cephalus, Liza ramada, L. saliens, L. aurata and Chelon labrosus. Its growth rate is considerably higher than the native mullet species (Okumus & Bascinar 1997). After the introduction of pacific mullet the population of native mullet declined to high level food competition (Turan et al., 2009). Fishermen also were obliged to change their gill nets to catch bigger sized Pacific mullet. Pacific mullet is a euryhaline species, which regularly enter the brackish and fresh waters of the black sea basin - therefore spread a negative effect on these waters. By now pacific mullet is massive species in Chorokhi delta and kolkheti area and have significant commercial importan.

Stone moroko - *Pseudorasbora parva*
The topmouth gudgeon (Stone moroko), Pseudorasbora parva (Temminck et Schlegel, 1846) is an inva-sive species that has expanded its natural range due to accidental introduction. Whereas the native range of the species is situated in the East of Asia, from Amur basin to Northern Vietnam, the invasive one oc-cupies broad areas both in Europe and Central Asia. Expansion of stone moroko in the Caucasus is tightly correlated with the work on acclimatization of eastern commercial fish. Expansion of the stone moroko is facilitated by man's impact on watercourses and high ecological plasticity of this fish. The stone moroko is an undesirable invasive animal that often generates numerous populations, has no commercial value, and reduces nutritional reserve of native species. . By now Stone moroko is significant quantities in Kolkheti area.

Rapa whelk - *Rapana venosa*
The gastropod mollusc Rapana venosa a native of the Sea of Japan was first discovered in 1947 in Novorossiysk Bay (Drapkin, 1953) and has settled along the coast of the Black Sea. It has reached high biomass and has serious consequences on oyster and mussel beds (Zolotarev 1996). There are no major predators of adult Rapana venosa in the Black Sea and the population has become very abundant and destructive to native marine life: it has been responsible for the destruction of native bivalve populations i.e. oysters, scallops, and mussels. It was first observed in 1949 (Gudauta Bank) in the Eastern Black Sea of Georgia. Settlement in the Georgian Black Sea area was completed about 25-30 years. At present, the growth rate of rapa whelk considerably decreased due to lack of food but recruitment of the population is out of control and its impact continues at maximum level.

Ctenophores - *Mnemiopsis leidyi* and *Beroe ovata*
Mnemiopsis leidyi was unintentionally introduced into Black Sea in the early 1980s, probably with ballast water of shipping vessels from NW Atlantic (Vinogradov et al. 1989). First it was recorded in the Black Sea in 1982 and six years later (1988) in the Azov Sea. It was well adopted the Black Sea conditions and its population has increased sharply due to lack of predators and abundant preys (Shiganova et al. 2001). Their prey is the eggs and larvae of zooplankton-eating fish. Total biomass of Mnemiopsis was estimated as 100 million tons in 1994. The first out-break of the M. leidyi population in the Black Sea occurred in 1989 causing dramatic decline in anchovy and then in horse mackerel production.
Four main impacts on the ecosystem and fisheries were identified:
1. Changes in the food web which was considerably stable over years,
2. Predation on fish eggs and larvae; in shelf waters Mnemiopsis was estimated to graze up to 70% of total Ichtioplankton stock (Tsikhon-Lukanina et al. 1993);
3. feeding on the food of larvae and adult fish, thus causing starvation (Bilio & Niermann 2004);
4. Further accelerating of ongoing ecological change due to euthrophication.

After the invasion of another predacious comb jelly, Beroe ovata in 1997, the abundance of M. leidyi declined sharply and was maintained at a level more than four

times lower than during the late 1980s (Kamburska et al. 2000). Introduction ways of Beroe ovata is not clear whether it was introduced with ballast waters or naturally transferred from the Mediterranean Sea. However, there are signs that the ecosystem of the Black Sea began to recover due to sharp decreases in Mnemiopsis population (Kideys & Romanova 2001; Shiganova et al. 2001; Yunev et al. 2001). Investigations in the Black Sea have shown that Beroe almost exclusively feeds on Mnemiopsis and very effective in controlling its levels (Kideys et al. 2000; Finenko et al. 2000; 2001, Shiganova et al. 2000, 2001).

6. Conclusions

(IMB)

1. The species list for the monitoring in the Ukrainian Danube delta consists of 51 species, including of 11 species of macrophyts, 8 – terrestrial plants, 6 – zooplankton, 11 – zoobenthos, 1 – aquatic insect, 7 – fish, 7 –terrestrial vertebrates.
2. There are 15 species in the list were not registered in the Danube delta at this time, but have likelihood of arrival in nearest time. Two of them have likelihood of establishment of the population.
3. 13 species have likelihood of spread post invasion and invade the nearest deltaic zones of the Black Sea
4. In the list, 33 species are invasive and have potential impact on biodiversity.

(KTU-MSF)

1. The Kızılırmak River is one of the larger river discharging the southern Black Sea. The mouth of the river has many small lakes which many of them are linked with sea. The wetlands of the Kızılırmak Delta, as a Ramsar area, are a part of the ecological structure and the fishing activities have been gone on for years in the area. With the impact of the protection status of the delta being constituted of protected areas of priority one, activities carried out in the area such as agriculture, animal husbandry, fish farming, fishing have been attempted to be solved sometimes through legal means and sometimes verbally.
2. The metodologies for sampling in the field studies were determined in each organism groups.
3. The IAS list was identified and each species specification was explained.
4. The summary of IAS were given as list.

(IBEDC)

Based on Assessment Report of the IAS for the Colchic area and Chorokhi Delta we can conclude the following:

1. Research studies on the bio-ecology and impacts of alien invasive species to the marine, freshwater, brackish and estuarine ecosystems are very limited in Georgia, we have only several scientific works and articles about aquatic alien invasive species of Georgia.

2. The Black Sea, a unique fragile ecosystem, has been under the threat of pollution, climate change, invasive alien species and overfishing over many years, combined impacts of these threats caused serious problems in the Black Sea ecosystem, fisheries by reduction of the catch of commercial fish species, decrease in biodiversity, loss of habitats, increased food competition of endemic species and related problems in the food web by changes in various trophic levels. The Black Sea biodiversity has become extremely more sensitive to immigrants' expansion than those in other seas. Rich diversity of biotopes and the poor local species diversity provide favorable conditions for some exotic invaders finding naïve ecological niches with no competitors or predators. The main invaders establishing and having the most dramatic impacts on species diversity are Rapa whelk Rapana venosa, Scapharca cornea, Comb jelly fish Mnemiopsis leidyi, Pacific Mullet Mugil soiuy. All kinds of impacts due to invasive species had a big effect on the reduction of total fish production in the Black Sea as predation, food competition and major destruction in the food web. There are many other species introduced to the Black Sea from phytoplankton to top predators.

3. The main invaders establishing and having the most dramatic impacts on freshwater, brackish and estuarine species diversity are: Prussian carp - Carassius gibelio, Stone moroko - Pseudorasbora parva, Pacific mullet - Liza haematocheila. All kinds of impacts due to invasive species had a big effect on the reduction of total fish populations in the wetlands and fresh water ecosystems as predation, food competition and major destruction in the food web. There are many other species introduced to the wetlands and fresh water ecosystems.

4. In Chorokhi Delta 4 species of Plants and 4 species of animals are invasive, including 3 species of fish: western mosquitofish - Gambusia affinis, Prussian carp - Carassius gibelio and Pacific mullet - Liza haematocheila.

5. In Kolkheti Area 7 species of Plants and 9 species of animals are invasive, including 4 species of fish (western mosquitofish - Gambusia affinis, Prussian carp - Carassius gibelio, Stone moroko - Pseudorasbora parva and Pacific mullet - Liza haematocheila) and 4 species of aquatic invertebrates (Warty comb jelly - Mnemiopsis leidyi, Comb jelly - Beroe ovata, Rapa whelk - Rapana venosa, Blood cockle – Anadara inaequivalvis).

6. Different impacts caused by IAS is: Reduction of total fish populations in the Marine, wetlands and freshwater ecosystems as predation, food competition and major destruction in the foods web; Impact on some of the unique grassland and forest ecosystems and threats to the indigenous species diversity, agriculture and human health; Destruction of native Bivalve populations – Benthic Biofilter of the Black sea and Predation on pelagic fish

eggs and larvae, feeding on the food of pelagic larvae and adult small pelagic fishes (Anchovy, Sprat, Horse mackerel etc.), accelerating of ongoing ecological change due to eutrophication.

7. List of species that will be used in the IAS monitoring in Chorokhi deltaic and Kolketi Area is: Prussian carp - Carassius gibelio; Pacific mullet - Liza haematocheila; Stone moroko - Pseudorasbora parva; Rapa whelk - Rapana venosa and Ctenophores - Mnemiopsis leidyi and Beroe ovata.

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