**Lagoon ecosystem and sustainable use: ecosystems factsheet characteristics, threats and uses**

**Sources follow the tabulated information**

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| QUESTIONS THAT PARAGRAPHS ANSWER | KEY POINTS | PARAGRAPHS  *Research and contributions by Marco Valenti, Caterina Zannini, Sulaaf Ahmed, Giulia Muzzati, Anna Gregoletto* |
| Where can tourists and Venetians learn about the typical lagoon environment? | >There is a natural history museum in Santa Croce, Venice | One of the main tourist attractions in Venice is the “Museo di storia naturale” ( <http://msn.visitmuve.it/> ) which not only offers guided tours about animal species from all over the world, but also contains an aquarium which is filled with typical lagoon fish and shellfish. In the aquarium (5 meters long) there is an authentic example of the lagoon’s environment in 5000 litres of water, in which 50 types of fish swim. The rarest is the “Pesce Balestra” which recently appeared in the lagoon because of global warming. |
| How is biodiversity changing in the Lagoon of Venice, and for what reasons?  In what ways does pollution and tourist generated rubbish affect the ecosystem? | >There are direct threats to the ecosystem, such as from climate change (temperature, sea level, salinity) and from pollution  >Indirect effects include the explosion of the population of seagulls due to human rubbish and how more seagulls affects other bird species  >Invasive species are an indicator of ecosystem change and can have complex knock on effects | *Research by Gaia Schiavon, Francesca Drago, and Johnny Wallace*  There are various causes for biodiversity change, including a warming climate, shipping, and changes in water quality and salinity. An effect of shipping and pollution into the lagoon (e.g. from Marghera industrial area and also the airport) has increased invasive algal blooms.  Another issue is the introduction of alien species by both shipping and rising sea temperature. For example, there are 19 animal invasive species, such as the alien crab *Percnon gibbesi*.  Several species of birds, such as the Cavaliere d'Italia, Nitticora, Svasso maggiore and the Gruccione, are in decline. This is in part due to invasive species and habitat destruction, but also due to the population explosion of native species of seagull, which prey on and compete with, these birds. The gulls consume huge amounts of rubbish, often stealing from rubbish bags (not enough proper bins in Venice).  The large number of tourists and the cruise ships produce an enormous amount of waste, so the number of seagulls that Venice can support has grown massively. The seagulls are a problem as they can become aggressive, and because tourists feed them they have no fear of humans.  There has also been a decline in the number of eels in the lagoon, with catches down from 40 tons to around 100 kilos over the past 30 years.  Occasional events linked with pollution have caused mass fish death (e.g. some 200 tons in 2015). |
| Are there protected areas which are dedicated to flora and fauna in the Lagoon of Venice?  Why are birds’ eggs endangered?  How does LIPU protect nesting birds? | >Protected areas do exist and are important for maintaining biodiversity | The Lagoon of Venice has a unique and fragile environment, and because of this, there are several protected areas in which species of animals, plants, and especially birds, dwell.  For many years in these areas, flora and fauna have only been supervised and monitored. In addition to this, they are increasingly being enjoyed by tourists and citizens to do bird watching or to observe typical lagoon plant and animal species.  Bird nesting and egg production are endangered by humans that destroy their habitat and/or by predators such as crabs or small mammals.  To protect birds’ nesting, LIPU (Italian Association for the Protection of Birds) has created some protected areas in the lagoon. The biggest and most important is called Ca’ Roman and is situated in the southern part of the lagoon, exactly on the Chioggia’s inlet. A lot of birds, like the Kentish Plover, Little Terns and seagulls, nest at Ca’ Roman’s beach near Chioggia’s inlet.  Near the MOSE there’s a beach (S.Niccolò) where some birds nest in the wood and seaweed left from high tide. While this is removed on popular beaches nearby to keep them clean for beach users, on S. Niccolò beach this habitat is protected. |
| What are the main sources of pollution entering the lagoon?  What can be done to reduce the pollution of the lagoon? | >In the 20th century there was more industrial pollution entering the lagoon from Marghera, although despite strict regulation today, this problem isn’t completely gone  >Shipping continues to be a source of pollution  >Tourism also generates a lot of waste, some of which pollutes the lagoon | *Research by Leonardo Bovo, Anna Gregoletto, Giulia Muzzati*  Historically there has been a lot of pollution in the lagoon. Even though organizations have made actions to stop it, the problem still exists. Much of the pollution used to come from Porto Marghera’s industrial site, when it was at fullest, it would dump any kind of chemical waste into the lagoon. Now since most of the industrial site has been closed and everything is being regulated by recent laws, there is less chemical output, but there is still a significant amount of polluted water going in the lagoon.  Another source of the pollution is the sewer system of Venice: it is, in many cases, obsolete; in fact some of the waste coming from houses goes directly into the canals. Some houses have added sewer tanks, and also there is public installation of sewer tanks as a legal requirement for some buildings.  Another source of pollution is tourism, and since there aren’t enough rubbish bins, some tourists throw things into the canals which are later dragged by the tidal currents into the lagoon. This is unsightly and harms sea life. |
| What ecosystem changes result from sea level rise and erosion? | >Mudflats are an important habitat at risk of inundation by rising seas  >Salt marsh is also threatened by sea level rise and erosion by wave action  >When salt marsh is lost, erosion in the lagoon is accelerated | *Contributions by Alice Sanguin, Bianca Illing, Arthur Chatto*  Erosion results in a retreat of salt marsh borders, associated with the loss of sediments transported by tidal currents to the sea. This alters the lagoon landscape and is a self-amplifying process since the disappearance of an area of salt marsh opens up new areas to erosion.  The consequences relate to the loss of the ecosystem services that salt marshes provide: e.g. for biodiversity; pollutants abatement and flood moderation, and also a reduction in human uses such as fishing, hunting and eco-tourism.  Sea level rise threatens the mudflats, which are only exposed at low tides. They appear to be muddy and bare, with minor channels running through, but are the home to much invertebrate life like worms and clams, and birds use the mudflats as both feeding and breeding grounds. Mudflats also provide a defence to the inner parts of the lagoon from storm surges. Mudflats even have economical contributions because of the clam farming that takes place there.  The salt marshes are only covered by water at high tides and include salt tolerant plants that support diverse wildlife. The survival of a salt marsh is dependent on the balance between sediment accumulation and the sea level. This balance is being challenged by human intervention. Rising sea level is also threatening the salt marshes - if vertical accretion cannot occur at the rate of sea level rise, they will be submerged and eventually washed away. When salt marsh becomes more exposed to higher wave energy, sediment can be removed faster than it is replenished.  Erosion also flattens out the bed of the lagoon reducing habitat diversity. |
| Is there farming in the islands of the lagoon? | >Agriculture is still an important activity on some islands such as Giudecca | With regard to farming, on Giudecca island there is a vegetable garden which yields 300 types of plants including 15 types of tomatoes and also edible flowers. These products are sold primarily to restaurants. This was originally a convent vegetable garden, but today it is instead successfully tended by inmates of the Women’s Prison. The co-operative running the scheme also promotes the importance of agriculture and plant husbandry. |
| What is a ‘valle da pesca’, and what types exist? (the plural is ‘valli da pesca’)  How does the valle da pesca method work? | >The system of ‘valli da pesca’ is an example of sustainable harvesting of lagoon resources  > There are three forms of valle da pesca, and they can be operated in an extensive or intensive way | *Compiled by Caterina Zannini, Marco Valenti*  A ‘valle da pesca’ is a particular place where fish and plants are farmed in order to be fished and picked, but in a relatively natural setting.  There are three different types of ‘valle’: they can be closed, semi-closed or open. Closed ones have got embankments, and conversely open ones haven’t. Semi-closed valleys have river banks, but they are interrupted by plants (like reeds).  Fishermen say that closed valleys are better than the others, because they can be more controlled, regulating water with sluices that connect the lagoon with freshwater canals.  The mode of operation consists of three phases: First, juvenile fish come (or are released) into the shallow, ‘valle’ areas, attracted by the warmer waters, abundance of food, shelter, and protection from predators.  Secondly, the juveniles are kept in the enclosure where they grow; productivity being influenced by temperature, salinity and tide action. The production can be ‘extensive’ or ‘intensive’: the main difference being in the way fish are fed. In extensive farming their nutrition depends only on natural resources, in intensive farming they are given artificial feed. The third phase is harvesting of the fish from the valle.  A GIS showing the location of valli da pesca in the lagoon can be viewed here: <http://cigno.atlantedellalaguna.it/maps/22/view> |
| What is the impact of valli da pesca on the Venetian lagoon’s biodiversity?  What species of birds can be found in valli da pesca? What other animals?  What species of plants are common in valli da pesca? | >Valli da pesca benefit biodiversity and the lagoon environment | *Compiled by: Lorenzo Rizzo,Vito Casagrande*  Valli da pesca help the environment to maintain the biodiversity of species that have always been found in the lagoon. These areas are also an optimal environment for nesting, wintering and feeding of many migratory waterfowl that come into the lagoon in winter from Northern Europe, and also other birds that live permanently in the lagoon.  They also benefit small mammals, reptiles and fishes.  In valli da pesca eels (*Anguilla anguilla*), gray mullet (*Mugil cephalus*), sea bass (*Dicentrarchus labrax*) and sea bream (*Sparus aurata*) are farmed, all species that can tolerate a wide range of salinity (euryhaline).  Here you can find nesting species such as the Mallard (*Anas platyrhynchos*), the marsh harrier (*Circus aeruginosa*), the moorhen (*Gallinula chloropus*), the coot (*Fulica atra*), the Kentish plover (*Charadrius alexandrinus*), the Common tern, the pendolino (*Remiz pendulinus*), the purple heron (*Ardea purpurea*), the redshank (*Tringa totanus*), and the Night heron (*Nycticorax nictycorax*).  Other species stopover during the winter months, such as the great and the small crested grebe (*Podiceps cristatus* and *P. nigricollis*), the great egret (*Egretta alba*), and different species of *Anatidae*.  In addition to fish and birds, in valli da pesca there are also small mammals such as the harvest mouse (*Micromys minutus*), the water shrew (*Neomys fodiens*), the polecat (*Mustela putorius*), the marten (*Martes foina*), the water vole (*Arvicola terrestris*), the weasel (*Mustela nivalis*), and the hedgehog (*Erinaceus europaeus*).  You can also find rat snakes (*Coluber viridiflavus*) and water snakes (*Natrix natrix* and *N. tessellata*).  The emergent vegetation of valli da pesca are typical of the salt marshes, e.g. Salicornia (glasswort), Sea lavender, Puccinellia (salt grass).  The submerged vegetation is mainly composed of two plant associations of seagrasses which are a valuable food source for ducks: one composed of *Zostera noltii*, which grows in brackish areas with a good water exchange, and the other one composed of *Ruppia maritima*, present in areas with lower salinity and higher stability.  In freshwater areas you can find reed beds of *Phragmites* that can also survive with a low presence of salt. Where only freshwater is found, cattail, especially *Typha latifolia*, is present. |
| What problems face the ‘valle da pesca’ system?  What could be done to keep the system going? | >Fish farming in the Venice lagoon is not economically viable due to competition from fish brought in from elsewhere  >More awareness and support for locally sourced fish would help to sustain the valli da pesca | *Francesco Barbato, Francesco Bellati, Pascal Tchen, Eva Mariotto, Catalina Josanu, Max Vaughan, Francesca Drago.*  Fish farming is declining because it is no longer viable economically due to unprofitability. Some fish farms have diversified to become hunting reserves. They contribute little to the economy of Venice, but they are an important part of the lagoon’s culture and history.  Habitats are being degraded due to erosion of lagoon banks and bed, and this decreases populations of shellfish and fish. Various forms of pollution, and changes to water quality and temperature (as discussed above) also affect the valli da pesca.  Fish sourced from valli da pesca could be promoted as high quality, environmentally sound, and as a regional speciality dish of Venice that could be sold for a higher price through the restaurants. Promoting such activities would help to reduce the reliance of the economy of Venice on tourism.  Unfortunately a lot of fish sold in Venice is imported, but tourists still believe that they are consuming local produce. This contributes to local fish farms being outcompeted by fishing done elsewhere. |

**Sources**

*The Science of Saving Venice* (Fletcher & Da Mosto)

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