Wetlands and hunters. Characteristics, management, and perspectives.

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ACADEMIC YEAR 2017/2018
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ABSTRACT

The scientific community proposed several definitions of wetland (Keddy, 2010), as well as the international community has tried to create a unique definition that could be shared by as many countries as possible. Wetland is a portion of land completely or partially covered by water. The wetlands are complex ecosystems hosting various genus of animals, the aim of this thesis is to consider those areas suitable for waterfowl and somehow managed by hunters. Ducks, rails and waders in general are animals that live in close contact with wetlands; hunting is always practiced near those areas, whenever possible, or the hunters create artificial ones when there are no natural area available. In the thesis, a specific classification will be used, i.e. the wetlands created by hunters will be divided into "Sguassi" and "Valli". The objectives of this work concern the management of the wetlands both at an administrative, technical, and practical level. From an administrative point of view, was underlined the need to have a precise definition of wetland, in order to have a clearer and more specific law; taking the Canadian situation as an example. Furthermore like the technical objectives it was quantified the amount of wetlands managed or restored by hunters, and it was quantified and characterized the wet areas and the vegetated ones. The wetlands managed or created by hunters in the Veneto Region are 120, divided into 70 "Sguassi" and 50 "Valli". The total area of wetlands in the Veneto Region is 21403.46 ha, divided into 16610.11 ha of water surface and 4793.34 ha of vegetated area. Comparing the Italian situation with the Canadian one, it was possible to understand how these two countries are not so close in the definition, protection, and management of these fundamental physical units. Taking advantage from the foreign experience, it would be important to increase the attention, guarantying also by law the sustainment to those hunters association that are managing and maintaining the wetlands for free and just for their purposes. In this sense, appear clear as there is the need of a national coordination to better manage all the issues.
RIASSUNTO
La comunità scientifica ha proposto diverse definizioni di zone umide (Keddy, 2010), così come la comunità internazionale ha cercato di creare una definizione unica che potesse essere condivisa da quanti più paesi possibili. La zona umida è una porzione di terra completamente o parzialmente coperta dall'acqua. Le zone umide sono ecosistemi complessi che ospitano vari generi di animali, l'obiettivo di questa tesi è di considerare quelle aree adatte agli uccelli acquatici e in qualche modo gestite dai cacciatori. Anatre, rallidi e trampolieri sono animali che vivono a stretto contatto con le zone umide; la caccia è sempre praticata vicino a quelle aree, quando possibile, altrimenti i cacciatori creano zone umide artificiali quando non ci sono aree naturali disponibili. Nella tesi, è stata utilizzata una classificazione specifica, vale a dire che le zone umide create dai cacciatori saranno divise in "Sguassi" e "Valli". Gli obiettivi di questo lavoro riguardano la gestione delle zone umide sia a livello amministrativo, tecnico e pratico. Da un punto di vista amministrativo, è stata sottolineata la necessità di avere una definizione precisa delle zone umide, al fine di avere una legge più chiara e più specifica; prendendo come esempio la situazione canadese. Inoltre, tra gli obiettivi tecnici, sono state quantificate le zone umide gestite o ripristinate dai cacciatori, ed sono state quantificate e caratterizzate le zone con acqua e quelle vegetate. Le zone umide gestite o create dai cacciatori nella Regione Veneto sono 120, suddivise in 70 "Sguassi" e 50 "Valli". La superficie totale delle zone umide nella Regione Veneto è di 21403,46 ettari, suddivisa in 16610,11 di superficie acquatica e 4793,34 di superficie vegetata. Confrontando la situazione italiana con quella canadese, è stato possibile capire come questi due paesi non siano così vicini nella definizione, protezione e gestione di queste unità fisiche fondamentali. Approfittando dell'esperienza straniera, sarebbe importante aumentare l'attenzione, garantendo anche per legge il sostegno a quelle associazioni di cacciatori che gestiscono e mantengono le zone umide gratuitamente e solo per i loro scopi. In questo senso, appare chiaro che vi è la necessità di un coordinamento nazionale per gestire al meglio tutte le questioni enunciate.
1. INTRODUCTION

1.1. WETLAND

1.1.1. Definition of wetland

The options of making a wetland definition are different. There is not a single definition accepted at both scientific and legislative levels. The scientific community described several examples of definition (Keddy, 2010), as well as the international community has tried to create a definition that could be shared by as many countries as possible.

Wetland is a portion of land completely or partially covered by water, which can have several different functions, like (Morri, 2016; Pruscini, 2016; Santorini, 2016):

- Supply food and essential habitat for many species of fish, shellfish, shorebirds, waterfowl, and furbearing mammals;
- Provide products for food (wild rice, cranberries, fish, wildfowl, salt), energy (peat, wood, charcoal), and building material (lumber);
- Filter water;
- Buffer from flooding;
- Provide appealing places for wildlife and people;
- Fight drought and erosion;
- Support the water cycle;
- Increase the Biodiversity;
- Decrease the surrounding temperature.

From a technical point of view, a wetland can be define as "an ecosystem that arises when inundation by water produces soils dominated by anaerobic processes, which, in turn, forces the biota, particularly rooted plants, to adapt to flooding" (Keddy, 2010). It is possible to identify four different typology of wetlands: marsh, swamp, bog, and fen (bogs and fens being types of mires). Wet meadows and aquatic ecosystems can be consider as additional wetland types (Keddy, 2010.).

- Marsh: is a wetland that is dominated by herbaceous rather than woody plant species. Marshes can often be found at the edges of lakes and streams, where they form a transition between the aquatic and terrestrial ecosystems. Grasses, rushes or reeds often dominate them. If woody plants are present, they tend to be low-growing shrubs. This form of vegetation is what differentiates marshes from other types of wetland such as swamps.
Swamp: is a wetland that is forested. Many swamps occur along large rivers where they are critically dependent upon natural water level fluctuations. Other swamps occur on the shores of large lakes. Some swamps have hammocks or dry-land protrusions, covered by aquatic vegetation, or vegetation that tolerates periodic inundation. The two main types of swamp are "true" or swamp forests and "transitional" or shrub swamps.

Bog: is a wetland that accumulates peat, a deposit of dead plant material (often mosses). Other names for bogs include mire, quagmire, and muskeg. They are frequently covered in ericaceous shrubs rooted in the sphagnum moss and peat. The gradual accumulation of decayed plant material in a bog functions as a carbon sink. Bogs occur where the water at the ground surface is acidic and low in nutrients. In some cases, the water is derived entirely from precipitation, in which case they are termed ombrotrophic (rain-fed).

Fen: Along with bogs, fens are a kind of mire. Fens are minerotrophic peatlands, usually fed by mineral-rich surface water or groundwater. They are characterized by their distinct water chemistry, which is pH neutral or alkaline with relatively high dissolved mineral levels but few other plant nutrients. They are usually dominated by grasses and sedges, and typically have brown mosses. Fens frequently have a high diversity of other plant species including carnivorous plants. They may also occur along large lakes and rivers where seasonal changes in water level maintain wet soils with few woody plants.

Wet meadows: is a type of wetland with soils that are saturated for part or all of the growing season. Debate exists whether a wet meadow is a type of marsh or a completely separate type of wetland. Wet prairies and wet savannas are hydrologically similar. Wet meadows may occur because of restricted drainage or the receipt of large amounts of water from rain or melted snow. They may also occur in riparian zones and around the shores of large lakes.

Acquatic ecosystem: is an ecosystem in a body of water. Communities of organisms that are dependent on each other and on their environment live in aquatic ecosystems. The two main types of aquatic ecosystems are marine ecosystems and freshwater ecosystems.

From a legislative point of view, the first time that an attempt was made to define a wetland that could be used and shared internationally was at the first Ramsar Convention. It is also called the Convention on Wetland and took place for the first time in Ramsar (Iran) in 1971 (Ramsar Sites Information Service, 1971).
Under the [Ramsar International Wetland Conservation Treaty] wetlands are defined as follows (The Ramsar 40th Anniversary Message for November, Ramsar, 2011):

- Article 1.1: "...wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters".

- Article 2.1: "Wetlands may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands".

Following the spread of the wetland concept within the international community, individual states have also begun to adapt their environmental legislation; among these countries, there is also Italy. According to the Italian Ministry of the Environment, represented by ISPRA, wetlands are defined as: "environments with high ecological diversity, remarkable productivity, characterized by considerable environmental fragility and the presence of species and habitats that are among those most threatened globally. In addition to being biodiversity tanks, these environments provide a high amount of ecosystem services, such as regulating hydrogeological phenomena or fixing carbon in the biosphere, resulting in mitigating the effects of climate change".

The European Union resumes the definition given by the Ramsar Convention (The Ramsar 40th Anniversary Message for November, Ramsar, 2011), but tries to expand it, emphasizing the difficulty of clearly defining this type of environment. The EU clarifies that a wetland does not include an environment characterized by only water or land alone, but both at the same time, even though the aquatic part remains essential, allowing the creation of particular habitats. Moreover, a wetland is easier formed where the fault is close to the surface (LIFE and Europe's Wetlands, 2007).

1.1.2. Wetland Legislation (Europe and Italy)
The agreements established at international level are numerous and include the protection of biodiversity and aquatic ecosystems, such as:

- The Ramsar Convention (1971);
- The Convention of Bonn (1979);
- The Convention of Rio de Janeiro (1992);
- AEWA (Agreement on the Conservation of African-Eurasian Migratory Waterbirds);
- IUCN2 (International Union for Conservation of Nature) "Countdown 2010" program, within which a joint action between the Ramsar Convention and the Rio de Janeiro
Convention was established in order to achieve a significant reduction in the loss of biodiversity in the aquatic environment by 2010.

Starting from these international initiatives, some activities have also started in our country, such as the MedWet project. Established in 1991, the Mediterranean Wetlands Initiative brings together 27 Mediterranean and peri-Mediterranean countries that are Parties to the Convention on Wetlands (The Ramsar 40th Anniversary Message for November, Ramsar, 2011). Palestine and a number of organizations and wetland centers are also part of the MedWet Initiative. The MedWet mission is to ensure and support the effective conservation of the functions and values of Mediterranean wetlands and the sustainable use of their resources and services.

As stated in the ISPRRA Report 107/2010, this public body, in collaboration with the Ministry of the Environment and the Protection of the Territory and the Sea, with the ARPA Toscana and the participation of regional, provincial, protected areas, the ARPA / APPA, the State Forestry Corps, the Universities (i.e. University of Pavia), several research institutes (i.e. ENEA - Saluggia Research Center) and environmental associations (i.e. WWF) that adhere to the project, is implementing the Italian wetland inventory. It will be integrated into the online inventory of MedWet (the Pan Mediterranean Wetland Inventory - www.wetlandwis.net) and will provide the basis for the definition of a national strategy for the conservation of biodiversity in wetlands.

At the European level, however, normative acts, which preserve the protection of biodiversity of the internal and coastal aquatic environments, are different, such as the Birds Directive (79/409/EEC), the Habitats Directive (92/43/EC) and the Water Framework Directive (2000/60/EC, called WFD). The WFD, which was transposed by d. 152/2006, is the only one that defines the timing and modalities for the implementation of the safeguarding of aquatic and coastal ecosystems. In fact, it aims at "the identification of significant anthropogenic pressures on surface water and groundwater, an economic analysis of water use and a framework of actions for the protection of water (internal, transitional, coastal and underground) in order to prevent further degradation of the status of aquatic, terrestrial ecosystems and wetlands directly dependent on the aquatic environment in terms of water requirements. The ultimate goal of the WFD is to achieve a "good" water ecological status by 2015".

The Birds Directive, which was issued in 1979 and recently replaced by the codified version (Directive 2009/147/EC), while establishing the protection and management of wild bird species, regulating their exploitation and foreseeing the maintenance or restoring suitable habitats for their protection, does not envisage a specific planning tool. It is with the Habitats Directive (1992) that
specific instruments (Article 6) are introduced for SIC (Site of Community Importance) and ZPS (Zone of Special Protection), like the SIC and ZPS management plans. The Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 related to the conservation of wild birds, in GUE (European Ufficial Gazette) 20/L of 26/01/2010. The aim is to avoid the "degradation of natural habitats and species habitats and the perturbation of the species for which the zones have been designated, insofar as such disturbance could have significant consequences for the objectives of this Directive". National transposition took place with D.P.R. 357/9720 as amended and supplemented by D.P.R. No 120/2003 "Regulation amending and supplementing the decree of the President of the Republic of 8 September 1997 n. 357 on the implementation of Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora. Other modifications and additions are made by D.M., which constitute the Ministry's address acts through which the regions can fully implement the Community and national standards. In particular in relation to D.P.R. 357/97 and the following two D.M. were issued: - D.M. 3-9-2002 "Natura 2000 Management Guidelines", the purpose of which is the implementation of the Community and national strategy for the conservation of nature and biodiversity under the Community Habitat Directives (Article 6) and "Birds", D.M. 17-10-2007 "Uniform Minimum Criteria for the Determination of Conservation Measures for Special Conservation Zones (ZSC) and Special Protection Zones" (ZPS) ". The guidelines (D.M. 3-9-2002) seek to define how to integrate environmental objectives into planning at different levels of government of the territory. The management of a site, whatever its contribution to the network, must meet a single obligation of achievement: to safeguard the efficiency and ecological functionality of habitats and/or species to which the site is "dedicated" thus contributing to local scale to achieve the general objectives of the Directive. The contents of the SIC and ZPS Management Plans are set out in Annex Ia. The minimum criteria for the definition of conservation measures (D.M. 17-10-2007) ensure the ecological coherence of the Natura 2000 Network and the adequacy of its management on national territory; they also support the maintenance and restoration of a satisfactory conservation status of Community living habitats and habitats of species of Community interest. The D.M. cited above identifies conservation measures for the Special Conservation Areas (Annex Ib) and the minimum uniform criteria for the definition of conservation measures applicable to all types of SPAs; It also divides the SPAs into 13 environmental typologies by identifying, for each of these, specific additional criteria, which are compacted in 9 macrocategories:

1. Coastal habitats and halophytic vegetation (Figure 1);
2. Maritime and inland dunes;
3. Fresh water habitats;
4. Temperate lands and shrublands;
5. Sparks and woodlands of sclerophyll (matorral);
6. Natural and semi-natural grass formations;
7. Tall peat bogs, low peat bogs and low marshes (Figure 2);
8. Rocky habitats and quarries;

According to art. 3 c. 1 such minimum criteria are adopted or adapted by regions Dir. 21-5-1992 n. 92/43/EEC "Habitat", “Regulation implementing Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora". Also based on the addresses expressed in D.M. 3 September 2002 "Guidelines for the Management of Natura 2000 Sites"; to the Regions is the articulation of uniform minimum criteria for the definition of conservation measures (a) valid for all types of SPAs and (b) valid for specific types of SPAs. In particular, the same D.M. “Minimum conservation criteria” include specific measures relating to wetland and river fluvial typologies;
these indications are particularly useful and appropriate for the definition of water conservancy objectives at the watershed level (ISPRA Report, 107, 2010).

1.1.3. The wetlands in Veneto

The Region of Veneto boasts an abundance of riches and varieties of wetland distributed over its territory. At a geographic level, it develops from the Dolomites in the north to the Adriatic Sea in the south, so it is possible to observe the entire evolution of a river from the glacier to the mouth. In the mid part of the region, there are several natural lakes, including Lake Garda, peat bogs, bights and water springs that allow the creation of several rivers. Among them there are some of the most important rivers in Italy, which create very significant humid environments along their route, such as Adige, Brenta, Sile, Piave, Tagliamento and Po, the longest river in Italy and with the largest delta, whose territory, since 1997, “Regional Nature Park of the Po Delta” is bordered by the Adige to the north and the Po of Goro to the south. In the south / east part of the region it is possible to find all the mouth of these rivers that enter to the Adriatic Sea. Consequently, there are several marshy areas and the lagoon characteristics of brackish water, which greatly increase the level of biodiversity of the region, being characterized by very specific habitat.

The Veneto Region (total surface 1.826.000 ha) also follows the trend that globally is transforming these environments, with high biodiversity value, into agricultural-industrial land from several decades. The survival of species related to aquatic environments strongly depends on the modification of stretches of the upstream streams (Arillo, 2007). The global surface occupied by wetlands - marshes and wetlands, lagoons, peat bogs, water mirrors and river deltas - is about 6%. Unfortunately, in the descent, as only in 1900, 60% of the world's heritage was destroyed, of which 90% in Europe (Carlo Delfino editore & C. s.n.c., 2002). Since the late 1800s in Veneto, thousands of hectares of wetlands have been eliminated to vanquish malaria. Between 1860 and 1877, only 7% of state interventions (equivalent to 22,000 ha of landfill) were made in this region, compared to 63% (corresponding to 109,000 ha) of private works (Pegoraro, 2009; Crotti, 2009). Only in these 17 years, almost 8% of the entire area of the Region has been reclaimed. Starting from the Unification of Italy, the entire national territory has been profoundly changed until the first half of the XX century, due to the enormous environmental intervention known as integral reclamation (Figure 3). From 1861 until the outbreak of World War II, the intervention covered more than 5 million hectares of agrarian territory, distributed over flat land and close to the coasts of almost the entire peninsula and islands. Within the general intervention, particular importance has been gained for the productive use of a land completely submerged by the marshes, normally below the sea level: over 600,000 ha, distributed mainly between Friuli Venezia Giulia, Veneto and Emilia Romagna regions. Of this new land emerged from the marsh, about 100,000 ha are found in the
Eastern Veneto, and half of them in the territory of Basso Piave (Coltri, 2012). This territory has emerged since the end of the XVIII century from the low waters of the swamp; it has formed almost entirely in its physical and spatial signs, in its productive structure, in its landscape, within the process of integral reclamation (Coltri, 2012).

![Image: Men at work during the land reclamation in the Padana plain.](image)

Figure 3. Men at work during the land reclamation in the Padana plain.

Furthermore land reclamation for agricultural purposes also caused the end of a "marsh economy" based on extensive farming: to date, the remaining valleys host mostly intensive farms or are highly exploited for hunting purposes, while the same realization of large industrial complexes since the 1950s, it has put pressure on fragile and complex ecosystems such as the Venice Lagoon and the Ravenna “Pialasse”. Erosion of the coasts, tourism exploitation, subsidence, complete a picture certainly not reassuring than the need to protect what remains of these environments and, consequently, the wildlife that lives there (www.legambiente.it).

The lagoon and delta areas in the Veneto Region are different and can be summarized in four areas: Venice Lagoon, Po Delta, Caorle Lagoon and Bibione Lagoon.

The lagoon of Venice is the largest lagoon in Italy, has an area of 550 km\(^2\) an average width of 10 km and a length of about 50 km, its drainage basin is 1870 km\(^2\). It communicates with the open sea through three port mouths: Lido, Malamocco and Chioggia, which give this system the salty character of the waters and the conformation of the emerged lands and the seabed. The depth of the lagoon is very variable: you can get to 15-20 m in the port channels, to 1-3 m in the water, up to a few centimeters in the slums. The lagoon waters are subjected daily to a double exchange by the
tidal inputs that favor the oxygenation and the de-pollution by dilution. The lagoon system depends on the relationship between the contributions of solid materials coming from the sea or rivers, and the erosive action of the waves and tides, to which it is necessary to add the contribution of eustatism (variation of sea level). If erosion, sedimentation and eustatism compensate the lagoon environment manages to survive; if the contribution of the sea and the rivers continues to grow, increasing sedimentation, the lagoon will tend to turn into emerged land; on the contrary, if erosion and erosive action prevail, this environment will tend to become one arm of the sea: and it is precisely this that currently seems to be the evolutionary tendency of the Venice lagoon. The evolution of the lagoon system is due to both natural and anthropic factors; the latter include the diversion of some rivers that flow into it, the reduction of the lagoon surface useful for tidal expansion due to the construction of fishing “Valli” and reclaimed crates, the construction of three piers that delimit the port channels and they extend to the sea, finally the dredging of the port channels that have modified the internal hydrodynamics. The continuous erosion of the Venice lagoon will take this step to the progressive deepening of the seabed and the disappearance of the “ghebi”, “velme” and sandbanks; this will determine the serious consequences on the whole ecosystem, such as the reduction of specific biodiversity of plants and animals, the increase in the risk of damage to the structures placed to defend the inhabitants and buildings, and the overall degradation of the quality of the environment. The salt marshes are environments characterized by high dynamism, play a fundamental role both as regulators of lagoon hydrodynamics and as a habitat for numerous species of birds, hosting a rich vegetation that helps sediment deposition; they are extremely complex environments, constantly subjected to natural and anthropogenic pressures. Given their importance, we are looking for a way to restore, reconstruct and protect this type of environment, which is able to moderate the action of waves and to limit, through the entrapment favored by the vegetation that grows, the dispersion of the sediments present in lagoon. The most characteristic feature of the salt marshes is in fact the presence of halophilous vegetation: plants capable of carrying out their entire life cycle in generally inhospitable environments for other plant species due to the high concentration of salts in the soil (salinity that may be three times greater than that marina). It is able to manifest the cumulative effects of the different environmental factors acting on the lagoon, for this it can be used as an indicator of the processes in which it participates. In other words, it can be considered a morphological indicator to be used as a mercury bulb of a thermometer when measuring it temperature (www.comune.venezia.it).

The Po Delta’s, with an area of 180 km², consists of a hydraulic system of river branches through which the river Po flows into the Adriatic Sea, after its course along the Po Valley. Its current hydraulic structure derives from the consequences of the Ferrara earthquake of 1570 and the Taglio
di Porto Viro, a large hydraulic work carried out by the Republic of Venice in 1604. The delta consists of the river branches and, by extension, from the territory between including them, reaching a surface area of about 18 thousand hectares. According to this definition the delta of the Po falls entirely in the Province of Rovigo or “Polesine” and almost entirely occupies the eastern portion (starting from the Po di Goro incile up to the sea) and is also defined as an "active delta". In a broader sense, it includes the largest area of the historical delta, that is to say the one between the ancient delta branches of the river Po: once there were important southern branches of the watercourse, among which we mention the Po di Volano and the Po of Ferrara or Po di Primaro, it would include the part of the Province of Ferrara in the shape of a cusp between the vertices of “Stellata”, “Sacca di Goro” and “Valli di Comacchio”. The delta del Po has been included, since 1999, in the list of Italian heritage sites by UNESCO as an extension of the recognition given to the city of Ferrara in 1995. The surface of the delta area is affected by a progressive expansion (equal to about 60 ha per year) due to the progress towards the east of the mouths of the various branches of the delta. This shift takes place due to the progressive deposition of the considerable solid transport of the river Po on the shallow seabed of the Adriatic, which determines its rise and therefore the constant extension of the bed of the various branches to the sea. The Province of Rovigo is therefore the only point in the Italian territory subject to expansion, with the consequent need to periodically update the statistical data relating to its area. The branches of the river Po currently active and that together make up the delta are, from north to south: the Po di Maistra, the Po of Venice - Po della Pila that flows into the sea through three distinct mouths (Busa di Tramontana, Busa Dritta and Busa di Scirocco), the Po delle Tolle (with the branches of Busa Bastimento and Bocca del Po delle Tolle), Po di Gnocca or della Donzella (also with a terminal fork) and Po di Goro. Separate discourse must be made for the Po di Levante which, although connected to the main course of the river Po through the navigation basin of Volta Grimana, is hydraulically separated and does not include the waters. In fact, following the imposing works of hydraulic arrangement of the Fissero-Tartaro-Canalbianco river, which occurred in the thirties of the last century, this ancient northern branch of the river was separated from the main course to become the terminal collector of the Canalbianco.

The delta of the Po includes the protected natural areas established in the geographical territory of reference:

- Regional Park of the Po Delta of Emilia-Romagna - established in 1988, but functioning only since 1996, it also includes territories that are part of the water basin of other rivers (including the Rhine). It includes the southern part of the Po historic delta, but only a small part of the current delta;
• Veneto Regional Park of the Po Delta - operating since 1997, includes practically all the geographical delta of the Po, as defined above;
• Delta del Po interregional park is the name of the park that the Regions of Veneto and Emilia-Romagna should have jointly established by 1993, in accordance with the Framework Law on Protected Areas (Law No. 394 of 1991, article 35). Since no agreement was found between the parties, the two distinct regional parks were established (www.parcodeitalpo.org).

The lagoon of Caorle (area in hectares of 4,385,000) is a lagoon located in the territory of Caorle, in the Metropolitan City of Venice. The lagoon, which separates the municipal capital from the area of Brussa, is identified as a site of Community interest (IT 325009). In the lagoon you enter the waters of the Lemene river. The site is located at the eastern end of the Veneto region, on the border with Friuli Venezia-Giulia, in the territory between the Tagliamento River, to the north-east, and the Nicesolo Canal, to the south-west. The Saetta canal, on the other hand, ensures the naval connection of the lagoon with the Clock dock and the Livenza river. The site has a very high ecological articulation that translates into a heterogeneous landscape and specific diversity, among the highest along the north-Adriatic coastal arch. For this characteristic, it has been identified as "Important Plant Area" (IPA) called "Lagoon of Caorle and Foce del Tagliamento" (code VEN5). The site hosts about 60% of the regional surface of habitat 2130 (fixed coastal dunes with herbaceous vegetation or gray dunes), and about 20% of the entire national surface, which makes the site the most important area for the conservation of the habitat and of the species that compose it. Moreover, on the site there is about 75% of the entire area currently mapped to the 2250 habitat (coastal dunes with Juniperus spp.), and 3% of the area expressed along the north-Adriatic arch. The remarkable originality of the area is mainly expressed in the system of stabilized dunes (www.parcolagunare.it).

In the most eastern part of the region, exactly on the border with the Friuli-Venezia-Giulia Region, we find the Bibione lagoon (4386 ha). Together with the Tagliamento river mouth, the Reghena and Lemene river, the Taglio and Rogge canal, the Cinto and Caomaggiore quarries and the two Valgrande and Vallesina ‘‘Valli’’, they form an extremely important concentration of wetlands that extends over 6000 hectares (Ferla et al., 2012).

1.1.4. Restoration

Another important concept linked to the world of wetlands is restoration. This term indicating the idea of bringing something back to a state before a disturbance reminds us of a series of useful actions that could be made to bring back these types of environments that are disappearing. For example, to rearrange the farmland in marshes, or even allow the normal development of a river by
eliminating the various embankments that force it to a precise path. The concept of restoration is very wide and can vary in so many ways, in this case it is meant to indicate an environmental requalification, which can be classified in more clear terms by specifying the difference between restoration and other similar terms, as follows (Picco, 2016):

- Restoration: a complete return to the structure and function of the river as they were prior to the human alteration (pristine conditions);
- Rehabilitation: a partial return to the pristine conditions;
- Enhancement: every improvement made to the environmental quality;
- Naturalization: development of a new ecosystem that was not present in that river reach, because of the human impacts still active.

In the Veneto Region, examples of restoration projects financed by public bodies are not many, as the intervention costs are high, the implementation times are long and the economic return is low (www.venetoagricoltura.it). An example, however, is the restoration of the Valle Vecchia of Caorle (Ve). The Valle Vecchia is an island that was completely reclaimed in the 1950s to create useful agricultural land for post-war shooting (www.vallevecchia.it). However, the ground was located in the middle of the Caorle Lagoon, which was too rich in salt and therefore the harvests were scarce; hence the idea of bringing the whole island back to origin with a project of restoration funded by Veneto Agricoltura. It is also interesting to open the public to this natural place by getting money from the parking lot to keep maintenance. Despite some virtuous examples of restoration interventions in wetlands are made by private companies or individuals, like for hunting, fishing, aquaculture, peatlands industry, salt flats, sometimes these activities create new wetlands accidentally.

The contraction and degradation of wetlands counterbalances the development of artificial formations such as rice fields (Figure 4), expansion tanks, artificial reservoirs that together with the large lakes of the internal areas are an integral part of this environmental typology.
Of a purely human origin, rice fields and other "flooded" crops have for decades constituted an "alternative" habitat ideal for many species: even here, however, the mechanism has sometimes jammed, due to the modification of cultivation techniques that today foresee less frequent flooding. Sometimes, even densely populated sites such as water purification basins, abandoned quarries, lakes for sport fishing, can be a vital support for some of the typical species of the disappeared wetlands. Even here, however, water levels, vegetation quality and prey, type of human activity present, have decisively influenced the potential suitability of these sites, which compensated only at the local level and for some of the species considered here the lack of areas traditional wet.

1.2. HUNTING IN ITALY

1.2.1. Legislation

Hunting activity, in Italy, is governed by Law no. 157/92 and s.m.i., It governs all rules for the protection of wild fauna and hunting bag. According to the Italian State, wildlife is defined as "an indefinable patrimony of the state and protected in the interests of the national and international community". Whereby hunting license is not a right, but a concession given by the State, if previously a government tax was paid (€ 173.56).

However, the legislative power about hunting belongs to the Regions, according to the Constitutional Law of October 11, 2001, No.3 (Article 117 of the Italian Constitution). It is also up to the task of fauna and hunting planning. Which envisages that each region comprise between 20%
and 30% of the agro-silvo-pastoral territory in which hunting is prohibited (oases, areas of respect, parks) and the wildlife can survive, reproduce and grow without further disturbances. Each Region may have a territory quota called "Alpin Area" and within it, the area of protection for fauna is instead from 10% to 20%. In general, within the Region, a maximum of 15% of the entire territory can be reserved for private hunting management (Hunting Faunist Company). On the remaining agro-silvo-pastoral territory, there is the planned management of the hunting run by the ATC (Territorial Hunting Areas) and the alpine areas. For the management of all this, a regional tax payment of about half the value of government tax (may vary slightly from Region to Region) is also required.

According to Law no. 157/92, hunting exercise can be practiced exclusively in one of the following forms:

a) roaming in the Alps;
b) fixed attachment;
c) in all other forms of hunting activities permitted by the same law (hunting in a wandering form, fixed attachment without live lurking, from nesting to ungulates, from buttress to dumplings).

For this project, it is necessary to better define hunting options according to Veneto Region rules.

"Hunting Emplacements" in the Veneto Region:
In accordance with the art. 12 paragraph 5 of the law no. 157/92 the hunting period can be applied in one of the following types:

a) Stray in alpine area;
b) From fixed emplacements;
c) In the settlement of other forms of hunting activities allowed by law.

The hunters who have made the choice of hunting exclusively for TYPE B in accordance with art. 12 paragraph 5 of state law no. 157/92, they can hunt from “Fixed Emplacements”, which provides:

- Up to 40 live calls can be used for catches for each hunter (up to 10 invitations per species) as well as an unlimited number of calls coming from breeding. At a fixed expedition can access weapons simultaneously own, in addition to the owner, two other hunters at a time,
authorized by the holder by means of delivery of copy authentication of the authorization act;
- The recovery of wounded game, even with the use of the rifle, for a radius of 200 meters away from fixed deployment;
- Fixed installation must be strictly functional to hunting;
- Fixed attachment may remain on the territory upon expiry of the authorization issued by the Province;
- Fixed deployment does not have to cause permanent alteration of the state of places;
- Fixed attachment does not need any authorization of building nature;
- Fixed attachment does not need any authorization of landscape nature;
- The shipbuilding material must be fixed: wood or other lightweight materials or traditional in the area, or with iron structures too tubular, or prefabricated when buried or immersed;
- Fixed attachment must be free of connections or of urbanization works;
- Fixed attachment must be easy and immediately removable at maturity authorization;
- Fixed Assignment requires the authorization of the owner or manager of the fund on which he is set.
- Fixed Assignment must comply with the following maximum measures:
  1. Maximum base 12 square meters;
  2. Maximum height 3 meters from the treadmill.

1.2.2. Hunting and Wetlands
One of the oldest and most traditional forms of hunting in the Veneto Region is hunting for aquatic birds. This type of hunting is performed typically by fixed attachment, with or without the use of live calls (usually ducks bred to call their fellows through call). The aquatic birds currently hunted (in the various hunting options) in the Veneto Region are:

- Ruff (*Philomacus pugnax*)
- Mallard (*Anas platyrhynchos*)
- Coot (*Fulica atra*)
- Common moorhen (*Gallinula chloropus*)
- Teal (*Anas crecca*)
- Northern shoveler (*Anas clypeata*)
- Pochard (*Aythya ferina*)
• Gadwall (*Anas strepera*)
• Water rail (*Rallus aquaticus*)
• Widgeon (*Anas penelope*)
• Surface (*Anas acuta*)
• Garganey (*Anas querquedula*)
• Tufted duck (*Aythya fuligula*)
• Common snipe (*Gallinago gallinago*)
• Jack snipe (*Lymnocryptes minimus*)
• Lapwing (*Vanellus vanellus*)

According to the fauna-hunting plan, all these species can be picked up following precise periods and restrictions of hunting bag.

1.2.3. Classification of Hunting Wetlands
Ducks, rails and waders in general are animals that live in close contact with wetlands, so hunters always practice their passion near them, whenever possible, or try to create artificial ones when it is not possible to be close to nature. This hunt is usually practiced along the shores of lakes, rivers, foci, or swamps. In recent decades, these areas often disappeared because of reclamation or were strongly modified because of anthropization, since the latest ISPRA (Institution for Higher Protection and Environmental Research) report on the environment defines these types of habitats as in a bad state of conservation (ISPRA, 2014). Land reclamation greatly affects the conservation status of all animal and vegetal species associated with these environments. Hunters have always been working to create artificial wetlands, the most similar to natural ones. Depending on their traditions and geographic areas, these artificial wetlands may have different characteristics, so it is crucial to give it a clear definition.

In this sense, three different types of wetlands have been identified: artificially built by hunters, semi-natural restored by hunters (i.e., oxbow lakes, gravel mines) and natural areas.

Artificial wetlands, created by hunters, are portions of farmland (which can range from one to ten hectares) modified to be flooded, maintaining a certain level of water throughout the hunting season and often also further. In Veneto dialect, they are called "Sguassi or Sguazzi". Usually with digging machines, the soil moves to create basins that can retain water and that are used as a protection for the tranquility of the animals that live there. On the banks are planted or allowed to grow naturally all those plant species typical of this environment such as reeds and sedges, in addition to the algae that grow in the areas covered by water. Water levels can be adjusted easily, with the help of
hydraulic pumps, depending on the waterfowl species that hunters prefer to hunt. It can range from ten centimeters to about half meter of water.

On the other hand, semi-natural wetlands are usually characterized by deeper waters, for example abandoned lakes (i.e., old gravel mines), which are retrained by hunters. Obviously, in these lakes, no major structural changes can be made, since filling a hollow to lower the level or shrinking it would have a huge cost. Therefore, normally, hunters just work on the vegetation creating better protection around the lake.

Finally, the natural wetlands managed by hunters are the swamps or “paduli” and the lagoons. These are not changed heavily, but simply kept. For example, regular forest cutting operations are carried out to cut the reeds, and keep the strong and bald strongholds so that the water does not flow out creating barriers.

Obviously all these types of wetlands provide for a small area where the hunting blind is located, from which the hunters shoot and this is the only part where artificial structures are constructed with external materials such as iron, wood or stone.

In the thesis, a specific classification will be used, i.e. the wetlands created by hunters will be divided into "Sguassi" and "Valli". The “Sguassi” are small wetlands used by hunters in the inner part of the region. The small size of these areas is due to the fact that buying land or renting it to hunt is very expensive, so usually these hunters belong to an average economic range. The “Valli” instead are located along the coast, in lagoon areas and on the Delta del PO. These are vast private areas of wealthy landowners, who run them for hunting and fishing purposes.

1.3. ANIMALS AND WETLANDS

The wetlands are complex ecosystems hosting various types of animals, such as mammals, reptiles, amphibians, fish, and birds. All these animals are useful for the survival of these ecosystems. In this thesis are considered only a type of animal, that is water birds. In the category of birds. Actually in Italy and in Europe thanks to the work of the hunters, constant over time, and thanks to the recent birdwatching enthusiasts it is present a huge database of data regarding these birds.

1.3.1. The importance of wetlands

Because of the great variety of wetlands, bird adaptation to and their use of wetland environments differs greatly from species to species. Birds' use of wetlands during breeding cycles ranges widely. Some birds depend on wetlands almost totally for breeding, nesting, feeding, or shelter during their breeding cycles. Birds that need functional access to a wetland or wetland products during their life cycle, especially during the breeding season, can be called "wetland dependent”. Other birds use wetlands only for some of their needs, or they might use both wetland and upland habitats.
Considerable research has increased the understanding of wetlands' influence on the numbers of waterfowl that breed and their breeding success. However, the relation between wetlands and the population and propagation of various waterfowl species is not well understood. This relation depends on (R. E. Stewart, 2016):

- The number of wetlands in the areal;
- The wetlands' size and relative water depth;
- Whether the wetlands hold open water in the early spring or through late August;
- The climate;
- The species of bird and the bird's adaptations to wetlands.

Wetlands managed by hunters are also of enormous importance in the breeding season of waterfowl. Especially in the Venetian lagoon area and the Po Delta where water is also present in spring and summer. In contrast, the wetlands within the region during seasons are exploited more for agricultural purposes or are simply emptied to save money. The reproduction of the anatidae is benefiting greatly from the progressive sweetening carried out in many "Valla" for hunting purposes, which have exceeded the importance of fish. Downstream nesting can be summarily subdivided into five types, which differ for the substrate and vegetation involved and by species association (Verza, 2012; Trombin, 2012):

- Nesting on barenas with vegetation;
- Nesting on barens with no or almost vegetation;
- Nesting at dry lakes;
- Nesting located on fixed hunting stands (the barrels are located on small islands, for a total surface of a few squaremeters each);
- Nesting in the reeds.

This specific subdivision emphasizes the complexity and biodiversity of these areas.

1.3.2. Birds in wetlands
Wetlands provide habitat and food sources for a large number of birds, more than 230 species (Verza, 2012; Trombin, 2012). It is possible to find mainly waterbird species, but also Passeriformes birds, which for structural reasons cannot exploit the wetlands effectively like waterfowl. All of these species can spend all or part of their lives in the wetlands. These areas are very important as a stopping point for migratory birds and a fundamental wintering place for birds coming from the north. Also during the spring season, they can host many nesting species. The
wetlands can be used for many other functions such as drinking, eating, resting, shelter and social relations. The variety of environments and the tranquility of these places, if well managed, can have an important conservative function as well as hunting.

Obviously, the main function of the wetlands is to provide a habitat for birds. The relationship between waterbirds and wetlands has been known and studied for thousands of years, ever since prehistoric populations drew scenes about this relationship on cavern walls. Native Americans already represented waterfowl hunting scenes (R. E. Stewart, 2016).

Waterbirds use many kinds of wetlands, including swamps, lagoons, mudflats, estuaries, bays and open beaches, freshwater and saltwater lakes, rivers, floodplain wetlands and dams. Waterbirds include:

- Waterfowl such as ducks, geese and swans;
- Grebes;
- Pelicans;
- Cormorants;
- Ibises and spoonbills;
- Egrets and herons;
- Crakes, rails and waterhens;
- Terns and gulls;
- Shorebirds, which are also known as waders.

Other species of native birds of our country depend on the wetlands as reed-warblers, grassbirds and birds of prey such as the swamp harrier (Circus aeruginosus) and the osprey (Pandion haliaetus). According to the Office of Environment and Heritage of Australia, these categories of birds can be divided into three categories:

1. Colonial nesting waterbirds require substantial floods to support large breeding events in floodplain wetlands. They include egrets, ibises, pelicans, cormorants and herons.
2. Non-colonial waterbirds, including resident shorebird species, generally don’t congregate to breed but are still dependent on wetlands for nesting and feeding habitat in which to raise their young. They include waterfowl, grebes, crakes, rails and waterhens.
3. Migratory waterbirds, such as migratory shorebirds, use a range of wetlands to rest, feed and breed during their annual long journeys between wetlands in Africa and their breeding sites in the northern hemisphere.
The wintering aquatic avifauna in the Italian wetlands has been registered for over twenty years as part of a project called IWC (International Waterbird Census), that covers all European and Mediterranean countries. These are censuses that are of an absolute value, because it is possible to detect the number of all the individuals present, of over 130 species identified according to a taxonomic criterion. The consistencies obtained from the censuses are also functional to establish the conservation priorities of the sites (Ramsar criteria, ZPS etc.). Higher Institute for Environmental Protection and Research has the role of national coordinator for Italy. Data are collected from over 400 surveyors, mostly volunteers, whose technical skills are tested with appropriate tests. The coverage that is obtained, for many Italian regions, is close to the totality of the existing wetlands.

Aims of IWC (www.isprambiente.gov.it):

- estimate the size of populations of various species of waterfowl;
- quantify local populations and define the value of sites;
- describe the numerical variations (trend) and distribution of populations of different species;
- to bring data into international archives that make their analysis possible at the global level or of macro-regions (areas of the different bio-geographical populations);
- theoretical possibility to quantify a possible hunting sampling or the impact of environmental perturbations.

1.3.3. Birds that stop-over in wetlands

Considering Europe as a potential area of life for a migratory species, it can be summarized that the life of a bird will be a continuous shift, with the changing of the seasons, from the northeast to the south-west in autumn and from the south-west towards north-east in spring. This happens mainly for food needs, in fact in the northern European countries, the winter is very hard and the land as well as the water can be frozen or covered with snow for several months, so it is almost impossible to find something to feed on. The birds are therefore forced to move south. In spring instead, especially the waterfowl, but also not only, are driven to go back to the north where they will find a less dry climate and places full of water where they can reproduce and nest. It is therefore essential to have a vast network of wetlands during this long journey, which can act as places of rest, protection and food fusion.
1.3.4. Wetland factors that affect birds

The relationship between wetlands and waterfowl can be influenced by several factors (R. E. Stewart, 2016):

- The availability, depth, quality, level and salinity of water;
- The water chemistry;
- The availability of food and shelter (vegetation);
- The patchiness or openness of vegetation;
- The type of vegetation;
- The type of soil;
- The presence or absence of predators;
- The physical and biological attributes of wetlands for breeding;
- The presence of surface water or moisture soils;
- The duration and timing of flooding,
- The proximity to the sea or to a river.
- The geographic or topographic location.

These and other characteristics can influence the choice of a single individual or an entire species in the decision to make a specific type of wetland.

Wetlands provide food for birds in the form of plants, vertebrates and invertebrates. There are some species of vegetarian birds that feed directly on emerging or submerged plants, in some cases they feed only the seeds produced by these plants. Other more carnivorous species (sometimes exclusively ichthyophagous) feed on fish, invertebrates or small organisms that live exploiting the presence of these plants. The temperature of the water can influence the presence of vegetation and these organisms; some are better suited to colder temperatures and others to warmer temperatures. The quality of the water instead can stabilize the presence or absence of any species (www.anisn.it).

1.3.5. Effects of wetland loss and degradation on birds

The loss of wetlands is a phenomenon that has occurred for several decades mainly due to land reclamation to create agricultural land, but the degradation of wetlands is a more complex phenomenon and not yet understandable at all, it can be caused by several factors, such as (www.environment.nsw.gov.au):
clearing and draining wetlands for agricultural and urban development
alterations to flooding patterns due to river regulation and climate change
disturbance of feeding and roosting habitats by recreational users such as people fishing or walking, especially with dogs, or by feral animals such as foxes.

Wetland loss due to draining, filling, or altering of surface-water and ground-water flow is a concern to many people. Wetland degradation also has a substantial effect on birds. Although wetland degradation is a serious problem, it is one that is more subtle and less understood than wetland losses. Degradation can take many forms (R. E. Stewart, 2016):

- Amounts and periodicity of water supplies can be altered;
- The quality of water flowing into and through a wetland can be modified;
- The flows of sediments or freshwater to coastal marshes can be reduced;
- Water levels can be stabilized in wetlands that otherwise would undergo beneficial drawdowns or water-table fluctuations;
- Wetland vegetation may be altered by harvesting or by introducing exotic species, making it of little or no value to wetland-dependent birds;
- Chemicals and sediments that move from agricultural areas into wetlands are two of the most pervasive sources of degradation;
- The large and growing volume of industrial wastes that enter ground- and surface-water supplies also threatens to degrade wetlands.

The degradation of these habitats, added to their complete disappearance due to land reclamation, has a negative effect on the environment and on the entire animal world. So if the quantity and quality of the wetlands decreases, therefore the presence of waterfowl is consequently destined to decline.

1.3.6. Waterfowl and Hunting

The most recent studies show that almost all species of hunttable ducks have in Italy, and in particular in the Delta and in the Venice lagoon, stable or increasing populations (Verza & Botazzo, 2011). This apparently unexpected situation, given the size of the annual game bag for the Delta (about 70,000 anatids - Sorrenti et al., 2006) can be explained by analyzing several factors. First of all, emphasis should be placed on the importance that the active management of man-made "Valli" (Figure 5) has on waterfowl: in the Delta almost 8,000 hectares are managed specifically to favor the stop and feeding of the highest possible number of wild ducks. Secondly it should be noted how
the “Valle” for hunting has always had some self-regulating mechanisms, capable of not depleting the heritage represented by the anatidae. To this must be added the presence of the “Valle” oases before, and of the Park today, for a total of 40% of the “Valle” area in which the hunting activity is precluded, as well as the favorable state of conservation that almost all the species of anatidae have in Europe (Verza, 2012; Trombin, 2012).

A certain malpractice related to hunting has begun to appear in the 60s and 70s of the twentieth century. From this period the “Valle” have opened more to a wider hunting public, including the middle class. This phenomenon has been accentuated due to the recent crisis in the fishing industry. The need to satisfy the growing needs of hunting users has led to a more oriented management of faunal aspects, with the emergence, in some situations, of distorted behavior (for example, the use of prohibited electroacoustic calls, excesses in baiting, excessive hunting pressure, placing of mallard ducks). The fact remains that, increasingly, the economy of the “Valle” is centered on the use of hunting, the true pivot, today, of the very existence of the “Valle” (Verza, 2012; Trombin, 2012).

A different matter must be made for the small wetlands created by hunters, called “Sguassi” (Figure 6), and scattered throughout the flat area of the region, which due to their small size (average size calculation) can not provide for isolated areas to hunt, so it is difficult to identify other birds except those that are shot by hunters.
Only some individuals of species forbidden to hunting (or some species to which the hunter sometimes does not care to shoot, es. Rallidi) and very confident, so as not to care for the noise of gunfire, exploit these areas in all their usefulness.

1.4. GENERAL OVERVIEW: FLORA AND VEGETATION OF THE WETLANDS

The wetlands used by hunters can be divided into three groups, which differ according to the degree of water salinity: sweet, brackish and salty. The salinity influences the type of vegetation creating different types of environment, the salty and brackish water is typical of the lagoon environment near the coast of the Adriatic Sea, and instead the fresh water characterizes the internal areas of the Veneto Region.

Hunters use this water from the rivers or irrigation channels to create the wetlands. Salinity is an environmental parameter that man adjusts according to management needs. Each “Valle” is usually divided into two parts by the "sbregavalle", a dammed canal that cuts the “Valle” from one end to the other (Verza, 2012; Trombin, 2012). A part of the “Valle” is managed in such a way as to satisfy the needs that are part of the fishing activity. The area used for hunting purposes is usually subject to very low salinity values, to determine the formation of a habitat suitable for the species of hunting Anatidae.

In areas where hunting is allowed, therefore, water derived from fluvial branches is mainly introduced. Furthermore, the area destined to hunting functionality involves the construction of small lakes, with luxuriant spondicolous vegetation, generally composed of helophytic plants, such as the swamp reed, which offer shelter and hiding places for waterfowl. Among these lakes, it is worth mentioning one in particular, small and artificially remodeled, in such a way as to create the right conditions to attract and host a large number of Anatidae of a particular species: the Teal (Anas crecca). This pond is considered a "tank", as it is used to contain a large amount of these ducks. The hunting lakes, as well as being shallow, are also equipped with many artificial salt marshes of little emerging from the surface of the water, which serve to provide places to rest and
rest water birds, and are, therefore, called "ponsaire". These salt marshes have a profile that slopes gently towards the water. In addition to some of these, hedges of tamarisks are planted, well pruned at the base, with the purpose of providing shade to ducks during the summer. The “Valli” more attentive to hunting management have differentiated hunting lakes: some provided with many sandbanks, possibly with reed and tamarisks, intended to host Teals and Mallards (Anas platyrhynchos); others, with deeper waters, managed to attract the Pochards (Aythya ferina); still others, with naked bales, prepared for the Widgeon (Anas penelope). As regards, instead, the lakes in the “Valli” where the fish is raised, these show general conditions of higher salinity (usually over 10 %), which are obtained through the introduction of lagoon waters, as the fish species of commercial interest they live in waters that tend to be more salty. Basins are generally much wider than those typically hunting are, and have within them a smaller number of embankments and artificial sandbanks (Verza, 2012; Trombin, 2012).

1.4.1. Lagoon

Among the various types of vegetation found in the lagoon, the most characteristic are certainly those (Scarpa, 2009):

1. The littoral;
2. The salt marshes;
3. The cane thicket.

Concerning the first two, these are two apparently very different environments, one generally dry, the other often submerged, yet the plants that populate them often resemble each other, because they share physiologically similar conditions.

1. The littoral:

   The sands of the coast are an extreme environment. The substrate is unstable due to storms and wind and plants are struggling to root. The saltiness, the wind and the rapid percolation of rain through the sand make the availability of fresh water scarce. The thermal excursions are remarkable: ice in winter and sand at 60-70 °C in summer. Few are the botanical species that can withstand these conditions, but those that are able to do so, thanks to their morphological and physiological adjustments, settling down do not find competitors. They are the so-called "pioneers", which are distributed in bands parallel to the shoreline, bands that take their name from the characteristic species: Cakileto, Ruchetta di mare (Cakile maritime), Agropireto, Agropireto (Agropyrum junceum). Other pioneers that are found in this strip only the Soldanella di mare (Calystegia soldanella), the Inula (Enula crythmoides), the Calcatreppola (Eryngium maritimum).
Figure 7. Structural scheme of sandy coastline with dune system. A the beach = intecotidal area; B grassy dune = agropireto; C bushy dunes = tortulo-scabioseto "gray dune"; D wooded dunes = pine and / or holm oak

Behind the dunes (Figure 7), the environmental conditions are mitigated. This allows other, less resistant, species to colonize the sands. It also comes to the formation of a state of moss (Tortula), a sign of the preservation of a certain degree of humidity. This is the band of the so-called "grey dunes", the Tortulo-scabioseto, in which are found, in addition to the characteristic Scabiosa (Scabiosa argentea), also species such as Apocino (Trachomitum venetum). The local climate, refreshed by the great alpine rivers that come to the lagoon, and lashed in winter by the bora wind, re-proposes the environmental conditions of the great eastern plains. In the depressions present in the successive dune strings, rainwater can accumulate to give rise to ponds populated by hygrophilous vegetation, such as the Canna di Ravenna (Erianthus ravennae) and several species of rushes. Sheltered by the selective action of the marine aerosol, they can also develop shrub species, preparing the land for the development, in correspondence of the oldest dune cordons, of wooded formations, often reworked by man with plantings of domestic pine (Pinus pinea), Maritime pine (Pinus pinaster) and Aleppo Pine (Pinus halepensis). However, it is still possible found traces of the indigenous coastal forest, with some rare examples of Holm oaks (Quercus ilex), an evergreen oak, with leathery leaves to limit the loss of water due to transpiration. Nevertheless, the coast is not just sands. The intervention of man has introduced the rocky substratum, especially with the construction of the murazzi and the piers forane. This allowed the colonization by species of the reefs, such as the Lesser Vetriola (common parietaria) and the Cornuta Poppy (Glaucium talvum) (Scarpa, 2009).
2. The salt marshes

Even the salt marshes is a selective environment. Fine substrate, free of oxygen, periodic submersions and salty waters impose special specializations to the plants that root. In addition, a few centimeters of difference in the mean sea level can determine different plant populations. Where the waters reach more often, in the middle of the salt marshes and the banks of the ghebi, the saline concentration is less, and the Salicornia veneta finds the conditions to which it is most suitable. At the edges of the salt marshes, higher than the center, salt instead concentrates, reaching the surface for exopercolation during the summer heat. Here the maritime Gramignone (Puccinellia palustris) is the star. However, it is another the graminacee that runs with the deposit and consolidation of the mud that constitutes the salt marshes. It is the Spartina delle Barene (Spartina maritima), which makes here how much the Ammofila does on the beaches, but playing with water and mud instead of wind and sand, there are other important species such as the Sea Juncus (Juncus maritimum) and the Pungent rush (Juncus acutus). Where organic matter has accumulated for some reason, the plants that settle there, as well as being halophile, are also nitrophilous. This is the case of the Inione (Halimione portulacoides), of the common Toliplex (Atriplex prostrata) and of the Enula (Inula crithmoides), especially the latter, already encountered on the sands of the coast (Scarpa, 2009).

Not lacking, in the higher areas, a shrub, also just the sands. It is the Tamerice (Tamarix gallica), a plant typical of extreme environments, capable of drinking salt water and then transpiring the salt, covering its leaves, making the tamarisks salty and burnt.

The most abundant species are the Veneto salicornia (Salicornia veneta), the soda or roscano salsola (Salsola soda) and the maritime hereda (Suaeda maritima). They are all annual biologic entities, easily observable at the edge of the “Valle” mirrors, especially in autumn for the color that they take on, characterizing the landscape with splendid red or reddish shades.

The plant association dominated by Salicornia veneta is named Salicornietum venetae and identifies the habitat of community interest 1310 "Annual pioneer vegetation in Salicornia and other species of muddy and sandy areas", in accordance with Directive 92/43 / EEC "Habitat". Salicornia veneta is a species considered of Community interest and the stations in which it grows are protected. Also the rushes are among the species that identify the habitat 1410 "Mediterranean flooded pastures (Juncetalia maritimii)" (Verza, 2012; Trombin, 2012).
3. The cane thicket

When the lagoon still reaches a freshwater course, the salt marshes give way to the reeds, given almost exclusively by the swamp's reed (*Phragmites australis*), hence called "fragmitetti". With its stems rising from the water up to almost 3 m in height, it gives rise to highly compact formations, essentially almost monophytic and practically impossible to cross. The marsh reed is a very well-known *graminacea*, because it combines the large size, which is usually able to reach, the ability to colonize even very different environments, thus being able to live from coastal lagoon areas up to mountain lakes placed at high altitudes. It is an ‘elophyte, which is a plant with the root systems fixed in the bottom and the epigeal part that emerges from the surface of the water. The stems are hollow and light and grow very close together, determining the formation of those compact and impenetrable barriers. The straw is a graminaceous plant with a certain tolerance for brackish water (10 %) that plays a role similar to that of its relatives (*ammofila* and esparto of the salt marshes) (Scarpa, 2009). In fact, by vegetating in shallow water, with its stems it slows down the run of the water causing the deposition of suspended material (sand, silt and clay). In this way, where the reed bed rises, the ground gradually increases, consolidating thanks to the dense network of horizontal stems (the rhizomes) of the reed that form the framework. However, the cane also offers another service on the ground. Rhizomes are hollow and, receiving oxygen from the photosynthetic parts of the stem (the leaves), they distribute it in the soil, facilitating the otherwise difficult mineralization processes in an anoxic environment such as mud. This oxygen supply and the absorbent capacities of the cane also collect the excess nutrients present in the waters coming from the agricultural hinterland, activating phytodepuration processes that protect the lagoon from eutrophication phenomena. The dominated formations of marsh reed, although mainly linked to fresh water, are able to find a certain development even in areas with higher salinity (alofic cane thicket).

1.4.2. Submerged vegetation

The submerged vegetation of the Venice lagoon is not very varied, this is due to several factors that make these areas less favorable to the establishment of the most sensitive species; among these the extreme variability of temperature, salinity and dissolved oxygen. These same limiting conditions determine the distribution of the species in fact, there are species present only in the living lagoon, because they prefer salty and vivified waters, while others find themselves almost exclusively in confined areas, characterized by poor hydrodynamism and presence of fresh water. In addition, the nature of the substrate affects the distribution, with species that prefer silty or clayey sediment and
others that instead settle in areas with predominantly sandy fraction. The typical species of hard substrates are found almost exclusively along the banks, *bricole*, piling etc. This type of vegetation has only been hinted to frame the environment in a generic way, but it will not be taken into consideration in the study of this thesis (Berto, 2009).

1.4.3. Marshy environment

In the inner part of the Veneto Region all the fresh water of the rivers feeds the wetlands managed by hunters, so that the vegetation that grows is typical of the marsh environment. In sections with deep water and present for a longer period, the reeds are replaced by the scirpeto, characterized by the dominance of *Schoenoplectus lacustris* and *Typha angustifolia*. In the flat stations, characterized by a notable slowing of the water current, aspects of marsh vegetation settle that require the presence of water throughout the year and silty-clayey substrates. Particularly in proximity of the water one observes a vegetation physiognomically dominated by the *Tila* (Typha angustifolia), to which few other hygrophilous species are associated, such as *Mentha aquatica*, *Schoenoplectus lacustris*, *Cyperus longus* and several charges (*Carex*). In a slightly higher position, the typhetes are replaced by reed beds with marsh reed (*Phragmites australis*). It is an almost monophysical phytocenosis that assumes considerable importance for the resting and nesting of various species of marsh birds (www.dipbot.unict.it).

1.5. SPECIFIC FRAMEWORK: USE OF VEGETATION IN THE HUNTING AREAS

Vegetation grows within hunting areas both naturally and artificially. The species that are planted always have a specific purpose and very often, they are native species. Local plants are chosen because they are more able to adapt to the climate and because they are closely linked to the life of the indigenous animals, especially from the trophic point of view. The main functions of vegetation are two: protect and give food. The arboreal and shrub species (e.g. poplars and tamarisks) are planted or left to grow naturally especially for protective purposes, or to isolate the animals from any external human disturbances, such as people walking, road noises and cars, etc, but also from natural disturbances like the strong wind. The windbreak barriers represent one of the aspects of the “*Valle*” landscape that has now become overbearing in the collective imagination. It plays several important functions, one of these is to protect the hunting lakes from the winter atmospheric forces that would otherwise significantly lower the water temperature. Different types can be distinguished, which vary mainly according to the characteristics of the soil and the salinity of the waters that lap it. Usually, they are made up of thick weaves of plants belonging to the genus Tamarix, introduced by man in the last decades due to the great resistance of these plants with salinity and marine aerosol. In some cases, it is possible to see some made up of species that,
instead, prefer the presence of markedly sweet waters. The species that enter in these formations are above all the willows (*Salix* sp.), and the poplars (*Populus* sp.), accompanied by other entities such as the buckthorn (*Rhamnus cathartica*), the elder (*Sambucus nigra*), the common dogwood (*Cornus sanguinea*), and other species of an exotic or naturalized nature, such as black locust (*Robinia pseudoacacia*) (Verza, 2012; Trombin, 2012). Recent habit, but of dubious naturalistic value, is to use especially exotic plants, including *cupressaceae*. Even some herbaceous species such as *fragmites* and *carex* have also protective functions directly on animals, especially for waterfowl, who spend most of their time in water, can have shelter points where they can hide from predators. Wetland vegetation provides shelter from predators and from the weather. The presence or absence of shelter may influence whether birds will inhabit a wetland or a nearby upland area. Predators are likely to abound where birds concentrate, breed, or raise their young. Wetlands form an important buffer or barrier to land-based predators and reduce the risk of predation to nesting or young birds. For the plant species used for feeding the wetlands managers often rely on agriculture, planting and cultivating species such as corn, sorghum, millet, rice, soybeans etc. that once ripened they are shredded and the land flooded, so that waterfowl can eat. It is also used wilder plant species such as “*grisa*” (Figure 8), which grows autonomously in brackish water and is much appreciated by birds.

![Figure 8. Photo of the "grisa" (*Nanozostera noltii*), one of the aquatic herbs most appreciated by ducks](image)

All this work is very useful for hunting, but also for birds, especially those species that do not fall within the hunting calendar and enjoy these benefits without suffering the consequences of hunting (Figure 9). Moreover, this complex system allows maintaining a very high degree of plant and animal biodiversity.
Seagrasses are superior plants that produce flowers and fruits, with an organization in tissues and organs similar to that of terrestrial plants, even if they have developed adaptations to aquatic life such as, for example, pollination and dissemination through the water. The success of these macrophytes in shallow basins is due to very complex morphological and physiological adaptations. In fact, very few species of higher plants are able to live constantly submerged in salt water. Currently, the species of marine phanerogams detected within the “Valli” of the Po Delta are three: the common chervish grass (*Ruppia maritima*), the spiraled grass (*Ruppia cirrhosa*) and *Nanozostera noltii*, belonging to the Potamogetonaceae family (Verza, 2012; Trombin, 2012). In dialect, they are collectively called "Grisa". They often form very thick lawns, which are an essential food source for many birds of hunting interest and represent an important refuge for aquatic fauna, both for various invertebrates and for fry of various fish species. These are all real superior plants that are fundamental for the feeding of many species of Anatidae and that constitute a perfect environment to host a thriving community of fish and invertebrates. These plants grow in the depths of the well-oxygenated “Valle” lakes, expertly managed by the hand of man. Hence, a large part of the managerial actions of the farmer is aimed at maintaining these plants, which represent an endangered habitat of great conservation interest. It is estimated, in fact, that the “Valli” of Rovigo currently maintain some thousands of hectares of submerged grasslands. The genus *Ruppia* is able to successfully colonize a large number of aquatic environments, both with high and low levels of salinity. In the substrates where a certain amount of silty material accumulates, the colonization starts from the common *chiozzi* grass, a plant so called because the
widgeon, locally called "ciosso", feeds its stems. Common cichlid grass develops in waters with salt values between 5 and 12 %o, often in association with *Lamprothamnium papulosum*, *Chaetomorpha linum* and *Valonia aegagropila*, depending on the granulometry of the substratum and salinity. In the canals of the “Valli” and in some other small lakes with deeper and more limpid waters, the grass can grow in the shape of a spiral upwards and this type of vegetation is very much appreciated by the pochard. Both the common grass clippings and the spiral-shaped grass are widespread in all the “Valli” of the Po Delta, although they tend to prefer weakly brackish waters, with a salt content of around 12 % (Verza, 2012; Trombin, 2012)

1.6. CANADA

Canada's federal state is divided into thirteen first-tier territorial units, ten of which are called provinces, while the remaining three are territories. The provinces are located in the southern part of the country, while the territories are located in the cold regions overlooking the Arctic. The ten provinces are Ontario, Quebec, Nova Scotia, New Brunswick, Manitoba, British Columbia, Alberta, Saskatchewan, Prince Edward Island, Newfoundland and Labrador. The three territories are Yukon, Northwest Territories, Nunavut.

![Figure 10. Lagoon of the peninsula of Gaspesi](image)

Regarding the organization of environmental policies and of any other kind, there are two levels of action, federal and provincial ones. Federal policies have action across the entire Canadian territory, instead provincial policies only on provinces that draft additional policies on specific topics, the important thing is that provincial policies do not act against or overpass federal ones. Wetlands (Figure 10) in Canada’s ten provinces are generally under provincial authority except on federal lands such as national parks. However, in its two northern territories, most wetlands remain under
federal management. Hence, while the federal authority applies directly to 29% of Canada’s wetland base (on federal lands), provincial wetland programs are responsible for the rest (www.canada.ca).

1.6.1. Classification
Canada has over 150 million hectares of wetlands, an estimated 24% of all the World’s wetlands (Government of Canada 1991, Pole Star Geomatics Inc. 1996) which exist in all of Canada’s biogeoclimatic regions. This huge amount of wetland permit a great diversity system and consequently needs a clear yet elaborate classification system for these environments. The wetland is function of climate (precipitation, temperature, wind and insolation), hydrology (internal and external drainage), chemistry (water and soils), geomorphology (landform and soil parent material), and biology (fauna and flora) (The national working group of Canada, 1997). The evolution of a wetland is a very complex dynamic process. It consists of a transition from one type of wetland to another; as a result a wetland with hybrid characteristics will often be created. These features may relate to the class, the shape, the subform or the type. “For example, peatlands may originate through the filling-in of lakes by growing over slow-flowing rivers and streams, or by spreading laterally from depressions into bordering uplands (a process referred to as “paludification”). These processes are very slow, they can take millions of years, and for this reason they are very precious environments and once ruined they are difficult to reconstitute” (The national working group of Canada, 1997).

A wetland is defined as: land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment (National Wetlands Working Group, 1988). Wetlands can be subdivided into two broad categories (The national working group of Canada, 1997):

1. Organic wetlands that are more simply referred to as peatlands. Peatlands contain more than 40 cm of peat accumulation on which organic soils (excluding Folisols) develop. This depth limit is consistent with soil classification standards established by the Canada Soil Survey Committee (1978);

2. Mineral wetlands that are found in areas where an excess of water collects on the surface and which for geomorphic, hydrologic, biotic, edaphic (factors related to soil), or climatic reasons produce little or no organic matter or peat. Gleysolic soils or peaty phases of these soils are characteristics of these wetlands.
Mineral wetlands are found in mineral soil areas associated with shallow water, which is generally less than 2 m deep. In some of these wetlands, vegetation is lacking and soils are poorly developed as a result of frequent and drastic fluctuations of water levels, wave action, water flow, turbidity, or a high concentration of salts or other toxic substances in the water or in the soil. Mineral wetlands include mineral soil areas that are modified by water control structures (e.g. dams) or that are tilled and planted but if allowed to revert to their original state, become saturated for long periods and are then associated with wet soils (e.g. Gleysols) and hydrophytic vegetation. The Canadian Wetland Classification System (1997) contains also three hierarchical levels:

1. Classes: (five) are recognized on the basis of the overall genetic origin of wetland ecosystems.
2. Forms: are differentiated on the basis of surface morphology, surface pattern, water type and morphology of underlying mineral soil.
3. Types: are classified according to vegetation physiognomy.

“Wetlands at the class (1) level are recognized on the basis of properties of the wetland that reflect the overall genetic origin of the wetland ecosystem and the nature of the wetland environment. Wetland forms (2) are subdivisions of each wetland class based on surface morphology, surface pattern, water type and morphology characteristics of underlying mineral soil. Many of the wetland forms apply to more than one wetland class. Some forms can be further subdivided into subforms. Wetland types (3) are subdivisions of the wetland forms and subforms based on physiognomic characteristics of the vegetation communities. Similar wetland types can occur in several wetland classes whereas others are unique to specific classes and forms” (The national working group of Canada, 1997).

An important definition for this thesis that is given by the Canadian classification system is that of the Constructed Wetlands. In some situations, wetlands are created by agricultural activities, hydroelectric structures and through other human activities (hunting). Over time, these sites evolve into naturally functioning wetland systems and are classified accordingly. These areas are also included in the Canadian wetlands mapping system. The constructed wetlands are just like those wetlands built by hunters in the Veneto region (Italy) that will be considered in this thesis, so it is very important to observe how in a country such as Canada so rich of wetlands it is also important to consider these artificial wetlands, which would certainly be taken as an example from our country.
1.6.2. Legislation
The main reason why a country needs a spread on wetlands is to protect these habitats from their continued decline. In Canada, approximately 0.5 ha of wetland are lost every minute to urban expansion, agricultural intensification, hydroelectric development, and other activities (Bond et al., 1992). The decrease was greater in some parts of Atlantic Canada (New Brunswick, Newfoundland and Labrador, Nova Scotia and Prince Edward Island), where an estimated two-third of coastal salt marshes have been lost (Government of Canada, 1991). In some provinces (Lewis, 1990) a bank mitigation process was started with wetland restoration projects. Credits that are earned now could be used in the future.

Generally, Canadian wetland policies emphasize (The national working group of Canada, 1997):
• Voluntary stewardship of private lands, encouraged by education and incentives, intergovernmental cooperation,
• Conservation partnerships involving government, industry, business, conservation organizations, landowners, and individuals;
• Exemplary wetland management on Crown lands;
• Regulation only “where necessary” to protect the needs of the general public, or focusing on enabling voluntary conservation, The need for regional frameworks for the design and implementation of wetland conservation strategies, and basin or watershed approaches to wetland management;
• The use of a range of mechanisms for achieving wetland objectives, including integrated planning processes and environmental assessment;
• The need for continuing research and science programs, including inventorying and monitoring.

The Canadian Wildlife Service of Environment Canada is the coordinating, agency. All departments of the Government of Canada are responsible for its implementation. The Policy commits the federal government, in cooperation with the provinces and territories and the Canadian public, to strive to achieve the following goals (The national working group of Canada, 1997):
• Maintenance of the functions and values derived from wetlands throughout Canada;
• No net loss of wetland functions on all federal lands and waters;
• Enhancement and rehabilitation of wetlands in areas of Canada where wetland losses or degradation have reached a critical stage;
• Secure wetlands of significance to Canadians;
• Use wetlands in a manner that ensures their sustainability for future generations.
The *Policy* comprises seven strategies for wetland conservation, concerning (The national working group of Canada, 1997):

- Developing public awareness;
- Managing wetlands on federal lands and waters and in other federal programs;
- Promoting wetland conservation in federal protected areas;
- Enhancing cooperation with other governments and with non-government organizations;
- Conserving significant wetlands in a national network;
- Ensuring a sound scientific basis for policy;
- Promoting international actions.

Treating environmental legislation is always complicated, since nature is by definition always in constant change and consequently the laws must be adapted to it. Moreover, some topics such as wetland very often do not fall only under a legal framework, not only the environment, but also for example the agricultural, hunting, tourism and so on. From this point of view, Canada is a country to be taken as an example, thanks to the fact that it has a large number of wetlands and is well distributed throughout the territory, and has clear and detailed legislation. Recently, in fact, a law has been approved that recommends its respect and conservation, this Act is called: "Act respecting the conservation of wetlands and bodies of water". This Act has been approved by the members of the National Assembly of Quebec on Friday, June 16. It will not only improve wetland management. This includes safeguarding waterfowl, safeguarding water resources, maintaining biological diversity and fighting to climate change.

The Act introduces a number of major improvements (www.ducks.ca), including:

- A clear definition of wetlands;
- Regional wetlands and bodies of water plans to be developed by regional county municipalities and included in land use plans;
- Clear assurances from the Minister that proper consideration will be given to watershed-based water management;
- Consideration of the “Avoid, Minimize and Compensate” mitigation sequence when delivering environmental authorizations;
- Implementation of a wetlands and bodies of water restoration and creation program, and increased accountability through progress reports based on the “no net loss” objective.
1.6.3. Previous legislative situation
The Canadian legislation began already in the early seventies to create instruments aimed at
stopping the continuous degradation of the wetlands. The Convention on the Wetlands of
International Importance (1971) was the first global, inter-governmental conservation treaty dealing
with one specific type of ecosystem, aiming to stem the loss of wetlands and ensuring their
sustainable use. The Convention on wetlands was signed in 1981 by the Government of Canada.
Subsequently the Canada's Federal Policy was established in Wetland Conservation (FPWC) in
1991, with the aim of conserving the wetlands "now and in the future" (Government of Canada,
1991, p.7) and recognizing a socio-economic value as well as environmental. From this policy was
created a hierarchical system of three-step to indicate if it is still possible to recover a specific
wetland or not. The three steps are wetland loss is avoided, one loss is minimized and any
remaining loss is offset through baseline of wetland functions (Lynch-Steward et al., 1996).
Depending on the size of the wetland, the nature of impacts, and other factors, developments
affecting the wetlands can trigger wetland policies and environmental standards (Bailey, 2000). In
the following years the Government of Canada released in 1992 under Canada’s Green Plan, which
with help of seven federal statutes contribute to wetland conservation in Canada:

- Migratory Birds Convention Act;
- Canada Wildlife Act;
- National Parks Act;
- Canada Oceans Act;
- Fisheries Act;
- Canadian Environmental Assessment Act;

1.6.4. Private sector legislation
Making the private sector understand the need to conserve the environment is always a challenge. In
fact, recently some of the major industry associations (agriculture, forestry, mining, petroleum
production, pulp and paper production and energy pipeline development) have communicated that
wetlands are not fundamental to them, but some of them are moving to favor storage (Kerr-Upal,
1998). Consequently, some associations have started to publish regulations that at least favor the
restoration of the wetlands after having exploited them. Below there are some examples:

- The Canadian Sphagnum Peat Moss Association has published a *Preservation and
  Reclamation Policy* (Canadian Sphagnum Peat Moss Association, 1991). This Association
has also adopted a *Peatland Restoration Guide* (Quinty and Rochefort, 1993) that focuses on peatland restoration after harvesting.

- The Canadian Pulp and Paper Association (CPPA) has established a *Wetlands Policy Statement* (Canadian Pulp and Paper Association, 1992), which describes the commitment by one of the country's major associations to implement an eco-sustainable exploitation of the wetlands.
2. OBJECTIVES

The objectives of this work concern the management of the wetlands both at an administrative, technical, and practical level. From an administrative point of view, was underlined the need to have a precise definition of "wetland", in order to have a clearer and more articulate law; taking the Canadian situation as an example. A further objective in this sense, will be to try to bring investments in wetland restoration projects, taking as an example and starting point those made by hunters in the Veneto Region.

Subsequently, analyzing most of these wetlands created by hunters, a series of more technical objectives were considered, such as to:

- Quantify the amount of wetlands managed or restored by hunters;
- Quantify and characterize the wet areas and the vegetated areas;
- Identify the bird species that are present (wildfowl, rails, crakes, waders);
- Identify the plant, shrubs, grass species that are present (reeds, sedges);
- Quantify the biodiversity created thanks to the hunters (particularly attention to the introduced alien species if the case);
- Analyze the water (brackish or fresh) and the water level;
- Identify the origin of the water (e.g., from the ocean, from a river, spring water, artificial channels);
- Identify the period during which the water is present (e.g., all the year or only some months);
- Analyze the rules and the laws of the hunting activities;
- Analyze how these areas are still managed and maintained.
3. MATERIALS AND METHODS

The identification of all the wetlands, created or managed by hunters, in the Veneto Region, was carried out using the orthofotos of the whole region (dated 2015). These aerial photos were analyzed using Arc-GIS software. As previously mentioned in chapter 1, the hunters' wetlands can be divided into "Valli" and "Sguassi". The position and the border of the “Valli” are already detected and can be consulted on the Hunting and Faunistic Plan, as these are part of the Venatory Faunistic Farms (www.regione.veneto.it). Since that, their identification was simplified. On the other hand, the identification of "Sguassi" took more efforts, since there is not yet a regional dataset. For this reason, this typology of wetlands were distinguished, firstly by consulting the Hunting Associations. Secondly, more information were obtained through the "word-of-mouth" method. Since the hunters' community is typically closed to the external world, this is the best way to get more information permitting to increase the level of details of this study. Finally, a part of these wetlands has been identified thanks to personal knowledge, after years of research and knowledge of the territory. Province by Province, all these wetlands were identified and georeferenced in GIS environment, using the available orthophotos. After that, for each wetland the total area, vegetation area, and water surface were calculated. In this sense, the total area was calculated by delimiting the outer perimeter of each wetland using a polygonal shapefile, and then the water surface was calculated in the same way.

Figure 11. Example of how the total surface, the vegetated surface and the water surface in an artificial wetland were identified, using ArcGIS
Therefore, to calculate the vegetation surface it was sufficient to subtract the water surface from the total surface (Figure 11). The few urbanized areas that fell into the identified wetlands were not considered in this count.

The calculation of the total surfaces of each wetland was reported on an Excel worksheet, in which these areas were divided into three classes, namely: “Valli”, "Sguassi", and quarries (Figure 12). This was done to define three different types of wetland used by hunters and to understand if there could be differences in their management approach.

![Figure 12. Example of restoration of a quarry used in the past for the extraction of gravel (source: guero.mor@alice.it)](image)

Instead, considering the political-administrative objectives, the trickiest part of the research has been to clearly define in a univocal way what a wetland is, as well as which is the related and more appropriate law; the source collection method was used. Canada has been taken as an example from a legislative point of view, so that everything related to the wetlands has been recovered and studied in terms of classification and legislation. Instead, to deeper understand the relationship that the scientific community and the stakeholders of this subject (i.e. hunting associations and environmental associations) have with this types of environments the Canadian example (specifically Quebec) was considered, taking advantage of specific study cases presented by the universities of Rimouski and Chicoutini, and from the Association Nature Conservancy Canada. Also as regards the Italian and European legislation in terms of wetlands, it has been proceeded to trace as many sources as possible, looking for official publications.
4. RESULTS AND DISCUSSION

4.1. Wetlands definition and legislation.
The availability of definitions given by the scientific (i.e. Keddy, 2010) and political (i.e. the Convention of Bonn, 1979) communities is considerable. To say that it is now a widespread and recognized topic, at least in the more developed countries, while in other countries such as Chile, environmental legislation is not yet well developed and limit itself to participating in the Ramsar convent, defining some wetlands to protect (Desplanque, 2016).

If the concept of wetlands is now clear and defined, it is not possible to say the same for the relative legislation. It develops differently in different parts of the world, even among developed countries. The legislative difference between Canada and Europe is evident, certainly given also by the environmental diversity. In the case of Canada, it is well developed and articulated within a fully dedicated "Act", instead in Europe the concept of wetlands is included in a more general directive on “Habitats”, or in other directives concerning the environmental issue, where it even covers a marginal role. Going deeper with the research within the member states, such as Italy, the theme of the wetlands is even more neglected. Only in the last few decades the sensitivity regarding this type of habitats is increasing, it is enough to mention that up to about fifty years ago it was customary the land reclamation of entire wetlands to create agricultural and industrial land. The Italian law, related to environmental issues, is almost completely based on European legislation and does not possess any specific framework for the conservation of wetlands.

A concept that lack in both, European and Italian legislation, compared to Canada, is restoration. There is no legislation that encourages or favors the restoration of wetlands, which would be very useful, especially in all those regions of the Po Valley reclaimed for hundreds of thousands of hectares.

4.2. Hunting wetlands analysis
Before starting to list the results of this work concerning the whole Veneto Region it is important to specify that for two Provinces there are no data, but for different reasons. In this sense, in the Province of Belluno, there are no wetlands managed by hunters, on the contrary in the Province of Treviso there are, even if minimally, but not related data have been found.

Despite this, the wetlands managed or created by hunters of the Veneto Region were 120 as can be seen from Figure 13, divided into 70 "Sguassi" and 50 “Valli".
The extension of restored wetlands is remarkable. As can be seen from Table 1, the total area of wetlands in the Veneto Region is 21403.46 ha, divided into 16610.11 ha of water surface and 4793.34 ha of vegetated area. The provinces that have contributed mostly are Venice and Rovigo, mainly thanks to the presence of the lagoon and the Po delta. In the province of Vicenza the wetland area is very low, unfortunately this is due to the absence of large hunting “Valli” and the difficulty of find data concerning "Sguassi". Padua has a fairly high surface, thanks to two large "Valli" in the lagoon area. In Verona, however, the surface is modest, there are many "Sguassi" and only one "Valle" but not very large (Table 1 and 3).

Table 1. Surface hectares created by hunters for each Province and the total of the Region

<table>
<thead>
<tr>
<th></th>
<th>Verona</th>
<th>Rovigo</th>
<th>Venezia</th>
<th>Padova</th>
<th>Vicenza</th>
<th>Total of the Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Surface</td>
<td>447,04</td>
<td>8234,09</td>
<td>11357,57</td>
<td>1331,66</td>
<td>33,09</td>
<td>21403,46</td>
</tr>
<tr>
<td>Water Surface</td>
<td>206,36</td>
<td>6966,78</td>
<td>8454,61</td>
<td>958,57</td>
<td>23,79</td>
<td>16610,11</td>
</tr>
<tr>
<td>Vegetation Surface</td>
<td>240,67</td>
<td>1267,32</td>
<td>2902,96</td>
<td>373,09</td>
<td>9,30</td>
<td>4793,34</td>
</tr>
</tbody>
</table>
It is possible to understand the different contribution of each province also from the Figure 14, where the same data are expressed in percentage. It is important to specify the difference in the average size of these two types of wetlands. For example, looking to the Verona Province it has almost exclusively "Sguassi", characterized by average total surface of about 6.3 ha. Instead of the "Valli", the wetlands have a total surface area of 392.85 ha.

![Pie graph of the distribution of the wetlands for each Province in percentage](image)

Figure 14. Pie graph of the distribution of the wetlands for each Province in percentage

Comparing the Table 2 and Table 3 this is even more evident. In the Province of Verona, a single "Valle" has an area almost equal to 34 "Sguassi". In the Vicenza Province there are only small "Sguassi", instead in the other Provinces the larger surface is justified by the presence of large "Valli". In the Province of Padua there are only two "Valli", instead at Venice and Rovigo more than twenty (Table 3).

Table 2. Hectares of "Valli" and "Sguassi" for each Province

<table>
<thead>
<tr>
<th>Province</th>
<th>&quot;Valli&quot;</th>
<th>&quot;Sguassi&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verona</td>
<td>184,12</td>
<td>262,92</td>
</tr>
<tr>
<td>Padova</td>
<td>1283,31</td>
<td>48,3536</td>
</tr>
<tr>
<td>Venezia</td>
<td>11335,18</td>
<td>22,3975</td>
</tr>
<tr>
<td>Rovigo</td>
<td>8179,19</td>
<td>54,9034</td>
</tr>
<tr>
<td>Vicenza</td>
<td>0</td>
<td>33,09</td>
</tr>
</tbody>
</table>

The distribution of the wetlands in general is concentrated in the more flat areas of the Region, where the land allows the formation of these environments. However, the wetlands are not homogeneously located in each Province as shown in Table 3.
Table 3. Number of “Valli” and “Sguassi” for each Province

<table>
<thead>
<tr>
<th>Number of &quot;Valli&quot;</th>
<th>VERONA</th>
<th>ROVIGO</th>
<th>VENEZIA</th>
<th>PADOVA</th>
<th>VICENZA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of &quot;Sguassi&quot;</td>
<td>34</td>
<td>9</td>
<td>1</td>
<td>8</td>
<td>18</td>
</tr>
</tbody>
</table>

Each province has also gave a different contribution to the creation of wetlands with different water and vegetation ratios, some provinces have more vegetated wetlands and others with more water. Also in these maps (Figure 15 and 17) it is possible to see how the Province of Venice and Rovigo contribute in a preponderant way. Analyzing only the water surface the Padua Province has an important role, instead the Provinces of Verona and Vicenza have both few hectares of water surface. Considering the vegetated surface, it is possible to note that the distribution is different.

Figure 15. Map of the water surface distribution for each Province
The Province of Venice has a large surface instead Rovigo less. This is probable caused by the different management of the “Val/”, The Provinces of Padua, Verona and Vicenza have all few hectares of vegetation. It is possible to understand the different contribution of each province also from the Figure 16 and 18, where the same data are expressed in percentage.

Figure 16. Pie graph of the distribution of the water for each Province in percentage

Figure 17. Map of the vegetated surface distribution for each Province
Figure 18. Pie graph of the distribution of the vegetation for each Province in percentage

In Figure 19 it is possible to see the distribution, province by province, of the wetlands. In this graphs is reported an index obtained by the ratio between the province surface and the total amount of wetlands area located into the considered province. Even considering this type of index and not only the surface in hectares as in Figures 15 and 17, the distribution does not change.

Figure 19. Map total surface distribution of wetlands in faction of the total surface of each Province
The provinces of Rovigo and Venice are still the most important and then come in decreasing order Padua, Verona, and Vicenza. This is due to the fact that the wetlands surface present in the Provinces of Rovigo and Venice is so great that even weighting it on the total surface of the province the resurrection does not change.

4.2.1. Specific analyzes
In addition to the general considerations on the quantification of wetlands created by hunters, it has been tried to deepen the very important function that these environments have within the ecosystem. In the cases of the Provinces of Rovigo and Venice, these areas managed by hunters are fundamental for the maintenance of some specific habitats such as lagoons and deltas. Some formations such as "Muddy and sandy plains submerged partially by the tides" (Figures 20 and 21) can only be found in these areas and their conservation is essential for biodiversity. In fact, excluding the lagoon area of Padua, which falls under Figure 21 for management and administrative reasons, all the other provinces have lost almost all their habitats, replacing them with agricultural and industrial land.

Figure 20. Map of the Habitats of the Po delta in the hunting “Vall/I”
In Figure 20 it is possible to see that almost all the “Valli” are in a lagoon habitat, but only the “Valli” of the central area of the Delta have an habitat rich in reeds and muddy. The habitats concerning the beach and the dunes are obviously located along the coast, but these are outside the “Valli” area.

![Map of the Habitats of lagoon of the Veneto in the hunting “Valli”](image)

In Figure 21 it is possible to see how even in the Province of Venice the lagoon habitat is the most extensive. The “Valli” of the southern lagoon are all covered by the green of this habitat. The “Valli” of the northern lagoon are characterized by brackish waters, excellent for hosting Widgeons and Pintails (Figure 25). In the Lagoon of Caorle you can see some non-colored areas due to the presence of agricultural land.

Furthermore, as reported in chapter 1.3, the presence of wetlands is essential for waterfowl. The ways in which a wetland is managed can affect the presence of one type of bird compared to another. In this sense, it is possible to choose the bird species to host in the wetland under consideration. This can be decided by the manager of a “Vallé”, for example who decides to want to hunt more Teals, than Widgeons or Pintails (Figure 22).
In fact, these three species have been taken into consideration to highlight how the “Valli” are managed differently and this contributes to increasing the level of plant and animal biodiversity.

The Widgeons and the Pintails, are very similar species, have a shy character and are very suspicious. They have no problem living in brackish water with concentrations reaching 15 %, in fact they tend to frequent wetlands near the sea. They prefer very large pools of water (from 5 to about 10 hectares) with a depth of about 25/30 cm and they very willingly eat the "grisa" (Nanozostera noltii). The Teals, instead, prefer more sheltered areas, perhaps rich in reeds, given the small size of this duck, help to defend themselves from predators. It prefers fresh water and in fact it can also be found in the innermost wetlands of the Veneto Region, the important thing is that there is very low water (less than 10 cm), sometimes even just wet ground. It feeds without problems the artificial baiting provided by hunters and composed of different types of cereals.

This knowledge, which derives from years of experience of hunters, is applied in the management of the wetlands. Some hunters prefer to hunt the Teals and other Widgeons or Pintails, so their distribution is not homogeneous in the various provinces, but also within the “Valli” themselves that are located a few kilometers far from each other, or at distances that in terms of migration do not affect the movement of birds at all.

Figures 23 and 24 concern the Province of Rovigo and observing the individual valleys it is possible to observe that where there are many Widgeons, there is not a high number of Teals, this is caused by the different management of the “Valli”. Comparing Figure 24 with Figure 26 it can be
seen, that in the lagoon of Venice the number of Teals is much higher and this indicates that environment of these “Vallii” is more suitable for this species of duck. Considering instead the Figures 25 and 26, it is possible to notice how the “Vallii” of the northern lagoon are managed differently from those of the southern lagoon, as they have a large number of Pintails, but a smaller number of teals.

Figure 23. Map of the Widgeon distribution in the hunting “Vallii” of Po delta

Figure 24. Map of the teal distribution in the hunting “Vallii” of Po delta
Figure 25. Map of the Pintail distribution in the hunting “Vallì” of Veneto lagoon

Figure 26. Map of the Teal distribution in the hunting “Vallì” of Veneto lagoon
Considering the migration of water birds, their trajectories always tend to follow wetlands, such as lakes, rivers or coasts (Berthold, 2003). In this sense, the position of wetlands has been analyzed. It was noted in particular for the "Sguassi" of the Province of Rovigo and Verona, which these areas tend to be distributed along the main rivers (Figure 27 and 28). These provinces have been selected, because they are the only ones with sufficient data to show a reliable tendency. In Figure 27 it can be seen that the "Sguassi" are located mainly along three rivers, which are the Adige, the Tartaro and the Tione. In Figure 28 instead it is possible to observe how the "Valli" are located all in the lagoon area (on the right), while the "Sguassi" are close to the river Po and other minor rivers. Obviously hunters know they will have to find water birds and for which they build their wetlands near the migration areas. This action is fundamental, because hunters go to recreate those marginal wetlands to the rivers that were present until the last century along all the rivers of the Po Valley, before they were channeled for agricultural purposes or for safety.

Figure 27. Wetlands distribution along the rivers of the Verona Province
Figure 28. Wetlands distribution along the rivers of the Rovigo Province
5. CONCLUSION

There were two main objectives of this thesis. First of all to bring to light some shortcomings from the political and administrative point of view towards the wetlands and then show how there is a part of the Veneto community, the hunters, instead showing attention to this type of environment. From a legislative point of view, the Veneto Region and Italy in general, has been shown to be deficient in the conservation and restoration of wetlands, although in recent decades the scientific community has provided numerous tools to give a clear definition of this type of environment and to demonstrate the positive effects it has on the climate.

The wetlands restored by the hunters have been identified and quantified, showing a significant area that no other category has been able to create. The hunting community is offering a voluntary work creating suitable areas for hosting different species of animal and especially migratory birds and is also maintaining a high vegetation biodiversity; wasting this voluntary action would be a pity. It is therefore necessary from the political and from the administration to increase this research so as to identify all these areas, thus having a clear idea of the real contribution made by the hunters. Unfortunately, the hunting community is showing a sharp decline in population in recent years and this could go to undermine the presence of these wetlands. Conservation of these habitats is essential and it would be useful for the regional administration to make contributions in order to keep the wetlands covered with water throughout the year and not just during the hunting season.

In this sense, it is essential to implement the regional legislation regarding the wetlands, which highlights not only the importance of conservation of these environments, but also the restoration of those areas that once hosted this type of environment naturally.


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6.1 SITOGRAFIA

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7. RINGRAZIAMENTI

Vorrei suddividere i miei ringraziamenti in due parti differenti, una dedicata alla realizzazione specifica di questa tesi e un’altra più in generale a chi mi ha accompagnato in questi anni di università.

Chi più di tutti mi ha aiutato a scrivere questa tesi è stato il dr. Lorenzo Picco (per me comunque il Prof), che ringrazio non solo per il sostegno tecnico puntuale e preciso datomi, ma soprattutto per essersi rilevato molto più di un classico relatore con cui si stende la tesi. Siamo stati in Quebec insieme e sia in quell’occasione che tutt’ora si è rilevato qualcosa di più simile ad un amico, che dispensa consigli utili e che ti aiuta nel momento del bisogno. Potrei dire lo stesso anche del professor Max Boivin e del professor Thomas Buffin-Belanger, i quali ci hanno fatto da ottimi accompagnatori nel breve soggiorno in Quebec.

Per realizzare questa tesi è stato necessario richiedere e cercare una grande quantità di dati riguardanti il mondo venatorio, per l’aiuto datomi in questo ambito ci tengo a ringraziare:

- Michele Sorrenti amico e responsabile dell’Ufficio Avifauna Migratoria della Federcaccia per i consigli tecnici (e non solo) datomi per la realizzazione di questa tesi.
- I Faunisti Veneti, nella persona di Marco Basso e Maurizio Bon, per i dati forniti riguardo gli uccelli svernanti nella Provincia di Venezia.
- La Provincia di Rovigo (Servizio Risorse Faunistiche) e l'Associazione Culturale Naturalistica Sagittaria, nella persona di Emiliano Verza, per i dati forniti riguardo gli uccelli svernanti nelle Valli da caccia della Provincia di Rovigo.
- La Federazione Italiana della Caccia (FlIdC) e l’Associazione Cacciatori Migratori Acquatici (ACMA), per il sostegno datomi nella ricerca degli appostamenti fissi della Regione Veneto e per avermi già chiesto di replicare questo lavoro in altre regioni.
- Luca Frigo, Paolo Crosato, Gabriele Fasoli, Mirco Bottaro, Lionello Marcato e Denis Biasi, per avermi aiutato con l’identificazione di numerosi Sguassi, per avermi aiutato con le rielaborazioni in ArcGIS e per avermi fornito preziose indicazioni sulla gestione delle Valli da caccia.

Ancora più importante, però, sono state le persone che mi sono state vicine in tutti questi anni. In primis la mia famiglia (Stefania, Gabriele e Lara) che mi ha permesso di seguire gli studi a Padova.
senza troppe preoccupazioni e che mi ha sempre sostenuto nel momento del bisogno. Ringrazio la mia fidanzata Sara che ha pazientemente atteso la fine di questo ciclo universitario e che per cinque anni mi ha visto andare via ogni settimana senza farmelo pesare. Grazie agli amici del “Branco del Pelmo”, in particolar modo Lorenzo e Matteo, con i quali ho condiviso il percorso di studi e la casa fino all’ultimo anno e che mi hanno fatto passare momenti di spensieratezza unici, ma al contempo anche intense giornate di studio. Infine voglio ringraziare gli amici di Verona, i compagni di università provenienti da ogni parte del mondo, i professori e i vari coinquilini per avermi fatto crescere molto come studente e come persona in questi anni universitari.