Where are all the boars?
An attempt to gain a continental perspective.

Alexander N.S.[1] and Wint W. [1]

[1]Environmental Research Group Oxford, Department of Zoology, South Parks Road, Oxford OX1 3PS, UK;

The Task:

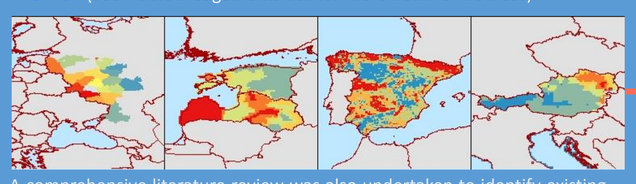
EDENext partners requested that the Data Management Team attempt to produce a continental scale distribution and abundance map for wild boar (*Sus scrofa*). This was required because:

A) Wild boar can be an important component of the ecological & epidemiological systems within which vector-borne diseases persist and spread.

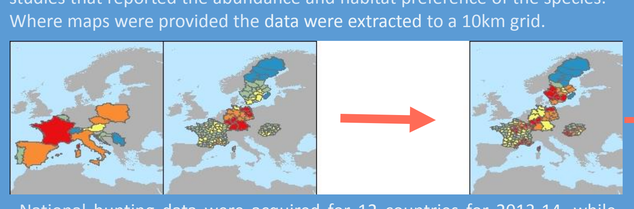
B) Existing studies on wild boar distribution generally focus on small areas such as national parks or at country level meaning they were difficult to compare and integrate into EDENext studies where a broader continental scale framework was used.

1: Acquiring & collating existing data

Five independent sets of distribution data were combined to produce a single presence absence mask. From L-R EMMA, GBIF, IUCN, Spanish MOA, NBN UK (See Acknowledgements box for more detail on Sources).



A comprehensive literature review was also undertaken to identify existing studies that reported the abundance and habitat preference of the species. Where maps were provided the data were extracted to a 10km grid.



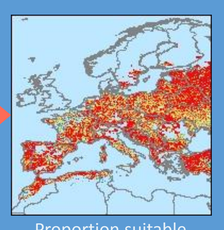
National hunting data were acquired for 12 countries for 2013-14, while sub-national (~NUTS3) figures were only available for five countries. Only sub-national figures were used in the input layer. However to account for the fact that the higher resolution data were from different years, the numbers were normalised to the national figures where both were available, then converted to numbers per sq. km. of suitable habitat.

1) Combined P/A data * Habitat mask
2) Proportion suitable habitat * P/A data

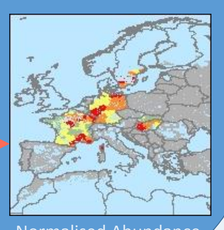
GlobCover Land classes were defined as either suitable (red) or unsuitable (blue)

Abundance studies data and normalised hunting data classified into quintiles and combined

Simple Presence/Absence



Proportion suitable habitat where present



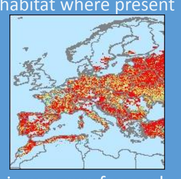
Normalised Abundance Index

2: Modelling

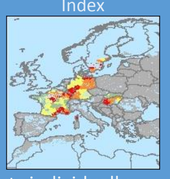
Inputs

Simple Presence/Absence

Proportion suitable habitat where present



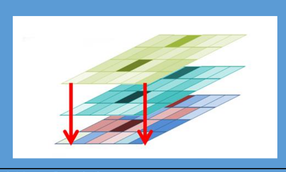
Normalised Abundance Index



A Random Forest analysis was run for each of the inputs individually using the VECMAP Modelling Suite.

VECMAP Predictor Variable Suite

A suite of spatial covariate layers of environmental data were used by the VECMAP model tools to define statistical relationships with the variable to be modelled.

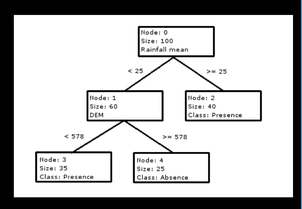


Variable	Description
03	MODIS Middle Infra-red
07	MODIS Day-time land surface temperature
08	MODIS Night-time land surface temperature
14	MODIS Enhanced vegetation index (EVI)
15	MODIS Normalised difference vegetation index(NDVI)
57	Worldclim precipitation
31	GRUMP human population density
90	MODIS Digital elevation model (DEM)

Random Forest Modelling (inside the black box)

A random forest (RF) is a versatile tool for modelling. It can handle categorical, presence-absence data & continuous data. As a result RF modelling is used over a wide range of disciplines.

A RF model consists of an ensemble of CART trees (classification and regression trees) constructed using a random subset of both the available samples and of the attributes recorded for each data point. A single CART tree is therefore the basis of a RF analysis. A RF can run in two modes, according to the CART model. In classification mode, the predictive result is a discrete class. In regression mode, the predictive result is a continuous variable.

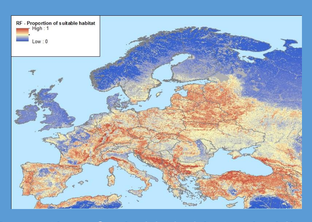


A very basic classification tree for a dataset with two classes, presence and absence

Further reading:
Visit the random forest website for more detail of the algorithm
http://www.stat.berkeley.edu/~breiman/RandomForests/cc_home.htm

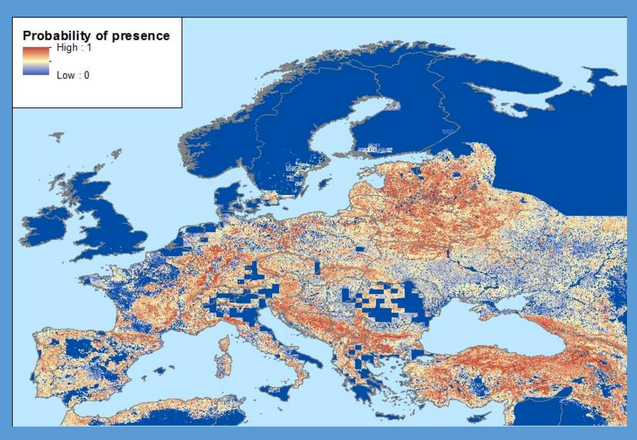
3: The Outputs:

Four maps are included in the final data package. These outputs have been designed to provide flexible alternatives to describe potential Boar presence and abundance within a European context. These can then be used to contribute to models of Vector-borne disease risk.

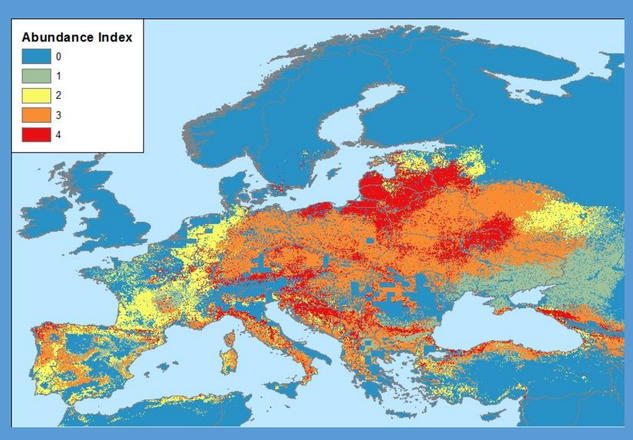


Proportion of suitable habitat coinciding With species presence model output

Habitat suitability mask for review derived from GlobCover



Probability of presence model output



Abundance index 0-4 model output

Request for collaboration:

If you have made it to this last box the chances are that you have a serious interest in either the modelling process or wild boar distributions. There are a number of further steps that could improve these models. If you can provide data or expertise to facilitate any of the following improvements please get in touch (neil.alexander@zoo.ox.ac.uk).

- Any feedback on the existing models is always useful. These models will be released for download shortly on www.edenextdata.com and also as a data paper in the near future.
- It is believed hunting data is recorded across Europe. It is however difficult to access the data which are normally reported in native languages, so please send links of your countries' hunting data or any other abundance studies. Helps with any necessary translation would be gratefully received.
- A further development to the model would be to refine and enhance the environmental factors which may limit species distribution, to combine with the existing land cover mask. These may include altitude, temperature & rainfall for example.

Similar methods have been utilised to model voles, disease vectors and deer. Please also check www.edenextdata.com to download the latest models.

Acknowledgements:

Many thanks to Giovanna Massei for providing invaluable feedback & data on the species and to the following people for identifying data & providing translations where required, Cornelia Silaghi, Gábor Földvári, Maria Kazimirova, Heidi Hauffe & Jonas Kindberg.
The VECMAP modelling suite was the tool used to run the models presented on this poster: http://www.avia-gis.com/vecmap

P/A Data references:

- The EMMA Database: Mapping Europe's mammals using data from the Atlas of European Mammals
- The Global Biodiversity Information Facility (GBIF)
- IUCN Red List Dataset
- The National Biodiversity Network UK 10k Data
- Spanish Ministry of Agriculture National Inventory of Biodiversity

Selected Abundance References:

- Réseau Ongulés Sauvages ONCFS/FNC/FDC (France)
- Deutscher Jagdverband, Handbuch 2014 (Germany)
- Hungarian Game Management Database 2013/2014
- National Forest Centre (Slovak Republic)
- The Swedish Association for Hunting and Wildlife Management, Wildlife Monitoring
- Acevado et al. 2009: Wild boar abundance and hunting effectiveness in Atlantic Spain: environmental constraints
- Melis et al 2006: Biogeographical variation in the population density of wild boar (Sus scrofa) in western Eurasia

GERI 2015
21-22-23 April 2015 • Heraklion, Crete, Greece
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