Wetland adaptation in Attica Region, Greece
Pilot Study 4: Effects of climate change on the wetland ecosystems of Attica Region, Greece

Thematic Centre: Drought, Water and Coasts
Pilot Study 4 Technical Report

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The present work is part of the Greek Pilot Study 4 “Effects of climate change on wetland ecosystems of Attica, Greece” which was carried out under the Thematic Centre “Drought, Water and Coasts” of ORIENTGATE project, which co-financed through the South East Europe Transnational Cooperation Programme.

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Reference:
Introduction

The effects of climate change on the wetland ecosystems of Attica Region were studied as regards their vulnerability to further degradation.

The results of the vulnerability assessment were incorporated in the documentation “Strategy for the Wetlands for Attica Region” with the scope to prioritise particularly vulnerable wetland areas for intervention and propose adaptation actions and mitigating measures to prevent or reduce wetland degradation and loss.

Key problem addressed from Pilot Study 4

Climate change is expected to seriously affect biological diversity. Biodiversity loss is of great concern, since, among others, ecosystem services will be degraded. In the Mediterranean, a rise in temperature and a reduction in runoffs are expected; they are both expected to influence wetland ecosystems. With regard to Greek wetlands, pilot studies show that quantity and quality of lakes will probably be affected due to deterioration of drought. Potential significant reduction in wetland surface areas is expected to affect coastal wetland and consequently bird migration routes. Climate change adaptation plans and sustainable wetland management help in the fight against climate change. Measures in this direction are: conservation and restoration of wetlands that act as natural flood defense systems and as water regimen regulators, and enhancement of their capacity to adapt to climate change by reducing over-exploitation, eutrophication, pollution, invasion of alien species etc.

Objective of the Pilot study and description of the study area

Within the territory of the Region of Attica, there are still wetlands that should certainly not be overlooked, both in terms of their number and significance. In particular, more than 100 wetlands have been recorded in Attica: streams and their estuaries, coastal marshes and lagoons, lakes and constructed wetlands. The lakes of Marathonas, Koumoundourou and Vouliagmeni, the coastal wetlands of Skala Oropou, Schinia, Vravrona, Brexiza, Lavrio, Loutsa, Vourkari-Megara, Psatha, Asopos and Kifisos, the streams of Pikrodafni and Rafina, and the salt marsh of Anavyssos are only a few of the wetlands in Attica. Wetlands constitute a significant element of the natural environment, not only as ecosystems for the conservation of different species, but also as part of the water bodies of the region, as recreational areas or even as areas for the development of activities, which must be managed and protected. As throughout the Mediterranean, in the Region of Attica changes have been observed over the last forty years in the use of land surrounding the wetlands, as has a degradation of their resources (e.g. over-abstraction of water, pollution caused by liquid and solid waste as well as synthetic chemicals, encroachment and destruction of natural vegetation). The pressure exerted by climate change is expected to act in synergy with anthropogenic pressures. Out of all wetland systems, many ephemeral wetlands are expected to vanish and many permanent wetlands are expected to shrink.

The objectives of Pilot Study 4 are (i) to assess the vulnerability of wetlands in Attica Region under projections of climate change, and (ii) to support Region of Attica to formulate a wetland strategy for their conservation and climate change adaptation.
Methodological approach, Data & Results

The methodology that was applied for the assessment of vulnerability of Attica wetlands, is based on the Vulnerability definition of the Intergovernmental Panel on Climate Change's (IPCC). According to this definition, “Vulnerability to climate change is defined as the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity” (IPCC, 2008).

The above definition draws on three main concepts: Exposure, Sensitivity and Adaptive Capacity.

**Exposure** is the “nature and degree to which a system is exposed to significant climatic variations” (IPCC 2001). Exposure changes are studied through climate models that demonstrate how, given certain assumptions, climate variables may change over a period time.

**Sensitivity** is the “degree to which a system is affected, either adversely or beneficially, by climate-related stimuli” (IPCC 2001, p.384). While an ecosystem is exposed to changes in climate, sensitivity determines the degree to which different receptors within the system are affected positively or negatively.

A climate change impact is a combination of the degree to which the system is exposed and the degree to which a system is sensitive to changes in climate variables (e.g. increased precipitation) and the consequences of these changes (e.g. increased flooding).

The third element of the IPCC's vulnerability definition is the **Adaptive Capacity**, which is defined as “the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences” (IPCC 2007).

**Vulnerability** is computed as a composite of indicators of Adaptive Capacity and indicators of Sensitivity under Exposure to climate change.

In this context, the vulnerability of Attica wetlands to climate change is considered as a function of: (i) exposure to drought, (ii) the degree of sensitivity of the wetlands to further degradation, and (iii) the capacity of the agencies involved to take measures so that the wetlands of Attica may maintain their adaptive capacity to future climatic conditions (Figure 1).

In particular, as it is presented in the Wetland Vulnerability Matrix (Figure 2) Wetland Vulnerability assessment is based on the qualitative relationship between Exposure to Drought and Sensitivity, resulting in the so called Impact, and Adaptive Capacity. According to the matrix, a wetland can range from being "extreme high vulnerable" when the Impact (synergy of drought and sensitivity) is high and the Adaptive Capacity is low, up to being "not vulnerable" when Impact is low and Adaptive Capacity is high. The matrix is adapted from the qualitative approach often used to express the extent of risk through a formal risk assessment (Burgman 2004).
Figure 1: Wetland Vulnerability assessment (adapted from Fussel and Klein, 2006)

Figure 2: Wetland Vulnerability Matrix (based on Burgman, M. A. 2004. Derived from Gitay et al. 2011).

Below follows a synoptic presentation of the three basic elements of Attica wetland vulnerability assessment.

(i) Exposure to drought; expressed by the Drought Vulnerability Index (DVI)
DVI (Greek Ministry of Environment, Energy and Climate Change, 2013) is an index for the assessment of vulnerability to drought and water scarcity and fixing relative risk zones. It is resulted from the combination of all the features of drought (duration, intensity, frequency) as they have analyzed and calculated in relation to Index SPI-12 (McKee et al 1993). DVI is classified in 4 classes where the score receives values from 1-4 (1: low Vulnerability, 4: high Vulnerability) (Table 1) following the formula:

\[
\text{DVI} = 0.25 \times \text{Score (drought events)} + 0.25 \times \text{Score (drought events with duration > 24 months)} + 0.25 \times \text{Score (magnitude_max)} + 0.25 \times \text{Score (duration_max)}
\]

where:
- drought events: number of drought events observed in the reference period.
- drought events with duration > 24 months: number of drought events observed for more than 24 months in the reference period.
- magnitude max: maximum drought magnitude in the reference period (magnitude=the absolute value of the sum of the SPI12 during the months that the drought episode lasted).
- duration max: maximum duration of drought events in the reference period.

### Table 1. Classification of parameters for calculating the DVI into classes and Score

<table>
<thead>
<tr>
<th>Drought incidents</th>
<th>Drought events with duration&gt;24 months</th>
<th>Maximum size of drought</th>
<th>Maximum duration of drought event</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>0-4</td>
<td>0 – 30</td>
<td>0 – 20</td>
<td>1</td>
</tr>
<tr>
<td>11-20</td>
<td>5-6</td>
<td>31 – 40</td>
<td>21 – 30</td>
<td>2</td>
</tr>
<tr>
<td>21-30</td>
<td>7-8</td>
<td>41 – 50</td>
<td>31 – 40</td>
<td>3</td>
</tr>
<tr>
<td>&gt;31</td>
<td>&gt;9</td>
<td>&gt;= 51</td>
<td>&gt;=41</td>
<td>4</td>
</tr>
</tbody>
</table>

Figures 3, 4 and 5 visualize the results of DVI for the baseline period (1970-2010), and for future projection upon the climate scenarios A1B and A2 accordingly.
Figure 3: Drought Vulnerability Index for the baseline period 1970-2010.

Figure 4: Drought Vulnerability Index upon climate scenario for 2010-2100 SRES A1B.
Figure 5: Drought Vulnerability Index upon climate scenario for 2010-2100 SRES A2.

(ii) Wetland Sensitivity (WS)

Figure 6: Wetland Sensitivity assessment

WS is a function of anthropogenic drivers (changes due to agriculture and urbanization), of their values for human beings and of their protection status (Figure 6) WS is expressed as "high", "moderate", "low" with the following formula:

\[ WS = 0,30*WCU + 0,30*WCA + 0,20*WP + 0,20*WV \]

where:
WCU is the wetland threat due to Urbanization; it is calculated as the change, between two dates, in the amount of land taken by urban and other artificial land development, in or around the wetlands. It includes all areas converted to industrial and urban uses, to transport infrastructures, to urban “green” areas and to sport and leisure facilities. Expressed as "high", "moderate", "low" or "none".

WCA is the wetland threat due to Agriculture; it is calculated as the change, between two dates, in the surface of land taken by agriculture in and, around the wetlands. Expressed as "high", "moderate", "low" or "none".

WP is the surface of nationally protected wetlands; it is calculated as the surface of wetlands that lay inside nationally designated areas. Expressed as "high", "moderate", "low" or "none".

WV is the degree of expression of wetland values (i.e protection against floods, protection against erosion, improving of water quality and quantity, biological, scientific, education, hunting, fishing, recreational, cultural). Expressed as "high", "moderate", "low" or "none".

The results of the sensitivity assessment are shown in Table 2 and Figure 6.
<table>
<thead>
<tr>
<th>Wetland name</th>
<th>AGRICULTURAL THREAT RANK</th>
<th>URBAN THREAT RANK</th>
<th>PROTECTED AREAS SENSITIVITY FACTOR RANK</th>
<th>VALUES RANK</th>
<th>WS = 0,30<em>WCA + 0,30</em>WCU + 0,20<em>WP + 0,20</em>Wval</th>
<th>Sensitivity Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bourkari Marsh</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2,5</td>
<td>3 (High)</td>
</tr>
<tr>
<td>Vravrona Marsh</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2,3</td>
<td>3 (High)</td>
</tr>
<tr>
<td>Loutsa Marsh</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2,4</td>
<td>3 (High)</td>
</tr>
<tr>
<td>Sxinias Marsh</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1,7</td>
<td>2 (Medium)</td>
</tr>
<tr>
<td>Vouliagmeni Lake</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1,7</td>
<td>2 (Medium)</td>
</tr>
<tr>
<td>Koumoundourou Lake</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2,2</td>
<td>3 (High)</td>
</tr>
<tr>
<td>Marathonas Lake</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1,9</td>
<td>2 (Medium)</td>
</tr>
<tr>
<td>Oropos Lagoon</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2,4</td>
<td>3 (High)</td>
</tr>
<tr>
<td>Psatha Lagoon</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2,4</td>
<td>3 (High)</td>
</tr>
<tr>
<td>Asopos Estuary</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2,4</td>
<td>3 (High)</td>
</tr>
</tbody>
</table>
Figure 6: Wetland Sensitivity Indicator for the baseline period (1970-2010)

(iii) **Wetland Adaptive Capacity (WAC)**

Figure 7: Wetland Adaptive Capacity assessment
Wetland Adaptive Capacity (WAC) is a function of stakeholders’ functional capacity and of stakeholders’ awareness in regard to wetlands and climate change (Figure 7). WAC is based on several criteria (Table 3) and is expressed as “high”, "moderate", or "low" with the following formula:

\[ \text{WAC} = 0.70 \times \text{WFC} + 0.30 \times \text{WA} \]

where:

- WFC is the stakeholders’ Functional Capacity; it indicates the functional capacity of stakeholders to adapt in climate change and prevent or reduce wetland loss. Functional capacity is based on several criteria (Table 3) and is expressed as "high", "moderate", or "low".
- WA is the stakeholders’ Awareness; it indicates the level of awareness acquired by stakeholders in relation to the needs for wetland conservation and climate change adaptation. Awareness is based on several criteria (Table 3) and is expressed as "high", "moderate", or "low".

In pilot study 4 the process of stakeholder involvement, the link between the scientific communities and policy makers, is part of the wetland vulnerability assessment, having a two fold purpose:

(a) to assess the stakeholders’ Adaptive Capacity (Table 2); and

(b) to disseminate the pilot 4 findings (i.e scenarios of drought deterioration in Attica region and wetland vulnerability to climate change and anthropogenic pressures) and formulate a Wetland Adaptation Strategy on a participatory basis.

Central, regional and local services, other authorities, research agencies, environmental organisations and interested citizens were encouraged to take action through interviews, information meetings, workshops and training seminars. Experiences were exchanged; weaknesses and good/bad practices in the management and protection of Attica’s wetland wealth were recorded; and the value of conserving wetlands and the need to adapt to climate change were promoted. Figure 8 visualizes the Adaptive Capacity assessment of pilot wetlands in Attica. On the top of all stakeholders stands the Region of Attica who focuses on the conservation and protection of wetland ecosystems in view of climate change. Through ORIENTGATE pilot study 4, the Region of Attica, a Metropolitan Region (Law 3852/2010 -Kallikratis Programme), becomes the first region in Greece that has been mobilized towards an adaptation Strategy in regard to natural ecosystems. The Environment Directorate of Attica Region in cooperation with the Greek Biotope-Wetland Centre of the Goulandris Natural History Museum (EKBY - the research partner of the pilot study), prepared the Wetland Adaptation Strategy based on the scientific findings (i.e drought deterioration in Attica territory and Attica wetlands condition). The research involved the gathering and processing of geospatial data, and of data on climatic parameters and wetland features as well as information from operational programmes and actions. The synergy between the Environment Directorate and EKBY helped to adequately and comprehensively address integration of climate knowledge into policy.
Table 3: Criteria applied to qualitatively assess Wetland Adaptive Capacity of stakeholders in Attica territory, through a questionnaire survey and interviews.

<table>
<thead>
<tr>
<th>Single Adaptive Capacity Indicators</th>
<th>Wetland Adaptive Capacity criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stakeholders’ FUNCTIONAL CAPACITY</td>
<td>Criteria for function &amp; financial power</td>
</tr>
<tr>
<td></td>
<td>Stakeholders’ level of function: operational, policy, strategic</td>
</tr>
<tr>
<td></td>
<td>Capacity to finance adaptation measures</td>
</tr>
<tr>
<td></td>
<td>Administrative capacity to support the implementation of adaptation measures</td>
</tr>
<tr>
<td></td>
<td>Criteria for knowledge &amp; skills</td>
</tr>
<tr>
<td></td>
<td>Knowledge on wetland management and protection</td>
</tr>
<tr>
<td></td>
<td>Experience on access/use/interpretation of meteorological data</td>
</tr>
<tr>
<td></td>
<td>Experience on access/use/interpretation of ecological data</td>
</tr>
<tr>
<td>Stakeholders’ AWARENESS - PARTICIPATION</td>
<td>Criteria for awareness</td>
</tr>
<tr>
<td></td>
<td>Understanding and recognition of wetland values and threats</td>
</tr>
<tr>
<td></td>
<td>Understanding and recognition of climate change effects</td>
</tr>
<tr>
<td></td>
<td>Criteria for participation</td>
</tr>
<tr>
<td></td>
<td>Stakeholders’ actions to adverse wetland degradation</td>
</tr>
<tr>
<td></td>
<td>Involvement on planning management and adaptation measures</td>
</tr>
<tr>
<td></td>
<td>Networking and knowledge exchange experiences</td>
</tr>
<tr>
<td></td>
<td>Operation of committees on climate change adaptation</td>
</tr>
</tbody>
</table>

Figure 8: Adaptive Capacity assessment of pilot wetlands in Attica.
Vulnerability results and experiences derived from the pilot studies

Based on future climate projections, Attica’s vulnerability to drought is expected to rise from low to moderate by the year 2100. Drought episodes are expected to last longer and occur more frequently than in the past.

The synergy of drought and human intervention determines the degree of sensitivity of the wetlands. It has been found that there is a lack of adequate legal protection and there has been a shrinkage in the size of wetlands by up to 50% in the last 40 years, as well as a degradation of their values, such as the support of biodiversity, flood control and recreation. Most of Attica’s wetlands are classified as being highly sensitive to further degradation.

Due to the synergy of deteriorating drought conditions and anthropogenic interventions, most of Attica’s wetlands are expected to suffer moderate to high impacts. At the same time, findings show that the agencies involved in the conservation of wetlands have an average adaptive capacity. In particular, there is inadequate knowledge of wetland ecosystems and their services, a lack of experience in the use and interpretation of climatic parameters, a low degree of networking and exchange of experiences and good practices, average operational capacity of the competent agencies and availability of funds for the implementation of adaptation measures. In parallel, however, society is gaining a high level of understanding of the role played by wetlands in our quality of life (Figure 8).

Currently, the vulnerability of wetlands is classified as low to moderate (Figure 9), however, in future, the vulnerability of most wetlands is expected to rise to a high level (Figure 10, 11).

**Figure 9:** Degree of vulnerability of Attica wetlands based on data on the reference period of 1970-2010.
Figure 10: Future projection (climate scenario for 2010-2100 SRES A1B): Severe deterioration of the vulnerability of Attica’s wetlands

Figure 11: Future projection (climate scenario for 2010-2100 SRES A2): Deterioration of the vulnerability of Attica’s wetlands
Putting Results into practice

The ORIENTGATE pilot study 4 enforced climate knowledge integration into planning. Its scientific results were used to prepare the Attica Wetland Adaptation Strategy and Action Plan for wetland conservation and restoration.

The “Strategy for Wetlands in the Region of Attica” is the result of the integration of climate knowledge into policy and planning. It was prepared on the basis of the scientific findings on climate change and on Attica’s wetlands condition, made by research institutes-partners of the transnational ORIENTGATE project. The research involved the gathering and processing of geospatial data, and of data on climatic parameters and wetland features as well as information from operational programmes and actions that are in progress or scheduled by various agencies, groups, organisations and institutions.

The Region of Attica, as a Metropolitan Region in accordance with Law 3852/2010 (Kallikratis Programme), is the first that has been mobilized towards an adaptation Strategy in regard to natural ecosystems, involving local authorities in its area, social groups, environmental organisations and research institutions for the protection of the wetlands in its jurisdiction.

In particular, the Strategy takes into account and incorporates proposals of strategy and planning papers, such as the operational plan for 2014-2020, the national strategy and action programme on biodiversity, the Master Plan of Athens/Attica 2021, the River Basin Management Plan-Attica Water District, as well as the operational plans of involved municipalities of the Attica Region. It includes actions and projects such as:

- Enhancement of research for the purpose of studying the phenomenon of climate change and its impacts on species, habitats and ecosystem functions;
- Development of flood forecasting and early warning systems;
- Inventory, delineation and legal designation of the wetlands of Attica;
- Creation of a cohesive network of wetland areas-biodiversity islands, also as elements of green infrastructure;
- Strict implementation of measures for protecting and tackling industrial pollution (matters of establishment, operation, anti-pollution technology and environmental restoration);
- Projects promoting efficient and sustainable water use;
- Regulations on the compatibility between conserving wetlands and urban expansion in the framework of promoting a compact and non-polluting city;
- Enhancement and utilisation of information centres in protected areas in order to raise public awareness about matters pertaining to the protection of wetlands;
- Protection and restoration of monuments and landscapes of water interest (e.g. springs of the ancient Erasinos River and the Makaria Spring at Schinias);
- Enhancement and technical support of inspection and environmental control mechanisms;
- Actions involving networking and exchange of successful examples, as well as training for the staff of the competent services;
- Development and diffusion of policies on environmental viability and sustainability to enterprises, and promotion of actions, practices and procedures for the conservation and enhancement of biodiversity in the framework thereof;
- Encouragement of activities that have beneficial effects on biodiversity and avoidance of those that have adverse effects during the planning and examination of investment plans by enterprises.

Conclusions and lessons learned

Key constraints and limiting factors with regards to adaptation to climate change in water sector

From the perspective of biodiversity, ecosystems and specifically of wetlands, the key constraints and limiting factors are the following:

Establish meteorological stations at high elevations. Currently, in Attica Region there are no stations at elevations higher than 237 m.

Although significance experience is available in climate future scenarios, neither the Water Management Plan of Attica Catchment nor any project for flooding protection are based on them, mainly due to lack of relevant specifications set by the central authorities.

Especially for the medium to small sized wetlands that have no jurisdicntional protection, there is still inadequate research on their ecological and hydrological status, the biodiversity they support, their connection with other terrestrial and marine ecosystems, and the ecosystem services they provide.

In general, data and information are scattered and the access usually is very limited. Improvement in digitization of information is required.

Overall it is proven, that the communication and cooperation is inadequate, between bodies that produce or gather data and information (research organizations) with those bodies (central, regional and local authorities) that plan and implement projects and actions. This is the case for the use of climate data and for ecosystem and biodiversity data.

Future challenges and opportunities with regards to adaptation to climate change in the water sector

From the perspective of biodiversity, ecosystems and specifically of wetlands, the key constraints and limiting factors are the following:

Improvement in data and experience exchange amongst scientific community and central and regional authorities and policy makers of Attica region; these are planned to be led by Attica Region in the context of the Attica Region Observatory.

Improvement in governance amongst climate adaptation programs at regional and national level.
Disseminate best practices and good examples of synergies between local authorities and research institutes that have led to wetland restoration and improvement of protection status.

Specifically for Attica Region, the future challenge and opportunity is the implementation of the Attica Wetland Adaptation Strategy for conserving and adapting them to climate change.

Possible solutions to these challenges and areas for further improvements in terms of raising the adaptive capacity in water sector, based on the results of the pilot study 4.

From the perspective of biodiversity, ecosystems and specifically of wetlands, the key constraints and limiting factors are the following:

Improve knowledge on climate change and its effects on wetland ecosystems and their services.

Build the capacity of competent local and regional services:

(i) in the use and interpretation of climatic parameters and of climate vulnerability indicators, such as the wetland vulnerability indicator.

(ii) on conservation and restoration of wetlands as natural flood defense systems and as “Green Infrastructures”.

(iii) on the need to reduce over-exploitation, eutrophication, pollution, invasion of alien species etc. in order to enhance wetlands capacity to adapt to climate change conditions.

Increase the level of networking and exchange of experiences and good practices through communication means, seminars, and regional events and enforce public awareness and education on ecosystem climate adaptation.

Build the capacity of competent local and regional services in absorbing funds and in implementing climate adaptation projects.

Recommendations

The following key messages and recommendations arise from the experience gained during the pilot study 4 implementation:

- EU level

The key message for EU authorities and policy makers, is that integration of climate change knowledge into planning and policy shall become an obligatory process. To this direction governance and networking mechanisms and structures shall be established at country or region level. The ORIENTGATE model could be followed and further be strengthened and expanded. In particular the creation of a Thematic Center on biodiversity and ecosystem services is strongly suggested.
From the perspective of biodiversity, ecosystems and specifically of wetlands, the following issues are further recommended for EU authorities and directorates:

- Encourage and support MS to coordinate climate change adaptation programs and activities at country and at regional level, by nominating national as well as regional Climate Change Committees, by producing manuals for the use of vulnerability indicators and by promoting best practices.
- Request from MS to submit National Adaptation Strategies including, amongst others, priority measures for ecosystem conservation and restoration, as an asp in climate change.
- Request from MS to take conservation and restoration actions for wetland ecosystems in the context of the FW Directive and of the Flood Directive implementation and as a key component in the implementation of the EU Biodiversity Strategy to 2020 and the Green Infrastructure strategy.
- Fund research on climate change and its influence on species, habitats and wetland ecosystem services.
- Fund capacity building programs on the role of wetland ecosystems in climate change adaptation for authorities, services and the public at large.

- National level

Similarly, as above determined for EU level, the key message for the country and specifically for the central authorities, is that integration of climate change knowledge into planning and policy shall become an obligatory process. Governance and networking mechanisms and structures are necessary to be established in linkage with the ORIENTGATE thematic centers. In this context, research institutes, which produce climate knowledge and results on effects of climate change on biodiversity and ecosystems, human activities, health and safety, shall be nominated by law to report to Ministry for Climate Change and to respective central and regional authorities.

From the perspective of biodiversity, ecosystems and specifically of wetlands, it is strongly recommended that the Ministry for Climate Change identifies biodiversity and ecosystems as a particular thematic area in planning the climate change adaptation of the country. In particular, the national adaptation strategy shall integrate priority measures for wetland conservation and restoration, as a means to reduce the catastrophic consequences of floods and the effect of waves and currents, to improve water quality and to benefit the development of economic activities and human well being.

- Regional level

The vulnerability of Attica’s wetlands to climate change results from the combination of (i) drought, (ii) the degree of sensitivity of the wetlands to further degradation from anthropogenic pressure (most of Attica’s wetlands are currently classified as being highly sensitive to further degradation), and (iii) the capacity of the involved agencies to take adaptation measures (which currently is classified as average).

The overall result of the pilot study 4 show that, the vulnerability of Attica wetlands to climate change is currently classified as low to moderate, however, in future, the vulnerability of most wetlands is expected to rise to a high level. This rise is due to the deteriorating drought conditions. Future climate
projections by the year 2100, show that drought episodes are expected to last longer and occur more frequently than in the past. Considering these, the key message for the Region of Attica, is proved to be the following:

“A decisive move in the direction of conserving the wetlands and adapting them to climate change is the improvement of the adaptive capacity of the involved agencies from average to high and to stop or mitigate anthropogenic pressure”.

These needs form the framework of future actions by the Region of Attica and have been reflected in the so called “Strategy for Attica wetland conservation and their adaptation to climate change”. It stands for the following axis of priority measures:

- Improving knowledge about climate change and its influence on species, habitats and ecosystem functions.
- Conservation actions including wetland designation, improvement of protection and restoration of wetlands as Green Infrastructure elements.
- Sustainable use of natural resource: Strict enforcement of measures to prevent and combat pollution. Investments to promote efficient and sustainable water use, wastewater treatment, irrigation, etc. Land use planning for conserving wetlands in the context of promoting a coherent and non-polluting city.
- Environmental interpretation: Enhancing environmental awareness, development of information centers and other interpretation infrastructure, protection and restoration of monuments and landscapes related to water etc.
- Business: Fostering the support from industry (e.g. reduced emissions, biodiversity friendly activities etc.).

References


