



# Progress and results or technical actions

## NCC

Oct 2013 – Apr 2016

PENA, 26/04/2016



### WINDFARMS & WILDLIFE

LIFE12 BIO/GR/000554

**Demonstration of good practices to  
minimize impacts of wind farms on  
biodiversity in Greece**





# A.1 Operational plan for implementation of concrete conservation actions



## Objectives:

- Operational plan for the assessment of mitigation efficiency, with special reference to methodologies and protocols of application of modern methods and technologies
- Identification of key site/species biodiversity issues in relation to wind farms, to be assessed by project's actions
- Field training of project personnel in implementation of field techniques



# A.1 Operational plan for implementation of concrete conservation actions



## Progress of activities:

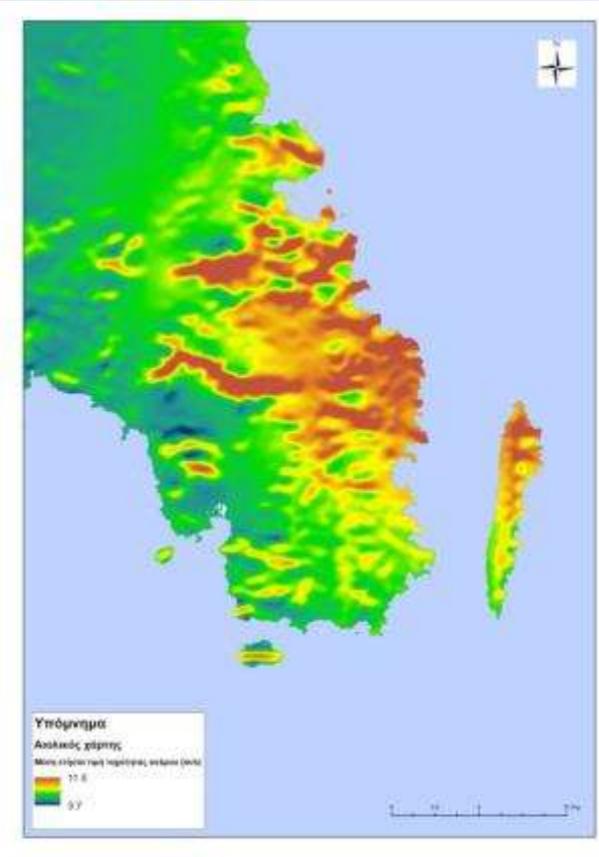
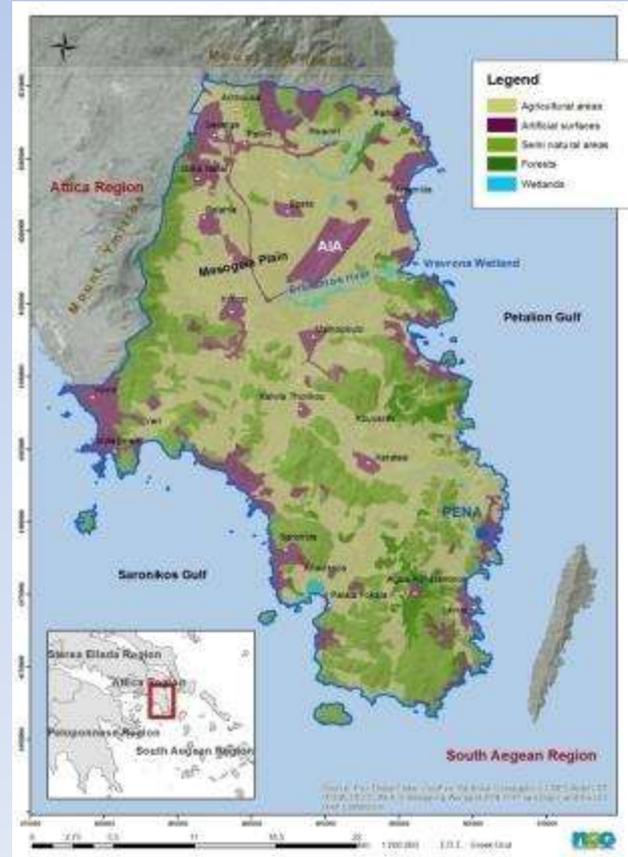
- ✓ Collection and review of up-to date information on available and in-use methods and technologies of bird/bat surveys related to wind farms **(completed – included in operational plan)**
- ✓ Collection and review of modern mitigation measures for reducing wind farm impact on biodiversity **(completed – included in operational plan)**
- ✓ Collection and review of key biodiversity issues in relation to impacts of wind farms on biodiversity in Greece and at project site **(completed – included in operational plan)**
- ✓ Guidelines for the production of Good Practice Guide (GPG and Decision Support Tool (DST) **(completed – included in operational plan)**



# A.1 Operational plan for implementation of concrete conservation actions

## Progress of activities:

- ✓ Collection and processing of geographical and topographical for the project site – topography, land use and wind energy potential data (completed – included in operational plan)



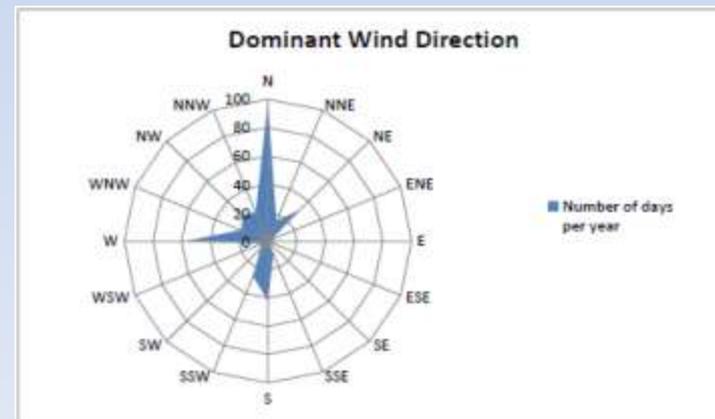
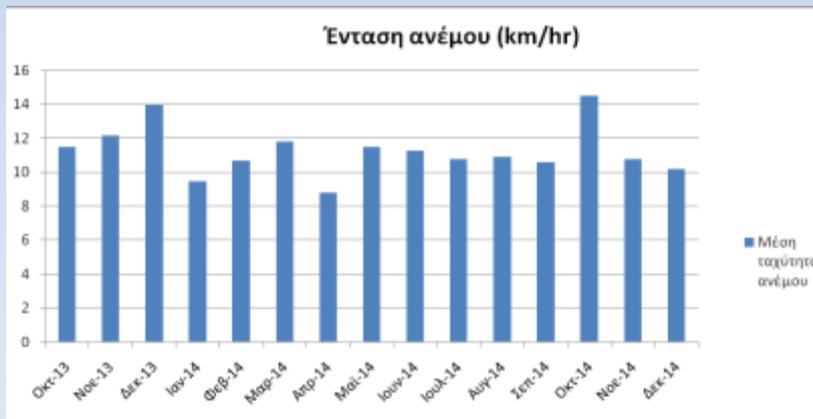
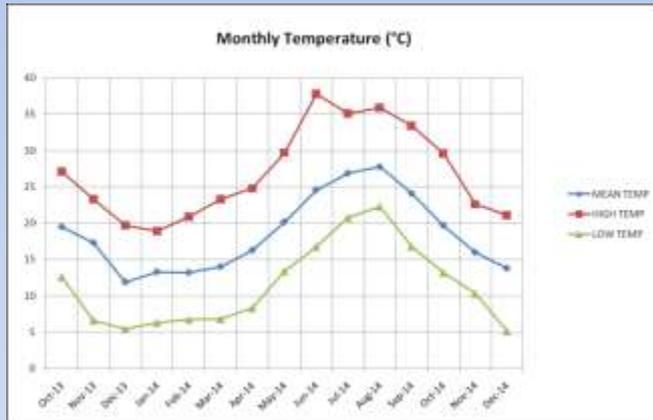


# A.1 Operational plan for implementation of concrete conservation actions



## Progress of activities:

- ✓ Collection and processing of geographical and topographical for the project site – meteorological data (**completed – included in operational plan**)





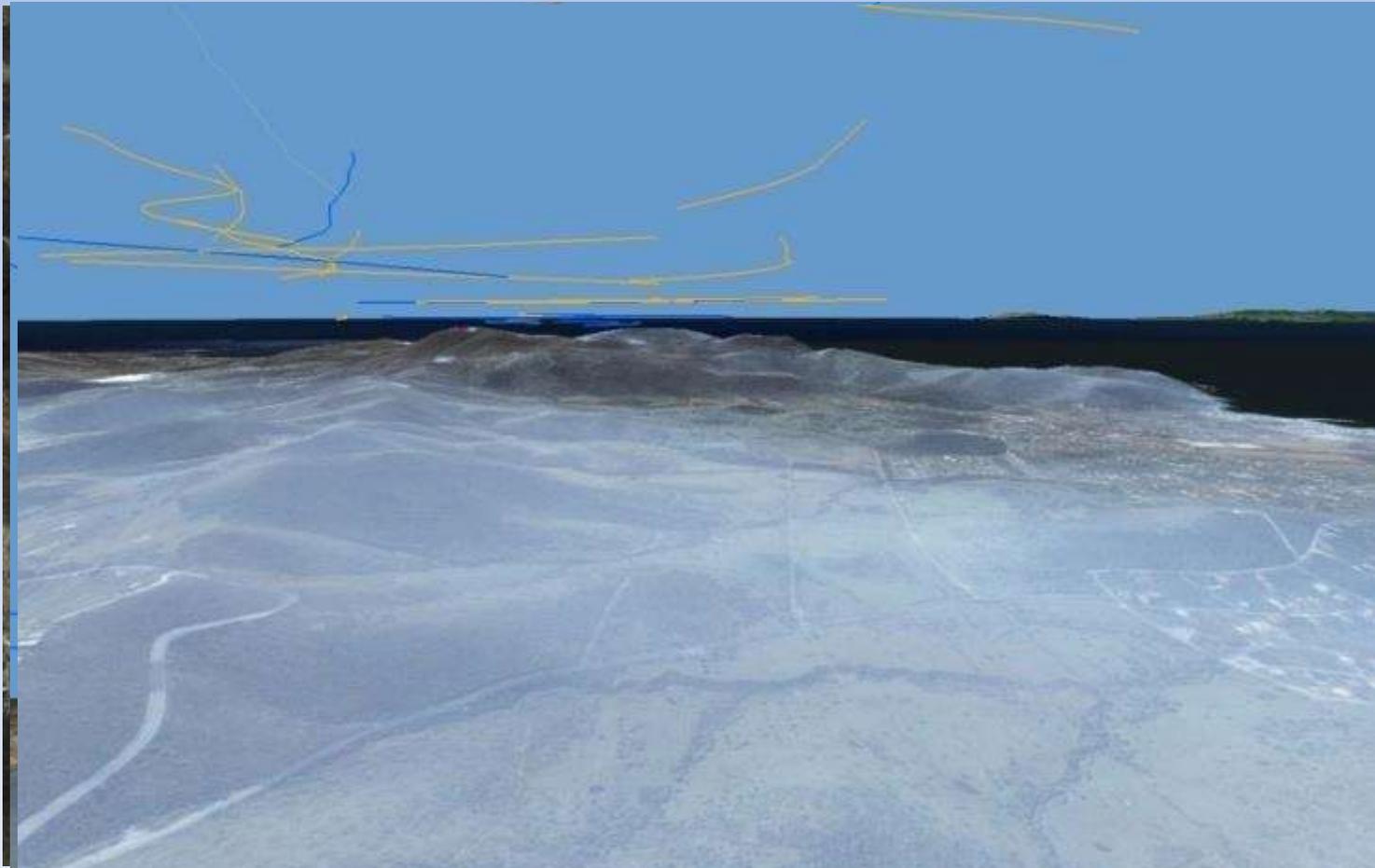
# A.1 Operational plan for implementation of concrete conservation actions



## Progress of activities:

- ✓ Collection of ornithological data for the project site (**completed**)

**Vantage point surveys – recording bird species, number and flight routes**

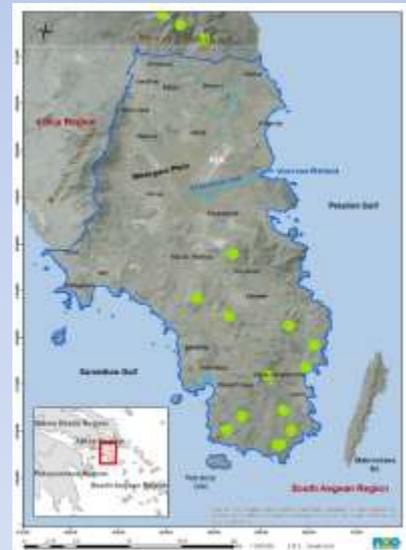
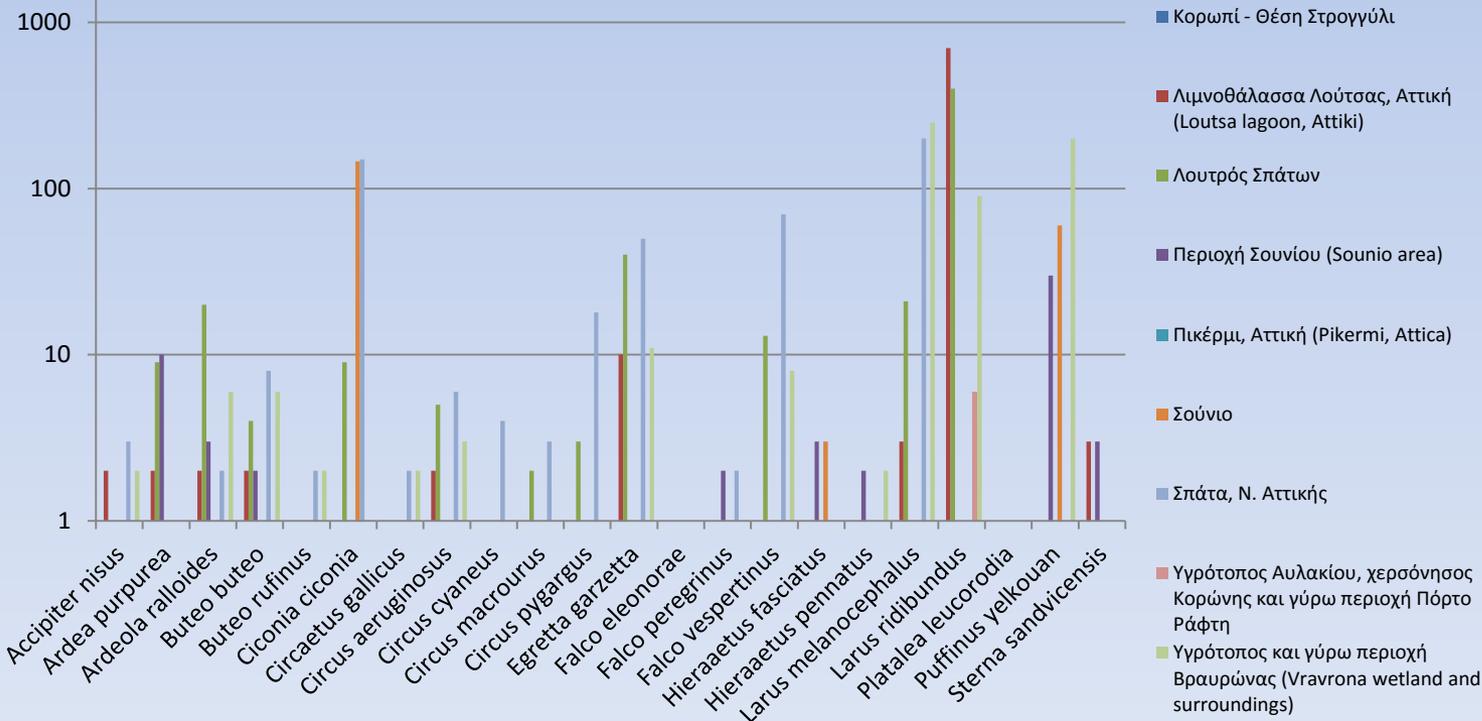


# A.1 Operational plan for implementation of concrete conservation actions

## Progress of activities:

- ✓ Collection and analysis of ornithological data for the project site **(completed)**

**DISTRIBUTION: Maximum no. individuals per species per observation location**





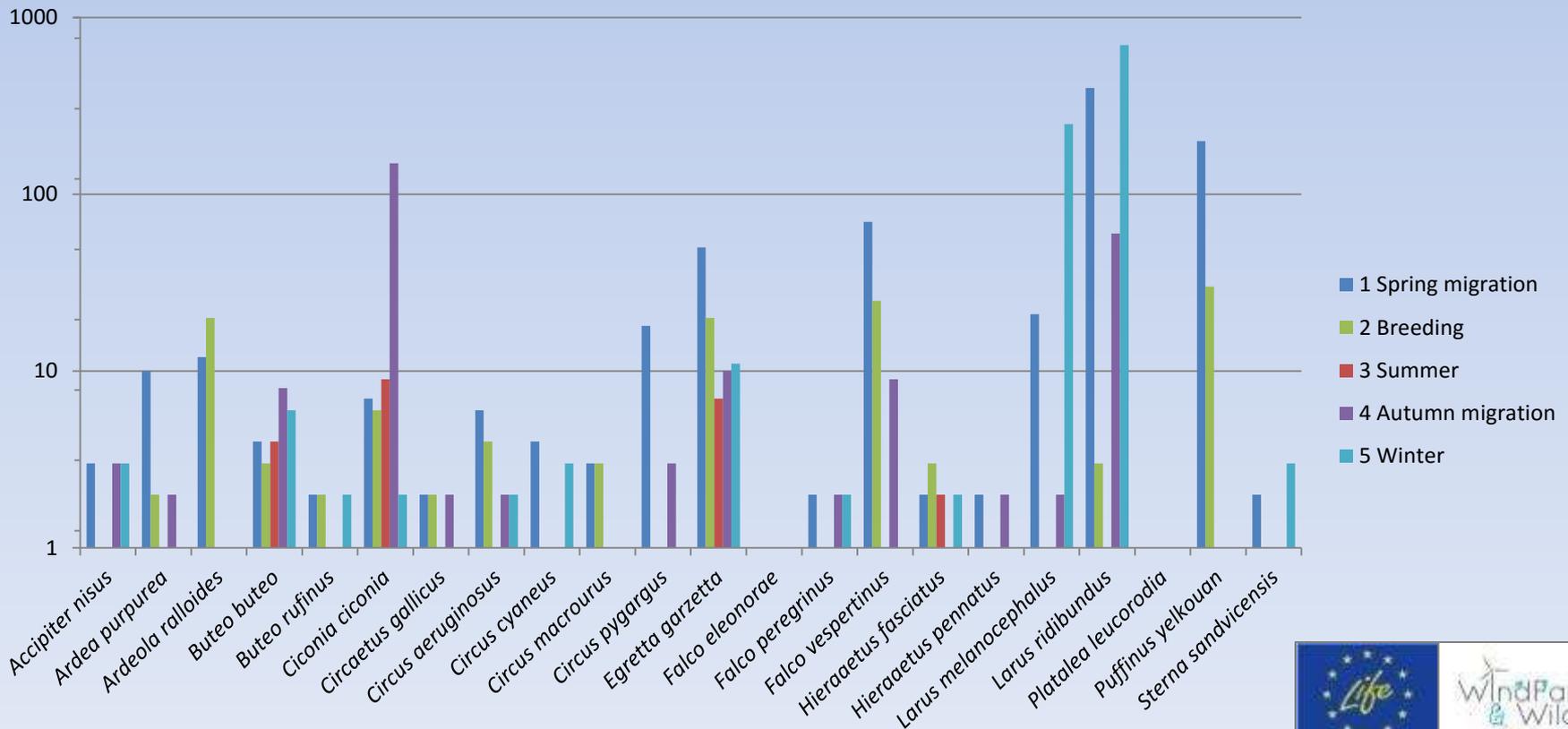
# A.1 Operational plan for implementation of concrete conservation actions



## Progress of activities:

- ✓ Collection and analysis of ornithological data for the project site **(completed)**

SEASONAL VARIATION: Max. num individuals per session





# A.1 Operational plan for implementation of concrete conservation actions



## Progress of activities:

- ✓ Collection and analysis of ornithological data for the project site **(completed)**

## Identification of major flight routes



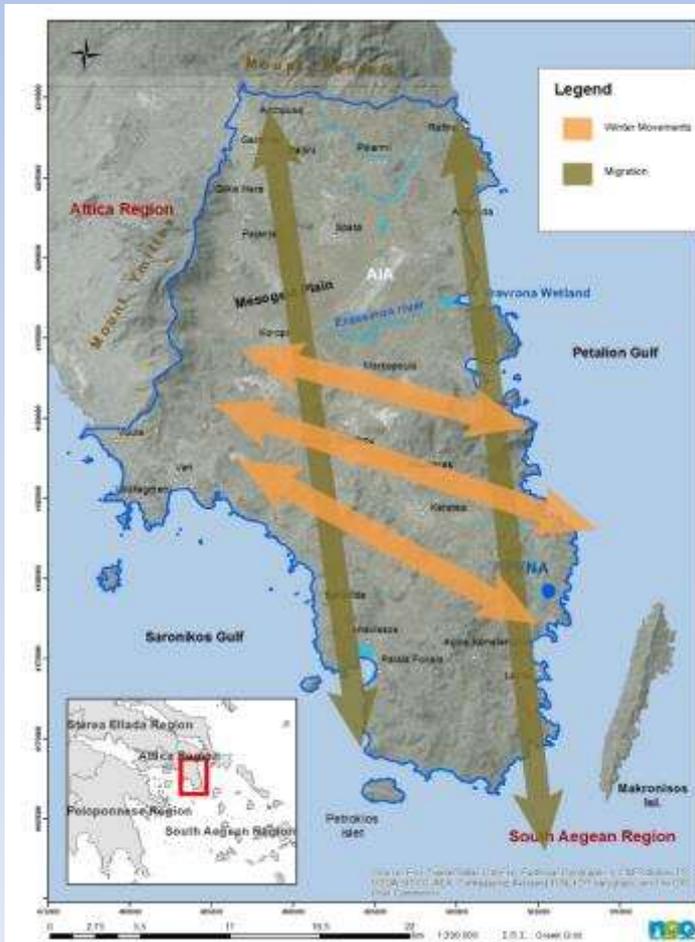
Photo: M.Tzali



Photo: J. Fric



Photo: M.Tzali





# A.1 Operational plan for implementation of concrete conservation actions



## Progress of activities:

- ✓ Identification of bird/bat groups sensitive to wind farms **(completed)**
  - Bats (March – October)
  - Migratory passerines (April – May, September- October)
  - Migratory soaring birds (April – May, August – September)
  - Breeding birds (May-July)
  - Wintering birds (November – April)





# A.1 Operational plan for implementation of concrete conservation actions



## Progress of activities:

- ✓ Identification of methods and methodologies for mitigation of to wind farms impact on aerial biodiversity to be implemented in action C.1  
**(completed)**
- **Early-warning/monitoring**
  - Ornithological radar
  - Video surveillance system
  - Thermal camera
  - Bioacoustic monitoring systems
- **Mitigation measures**
  - Acoustic deterrence system
  - Wind turbine operation control
- **Wind energy production output**





# A.1 Operational plan for implementation of concrete conservation actions



## Progress of activities:

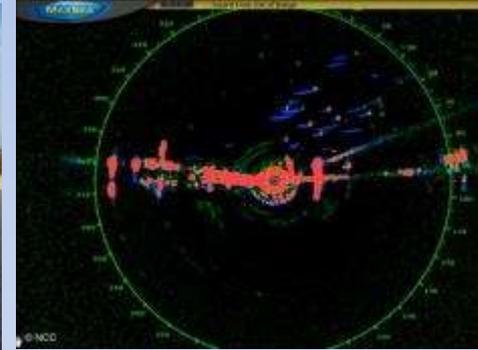
- ✓ Production of the operational plan for the implementation of early warning/mitigation measures in action C.1 **(completed)**



# A.1 Operational plan for implementation of concrete conservation actions

## Progress of activities:

- ✓ Training of project personnel in using modern technologies (**completed**)
- **Ornithological radar** (in cooperation with PPC Renewables and BuWa B.V.)



- **Video surveillance system** (in cooperation with Anemos Makedonias and Liquen Ltd.)



- **Bat detectors** (in cooperation with external bat expert)



# A.1 Operational plan for implementation of concrete conservation actions



## Progress of activities:

- ✓ Provision of equipment for mitigation of to wind farms impact on aerial biodiversity to be implemented in action C.1 **(largely completed)**

## Available:

- ✓ Ornithological radar
- ✓ Mobile and stationary bioacoustic monitoring systems (bat detectors and sound recorders)
- ✓ Thermal camera
- ✓ Stationary video surveillance and bird deterrence system

## Pending:

- ✓ Mobile video surveillance system





# A.1 Operational plan for implementation of concrete conservation actions



Results	Foreseen	Realized
Mitigation action plan - Operational plan for the demonstrative implementation of technologies and methods for mitigation of impacts of wind farms on aerial biodiversity	Operational plan	<b>Completed</b>
Methodology for the estimation of wind energy production losses due to mitigation measures	Monitoring protocol	<b>Completed</b>
Training of project personnel in use of advanced methods and technologies	Personnel trained	<b>Completed</b>
Provision of equipment for demonstrative implementation of early warning/ mitigation measures: Radar, thermal camera video surveillance system bioacoustic monitoring system	Equipement for C.1 purchased	<b>Almost Completed</b>

## Deliverables:

- ✓ **Mitigation action plan**





# A.1 Operational plan for implementation of concrete conservation actions



## Timetable:

	13	2014				2015				2016				2017			
Foreseen																	
Realized																	

## Problems encountered:

Delay in the purchase of the HD video surveillance system (DTBird) – installed and operational in March 2016, but compensated by operation of other systems (radar, bat detectors, thermal camera)

**Foreseen activities:** The action has been completed.





## A.2 Operational plan for monitoring and public awareness/dissemination actions



### Objectives:

- Monitoring methodologies and protocols for the assessment and evaluation of the effectiveness of implemented early warning and mitigation measures **(completed)**
- Identification of monitoring indicators for the evaluation of the effectiveness of the mitigation measures and dissemination actions **(completed)**





## A.2 Operational plan for implementation of concrete conservation actions



### Progress of activities:

- ✓ Preparation of monitoring methodologies and protocols for birds/bats in order to assess and evaluate of the effectiveness of implemented early warning and mitigation measures

### Birds

- Vantage point counts
- Radar surveys
- DTBird (HD video surveillance system) surveys
- Thermal camera surveys

### Bats

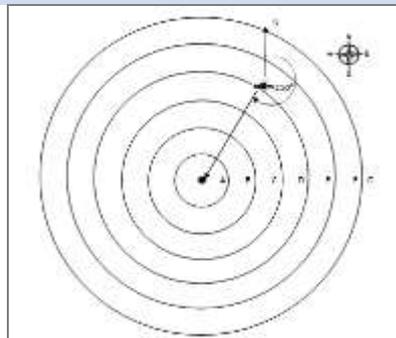
- Bat detectors surveys
- Radar surveys
- Thermal camera surveys



## A.2 Operational plan for implementation of concrete conservation actions

### Progress of activities:

- ✓ Identification of monitoring indicators:
  - Detection capabilities of early warning technologies (radar, HD video surveillance system & thermal camera)
    - % of successful detections of flying targets of various sizes at 0-150m and 0-300m
    - Number of detected targets per minute
    - Size of flying targets
  - Efficiency of collision mitigation
    - Effects of deterrence systems on bird avoidance rates
    - Carcass searches





## A.2 Operational plan for implementation of concrete conservation actions



Results	Foreseen	Realized
Preparation of monitoring methodologies and protocols	Monitoring operational plan	<b>Completed</b>
Identification of monitoring indicators to assess the effectiveness of early warning and mitigation measures	Monitoring indicators	<b>Completed</b>

### Deliverables:

- ✓ **Monitoring operational plan**





## A.2 Operational plan for implementation of concrete conservation actions



### Timetable:

	13	2014				2015				2016				2017			
Foreseen																	
Realized																	

**Problems encountered:** -

**Foreseen activities:** The action has been completed.





# C.1 Demonstration of Early Warning Systems and mitigation technologies



## Objectives:

- ✓ Demonstrative operation of a series of advanced early warning and mitigation measures to reduce collision risk for birds and bats at wind farms **(in progress)**
  - ✓ HD video surveillance system
  - ✓ Bioacoustic surveillance systems
  - ✓ Ornithological radar
  - ✓ Thermal imagery
  - ✓ Panorama scans
- ✓ Assessment of the mitigation measures on the wind energy production **(in progress)**









# C.1 Demonstration of Early Warning Systems and mitigation technologies



## Progress of activities: Ornithological radar

- ✓ Setting up of RadR freeware radar video analysis software (<https://radr-project.org/>) for the requirement of the NCC ornithological radar in order to improve processing of large dataset **(in progress)**

The screenshot displays the RadR software interface, which is used for analyzing radar data for ornithological purposes. The main window shows a radar plot with a 1 km scale bar. The plot displays various radar returns, including a prominent red return and several blue returns. A central information panel shows the current position: N 37°45.781', E 24°03.961', with an altitude of 356.6 m and a distance of 100 m. The interface is divided into several panels:

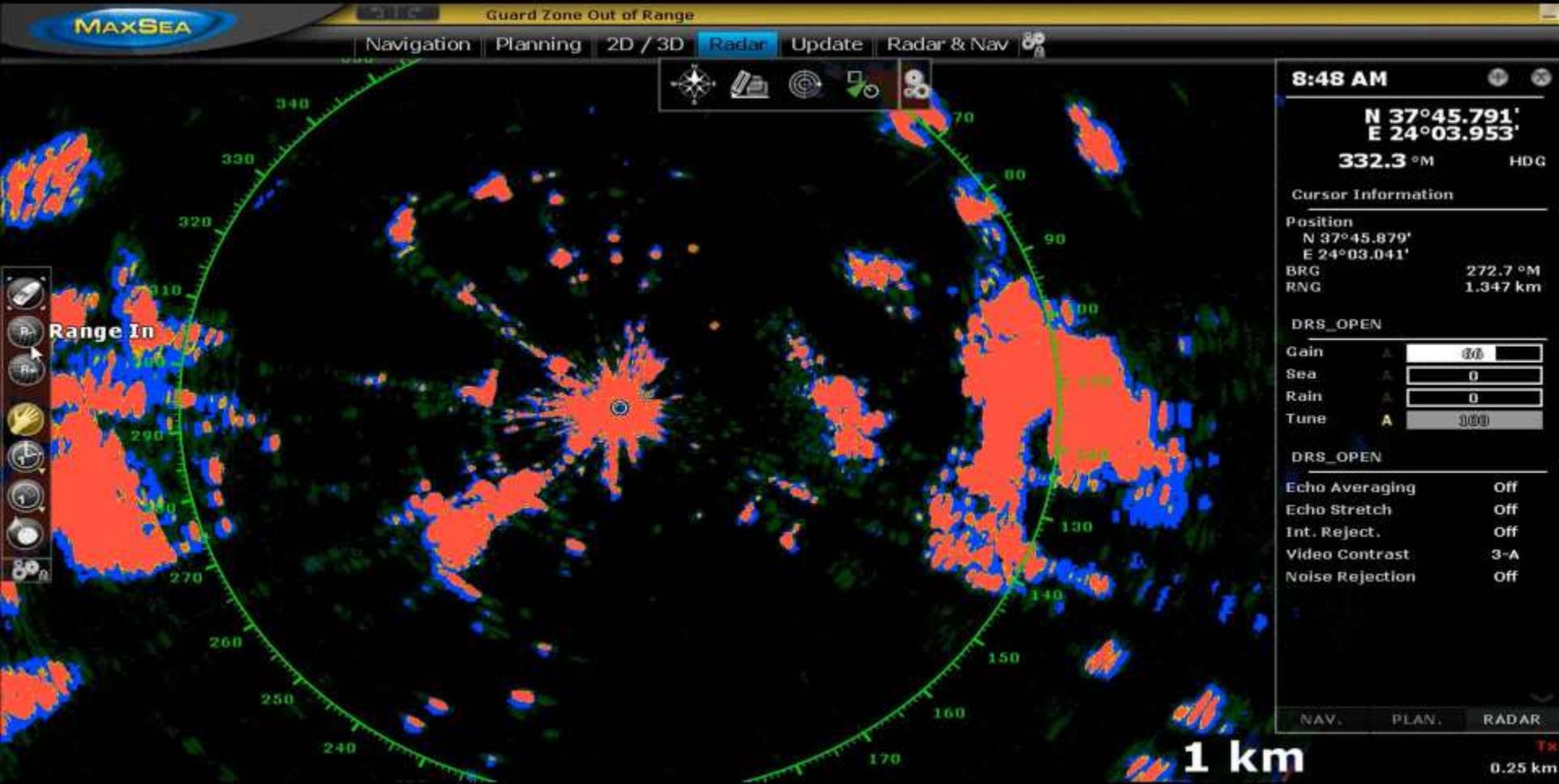
- Blip Parameters:** Contains settings for finding blips, updating state, and filtering blips based on various criteria like amplitude, angular span, and radial span.
- Display Options:** Allows users to customize the display, including background layer, range rings, and plot data.
- Tracker Controls:** Provides settings for tracking objects, such as the minimum number of blips required for a track and the minimum speed of tracked objects.
- Video Controls:** Manages video playback, including frame rate, image size, and scale.
- Playback:** A video player at the bottom shows the current frame and provides standard playback controls.



# C.1 Demonstration of Early Warning Systems and mitigation technologies



## Results: Ornithological radar – identifying bird flight routes

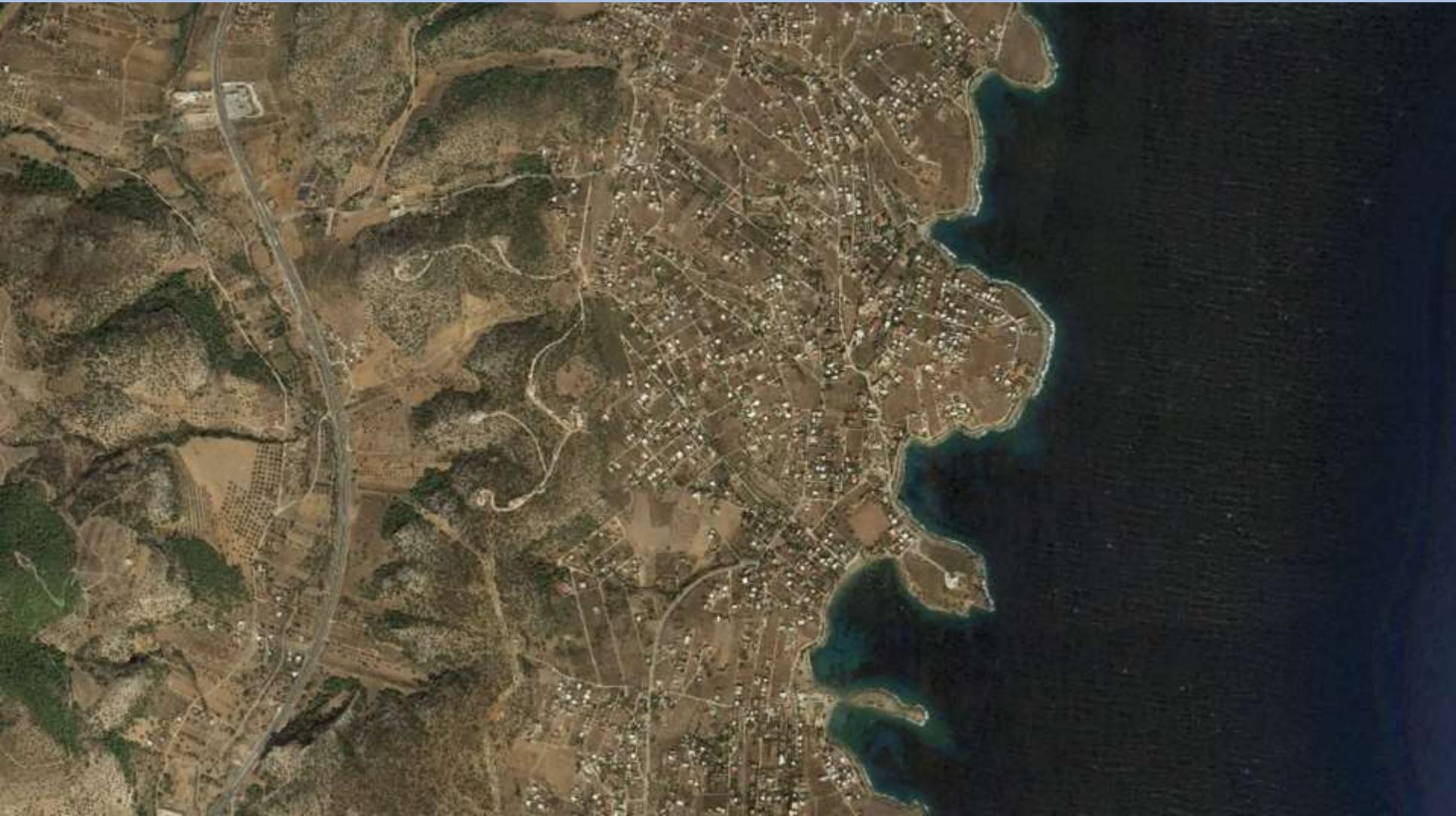




# C.1 Demonstration of Early Warning Systems and mitigation technologies



**Results: Ornithological radar – identifying bird flight routes**

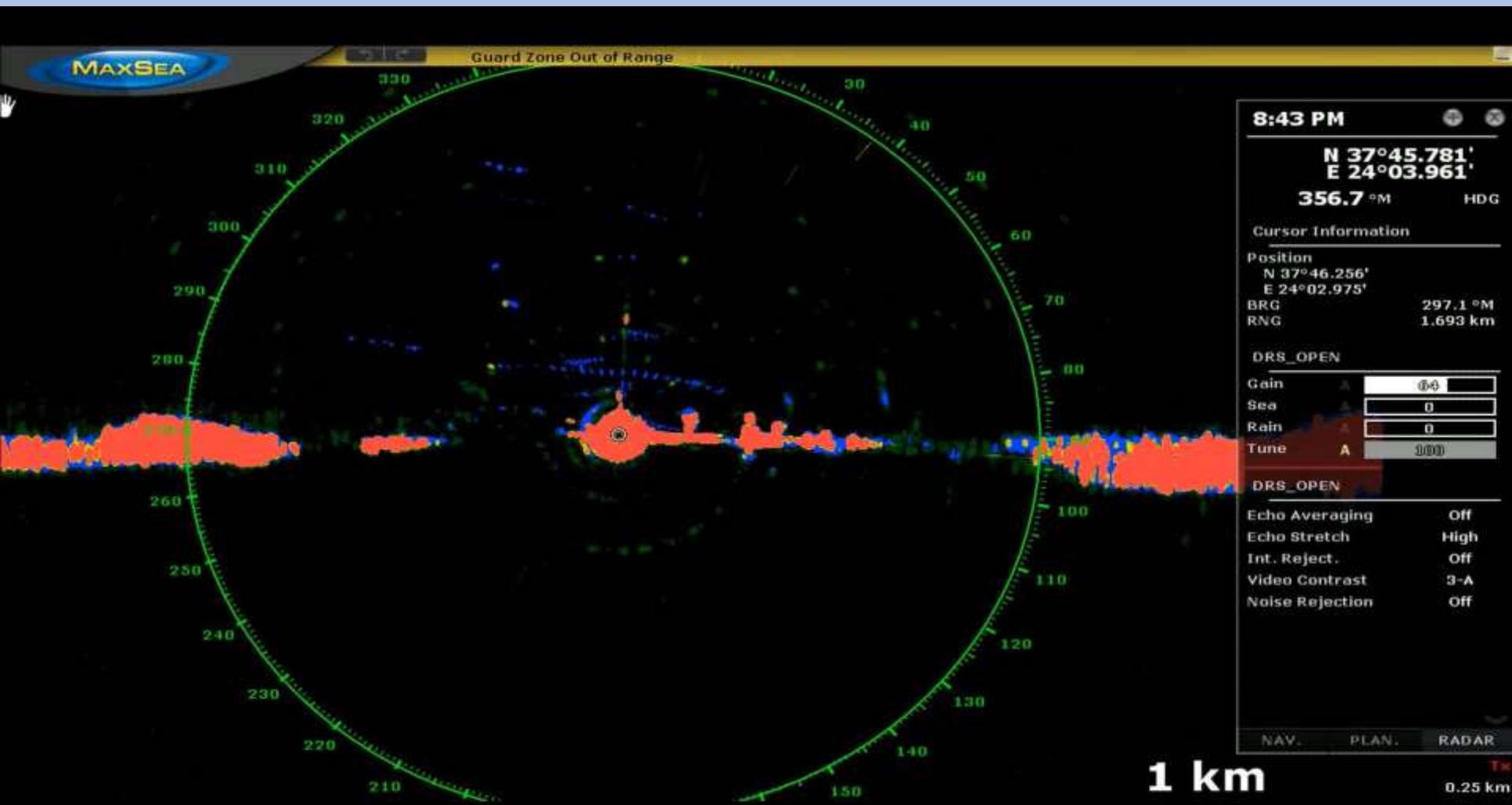




# C.1 Demonstration of Early Warning Systems and mitigation technologies



## Results: Ornithological radar – nocturnal migration

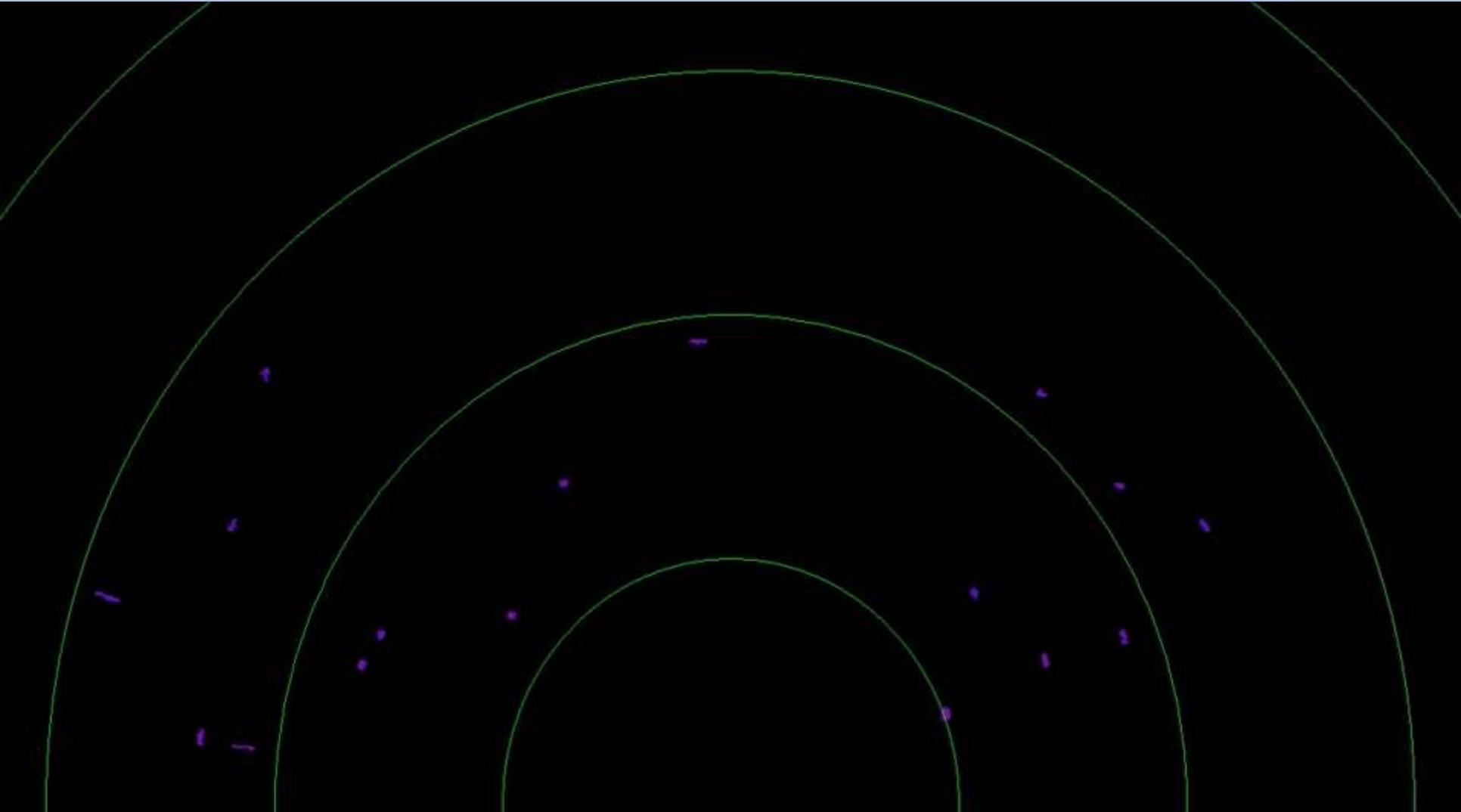




# C.1 Demonstration of Early Warning Systems and mitigation technologies



Results: Ornithological radar – nocturnal migration



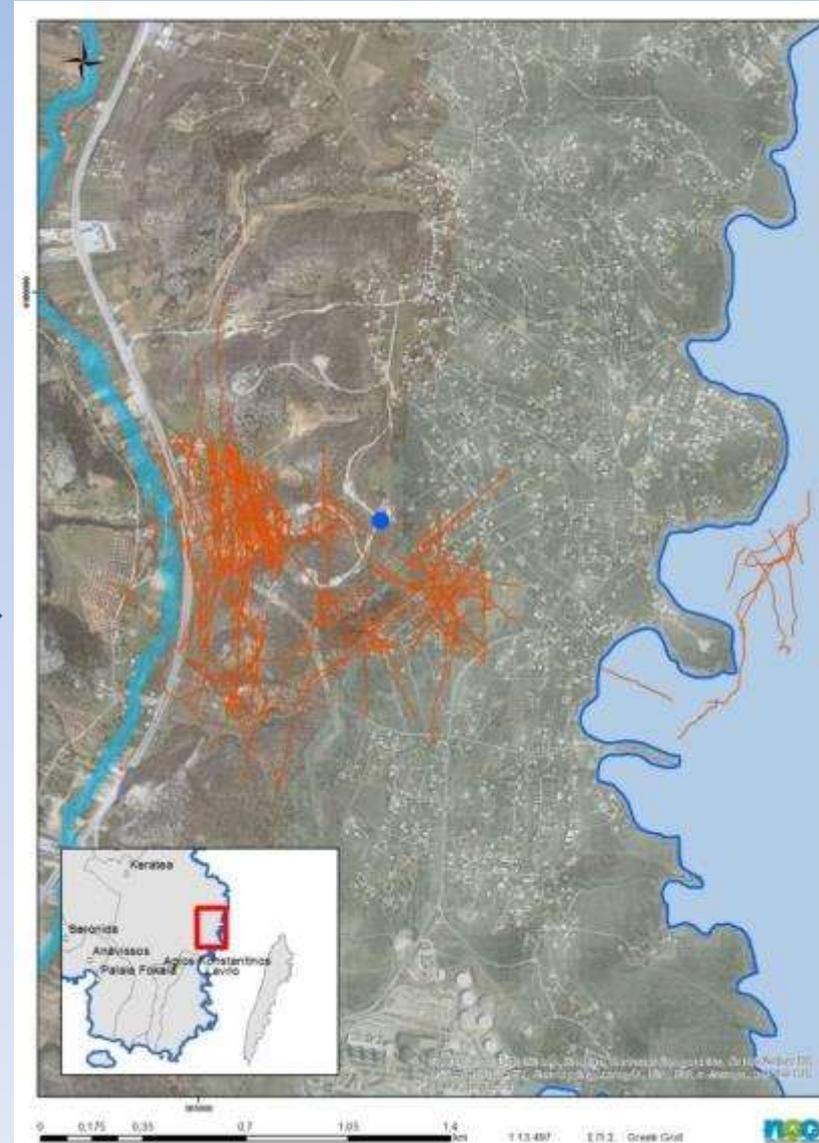
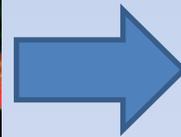
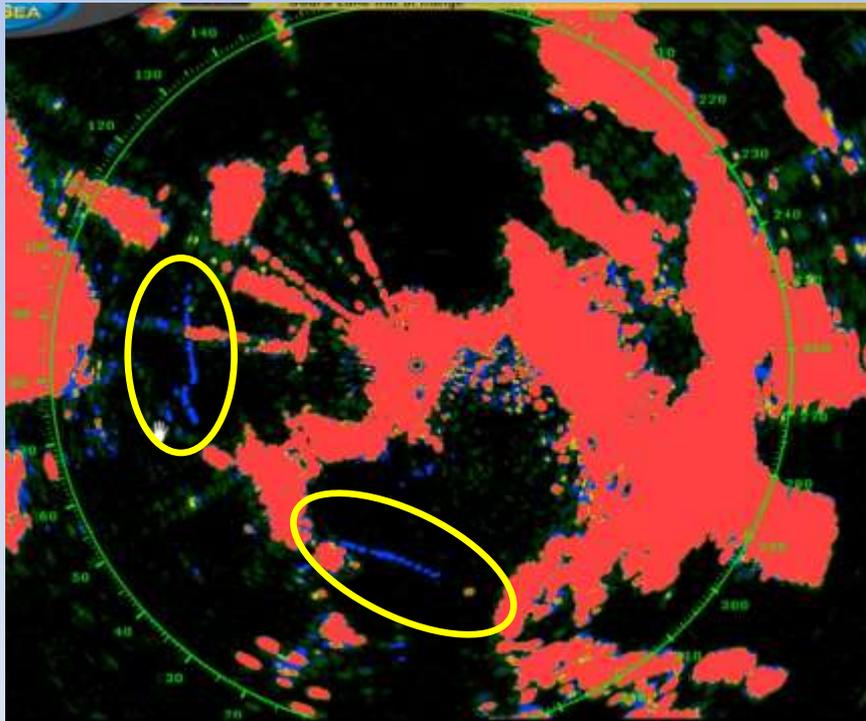


# C.1 Demonstration of Early Warning Systems and mitigation technologies



## Results: Ornithological radar

- ✓ Tracking local movement of birds in the wider area of PENA wind farm



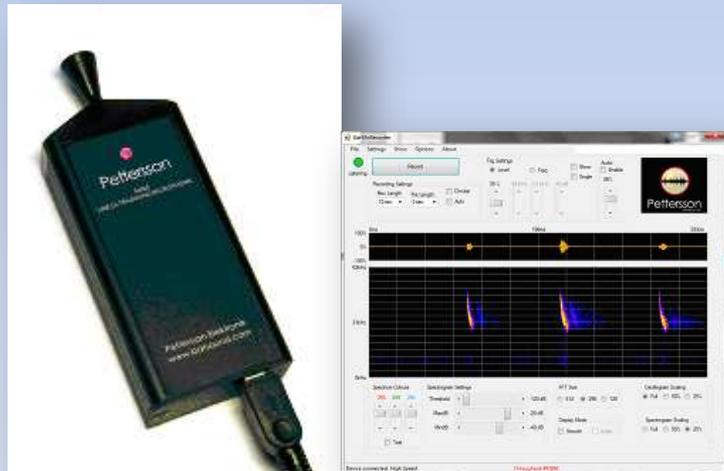


# C.1 Demonstration of Early Warning Systems and mitigation technologies



## Progress of activities: Hand-held bat detector

- ✓ Line transects within and around wind farm to determine species composition and abundance at ground level **(in progress)**





# C.1 Demonstration of Early Warning Systems and mitigation technologies



## Progress of activities: Automated bat detectors

- ✓ Automated recording of bat calls at nacelle height (purchased)





# C.1 Demonstration of Early Warning Systems and mitigation technologies



## Progress of activities: Automated bat detectors

✓ 1<sup>st</sup> automated system installed in 2015 (completed)



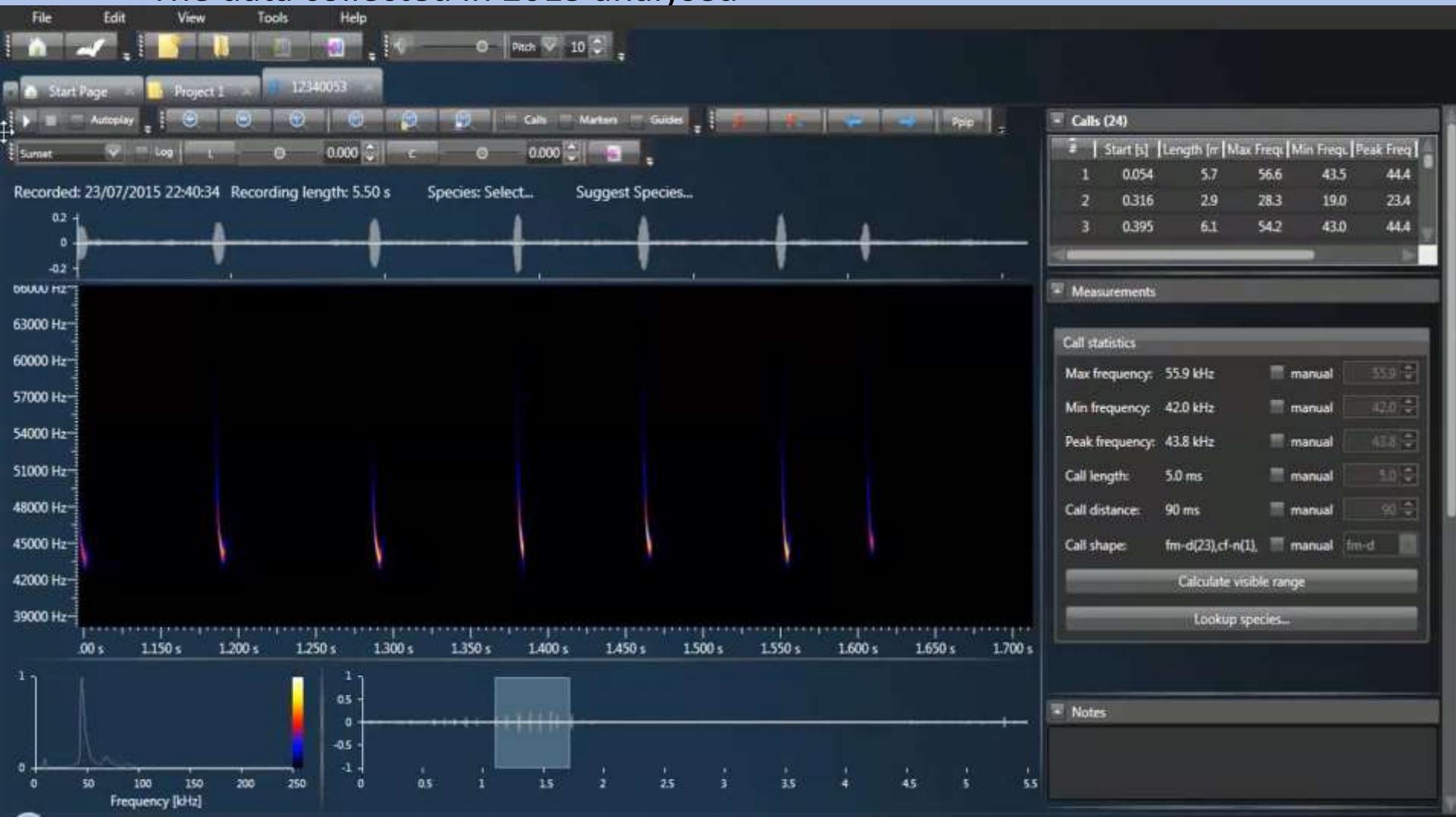


# C.1 Demonstration of Early Warning Systems and mitigation technologies



## Progress of activities: Bat sound analysis

✓ The data collected in 2015 analysed



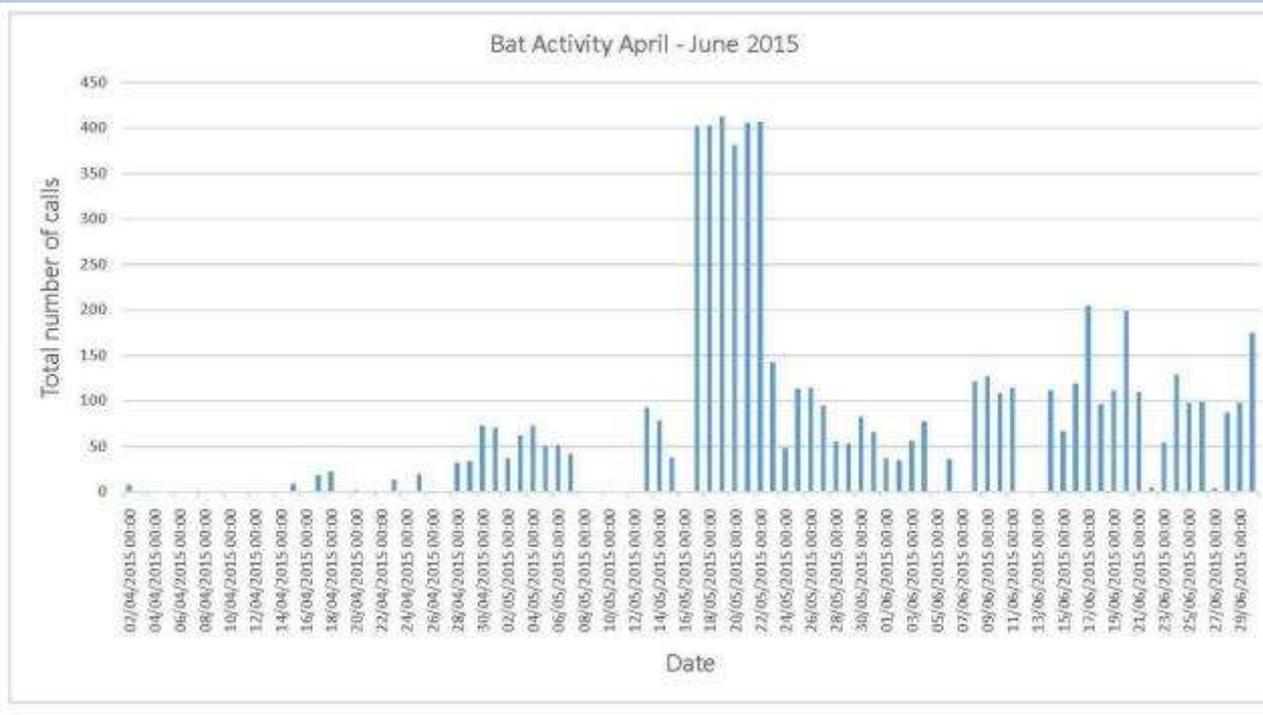


# C.1 Demonstration of Early Warning Systems and mitigation technologies



## Results: Bat detector surveillance

- 4 species recorded (all Annex IV of the Habitats Directive)



Species	Total num. recordings
<i>Pipistrellus kuhlii</i>	941
<i>Hypsugo savii</i>	100
<i>H. savii / P. kuhlii</i>	140
<i>Tadarida teniotis</i>	211
<i>Eptesicus serotinus</i>	1
Other	45



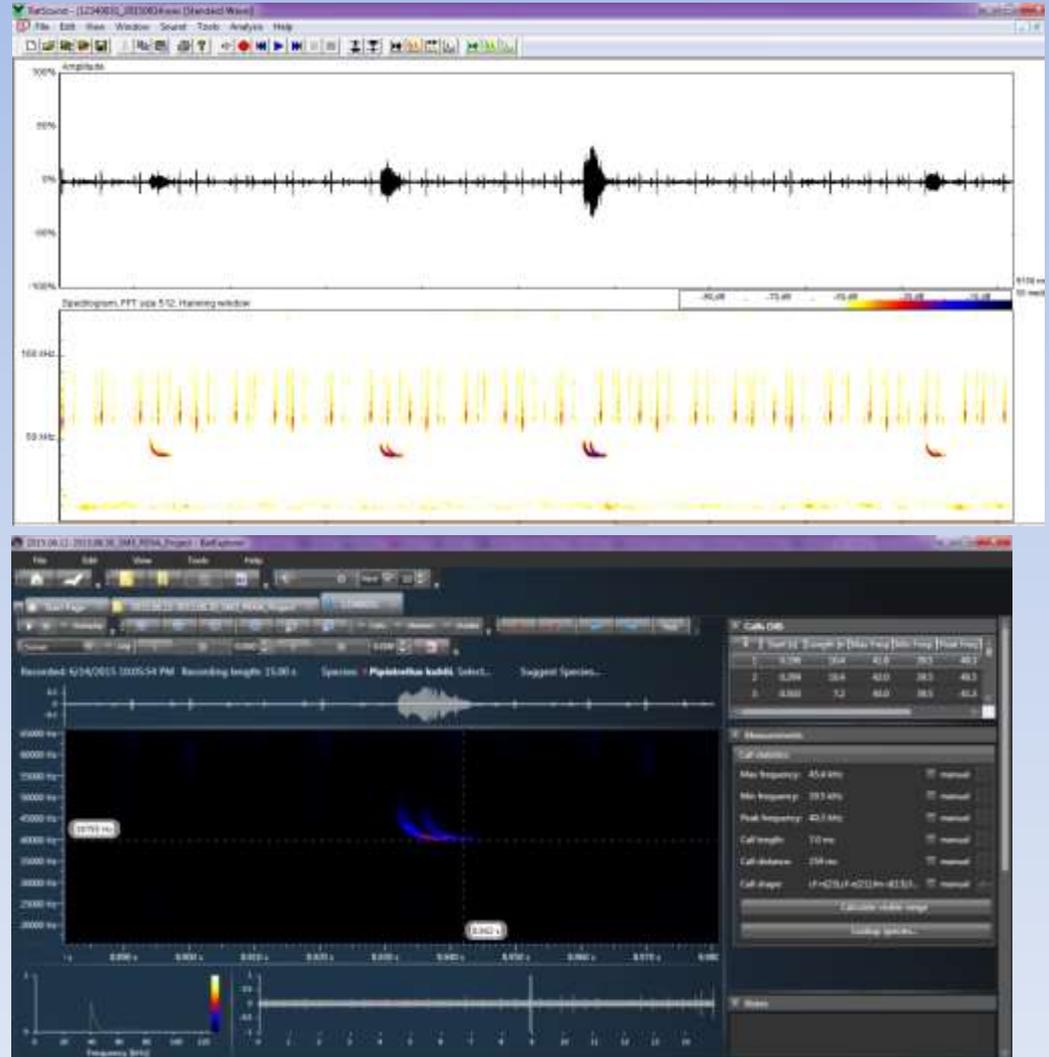
# C.1 Demonstration of Early Warning Systems and mitigation technologies



## Kuhl's pipistrelle bat



Probably the most common bat species in Greece. The most common species in the recordings to date (April – June 2015).





# C.1 Demonstration of Early Warning Systems and mitigation technologies



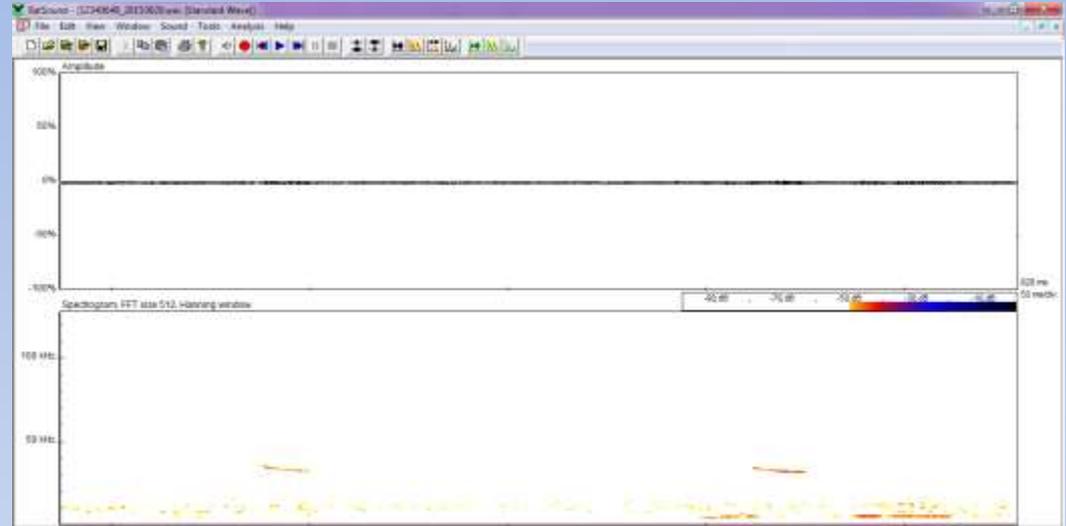
## Savi's Pipistrelle Bat



*Hypugo savii*

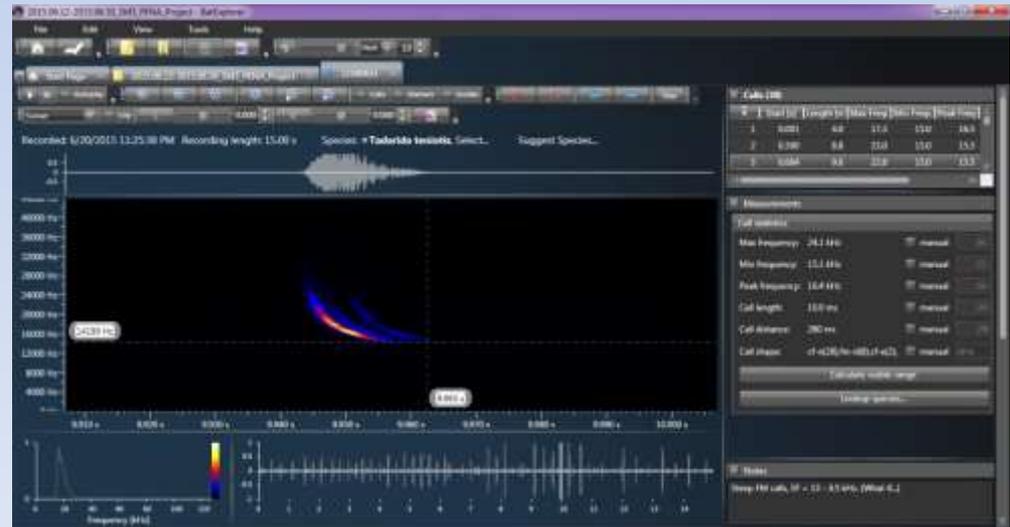
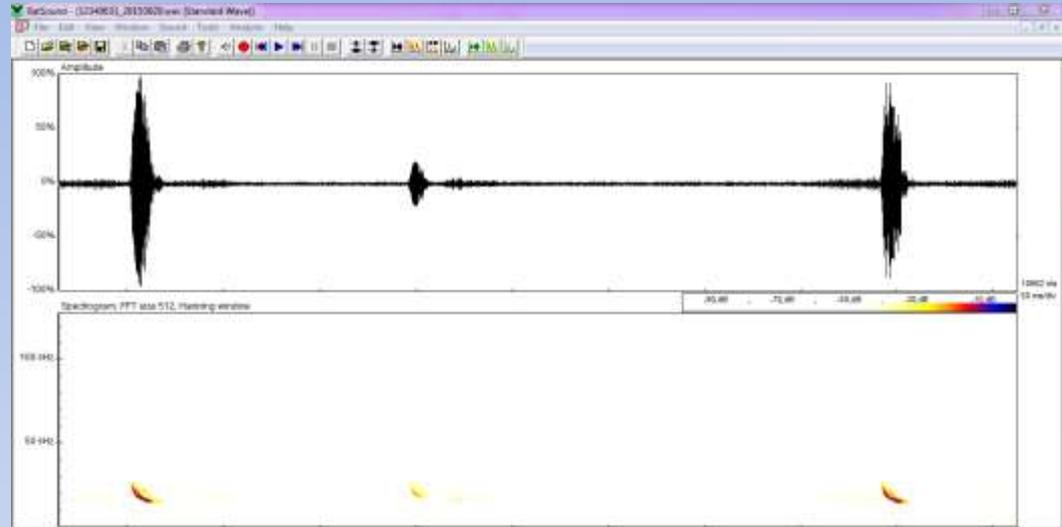
© Eleni Papadatou

One of the most common bat species in Greece. Proven to be vulnerable to wind turbines. The 2<sup>nd</sup> more common species in the recordings to date.



# C.1 Demonstration of Early Warning Systems and mitigation technologies

## European Free-tailed Bat



A common bat species in Greece flying high, often at the height of the WT's.

The 3rd species in the recordings to date. Often flew too close to the WT's (high intensity calls, and other characteristics of the recordings).



# C.1 Demonstration of Early Warning Systems and mitigation technologies



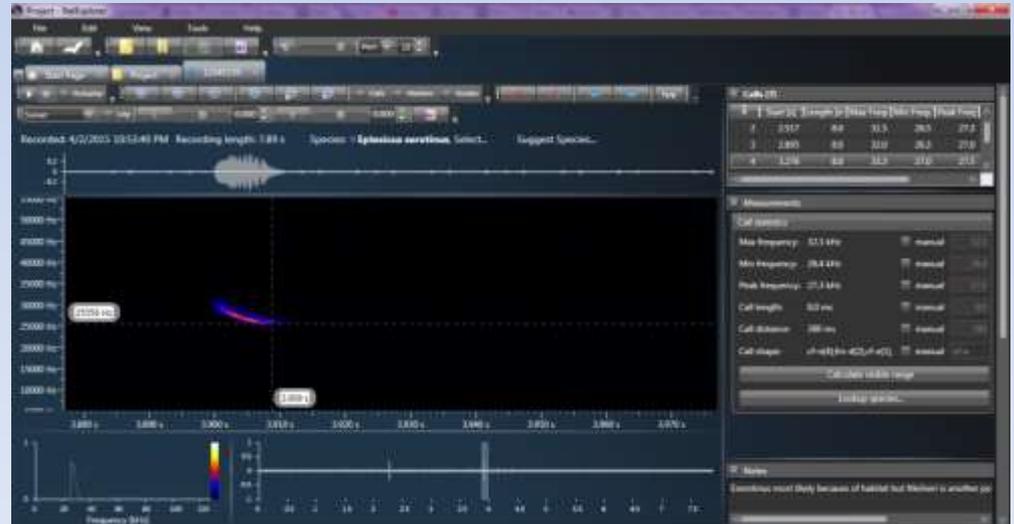
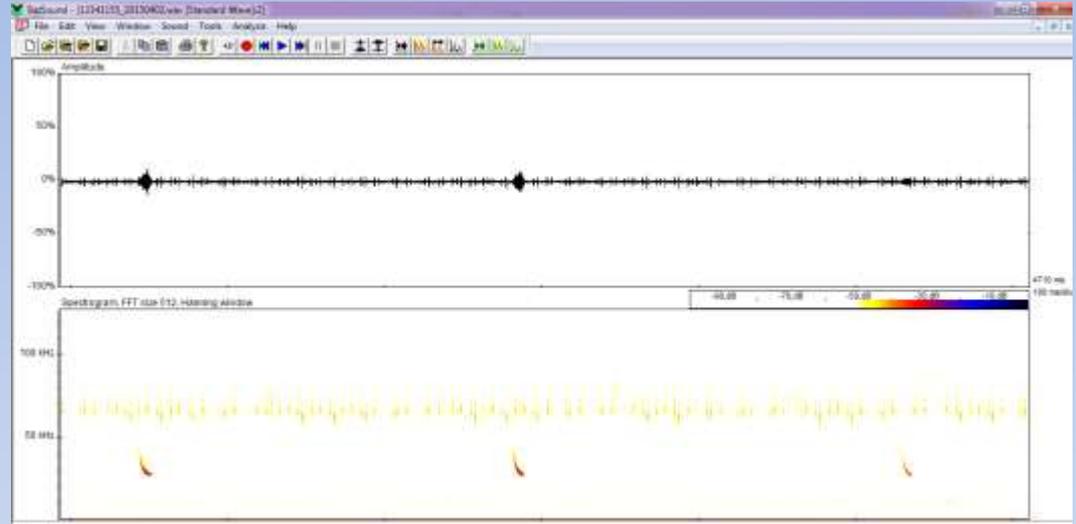
## Serotine Bat



© Eleni Papadatou

*Eptesicus serotinus*

Only one recording in April 2015.  
One of the vulnerable species to WTs.



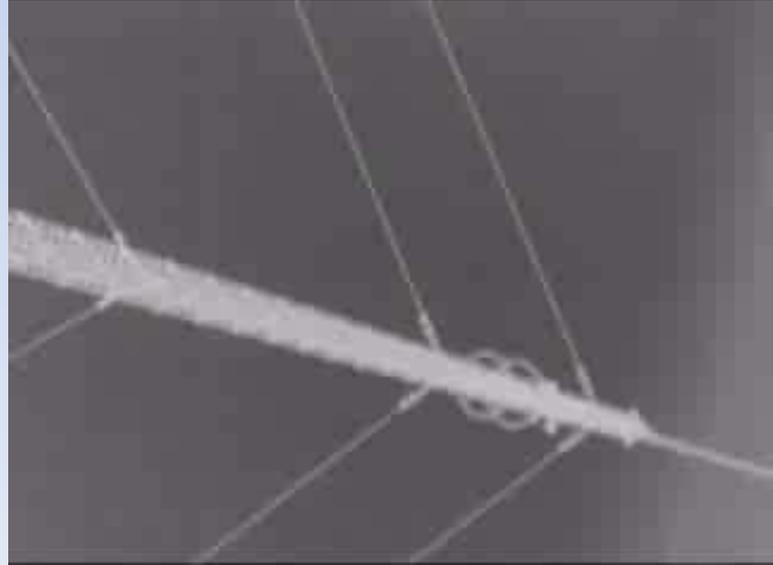


# C.1 Demonstration of Early Warning Systems and mitigation technologies



## Progress of activities: Thermal camera

- ✓ Monitoring nocturnal bird and bat movements with mobile thermal camera (in progress)



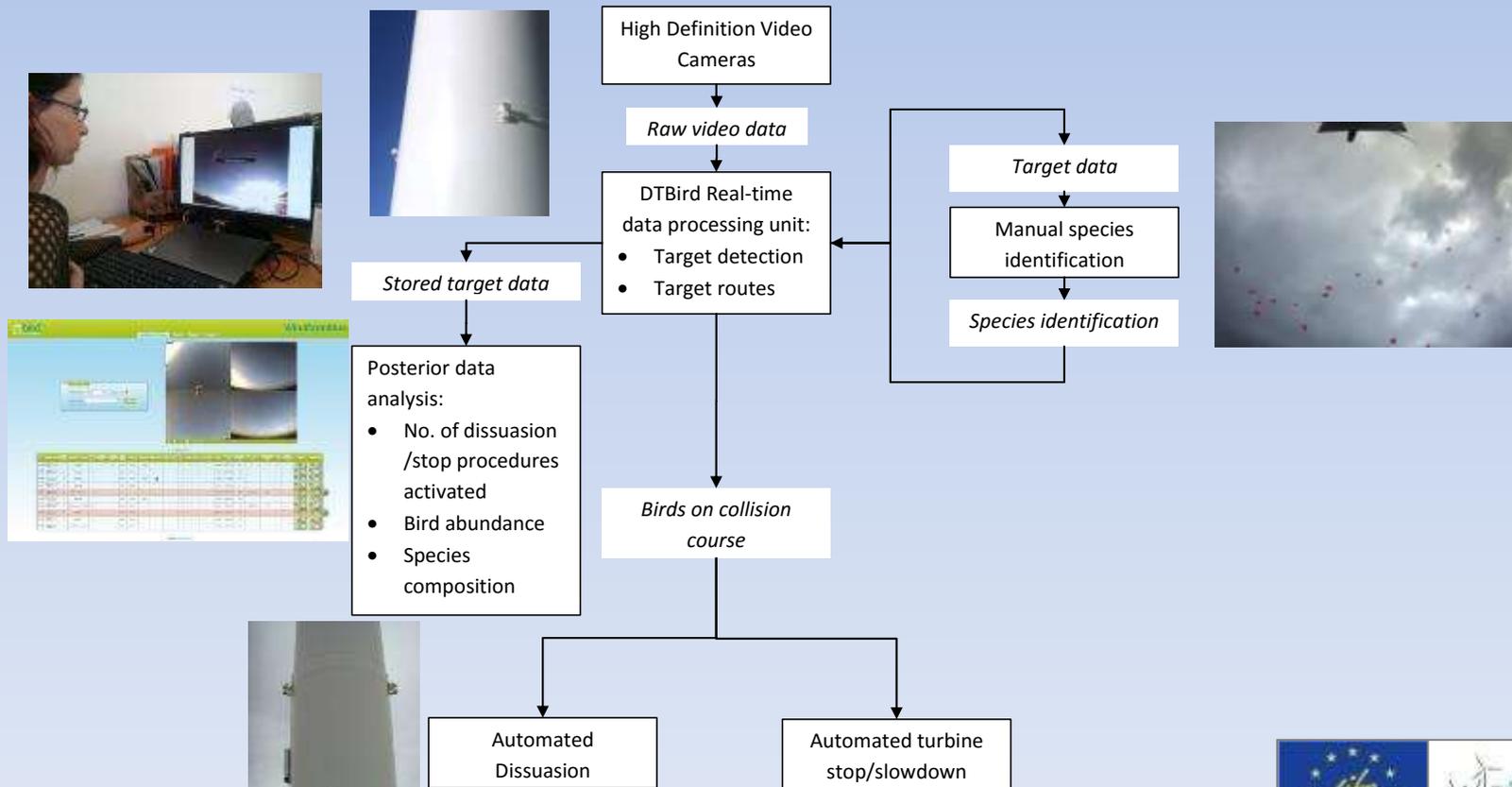


# C.1 Demonstration of Early Warning Systems and mitigation technologies



## Progress of activities: HD video surveillance system DTBird

- ✓ Installed and operational in March-April 2016 **(completed)**
- ✓ Operation of the surveillance and deterrence system **(in progress)**





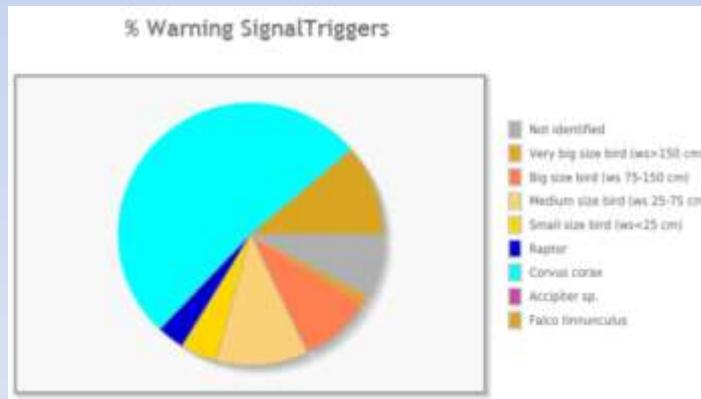
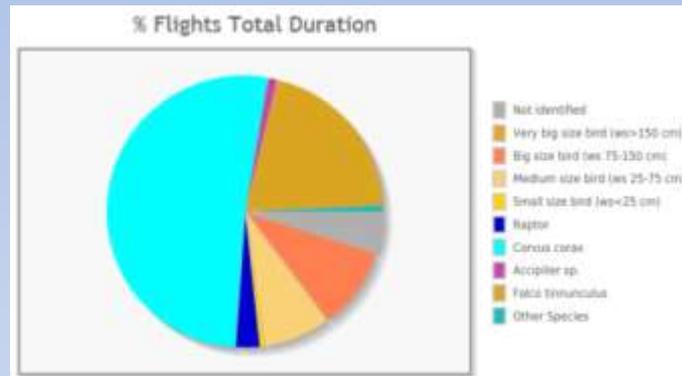


# C.1 Demonstration of Early Warning Systems and mitigation technologies



Progress of activities: HD video surveillance system DTBird

✓ DTBird reporting





# C.1 Demonstration of Early Warning Systems and mitigation technologies



## Progress of activities: Demonstration visits at existing wind farms

- ✓ Demonstration visits at existing wind farms **(in progress)**
  - Anemos Makedonias S.A. wind farm at Varnountas mountain, Northern Greece in cooperation with the Society for the Protection of Prespa
  - Panachaiko I and Panachaiko II wind farms of Acciona Group on Panachaikos mountain, Peloponense
  - Dadia forest and 2 wind farms south and west of it
- ✓ Acciona Group, after the demonstration visit in 2015 decided to introduce at Panachaiko I and II in 2016:
  - Bat monitoring programme
  - Turbine stop-control based on panorama scans



# C.1 Demonstration of Early Warning Systems and mitigation technologies



Progress of activities: Demonstration visits at existing wind farms





# C.1 Demonstration of Early Warning Systems and mitigation technologies



Results	Foreseen	Realized
Demonstration of operation of integrated set of early warning/mitigation options	Early warning system/ Mitigation system operational	<b>Operational and in progress</b>
Estimation of energy production reduction due to mitigation measures	Energy production estimation	<b>In progress</b>
Demonstration of early warning system at operational wind farms	12 wind farms	<b>5 wind farms up-to-date</b>





# C.1 Demonstration of Early Warning Systems and mitigation technologies



## Timetable:

	13	2014				2015				2016				2017			
Foreseen																	
Realized																	

## Problems encountered:

- Some of the equipment items (e.g. DTBird system) purchased with delay, however the delays were either compensated by the NCC existing equipment or are expected to be compensated by the end of the project.

**Foreseen activities:** The demonstrative operation of early warning and mitigation methods and technologies at PENA as well as at other operational wind farms will continue until the end of the project.





# D.1 Monitoring of impacts of concrete conservation actions

## Objectives:

- ✓ Monitoring and evaluation of the efficiency of early warning system and mitigation methods and technologies

## Progress of activities:

- ✓ Regular carcass searches at PENA **(in progress)**
  - A single bird found since 2014 - Magpie (*Pica pica*), however not confirm to be collision casualty



- ✓ Testing detection capabilities of different types of technologies using drone **(in progress)**



# D.1 Monitoring of impacts of concrete conservation actions





# D.1 Monitoring of impacts of concrete conservation actions





# D.1 Monitoring of impacts of concrete conservation actions



Results	Foreseen	Realized
Evaluation of technologies and methods employed	Monitoring	<b>In progress</b>

## Timetable:

	13	2014				2015				2016				2017			
Foreseen																	
Realized																	

## Problems encountered:-

**Foreseen activities:** Monitoring of concrete conservation activities will continue until the end of the project.





## E.4 Good Practice Guide and Decision Support Tool

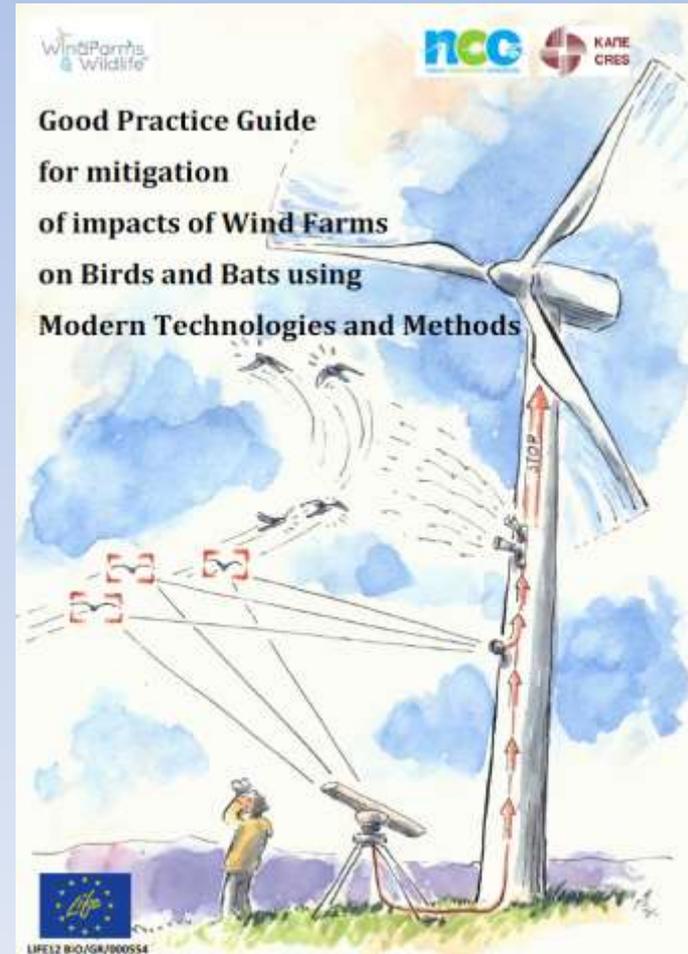


### Objectives:

- ✓ Production of Good Practice Guide (GPG) and Decision Support Tool (DST)

### Progress of activities:

- ✓ 1<sup>st</sup> version of GPG in English **(completed)**
- ✓ GPG in Greek **(in progress)**
- ✓ Update of GPG based on results of practical application of early warning and mitigation measures by the project **(in progress)**



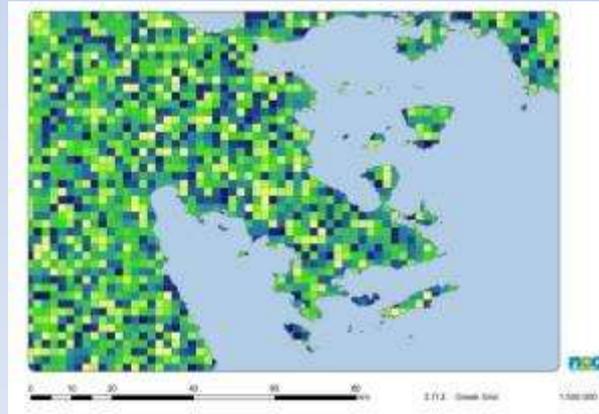
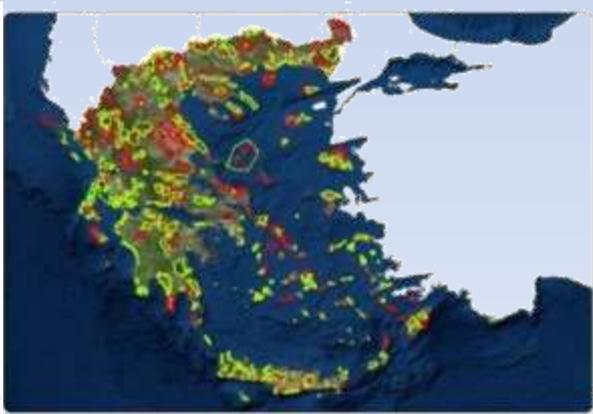
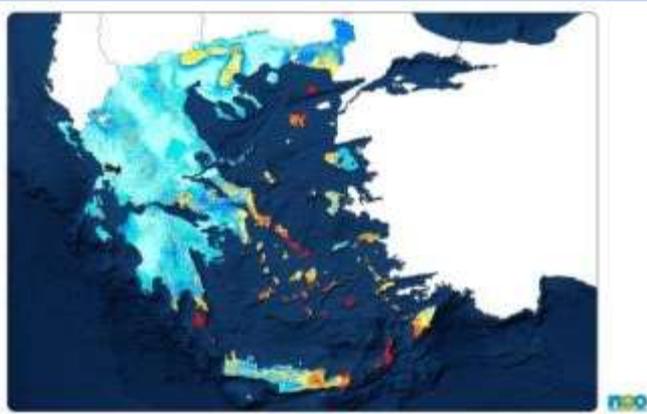
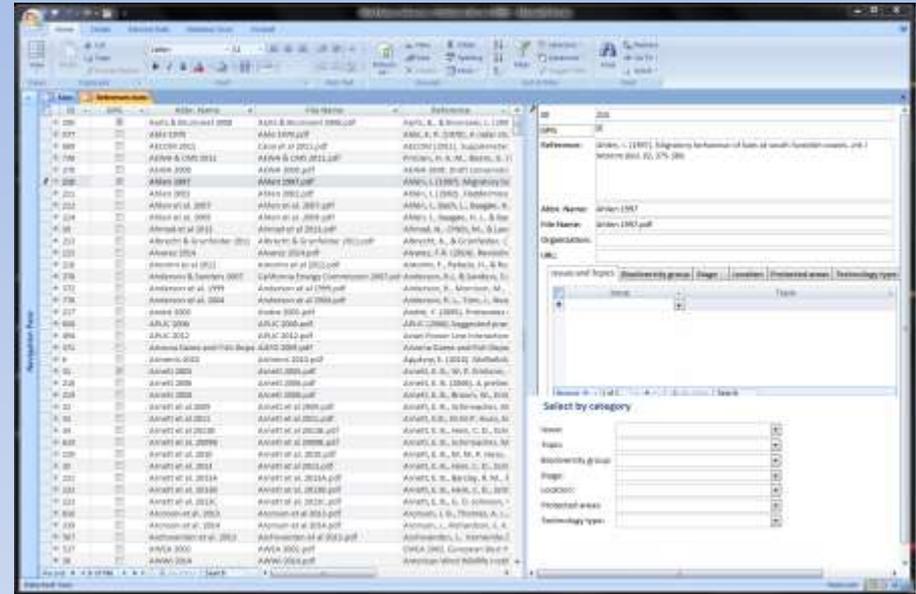


# E.4 Good Practice Guide and Decision Support Tool



## Progress of activities:

- ✓ Preparation and design of DST:
  - Collection of main bibliographical reference (766 up to date) and its management in database **(completed)**
  - Design of DST algorithms, GIS data processing (on 2x2km grid) and preparation of detailed guidelines **(in progress)**





# E.4 Good Practice Guide and Decision Support Tool



Results	Foreseen	Realized
Good Practice Guide	GPG produced and printed	<b>1<sup>st</sup> version produced and uploaded , printed version after inclusion of project results</b>
Decision Support Tool	Web & GIS based DST	<b>In progress</b>

## Timetable:

	13	2014				2015				2016				2017			
Foreseen																	
Realized																	

**Problems encountered:** Due to huge number of available information and bibliography their processing and compilation takes longer than initially anticipated, however minor delays will not affect overall action;s objectives

**Foreseen activities:** During forthcoming period DST is expected to be completed and GPG updated with practical results of the implementation of early warning and mitigation measures





**Thank you for your attention**

<http://www.windfarms-wildlife.gr>