EVALUATING THE IMPACT OF LARGE SCALE INFRASTRUCTURE ON BROWN BEARS IN GREECE

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INTRODUCTION

The largest carnivore of Europe the brown bear (*Ursus arctos*) occurs throughout northern Greece with an official estimated population size of 190-260 individuals. It forms the southernmost range of the species in Europe and its distribution is divided into two distinct nuclei covering in total 16,500km^2.

Over the past two decades intensive conservation actions at a range scale have taken place and recently a species range expansion in the western part of the distribution has been observed and bears are re-colonising areas of their historical distribution. At the same time a rapid development of the transportation infrastructure can be observed throughout the country, leaving a permanent effect on the landscape. An example of such development is Via Egnatia Highway a 680 km closed highway -part of the trans-European highway network (TENT- which connects the eastern with the western part of the country. Approximately 37km of the highway cuts through primary bear habitat in the threatening to cut off the Pindos subpopulation in the middle. The direct effects of this development are evident since in the past two years 17 bears have been involved in road traffic accidents, yet this project aims to investigate the potential unseen effects of this development in terms of fragmentation and viability of bear sub-populations by assessing their genetic connectivity and the effects of isolation.

OBJECTIVES & METHODS

The main aims of this project are to:

1. Investigate the genetic structure of the bear population in the country.

2. Evaluate the effect of large scale human disturbances as well as landscape characteristics on gene flow.

3. To estimate the population size of bears over a defined geographic area by applying the genetic equivalent of a capture-mark-recapture method.

4. To identify the major sources of dispersing individuals and predict the major recolonisation routes with the use of Geographic Information Systems (GIS) models..

Since May 2008 field surveys have taken place at large pre-defined representative sample units of the permanent and recolonising parts of the species' distribution. Genetic material such as hairs and scats have been collected using non-invasive techniques. Laboratory analysis has began and nuclear DNA has been isolated from samples and amplified at 10 microsatellite loci commonly used for brown bears in order to achieve individual identification through Polymerase Chain Reaction (PCR). Sexing will be achieved by the amplification of the SRY fragment of the Y chromosome. PCR products will be multiplexed in an automated capillary sequencer and data will be analysed for genetic variability and population differentiation.
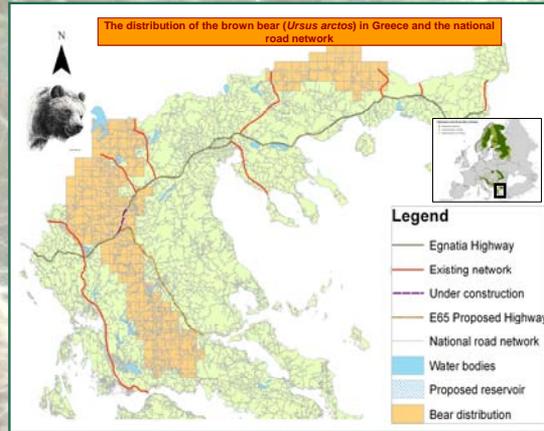
The effect of human disturbance and landscape characteristics on the gene flow of brown bears will be evaluated. The results of the genetic analysis will be inserted to a Geographic Information System matrix and variables which describe habitat connectivity will be generated to model the various factors associated with fragmentation. For that reason a digital layer of the habitat in the main study corresponding to approximately 750km^2 of surface area has been created, following heads-on digitization in ArcGIS.

The distribution of the brown bear (*Ursus arctos*) in Greece and the national road network

Legend
- Egnatia Highway
- Existing network
- Under construction
- E65 Proposed Highway
- National road network
- Water bodies
- Proposed reservoir
- Bear distribution

Map showing the two distinct sub-populations of the brown bear (*Ursus arctos*) distribution in Greece, the Pindos mountain range (left) and the one of Rhodope (right). The national road network and the recently constructed Egnatia Highway which is threatening the population with further fragmentation is also shown. At the moment genetic material has already been collected from approximately 1/3 of the species range in the country and data collection is expected to conclude this year.

Legend
- Pole traps
- Rub tree traps
- Buffer zone pole traps
- Tunnels
- Egnatia Highway
- Civil
- Highway buffer zone

To accurately appreciate the barrier effect of a closed highway over a defined geographic area, the genetic equivalent of a capture-mark-recapture method will be applied to estimate a specific sub-population of brown bears. The map is showing the alignment of the Egnatia highway intensive study area of Grevena where both hair and scats are collected. The area is divided in grids of 25km^2 and the locations where pole and rub-tree hair traps have already been established for the purpose of hair collection are shown.

Legend
Vegetation types
Category
- A
- AG
- D1
- D2
- MD
- N
- RV
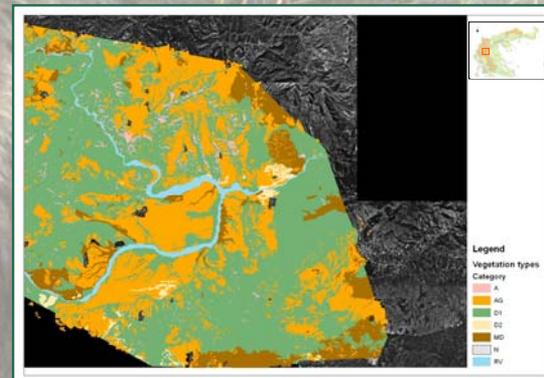
Image showing the digital vegetation layer that will be used for GIS modelling. Habitat categories are as follows: A= rock and badlands, AG= agricultural land, D1=forested areas, D2= pasture areas, MD= partially forested areas, N= civil and infrastructure, RV= riparian vegetation and water bodies

CONCLUSIONS

The project aims contribute significantly to our knowledge on the genetics of Europe's largest carnivore and the effects of unsustainable development on its fitness. The information can hopefully be used to minimize the ecological impact of large scale infrastructure and particularly transportation corridors in the future.
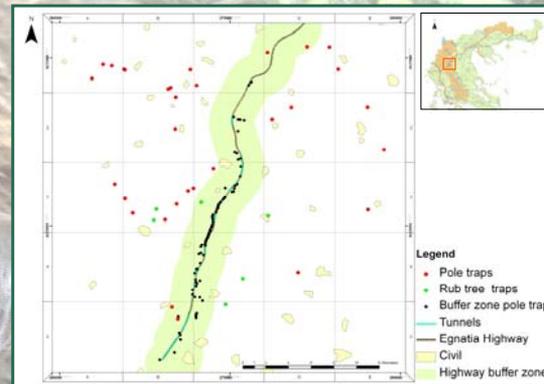
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