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# Scoping of an App for use in the field

# to provide ground-truthing data.

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| **Abstract** | This document describes the smartphone application MapNat2, developed in the context of ECOPOTENTIAL WP12. The App is intended to facilitate the assessment of the actual use of ecosystem services (mostly cultural services) by providing ground-truthing data. |
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| Keywords | MapNat2; smartphone application; ecosystem service; actual use; citizen science |
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# 1. Executive summary

The assessment of ecosystem services (ES) can seize **participatory mapping** as a way to consider expert and place-based knowledge as a source of information, while improving the dialogue at the science-practice interface.

The **smartphone application MapNat2** (Mapping Nature's services – version 2) contributes to the development and operationalization of participatory mapping methods based on new technologies. It has been designed as a tool for citizens and scientists to map nature's services, focusing on the actual use of ES and including the location where they are used.

This app can be used as a **citizen science tool**, through which citizens map and share their use of ES on site, and as **a research tool**, with scientists observing the actual locations and modalities of ES use.

It has been developed by the **Helmholtz Centre for Environmental Research-UFZ** (Germany) in cooperation with the **Norwegian Institute for Nature Research-NINA** (Norway) and **Leibniz Universität Hannover-LUH** (Germany).

In the context of the **Ecopotential project**, the use of MapNat2 app will be promoted in **three protected areas** (Swiss National Park, Austrian Northern Limestone National Park and Portuguese Peneda-Geres National Park) during the summer 2018 to collect visitors' use of cultural ES.

## 2. What is the MapNat2 smartphone app?

### 2.1 Rationale for developing the MapNat2 app

Innovative tools and products can be designed to provide information on ecosystem services (ES) in protected areas (PAs). ES assessments can characterize i) **ES supply**, based on current landscape features and uses, ii) **ES demand**, depending on individual and societal preferences, or iii) **ES use**, identifying the actual benefits that people get from social-ecological systems (e.g., Crouzat et al. 2016). The methods and tools selected for assessing ES influence the ability to characterize these three facets across ES categories. To date, cultural ES and their actual use remain challenging to map and are still under-accounted for in ES assessments, although being considered as increasingly critical for sustaining human well-being (Plieninger et al. 2013).

**Participatory mapping** refers to the collective creation of a map where individual share their knowledge, perception or use of a place. It allows relying on expert and place-based understanding, differing in that sense from assessments deriving information from the literature (proxy-based) or from process modelling (Brown & Fagerholm 2015; Priess and Kopperoinen 2016). Participatory mapping has been increasingly used to engage the general public and stakeholders to identify locations prone to supplying given ES. Indeed, by combining inputs from experts, scientists, students and citizens, participatory mapping provides information on ES for land management, planning and monitoring, and contributes to improving the science-practice interface.

Participatory mapping can rely on the use of conventional paper maps or of digital maps displayed through GIS. Such approaches require from participants to have the ability to orientate themselves over a map to assign ES values to specific locations. New technologies (generalized internet access and spreading of smartphones) allow for the development of innovative approaches based on the use of **smartphone applications** to assess on the spot the uses and perceptions of the environment.

In this context, the **smartphone application MapNat2** (Mapping Nature's services – version 2) has been designed as a tool for citizens and / or scientific research to map nature's services, focusing on the actual use of ES and including the location where they are used or studied. This app can be used as a **citizen science tool**, through which citizens map their use of ES on site, and as **a research tool**, with scientists observing the actual locations and modalities of ES use (Pueffel et al. 2018). It is conceived as an easy-to-use direct mapping tool, providing not only immediate feedback of the mapped ES, but also access to the ES mapped by other users. Thus, citizens can identify locations with ES of interest, while scientists or planners can assess the spatio-temporal pattern of ES use.

The MapNat2 app has been developed by the **Helmholtz Centre for Environmental Research-UFZ** (Germany) in cooperation with the **Norwegian Institute for Nature Research-NINA** (Norway) and **Leibniz Universität Hannover-LUH** (Germany).

In the context of the Ecopotential project, the use of MapNat2 app will be promoted in **three PAs** (Swiss National Park, Austrian Northern Limestone National Park and Portuguese Peneda-Geres National Park) during the summer 2018 to collect visitors' use of cultural ES.

### 2.2 General description of the app

The MapNat2 app is based on the existing MapNat App prototype (Priess et al. 2014; Priess and Kopperoinen 2016; Pueffel et al. 2018) and enables the user to map a **diverse set of cultural ES**, framed as activities such as picnicking in city parks, biking in fields or forests, or bird watching in grasslands or

wetlands (Figure 1). Some **provisioning and regulating ES** are also proposed to the user, although the main focus of the app is on cultural ES. They include the provision of shade and shelter by nature as well as the provision of drinkable water from ground or surface sources. In addition, **environmental problems or threats** (ecosystem 'disservices') such as bad water quality, pests or plants causing allergies or hay fever can also be reported by the user. The complete description of ES categories proposed to the mapping is displayed in Figure 2.



**Figure 1: Screen shots of the MapNat app - Entry pages (left, middle) and map view (right) displaying results from the server.**
Source : UFZ http://www.ufz.de/index.php?en=40618

## Products of nature

| | |
|---|---|
| Collecting food, medicine or fibre from plants or animals | - Collecting food from plants |
| | - Collecting food from animals |
| Drinking water | - Drinking water |
| | - Collecting medicine, fibres and other materials from plants or animals |
| | - Using plants or animals as feed or fertilizer |
| Using energy from plants/ animals | - Using energy from plants |
| | - Using energy from animals |
| Using other products of nature | - Draft animal or mount |

## Mediation or shelter

| | |
|---|---|
| Nature mediates smell, noise, visual impacts | - Nature mediates smell, noise, visual impacts |
| Nature provides shade and shelter | - Nature provides shade and shelter |

## Cultural, physical or spiritual activities

| | |
|---|---|
| Sport fishing or hunting | - Sport fishing or hunting |
| Water sports | - Boating, canoeing |
| | - Swimming, snorkeling, diving |
| Biking | - Biking |
| | - Walking the dog |
| Walking (the dog), jogging, hiking, climbing … | - Walking, strolling, hiking |
| | - Jogging, running |
| Doing winter sports | - Doing winter sports |
| | - Barbequeing, picnicing |
| Having barbeque/ picnic or meeting people | - Meeting people |
| | - Camping |
| | - Gardening |
| Other sports or recreation in nature | - Doing other activities in nature |
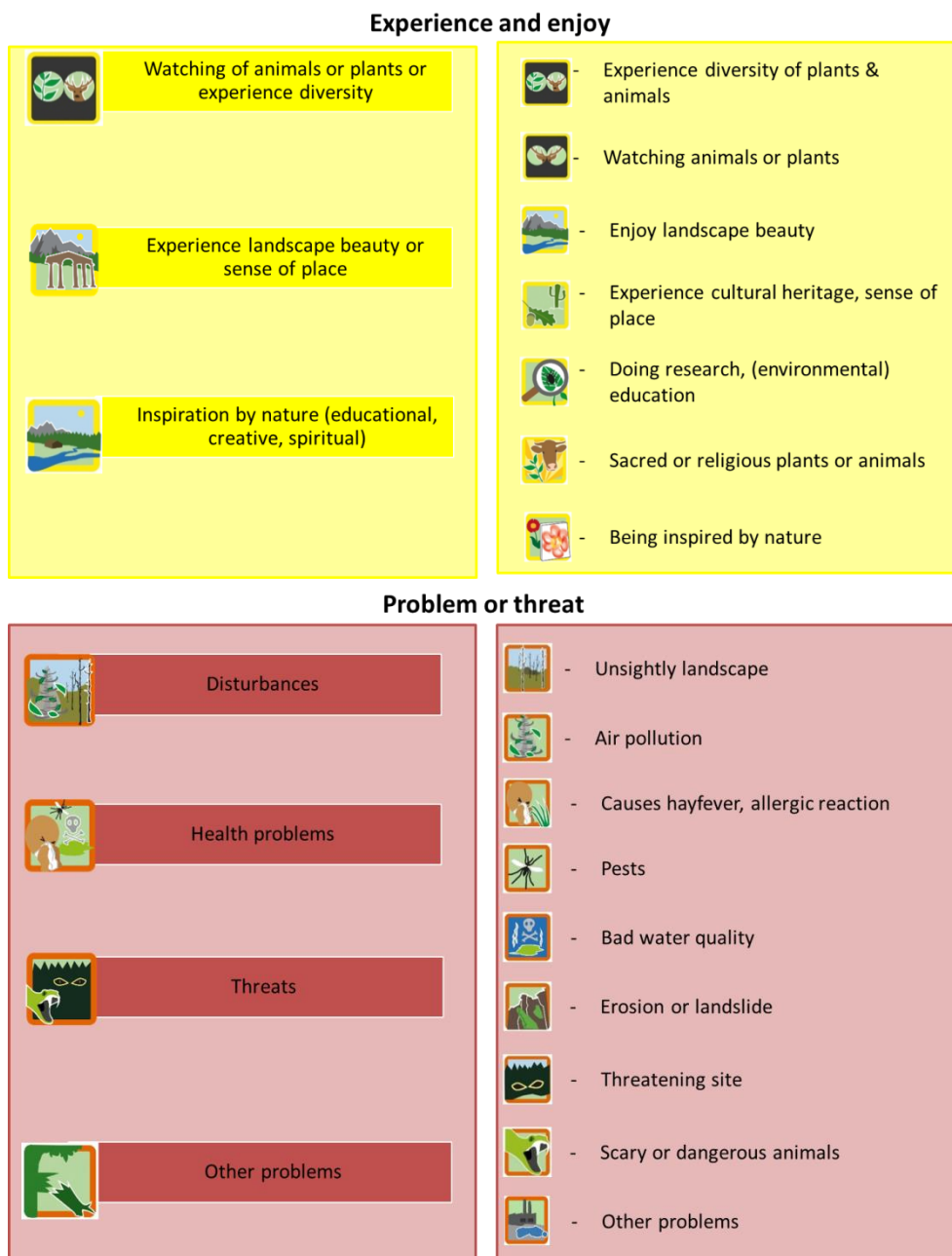
**Figure 2: Categories of ecosystem services proposed in the MapNat2 app. On the left panels are displayed the categories used in Basic mode, while on the right panels are displayed the categories used in Advanced mode. Icons have been designed specifically for the MapNat2 app.** Source: UFZ

The app enables the creation of **geo-referenced data points** locating where and when ES are used. It contains **additional information** voluntarily provided by the user, e.g. about the **type of land** where the ES is supplied. After selection a location (point or line, in advanced mode), users are **guided through a list** to select the ES used. Users can provide additional public information related to the use of services such as **frequency** and **importance** of use or the **means of transport** used to reach the place. A **free text** comment field is provided and one **photograph** per entry point can also be uploaded (with a limited resolution, to reduce data traffic and storage).

Opening the find mode in the map view of MapNat, users are enabled to identify spots or regions providing nature's services they may be interested in and which have been mapped by other users. Different color bullets distinguish the main ES categories in the map view.

The records are sent from the device (i.e. phone, tablet) to a **server**, which is collecting and processing the records of all users connected to the wireless local area network. MapNat2 stores all mapped ES on the user's device and in a database on the server. **Internet connection** is not needed during use, but is required for up-and downloading data as well as refreshing the map display.

The app has been initially developed for **ANDROID**-based smartphones and is further evolving to be compatible with **iOS operating systems**. It is a **non-commercial App** developed for citizens and scientists. A further objective for the app is to be performed as an **OpenSource Project**.

The App strictly respects the **privacy** of its users, who can contribute without being registered. To get registered and use e.g., the Advanced mode, an email address is required and basic personal information collected. All contributions are **anonymous** except if the user decides to identify her- or him-self e.g. by providing feedback.

## 2.3    Aspect of the MapNat2

The App is developed according two modes (Basic and Advanced), displaying different degrees of information (Table 1). App-users are asked to register by entering socio-demographic data (age, gender, place of residence) to use basic and advanced mode but are also able to use the app without registration in the base mode. In the context of ECOPOTENTIAL, a Scientific mode can be used, displaying similar characteristics than the Advanced mode but enabling the management of records by a group administrator as well as the inclusion of further information (e.g., on socio-demographic questions) on a section of non-public comments.

Table 1: Characteristics of the different modes developed for the MapNat2 app.

| | Basic mode | Advanced mode | Scientific mode |
|---|---|---|---|
| Number of ES categories | 20 | 41 | 41 |
| Number of land use classes | 10 | 30 | 30 |
| Importance of the ES / Severity of the threat | X | X | X |
| Free public comment / Photo upload | X | X | X |
| Non-public comment | | | X |
| Personal information (country, postcode, age, sex) | X | X | X |
| Spatial entry = Points | X | X | X |
| Spatial entry = Lines | | X | X |
| Means of transport | | X | X |
| Frequency of use | | X | X |
| Motivation for the visit | | X | X |

Table 2 below provides some screenshots of the app under a Basic mode use.

**Table 2: Wireframes used of the base mode used for the development of MapNat2.** Source : Joerg Priess - UFZ
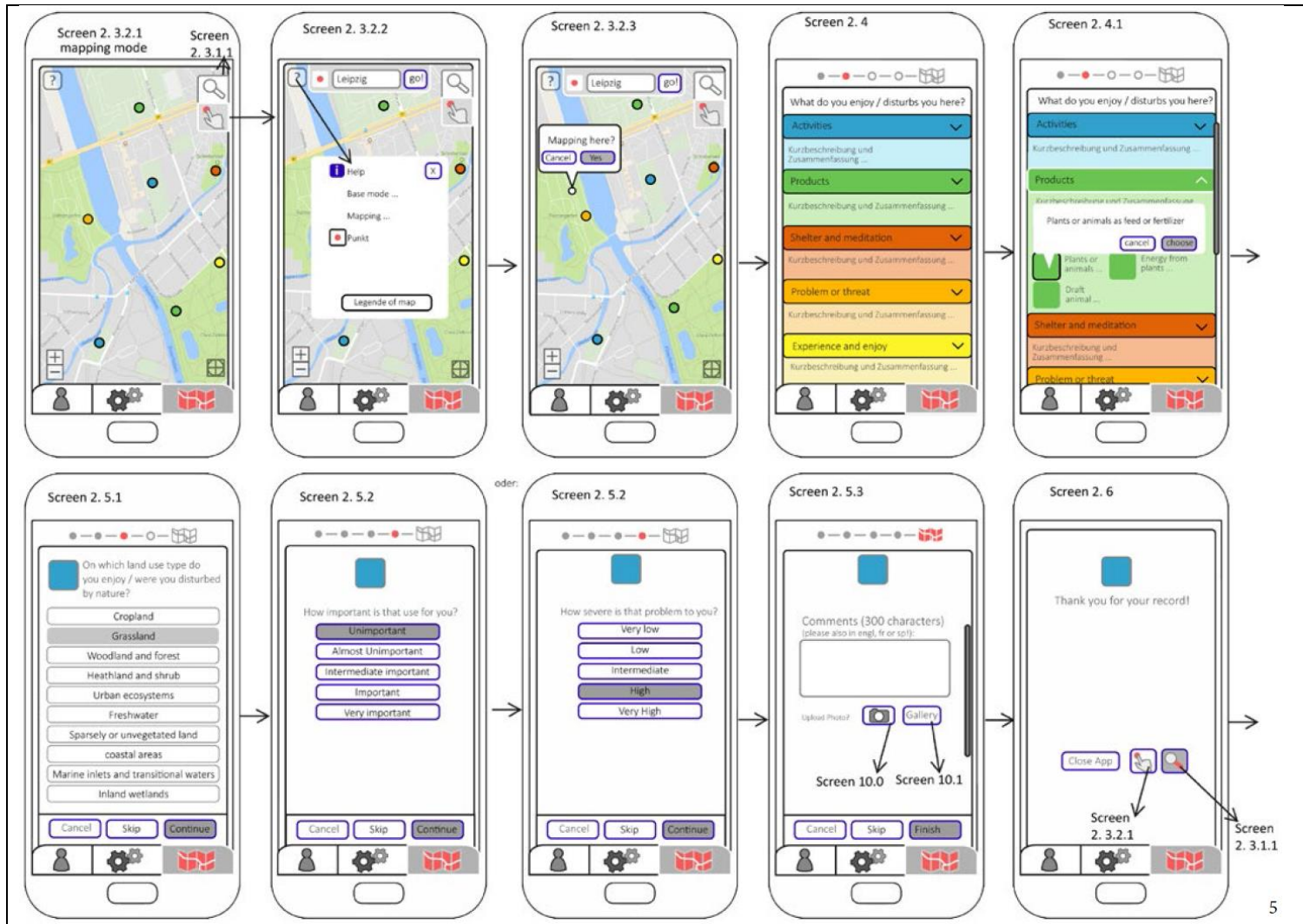
# 3. Why using the MapNat2 app?

Building on the advances made with the version 1 of the MapNat app (see OpenNess Method factsheet https://oppla.eu/sites/default/files/uploads/methodfactsheetsmartphoneapp.pdf), below are summarized the main advantages and limitations of its second version.

## 3.1 What are the main advantages of the approach?

- The MapNat2 App only requires **a smartphone (or comparable device) with a GPS device**, a technology which is increasingly common;

- **No prior knowledge** on ES or on their classification is required;

- The thematic focus is on **cultural ES mostly**, that are otherwise through remote sensing often under sampled, leading to their overrepresentation in the list of ES proposed. A couple of regulating and provisioning ES which are considered to be relevant for direct use by citizens, such as using drinking water or fire wood, as also proposed. Additionally, also disservices can be mapped.

- Several **languages** are available (so far, English and German; French and Portuguese versions are under development);

- The MapNat App is designed to be **easy to use** by non-specialists;

- **Different modes of use** are available, accommodating with the diversity of contributors' profiles.

- It has **global applicability** and **comparability of results**;

- Users can download or export the ES they map from their devices and display or evaluate them **for their own purposes**;

- Unlike many other smartphone apps, MapNat2 does **not collect any personal information** unless users decide to register voluntarily (which is required to use for instance the Advanced mode);

- The ES categories used in the app are compatible with the widely used **CICES** (V 4.3; https://cices.eu/) list.

## 3.2 What are the constraints / limitations of the approach?

- The app focuses on **one ES facet**, i.e. ES use, directly informed by the user or indirectly by a scientist conducting field work;

- The method does not explicitly address **uncertainty** and does not test the influence of the **App design** on the user's answers (e.g., order of the ES in the list proposed).

- Although increasingly accessible, smartphone apps are used by a **specific part of the society** only.

## 3.3 Different interests for different stakeholder groups

In the context of the ECOPOTENTIAL project, the MapNat2 app can serve the interests of diverse stakeholder groups.

- **Individual users / Park visitors**:
  - Tracking of **personal favorite uses and activities** (and environmental concerns)

- o Identifying **suitable locations for enjoying ES** identified by the community of users
  - o Participation to a **citizen science project**
  - o **Contribution** to park management and scientific study

- **Protected area management team / related local stakeholders**:
  - o Identification of spots or regions providing nature's service or attractions **people are interested in** (spatial and temporal patterns)
  - o Information for the **management and communication** strategy

- **ECOPOTENTIAL academic partners**:
  - o Information on the **actual use** of ES (usually hard to collect), with the potential to compare this data to information on **potential supply** of ES
  - o Characterization of the influence of **socio-demographic data and landscape features** on ES use.

# 4.    What is new in the MapNat2 app?

The app has already **successfully been used** globally under its first version (Priess et al. 2014; Priess and Kopperoinen 2016) and in an urban project to map ES use on brownfields in Leipzig (Germany). The methods and results of the latter study are described in **Pueffel et al. 2018**. Results from field surveys enable identifying the ES mostly used, as well as characterizing the importance and frequency of their use. By applying cluster analysis on the results, the authors were able to group brownfields depending on their specific ES use profiles as well as on the types of individual motivations to visit them. In the context of ECOPOTENTIAL, such information on bundles of ES used on different locations appears highly relevant for informing protected area management.

The **second version of the MapNat** offers additional features that have been developed partly regarding ECOPOTENTIAL targets. In particular, the MapNat2 app proposes:

- **An advanced mode**, with more detailed ES categories and land use classes, as well as with more questions characterizing each record (mean of transport, frequency of use, motivation);
- The possibility to access **a scientific mode**, manageable by a group administrator and including further socio-demographic questions and non-public comments;
- An **offline mode** enabling the use of the app (including a background map , which can be downloaded beforehand) even without internet connection;
- **Refinements** in App design, applicability and personalization;
- Several **languages**, and the possibility to add other ones;
- Compatibility with **iOS operating systems**.

# 5.    Technical elements about the App

### 5.1    Timeline of the development of the MapNat2 app – 2018

The different steps of the app development are displayed below in Table 3.

**Table 3: Development steps of the MapNat2 in 2018.**

| January 2018 | Agreement on the specification sheet with developers |
|---|---|
| February / March 2018 | Interactive prototype |
| March to May 2018 | Development of  Android App, Web Backend |
| May 2018 | Prototype for  testing |
| June 2018 | App-Store entries |
| July 2018 | iPhone Version |

## 5.2    Entity relationship model

Records in the app inform different features, which are related to specific tables in the design of the MapNat2 database. The **Entity Relationship Model** displayed in Figure 3 exposes the architecture of the database.
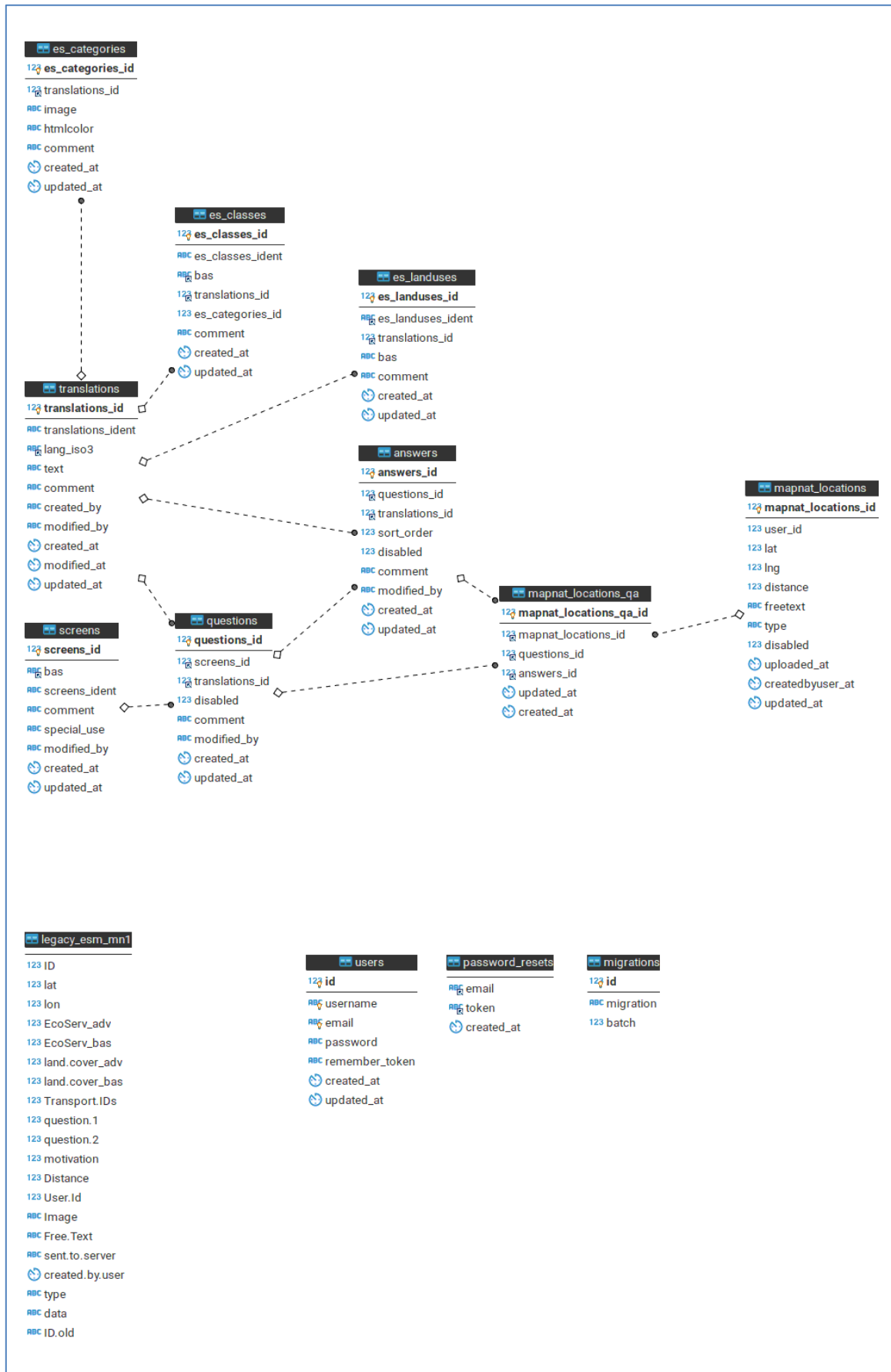
**Figure 3: Entity Relationship Model (ERM) of the MapNat2 database.**

## 5.3    Installation and use

MapNat2 is an App initially developed for Android phones and tablets. The current version is a beta version, but should be stable on most Android phones. After finishing a stable version, MapNat2 will also be available for download via the Android Play Store. A version compatible with iOS operating systems will be developed after the stable version for Android is finished.

The App will be accessible on the **Android Appstore** and the **Appstore of iOS**. It will be advertised on partners websites (e.g., National Park website), with a link enabling the download. The MapNat has also been promoted and used in the ESMERALDA project (http://www.esmeralda-project.eu/) and can be downloaded from its website (http://esmeralda-project.eu/news/13499_mapnat---the-ecosystem-service-mapping-smartphone-app/).

Installation is simple and only requires access to the Android or Apple app-stores.

The internet connection also allows for downloading maps and existing records from the server. After using the App offline, at the next stable WLAN connection to the internet, the smartphone starts to synchronize the user's records with the server.

MapNat2 runs first in basic mode. If the user wants to use advanced functionalities, he/she can switch to the advanced mode. For the advanced mode, a user registration with a valid E-mail address and a password are needed.

For the MapNat2 App, the following Smartphone rights are required:

- camera
- file transfer
- gallery
- geolocation (GPS or other sensors)
- internationalization
- local storage
- network connection.


To organize and administrate the MapNat2 data and users, a responsive web frontend is developed with different user rights. Five user roles are implemented:

- Super administrator
- Group administrator
- Advanced user
- Basic user
- Anonymous (user).


To evaluate the MapNat2 data, the web frontend can export selected data of own records, or in case of a group administrator of records of the group members. Additionally, records will be visualized in different forms such as maps or charts.

The App contents such as ES lists, questions or languages can easily be updated or adapted, as they are organized in a web-backend handled by the super administrator.

# 6. Concluding remarks

When developed, the MapNat2 app will be made available to the ECOPOTENTIAL community. It will be trialed in three national parks over the summer 2018 and can also be used in other protected areas interested to assess the actual use of (cultural) ecosystem services. Besides, the MapNat2 will be used in teaching at University (e.g., at Leibniz Universität Hannover), especially during excursions and study project.

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