Place Knowledge: Organizing Data on the Venetian Lagoon Park

An Interdisciplinary Qualifying Project
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ABSTRACT

The "Place Knowledge: Organizing Data on the Venetian Lagoon Park" project, sponsored by the *Osservatorio Naturalistico*, created a system to easily and inexpensively update information on the northern lagoon to supplement the *Atlante della Laguna di Venezia* (Atlas of the Lagoon of Venice). The northern lagoon was divided into, identifiable, morphologically homogeneous sections to assist data collection. *Relazione di Valutazione di Incidenza Ambientale* (V.Inc.A Reports) were examined for reusable data, and citizen monitoring programs were suggested for the lagoon.

EXECUTIVE SUMMARY

The Venetian lagoon is a unique habitat both for its relationship with the city of Venice and for the diversity of unique wildlife. As with many fragile and unique ecosystems, the lagoon has been threatened by the effects of an expanding human population. Since its founding Venice has used the lagoon as a natural wastewater treatment plant, but the lagoon is now choking under the increased surrounding resident population and the ever-increasing number of tourists that visit the city every year. The lagoon's ability to purge waste has also been taxed by the nearby industrial plant in Porto Marghera that has caused a buildup of heavy metal waste. Rivers from agricultural areas further inland wash fertilizer into the lagoon. The increase in nutrients causes algae to multiply and cover the water's surface, blocking out the sun and upsetting the balance of the ecosystem. Due to human and natural factors, the land in the lagoon is being eroded and washed out to sea. Human impacts, such as the waves created by motor boats, only exacerbate this process, leaving the lagoon in danger of losing all of its unique species and becoming just another saltwater bay on the Adriatic Sea.

In order to rescue the Venetian lagoon from the increasing effects of human beings, it is crucial to study the ecosystem of the lagoon and understand the extent of the damage done. Once this has been accomplished, steps can be taken to prevent further damage and to restore the lagoon to its former state. In 2002 the city of Venice created the *Casa della Laguna: Osservatorio Naturalistico della Laguna* to study the Venetian lagoon and distribute knowledge of the lagoon to the public. The *Osservatorio* is currently in the final stages of completing an atlas showing several different types of information on the lagoon. They also collect impact assessments from proposed industrial projects and give recommendations on whether those projects should be started.

The *Osservatorio* has realized that its atlas will only be accurate for a few years, and it will require large amounts of data on the entire lagoon in order to keep it up to date. The biggest problem facing the *Osservatorio* is a lack of sources for information. Studying the environment is an expensive process, and often scientific studies will be very time-consuming and have a very narrow focus. Furthermore, the different organizations studying the lagoon have different ways of collecting and storing their data,

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which makes it difficult for data to be transferred from one organization to another. In order to help the *Osservatorio* with this goal, the team created a database in which large amounts of data on the northern lagoon could be stored and displayed. The team also analyzed two sources of inexpensive and reusable data: citizen monitoring, and the environmental impact assessments, or V.Inc.A reports, submitted to the *Osservatorio* by companies. Recommendations for changes were made to the V.Inc.A reports to make the transfer of information to the database easier. Finally, the team used these resources to demonstrate how the *Osservatorio* could use this system to study the lagoon and monitor any changes that occur.

In order to organize the massive amount of data that the *Osservatorio* would receive from these sources, the team made a database in which the information could be stored. The team divided up the lagoon into recognizable segments, and gave each segment a code representing the area. Since the database was made using the MapInfo program, data that is entered in to the database could be displayed as a map of the northern lagoon.

The team researched citizen monitoring activities that took place in other parts of the world, and showed them as evidence that a citizen monitoring program can collect useful data. They then made plans for citizen monitoring activities that the *Osservatorio* could use based on the successful programs already in place elsewhere. Student field trips were considered as a possible source of citizen monitors, and appropriate age groups were assigned for each activity. The team also designed a system by which citizens can choose an activity and submit their data to the *Osservatorio* when finished. In order to easily input the data from volunteers into the database, the citizen monitors will be given the appropriate codes for their location when they sign up for the activity.

The V.Inc.A reports were analyzed by the team to determine whether the data contained in them could be reused. The team found that the data in the V.Inc.A reports were not a viable source of data in their current state because they did not contain any raw data. Everything submitted in the V.Inc.A report was highly analyzed and graded causing a loss of the information needed for the database. After determining the reasons why the V.Inc.A reports were not useful, the team proposed changes which would make them reusable. The V.Inc.A reports should be submitted in digital form rather than paper

form, and should be submitted with the original data needed to create the report. The team suggested that the original data be assigned codes from the database to show where the data came from.

The team received data on birds from the *Museo Naturalistico di Storia Naturale*, which was entered into the database and displayed on the maps as an example of reusable data. It is the hope of the team that the *Osservatorio* will be able to use this system to further its goals of collecting data on the lagoon and distributing it to the public.

ACKNOWLEDGEMENTS

AUTHORSHIP

In completing this project each team member had significant individual responsibilities. Although this was a team effort each member focused on specific parts of the project. Laurel named the general canals in the GIS layer, segmented and named the barene, and assissted with the paper; both writing the executive summary and bibliography, and peer editing. Katherine segmented the canals, segmented and named the paludi and velme, designed the bubbles for the citizen monitoring, produced the slide show, and helped out with the paper; both writing the analysis and peer editing. And lastly, Mark identified and extracted data from V.Inc.A reports, researched citizen monitoring programs and created forms and a database, analyzed the bird data, wrote the background, methodology, results, conclusion and suggestions, made the appendices and tables, and edited and formatted the paper.

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1   INTRODUCTION

Interest in preserving the environment is spread world wide. In the United States, for example, the Environmental Protection Agency office of Water encourages citizens to learn about the local environment and participate in a monitoring system, which results in many benefits for scientists and regulators. In this specific case, volunteers deal with human-caused problems, learning how to recognize, prevent and fix problems such as pollution. They also test and obtain data on water to increase the level of information available for studies[1].

By conducting scientific studies and volunteer programs such as the one mentioned above, environmentalists can learn the extent of a problem caused by human impact and find ways to reduce it. By reducing the impact of civilization on the environment, people and organizations can help to preserve it. Preserving the environment includes, but is not limited to, keeping the area free of waste products and trash, keeping the area free of vandalism, which results in erosion of landforms, and making sure that no resource is overused to the point of depleting the environment of that resource.

There is international interest in preserving nature, and the city of Venice is no exception. In the past, the lagoon surrounding Venice has served as a natural barrier between the ocean and the thriving city, and also as a purge for the city's waste. The lagoon has always protected Venice both from natural disasters and from human invasions.

Venice's lagoon is a fragile and unique ecosystem. Throughout history it was able to act as a dump site for the city's garbage. In the last century, however, increases in human visitors and the addition of industrial plants have taxed the land in the lagoon area and damaged the ecosystem. Since the flood in 1966, the people of Venice have been paying careful attention to their city and its surrounding environment, and the lagoon has

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[1] "EPA Volunteer Monitoring." Monitoring and Assessing Water Quality, 7 January 2005, < http://www.epa.gov/owow/monitoring/volunteer> (2 April 2005).

regained some of its former quality.[2] Several laws and decrees have been passed on the local, regional, and national levels intended to protect and restore the Venetian Lagoon. These decrees include limits to industrial discharge into the lagoon, water quality requisites, and the creation of organizations, such as the Consorzio Venezia Nuova, which is responsible for "measures to safeguard Venice and its lagoon." The Consorzio conducts many studies to determine the changing health of the lagoon, and creates programs for solving the major issues. In the past few years, for example, the Consorzio Venezia Nuova harvested macroalgae which built up in the lagoon, dredged canals, reconstructed salt marshes, and is currently building the MOSE system for flood control.

In addition, within the past several years Venice has created the Osservatorio Naturalistico to study and control these interventions. The city has also proposed that the northern lagoon be designated a natural park for study and visitation. However, the "lagoon park" is not yet recognized by the Italian Government, and its future is now in question within Venice itself.

Studying the environment is an expensive and time-consuming process, and organization is important in order to use the collected data to analyze human impact on the environment. In the case of the lagoon, much information is acquired every year by different orginizations, but there is not method of sharing this data. The several groups in charge of collecting data have no direct contact with each other and therefore their information is not organized in the same manner as the other groups. Lacking a common database structure is a big weakness because it's hard to determine which subjects have been studied thoroughly and which subjects require further study.

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[2] *Defence from high waters: activities for the safeguarding of Venice and its lagoon*, <http://www.salve.it/uk/> (12 April 2005).

2   BACKGROUND

There is a widespread belief that the earth is experiencing an environmental crisis, due to human impact. "We have gradually eroded the life systems and ecological processes of the planet to such a degree that our present ways of living are no longer viable."[3] People all over the world recognize the validity of this opinion, and are taking actions to alleviate the pressure humans place on the environment. Hundreds of private organizations aimed at preserving the natural world are operating across the globe. In nearly every country in the world, there exist multiple government agencies whose purpose is to monitor and protect the environment.

In the United States the National Environmental Policy Act (NEPA) was passed in 1969 in order to protect the environment from "the profound impact of man's activity on the interrelations of all components of the natural environment."[4] This act illustrates the significance of environmental protection; the issue is of such importance that the national government needed to take action to ensure the preservation of our world.

2.1   Environmental Issues in the Venetian Lagoon

The worldwide issue of environmental protection has become a serious concern within the Venetian Lagoon. The lagoon is a unique and globally important ecosystem. The lagoon is home to several rare species of birds, and the winter destination of others. Despite this global importance, the lagoon faces many risks, including industrial, urban, and agricultural pollution, as well as rising sea levels and land erosion. Determining the effects of these factors is vital to identifying ways of reducing their impact.

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[3] David Hutchison, *Growing Up Green: Education for Ecological Renewal* (New York: Teachers College Press, 1998), 9.
[4] *The National Environmental Policy Act of 1969, as amended.*
<http://ceq.eh.doe.gov/nepa/regs/nepa/nepaeqia.htm> (12 April 2005).

2.1.1 Urban factors

The city of Venice is the home of approximately 60,000 residents, but is the destination of sixteen million tourists each year, and that number continues to grow.[5] These tourists produce enormous quantities of sewage which is dumped directly into the canals of Venice and transported by currents and tides throughout the lagoon. However, this ever increasing pollution is a minor issue compared to the agricultural and industrial factors.[6]

2.1.2 Industrial factors

The Porto Marghera is the major industrial factor affecting the lagoon. The petrochemical complex, shown in Figure 1, is located on the mainland shore of the lagoon. The factories had dumped industrial waste

Figure 1: Porto Marghera

directly into the lagoon for years. This unrestricted pollution throughout the 60's and 70's led to extremely high levels of heavy metals found in the water and soil of the lagoon.[8] In addition, the industrial plants had been extracting groundwater from beneath the city of Venice, which greatly
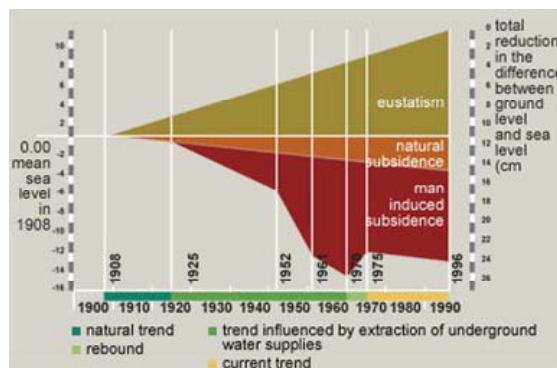
Figure 2: Net Change in Sea Level[7]

[5] Caroline Fletcher and Jane Da Mosto, The Science of Saving Venice (Venezia: Umberto Allemandi e C., 2004).

[6] Michael Freemantle, "Safeguarding Venice," *Chemical Engineering News 78,* no. 35 (2000)

[7] SAL.VE, High Waters, <http://www.salve.it/uk/soluzioni/f_acquealte.htm> (12 June 2005).

[8] Caroline Fletcher and Jane Da Mosto, The Science of Saving Venice (Venezia: Umberto   Allemandi e C., 2004).

increased the rate of subsidence, or sinking, of the land for decades.[9]

In conjunction with this land subsidence there has also been an overall rise in sea level. The combination of these two factors has resulted in a net loss of 23 centimeters of land in relation to sea level in the past century, as seen in Figure 2. The increase in normal sea level results in more frequent and more extreme flooding of the city and the erosion of soil throughout the lagoon due to the higher water.

Loss of land is a serious issue in the lagoon, and is entirely due to human actions throughout history. In the 15th and 16th centuries, sediment carried to the lagoon by rivers threatened to transform the lagoon into a part of the mainland. Venetians took measures to prevent this from happening, such as diverting rivers and building jetties. By doing this people have caused the

Figure 3: Erosion of an Island[10]

opposite problem: the lagoon is losing land, seen in Figure 3. Several recent factors now play an additional role in the loss of land to the sea. The aforementioned induced subsidence is just one of the many factors contributing to the problem. Dredging canals to allow the passage of larger ships to reach Porto Marghera has increased currents which increases erosion. These ships also cause waves which erode the islands. Water pollution kills the aquatic plant life which holds the land together.[11]

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[9] A. Ghetti, "Subsidence and sea-level fluctuations in the territory of Venice," *Landscape and Urban Planning 16*, no. 1-2 (1988)

[10] SAL.VE, Morphological Deterioration, <http://www.salve.it/uk/soluzioni/ambiente/f_recupero.htm> (12 June 2005).

[11] Ibid.

As a result of these actions, a significant portion of the lagoon's salt marshes and mud flats have been lost to the sea. Figure 4 displays the extent of this issue; the area in red represents land lost to erosion since 1810. This erosion of land has many negative impacts within the lagoon. These small islands protect the city of Venice from significant wave action. They are the home to a huge variety of plants and animals, some of which are only found in this habitat. As the mudflats and salt marshes

Figure 4: Effects of Erosion[12]

disappear, the lagoon loses its distinctive qualities and biodiversity. As the erosion continues, the lagoon is losing its unique identity and transforming into a saltwater bay with characteristics similar to those of the Adriatic Sea.[13]

2.1.3 Agricultural factors
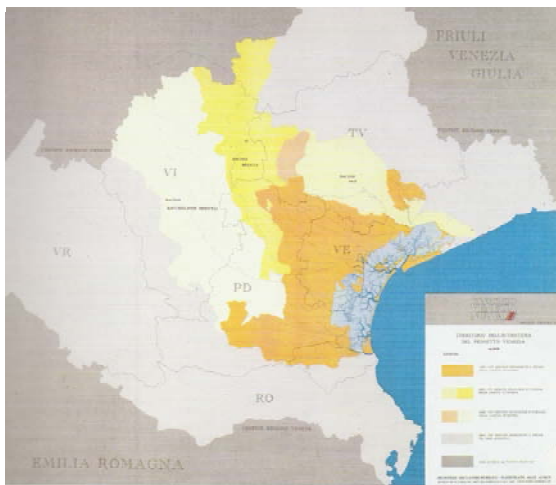
Figure 5: Watershed area

The lagoon is the drainage basin for the nearby mainland provinces of Venice, Treviso, and Padua, as shown in Figure 5. Much of the land in this area is dedicated to agriculture. A large quantity of agricultural waste is transported from this watershed to the lagoon by the rivers. Generally these wastes are nitrate and phosphate nutrients from the fertilizers used on the farms. These nutrients benefit certain types of macroalgae and result in population explosions of the algae. The massive amount of algae in the lagoon reduces the oxygen content of the water and blocks sunlight, negatively impacting the other species of the lagoon. Figure 6 shows

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[12] Ibid.
[13] Ibid.

the impact of one of these algal blooms on the fish of the lagoon.[14] The algal blooms also smother the seagrass on the lagoon bed. Seagrass anchors the sediment of the lagoon, meaning that the destruction of seagrass further accelerates the erosion of the lagoon.[15]
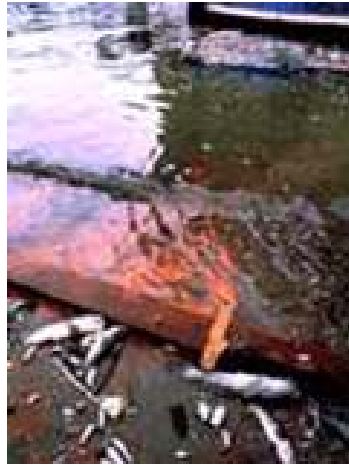
Figure 6: Impact of Algae[16]

2.2   The Environmental Movement in Venice

Within Venice there are organizations created with the purpose of studying these problems and finding ways to solve them.

2.2.1   Consorzio Venezia Nuova

A major contributor to current preservation efforts is the *Consorzio Venezia Nuova*, an organization "responsible for implementing the measures to safeguard Venice and its lagoon."[17] This group of large companies has conducted hundreds of scientific studies on the lagoon, covering many topics, from rising water levels to pollution to erosion and subsidence of the land. The *Consorzio Venezia Nuova* then designs interventions to relieve the most serious issues.

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[14] Ibid.

[15] Caroline Fletcher and Jane Da Mosto, The Science of Saving Venice
(Venezia: Umberto   Allemandi e C., 2004).

[16] SAL.VE, Environmental Deterioration, <http://www.salve.it/uk/soluzioni/ambiente/f_recupero.htm> (12 June 2005).

[17] SAL.VE, Frequently Asked Questions, <http://www.salve.it/uk/banchedati/f-domande.htm> (25 June 2005).

Figure 7: Algae Harvesting[18]

The *Consorzio Venezia Nuova* is involved in several programs aimed at improving the health of the lagoon environment. For example, the waste dumps in and around the lagoon are being secured to eliminate the pollution leakage. Canals are dredged and mudflats and salt marshes are reconstructed with the material removed from the canals. Vegetation is replanted to decrease erosion. During the algal blooms, the *Consorzio Venezia Nuova* used specially designed boats to remove the algae from the lagoon, as seen in Figure 7.[19]

The major construction project they are currently working on is the *MOSE* system. *MOSE* is a system of floodgates which will stop extreme high tides from entering the lagoon. The gates will lie on the floor of the lagoon until a significant tide is predicted. They will then be raised and completely block the inlets of the lagoon, stopping the water and preventing flooding. The project is currently underway, but is not scheduled to be completed for several years.[20]

Figure 8: NO MOSE

Although the *Consorzio Venezia Nuova* is meant to protect and preserve the lagoon, there is significant opposition to the organization's projects. The *MOSE* gates are not a universally accepted solution to the lagoon's problems. It is also possible that the process of constructing the *MOSE* gates will harm the lagoon more than the gates will actually help.

2.2.2   CoRiLa

Another organization concerned with the study and preservation of the lagoon is the *Consorzio per la Gestione del Centro di Coordinamento della Attivita di Ricerca*

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[18] SAL.VE, Arrest of Environmental Deterioration, Some Examples, http://www.salve.it/uk/soluzioni/ambiente/f_miglioramento.htm (12 June 2005).
[19] Ibid.
[20] "Defence From High Waters," SAL.VE, < http://www.salve.it/uk/soluzioni/f_acquealte.htm> (25 June 2005).

inerenti il Sistema Lagunare di Venezia (CoRiLa).[21] This organization encourages and sponsors research on the lagoon, as well as interaction and communication between its members. *CoRiLa* also maintains a database of all the information gathered and GIS maps of the lagoon.[22] However, the data and GIS maps collected by *CoRiLa* are only available to members of the organization.

2.2.3 Osservatorio Naturalistico della Laguna

The sponsor for this project, the Casa della Laguna: Osservatorio Naturalistico della Laguna is an organization created in 2002 by the city of Venice. The office, shown in Figure 9, is located on the Grand Canal, near the Museo Naturalistico di Storia Naturale. The Osservatorio has two primary objectives. First, it is assigned the task of studying the natural characteristics of the lagoon. Secondly, the Osservatorio distributes this information to the public and encourages the community to participate in the preservation of the lagoon environment.

Figure 9: Osservatorio Naturalistico della Laguna

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[21] "The Island of Pellestrina: Case Study for the Environmental Atlas of the Venetian Lagoon," (IQP, WPI, 2003), 21.
[22] CORILA, <http://www.corila.it/> (15 June 2005).

The primary focus of the Osservatorio is currently on the completion of the Atlante della Laguna di Venezia (Atlas of the Lagoon of Venice). This atlas contains many maps displaying many types of information on the lagoon. These maps pertain to the climate, geology, water quality, wildlife, and several other topics relevant to the study of the lagoon. The atlas is a collection of data which can be used to study the lagoon. The creation of the maps makes the data easier to understand which allows easy dissemination of information to the public.
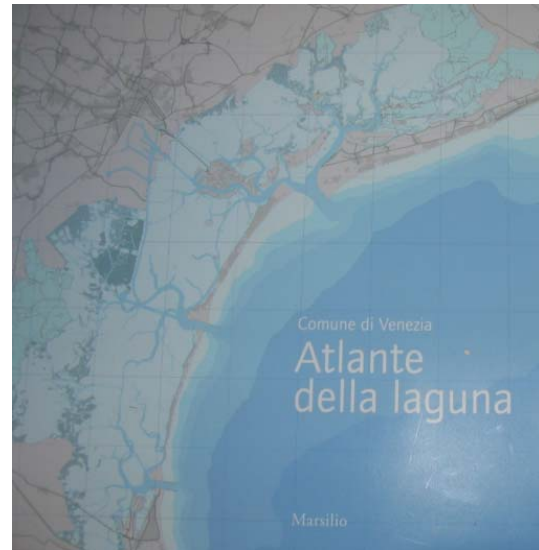
Figure 10: Atlante della laguna

The creation of the atlas is a significant achievement. However, the Osservatorio is concerned that the lagoon is a dynamic system whereas the atlas is static. The atlas describes a baseline condition of the lagoon. To be most useful the same studies would be conducted year after year in order to observe changes and trends away from this initial condition.

The Osservatorio is also responsible for the collection and review of the Valutazioni di Incidenza Ambientale (V.Inc.A) reports. These reports must be filed before any project can be undertaken within the protected areas of the lagoon: Siti di Importanza Comunitaria (SIC) and Zone di Protezione Speciale (ZPS). The vast majority of the lagoon is contained within one or both of these protected areas. The V.Inc.A reports outline the proposed project and the
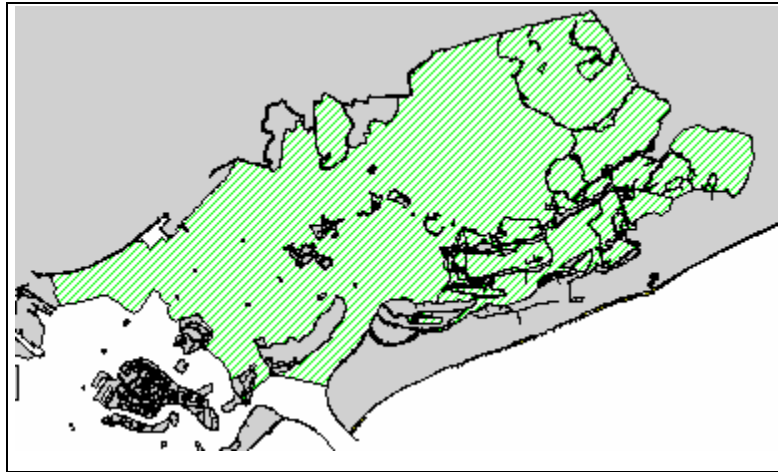
Figure 11: SIC boundries
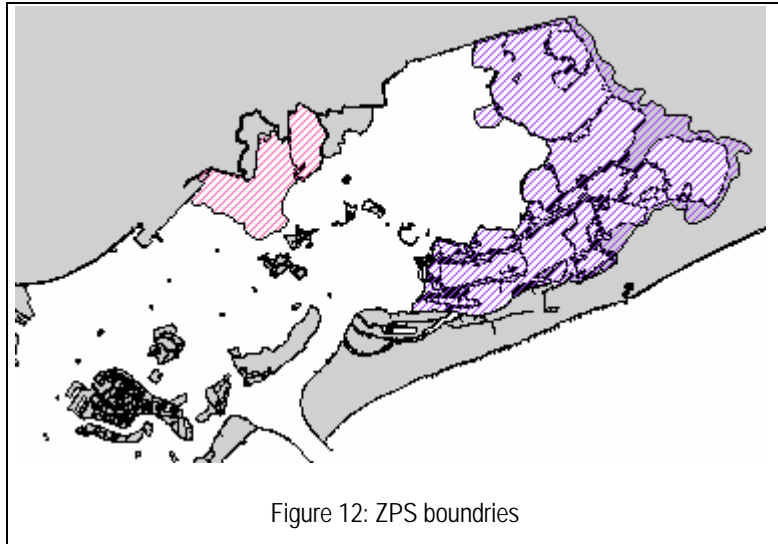
Figure 12: ZPS boundries

expected environmental impact of the project. The Osservatorio then decides if the project will be allowed to proceed based on the expected impact. These reports help the fragile environment of the lagoon survive continued human expansion.

2.3   Sources of Environmental Data

The consequences of human actions are qualitatively obvious; people notice when salt marshes disappear or when the city stinks from the overabundance of macroalgae. However, in order to understand the processes taking place within the lagoon, specific quantitative data must be collected.

Information is the key to identifying environmental issues and finding ways of stopping and reversing the damage. As interventions are undertaken it is vital to monitor the widespread effects. However, scientific studies of the environment, such as those mentioned above, are extremely expensive. Even when there is funding for research, the timeframe of the study is often very limited, so identifying long term trends is difficult.

Luckily, there are untapped sources for environmental data. The two possible sources of data which were considered for this project are citizen monitoring and V.Inc.A reports.

2.3.1 Citizen Monitoring

A citizen (or volunteer) monitoring program is a possible solution to these problems. Citizen monitoring is fairly new, but is a proven and effective system. These programs utilize people from the community interested in helping to preserve the environment. The volunteers collect data and report their results to a sponsoring agency. This type of program can provide a large amount of data covering a wide area over a long period of time at very low cost. This vast supply of data can reveal trends that would otherwise go unnoticed. In addition to the data collection, these programs also educate the public about the environment and what can be done to protect it.

2.3.1.1 NatureWatch

An example of citizen monitoring is "NatureWatch," a program in Canada which encourages national participation of ordinary citizens in scientific observations. The Nature Watch websites include instructions for completing observations as well as a

means of submitting results and viewing the results of others. Nature Watch currently consists of four major components: "IceWatch," "FrogWatch," "PlantWatch," and "WormWatch."[24]

Figure 13: Ice Watch Locations[23]

"IceWatch" enlists volunteers to monitor the freezing and thawing patterns of lakes and rivers across Canada. Each volunteer signs up for a specific location and simply records the dates on which that water freezes over and melts each year. The data is then submitted to the Ice Watch website. This seemingly trivial task is very helpful for scientists studying climate change. With locations all across Canada the scientist can see overall patterns as well as differences in the trends at specific locations across the country.

Figure 14: Ice Watch Results[25]

The collected data is reviewed, organized, and displayed on the ice watch website. Figure 13 displays a map of Canada. Each snowflake represents a single Ice Watch monitoring location. The map allows a user to select a location and view the actual data taken at that location, displayed in graph form, like that seen in Figure 14.[26]

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[23] IceWatch Assessments, <http://emandev.cciw.ca/icewatch/icewatch.phtml?language=english> (22 June 2005).
[24] Nature Watch, <http://www.naturewatch.ca/english/> (22 June 2005).
[25] Ibid.
[26] Ibid.

Another component of Nature Watch is Worm Watch, a very successful citizen science program which investigates the number and diversity of earthworms found in the Canadian soil. This information is useful in the study of soil ecology. Worm Watch has created several sampling methods to accommodate different levels of interest and ability. The website even suggests school projects, supplying experiment instructions and lesson plans. There are detailed instructions for each different experiment which can be attempted, with a step by step methodology to lead to a successful study. Worm Watch clearly illustrates the importance of the data to scientists, which encourages people to participate and properly complete the tasks. The success of NatureWatch illustrates the vast possibilities of citizen science programs.[27]

2.3.1.2 EPA Office of Water

In the United States the Environmental Protection Agency Office of Water has taken great interest in volunteer monitoring, assisting in the creation and growth of hundreds of programs throughout the country to monitor local bodies of water. The agency recognizes the benefits of such initiatives. "Volunteer monitors build awareness of pollution problems, become trained in pollution prevention, help clean up problem sites, provide data for waters that may otherwise be unassessed, and increase the amount of water quality information available to decision makers at all levels of government." With EPA Office of Water sponsored monitoring programs in place in each state, and over sixty individual organizations in Massachusetts alone, there is obvious public interest in participating in environmental preservation programs.[28]

2.3.1.3 Christmas Bird Count

The National Audubon Society is an organization created for the study and protection of birds. The society sponsors a number of citizen monitoring bird counts during the year. The Christmas Bird Count first occurred in 1900 as an alternative to the traditional bird hunts. This initial bird count included 27 people in the United States and

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[27] Worm Watch, <http://www.naturewatch.ca/english/wormwatch/> (22 June 2005).
[28] EPA's Volunteer Monitoring Program,
<http://www.epa.gov/owow/monitoring/volunteer/epasvmp.html> (28 June 2005).

Canada taking a census of early-winter birds. The bird count now includes 50,000 observers spread from northern Canada to South America. The Christmas Bird Count of 2004-2005 took place during three weeks from the end of December through the beginning of January and was the 105th annual occurrence of this study, making it the oldest citizen monitoring program in the world.[29]

Participation in the Christmas Bird Count requires significant commitment over three weeks. Participants collect data on which species were observed, the number of each species, and the amount of time spent counting birds. The data is submitted by the observers to a panel of experts to be reviewed before it is included in the database. These factors make the Christmas Bird Count most appropriate for serious bird watchers.

The Christmas Bird Count database has recently been transferred to a public system, accessible to anyone interested in viewing the results. The results are also released as an annual report on American birds. The Audubon society has taken the initiative to have the Christmas Bird Count officially reviewed by independent scientists who endorsed the count as a valuable tool in the study of birds which gives credence to the data collected.[30]

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[29] "Over a Century of Conservation: An Audubon Timeline," *National Audubon Society*, <http://www.audubon.org/nas/timeline.html> (7 July 2005).
[30] "The 105th CBC, December 14th 2004 to January 5th 2005: Successful completion of a new record number of counts," *Christmas Bird Count*, <http://www.audubon.org/bird/cbc/index.html> (28 June 2005).

Figure 15: GBBC Goals and Achievements[31]

2.3.1.4   Great Backyard Bird Count

The Audubon Society also sponsors the Great Backyard Bird Count which occurs at the end of the winter. This bird count is a simpler version of the Christmas Bird Count, requiring less time commitment and less rigorous data collection and submission requirements. It is a four day annual event which encourages participation of anyone, from families to school classes, despite experience or skill level. This program is meant to educate its participants as well as gather useful data on the bird population across the country at the end of the winter to compliment the data collected at the beginning of winter in the Christmas Bird Count.

The program is promoted through press releases to papers and television in order to gain as many volunteers as possible. Once a person or group decides to participate, they visit the GBBC website where they find detailed instructions on the actual process of collecting and submitting data. They also print an observation form from the website. Each form is specific to a particular region of the country and is a checklist of only the species that will be found in that area. The participant is allowed to perform bird counts on as many of the four days and at as many locations as they wish. For each location on each day a separate checklist must be completed.

The website instructs the participant to record the maximum number of each species he sees at any one time. This is a standardized collection method everyone can follow and it eliminates the possibility of counting the same bird multiple times. The number of each species is then submitted to the GBBC. During the bird count of 2005 over 100,000 checklists were received.[32]

Despite the lack of training and experience of the people submitting data to this bird count, the results are subject to a certain degree of quality control. The regionally specific checklists do not allow participants to claim they saw birds that could not

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[31] *The Great Backyard Bird Count*, <http://www.birdsource.org/gbbc/> (28 June 2005).
[32] *Ibid.*

possibly be in their location. More important is the shear number of observations submitted. There is sufficient accurate data to virtually eliminate the effect of the few inaccurate observations.
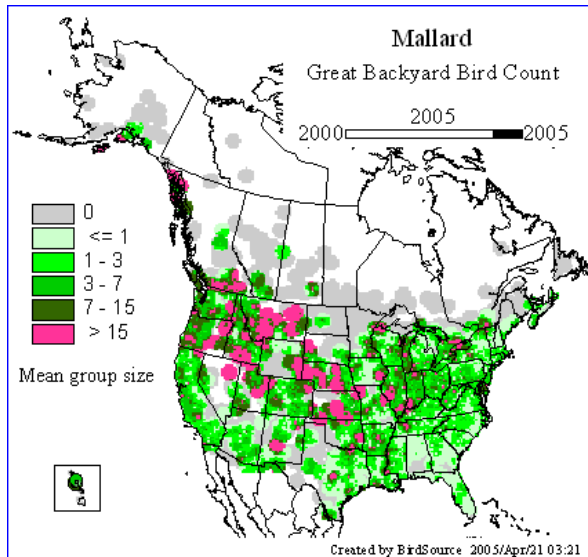
Figure 16: GBBC Results Map[33]

Similar to the Christmas Bird Count, the results of the Great Backyard Bird Count are stored in a database and displayed on the website for anyone to access and use. Figure 16 is an example of a results map for the mallard duck population in 2005, taken from the GBBC website. Results can also be viewed from previous years, and the map can even be animated to show the changes over the past five years.

The data collected in the Great Backyard Bird Count is used to monitor major topics in bird populations. The data can be combined with that collected during the Christmas Bird Count to view changes in the populations over the winter. As the counts continue year after year, trends will become more obvious. When issues become apparent they may require further study of a more scientific nature. Examples of these large scale issues which may be discovered through the citizen monitoring programs are a significant decline in the population of a certain species or a change of migratory habits.[34]

The Great Backyard Bird Count not only creates a significant amount of useful data, but it is also an educational tool. It encourages citizens to learn about the environment and conservation efforts. It expands public concern for environmental issues since they are observing the effects of the problems. Furthermore, each year citizens become better at performing the counts. Experienced participants can train others, or even move on to more advanced efforts such as the Christmas Bird Count.

[33] "Great Backyard Bird Count Results," *The Great Backyard Bird Count*, <http://gbbc.birdsource.org/gbbcApps/maproom?cmd=OneMapDisplay&sppOrder=alpha&species=mallar &year=2005&region=NAm&submit.x=18&submit.y=16> (14 July 2005).
[34] "Why Count Backyard Birds?" *The Great Backyard Bird Count*, <http://www.birdsource.org/gbbc/whyCount.html> (5 July 2005).

2.3.2 <u>V.Inc.A</u>

A second possible and untapped source for valuable environmental data is Environmental Impact Reports. These reports, known as *Relazione di Valutazione di Incidenza Ambientale* (V.Inc.A) in Venice, are filed before any major project can be undertaken within the city or lagoon. The reports describe the project and its effect on the environment.

These reports include an entire section pertaining to the natural characteristics in the impacted area.[35] This section of the V.Inc.A report is basically a scientific study of the area of the project as well as the surrounding area. The data is collected and reported to the Venetian government. This information can be very useful to scientists studying the same area. Recent V.Inc.A reports may contain data which need not be collected a second time. Data from past reports can be compared to current research to observe changes.

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[35] Relazione di Valutazione di Incidenza Ambentale, *Progetto Unitario di Utilizzo per la construzione di cavane in localita Ca' Noghera (VE),* July 2003, 17.

3   METHODOLOGY

Our project is intended to improve the ability of the Osservatorio Naturalistico della Laguna to evaluate impacts of proposed interventions in the Venetian Lagoon by identifying effective and inexpensive sources for the gradual and systematic accumulation of re-usable environmental data.

To accomplish this mission, we have identified four primary objectives:
1. To facilitate the collection and sharing of environmental data by dividing the lagoon into morphologically homogeneous coded sections.
2. To design programs that will engage visitors in citizen monitoring activities which will generate informational returns.
3. To demonstrate the reusability of the data.
4. To extract reusable data from V.Inc.A reports (Relazione di Valutazione di Incidenza Ambientale).

3.1   Study Area

Although there are several possible sources for environmental data, the team examined two possibilities: reusing information from the V.Inc.A reports and creating citizen monitoring programs. The focus of this
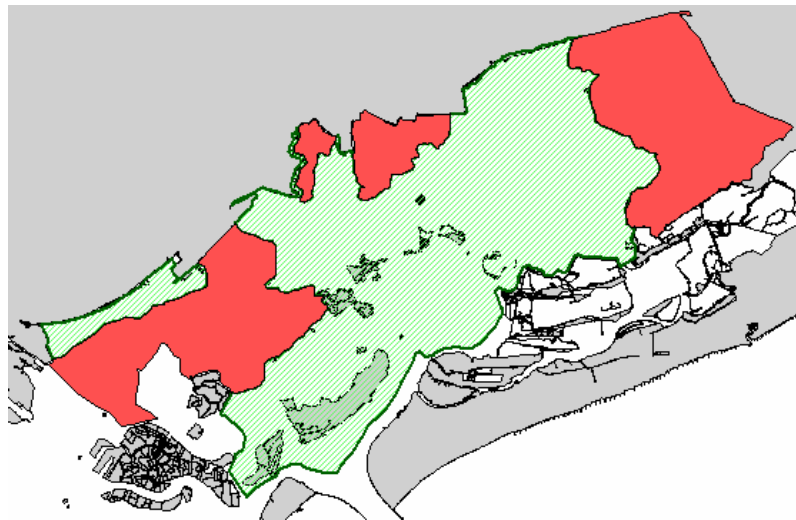
Figure 17: Lagoon Park Area

project was on the area of the proposed Lagoon Park encompassing the northern lagoon,

shown in green in Figure 17. The project does not encompass prepark areas of the lagoon, shown in red. Specific sections of the project were further limited to areas where V.Inc.A reports have been filed and by the areas which are accessible to visitors.

The team was only in Venice for the summer months, so the time of our study was limited to the months of June and July. The team created the strategy for accomplishing the stated objectives in the limited area of the Lagoon Park during the summer. The hope of the team is that these techniques will be used to create a year-round data collection program for the northern lagoon.

3.2   Facilitating the collection and sharing of environmental data

In order to gain precise knowledge of the entire northern lagoon, environmental data needs to be collected at every point throughout the lagoon. However, by dividing the lagoon into homogeneous sections based on natural features, data collected at a point can now be extended to an entire section. A common division and labeling system also eases the process of transferring data from one organization to another.

3.2.1   Obtaining old maps

In order to accomplish the task of dividing and labeling the lagoon, the team has acquired two series of maps of the northern lagoon from the Osservatorio, one from 1843-1844 and another from 1887-1901. These detailed maps depict all of the natural features of the lagoon, such as the canals and barene, many of which are named. These names no longer exist on current maps. One of these old maps from 1901 is shown in Figure 18, the rest are displayed in appendix 7.6.

Figure 18: Lagoon Map From 1901

3.2.2 Combining old maps and GIS layers

The maps were then scanned onto a computer and displayed over the lagoon GIS layers. Common points were identified between the old maps and the GIS layers, as shown in Figure 19. The team then matched the GIS coordinates to corresponding points on the old maps so that the two would overlap. This process was completed for each of the ten maps acquired.

3.2.3 Canals

Canals are the deep channels which run through the shallow lagoon. The process of transferring information from the old maps to the GIS layers began by first identifying and naming each of the large canals throughout the northern lagoon, followed by the creation of useful

Figure 19: Registering the old map to the GIS layer

segments.

3.2.3.1 Defining canals

The canals were segmented in the current GIS layers, but not in a way that was useful to the team, so a new layer was created by recombining these segments into entire canals. The recombined canals were then assigned their historical names taken from the maps. The name in the red box in Figure 20 is taken from the old map and assigned to the canal in the GIS layer.

Figure 20: Naming Canals

Since the old maps were created there have been some changes to the canal system in the lagoon. Many canals displayed on the old maps no longer exist and are therefore not shown on the current GIS layer. A layer was created depicting these ancient canals in their original location by tracing their path from the old maps to the current maps. Figure 21 shows old canals not displayed on the GIS layer.

Figure 21: Examples of old canals

3.2.3.3 Segmenting the canals

Once the large canals were identified they were then divided at intersections with other existing canals as well as at intersections with the old canal mentioned in section 3.2.3.2. Each red line in Figure 22 represents a location of segmentation. These sections retained the name of the canal and were then numbered from the Adriatic Sea towards the mainland.

Figure 22: Segmenting the Canals

3.2.4 Barene

Barene are the mudflats found throughout the lagoon. Due to erosion and reconstruction efforts, the barene are constantly changing shape and size, so it was imperative to obtain the most up to date and detailed barene layer available. The layer received from the Osservatorio was the most recent and had the most detail of the barene

layers. Each island of barene was displayed and was individually selectable. This was beneficial in the grouping and naming process.

3.2.4.1 Naming the barene

Individual barene islands were grouped into reasonable clusters and named based on their ancient names whenever possible. In many cases the actual barene cluster was not named on the old maps. In this situation the barene cluster would be given the name of a nearby canal, palude or other landmark. Sections of barene with the same name were also numbered starting with a "1" at the Adriatic and increasing as they got closer to the mainland.

3.2.5 Velme

The map of paludi shown in Figure 23 also showed the boundaries for Velme, mudflats located at or slightly below sea level. While similar to barene, the regular inundation creates a different type of habitat which needs to be classified separately.

3.2.5.1 Creating the velme layer

The team was originally provided with a velme layer, but this layer focused only on velme close to Venice and was therefore useless for the purposes of the project. Instead, velme sections were drawn in based on the pink areas of the map in Figure 23.

3.2.5.2 Naming the velme

Like the barene, the velme generally had no names assigned to them on the old maps, and sometimes did not appear on the old maps at all. Since they were usually found near barene, the velme sections were often named after nearby barene sections. In the few cases in which there were no barene nearby, the velme sections were named after nearby canals or paludi. When two or more sections of velme were given the same name, they would be numbered starting with the section closest to the Adriatic and moving inland.

3.2.6 Paludi

Paludi are the large sections of shallow water in the lagoon. Once the canal system was mapped, this open water needed to be divided. This process has been attempted by scientists, who created a system of polygons within the lagoon, but one which is not usable for this project.

3.2.6.1 Dividing the paludi

The area of a palude is defined by the surrounding canals, barene, and islands. Unlike the canals and barene, there was no GIS layer displaying the paludi. Therefore the paludi had to be traced from the map in Figure 23. The paludi are large areas so a method for dividing them was necessary. After discussing the issue with Davide Tagliapietra it was decided that the water depth would be the best way of further dividing the paludi into smaller sections. Paludi are generally deeper in the center and shallow around the edges. Therefore most paludi were divided into two sections, the center and the edge, based on the depth of the water. In some cases paludi contained two or more "centers," or deep areas, and each of these deep areas was made into its own section. A few paludi had no significantly deeper center and therefore were not divided any further.
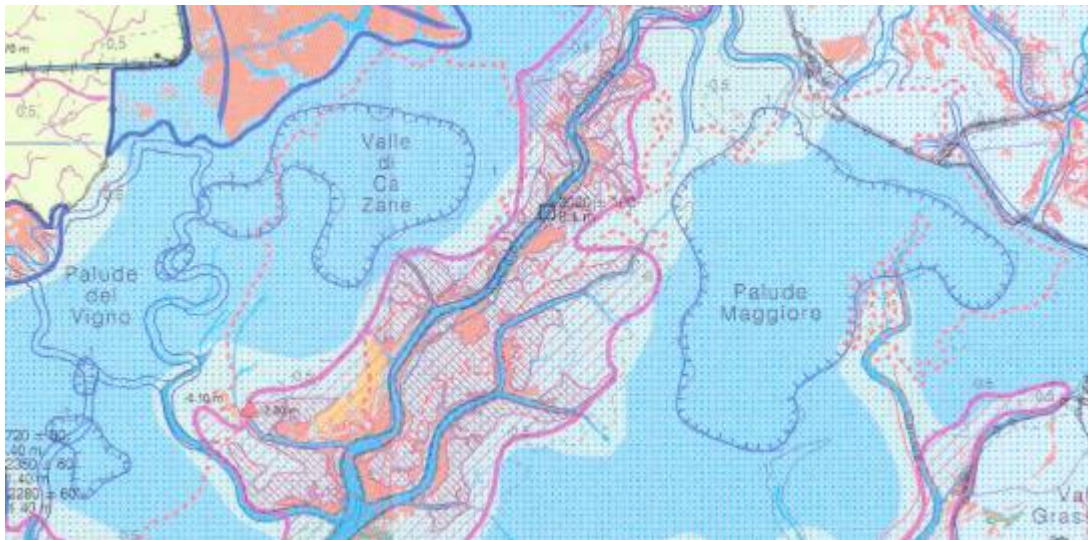
Figure 23: Map of paludi

Some sections of open water were named on the old maps, so these names were used whenever possible. If no name was given on the paludi map in Figure 23, areas were named according to the bordering canals. Sections of the paludi were labeled with the general name of the paludi, plus an "E" for the exterior region and a "C" for the center. In the case where multiple centers existed in a single paludi, the name also includes a number identifying a specific center.

3.2.7 Assigning codes

Once each feature had been identified and named, codes were created for each individual section based on the type of feature, the name, and the number of the section. The base of each code was made by shortening the name of each feature into a unique four-letter series. These series were preceded by a letter and a dash denoting which type of feature they represented: C for canals, B for barene, V for velme and P for paludi. The code was followed by a two-digit number matching the number assigned in the name. For example, a section of barene labeled Monte dell' Oro 5 would be given B-MORO05 as a code. The codes will be useful in storing data and displaying it on a GIS map.

3.3 Designing citizen monitoring activities

Citizen monitoring is a possible source of environmental data. Several types of programs have been suggested, while a detailed bird watching citizen science program was created as a prototype for future activities.

3.3.1 Possible Activities

Several possible citizen monitoring activities have been discovered. Activities which can produce useful data have been suggested for further development. Details for each activity can be found in appendix 7.2.

3.3.1.1 Updating the Atlante della Laguna di Venezia

The index of the Osservatorio's lagoon atlas, shown in appendix 7.3, was examined in detail. The index lists data contained on each map of the atlas. Some data within the atlas can possibly be collected by citizen volunteers to keep the information up to date.

3.3.1.2 Developing the programs

In order for citizens to update the atlas, citizen monitoring programs need to be created. After the topics of the possible programs were determined from the atlas, research was conducted to find developed citizen science programs researching the same topics. These successful programs provide support for the legitimacy of our suggested activities as well as examples of how to develop them. From these examples, several activity descriptions were created as seen in section 4.2.1 and appendix 7.2.

3.3.2 Activity Selection

Citizen monitoring activities were organized by several criteria which would assist an interested party in the selection of an appropriate project.

3.3.2.1 Determining activity locations

The team visited and studied five islands of the northern lagoon: Burano, Mazzorbo, Sant' Erasmo, Torcello, and Vignole. Barene and velme are additional locations for citizen monitoring activities. For each location a list of possible citizen monitoring activities was produced including water testing, plant watching and bird counting.

3.3.2.2 Creating activity requirements

Several systems were considered for the division of activities. The age of the participants and location were deemed the most important factors for selecting an

appropriate activity. A decision tree and database were created as methods of selecting an appropriate activity.

3.3.3 School field trips

The team then suggested the possibility of utilizing school field trips to the lagoon for data collection. School children could perform simple experiments and report the results to the central database. The data could be self-verifying if multiple groups perform the same experiment on the trip. If the results are reasonably close, the data will likely be accurate.

3.3.4 Storing the data

A database was created to store the results citizen monitoring programs. This database will be automatically updated when a citizen monitor submits data through the internet.

3.3.4.1 Data submission

Data will be submitted to the Osservatorio by citizen monitoring participants using the data submission form on the internet. These forms, created in Microsoft Access, are specific to each activity. They require biographical information of the participant and a description of the location, along with the data collected (see appendix 7.11.2).

3.3.4.2 Inputting data

After the data has been submitted to the Osservatorio online, it will be automatically included in the database specific to the activity. The water monitoring data table is shown in appendix 7.3. The data will be viewable by anyone, for research or otherwise. Only the Osservatorio will be able to edit or delete the submitted data, allowing them to control the input of accurate information into the database.

3.3.5 Bird Watching

A detailed citizen bird watching program was created as an example and prototype for developing other activities. Our program is closely based on the Great Backyard Bird Count, a very successful program in the United States.

3.3.5.1 Studying the birds of the lagoon

Meetings were arranged with Mauro Bon of the Museo Civico di Storia Naturale to get his opinion on the use of citizen volunteers for data collection as well to obtain information from past bird studies and learn about current counting techniques.

3.3.5.2 Planning bird checklists

The Great Backyard Bird Count provides checklists for separate sections of the country. A part of the Massachusetts checklist is shown in Figure 24. The northern lagoon is not large enough to separate by this method since most birds are found throughout the lagoon. However, checklists can be created based on the different environments of the lagoon. For example, the checklist for the barene includes only the birds which can be found on barene.

February Massachusetts Checklist : Complete

Show this checklist with rare species included.
Click on linked species names for more information about those species.

Swans, Geese and Ducks

Greater White-fronted Goose	Tufted Duck
Snow Goose	Greater Scaup
Brant	Lesser Scaup
Canada Goose	King Eider
Mute Swan	Common Eider
Wood Duck	Harlequin Duck
Gadwall	Surf Scoter
Eurasian Wigeon	White-winged Scoter
American Wigeon	Black Scoter
American Black Duck	Long-tailed Duck
Mallard	Bufflehead
Northern Shoveler	Common Goldeneye
Northern Pintail	Barrow's Goldeneye
Green-winged Teal	Hooded Merganser
Canvasback	Common Merganser
Redhead	Red-breasted Merganser
Ring-necked Duck	Ruddy Duck

Upland Game Birds

Ring-necked Pheasant	Wild Turkey
Ruffed Grouse	Northern Bobwhite

Loons

Red-throated Loon	Common Loon

Figure 24: GBBC Checklist[36]

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[36] "February Massachusetts Checklist," *The Great Backyard Bird Count*, <http://gbbc.birdsource.org/gbbcApps/checklist?checklistID=CL16995&rare=false> (14 July 2005).

3.3.5.3 Program instructions

The instructions for the bird count, shown in appendix 7.11.1 closely resemble those from the Great Backyard Bird Count. The GBBC is a successful program which creates useful data from citizen volunteers, so the methodology they use for collecting data must be sufficiently scientific while also being easily understood and followed.

3.3.5.4 Storing the data

A database specifically for the bird watching data has been created (see appendix 7.11.3). It was developed to facilitate the transfer of data from the submitted checklists to the database. The fields of the database include biographical information of the participant and information on weather conditions along with the number and species of birds observed. Scientists can easily reuse the information since it will be stored in an organized and usable database.

3.4   Extracting reusable data from the V.Inc.A reports

Relazione di Valutazione di Incidenza Ambientale (V.Inc.A) reports filed with the Osservatorio contain large quantities of environmental information. This information

could be very useful in the study of the lagoon. However, the reports are filed in paper form so the data is not reusable. The team extracted what data was available from the reports and placed it in a digital database. Furthermore, changes to the reporting process have been suggested so data from future reports will be more useful and easily added to the database.

Figure 25: V.Inc.A Report[37]

3.4.1   Obtaining the V.Inc.A

The Osservatorio has several V.Inc.A reports on file. However the reports are in paper form. Therefore they had to be scanned into the computer to create an Adobe .pdf file. Only two V.Inc.A reports were available for analysis.

3.4.2   Identifying reusable data

After obtaining the V.Inc.A, the first step was to identify the reusable data within the reports. After studying the two V.Inc.A reports, data tables have been identified in each.

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[37] Relazione di Valutazione di Incidenza Ambentale, 1.

SELC *biologia e geologia applicate*

SELC *piccola Società Cooperativa a responsabilità limitata*

Tab. 4.2 Specie di uccelli presenti nel SIC ed incluse nell'Allegato 1 della Direttiva Uccelli.

NOME DELLA SPECIE	RESI DENZA	NIDIFICA ZIONE	SVERNA MENTO	TAPPA	POPOLA ZIONE	CONSERVA ZIONE	ISOLA MENTO	VALUTAZIONE GLOBALE
Glareola pratincola				P	D			
Ixobrychus minutus		P			C	A	C	B
Porzana parva				R	D			
Circus cyaneus			P		D			
Philomachus pugnax				P	D			
Chlidonias niger				C	C	B	C	C
Egretta alba			P		D			
Egretta garzetta			C		C	B	C	B
Gavia stellata			R		D			

Figure 26: V.Inc.A Bird Data[38]

3.4.3 Extracting the data

A database was created to store the data that was available. This database contains all of the data shown in the tables of VINCA reports, but the information is stored in a more useful and reusable manner since it is in digital form.

3.4.4 Suggesting changes to the reporting process

It was determined that the data contained within the V.Inc.A reports is not reusable. Suggestions have been made which will make the data reusable.

3.5 Demonstrating the reusability of the data

The data collected from the V.Inc.A is stored in a computer database. A database for citizen monitoring data has been created. These databases greatly increase the reusability of the data due to their ease of use and manipulation of data.

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[38] Relazione di Valutazione di Incidenza Ambentale, 15.

3.5.1 Sample bird data

Since citizen monitoring data is not yet available and the data from the V.Inc.A reports is not reusable, information from a scientific count of nesting birds, performed in 1996, has been obtained and used as a preview of displaying and using a large quantity of data. The information is stored in a database which makes it useful since it is easily searched and organized with queries.

3.5.1.1 GIS location codes

A map was included with the bird data which displays the precise location of each data collection point. The points on the map were transferred to a GIS layer and labeled with a "Location_code."

3.5.1.2 Database location codes

Each record in the database included information describing its particular location of collection, which consisted of a grid number and a letter defining the location within the grid. These two fields were combined to create the "Location_code" of the records in the database.

3.5.1.3 Linking the database and GIS map

The database was linked to the GIS layer using the "Location_code" and sample maps of the bird data have been produced. The map was used to transfer the morphological location codes created by the team to the data. This allowed a demonstration of the usefulness of the team's standard referencing framework.

4   RESULTS

The results of this project include: 1) the segmented map of the northern lagoon 2) the developed citizen monitoring programs, 3) the database of the V.Inc.A data, and 4) sample maps of bird data.

4.1   Segmentation of the map

The map of the northern lagoon was successfully divided into small, morphologically homogeneous sections based on physical features of the lagoon. Several GIS layers were created, each displaying a particular feature of the lagoon. These layers can be seen in appendix 7.7.
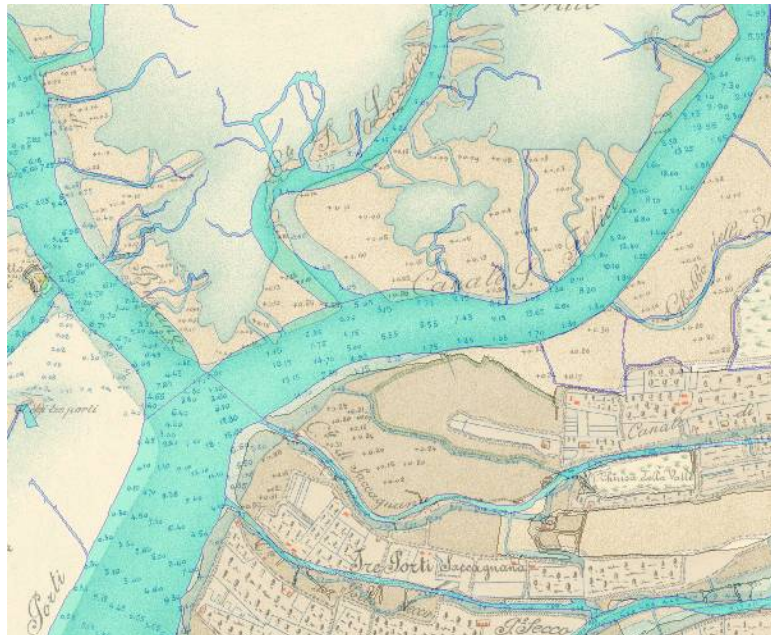
Figure 27: Combined map and GIS layer

4.1.1   General Canals

The first layer is of the general canals seen in Figure 28. There are 111 general canals named from the old maps of the lagoon.
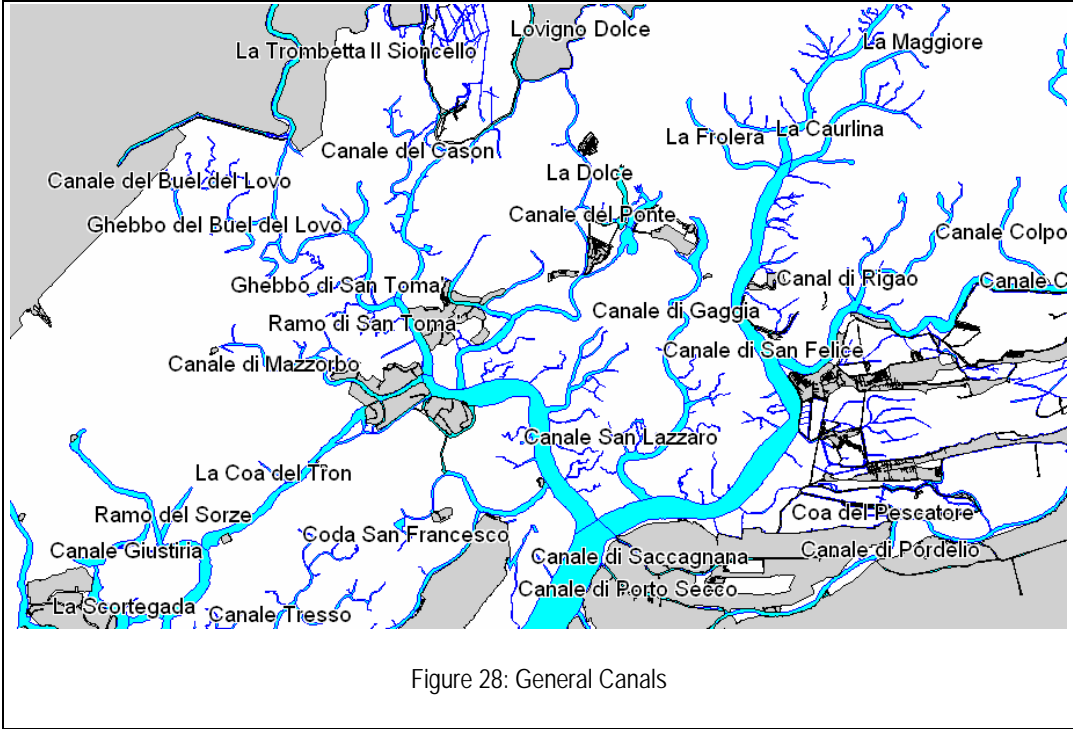
Figure 28: General Canals

4.1.2 Old canals

A layer was created displaying the old canals of the lagoon which no longer exist. The line segments on the GIS layer shown in Figure 29 represent the center line of the old canals.
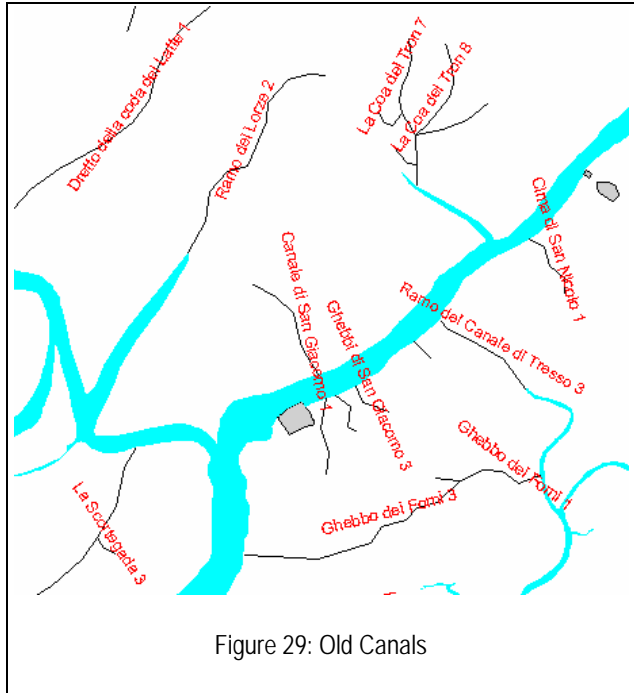
Figure 29: Old Canals

4.1.3 Canal segments

The canals were then segmented at intersections with other canals. This process resulted in 1442 canal segments. Each segment was assigned a unique name created by combining the name of the general canal with a number for each segment. The numbers are determined by the location of the segment along the canal. The numbers start at one at the segment closest to the Adriatic Sea and increase as the canal approaches the mainland. After the segments were named, a code was created for each segment. A section of coded segments is displayed in Figure 30.

Figure 30: Coded Canal Segments
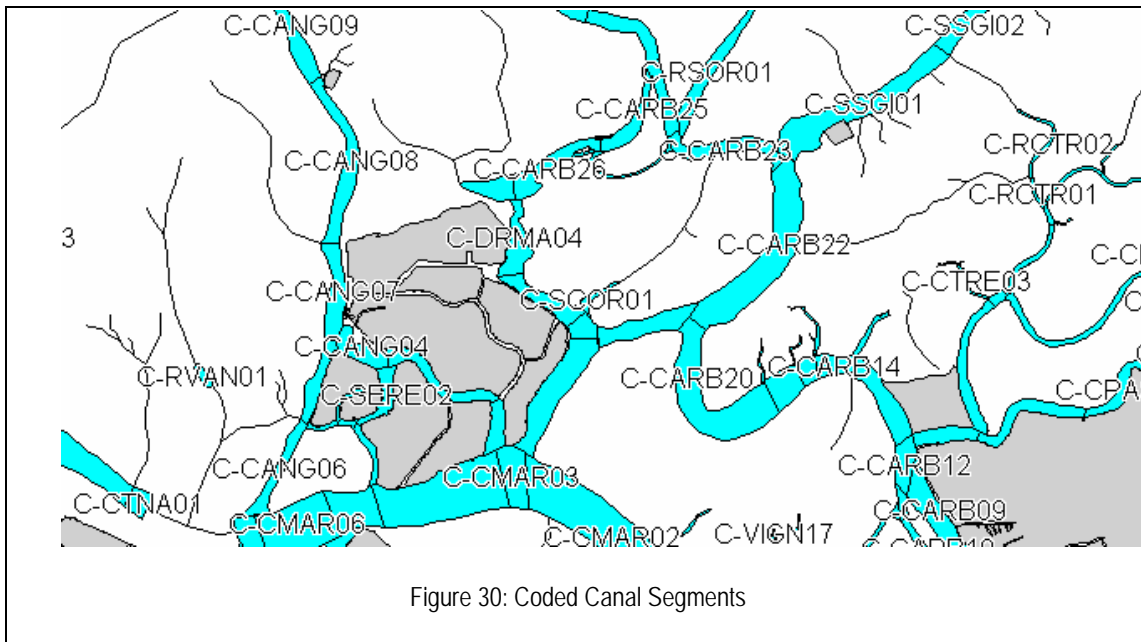
4.1.4 Barene

The barene were next to be labeled. Each individual piece of barene in the northern lagoon was named and coded. Very few areas of barene are named on the old maps so the names are assigned according to the names of nearby canals or paludi. There are a total of 547 barene codes. Figure 31 shows a section of the named barene.

Figure 31: Named Barene
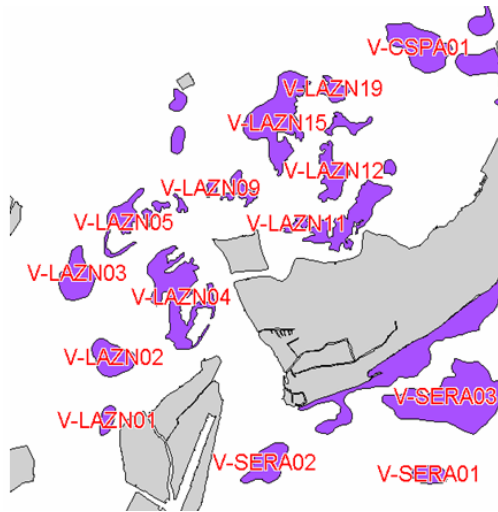
4.1.5 Velme

Being similar to the barene, the velme were also named and coded based on nearby features such as canals and paludi. The velme are often near the barene and were given similar names and codes, as shown in Figure 32.

Figure 32: Coded velme

4.1.6 Paludi

The paludi were the most difficult feature to divide. Large areas of water were separated based on the canals and barene. They were further divided by velme, where applicable, and finally by the depth of the paludi. The deepest section of the paludi was assigned one code, while the shallower edges received another as shown in Figure 33.
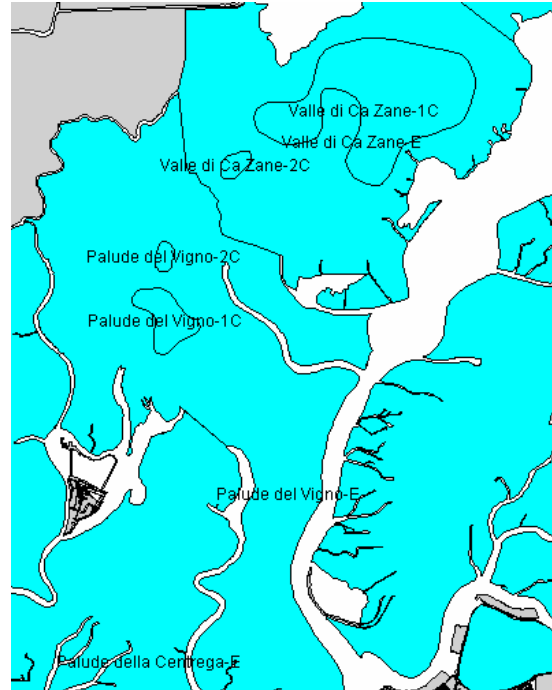
4.1.7 Final map

After every feature has been

Figure 33: Paludi

defined, the entire study area is now coded. Unlike prior to our project, every location is selectable which means data can be assigned to any location within the lagoon. Figure 34 shows the final map, with each feature in a different color. Entire maps of each feature can be found in appendix 7.7.
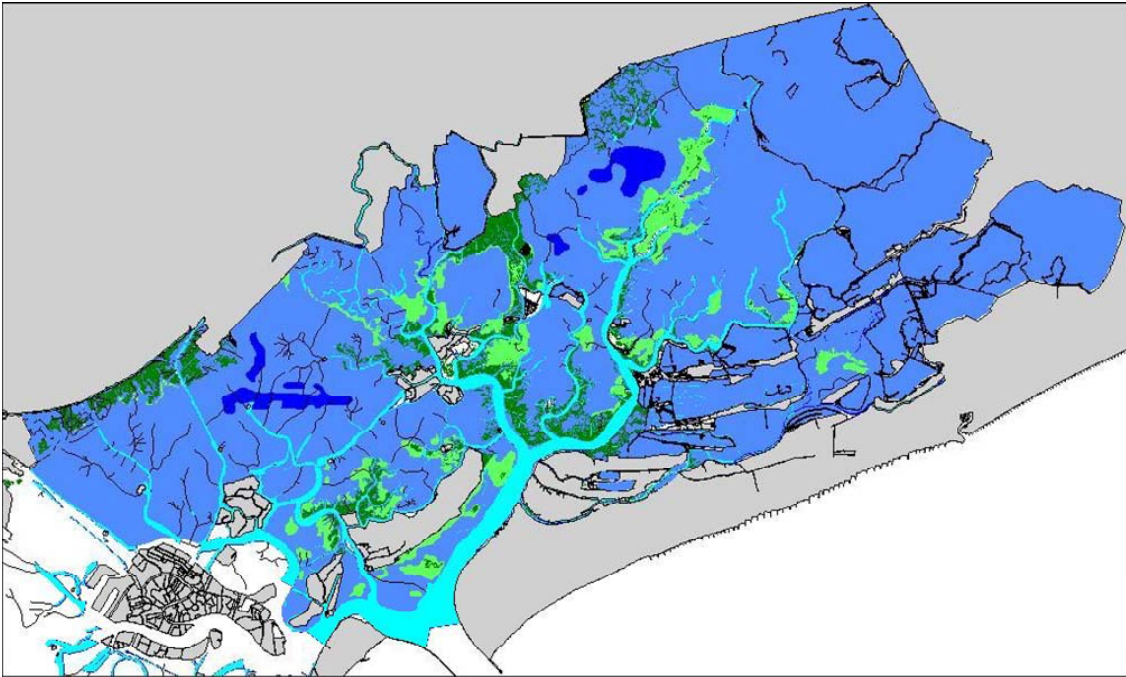
Figure 34: Completed map

4.2 Citizen science programs

A prototype citizen monitoring program was created including several suggested citizen monitoring activities and a detailed bird watching program.

4.2.1 Suggested Activities

Possible monitoring activities were determined by identifying the data in the Atlante della Laguna di Venezia which could be collected by citizen volunteers. Other possibilities were inspired by successful programs from other parts of the world which could generate useful data on the Venetian Lagoon. Descriptions of suggested activities can be found in appendix 7.2.

A clam counting program has been suggested for the velme of Venice. This program will be based on a school program in Maine designed to study the clam population of the local clam flats, as shown in Figure 35.

This program, for fifth through eighth grade students, involves students digging for clams in a measured area. They

Figure 35: Clam counting[39]

measure and record each clam found in the plot. They then move on to several other areas, creating a grid on the clam flat to get a diverse sample of data. This data is entered into a computer for analysis. The clam count results in a "bushels per acre" number, but other data is collected including the size (age) of the clams found. The data is presented to the state government to convince them to reopen the clam flats for harvesting.[40]

A similar program can be successful in Venice in studying the number of clams. This data could be used as an indicator of the health of the lagoon. It could also be used by the government to define limits on clamming in certain areas where the population has become too small or unhealthy.

4.2.1.2   Barene Watch

The erosion of barene is a major concern within the lagoon. A citizen science program can be created to monitor this erosion. The program would require installing several permanent posts on the barene. Volunteers can then go to the barene and measure the distance from the post to the edge of the barene. This data, along with the location code displayed on the post, would be submitted to the Osservatorio where it could be

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[39] Katie Dean, "Counting Clams on Fingers, Palms," *Wired News*, <http://wired-vig.wired.com/news/print/0,1294,56102,00.html> (13 July 2005).
[40] Ibid.

transferred to a map file which would show the change in the size of the barene over time. The benefits of this program would need to be weighed against the possible damage caused by participants walking on the barene.

4.2.1.3 Picture posts

Picture posts are a method of obtaining a series of pictures of the same location over a long period of time. The post will be a permanent feature of an island. It will allow the attachment of a camera to the top and have markings which identify the precise direction at which a photo should be taken. These posts can be installed at any place where long term physical changes need to be monitored.

The picture post might be a better way of monitoring the changes in the shoreline of barene since it would not require participants to walk on the barene, particularly along the delicate edge of the barene.

Pictures can be taken of barene from a picture post on a nearby island without damaging the barene. A second post can be positioned near the shore of the barene to act as a marker from which to measure. The picture taken from the picture post will include the marker post and the shoreline. As these pictures accumulate over years they can be strung into an animation of the changing shoreline.

The accumulation of pictures from a picture post will also be useful in monitoring changes in plant growth or the width of a hiking trail. The picture posts will need to be clearly marked with a unique code and instructions. After the picture is taken it will be submitted via internet to the Osservatorio along with the code from the particular post, the date and the time of the picture.

4.2.1.4 Water monitoring

Many water monitoring programs exist in the United States. The United States Environmental Protection Agency supports hundreds of programs across the country. The programs are started by private individuals interested in preserving the environment. Local and state governments, along with the EPA, provide financial support for these programs and use the data collected to make official decisions. These groups measure

indicators such as pH, temperature, salinity, dissolved oxygen, and turbidity. They also make observations of wildlife and reduce pollution through volunteer clean-ups.

A program such as this would be beneficial for Venice. Measurements could be taken at locations throughout the northern lagoon, from the shore of an island to the center of a palude. The measurements could be useful in updating the data in the Osservatorio's Atlas or identifying problem areas where further study is required. The volunteer

Figure 36: Lagoon pollution

clean-up would also be beneficial in reducing trash.

4.2.1.5   Weed watch

A group of EPA sponsored water monitors has also taken the initiative of weed watching. Each year they catalog the types and locations of weeds along the banks of the waterways they monitor. They also measure the relative weights of each species.[41] This type of survey would be useful in monitoring the seagrass and plant growth on the barene. The depletion of vegetation, due to pollution, is a major factor in the erosion of barene. The existence of seagrass can be used as an indicator for the pollution within the lagoon as well as a predictor of future rates of erosion.

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[41] EPA's Volunteer Monitoring Program,
<http://www.epa.gov/owow/monitoring/volunteer/epasvmp.html> (28 June 2005).

A bird counting program in the style of the Great Backyard Bird Count is an activity likely to be a success in the lagoon. Bird watching is a common hobby so there should be widespread interest in participating in the program. The bird count is further developed in section 4.2.3.

4.2.2   Activity selection

4.2.2.1   Decision tree

The decision tree (see appendix 7.9), partially shown in Figure 37, was created to allow the determination of an appropriate activity by an interested citizen. The appropriate time of year is first chosen, followed by the participant's age. The participant then can choose an island they are visiting to see possible activities at that island, or choose an activity they are interested in to see the locations at which it is available.
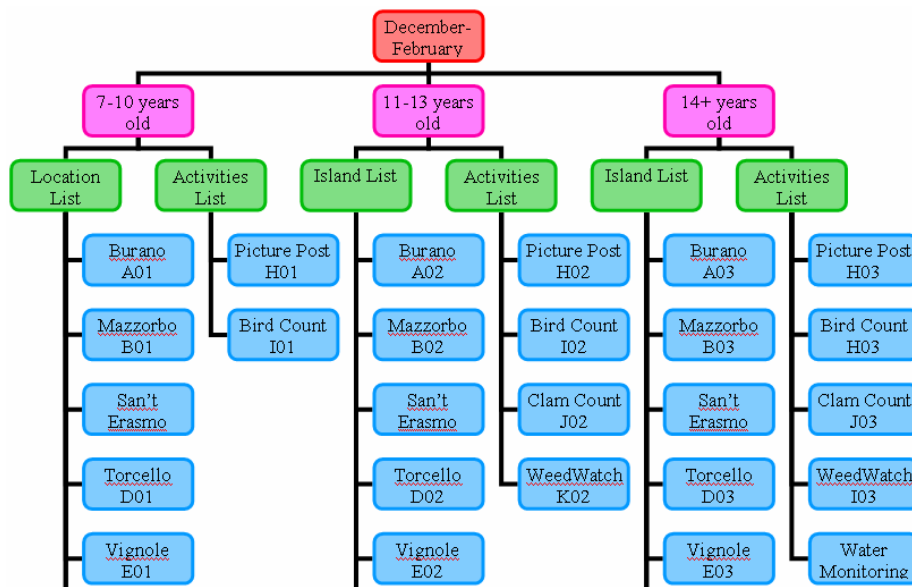
Figure 37: Decision tree

This figure can be used in paper form to choose an activity. It can also be used to create a website so as to reach the widest possible audience. On the website the participant will click their selected blue box and be linked to a page with the options available.

A sample database table was created which also allows selection of an activity. This database can be queried to identify appropriate activities. It can be used by the Osservatorio to reply to inquiries about which activity to complete and where the most beneficial location would be to complete the activity.

For example, if someone was traveling to Sant' Erasmo, a query for activities on Sant' Erasmo would be run, as shown in Figure 38. The results are the activities available. The top activity, "SandWatch," would be the suggested activity since it was last completed longest ago.

Field:	Minimum Age	Nearest Island	Location	Activity	Date of Last Comple	Instructions
Table:	Activity Search	Activity Search	Activity Search	Activity Search	Activity Search	Activity Search
Sort:					Ascending	
Show:	✓	✓	✓	✓	✓	✓
Criteria:		"SE"				

Minimum Age	Nearest Island	Location	Activity	Date of Last Completion	Instructions
10	SE	C-CPAS02	SandWatch	6/2/2001	SandWatch
7	SE	B-CTPO02	BareneWatch	3/5/2002	BareneWatch
14	SE	73-A	Bird Count	5/5/2003	BirdCount
14	SE	73-D	Bird Count	6/30/2003	BirdCount
14	SE	P-CARBE	Water Monitoring	5/2/2004	WaterMonitoring

Figure 38: Activity selection query

4.2.2.3   Tour itineraries

Itineraries were obtained from Daniela Pavan's dissertation. These itineraries suggest tours on islands throughout the park. There are symbols representing suggested activities, such as bird watching, at different locations along the tour. The team created a sample tour by including citizen monitoring activities along these predetermined routes. A possible tour is shown in Figure 39.

Figure 39: Tour itinerary

4.2.3 Bird count program

A detailed bird counting program, closely based on the Great Backyard Bird Count, was developed. There are detailed instructions of how to perform the experiment and a data submission form for this particular experiment. The database to store the submitted results was also created. The database utilizes the location codes described in section 4.1, previously determined island codes, and bird species codes. See appendix 7.11 for the fully described program.

Uccelli:

Residenza, Nidificazione/Riproduzione, Svernamento, Tappa:
C = la specie è comune
R = la specie è rara
V = la specie è molto rara
P = specie presente nel sito (non si hanno informazioni quantitative)

Popolazione:
A : popolazione compresa tra il 15,1% ed il 100% della popolazione nazionale;
B: popolazione compresa tra il 2,1% ed il 15% della popolazione nazionale;
C: popolazione compresa tra lo 0% ed il 2% della popolazione nazionale;
D: popolazione non significativa.

Conservazione:
A = conservazione eccellente;
B = buona conservazione
C = conservazione media o limitata

Isolamento:
A = popolazione (in gran parte) isolata
B = popolazione non isolata, ma ai margini dell'area di distribuzione
C = popolazione non isolata all'interno di una vasta fascia di distribuzione

Valutazione globale:
A = valore eccellente
B = valore buono
C = valore significativo

Figure 40: Analysis description

4.3 Data extraction from the V.Inc.A

Data on bird populations in the lagoon was extracted from the V.Inc.A reports. The data in the V.Inc.A is displayed using analysis codes described in Figure 40. A database was created with the same fields as the V.Inc.A

table. This database was populated with the same codes displayed in the V.Inc.A, along with a field for the date of the V.Inc.A.

Catalog of bird : Table

Date	Species Name	Residenza	Nidificazione	Svernamento	Tappa	Poplazione	Conservazione	Isolamento	Valutazione
01-Jun-03	Glareola pratinc				P	D			
01-Jun-03	Ixobrychus minu		P			C	A	C	B
01-Jun-03	Porzana parva				R	D			
01-Jun-03	Circus cyaneus			P		D			
01-Jun-03	Philomachus pu				P	D			
01-Jun-03	Chlidonias niger				C	C	B	C	C
01-Jun-03	Egretta alba			P		D			
01-Jun-03	Egretta garzetta			C		C	B	C	B
01-Jun-03	Gavia stellata			R		D			
01-Jun-03	Gavia arctica			R		D			
01-Jun-03	Pluvialis apricar				P	D			
01-Jun-03	Circus aerugino	P				C	B	C	A

Table 1: V.Inc.A Database

4.4   Nesting bird data

The information obtained from the Museo Civico di Storia Naturale was already in a database, and also included a GIS map of the data collection points. However, a certain amount of modification was necessary to make the data truly reusable.

4.4.1   Configured database

The data obtained from the Museo is attached to a specific point in the lagoon. First, a numbered grid five kilometers on a side is drawn over the study area. The grids are identified by the "UTM" number in the database. Within each grid square is an additional grid of one kilometer squares creating 25 small squares within each large square. Data is collected at a point within the one kilometer square area. Each point is assigned a letter, displayed in the "X" field of the database. These two values were combined to create unique location codes for each record as shown in Table 2.

Location_code	UTM	X
28-T	28	T
96-H	96	H
28-I	28	I
99-K	99	K
98-G	98	G
28-I	28	I
103-B	103	B
21-E	21	E
103-F	103	F
21-L	21	L
61-A	61	A
79-E	79	E

Table 2: Database location codes

4.4.2 Configured GIS layer

A map was also included in the information from the Museo which displayed the location of each data collection point (see appendix 7.5). This information was transferred to a GIS layer with the appropriate code, in the same format as the database codes. For example, the point circled in red on Figure 41 has been assigned the code, 73-A. The result is a coded map which allows the information from the database to be displayed on the GIS map.

Figure 41: GIS location codes

4.4.3 Morphologically coded data

The bird data is assigned to a specific point. This data was assigned the morphological code of the area in which the point is included. This allows the data to be extrapolated to a reasonable area of the lagoon beyond the specific point of collection. The database was updated to include the morphological codes, as shown in Figure 42.

Nesting_birds_1996 : Table

Morphological_l	Location_code	SPECIE	ADU	JUV	ATTR	N1	N2
B-MORO05	61-G	PASDIT	1	0		1	
B-MORO05	61-G	ALBMIN	1	0		1	
B-MORO05	61-G	RONDIN	3	0		1	
B-MORO05	61-G	MERLO	1	0	C2	2	
B-MORO05	61-G	AIRROS	1	0			
B-MAZZ02	61-J	BECCAM	2		C2 2	1	5
B-MAZZ02	61-J	RONDIN	4			1	
B-MAZZ02	61-J	CANVER	1		C2	2	
B-MAZZ02	61-J	CAPINE	1		C2	2	
B-MAZZ02	61-J	GABCOM	1			0	
B-MAZZ02	61-J	BECCAM	1		C2	1	5

Figure 42: Morphologically coded bird data

5   ANALYSIS

Using the results the team was able to plan out a method for the gradual and systematic accumulation of data on the Venetian lagoon. This method is based on the divisions of the lagoon into identifiable sections to identify the location of the recorded data.

5.1   Reason for dividing the lagoon into identifiable sections

The canals, barene, paludi, and velme were each individually divided in a manner which was best for each feature. The canals were divided by existing and previously existing intersections, the paludi by center and exterior regions, and the barene and velme were both divided into groups. By breaking up the lagoon into identifiable sections, information can be collected and recorded at specific locations allowing the environment to be monitored over time at those locations.

Over time, if the northern lagoon environment is monitored, it will be possible to determine patterns and norms for each segment. In knowing the baseline conditions of an area, abnormalities will be easy to recognize and control before the problem becomes too large to amend.

Another positive outcome of dividing the lagoon into sections is that by monitoring the sections of the lagoon, gaps in the data will be easy to spot and fill. If results are recorded noting the section where the observations or results were taken from, then the results will also reveal which sections have not yet been monitored.

Each division made for canals, barene, paludi, and velme in our technique involved a logical reason based on morphological features, as opposed to a randomly determined grid or the changing habitats.

5.1.1 Canals

The canals were divided at each existing and previously existing intersection for two main reasons. The first reason is that these points are visually identifiable. The second reason is that these points are also where major changes take place in the qualities of the water. When two canals merge into one, the waters mix and take on new properties.

5.1.2 Barene and velme

The barene and velme were divided into groups and coded next. The barene and velme are present in groups throughout the northern lagoon. The individual pieces were combined into these groups with a single name and code. Because the individual pieces are so close together, data taken from one part of the group should accurately represent all other parts of that group.

Figure 43: Segmenting logic

5.1.3 Paludi

The paludi were divided by depth because it was felt that differences in data would appear with differences in depth. The shallow parts of the paludi would be somewhat consistent, but the change in depth could cause changes in the environment and therefore changes in the data that would be collected.

5.2 The citizen monitoring program break-up

The citizen monitoring program is first broken up by time of year, by the seasons. It is next divided by minimum age. The three age options include seven to ten, eleven to

thirteen, and fourteen and up. The team determined that the youngest age of an individual who could collect useable information is age seven. At age seven most children have been taught colors, counting, and reading. The next division of age is between ages ten and eleven. The team felt that this was a reasonable point to make the next division because age eleven is when children are more capable of following complicating instructions. The last age break was between the ages of thirteen and fourteen. At age fourteen teenagers will have been exposed to laboratory classes in high school and can therefore perform a detailed study. At age fourteen, teenagers are just as capable as a twenty year old to look up a bird in a book or follow directions on collecting water.

The last break-up in the program is a choice between picking the citizen monitoring event by the location or by the activity. It was decided to give the option of location or activity because different people might be interested in citizen monitoring for different reasons. For example, if a person is going to a particular island one weekend, they would be able to participate in citizen monitoring, but only on the island of which they are attending. If a different person is interested in birds, however, they would be able to find a location where they could monitor birds and their resulting data would be beneficial. The program should be as accommodating to the people as possible to yield as much citizen participation as possible.

5.3 How dividing the lagoon into identifiable sections supplements citizen monitoring

The segmented GIS layer of the lagoon will also help to supplement the citizen monitoring program. The citizen monitoring program alone provides the name of the island on which the activity is performed, but doesn't pinpoint the specific location on the island where the data is collected. Scientists have the tools such as GPS to further specify their locations, but the majority of citizens lack these scientific tools. Without pinpointing the location of the monitoring activity, the collected data is almost useless.

With the GIS layers, citizens can precisely identify their location, allowing scientists to use this information to keep accurate records of the lagoon and help them to analyze

the results received, as well as extrapolate the data to a specified area. Multiple datasets will be collected for the same location so they can be compared and related.

5.4   Demonstrating the reusability of data

Databases and GIS maps are vital in making data reusable. Since citizen monitoring data is not available, the reusability is illustrated using the bird data obtained from the *Museo Civico di Storia Naturale*.

5.4.1   Database reusability

Databases are vital in storing data in a reusable manner. The information can be organized and sorted in any way desired. This allows scientists to easily extract only useable data. Sorting the data can also show trends, such as a decline in the population of a certain species of bird over time.

Databases are also vital in displaying data on GIS maps. The database can be linked to the GIS map so the data appears on the map.

5.4.2   GIS map reusablitiy

Maps are another important feature in creating reusable data. Linking the database and GIS layer allows the data to be displayed visually in meaningful and easily understood ways. The map is easily updateable by simply updating the database.

5.4.3   Reusing bird data

There are over 31,000 records in the database of nesting birds. This information would be almost useless in paper form because there are just too many records. However, the data is easily reusable in digital form.

The database alone offers advantages over paper documents. The database can be sorted to view trends or queried to obtain only relevant information. For example, if a scientist is interested in only birds on Sant' Erasmo, a query can be created to obtain only this data, as shown in Table 3.

LOCALITA	PR	UTM	X	DATA	H_	AMB_
Nesting_birds_1996	Nesting_birds_1996	Nesting_birds_1996	Nesting_birds_1996	Nesting_birds_1996	Nesting_birds_1996	Nesting_birds_1996
☑	☑	☑	☑	☑	☑	☑
		73	"A"			
		73	"B"			
		73	"E"			
		73	"G"			
		73	"F"			
		73	"D"			
		73	"I"			

Table 3: Query for birds of Sant' Erasmo

This query gathers data obtained at the collection points on Sant' Erasmo. The query will result in a table of 143 records, which can either be used in its entirety or can be further narrowed, perhaps to a particular species of bird.

5.4.3.2   Bird GIS maps
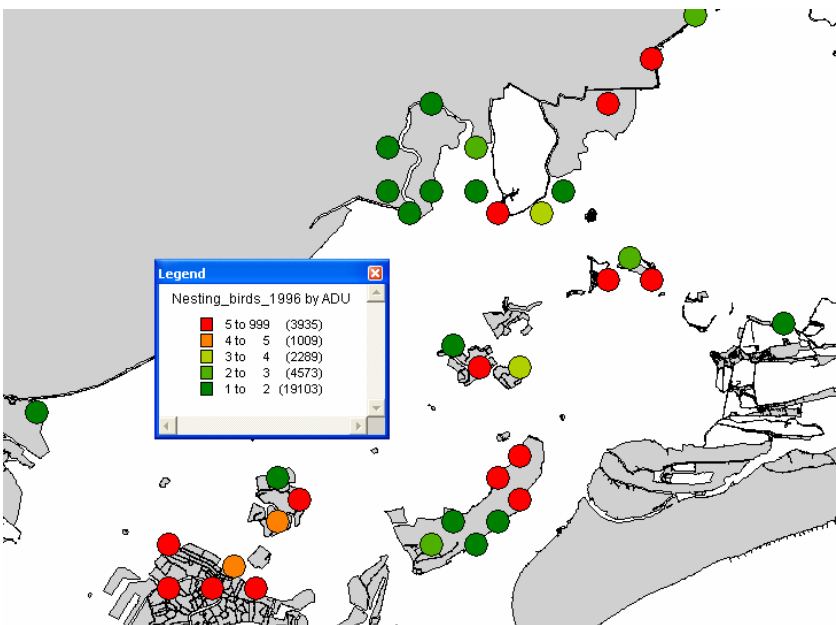
Figure 44: Number of adult birds observed

The database can also be combined with a GIS layer to create maps. The location codes created on the GIS layer were linked with the location codes created for each data record. This allowed the bird data to be displayed on the GIS map as shown in Figure 44.

Displaying the data in a map makes a large quantity of data easily comprehensible. This map demonstrates the reusability of information stored in a database.

Morphological codes were transferred to the data based on the location of data collection points. This allows the data to be assigned to a specific island. The example shown in Figure 45 is bird observation point 61-G. This point is located on the barene Monte dell' Oro 5 (B-MORO05). By using this code to define the bird
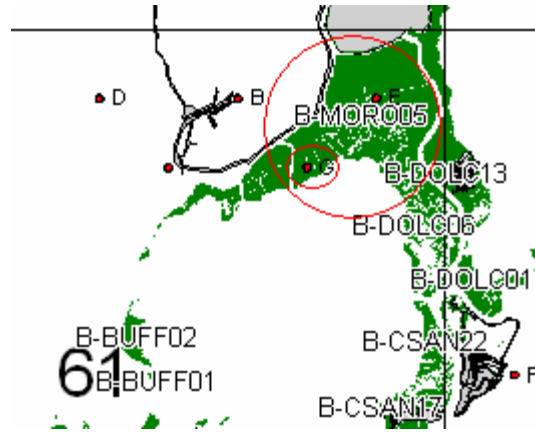
Figure 45: Adding morphological codes

location, other information collect on that same barena can be confidently related to the bird data. For example, if citizen monitors report that the bird population decreases year after year, other information on this same barena can be investigated to determine the cause. The "Barene Watch" program might show this barena is eroding, which means the birds are losing their habitat and explains the decrease in population.
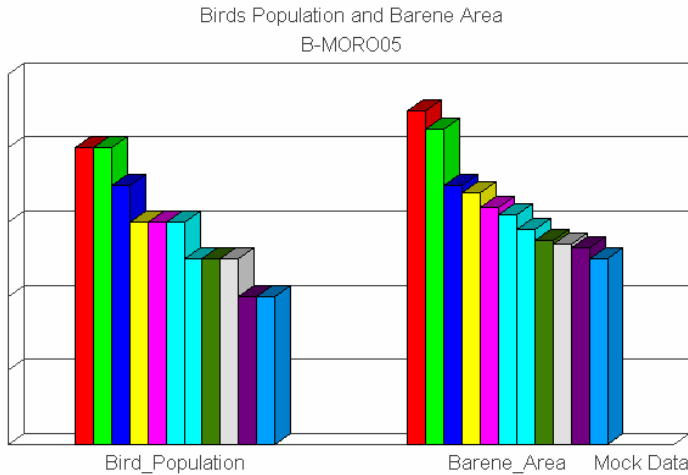
Figure 46: Relating data through morphological codes

Figure 46 is a possible graph which can be created that relates bird data and barene data at a point. This example illustrates the importance of using the same location codes for each dataset in determining relationships.

5.5   V.Inc.A data

Despite the more organized and understandable storage method of the data from the V.Inc.A reports, it was discovered that the data is still not particularly useful. The V.Inc.A does not contain the raw data collected on site. In the V.Inc.A, each species of birds is ranked in several categories which describe the health of the species population. For each category the species is assigned a

Uccelli:

Residenza, Nidificazione/Riproduzione, Svernamento, Tappa:
C = la specie è comune
R = la specie è rara
V = la specie è molto rara
P = specie presente nel sito (non si hanno informazioni quantitative)

Popolazione:
A : popolazione compresa tra il 15,1% ed il 100% della popolazione nazionale;
B: popolazione compresa tra il 2,1% ed il 15% della popolazione nazionale;
C: popolazione compresa tra lo 0% ed il 2% della popolazione nazionale;
D: popolazione non significativa.

Conservazione:
A = conservazione eccellente;
B = buona conservazione
C = conservazione media o limitata

Isolamento:
A = popolazione (in gran parte) isolata
B = popolazione non isolata, ma ai margini dell'area di distribuzione
C = popolazione non isolata all'interno di una vasta fascia di distribuzione

Valutazione globale:
A = valore eccellente
B = valore buono
C = valore significativo

Figure 47: Analysis description

letter grade which is defined by a complex analysis of the raw data. This analysis is described in Figure 47. This analysis causes a significant loss of knowledge. Furthermore, the data from one of the V.Inc.A reports pertain to the entire lagoon so this data is simply an average of the entire lagoon. The source of the data could not be identified and the data can not be assigned to any specific point.

6   RECOMMENDATIONS AND CONCLUSIONS

After completing this project several key issues became apparent. The inexpensive accumulation of environmental data is entirely possible with the implementation of a few suggestions. Methods of implementing citizen monitoring programs have been suggested, along with changes to V.Inc.A submissions and bird data collection procedures.

6.1   V.Inc.A

It was expected that the V.Inc.A reports would be a valuable source of environmental information. Initial inspection seemed to confirm this fact. However, after further review several problems with the V.Inc.A reports became apparent.

6.1.1   Digital submission

The V.Inc.A reports were difficult to obtain. Only two reports were available for inspection because they are submitted in paper format, which is not only inconvenient, but also a waste of resources and time. The submitting organization had to print out the entire report on paper. The Osservatorio then scans the pages into the computer to create a .pdf file to transfer to someone interested in examining the report. It would be extremely convenient if the submitting organization simply submitted the report digitally.

6.1.2   Inclusion of raw data

After obtaining the reports information was extracted and examined. Unfortunately the data contained within the V.Inc.A is not reusable because it has already undergone extensive analysis. It is recommended that future V.Inc.A reports be required to submit the raw data collected in the field along with their analysis. Additionally, the data should be submitted in an easily reusable database, eliminating the entire data extraction process. Enacting these data submission requirements would allow the information collected for the V.Inc.A to be easily reused.

6.2　Citizen monitoring

Citizen monitoring has been deemed a valuable source of environmental data. However, implementing the programs will take a significant commitment from the Osservatorio. Recommendations have been made to ease the creation of the programs.

6.2.1　Creation of programs

Several citizen monitoring activities have been suggested and explained, with details and preliminary methodologies found in appendix 7.2. Despite the team's best efforts, we are not scientists. Therefore it is recommended that the suggested activities be reviewed by qualified personnel who can create detailed, explicit, and scientifically sound methodologies for each activity.

To assist in the process of creating these project instructions, several citizen monitoring programs from America have been cited. It is recommended that the Venetian programs be based on established and successful programs elsewhere.

6.2.2　Attracting participants

In order for a citizen science program to be successful, there must be volunteers willing to participate. This requires the Osservatorio to actively seek participants.

6.2.2.1　School trips

School field trips seem to be the best way to begin gaining participants in the citizen science activities. Daniela Pavan has begun the process of creating these field trips but additional effort to coordinate Venetian schools with the Osservatorio would be greatly beneficial in spreading the word of citizen monitoring. The students would produce useful information during their field trip. Furthermore, participating students would be informed of other activities they could perform on their own, and would hopefully include friends and family.

To further gain the support of the general public for the citizen science programs the Osservatorio could create press releases outlining the importance of citizen participation in preserving the lagoon and, therefore, the city.

6.2.3   Collecting and displaying the data

Databases for the storage of data have been created. However, the more complex task of creating an online submission program is not within the ability of this project team. A submission website similar to that of the Great Backyard Bird Count is recommended. Like the Great Backyard Bird Count, the data should be made available for public access which will illustrate the fact that the submitted data is actually used. This will give participants a sense of accomplishment and encourage additional contributions.

6.3   Museo Civico di Storia Naturale Bird Count

Although modifying this program was not an initial goal of this project, possible improvements to this bird count have been discovered through our research and analysis.

6.3.1   Data submission

The bird counting procedure involves individuals filling out and filing paper forms. An updated version of this method could require each counter to fill out an online form and submit their data in digital format so it can be automatically inserted into a database.

6.3.2 Updating the data

The only data available to the team was from 1996. This illustrates the need to find a method of updating the database. It is proposed that this database be supplemented with data from citizen monitoring programs.

If this system were implemented, each record would include a field identifying the source of the data; a trained bird counter or a citizen monitor. Therefore the database will be constantly updated with data from citizen monitors, but can also be queried to obtain only professionally collected data if necessary.

6.3.3 Division of the lagoon

A new system of labeling the divisions of the lagoon is advised. The team advises the use of the morphological codes. The usefulness of these codes was demonstrated in section 5.4.3.3.

However, if a grid system must be used, the labeling of points need adjustment. The letters assigned to specific points within each large grid area do not follow a consistent pattern. It is recommended that each corresponding point within the grid be assigned the same letter, as shown in Figure 48. Section "A" would always be the top left point in the grid and point "Y" would always be on the bottom right. This would greatly simplify determining the appropriate code at a particular location and allow the addition of data at any point in the lagoon.

GRID 51					GRID 52				
51-A	51-B	51-C	51-D	51-E	52-A	52-B	52-C	52-D	52-E
51-F	51-G	51-H	51-I	51-J	52-F	52-G	52-H	52-I	52-J
51-K	51-L	51-M	51-N	51-O	52-K	52-L	52-M	52-N	52-O
51-P	51-Q	51-R	51-S	51-T	52-P	52-Q	52-R	52-S	52-T
51-U	51-V	51-W	51-X	51-Y	52-U	52-V	52-W	52-X	52-Y

Figure 48: Suggested labeling method

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Venice in Peril: The British Committee for the Preservation of Venice.
<http://veniceinperil.org/> (19 April 2005).

"What has Citizen Science Accomplished So Far?" *Cornell Lab of Ornithology*,
<http://www.birds.cornell.edu/LabPrograms/CitSci/CitSciPublications.html> (28
June 2005).

World Water Monitoring Day, <http://www.worldwatermonitoringday.org> (28 June
2005).

7 APPENDICES

7.1 Annotated bibliography

Arnal, Keyla, Sarah Doyon, Erin Ellsworth, and Jason Sansoucie. "Management of the Citizen Science Program Through the Boston Museum of Science." *Venice Project Center*. < http://users.wpi.edu/~erin/mos/> (19 April 2005).

This proposal was from a project taking place in Boston, Masachusetts, evaluating Various approaches to citizen monitioring. It was helpful in finding the best methods for creating and maitaining a citizen monitoring program.

Atlante della Laguna di Venezia. **Venice: 2005.**

This is the atlas made by the Osservatorio, which is in the process of being published. The atlas provided ideas for subjects that could be monitored by volunteers, and the Osservatorio hopes to use the team's system to keep this atlas up to date.

Battocchi, Scott, Caitlin Bell, Jeffrey Blair, and Natalie Cole. "The Island of Pellestrina: Case Study for the Environmental Atlas of the Venetian Lagoon." *Venice Project Center.* **30 July 2003. <http://www.wpi.edu/Academics/Depts/IGSD/Projects/Venice/Center/Projects/IP_public/E03/Pellestrina> (19 April 2005).**

This document is a study of the environment around the Venetian lagoon. This project is used in order to determine the best ways to collect and re-use data based on traffic and beach use data.

Bianchi, F., F. Acri, F. Bernardi Aubry, A. Berton, A. Boldrin, E. Camatti, D. Cassin and A. Comaschi. "Can plankton communities be considered as bio

indicators of water quality in the Lagoon of Venice?" *Marine Pollution Bulletin* **46, no. 8 (2003): 964-971.**

This article details a study performed in Venice to discover whether plankton in the lagoon could be used as an indicator of the health of the local water, and of the local ecosystem.

Chandonnet, Eric, Daniel Richardi, Christie Rudis, and Agnieszka Ziolek. "Planning Sustainable Tourism for the Northern Lagoon Park of Venice." *Venice Project Center*. **7 December 2004. <http://www.wpi.edu/Academics/Depts/IGSD/Projects/Venice/Center/Projects/IP_public/E04/Lagoon_Park/Project%20Report> (19 April 2005).**

This document is the perquisite to the upcoming project for creating a maintainable and useful database of the Venetian park environment.

"Citizen Monitoring." *Alliance for the Chesapeake Bay*. **< http://www.acb online.org/project.cfm?vid=87> (6 April 2005).**

This site describes the success of citizen monitoring in the Chesapeake Bay. It was helpful in demonstrating the willingness and ability of citizens to collect data, as well as in providing methodological information.

CoRiLa. **<http://www.corila.it/> (17 April 2005).**

This is the home page for the Consortium for Coordination of Research Activities Concerning the Venice Lagoon System, or CoRiLa. It has many research programs taking place concerning the environmental health of the lagoon.

Dean, Katie. "Counting Clams on Fingers, Palms." *Wired News*.
<**http://wiredvig.wired.com/news/print/0,1294,56102,00.html**> **(13 July 2005).**

This article describes a citizen monitoring program in Maine whose results will have a significant impact on the region. It is a good example of a way in which citizen monitors collect data which can be used by scientific studies, and is the basis for one of the programs in the project.

Defence from high waters: activities for the safeguarding of Venice and its lagoon.
<**http://www.salve.it/uk/**> **(12 April 2005).**

This is the home page of the Consortio Venezia Nouva, the organization in charge of the Mose project. The site promotes general environmental awareness concerning the lagoon while focusing on the effects of the Mose.

"EPA's Volunteer Monitoring Program," U.S. Environmental Protection Agency,
<**http://www.epa.gov/volunteer/epasvmp.html**> **(28 June 2005).**

This is the site for the citizen monitoring activities for the Environmental Protection Agency. The EPA collects data from several different types of studies through citizen monitoring, and encourages citizens to spread citizen monitoring in order to further their research.

Fletcher, Caroline, and Jane Da Mosto. *The Science of Saving Venice*. **Venezia: Umberto Allemandi e C., 2004.**

This book outlined the problems facing Venice today. It also detailed the steps that have been taken to solve these problems, and proposes new methods to solve the problems that have not yet been addressed.

Freemantle, Michael. "Safeguarding Venice." *Chemical and Engineering News*. **28 August, 2000. <http://pubs.acs.org/cen/coverstory/7835/7835sci1p.html> (20 April 2005).**

The article discusses the problems taking place in Venice due to its unique relationship with the lagoon. The article focuses on the development of the industrial site in Marghera and its effects on the environment of the lagoon.

Ghetti, A. "Subsidence and sea-level fluctuations in the territory of Venice." *Landscape and Urban Planning* **16, no.2 (1988): 13-33.**

This article gave a history of the problem of flooding in Venice. It gave a few contributing factors to the increased flooding, and discussed the effectiveness of the Mose project as a possible solution.

Gomes, Egas, Jeremy Griffin, Virgil Vaillancourt, and Mary Wood. "Environmental Impact Reports: Re-usable EIR Information for the City of Boston." *Venice Project Center*. **< http://users.wpi.edu/~griffinj/EIR05> (19 April 2005).**

This is a similar project taking place in Boston, Massachusetts. The project team there is assessing the Boston Environmental Impact Reports and finding ways in which their information can be reused. They have also created a good standardized methodology for extracting information.

Hutchison, David. *Growing up green education for ecological renewal.* **New York: Teachers College Press, 1998.**

This book details the evolution of the educational system and how it has become more environmentally inclined. The book advocates teaching about environmental concerns early on. This source was useful for its information on the continuing evolution of environmental awareness.

"Monitoring and Assessing Water Quality." *U.S. Environmental Protection Agency.* <http://www.epa.gov/owow/monitoring/volunteer/> **(6 April 2005).**

This site includes guides for volunteers, which can be used as examples for the guides the team will create. It also includes several links which appear to be useful, including a link to a volunteer monitoring newsletter.

National Audubon Society. <http://www.audubon.org/> **(28 June 2005).**

This is the website for the National Audubon Society, an organization dedicated to the preservation and observation of birds. The Audubon Society conducts multiple citizen monitoring activities to monitor bird populations and trends among species.

Nature Watch. **20 November 2002.** < http://www.naturewatch.ca/english/> **(14 April 2005).**

This is the home page for Nature Watch, a prominent citizen monitoring program in Canada. The program has four divisions: Ice Watch, Frog Watch, Plant Watch and Worm Watch. Each of these programs gives visitors to the sites instructions on how they can help. This organization is a good example of using citizen monitoring to collect large amounts of data inexpensively.

Ortolano, Leonard. *Environmental Regulation and Impact Assessment.* **New York: John Wiley & Sons, 1997.**

This book emphasizes the link between Environmental Impact Assessments and Environmental Regulations. This book will be useful in demonstrating the usefulness of the VINCA reports.

Pavan, Daniela. "Il Contributo di Itinerari Naturalistici alla Raccolta Graduale di Una Conoscenza Sistematica dell'Ambiente Naturale: Caso di Studio nell'Area del Parco della Laguna Nord di Venezia." Ph.D. diss., Università Ca' Foscari Venezia, 2004.

This dissertation by Daniela Pavan was the basis for the citizen monitoring section of this project. The team applied her idea to use school field trips as sources of citizen monitoring data and designed the programs based on age groups.

"Proceedings, 6th National Volunteer Monitoring Conference, April 26 - 29, 2000 Austin, Texas." *U.S. Environmental Protection Agency*. <http://www.epa.gov/owow/volunteer/proceedings/sixth/pdftoc.html> (10 April 2005).

This conference covers many useful topics including methods of attracting volunteers and a section dedicated to monitoring the health of wetlands. There is also information about data storage and use.

Relazione di Valutazione di Incidenza Ambientale. "Progetto Unitario di Utilizzo per la costruzione di cavane in localita Ca'Noghera (VE)." *Associazione Sportiva*. (July 2003).

This is one of the *Relazione di Valutazione di Incidenza Ambientale* (V.Inc.A). V.Inc.A Reports were one of the sources considered for the accumulation of data on the lagoon.

"The 105th CBC, December 14th 2004 to January 5th 2005: Successful completion of a new record number of counts." *National Audubon Society*.   <http://www.audubon.org/bird/cbc/index.html> (28 June 2005).

This article details the results of the Christmas Bird Count of 2005. The Christmas Bird Count is the National Audubon Society's first citizen monitoring activity, and volunteers participate in it nationwide.

The Great Backyard Bird Count. <http://www.birdsource.org/gbbc/> (28 June 2005).

       This is the website for the Great Backyard Bird Count, a citizen monitoring activity run by the National Audubon Society. The Great Backyard Bird Count is the basis for a program in the project.

"The National Environmental Policy Act of 1969." *Council on Environmental Quality*. 1 January 1970.
<http://ceq.eh.doe.gov/nepa/regs/nepa/nepaeqia.htm> (21 April 2005).

       This was a United States Government Act made in the late 1960s creating policies for better preserving the environment. This Act was responsible for the creation of the United States Council on Environmental Quality. It also advocates heightening environmental awareness.

Venice in Peril: The British Committee for the Preservation of Venice.
<http://veniceinperil.org/> (19 April 2005).

       This site is the home page for Venice in Peril, the British organization for preserving Venice which was founded in response to the flood in 1966. The site describes the issues plaguing Venice today, and has several projects currently in place to help save the city.

"What has Citizen Science Accomplished So Far?" *Cornell Lab of Ornithology*,
<http://www.birds.cornell.edu/LabPrograms/CitSci/CitSciPublications.html (28 June 2005).

       This article cites citizen monitoring programs that have assisted in scientific studies. It supports the project in showing how citizen monitoring has benefited other places.

***World Water Monitoring Day*, <u>http://www.worldwatermonitoringday.org</u> (28 June 2005).**

This website describes World Water Monitoring Day, a citizen monitoring program dedicated to testing water quality in watersheds. The site encourages schools to use the program as a class activity.

7.2   Citizen monitoring activity descriptions

7.2.1   <u>SandWatch</u>

Sandwatch is a program designed to monitor the types of sand in the lagoon. The sand will be divided based on the size of a grain into a "mud" category and a "sand" category. This will provide scientists with information on the source of sediment in the lagoon.

Suggested age: 10 and up

Equipment required: Shovel
                      2 Buckets
                      Large tray
                      Sifter
                      Scale

Description:
        Begin by selecting an appropriate location for the experiment. Record the exact location as well as: date, time of day, and weather conditions.
        Collect a sample of sand from the selected location with the shovel and place it in the large tray. Leave the tray in the sun so the sand will dry. While waiting for the sand to dry, measure and record the weight of each bucket.
        Once the sand is dry, place the sifter over a bucket and pour the sand through the sifter, allowing the smaller grains to fall through into the bucket. Repeat the sifting process to ensure all the sand is separated. Place the large grain sand in the second bucket and record the mass of the buckets and the sand.
        Calculate the mass of each type of sand as well as the total mass of sand collected. Divide the mass of each type by the total mass to obtain the percent mass of mud (the small grain) and sand (the large grain). Record this data and enter it into the online form for submission to the database.

7.2.2 Bird Count

Bird count is a program designed to monitor the number of each species of bird found in the lagoon. This information will be used to determine the health of local bird populations and monitor for changes.

Suggested age: 14 and up

Equipment required: Bird watching manual
                     Binoculars

Description:
Begin by selecting an appropriate location and time for the experiment. Record the exact location as well as date and time of day.

Staying within the general area of the initial point, begin to observe different species of birds. As a species is identified record the maximum number of that particular species seen at the same time. For example, if you see three of the same species now, then one more in 10 minutes, you would still only record three because that last bird might be one of the original three. This eliminates the possibility of counting the same bird more than once. However, if later in the day you see five of that species at the same time, your new result will be five.

Take a count of every species identified with the method described. Record your results on the data submission form. Once the experiment is complete for the selected area, input the collected data into the online form and submit it for inclusion in the database. You can complete this activity for as many areas as you wish, as long as you begin a new data submission form for each location.

7.2.3   Picture posts

Picture posts provide a method of documenting physical changes to the environment over a long period of time. Participants will take a picture from a defined location. All pictures from this location will be grouped together to watch changes occur. This is a useful method for watching the green-up of vegetation and to monitor visitor impacts on trail width.

Suggested age: 10 and up

Equipment required: Digital camera

Description:
Begin by selecting an appropriate location for the experiment. Select a particular post from the map. Record the post code as well as date and time of day of the picture.
Attach the digital camera to the top of the post. Align the camera with one of the directions indicated on the post. Record the direction and take the picture. Repeat for each direction on the post. If possible, continue on to the next post and repeat the experiment.
Complete the online data entry form for each post and upload the appropriate pictures. Submit the form and pictures for entry into the database.

7.2.4   Water monitoring

The water monitoring experiment will collect data on several water quality factors at particular location throughout the lagoon. Turbidity is a measure of the clearness of the water, providing information on the suspended sediment in the water. The amount of dissolved oxygen determines which species can survive in the water and can indicate problems such as algae blooms. Temperature and salinity are other factors important to studying a body of water.

The program will also request that participants spend time cleaning the chosen location of trash and debris.

Suggested age: 14 and up

Equipment required: Water testing kit (www.worldwatermonitoringday.org/orderkits)
Secchi disk
Thermometer
Ruler

Description:

Begin by selecting an appropriate location for the experiment. Precise locations are shown on the map and marked with a post. Water quality changes significantly from one location to another so it is imperative that you perform the experiment at an approved location. Select a particular post from the map. Record the post code as well as date, time of day, and weather conditions.

Begin by measuring the air temperature and the water temperature with the thermometer. Use the secchi disk as instructed to measure the turbidity. Careful perform the suggested chemical tests with the water testing kit and record all results.

Once the experiment is complete, input the collected data into the online form and submit it for inclusion in the database.

7.2.5 BareneWatch

This program is designed to monitor the change in size of the barene in the Venetian Lagoon. This will be done by measuring the distance from a set location (a post) to the edge of the barene. By recording this distance regularly, the rate of erosion can be determined.

Suggested age: 7 and up

Equipment required: Tape measure

Description:
Begin by selecting an appropriate location for the experiment. Select a particular post from the map. Record the post code as well as date and time of day.
With one person holding the end of the tape measure at the base of the post closest to the shore, the other person will measure and record the shortest distance to the edge of the barene. If possible repeat the experiment at nearby posts. Finally, enter your results in the online form and submit them to the database.

7.2.6 Clam Count

Clam count is a program designed to monitor the number, species, and size of clams found in the lagoon. This information will be used to determine the health of local clam populations, monitor for invading species, and indicate the overall health of the lagoon environment.

Suggested age: 10 and up

Equipment required: Clam information packet
                     Shovel
                     Several buckets
                     Ruler

Description:
      Begin by selecting an appropriate location and time for the experiment (low tide on velme). Record the exact location as well as date and time of day.
      Dig in a 40 cm x 70 cm area and place the clams in a bucket. Sort the clams by species into different buckets and record the number of each species. Furthermore, measure the width of each clam and record these values for each species. After the data is recorded return the clams and move to another location 20-30 meters away. The experiment will be conducted repeatedly in order to form a grid of plots from which data was collected.
      Once the experiment is complete, input the collected data into the online form and submit it for inclusion in the database.

7.3 Water monitoring database

Observer Age	Date	Time of Day	Location	Recent Precipitation	Dissolved Oxygen	pH	Air Temperature	Water Temperature	Water Turbitity

7.4 Index of "Atlante della Laguna di Venezia"

		Tema	Titolo Carta
GEO			**Clima**
	1	Temperatura	**Climatologia media annuale (2001-2003)**
	2		**Climatologia media stagionale (2001-2003)**
	3	Venti dominanti	**Campi di vento**
	4	Marea	**Maree e acqua alta**
	5		**Rete ondametrica**
		Geologia	
	6	Batimetria	**Batimetrie dei fondali, anno 2002**
	7		**Batimetrie dei fondali, anno 1970, 1990 e 2 differenze**
	8	Sedimenti	**Sedimenti superficiali: la classificazione granulometrica**
	9		**Sedimenti superficiali: la pelite**
	10		**Sedimenti superficiali: la mineralogia**
	11		**Carbonio organico totale nei sedimenti superficiali**
	12	Geopedologia	**Morfogenesi degli ambienti intertidali**
	13		**Unità pedologiche delle barene naturali**
	14		**Ossidi di ferro quali indicatori ecologici**
	15		**Funzione dei suoli**
	16	Suolo	**I suoli del Bacino Scolante**
	17		**I suoli del Bacino Scolante/ dettagli**
		Idrologia	
	32	Idrologia	**L'idrodinamica della laguna: l'effetto della marea**
	33		**L'idrodinamica della laguna: l'effetto dei venti**
	18	Acqua	**Salinità media triennio 2001-2003**
	19		**Salinità stagionale**
	20		**Fosforo reattivo media triennio 2001-2003**
	21		**Fosforo reattivo stagionale**
	22		**Azoto inorganico disciolto media triennio 2001-2003**
	23		**Azoto inorganico disciolto stagionale**
	24		**Clorofilla a media triennio 2001-2003**

	25	**Clorofilla a stagionale**
	26	**Evoluzione temporale della clorofilla (estate 1987, 1993, 1998 e 2003)**
	27	**Salinità lungo il litorale**
	28	**Azoto nitrico stagionale lungo il litorale**
	29	Bacino scolante **Corsi d'acqua del bacino scolante**
	30	**Acque dolci dal bacino scolante**
	31	**Eventi di piena nel bacino scolante**
	34	Acque sotterranee **Qualità delle acque sotterranee**
	35	**Concentrazione nitrati nelle acque sotterranee**
BIO		**Fauna**
	39	Foraminiferi **Distribuzione dei foraminiferi**
	43	Zooplancton **Ciclo annuale del mesozooplancton**
	36	MacroBenthos **Invertebrati di fondo mobile:abbondanza**
	37	**Invertrebrati di fondo mobile: diversità**
	38	**Invertrebrati di fondo mobile: distribuzione di quattro specie caratteristiche**
	40	Pesci **La comunità ittica di basso fondale**
	41	**La laguna come "nursery" per la fauna ittica**
	42	**Spece ittiche lagunari in direttiva Habitat**
	54	Rettili e/o anfibi **Anfibi e Rettili**
	44	Uccelli **Il ruolo della Laguna di Venezia per la conservazione degli uccelli acquatici europei**
	45	**Limicoli svernanti**
	46	**Anatidi svernanti**
	47	**Colonie di Aironi**
	48	**Sternidi nidificanti**
	49	**Pettegola e Falco di palude nidificanti**
	50	**Gabbiani in laguna**
	51	**Gabbiani in città**
	52	**I Colombi in città**
	53	Micromammiferi **Micromammiferi**
		Flora
	55	Fitoplancton **Ciclo annuale del fitoplancton**
	56	**Evoluzione temporale del fitoplancton (estate 1993,1998 e 2003)**
	61	Macroalghe **Distribuzione delle macroalghe (2002)**
	62	**Biodiversità della comunità macroalgale**

63		**Attuale distribuzione e produzione di macroalghe**
64		**Distribuzione e produzione di macroalghe negli anni '80 e '90**
57	Fanerogame	**la mappatura del 1990**
58		**il rilievo aggiornato del 2002**
59		**dinamiche spazio temporali**
60		**Distribuzione e produzione delle fanerogame marine**
65	Vegetazione emersa	**Il paesaggio vegetale**
66		**Vegetazione dei litorali**
67		**Habitat dei litorali**
68		**Valore floristico-vegetazionale dei litorali**
69		**Vegetazione: barene e canneti**
70		**Vegetazione alofila da satellite**
ANTRO	**Inquinamento**	
77	Atmosfera	**Deposizione atmosferica degli inquinanti inorganici**
78		**Deposizione atmosferica degli inquinanti organici**
79	Inquinanti dal Bacino scolante	**Carichi di inquinanti dal bacino scolante**
80		**Qualità delle acque dal bacino scolante**
71	Inquinanti laguna	**Metalli pesanti nei sedimenti superficiali**
72		**Microinquinanti organici nei sedimenti superficiali**
73		**Inquinanti organici nell'acqua**
74	Inquinanti nei rii	**Cadmio nei sedimenti dei canali di Venezia**
75		**Metalli pesanti nei sedimenti dei canali di Venezia**
76		**Inquinanti organici nei sedimenti dei canali di Venezia**
	Trasformazione territoriale	
81	Suolo	**Uso del suolo**
82	Barene	**Evoluzione delle barene 30/70/90**
AMBITI	**Dinamiche sociali**	
83		Utilizzo e competenze dei canali lagunari
	Vincoli amministrativi	
84	La disciplina Territoriale	**Siti di Interesse Comunitario (SIC)**
85		**Zone di Protezione Speciale (ZPS)**
87		**Important Bird Areas (Bioitaly, IBA)**
86		**Aree blu e limiti di velocità**

ANALISI	88		Biotopi naturali
	89		Biotopi naturali Zoom
	100		Localizzazione delle cisterne secondo il rilievo dell'ing. G. Bianco (1857-58)
	101		Localizzazione delle cisterne secondo il rilievo dell'ing. G. Bianco (1857-58) dettagli
	90	La suddivisione della Laguna	Aree morfogenetiche: stato attuale
	91		Complessi ecosistemici funzionali
	102		Unità di Paesaggio della Laguna
	98		stato ambientale delle acque superficiali
	92		Evoluzione temporale dello Zinco nei sedimenti superficiali
	93		Variabilità delle caratteristiche dei sedimenti a breve scala spaziale
	94		Evoluzione nel tempo di PCB e IPA
	96		Rischio ecologico da metalli pesanti e PCB
	97	Alloctone	specie alloctone in laguna di venezia
	103		Conflitti tra usi in Laguna
	104		Impatti Cumulativi
	99	Impronta ecologica	Indicatori di sostenibilità

7.5 Bird data divisions

7.5.1 Numbered grid
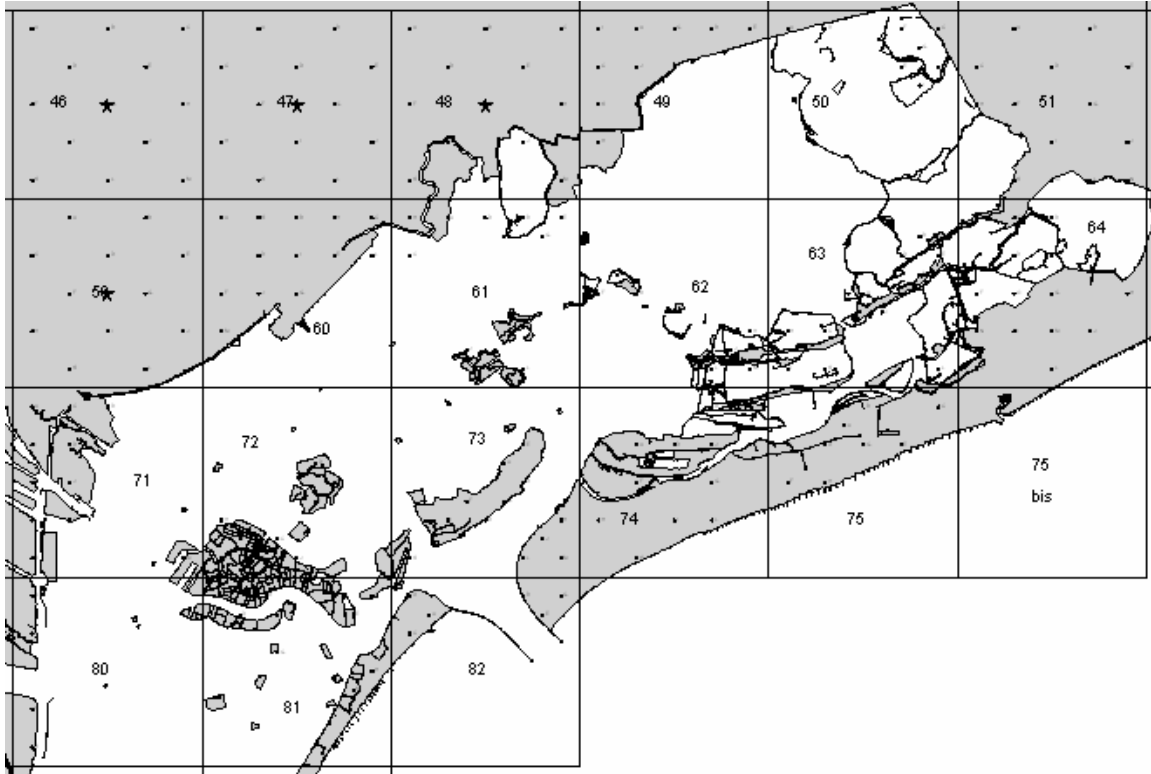
7.5.2   Observation points

7.6   Old maps

7.6.1   1843 med-a

7.6.2   1843 med-c

7.6.3   1843 med-d
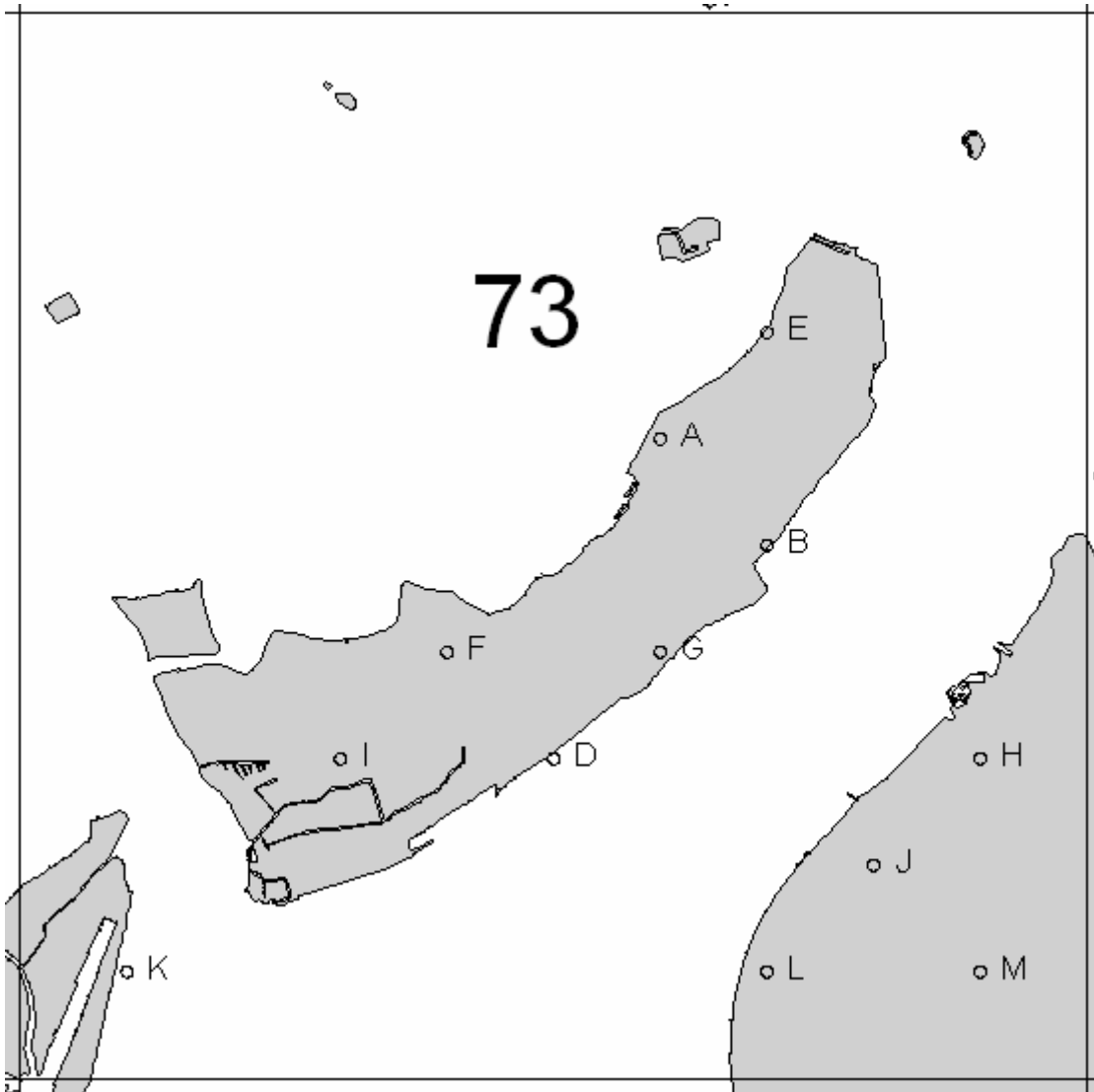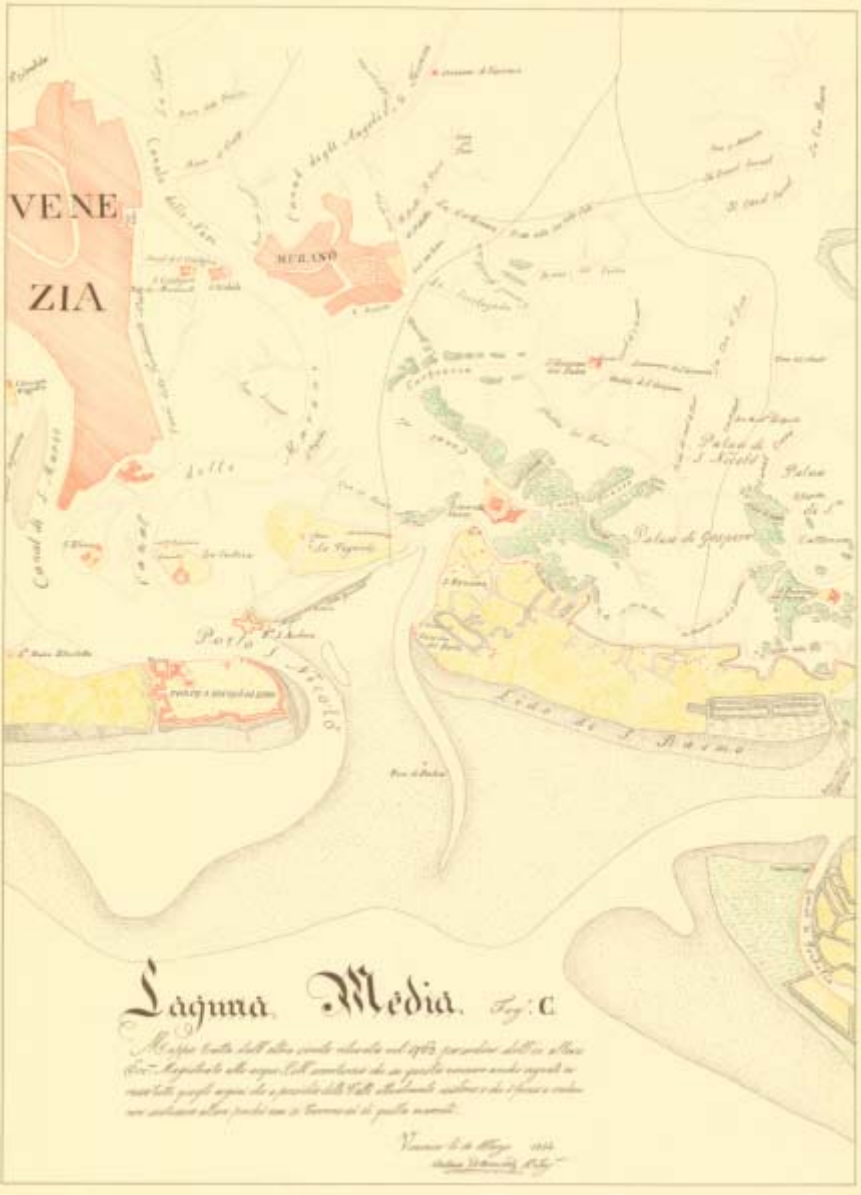
7.6.4   1843 sup-a
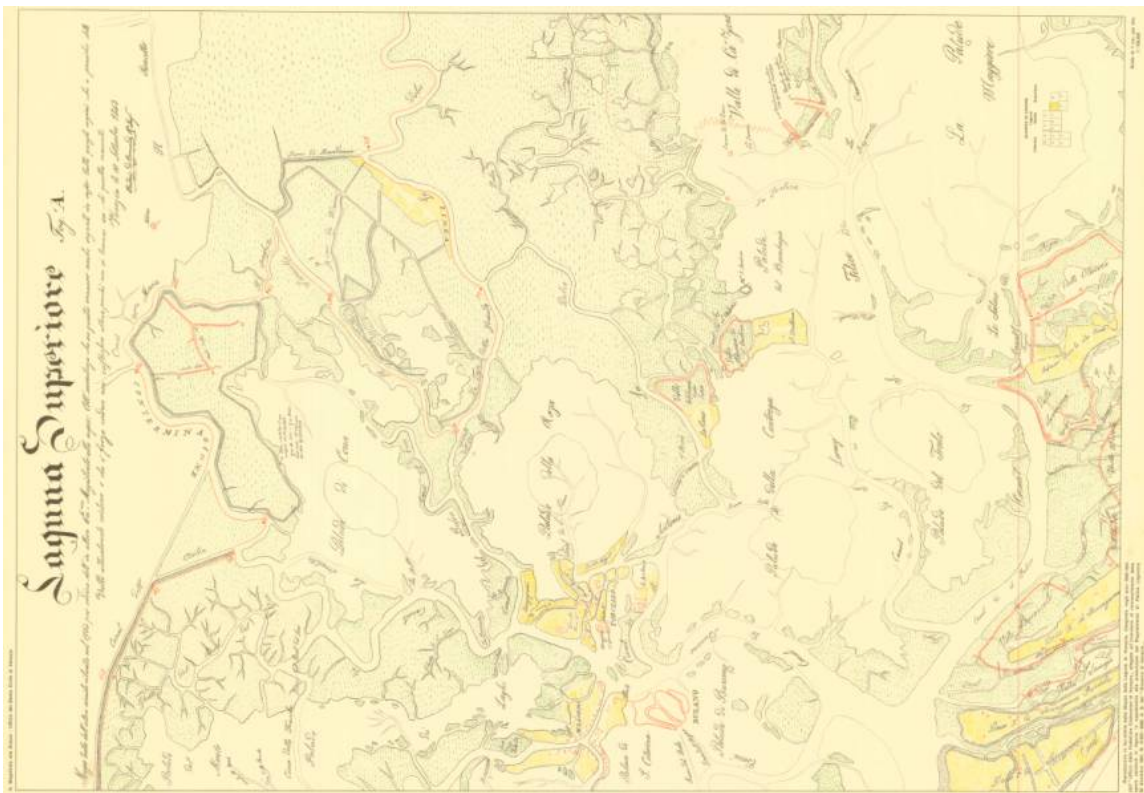
7.6.5   1843 med-c

7.6.6   1843 map arrangement

QUADRO DI UNIONE
Laguna
Inferiore   Media   Superiore
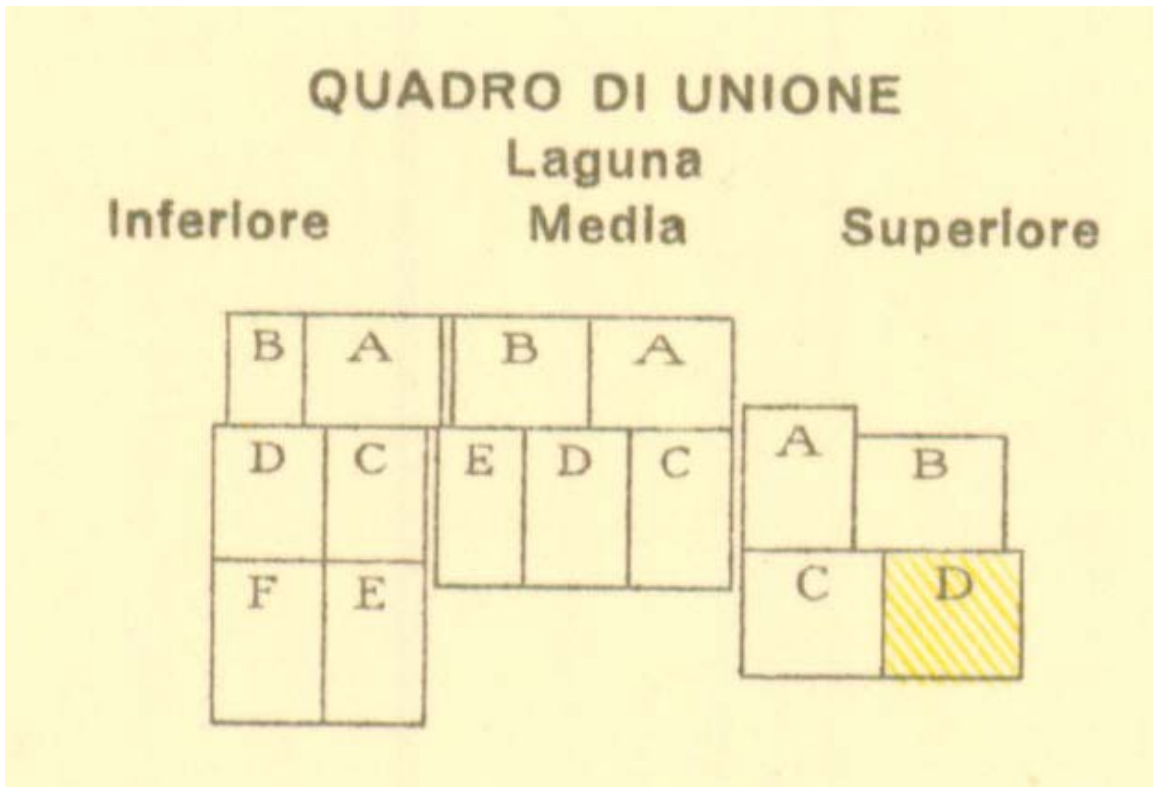
7.6.7 1901 tav 7

7.6.8   1901 tav 8
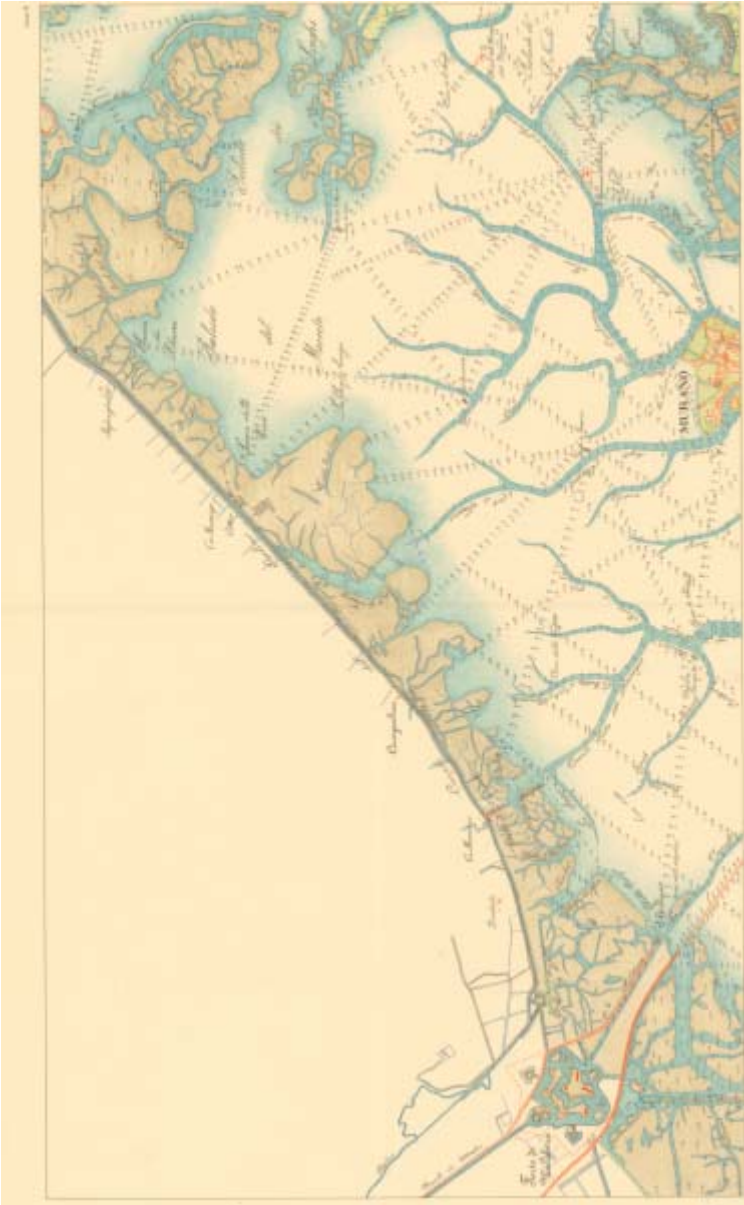
7.6.9   1901 tav 9
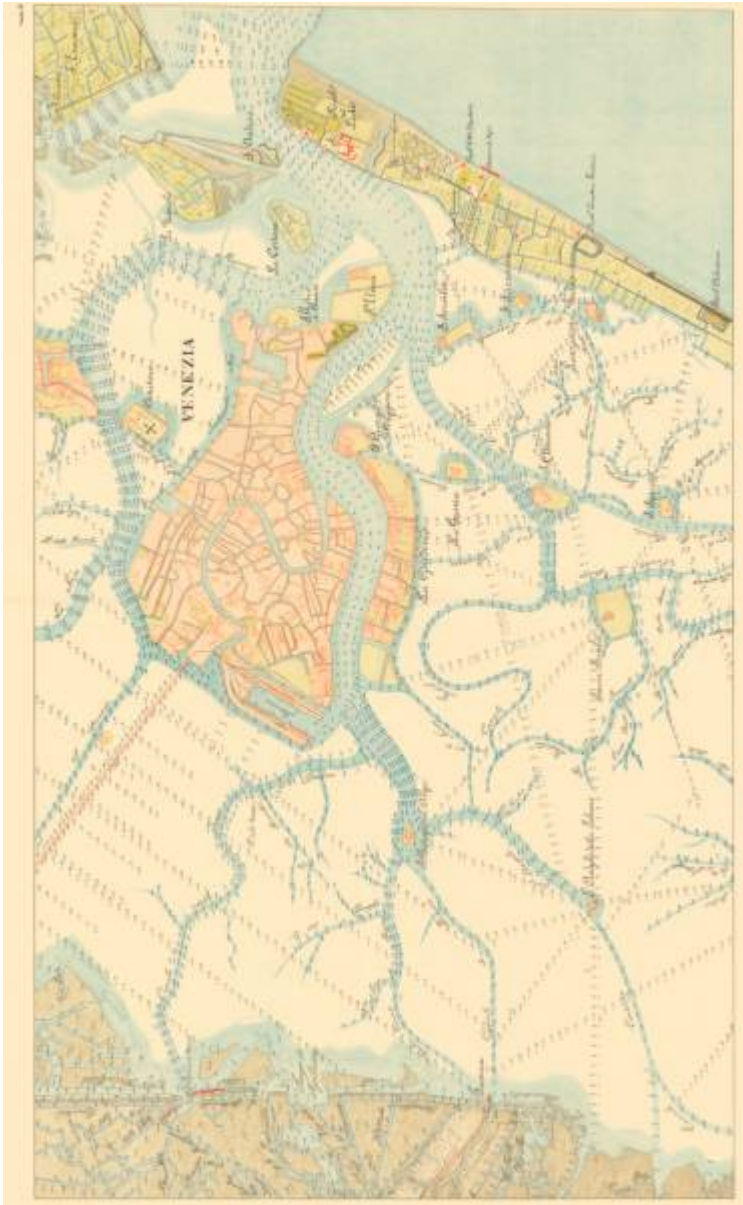
7.6.10 1901 tav 14
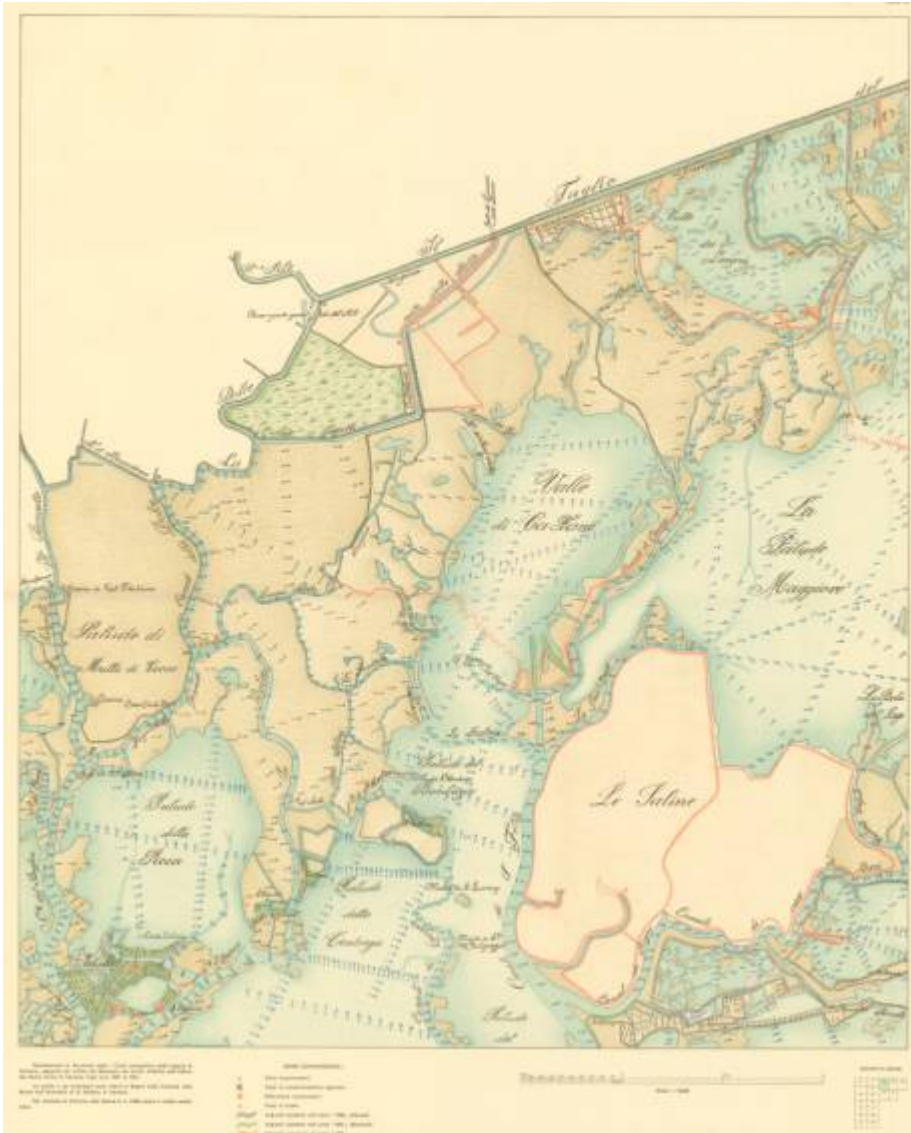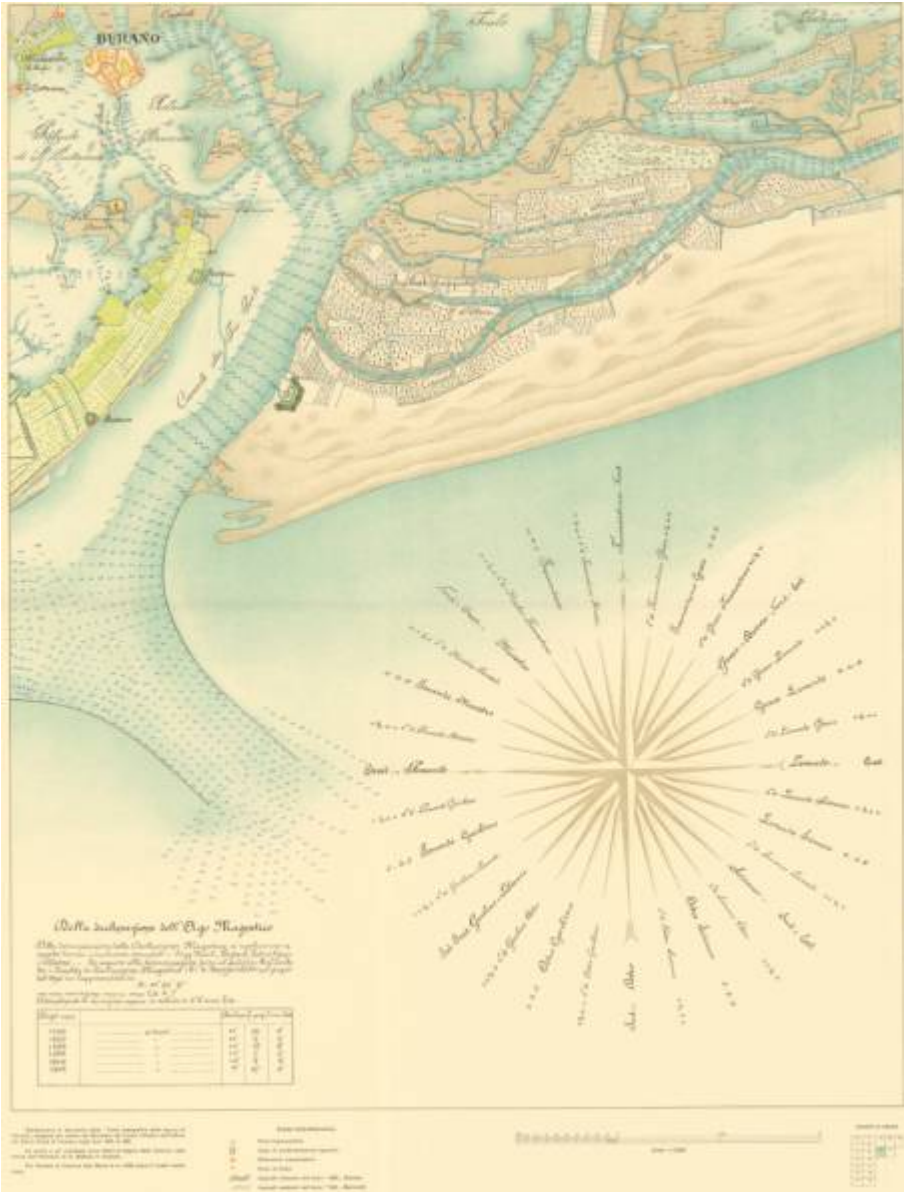
7.6.12 1901 map arrangement

QUADRO DI UNIONE

O	7	14	16	18
1	8			
2	9	15	17	
3	10			
4	11			
5	12			
6	13			

7.7 GIS Layers

7.7.1 General canals
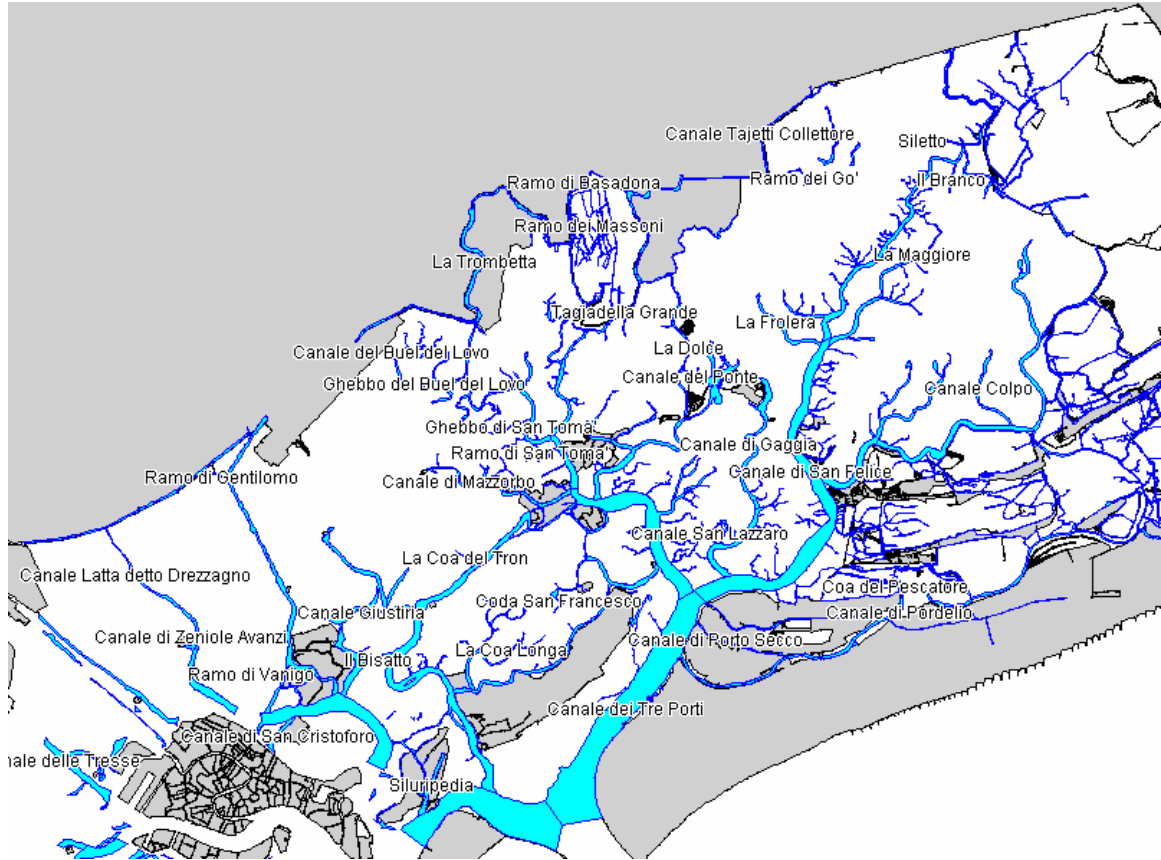
7.7.2 Old canals
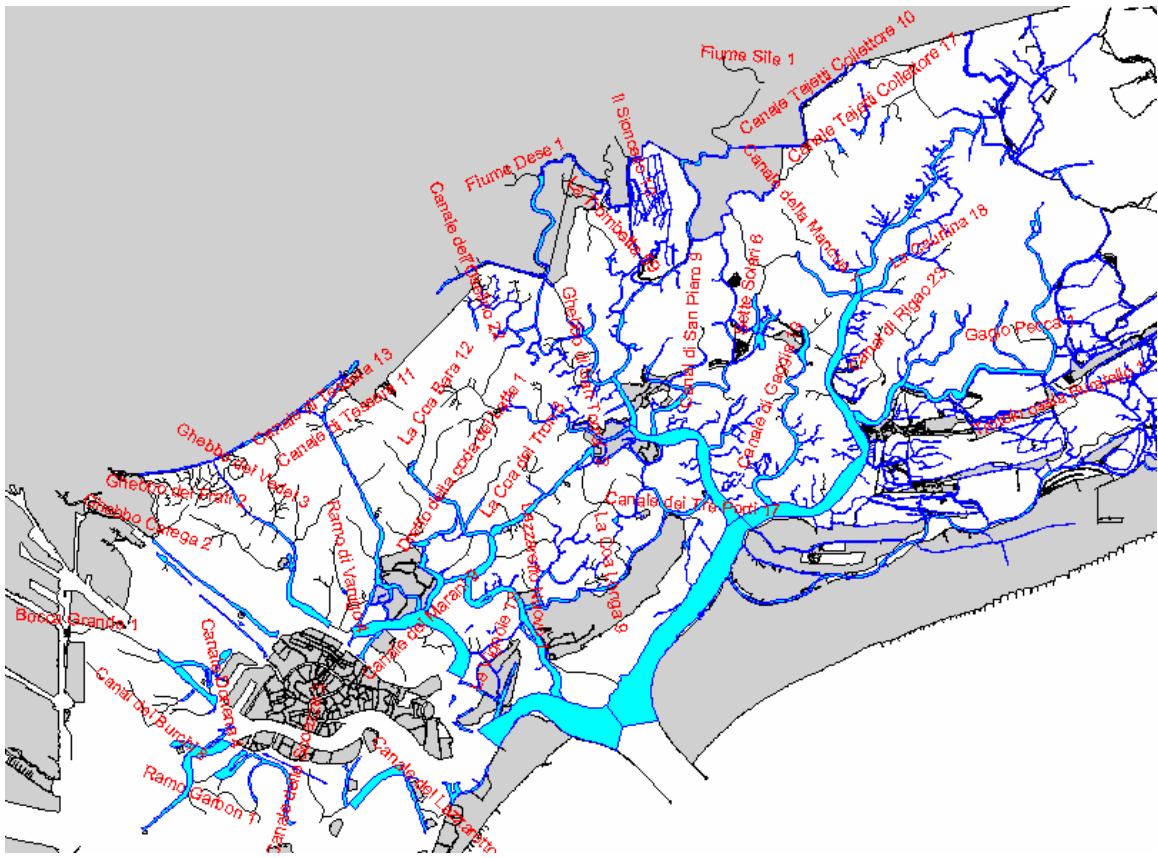
7.7.3 Canals segments
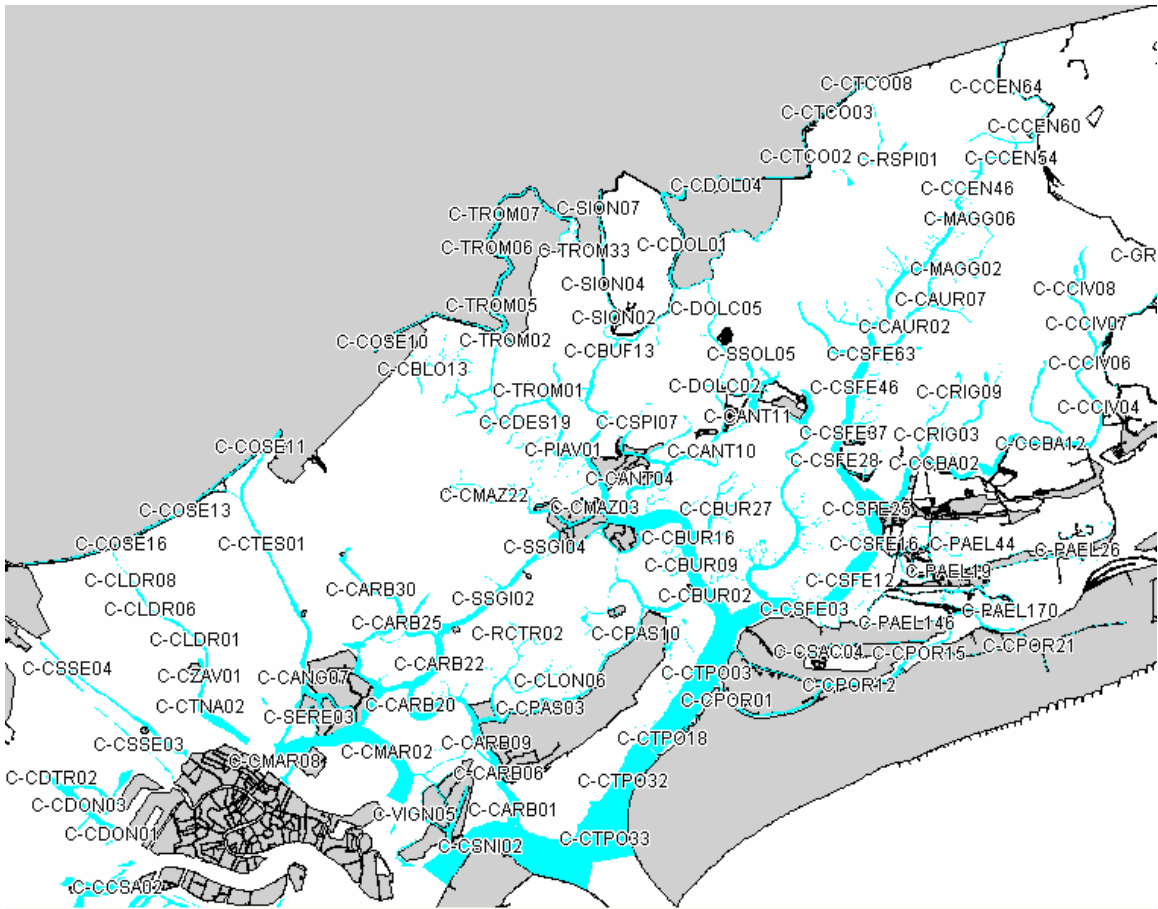
7.7.4 Barene
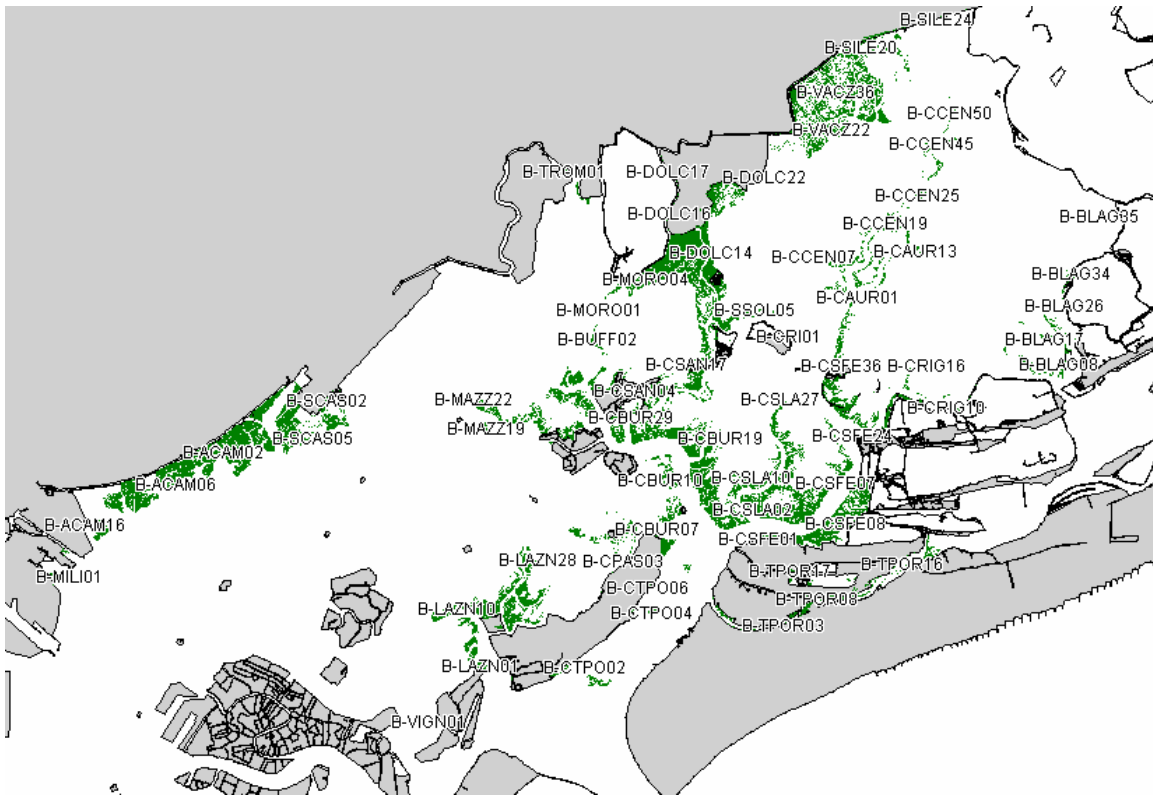
7.7.5 Velme

7.7.6   Paludi and Fondi

SELC biologia e geologia applicate

SELC piccola Società Cooperativa a responsabilità limitata

Tab. 4.2 Specie di uccelli presenti nel SIC ed incluse nell'Allegato 1 della Direttiva Uccelli.

NOME DELLA SPECIE	RESI DENZA	NIDIFICA ZIONE	SVERNA MENTO	TAPPA	POPOLA ZIONE	CONSERVA ZIONE	ISOLA MENTO	VALUTAZIONE GLOBALE
Glareola pratincola				P	D			
Ixobrychus minutus		P			C	A	C	B
Porzana parva				R	D			
Circus cyaneus			P		D			
Philomachus pugnax				P	D			
Chlidonias niger				C	C	B	C	C
Egretta alba			P		D			
Egretta garzetta			C		C	B	C	B
Gavia stellata			R		D			
Gavia arctica			R		D			
Pluvialis apricaria				P	D			
Circus aeruginosus	P				C	B	C	A
Botaurus stellaris				R	D			
Nycticorax nycticorax				P	D			
Sterna hirundo		C			C	B	C	B
Himantopus himantopus		P			C	B	C	B
Sterna albifrons		C			C	C	C	B
Phalacrocorax carbo			C		C	B	C	C
Pandion haliaetus				V	D			
Sterna sandvicensis			P		D			
Recurvirostra avosetta				P	D			
Ardeola ralloides					D			
Ardea purpurea		C			D			
Circus pygargus				P	D			
Porzana porzana					D			
Alcedo atthis					D			
Asio flammeus				R	D			
Aythya nyroca				R	D			
Grus grus				R	D			
Falco columbarius				R	D			
Falco peregrinus				R	D			
Plegadis falcinellus				R	D			
Phalacrocorax pigmeus			R		C	B	B	B
Lanius collurio		P			D			

7.9   Citizen monitoring decision tree

```
                          ┌──────────────┐
                          │  Decemer-    │
                          │  February    │
                          └──────────────┘
          ┌────────────────────┼────────────────────┐
   ┌─────────────┐      ┌─────────────┐      ┌─────────────┐
   │ 7-10 years  │      │ 11-13 years │      │  14+ years  │
   │    old      │      │    old      │      │    old      │
   └─────────────┘      └─────────────┘      └─────────────┘
```

Location List	Activities List	Island List	Activities List	Island List	Activities List
Burano A01	Picture Post H01	Burano A02	Picture Post H02	Burano A03	Picture Post H03
Mazzorbo B01	Bird Count I01	Mazzorbo B02	Bird Count I02	Mazzorbo B03	Bird Count H03
San't Erasmo		San't Erasmo	Clam Count J02	San't Erasmo	Clam Count J03
Torcello D01		Torcello D02	WeedWatch K02	Torcello D03	WeedWatch I03
Vignole E01		Vignole E02		Vignole E03	Water Monitoring
Velme F01		Velme F02		Velme F03	
Barene G01		Barene G02		Barene G03	

7.10 Citizen monitoring database

Minimum Age	Nearest Island	Location	Activity	Date of Last Completion	Instructions
14	MZ	P-MAZZE	Water Monitoring	10/11/2002	WaterMonitoring
14	TC	P-TORCC	Water Monitoring	3/23/2004	WaterMonitoring
14	SE	P-CARBE	Water Monitoring	5/2/2003	WaterMonitoring
7	SE	B-CTPO02	BareneWatch	3/5/2003	BareneWatch
7	MZ	B-MAZZ19	BareneWatch	4/5/2002	BareneWatch
7	TC	B-TORC11	BareneWatch	5/23/2004	BareneWatch
14	SE	73-A	Bird Count	5/5/2003	BirdCount
14	SE	73-D	Bird Count	6/30/2003	BirdCount
14	BU	61-L	Bird Count	6/1/2001	BirdCount
14	TC	62-B	Bird Count	5/3/2003	BirdCount
10	VG	C-VIGN04	SandWatch	4/5/2002	SandWatch
10	SE	C-CPAS02	SandWatch	6/2/2003	SandWatch
10	BU	C-CBUR36	SandWatch	5/23/2004	SandWatch
10	MZ	C-RARG02	SandWatch	9/13/2001	SandWatch
10	LZ	B-LAZN14	Picture Post	4/14/2003	PicturePost
10	LZ	B-LAZN13	Picture Post	1/2/2000	PicturePost
10	LZ	B-LAZN04	Picture Post	6/23/2002	PicturePost
10	TC	B-TORC16	Picture Post	9/5/2004	PicturePost

NOTE: This database is a prototype. An actual database with exact locations can be created when/if posts are installed and programs are precisely defined.

7.11   Bird Watch Program

7.11.1 <u>Instructions</u>

Bird Count

Time required: 15 minutes – 2 hours

Suggested age: 14 and up

Goal: To identify each species of bird present in a given location.

Supplies: Map
                 Bird Manual
                 Binoculars
                 Notebook

Procedure:

Begin by completing the biographical section of the data submission sheet. Also, note the date and time of day that the observations will be made. Select a location from which to make observations. Locate your position on the map and make a note of the location code.

Spend at least 15 minutes, preferably more, in the selected area. Walk no further than 100 meters from the initially selected point. Observe a bird and identify the species, with the help of the bird manual if necessary. Count the number of that one species you can see at once. Keep a record of the number of each species seen are report the maximum number for each species.

*Example: You see 3 garzetta at once now. In 10 minutes you see 2 garzetta. Five minutes after that you see 4 garzetta. You will report 4 garzetta since that is the maximum number you saw at one time.

Once you have spent a minimum of 15 minutes in the selected location and have identified and counted every species present you have completed this experiment. If so desired, repeat the experiment in another location, but be sure to begin a new data submission form.

7.11.2 Data submission form

Bird Count
Data submission form

Name:	Age:	Adult Assistance? yes no
Date:	Time:	Location:
Visibility:	Wind:	Precipitation:

Species	Number Observed

7.11.3 Database

Bird Count : Table

Observer Name	Observer Age	Adult Assistance?	Date	Time of Day	Location	Visibility	Wind	Precipitation	Species Observed	Number Observed
		☐								0
		☐								0
		☐								0
		☐								0
		☐								0
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		☐								0

NOTE: This database will contain a large number of records once the citizen monitoring program begins. The location field will contain location codes created by the team.