INTERREG V-A COOPERATION PROGRAMME
GREECE – BULGARIA 2014 – 2020
Reinforcing Protected Areas Capacity through an Innovative
Methodology for Sustainability
– BIO2CARE –
(Reg. No: 1890)

WP4
<u>Deliverable 4.1</u>
High-tech monitoring system in the areas of interest (fauna/flora &
illegal activities)

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1.1 Objective

Protected Areas (PR) are characterized by the unique flora and fauna, as well as the habitats that are present and well preserved in them. Both biodiversity and habitats conservation and improvement are the goals to be accomplished by the Management Bodies of the PR. Endangered species' presence in PR indicates the environmental value of the area, thus continuous flora and fauna monitoring is thought essential. In addition, monitoring offers the necessary data for calculating the abundance of endangered species, which is required for planning the management strategy for the PR and choosing the implementation of better management Actions.

For the monitoring of fauna in Nestos Delta Natura 2000 site two different monitoring systems were purchased. A set of five (5) trail cameras and an ultrasound recording unit have been selected for monitoring of mammals.

1.2 Trail Camera

The trail camera selected (SPYPOINT FORCE-DARK) is appropriate for outdoors use and can be used both for photos and videos. Five (5) cameras had been installed in the PR for 10 days interval. The installment has been repeated twice and the points of the installment is shown in Appendix II. The characteristics of the cameras are presented in Table 1.1.

Table 1.1. Characteristics of Spypoint Force-Dark trail camera

PHOTO
Analysis: 12 Megapixels
No of LEDs: 42
Flash range up to 90 ft
Millisecond trigger speed (0.07 sec)
Built-in 2" viewing screen with zoom & pan functions
Color photos by day, infrared by night
Multi-shot mode up to 6 photos per detection
Hybrid illumination: invisible, optimal, boost, blur reduction
Continuous mode
Time-lapse mode
Detection technology (patent pending)
VIDEO
Full HD video recording from 10 to 90 sec (1080p) with sound
Photo first option
MEMORY/POWER
Requires an SD card, up to 32 GB
Requires 8 AA batteries

Can be powered by a rechargeable lithium battery pack
12V jack
OTHER
Date, time, moon phase and temperature (°C/°F) stamp on photos and videos
Detection range up to 34m
1 sensor for a total of 5 detection zones
Standard 1/4"-20 tripod mount
Mounting bracket
7-day schedule setup
Dimensions: 9,6 cm L x 12,7 cm H x 8,1 cm P

The FORCE-DARK is a camera equipped with invisible LEDs that produce no visible flash when used on the no-glow setting. SPYPOINT's hybrid illumination technology allows the selection one of four flash settings for optimal performance on photos and videos, such as blur reduction setting, and the optimal setting which is a blend which produces a lower glow than standard IR flash.

The FORCE-DARK is also equipped with a trigger speed of 0.07 second, in order the camera to come out of sleep mode and start taking photos in just milliseconds, when the detection sense is tripped. That means that there will be more clear images, instantly improving the scouting results. The FORCE-DARK can function in standard photo, multi-shot, time-lapse, or video mode.

For the unhampered use of the cameras for at least 3 years, accompanying equipment was also purchased, which includes:

- 30 MicroSD Memory cards
- 30 adaptor MicroSD to SD cards
- 360 AA alkaline bateries

1.3 Ultrasound detector

The ultrasound recording unit selected (Pettersson D500X) is intended for long-term, unattended recording of Bat calls. The unit had been installed in the PR for 10 days in the point shown in Apprendix II. The characteristics of the ultrasound recording unit are presented in Table 1.2.

Table 1.2. Characteristics of the ultrasound recording unit Pettersson D500X

Sampling rates: 44.1 kHz, 300 kHz and 500 kHz (optimized for 500 kHz)
Total storage space: 128 GB (4 x 32 GB CF cards)
Triggering system to allow the device to start recording as a sound is detected
Rugged aluminium housing for weather protection
High-pass (HP) filter to attenuate low-frequency signals (<15 kHz)
Jack for external microphone, jack for external trigger
4 Timers to turn the unit on/off at desired intervals
Powered either from 4 AA cells (internal) or external batteries/power supply (5.5-8 V)
Size: 165 x 170 x 53 mm
Built-in electret microphone
ADC resolution: 16 bits
Time/date stamped sound files
Operating temperature range is 0 - 50 ºC.

Pettersson D500X has the ability to detect and record in real time the full spectrum of ultrasound, providing detailed data and is particularly good at detecting those `hard to detect' species such as the Brown Long-eared bat.

The Pettersson D500X ultrasound recording unit allows continuous use for two weeks by the use of four 32 GB CF cards. The recording length can be selected from 0.3 up to 30 second. The ability of the unit to start recording as a sound is detected is helpful in order the cards not to be filed too fast. In addition, in low power mode the recorder operates with no pre-trigger increasing the number of recordings in the CF card. Moreover, the «Power Fail-Resume Recording» feature resumes a recording session if power is interrupted.

An external microphone can be connected to D500X and can be extended up to 100m without any signal loss, in order to have better recordings. A soft protective case to hang from a tree is included.

For the unhampered use of the ultrasound recording unit for 3 years, accompanying equipment was also purchased, which includes:

- 12 CF Memory cards
- 900 AA alkaline batteries
- Soft protective case (included with the original purchase)

Chapter 2 - Sound Meters

2.1 Objective

Illegal activities in Protected Areas (PR) are one of the main reasons for habitat loss and degradation of the ecosystem in total. Mitigating illegal activities is necessary for the benefit of environment, the local economy and the social cohesion of the surrounding areas. Monitoring activities in Nestos Delta is important both for natural habitats, as well as for flora and fauna conservation.

For the monitoring of illegal activities three (3) sets of high-tech monitoring systems, with the use of sound level meters, have been purchased and settled in the field. Each set is consisted by one (1) sound level meter, one (1) logger, two (2) solar panels connected to two (2) rechargeable batteries. The points of the installment is shown in Appendix II.

2.2 Sound level meter

The sound level meter selected (Delta OHM-HD 2010UC/A) is appropriate both for outdoors and indoors use. Moreover, it is suitable for statistical and spectral analyses. The characteristics of the sound level meter is presented in Table 2.1.

Table 2.1. Characteristics of Delta OHM - HD 2010UC/A sound level meter

Standards	Class 1 or 2 group X according to IEC 61672-1-2002, Class 1 or 2 according to IEC 60651:2001 και IEC 60804:2000
Dynamic range	30 dBA – 143 dB Peak
Spectrum analysis	• Octave bands from 32 Hz to 8 KHz • Third octave bands from 25 Hz to 12.5 KHz • Average spectrum mode (AVR) – Multi spectrum in "REPORT" mode
½ inch Microphone	UC52 condenser type, pre-polarized, for free field
Linearity range	80dB
Acoustic parameters	Spl, L_{eq}, $L_{eq}l$, SEL, $L_{EP,d}$, L_{max}, L_{min}, L_{pk}, L_n, Dose
Frequency Weightings	Simultaneous A, C, Z (only C and Z for L_{pk})
Time Weighting	Simultaneous FAST, SLOW, IMPULSE
Integration	From 1s to 99 hours with Back-Erase function
Statistical analysis	Probability distribution and percentile level calculation L_1 to L_{99} • Sampling frequency: 8 samples/second • Classification: Classes of 0.5 dB
Combined data logging	Record of measuring reports with programmable intervals from 1s to 1 hour with a customable set of 5 parameters, complete statistical analysis and frequency spectra
Profile Data	1 profile with sampling 1/8 s and 3 profiles with 2 samples/second, 5 parameters

Logging	profiles in "Report" mode with minimum sampling interval 1s
Spectrum data logging	Programmable sampling from 1s to 1hr (AVR mode). Multi-spectrum data logging in "Report" mode with minimum sampling interval 1s
Analysis of events	- Calculation of 5 freely-programmable event parameters - Average spectrum calculation by octave and third octave bands - Calculation of statistical levels from L_1 to L_{99} - Event identification trigger with programmable threshold and duration filter - External and manual filter
Display	Graphic backlit LCD display 128x64 3 parameters in numeric format - Profile L_{AFp} with 8 samples/second - Graph of sound level probability distribution - Graph of percentile levels from L_1 to L_{99}
Acoustic Calibrator	Sound pressure level: 94dB and 114dB ±0.2dB at 1kHz
Memory	Internal, equal to 4 MB expandable to 8 MB
Input/Output	- RS232 serial and USB interfaces - AC output (line) - DC output
PC Programs	Noise studio (supplied with the instrument): PC interface for data download, set up and instrument management – Connection with Opton 4 software
Operating conditions	-10°C to 50°C 25%-90% RH 65kPa-108kPa - Protection degree: IP64
Power	4 alkaline or rechargeable NiMH type AA batteries - External 9V-12V 300mA
Dimension	445x100x50mm equipped with preamplifier
Weight	740g (with batteries)

HD2010UC/A is a portable integrating sound level meter, with multiparametric data logging capability which is suitable for statistical and spectral analyses. The possibility to display, store and even print the multi-parameter analysis of the sound level allows the sound level meter to work as a sound level logger capable of storing for more than 23 hours. For sound level monitoring, 3 programmable parameters can be stored, while the time profile of 4 simultaneous parameters freely selecting time or frequency weightings can be logged by the user. Moreover, a versatile trigger function can identify the sound events and record their analysis with 5 dedicated parameters, average spectrum and statistical analysis.

HD2010UC/A sound level meter is suitable for environmental noise, noise monitoring and acoustic mapping. Trigger functions for sound events capture with threshold level and event duration filter.

Using the "Advanced datalogger", it can also perform analysis of the acoustic climate with capture and analysis of sound events. Remote electrical calibrations and diagnostic tests can be executed using its remote control capabilities.

As a statistical analyzer, the HD2010UC/A samples the sound signal 8 times per second with A-weighting and FAST time constant and analyzes it statistically in 0.5 dB classes. Up to 4 percentile levels, selectable between L1 and L99, can be programmed. Statistical analysis in graphic form is also offered.

2.3 Data Logger

The portable data logger selected (Symmetron-Stylitis-10) can be connected with Opton 4 software and can be used in data recording network. The characteristics of the data logger is presented in Table 2.2.

Table 2.2. Characteristics of Symmetron - Stylitis-10 data logger

8 multi-functional channels, which can be used as measurement inputs or control outputs
10 digital bus channels, for connecting SDI-12 sensors, MODBUS RTU (RS-485 / RS-232)
Optional GPS location recording
Measures direct voltage, current, frequency, events and more with optional sensors
SMS or Email alarms in conditions selected by the user
Automatically send data to Captum portal by completing an interval
Remote communication on-line by GPRS / Ethernet client (dynamic IP)
GPRS / Ethernet server operation (static IP)
Daily data sent via email
SMS messages with data from an interval or a day period
Up to 5 programmable alarms for each parameter
Local or remote data programming and downloading
Slot for removable 2 GB micro SD memory / Internal memory flash 4 MB
Data recovery through any port or modem
Opton 4 software manages the data logger
Data available as: Text Files (ASCII) organized in columns, Graphs, Excel files, CSV files
Channels independently selected as analog inputs or digital TTL inputs
Input voltage range: from 0 ~ 125mV to 0 ~ +2.5 V (Distinctive capacity: 15 µV / 305 µV). Input resistance: 1 MΩ
Input current range: from 0 ~ + 5 mA to 0 ~ +50 mA (Distinctive capacity: 0.61 µA / 6.1 µA). Input resistance: 40 Ω
Real time watch: With automatic correction of discontinuous year. Accuracy: 20 seconds / month.
Independently programming slope, slope2 and offset for each input. Sampling: 1 Hz.
Interval from 1 sec to 60 min
2 built-in serial RS232 ports for communication with PC, external modem, etc
LCD screen 2 x 16 and 4 buttons

One analogical output voltage pulse 2.5V. Total current 20mA. Accuracy ± 0.2%
Safety protection of overvoltage at all inputs and outputs

STYLITIS-10 is a portable data logger which offers low cost and high performance data recording and control. It is part of a complete system which works with other Symmetron products and can be connected with Opton 4 software to manage data. In addition, build-in GSM Modem allows the remote connection and transfer of data. Moreover, the ability to use external memory card gives also the ability of storage in case of connection loss. SMS and E-mail alarms can be programmed by the user for 5 parameters. Data can be sent through SMS and e-mail in a daily basis or an interval selected by user from 1 sec to 60 min.

The power supply of the equipment is achieved with solar panels and auxiliary equipment. The characteristics of the solar panel are:

- Solar panel of 40 Watt
- Rechargeable battery 40 - 50 Ah
- Charger (included).

Solar panels are necessary for the unhampered operation of the sound level meter and the data logger. A set of two (2) solar panels of 40 Watt are installed in each station. The solar panels are able to charge a set of two rechargeable batteries (40-50 Ah) also installed in each station.

For the proper protection and operation of the above equipment (A, B and C) accompanying equipment for each station, which is presented in table 2.3, is also purchased.

Watertight box for sound meter, battery, recorder and charger
Proper fasteners

Fence
    • 3(l) x3(w) x1.8(h) m
    • Grid or sieve with gaps not exceeding 10 X 10 cm.
    • Door with padlock

Four (4) SIM cards (operating for 3 years period)
Two (2) spare microphones
Six (6) rechargeable batteries
1 portable calibrator (model HD2020) for sound level meters

Chapter 3 - Drone

3.1 Objective

Human activity, climate change and extreme natural events are reshaping and transforming the landscape that we live in. Natural resources are being affected and there is a need for

sustainable use and management of land and water. For this reason, an integrated management system is needed which will monitor and evaluate related data, collected or obtained. A UAV model (fixed wing, ebeeX) and satellites' data will be used for this task.

The main activity will deal with geospatial data management collected by the UAV (covering various areas in Region of Eastern Macedonia and Thrace) and their use as validation data to what a range of satellites has already observed. The specific UAV will not replace the satellites, but it will add accuracy and promptness. All this information will be managed by a related software so that it can be comprehensible and will be inserted into a Coordination and Decision – making Software which is an online application.

The scope is to combine field and desk activity (monitoring, data processing and evaluation) in order to create a procedure for scientific or other purposes. Related thematic applications may refer to spatial and urban planning, forest/water/soil/coast management, agriculture/livestock activities, nature conservation and restoration. The objectives are the following:

- Creation of data base with the existing landscape and environment condition. This will be mainly implemented by satellite data which has already been recorded (depending on the availability each time). UAV will support this objective whenever data from satellites is insufficient or a prompt data update is required. UAV will also support when a more detailed or specialized survey needs to be done.

- Evaluation of the existing condition and regular evaluation after updates based on data from aerial photographs and high resolution imagery. Mapping of the data of each thematic area will be the main body of the results' interface.

- Development of a Decision making tool, applicable to landscape management from environmental and social point of view. It will involve all stakeholders from local authorities and organizations to owners and users.

- Setting up a monitoring system which will concern illegal conditions related to the environment (pollution, waste, land use) or dangerous conditions which will concern civil protection such as natural disasters (floods) or other phenomena (erosion, drought).

3.2 Description of the equipment

The eBeeX is able to fly independently without the use of hand remote control and provides the possibility of aerial photography of areas. Photographs are recorded in the visible spectrum but can be upgraded to capture images in other spectral areas using other cameras (eg multispectral).

It is supported by the specialized software eMotion that manages flights' planning, control and information. It allows flight management in real time and in this way the user is able to intervene and change either the data associated with the route or with the aerial photographs. The system provides two-way wireless communication between the drone and the computer ground station for transmitting and receiving telemetry /radio-link data within a maximum range of 3Km.

It is accompanied by photogrammetric software for the processing and production of soil models, orthophoto maps, 3D cloud points and 3D grids. The software incorporates routines and tools for volumetric measurements and performance in 3D polylines. In the case of using a camera in other ranges, the software is able to process the corresponding images and produce spectrum reflection maps.

The software for Coordinating and Decision - making is an online application which completes the information from the individual systems of the project, providing users with the tools needed to monitor the area and make the right decisions. The application, at the data level, is based on the design, development and operation of a central, spatially activated database. It stores all the data collected by the project equipment (sensors, cameras, UAV, satellite data, etc.). The application is user-friendly and easy to use so that it can be used by Laboratory's staff which has been trained.

3.3 Characteristics of the equipment

The eBee X is a Fixed Wing Drone with a wingspan of 1.16 m and a weight of 1.4 kg. It is designed for mapping needs covering up to 500 ha (1,235 ac) at 122 m height (400 ft). Its electrical motor needs batteries of Li-Poly type and the related capability of flight autonomy is at least 59 min (favorable weather conditions and circumstances) while its speed limit ranges from 40 to 110 km/h.

Its installed Pitot system, telemetry (3-8 km) in coordination with a computer ground station and integrated RTK GPS (accuracy of 2.5 cm) play a significant role in the flight and control capabilities. These include a take-off without technical support, fail-safe system (in case of strong wind, camera malfunction, low endurance, telemetry loss, GNSS low accuracy) during flights and automatic smooth linear or sharp linear landing (accuracy of 2m).

It has the senseFly S.O.D.A. camera (which can be replaced by another type with different features, eg multispectral camera), suitable for photogrammetry and production of orthomosaics and 3D digital surface models. This 20MP camera acquires regular image data in the visible spectrum using a 1'' sensor and a 29 mm lens equivalent to 35 mm (f/2.8-11).


It is supported by the specialized software eMotion that manages flights' planning, control and information. With eMotion, flights are built using mission blocks. The flight plan is auto-generated after choosing a block or by designing it (aerial mapping, corridor etc.), highlighting the region which is going to be mapped and defining the key settings. There is a suitable routine of automatic flight design with parameters such as desired pixel size and percentage of overlapping of photos to automate the process of producing flight plans. A simulator mode optimizes the flight plan and by entering the wind strength and direction. There is also the ability to use ground models so that the terrain is taken into account when designing the flight or color the cartographic background according to the terrain.

The drone can be "launched" (after setting the take-off and landing point) and all the aspects of the flight can be seen. Any command can be transferred through the ground station and the software to the drone in real time and any flight data (flight speed, wind speed, position, battery condition, warning messages, etc) from the drone can be seen. Flight Data Manager automatically handles the geo-referencing and preparation of images required for post-processing in a photogrammetric software.
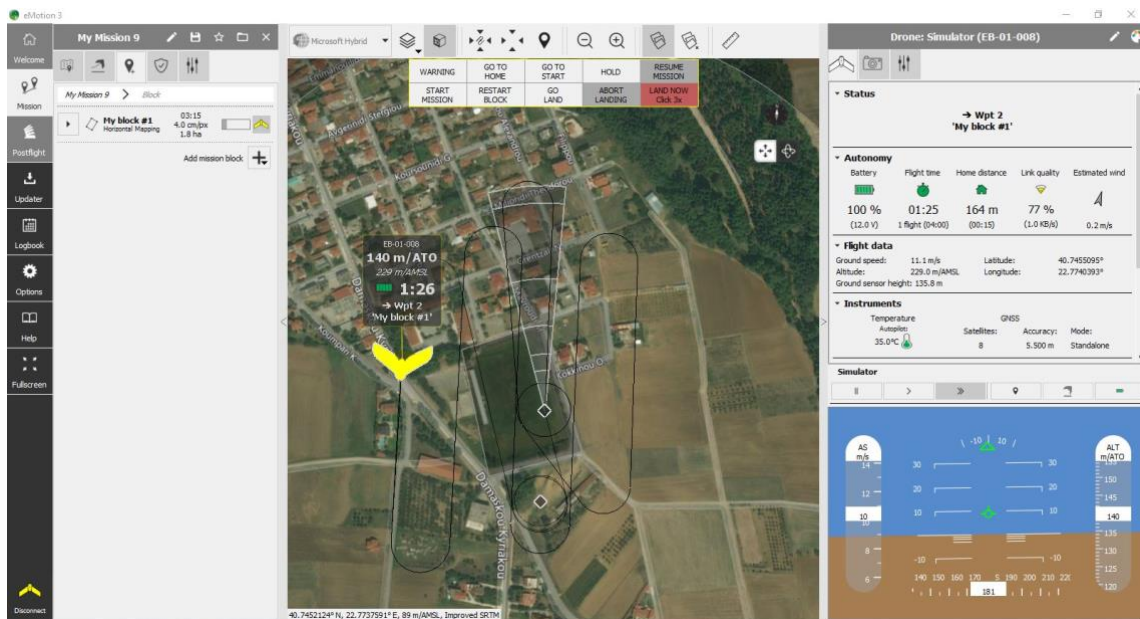
This photogrammetric software is used for the processing and production of soil models, orthophoto maps, 3D cloud points and 3D grids. The software incorporates routines and tools for volumetric measurements and performance in 3D polylines. In the case of using a camera in other ranges, the software is able to process the corresponding images and produce spectrum reflection maps.

Any information from the above mentioned process is inserted in a special Coordination and Decision-making Software which is an online application. It completes the information from the individual systems of the project (sensors, cameras, UAV), providing to users the tools needed to monitor the area of study and to the correct decision making. The software is an ideal solution for the development of online cartography applications (Web GIS) and spatial enabled web ports (Geoportals). It works as a client application for open space geospatial data services, being the interface for a Spatial Data Infrastructure (SDI). Its main features and capabilities include:

- Navigation on an interactive map.

- Compatibility with international and widely used geospatial standards information such as WMS, WFS, WMTS, CSW, KML, Atom, GeoRSS, Shapefile.
- Ability to integrate multiple different services on the same map as alternation of cartographic background (topographic, satellite, altimeter, customized) or possibility to choose a background both from online sources (Google maps, Bing maps, Cadastral Service orthophotos) or from local data sources (geo-referenced topographic maps, UAV database maps, etc.)
- Access to Sentinel-2 high resolution satellite data using web services (WMS, WCS). Users are able to dynamically determine the viewing format of satellite data (true color, false color, NDVI) as well as the date.
- Data management from unmanned aerial vehicles (UAV - drones) providing swipe comparison and time stamps and ability to create dynamic statistics with the user's interaction with the map and the tools of the application. The results will be presented in tables and diagrams.
- Display of equipment and related data on the map with the ability to display / hide, determine transparency, change symbolism and formatting, determine the scale of appearance, focus on each level. The information appears in a pop-up window or in a table. It includes descriptions such as date, description, etc., as well as images or hyperlinks to other websites or files.
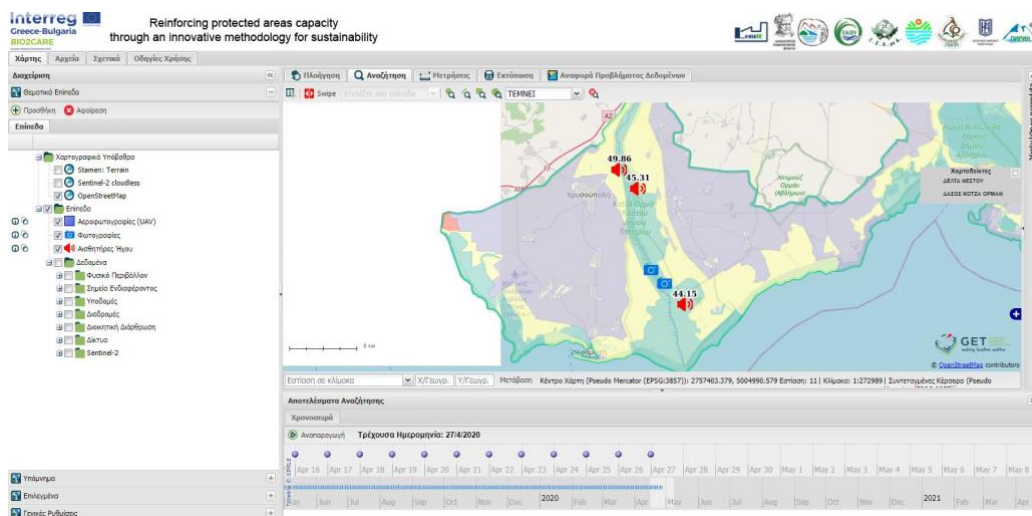
Accompanying equipment includes 2 batteries, 2 motor propellers, 1 charger and 1 cable for any firmware update (connection between computer and UAV) and one compact safe case for proper transportation. Regarding softwares, eMotion software and a photogrammetric software accompany the main equipment.

3.4 Training, Examination, and Licensing

Greek & European legislation obliges anyone wishing to provide services related to UAV to become a licensed UAV operator. The theoretical and practical training of flight attendants in accordance with the current regulatory framework of the Civil Aviation Authority and the certificate of attendance recognized by the CAA, are taken over by specialized training centers. The ebeeX (type license UAS Pilot B and skill for fixed-wing drone) required 50 hrs of theoretical training and 15 hrs of practical training for both multirotor and fixed-wing drone. The official license is given by the CAA after examinations (both theoretical and practical). Theoretical training included the following aspects:

1. Regulation of UAVs in Greece
2. Air traffic rules
3. Meteorology
4. Legislation for UAVs in Greece
5. Air navigation
6. Aerodynamics
7. Communications
8. Technical knowledge
9. Human capabilities
10. Pilots/Users
11. Drone Anatomy
12. Failsafe and Security
13. Flight modes
14. Preflight checks
15. Drone physics
16. Crew

3.5 Flight Procedures

Before any activity, a flight plan should be uploaded on the Civil Aviation Authority platform in order to be checked. It is going either to be accepted or to be declined (potential reasons could be a dangerous

flight plan above inhabited area, a nearby flight to an airport, prohibited flight above 122 m etc). Also other stakeholders play a role in the flight plan check such as the Military, the Ephorates of Antiquities and the Police. After the acceptance, there is another procedure in the field that should be followed and concerns preflight checks, checks during the flight and checks towards or after landing. During flight at least 2 persons are needed, a drone monitor and computer ground station controller. After the activity, the flight is registered in the UAV's logbook. Related checks are the following:

A) Preflight checks:
1. Free air space (no obstacles)
2. Weather conditions (Visibility>3km, Wind<8 m/s, Temperature, no potential thunders)
3. Space weather (Kp<4)
4. Aircraft and helix condition (no cracks or deformation)
5. UAV battery condition (at least 80% charged)
6. Computer ground station battery condition (at least 80% charged)
7. Data storage
8. Monitor of the drone – crew (well informed about his/her responsibilities)
9. Protectice equipment (taken out)
10. Battery connection (YES)
11. Computer Ground Station On (YES)
12. Telemetry (YES)
13. UAV status lights (Green/Blue)
14. Camera check (YES)
15. GPS Position fix (YES)
16. Horizontal and Vertical Geofence (SET)
17. Upload Mission (YES)
18. Home point set (SET – Ensure a clear landing path and enough space for overshoot/undershoot)
19. Start point set (SET – Towards the take-off path)
20. Landing sector set (SET – Consider backwind as last resort – prepare for overshooting)
21. Take-off location (Always into the wind. Ensure 30m minimum clear space towards the take-off path
22. UAV Power On (YES)
23. Servo check (all movements)
24. Motor kick-in (green light, appropriate angle)
25. Launch (towards the wind)

B) During flight:
1. Note of start time
2. Wind speed check
3. Note of mission log filename
4. Weather conditions check
5. Flight's orbit check
6. Camera check
7. Battery check (go land in case of 40% or less)
8. Airspace check (ready for termination in case of unexpected activity)

C) Towards and after landing:

1. Landing sector (confirmation of sector)
2. Space of landing sector (free without obstacles)
3. Beginning of landing (Orbit check, abort in case of unexpected activity)
4. Touch down (collection of drone and batteries removal)
5. UAV inspection (note of any damages)
6. UAV cleaning (aircraft, helix)
7. UAV security (after temperature's decreasing)

Chapter 4 - Monitoring Software

The Decision Making Software is a cartographic online application that integrates all available data for the area of interest. The application is accessible at the following link: https:/dpth.getmap.gr

This version allows users to navigate to all the free data included in the application as well as to interact with it with the available tools that will be presented briefly below.

The application includes three sections:

Section A includes:
- Thematic layers
  - Mapping backgrounds
  - Thematic layers
    For each of the thematic layers the user has some basic functions, with the most important being the activation of the view, the adjustment of the transparency,

the appearance of the table with the descriptive elements of the objects, receiving the data, and focus on the level.

In addition, there is the possibility of adding more data from other cartographic services compatible with OGC standards.

- Memo
  - o In this section, the cartographic symbols of the active thematic layers are presented.

- General Settings
  - o Includes a series of settings related to the functionality of the application, such as the projection system, information points, etc.

Section B includes:
- The interactive map
- Interaction tools:
  - o Navigation tools

These are:
  - Change language
  - Move map to the left
  - Move map up
  - Move map down
  - Move map right
  - Zoom in and out
  - Zoom in a specific area
  - Zoom in the content
  - Set co-ordinates
  - Show co-ordinates
  - 3D View

  - o Search tools

These include
  - Point information retrieval tool
  - Layer comparison tool
  - Polygon selection tool
  - Line selection tool
  - Rectangle selection tool
  - Selection method

- Cancel selection

  o Measuring tools

  o Printing tools

Of particular interest is the point information tool. The tool can provide information on any thematic level of the map. Initially, the subjects are identified from all thematic levels. The results are presented in the form of a list.

From there, the user can choose to focus on the object or receive information about it, which appears in the form of a pop-up window.

Especially for the data related to the measurement of noise in the installed stations, there is the possibility of viewing the measurements. First, the period is selected and then the measurements are displayed in the form of a diagram and a table.

In case the user selects information about the images of the surveillance cameras, he receives both the image and information from the metadata contained in it, such as the date of download and the location.

Section C includes:

- Multi-level search
  Through an easy to use form, the users can search within the thematic layers based on spatial and descriptive characteristics.

- Photo Upload (only for certified users)

- UAV Data Upload (only for certified users)

Chapter 5 - BIO2CARE Calc Tool

5.1 Objective

The Bio2Care Calc Tool is an online application that provides the opportunity to the user to calculate the Carrying Capacity, the Ecological Footprint, the Biocapacity and the Carbon Footprint of a protected area.

The application has a simple and friendly work interface and integrates all the complicated calculations of the methodology included in the Delivered 3.2, as it is available online (https://bio2care.eu).

The development of the application contributes to the reduction of the complexity and the expertise needed for the implementation of the aforementioned methodology.

5.2 Characteristics of the software

The Bio2Care Calc Tool is based on an open and multi-level online architecture. In this way, the development and the future escalation of the system and the applications are facilitated, while there is a possibility to **connect** with other systems, as **open** protocols and communication **standards** are observed (e.x. WSDL, SOAP, XML) according to the national interoperability framework. An important role in the possibility of expansion and escalation has the utilization of virtual machine technology and virtualization environment in general.

The main characteristics of the Bio2Care Calc Tool are the following:
- Ease to use, operation, maintenance
- Flexibility in the adoption and the integration of new technologies
- Use of open standards
- Scalability
- Performance
- Availability
- Utilization of existing resources both at the level of human resources and know-how, as well as at the level of logistical equipment.

More analytically, its architecture meets in total the following requirements:
- To be based on a high level of completion of technologically advanced and acclaimed software solutions in the field of open source software, based on open standards.
- Easily scale to adapt the system to the requirements of the application.
- Support access to the system by a large number of users.
- Support remote access.
- Support system access in a controlled manner, allowing different levels of user rating.

In the architecture of the system, three (3) logical levels are distinguished. The distinction arises from the grouping of the relevant functions concerning the object of the operational functions and the requirement for the provision of electronic services via the internet. These levels are:
- **Administration Level**: The level includes the infrastructure for storing, managing and processing data.
- **Service level**: At this level, the whole business logic is integrated with the development of the necessary applications and (inter) web services.

- **Interface level**: It is the interface of the infrastructure with the users of the system.

The data and the content are stored in appropriate database formats. The available applications and services are executed on the servers. The access to the application is provided through the Internet and it is compatible with the main Web browsers, like Internet Explorer, Mozilla Firefox, Google Chrome etc.

5.3 Description of the software

The Bio2care Calc Tool has been developed in English language and can be found at the following link: https://calctool.getmap.gr. Only registered users are supported.

The Bio2Care Calc Tool includes the above:
1. Welcome page (screen) with general information about the tool
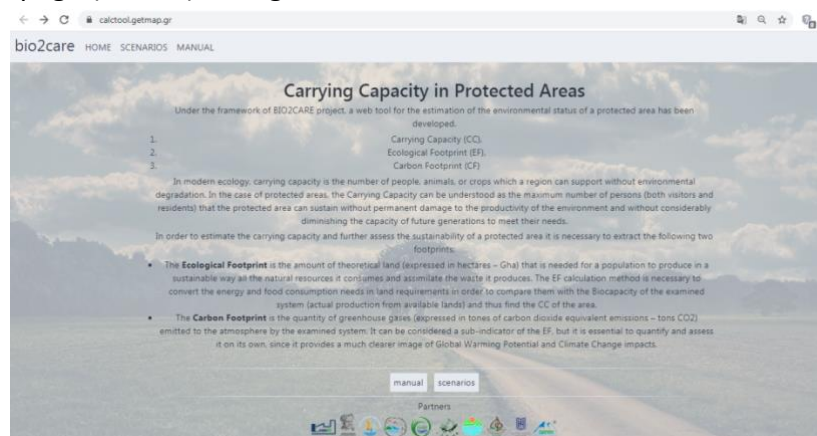
Figure 5.1. Welcome page of the Bi2Care Calc Tool

2. User authentication page
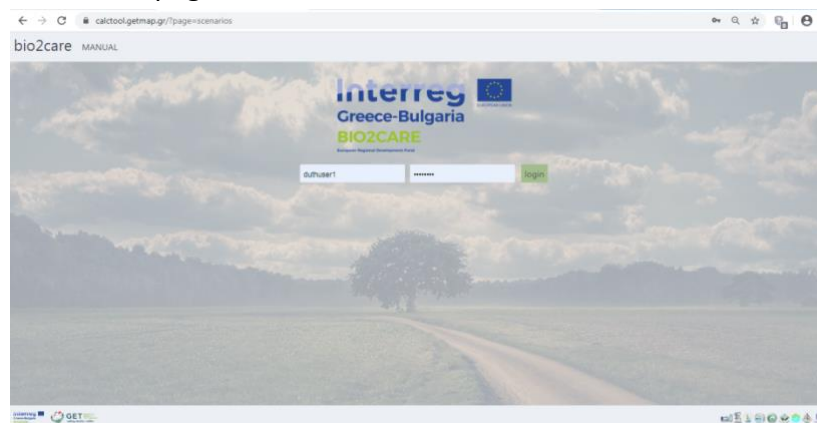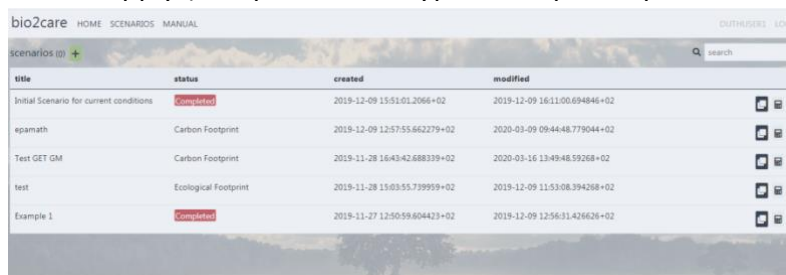
Figure 5.2. User authentication page
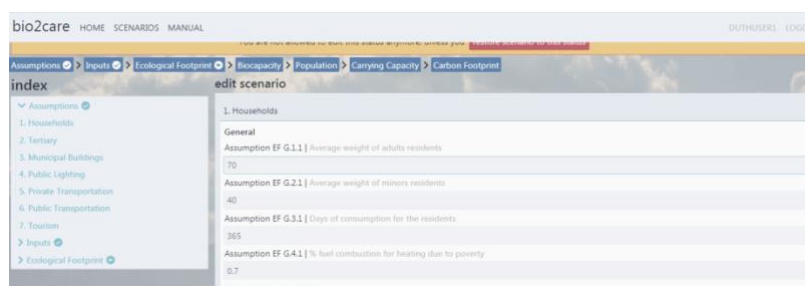
3. Create a new scenario. Allows users to enter the inputs necessary for the calculations or to modify the assumptions through online forms. The items are grouped according to their type. The registration is done by using appropriate objects that ensure their integrity. In addition, validation rules apply (acceptable data types, acceptable price limits, etc.).

Figure 5.3. Create new scenario

Figure 5.4. Grouped Assumptions display

Figure 5.5. Grouped Inputs interface

4. Model Implementation. It presupposes the completing of Inputs entry and the confirming of the Assumptions. It leads gradually to the calculations of Ecological Footprint, Biocapacity, Carrying Capacity and Carbon Footprint. At the specific level user can also view the parameters of the models (ex. Conversion factors).
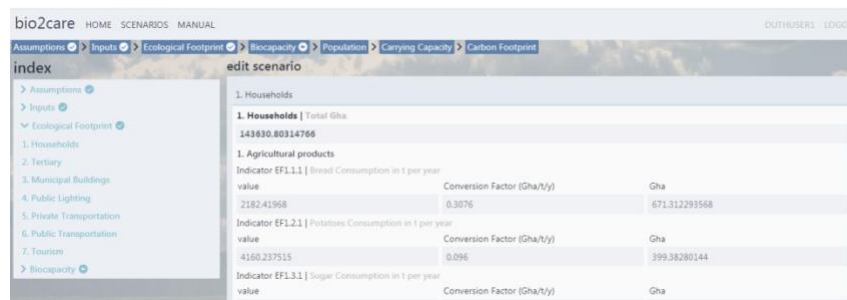
Figure 5.6. Ecological Footprint calculations display
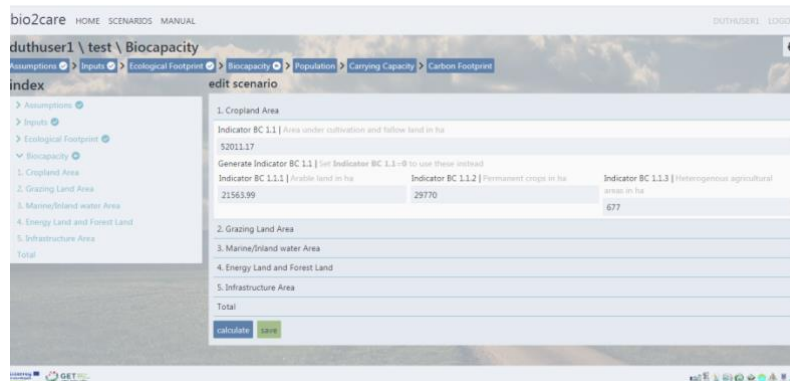
Figure 5.7. Biocapacity calculations display
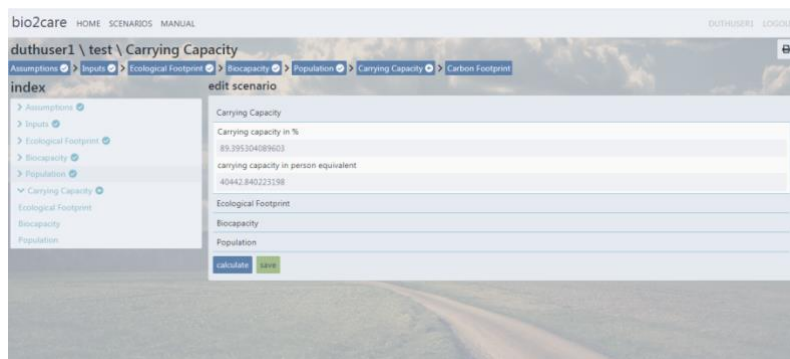
Figure 5.8. Carrying Capacity calculations display

Figure 5.9. Carbon Footprint calculation display

5. Results presentation. The results produced (as well as the input data, assumptions, conversion factors) are stored in tables in the database to be available for viewing and analysis.

Figure 5.10. Report display

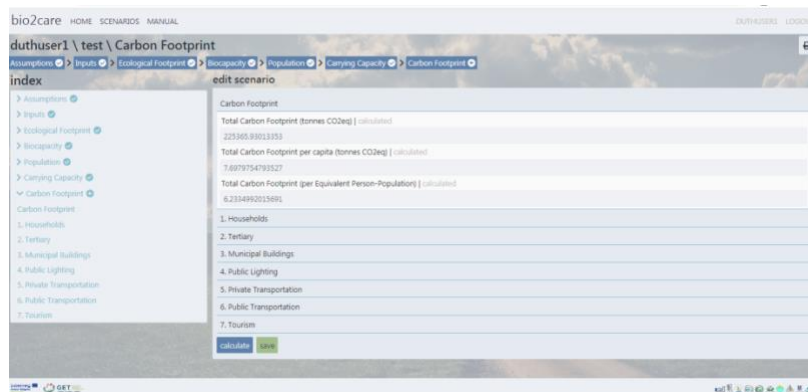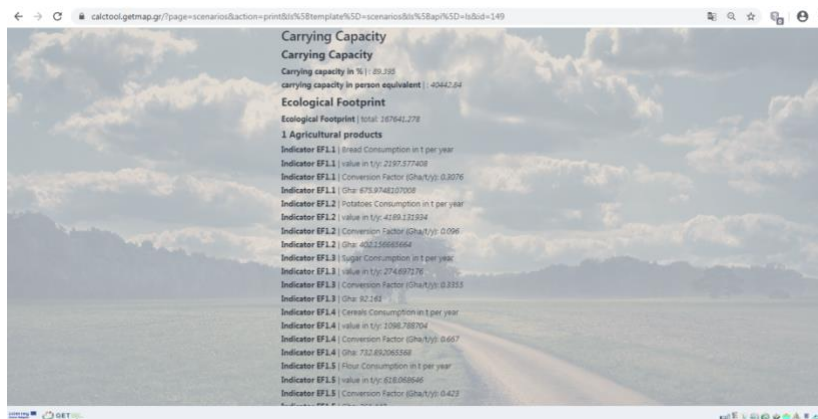6. Selection of a default scenario (Figure 3). The application allows users to select a default (saved) scenario. Users can see all the Inputs, the Assumptions, the Conversion Factors and the results. The application allows user to save the results for later retrieval / processing.

7. Assist provision. A manual of the application is provided, which is an explanatory text for each individual section of the computational process.

The application stores the data in the Postgresql database, which is open code, supports advanced features and is used by a large number of users to implement modern applications that require the organization / management of information in a relational database.

5.4 Training

A preliminary training was carried out according to the following details:

Location of training:	Teleconference (Cisco Webex Meetings)
Date of training:	16th March 2020, Monday
Duration of training	4 hours
Method of training:	presentation, site tour (https://calctool.getmap.gr) and workshop

Educational Material	The manual and the presentation of the Bio2Care Calc Tool application are quoted in Annex 1 and 2, respectively.
Name of Trainer:	Symeonidis Panagiotis, Chief Scientific Officer & Presales Manager Geospatial Enabling Technologies Company www.getmap.eu
Number of trainees:	10-12 trainees

Chapter 6 - BIO2CARE Symbiosis Tool

6.1 Objective

The Bio2care Symbiosis Tool is an online cartographic/mapping application that allows users to search for potential symbiotic activities, using as data the inputs and outputs of their own production activity, but also the production activities of other users.

The application has a simple and friendly work interface and it was based upon the cased study developed in the Delivererable 3.4, as it is available online (https://bio2care.eu).

The development of the application contributes to the implementation of circular economy/industrial symbiosis principles at local scale.

6.2 Characteristics of the software

Bio2Care Symbiosis Tool supports the following functions:

- Entry of activity data. The entry is initially made by selecting the location from the map. Then the users enter the requested data regarding the type of activity (Industry, Municipal Authority, Regional Authority, etc.) as well as the basic input and output material flow.

- Tool for finding activities with common input-output material flow. Users can search for activities that have common input-output material (raw materials, by-products etc.) with a selected activity. The search results are presented in a table and on the map, along with the relevant distances.

- Connectivity tool. Users have the ability to import links between activities with common input-output material flow. The application allows you to display all related activities on the map.

- Management environment. Enables users with the corresponding rights to manage the database, updating price lists and other data used in the system.

6.3 Description of the software

The Bio2care Symbiosis Tool has been developed in Greek language and can be found at the following link https://dpth.getmap.gr/admin/. Only registered users are supported.

The Bio2Care Calc Tool includes:

1. User Authentication Page

Figure 6.1. Use authentication page of BIO2CARE Symbiosis Tool

2. Sign Up Page

Figure 6.2 User Sign Up Page

3. User Interface

Figure 6.3. User Interface of the BIO2CARE Symbiosis Tool

4. User Interface (detailed)

The user interface of the application includes three section as shown in the figure below.
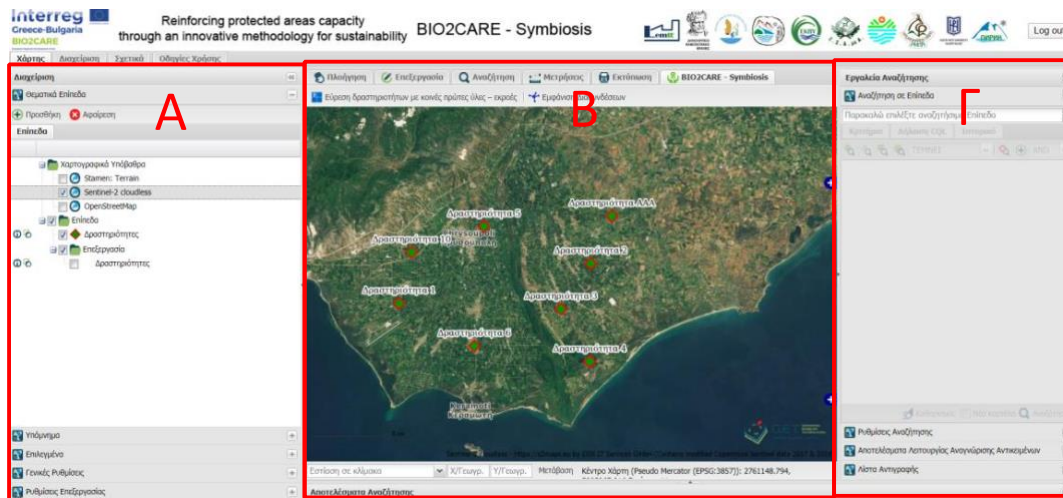
Figure 4: Sections of the user interface

Section A includes:

- Thematic layers
  - Mapping backgrounds
  - Thematic layers

    For each of the thematic layers the user has some basic functions, with the most important being the activation of the view, the adjustment of the transparency, the appearance of the table with the descriptive elements of the objects, receiving the data, and focus on the level.

    In addition, there is the possibility of adding more data from other cartographic services compatible with OGC standards.

- Memo
  - In this section, the cartographic symbols of the active thematic layers are presented.

- General Settings
  - Includes a series of settings related to the functionality of the application, such as the projection system, information points, etc.

Section B includes:

- The interactive map
- Interaction tools:
  - Navigation tools

These are:

- Change language
- Move map to the left
- Move map up
- Move map down
- Move map right
- Zoom in and out
- Zoom in a specific area
- Zoom in the content
- Set co-ordinates
- Show co-ordinates
- 3D View

o Search tools

These include

- Point information retrieval tool
- Layer comparison tool
- Polygon selection tool
- Line selection tool
- Rectangle selection tool
- Selection method
- Cancel selection

o Measuring tools

o Printing tools

o Editing tools

These include:

- Object selection tool
- Rectangular selection tool
- Deselect object
- Create new activity
- Copy object

- ▪ Move object
- ▪ Delete object
- ▪ Undo action
- ▪ Redo action
- ▪ Update database
- ▪ Update user

o Symbiosis tools

The "find activities" tool allows the user to select an activity and see what other activities on the database have common input-output material flows. The result is shown schematically on the map and in a form.

The form allows the use to create a symbiotic relationship. Selecting the relevant option opens up a new form in which the user specifies the connection. This connection then will be available exclusively for the user.

The "Symbiotic connections" tool allows the user to select a connection and see the data specified for the specific connection.
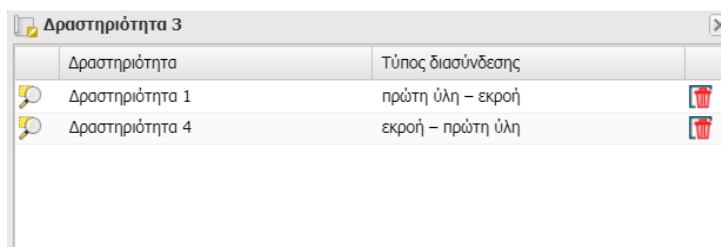
Section C includes:

- Multi-level search
Through an easy to use form, the users can search within the thematic layers based on spatial and descriptive characteristics.

6.4 Training

A preliminary training was carried out according to the following details:

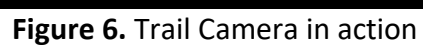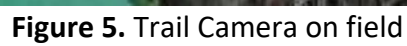| Location of training:	Teleconference (Cisco Webex Meetings)
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Number of trainees:	10-12 trainees

Appendix - Photos

Ebeex Drone

Figure 1. The eBeeX model.

Figure 2. eBeeX accompanying equipment (1)

Figure 3. eBeeX accompanying equipment (2)

Trail Camera

Figure 4. Trail Camera on field

Figure 5. Trail Camera on field

12/17/2019 04:32 02°C SPYPOINT FORCE-DARK

Figure 6. Trail Camera in action

Ultra Sound Recording Unit

Figure 7. Pettersson ultrasound recording unit

Station Photos

Figure 8: Environmental measurement Station 1

Figure 9. Environmental Measurements Station 2

Figure 9. Environmental Measurements Station 3