

Effects and consequences of agriculture, tourism and hunting on the birdlife at Gialova lagoon
- an area of international importance for migratory birds

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Abstract

Many populations of migrating waterbirds in Africa and Western Eurasia are in a long-term decline, largely because of the loss of wetlands along their migration routes. Between 1950 and 1985, 63 % of the wetlands in Greece were lost due to human activities. However, humans are also a source of more direct disturbance to birds that may have a negative influence on their fitness. The purpose of this study has been to assess how human disturbance in the form of agriculture, tourism and hunting might affect the birdlife in a coastal lagoon in southwestern Greece, and, if needed, propose measures on how to improve the status of the birdlife. To evaluate this, interviews and studies of monitoring reports and literature have been conducted. The studied area, Gialova lagoon, is the southernmost wetland in the Balkan Peninsula, which makes it especially important for migratory birds. The study shows that the major threats to the lagoon have already been dealt with. However, there are still improvements that can be made. Currently, agriculture seems to have the most negative effect on the concerned area, but since there appears to be an ambition to increase tourism in the area this may change in the future. Disturbance from hunting only plays a minor role in the area around the lagoon. The establishment of an official management body as well as an official management plan would probably be an effective way to continue the conservation work and reduce the disturbance of human activities in Gialova lagoon.

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1. Introduction

Wetlands are among the most productive ecosystems on Earth, sustaining many different species of animals and plants (Ramsar convention 2014-06-11). However, wetlands are also one of the most threatened types of ecosystems, and it is estimated that around half of the world's wetlands were lost during the 20th century (European Commission 2007). For a long time wetlands have been considered as marginal lands whose only value lie in being drained and converted into more useful areas, e.g. for agriculture, or simply as sources of diseases, like malaria (*ibid.*). But suitable wetlands along migration routes are needed by migratory waterbirds as assembly and wintering areas (de Klemm 1994). In Greece around 2000 km² of wetland, comprising 378 sites, still remain (Zalidis & Mantzavelas 1996 in Gerakis & Kalburtji 1998). However, many of the lost wetlands were situated along the coast, which migration routes for birds often follow (Bortels *et al.* 2011). The loss and deterioration of wetlands along the migration routes used by waterbirds are one of the major reasons why many populations of waterbirds in Africa and Western Eurasia are in a long-term decline (Davidson & Stroud 2006). There are actually more populations decreasing than are increasing (*ibid.*). Member states of the European Union must, according to article 10 in the habitats directive, promote the management of features of the landscape that are important for the wild flora and fauna, e.g. areas that are essential for the migration of species (EUR-Lex 2014-06-12).

Some of the activities performed by humans that most frequently impact wetlands in Greece include expansion of agriculture which reduces the wetland area, pollution from agriculture causing changes in the quality of the water of wetlands, usage of water from wetlands for irrigation of farms, and the illegal hunting of animals (Zalidis *et al.* 1997). Outdoor activities and ecotourism are gaining more and more popularity and this leads to an increasing amount of contact between humans and wildlife (Ikuta & Blumstein 2003). This may be beneficial for increasing the support from the general public for the protection of valuable areas. However, it may also affect the species we are trying to protect negatively.

How birds react to different kinds of disturbance depends on the species of bird. Some sensitive species might completely disappear from the area or appear in lesser numbers, while others might not be affected at all or even increase in numbers (Foin *et al.* 1977; Robertson & Flood 1980; Clark *et al.* 1984; Blakesley & Reese 1988 all in Hockin *et al.* 1992). The reactions also depend on what time of the year it is (Collins-Kreiner *et al.* 2013) as well as local conditions of the habitat. Therefore it is quite difficult to give definite answers to how disturbance might affect the birds in a specific area without further studies of the birdlife in that area. However, some general effects and consequences can be found. Disturbance caused by humans can have a negative influence on the fitness of birds (Collins-Kreiner *et al.* 2013). This is because humans are often perceived as a threat by birds, as well as by other animals, and the reaction to the presence of humans is often increased vigilance or flight (Burger & Gochfeld 1998; Collins-Kreiner *et al.* 2013). This means that the birds spend less time foraging for food (Burger & Gochfeld 1998) and instead expend more energy on flying. They also spend less time brooding and caring for their young, leaving their nests exposed to predators and the weather (Hunt 1972; Titus & VanDruff 1981; Pfluger & Ingold 1988; Götmark *et al.* 1989; Keller 1989; Yalden & Yalden 1990 all in Hockin *et al.* 1992). If forced to take flight they may return to the area later or move to another area where there might be more competition about food resources (Goss-Custard *et al.* 2006) or where the food might be of lower quality. Some species are able to compensate the energy loss caused

by disturbance by expanding their feeding time into the night (Hockin *et al.* 1992). Habituation may occur in areas with high disturbance, resulting in some species reacting to the disturbance at shorter distances than they would have done in an undisturbed area (Cooke 1980; Burger & Gochfeld 1981; Titus & VanDruff 1981; Keller 1989 all in Hockin *et al.* 1992).

To investigate how different kinds of disturbance might affect the birdlife in a wetland I have conducted a study in Gialova lagoon. This coastal lagoon is situated in the southwestern part of Peloponnese — a peninsula in southern Greece. This area is part of one of the most important migration routes for migratory birds in Greece: the route along the western coastline (Casement 1966, Kominos 2004 in Dimaki *et al.* 2006). A total of 271 different bird species have been observed in the lagoon over the years (Roncero Crespo 2010).

The Hellenic Ornithological Society (HOS) started to monitor the bird populations at Gialova lagoon in 1989, and they discovered a severe decrease in the populations of waterbirds in the area (Hellenic Ornithological Society 2014-06-03). In part thanks to the work and research done by HOS and other NGOs, Gialova lagoon was included in the Greek list of sites proposed as Natura 2000-areas in 1995 (*ibid.*). The year after, HOS made a preliminary management plan which included the main actions needed to be done to improve the conditions of the lagoon (*ibid.*). In 1997, HOS, together with The Sea Turtle Protection Society (STPS) and The Institute of Marine Biology of Crete (IMBC), was granted financing from LIFE¹ with the goal of restoring natural habitats, protecting species, raising public awareness and interest in the area, and preparing the legislative process for the area to be protected under Greek law (Hellenic Ornithological Society 2014-06-03). The area is now protected under both the Birds Directive and the Habitats Directive (BirdLife International 2014-06-12).

The purpose of this study is to try to assess what impact agriculture, tourism and hunting might have on the birdlife in Gialova lagoon and, if needed, propose measures on how to improve the status of the birdlife. Previous studies of the area have mostly focused on the benthic fauna of the lagoon, land use in the surrounding area, and the hydrology of the area. The birdlife in the area and the properties of the lagoon, e.g. salinity and oxygen content, have been monitored for several years. However, I have not found any studies that focus on how different kinds of disturbance might affect the birdlife of the area.

2. Methods

2.1. Study area

Gialova lagoon (sometimes called the Divari Pilou lagoon) (36° 58' N, 21° 40' E) is situated in the region of Messenia in southwest Greece (figure 1). The Messenia region comprises the southwestern part of the peninsula of Peloponnese. The wetland is classified as an Important Bird Area that covers a surface of 600 ha (BirdLife International 2014-05-29). It is also situated inside a Natura 2000-area (European Environment Agency 2014-05-29). The protection of the area consists of a wildlife refuge (960 ha), a Special Protection Area (under the Birds Directive) (1010 ha), and a Special Area of Conservation (under the Habitats Directive) (3552 ha). A large part of these areas overlap (BirdLife International 2014-06-12). The wetland consists of an open lagoon (250 ha) with a maximum depth of one meter. To the north and east, the

¹ LIFE is the financial instrument of the European Union to support environmental and nature conservation projects (European Commission 2014-06-03)

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lagoon is surrounded by marshland and reed beds (Hellenic Ornithological Society 2014-05-29). Beyond the marshland and reed beds is a zone of cultivated fields, consisting mostly of olive groves, and maquis situated inside the protected area. To the west the lagoon is separated from the Ionian sea by a belt of sand dunes. Directly south of the lagoon lies Navarino bay which is connected to the lagoon through a man-made channel situated in the southwest part of the lagoon. The Xerolagados river and the Tyflomitis river enter the lagoon from the north and from the east respectively, providing the lagoon with freshwater. The salinity level of the lagoon varies both in space and time, with the lowest levels in the eastern parts of the lagoon where the Tyflomitis river discharge freshwater into it, and during early spring when the rivers transport more water and the lagoon reaches its maximum expansion. The highest salinity levels occur in the western part of the lagoon because of its proximity to the ocean and the channel that connects the lagoon with Navarino bay, and during the months of September and October because of the high level of evaporation during the summer.

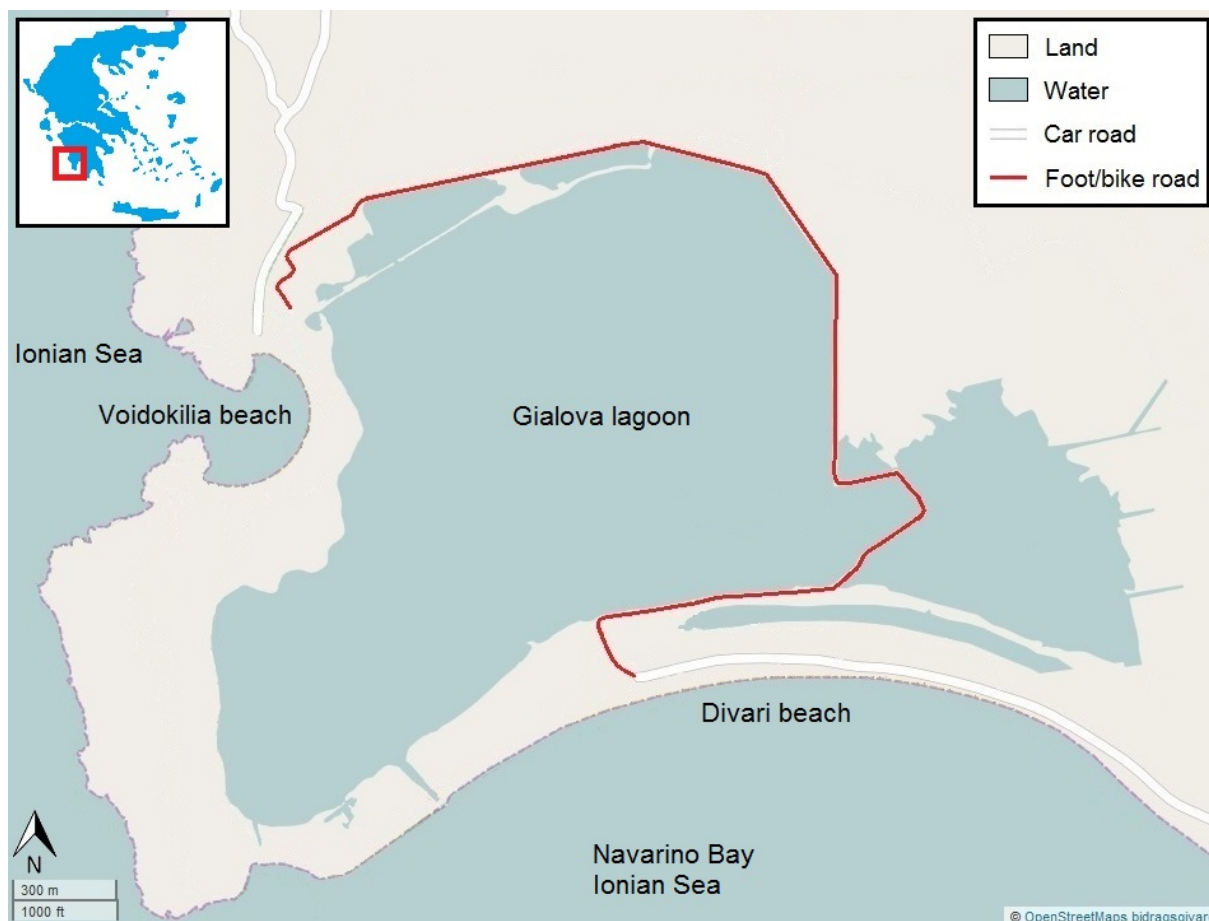


Figure 1. Map of Gialova lagoon. (Based on, and modified from, material from OpenStreetMap, © OpenStreetMap contributors, 2014-06-30)

2.2. Data collection

The first part of the research process was to get a general view of the lagoon and its surroundings. This was accomplished through searching for information about Gialova lagoon on the search engine Google. This general information was mainly collected from websites directed to tourists but also from the information about the area provided

on the Hellenic Ornithological Society's website. Satellite images from Google Earth and regular maps of the lagoon and its surroundings were studied to aid in this process.

The second part of the research process was to get a deeper understanding of how different factors could influence the lagoon and its birdlife. For collection of published scientific material the search engine ScienceDirect was used. Previously published studies where Gialova lagoon was used as a study site have mainly focused on the benthic fauna of the lagoon. Therefore the search was aimed at finding more general information about birdlife and information about similar lagoons and wetlands. The search words that were used in different combinations were: "birds", "birdlife", "Gialova lagoon", "Mediterranean", "lagoon", "wetland", "agriculture", "tourism", "disturbance", "hunting". Published articles regarding the effects of agriculture, land use and tourism/human presence on birdlife and bird migration were collected and studied. Through the website of the European Environment Agency (EEA) information and distribution of the Natura 2000-area was obtained, as well as a list of most of the bird species observed at the lagoon. From Giorgos Maneas, station manager at the Navarino Environmental Observatory a few kilometres north of Gialova lagoon, unpublished material on bird monitoring and land use at the lagoon was obtained. Interviews were conducted with Xenophon Kappas, general director at the Captain Vassilis Foundation, and Giorgos Maneas with regard to land use, agriculture, tourism, hunting, pollution, birdlife, threats and management of the lagoon. The interviews lasted for 40 minutes and 80 minutes respectively, and were recorded using a Zoom H2 recorder.

It would have been good to have made an interview with someone from the local community too, preferably one of the farmers who has a farm close to the lagoon and situated inside the protected Natura 2000-area. Unfortunately, there was not enough time for this. The farmers inside the protected area are likely the persons that are affected by the protection to the highest degree but it is also likely that they themselves affect the protected area to a higher degree than others, and it could be of importance to involve them in the management of the Natura 2000-area. It would have been interesting to get their view on the protection of the area, agriculture, tourism, birdlife and how extensive the usage of fertilizers, pesticides and herbicides is in the area.

Maps were created using material from OpenStreetMap². OpenStreetMap provides open data licensed under the Open Database License³ and cartography licensed under the Creative Commons Attribution-ShareAlike 2.0 license⁴, more commonly referred to as CC BY-SA, which allow for distribution and alteration of data and maps as long as appropriate credit is given and the modified material is distributed under the same license as the original. The maps were modified to suit the need of the study, using Microsoft Paint.

2.3. Fieldwork

The fieldwork was conducted during daytime on three consecutive days: 11-13th of May 2014. As preparation for the fieldwork, maps, satellite images and lists of bird species observed in the area were studied as described above. Unfortunately, the field time available was only a week, so it was not possible to make a thorough inventory of the birdlife at the lagoon.

The first day of fieldwork consisted of getting to know the study area. This was accomplished by hiking around the entire lagoon in a larger group, consisting of 13

² <http://www.openstreetmap.org>

³ <http://opendatacommons.org/licenses/odbl/>

⁴ <http://creativecommons.org/licenses/by-sa/2.0/>

people, under the guidance of Giorgos Maneas, who told us about the lagoon, its surroundings and the history of the area. Some bird observations were also made during this first day.

The second day was spent studying the birdlife in the lagoon. To help me with this task my supervisor Bo Eknert, lecturer at the Department of Physical Geography and Quaternary Geology at Stockholm University, joined me during the day. Our equipment consisted of two binoculars (8x and 10x magnification), a monocular (20-60x magnification), a camera (up to 50x magnification), and the Swedish edition of Collins Bird Guide 2nd Edition by Lars Svensson, Killian Mullarney and Dan Zetterström. Thanks to information from Giorgos Maneas we knew that the most abundant birdlife would be in the reed beds in the east part of the lagoon, and therefore we followed the foot/bike road leading from Voidokilia beach in the northwest part of the lagoon along the north and east parts down to the south side of the lagoon (figure 1). We identified the encountered bird species by either visual observation or their song. If neither of these were sufficient to make a confident identification we used photographs taken during the day to identify the species later on.

During the third day I spent half the day following the same foot/bike road as during the second day, but this time only along the north and east parts of the lagoon and back again. The farms that are situated inside the Natura 2000-area lie along the north and east parts of the lagoon, and the purpose of the third day's fieldwork was to observe what type of agriculture was performed in the closest proximity of the lagoon, how close the farmlands were to the lagoon, and if there were any visual signs of agricultural machinery driving past the border of the farmlands and into the dried up parts of the lagoon.

A problem with the fieldwork conducted during the third day was that it was not possible to make any precise measurements of the distance between the farmlands and the lagoon. There are two reasons for this: firstly, the farmlands are private property and I did not have permission by the different owners to enter their land, and secondly, the farmlands were separated from the foot/bike road by a water-filled channel a few meters in width, with no point of crossing along the path I followed. Therefore the observations made during the third day had to be made solely by visual observation from a distance, with the aid of binoculars when needed, and a camera for documentation.

Unfortunately the fieldwork was conducted during the low season for birds, since very few species use the area for breeding. However, the lagoon is a popular stopover site during spring and autumn migration, with a great number of species in the area during March-April and September-October. A visit during the high season for birds would most likely have given a better picture of the importance of the area as a stopover site for migrating birds. It would also have been possible to make observations of how human presence and activities in the area affect behaviours, e.g. vigilance or feeding, when the area available for each individual bird is more limited because of the higher number of birds. Studies like this, together with observations of which parts of the lagoon are most frequently visited by birds, could be useful for planning where to place observation towers and if some areas need restriction of access during parts of the year.

3. Results

3.1. General

The information in this section comes from an interview with Giorgos Maneas, 2014-05-15, unless otherwise stated.

During the 1950s attempts were made to completely drain Gialova lagoon of its water. This was done by altering the course of the Xerolagados river and the Tyflomitis river, diverting them into the sea, and through the construction of a channel which connects the lagoon to the sea (Hellenic Ornithological Society 2014-06-03). A pump house was also constructed to pump water out of the lagoon and into the sea. However, the project failed because the amount of water entering the area was miscalculated, but the lagoon lost a third of its original size due to this project (Xenophon Kappas, personal comm. 2014-05-13). The reduction of its size and the prevention of freshwater inflow into the lagoon also altered the properties of the lagoon, causing low oxygen levels, frequent dystrophic crises and high salinity levels, reaching up to 60-70 ‰ during the end of summer (Hellenic Ornithological Society 2014-06-03). During 1998, action was taken to improve the condition of the lagoon. This was accomplished by the construction of two sluices which allowed a controlled input of freshwater from the two rivers into the lagoon. A complete restoration of the two rivers was not possible due to the need for freshwater for irrigation of nearby farms, and the fact that a factory producing olive oil releases its process water into the rivers during the harvest season (Hellenic Ornithological Society 2014-06-03). This inflow of freshwater into the lagoon removed almost entirely the problem with low oxygen levels in the water. It also altered the salinity of the lagoon to a high degree. Nowadays, during March, the salinity level in the eastern parts is down to 10 ‰, and around 25 ‰ in the western parts. In September, the salinity level in the eastern parts is around 45 ‰, and in the western parts it can reach values of up to 55-60 ‰. There is a need for better control of the inflow of freshwater into the lagoon to allow more freshwater to enter during dry seasons and to have some of the fields flooded for longer periods, especially during May and June, so that the birds can find food more easily.

There has not yet been an official management body assigned to Gialova lagoon that would be able to perform the conservation work and enforce the regulations of the protected area. Since 2012, HOS has ceased with their work at the lagoon. As an NGO they are quite dependent on financing from outer sources, e.g. donations and allotted project money from public agencies, to be able to carry out their conservation work. Therefore there is only quite limited conservation work currently being done at the lagoon.

According to Xenophon Kappas (personal comm. 2014-05-13), there were a lot of protests against the protection of the area during the late 1990s and early 2000s. He states that this was caused by the spread of misinformation about what implications the regulations of a Natura 2000-area would have on landowners and visitors. This apparently resulted in a widespread misconception that they would not be able to visit or use the area anymore. According to Xenophon Kappas (personal comm. 2014-05-13), this problem was solved, and today most people seem to understand why the area is protected and that they are still able to visit and use the area.

3.2. Birdlife

During the fieldwork a total of 35 bird species were observed at Gialova lagoon. For a list of the observed species see Appendix 1.

The information in this section comes from an interview with Giorgos Maneas, 2014-05-15, unless otherwise stated.

In the summer there are quite few bird species that inhabit the lagoon, and they are small in numbers. Some of these species breed in the area, while others only feed and rest there. According to bird monitoring data collected by volunteers for the HOS, there

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were 44 confirmed nest by 10 different species during 2010 (Roncero Crespo 2010) and 25 confirmed nests by 3 different species during 2011 (Ruiz de Azua 2011a). However, large areas of the lagoon were inaccessible for monitoring due to vegetation and water, and therefore there are believed to be many more nests and species breeding in the area. The lagoon is most important during the spring and autumn migration when large numbers of birds of many different species pass by (figure 2 & 3), but also as an overwinter site for many species. Spring migration begins in March and ends in May, while autumn migration begins at the end of August and ends at the end of October (Roncero Crespo 2010).

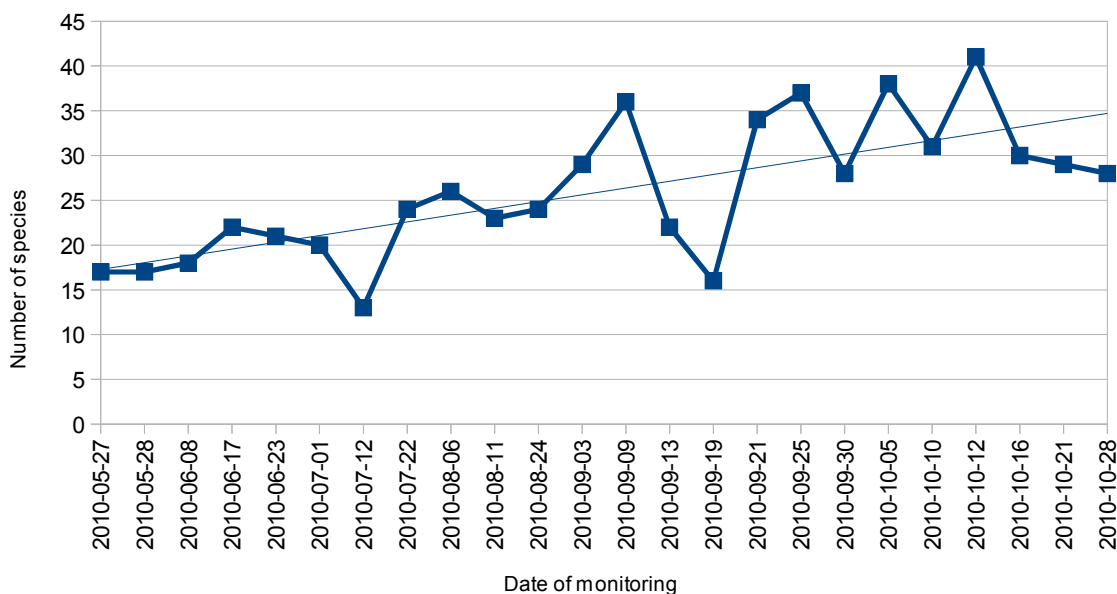


Figure 2. Number of bird species observed during each time of bird monitoring at Gialova lagoon from May to October, 2010. (Based on data from Roncero Crespo 2010)

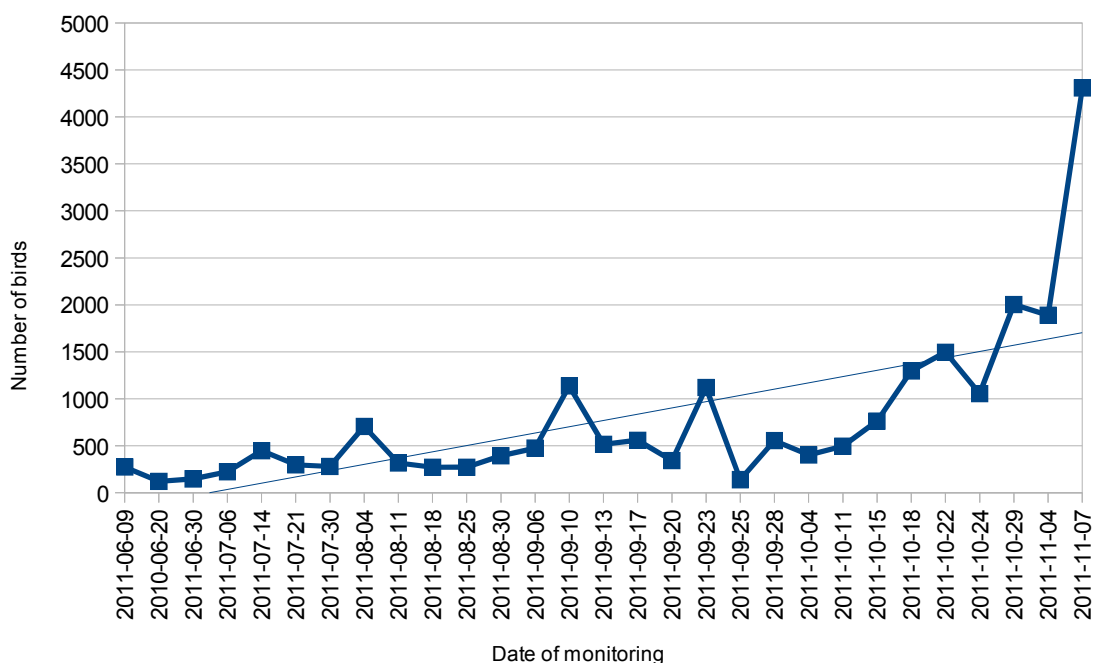


Figure 3. Number of birds observed during each time of bird monitoring at Gialova lagoon from June to November, 2011. (Based on data from Ruiz de Azua 2011b)

Since the lagoon has a combination of areas with freshwater, brackish water and saltwater it consists of several different habitats and can thereby support many different species of birds. When it comes to resting and feeding, the reed beds in the eastern part of the lagoon seems to be the most preferred area in the wetland (Roncero Crespo 2010; Ruiz de Azua 2011a, 2011c). Here you find the largest number of birds (*ibid.*). The areas along the north and south side of the lagoon come in second place, while the western part seem to be the least popular place (*ibid.*). The main lagoon appear to be mostly used for feeding (*ibid.*).

There used to be many wetlands along the west coast of Greece. However, it is estimated that 63 % of the wetlands in Greece were lost between 1950 and 1985 (European Commission 2007). As of now, the closest wetland along the coast is 150 - 200 km to the north of Gialova lagoon. The lagoon is the southernmost wetland of international importance in the Balkan Peninsula (Roncero Crespo 2010), which makes it the last stop before crossing the Mediterranean and, possibly, the Sahara desert for many birds. More birds arrive at the lagoon in spring than in autumn, so it is most important for birds travelling from their wintering areas in the south to their breeding areas in the north. However, there is not any extra form of protection for the birds during parts of the year when they might be more susceptible to disturbance.

3.3. Agriculture

The information in this section comes from an interview with Xenophon Kappas, 2014-05-13, unless otherwise stated.

Agriculture is permitted in some parts of the Natura 2000-area, but there are also parts of the protected area that are occupied by illegal farms. In the 1950s and 1960s the state rented out land to farmers. The land was then supposed to return to the public after around 50 years, but some farmers in the area stayed and continued to cultivate it. Originally, the thought was for them to cultivate annual crops, like vegetables, but in many parts the farmers planted olive trees instead (Giorgos Maneas, personal comm. 2014-05-15). Because the farmers had planted trees there it was easier for them to claim their right to the land, and since most of the farmers were quite poor the municipality allowed them to use the land free of charge. Some farmers inside of the protected area are expanding their farmland further into the wetland. Between 2008 and 2011 around 10 ha of wetland were lost because of this (Lauterbach & Le Cunff-Guillard 2011).

If the farmers use fertilizers (mostly commercial fertilizer is used in the area), pesticides or herbicides, or use organic methods of cultivation depends on the farmer. In the group of farmers who use fertilizers, pesticides, and other such materials there are both those who use them in the proper way and those who use them in too large quantities. According to Xenophon Kappas (personal comm. 2014-05-13), the reason that they use too much of it could be that they simply do not care or because they do not have the proper education on how to handle these materials. This could be a potential risk of danger, both for themselves and for the environment. However, the usage of fertilizers and pesticides has gone down since the financial crisis, and this has had a positive impact for the water in the lagoon. Whether or not the farmers use some kind of technique to reduce the leakage of nutrients and pesticides from their farms and into the water depends entirely on the farmer.

Freshwater from the Xerolagados river and the Tyflomitis river is used for irrigation of the farmland in the area. However, there are restrictions on how much water the farmers are allowed to use, but they are probably not followed. Since there is no

management body for the Natura 2000-area, no one makes sure that the regulations in the management plan are followed. It is left entirely up to the farmers in the area to decide whether to follow restrictions or not. When the management plan was made it was based on less cultivated area than actually existed, because those who made it did not take the illegal farms in the area into consideration.

During the time of my field studies the water level had decreased from the maximum level, and some areas, which probably were flooded earlier in the spring, were now dried up and bare. This made it easier for me to observe the tracks left behind by vehicles in the previously flooded areas. There were distinct tracks, around 20 cm in depth, and due to their width they appeared to have been made by a tractor. However, they were quite limited in number and only appeared in connection to the fields, extending approximately five meters into the dried up areas. There were also several tracks, possibly from cars and motorcycles, in the dried up areas in the northwestern part of the lagoon close to where the road to Voidokilia beach ends (figure 4). It is unlikely that these tracks come from agricultural machines, since the area is situated several hundred metres away from the closest field and is separated from it by a channel of water. It seems more probable that they were made by people who were out driving just for fun.



Figure 4. Tracks, possibly from cars and motorcycles, probably made by people out driving just for fun. Found in the dried up areas in the northwestern part of the lagoon. (David Söderblom-Tay, 2014-05-13)

There were fields that appeared to have been mowed quite recently and fields that were not mowed, though you could see traces of mowing from previous years in the form of vehicle tracks. It would therefore appear likely that they will be mowed during this year too. In the fields that were mowed the vegetation was cut all the way up to the

border of the dried up areas, leaving no zone of uncut vegetation. In between the fields there were plantations of olive trees. Most of these plantations were situated at a distance of between 50 to 100 meters away from the dried up areas and the water-filled channel, which followed alongside the foot/bike road. However, in one of the plantations the olive trees closest to the lagoon were less than ten meters away from the channel, separated by a zone of vegetation around one meter wide and consisting mostly of *Schoenoplectus* sp. (figure 5). The olive trees in this plantation appeared to be quite young due to their small size. The ground cover had been completely removed, leaving the soil bare.



Figure 5. The cultivation of olive trees that was situated closest, less than 10 metres, to the channel separating the lagoon from the farmlands. (David Söderblom-Tay, 2014-05-13)

3.4. Tourism

The information in this section comes from an interview with Giorgos Maneas, 2014-05-15, unless otherwise stated.

Gialova lagoon is situated in the region of Messenia. According to Xenophon Kappas (personal comm. 2014-05-13), this region of Greece is most famous for its natural beauty and its beaches, but it also has many areas of archaeological interest. The primary time of the year for tourism is during July and August (Xenophon Kappas, personal comm. 2014-05-13). However, the summer months are the least interesting time in terms of biodiversity in the area (*ibid.*). Close to Gialova lagoon lies the Costa Navarino Hotel. The hotel states that one of its major goals is to create sustainable tourism, both with regard to nature and the local community (Costa Navarino 2014-06-30). The Costa Navarino Hotel has been working on increasing the length of the tourism

season in the area to attract visitors during what has formerly been considered as low season by developing the activities available (Xenophon Kappas, personal comm. 2014-05-13). Visitors coming for conferences, and even more for playing golf, have expanded the tourist season into early spring and late autumn (*ibid.*). The hotel and the foundation that manages it also want to promote local gastronomy and therefore buy locally produced food (*ibid.*). They have high demands on the quality of the food produced and are also trying to influence other hotels and restaurants in the area to buy more locally produced food (*ibid.*).

A few years ago there could be 200-300 cars per day at Voidokilia beach, which is to the west of the lagoon, facing the sea, and around the double at Divari beach, which is directly to the south of the lagoon, during July and August. However, most of the people visiting the area did not come for the lagoon. There used to be a beach bar at Divari beach that, among other things, arranged night parties. This, together with the beaches, was the main reason to come for people visiting the area. In 2012 HOS managed to get the beach bar shut down. The reason for this was that it caused a lot of problems for the environment and wildlife in the area. There was no parking area close to the beaches and the roads leading there were mostly dirt roads. Cars parking at the side of the roads destroyed the plants growing there, making the roads increasingly wider (Xenophon Kappas, personal comm. 2014-05-13). The activities at the beach bar also affected the animals inhabiting the area, disturbing and displacing them. There were much less cars at the lagoon the year after the beach bar was shut down. One of the responsibilities that the HOS had at the lagoon was to raise public awareness and interest of the area (Hellenic Ornithological Society 2014-06-03). They did this in a number of ways. They had an information kiosk in the village of Gialova, because the village gets a lot of tourists during summer, and an information centre at the lagoon where they provided visitors with information about the lagoon and gave guided tours of the area. In the winter they organized environmental education activities with schools from different parts of Peloponnese. There was a nature trail with signs that informed the visitors about the area and what kinds of plants and animals that could be observed. Two hides and an observational tower were built to make it easier to observe the wildlife. Since the HOS stopped their work at the lagoon in 2012 some of the paths have become overgrown, the signs, which are made of wood, have started to deteriorate, and the observation tower has fallen over. There is, however, a plan to rebuild the observation tower, but the financing of it has to be sorted out first.

During the time that HOS had the information centre there was a rising trend for people who wanted to visit the lagoon, and the Costa Navarino Hotel still offers tours to Gialova lagoon as an outdoor activity for their guests (Xenophon Kappas, personal comm. 2014-05-13). Both Giorgos Maneas and Xenophon Kappas believe that Gialova lagoon has a great potential for ecotourism, especially since there are other locales in this part of Peloponnese which also are suitable for ecotourism, and the lagoon is close to a hotel which focuses on being environmentally friendly.

According to data on the number of people visiting the information centre at Gialova lagoon during June and July in 2011, there were a total of 1095 visitors (Lauterbach & Le Cunff-Guillard 2011). 43 % were of Greek nationality and the rest were mostly from other European countries (*ibid.*).

3.5. Hunting

The information in the following section comes from an interview with Giorgos Maneas, 2014-05-15, unless otherwise stated.

According to Giorgos Maneas (personal comm. 2014-05-15), hunting is a common activity in Greece and it is allowed during the hunting season in areas that are not protected. However, illegal hunting is also quite widespread. The hunting period starts at the end of August and ends in February, and thus encompasses the autumn migration as well as the wintering. Hunting has never been permitted in Gialova lagoon, and before the area was protected, illegal hunting used to be a major problem. After a lot of efforts to prevent illegal hunting in the lagoon, it is now quite limited in extent. Mostly ducks are hunted in the area, but also turtle doves (*Streptopelia turtur*), to be used as food. Sometimes swans or even eagles are killed just for fun. The hunting is performed exclusively with guns. Between June and November 2011, volunteers for the HOS found a total of 971 bullets around the lagoon (Ruiz de Azua 2011d). 56 % of these were found along the foot/bike road which passes by the areas most preferred by birds (*ibid.*).

4. Discussion

4.1. General

Some of the major problems of Gialova lagoon, e.g. the lack of freshwater and the beach bar, have been dealt with already. However, there are still problems in the area that can be solved. An effective way to solve several of these problems would probably be to assign a management body for the protected area. As there is only a preliminary management plan, there is a need to update it and make it official to complement the management body. The management body would make sure that the rules and regulations of the Natura 2000-area and its management plan are followed, as well as conduct further work on improving the conditions of the area.

One thing that could be improved which also came up during the interviews as a possibility of improvement, would be to increase the amount of freshwater entering the lagoon, especially during certain parts of the year. An increased inflow of freshwater would create larger areas for feeding birds and would be most important during late spring migration, when the lagoon is diminishing because of increasing evaporation, and early autumn migration, when the lagoon has reached its smallest extent at the end of the summer. The birds that prefer the areas in the northwest part of the lagoon would probably benefit the most from this, since these areas seem to be the first to dry up. A larger inflow of freshwater could expand the areas of the lagoon that have a low salinity level. Since these areas seem to be the most preferred by the birdlife this might be beneficial. According to Hockin *et al.* (1992) a reduced salinity level in coastal lagoons is beneficial for invertebrates that the birds use for food. It also has the possibility of reducing the fluctuation of the salinity level in the lagoon over the year, making it more stable. An increase in the inflow of freshwater would, however, need to be balanced with the need for freshwater for irrigation of the farms in the area. Before allowing a greater inflow of freshwater into the lagoon, the water from the rivers should be analysed to make sure that no harmful chemicals that might come from the olive oil factory upstream remain.

4.2. Agriculture

Since the preliminary management plan only accounted for the impact from the legal farms, an updated management plan should be based on all the agricultural land present in the area and not just the theoretical extent of it. This would mean that the regulations

of the Natura 2000-area would be more adapted to what the protected area can actually tolerate, e.g how much freshwater that can be used for irrigation. To remove the illegal farms from the area would be a bad idea. Most of the farmers are quite poor and to evict them from their farms might leave them with nowhere else to go, especially in the aftermath of the financial crisis. It might also lead to a shift in the public opinion regarding the protection of the lagoon if farmers were to be removed from the area. Since a lot of work has been done to improve the public's support for the protection of the area this seems like a very bad idea. A better way to deal with it would be to make the farms more environmentally friendly. Several things can be done to reduce the negative impact on the lagoon caused by agriculture. To reduce the usage of fertilizers, pesticides and herbicides, as well as ensure a safer handling of these substances, there seems to be a need to provide education for the farmers on how to properly use them. This, in combination with regulations in the management plan, might lead to improvements of the condition of the lagoon.

To reduce the leaching of fertilizers into the water, a zone of vegetation could be left along the border of the fields. This vegetation would be able to take up some of the nutrients leached from the fields before they enter the water. The complete removal of the ground cover (figure 5) should be stopped. Since the soil is not held together by plant roots to the same extent that it normally would be, the erosion of the fields is increased, resulting in a loss of soil into the water (FAO 2005; Gómez *et al.* 2014). Vegetation also helps to bind moisture in the soil (FAO 2005), when the ground cover is removed this function is lost. This loss of soil moisture creates a higher demand for freshwater used for irrigation, meaning less freshwater that can enter the lagoon. Leaving the soil bare also increases the amount of fertilizers, pesticides and herbicides leaching from the soil and into the lagoon (FAO 2005), which might be harmful to the plants and animals in the lagoon. The removal of the vegetation also has a more direct consequence for the birdlife since it removes a potential food source for the birds, both in the form of seeds produced by the plants, and in the form of insects that live of or in the plants. The act of mowing fields may also have negative consequences for birds. This is the case if birds use the fields for feeding or nesting and the fields are mowed during that time of the year. No indication that this is a problem in the area has been found during this study, but it still remains as a potential threat, so further studies regarding the usage of the fields by the birds might be needed. If this is shown to be a problem, the simplest solution would be to mow the fields during the time of least activity in the concerned fields. This would probably be in the summer after the nesting period is over.

According to Gerakis & Kalburtji (1998), one of the most negative effects of agriculture neighbouring to wetlands is the expansion of farmland into the wetland. This affects both functions and values, the most obvious effect being that it reduces the wetland area, but it might also displace birds, and some species will, even if the disturbance has ended, avoid the disturbed areas (*ibid.*). The knowledge that the wet meadows surrounding wetlands remove most of the nutrients leaching from the farmland and maintain the quality of the water is very limited among Greek farmers (Baker & Maltby 1995 in Gerakis & Kalburtji 1998). This is unfortunate, since it is common in Greece to cultivate these areas during years of drought (*ibid.*), reducing their important function. Education and information about the functions and values of the wetland for the farmers might prevent this, but there should also be observations made with regular intervals to determine if the farms are expanding or not, and if they are — action should be taken to stop this.

A way to solve several of the problems caused by agriculture in the protected area — e.g the use of pesticides and herbicides, and the bare soil — would be to promote organic farming. The Costa Navarino Hotel has an important role in this since they have profiled themselves towards being environmentally friendly, using food that is locally produced and of good quality (Xenophon Kappas, personal comm. 2014-05-13). Their willingness to buy products produced in organic farms might work as an incentive for the farmers to become more environmentally friendly.

The tracks made by tractors in the previously flooded areas in close proximity to the fields are most likely not a big threat for birds, because of their limited extent. However, if their extent were to increase this might add to the problem of farmland expanding into the wetland. A management body that informs the farmers of what the consequences might be and enforces the protection of the area would probably solve this problem easily. The tracks from cars and motorcycles in the dried up areas in the northwest seem to be a more severe problem. They were much more numerous, situated closer to areas used by birds, and appeared to have been made just for fun. Since the observation of these tracks was made just after the spring migration had ended, the tracks themselves were probably made sometime during the later parts of the migration. This part of the lagoon is one of the areas most used by birds, and since the tracks were close to the edge of the water, were waders and other bird species often search for food, this might be quite a severe disturbance to birds. During the spring migration birds arrive to the lagoon after crossing the Mediterranean and perhaps the Sahara desert, and then need to feed to fill up their fat reserves before continuing north to their breeding grounds. Disturbance causes them to lose feeding time and if the total disturbance is severe it might force them to leave to search for more tranquil feeding areas further away (Goss-Custard *et al.* 2006). However, this is a problem that a management body would be able to solve quite easily by informing visitors that they should not disturb the wildlife, and taking action against people who do these kind of things. It is also possible to put up a fence bordering the concerned area so that vehicles are not able to enter it.

4.3. Tourism

Currently the primary time for tourism, July and August, coincides with the time of the year when the least amount of birds live in the lagoon (figure 2 & 3). Therefore the disturbance of birds by tourism is likely to be quite limited. If the tourist season is expanded to other parts of the year, especially spring and autumn, there will be more disturbance to birds mainly during the migration, when large numbers of birds visit the lagoon (figure 3). However, an increased tourist season may also be beneficial for the birds, since it can work as an incentive for the community to support more protection and conservation actions towards the area if the lagoon draws tourists and publicity to the region. There are ways to reduce the disturbance caused by tourism on birds, but some of the actions suggested here might require more studies of how the birds are affected by tourism before it can be motivated to implement them.

The vehicle traffic in the area has gone down since the beach bar closed, but if the visitor numbers are expected to increase again through ecotourism it might be wise to construct an area for parking in the outskirts of the protected area and let the visitors walk the last part of the road. Previously the parking caused problems for the wildlife and made the roads increasingly wider. A specific area for parking would limit this problem as well as making the lagoon more peaceful by removing the noise of traffic. An increase in visitors will also mean an increase in litter left behind, and therefore it would be good to place a few litter bins in the area. This would not only reduce the

hazard that some types of litter pose to wildlife, but it would also make the area more appealing to visitors.

The information centre and the activities arranged in conjunction with it seem to have been a good way to attract tourists and educate visitors about the area and its wildlife. It would probably be beneficial to resume this activity to increase tourism in the area. The work with keeping signs and paths in good condition is also important for visitors to be able to move around in the area and learn more about it.

It would probably be negative for birds if many people would pass through the area they inhabit. This may result in birds sensitive to disturbance moving further away from the area or leaving it, while more tolerant birds may become more common (Wolf *et al.* 2013). The total amount of birds in the area may be unchanged, but the species composition may be different than in a similar area with lower disturbance (*ibid.*). According to Remacha *et al.* (2011), large groups of visitors generally have a stronger impact on birds than smaller groups, because they are perceived as a greater threat. This may result in a decreased number of birds seen where common species with a low tolerance to disturbance may be present but in reduced numbers, while rare species with a low tolerance to disturbance may be missing altogether (*ibid.*). This is something to take into consideration when arranging guided tours in the area. Not only is it negative for the birds, but the visitors may see fewer birds, and it may be the rare species that bring the most excitement, or they may even be the goal of the journey. However, there are ways to mitigate these negative effects. In areas where tourists are separated from birds by vegetation and observations can be made from concealed places, birds are less affected than birds in areas that are more open and have less developed vegetation (Collins-Kreiner *et al.* 2013; Wolf *et al.* 2013). A better developed natural vegetation provides the birds with more places to hide, but it also conceals visitors, making it possible to get closer to the birds without disturbing them. On the foot/bike road that leads from the south side of the lagoon, along the east side and ends in the northwest, there are a few sections with quite well developed vegetation (figure 6). This vegetation provides some concealment for visitors, moderately on the side closest to the lagoon and quite good on the other side of the road. Most of the foot/bike road is, however, quite exposed, with only low vegetation (figure 7), which means that visitors are visible from a long distance. If the vegetation along the foot/bike road was allowed to grow in height it may reduce negative impact from tourism and allow birds to use more of the area of and around the lagoon. The two hides at the lagoon enable observation of birds without disturbing them, since the observers are concealed. The construction of more hides would make it easier for visitors to observe birds, since a higher vegetation along the foot/bike road would also impede the vision of visitors. The use of observation towers means that humans are visible to birds from a much longer distance than if hides were used, which may result in a higher disturbance to birds, but they allow visitors to see farther, making it possible to see more birds and species that prefer more distant areas. Observation towers may also concentrate the disturbance to a few limited areas.



Figure 6. Area in the north east part of the lagoon, along the foot/bike road, where visitors are quite well concealed by surrounding vegetation, meaning less disturbance to birds. (David Söderblom-Tay, 2014-05-12)



Figure 7. Area in the south east part of the lagoon, along the foot/bike road, where visitors are exposed because of the low vegetation, meaning more disturbance to birds. (David Söderblom-Tay, 2014-05-12)

Along almost its entire stretch, the foot/bike road is surrounded by water on both sides. The visitors are therefore bound to the road, and it is difficult to approach birds further. This delimits the disturbance from visitors to the area closest to the road. However, the northwest part of the foot/bike road, just before it connects to a larger road, passes very close to one of the popular areas for birds. This area also dries up during spring, making it possible for visitors to get closer to birds. Further studies of how the birds in this area are affected by disturbance is needed, but it seems to be one of the most exposed areas in the lagoon, especially regarding the tracks made by cars and motorcycles in this area (figure 4). If studies show that this area has a high degree of disturbance, one way to reduce it would be to redirect the foot/bike road so that it passes by the area further away (figure 8). To still allow a good view of the birds in this particular area an observation tower could be constructed. The area seems like a good location for an observation tower since it is situated nearby a popular beach that attracts many visitors and may therefore raise the interest of people who are not visiting for the birds.

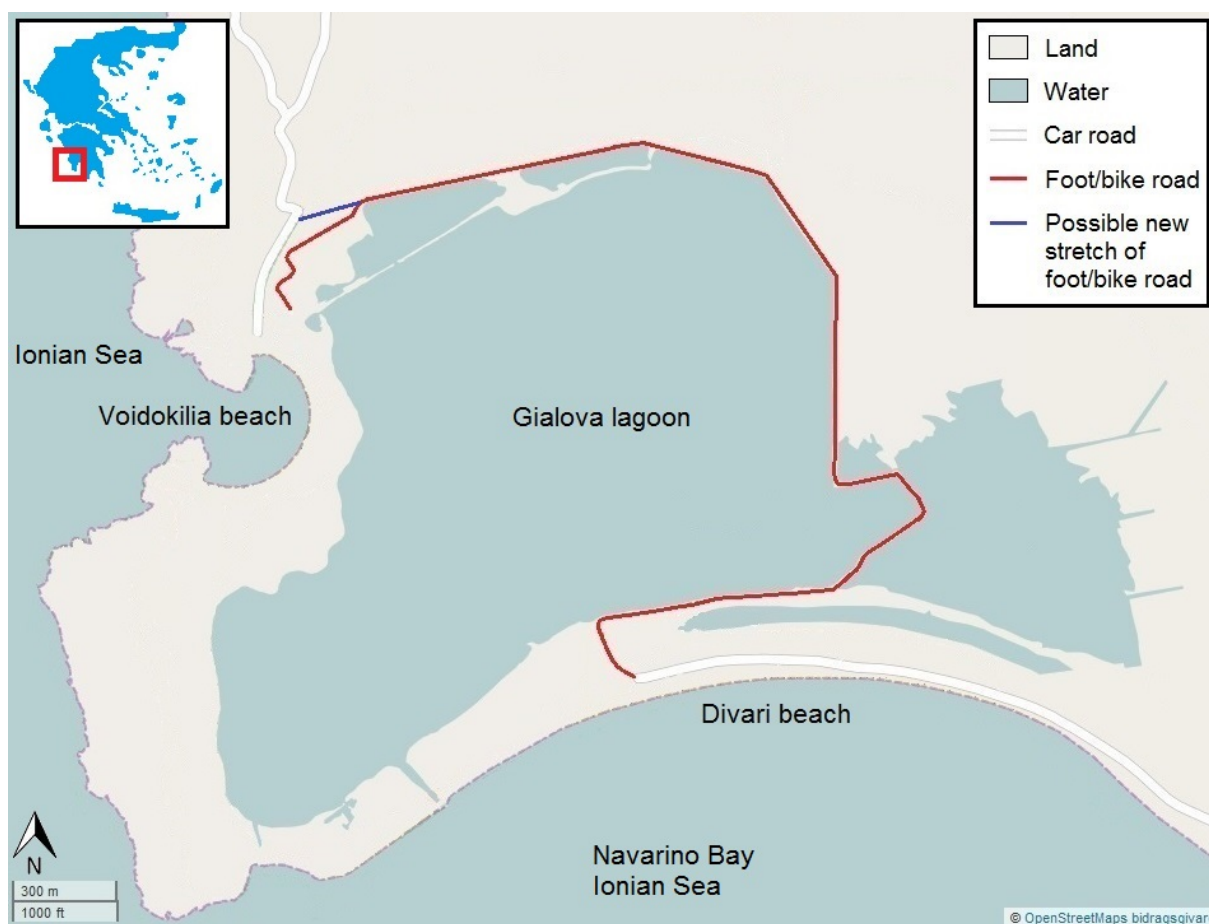


Figure 8. Map of Gialova lagoon with the possible new stretch of the foot/bike road marked on it. (Based on, and modified from, material from OpenStreetMap, © OpenStreetMap contributors, 2014-06-30)

4.4. Hunting

Hunting does not only kill birds — it also disturbs them. It is herbivorous birds that are most affected by disturbance from shooting, since they need to spend a large part of their day feeding to maintain their energy balance (Hockin *et al.* 1992). The bullets found in the area only indicate that guns have been fired and not when they have been

fired. Therefore, it is not possible to determine how many shots were fired during that particular year since the bullets could have been there for several years. However, the efforts to prevent illegal hunting in Gialova lagoon seem to have paid off and it does not seem to be a major problem in the area anymore. A management body of the protected area would be able to continue the work against illegal hunting and reduce it even further.

5. Conclusions

Wetlands are important for many species of birds, especially those that migrate. But the loss of wetlands in the world during the last century have been severe, and Greece is no exception. As a result, many populations of waterbirds in Africa and Western Eurasia are in a long-term decline. But it is not only the loss of wetlands that affects birds. Birds often perceive humans as a threat, and disturbance from humans can reduce the fitness of birds. Human activities like agriculture, tourism, and illegal hunting both cause disturbance and deteriorate the wetlands that the birds depend upon. To prevent further decline among migratory birds actions are needed to improve the condition of the wetlands that they use. Since Gialova lagoon is part of one of the most frequently used migration routes in Greece, at the same time as it is the southernmost wetland of international importance in the Balkan Peninsula, it is a very important wetland for birds. This study shows that some of the major problems of Gialova lagoon have already been solved, but there are still areas where improvement can be made to decrease the disturbance of the birdlife and improve the conditions of the lagoon.

By increasing the inflow of freshwater into the lagoon larger areas would be available to birds for feeding, since the areas that dry up would be more limited than at present. More freshwater in the lagoon may also lower the salinity level, which could be beneficial for invertebrates in the lagoon that many birds feed on. However, an increased inflow of freshwater has to be balanced with the need for freshwater for irrigation of the farmland in the area. By making the farms more environmentally friendly their negative impact on the lagoon and its birdlife can be reduced. Educating farmers on how to properly use and handle fertilizers, pesticides, and herbicides, may reduce the usage of these substances. Combining this with having a zone of vegetation along the border of fields, as well as maintaining a ground cover in the cultivations of olive trees, may reduce both the leaching of these substances into the water and the loss of soil into the water as a result of erosion. By maintaining a ground cover around the olive trees the use of freshwater for irrigation may be decreased, since vegetation helps to bind moisture in the soil, meaning that more freshwater can enter the lagoon. This ground cover may also act as a food source for birds, both in the form of seeds produced by plants, and in the form of insects attracted to plants. The expansion of farmland into wetlands is one of the most negative effects that agriculture has on wetlands, and this should be stopped. By preventing the use of vehicles in areas where birds feed and roost the direct disturbance may be decreased.

The peak of the tourist season in the area coincides with the time when the least amount of birds inhabit the lagoon. Therefore disturbance from tourism is likely to be quite limited. However, there are plans to extend the tourist season into spring and autumn — the time of migration for birds. This may increase the disturbance of the birdlife in Gialova lagoon, but it may at the same time be beneficial, since it could increase the support for actions regarding protection and conservation of the area if the lagoon attracts tourists and publicity. Resuming the activities at the information centre at the lagoon, as well as the maintenance of paths and signs, may not only increase the

amount of visitors, but also allows for informing visitors about the birdlife and how to not disturb it. If tourism in the area would increase, this might motivate further studies on how it affects the birdlife, and the implementation of measures to decrease disturbance by visitors. Since humans are perceived as a threat by birds, it may be wise to reduce the size of visitor groups and to try to conceal visitors, to reduce their disturbance of the birdlife. By allowing the natural vegetation along the paths to increase in height, in combination with the usage of hides, the visitors would be more concealed, which might allow them to see more birds and get closer to them. Observation towers may allow visitors to see more birds since they can see farther, but they could also increase the disturbance, since they makes the visitors more visible to the birds. However, with a combination of vegetation, hides, and observation towers, the disturbance can be concentrated to a few limited areas. An area of special concern in regard to disturbance by tourists is the northwest part of the foot/bike road that leads from the south side of the lagoon, along the east side, and ends in the northwest. Along this part of the road visitors come quite close to an area popular among birds, and they are even able to leave the road to approach them further. One way to reduce the disturbance in this particular area would be to redirect the road to make it pass further away from the area, and instead build an observation tower in the vicinity. However, further studies on how the disturbance of visitors affects birds in this area are needed before this could be motivated.

The efforts to prevent illegal hunting in Gialova lagoon seem to have been efficient and hunting does not appear to be a major problem in the lagoon anymore. Currently agriculture seems to have the most negative effect on the birdlife in Gialova lagoon, but since there appears to be an ambition to increase the tourism in the area this may change in the future. However, by assigning a management body for the protected area, as well as updating the management plan, several of the problems in Gialova lagoon could be solved and the disturbance of the birdlife reduced.

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Maps

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Appendix

Bird species observed at Gialova lagoon during the fieldwork (11-13/5 – 2014)

No.	Scientific name	English name
1	<i>Cygnus olor</i>	Mute Swan
2	<i>Anas platyrhynchos</i>	Mallard
3	<i>Egretta garzetta</i>	Little Egret
4	<i>Casmerodius albus</i>	Great Egret
5	<i>Ardea cinerea</i>	Grey Heron
6	<i>Circus aeruginosus</i>	Western Marsh Harrier
7	<i>Buteo buteo</i>	Common Buzzard
8	<i>Falco tinnunculus</i>	Common Kestrel
9	<i>Himantopus himantopus</i>	Black-winged Stilt
10	<i>Glareola pratincola</i>	Collared Pratincole
11	<i>Charadrius hiaticula</i>	Common Ringed Plover
12	<i>Charadrius alexandrinus</i>	Kentish Plover
13	<i>Calidris minuta</i>	Little Stint
14	<i>Larus michahellis</i>	Yellow-legged Gull
15	<i>Sterna sandvicensis</i>	Sandwich Tern
16	<i>Galerida cristata</i>	Crested Lark
17	<i>Hirundo rustica</i>	Barn Swallow
18	<i>Delichon urbicum</i>	Common House Martin
19	<i>Motacilla alba</i>	White/Pied Wagtail
20	<i>Motacilla flava</i>	Yellow Wagtail
21	<i>Luscinia megarhynchos</i>	Common Nightingale
22	<i>Saxicola torquatus</i>	Common Stonechat
23	<i>Turdus merula</i>	Common Blackbird
24	<i>Sylvia melanocephala</i>	Sardinian Warbler
25	<i>Cisticola juncidis</i>	Zitting Cisticola
26	<i>Cettia cetti</i>	Cetti's Warbler
27	<i>Acrocephalus scirpaceus</i>	European Reed Warbler
28	<i>Acrocephalus arundinaceus</i>	Great Reed Warbler
29	<i>Parus major</i>	Great Tit
30	<i>Corvus cornix</i>	Hooded Crow
31	<i>Passer domesticus</i>	House Sparrow
32	<i>Chloris chloris</i>	European Greenfinch
33	<i>Emberiza hortulana</i>	Ortolan Bunting
34	<i>Emberiza citrinella</i>	Yellowhammer
35	<i>Emberiza calandra</i>	Corn Bunting