The Biology of Lacertid lizards. Evolutionary and Ecological Perspectives (2004). Pérez-Mellado, V., Riera, N. and Perera, A. (eds.). Institut Menorquí d'Estudis. Recerca, 8: 159-164.

EVALUATING THE SAMPLING EFFORT OF NATURAL HISTORY MUSEUM COLLECTIONS: THE CASE OF PORTUGUESE LACERTIDS FROM THE COLLECTIONS OF THE MUSEU BOCAGE

ANTUNES, P. & VICENTE, L.[1]

Abstract: The last catalogue of the Reptile collection of the Museu Bocage dates back to 1972. The collections were lost in a fire 25 years ago, so it was necessary to analyse the effort of various donors, who offered the Museum a new collection. The evaluation of the sampling effort is important to gather information (on quantity and origin) on the various samples of the species of lacertid lizards present in the Museum and enables an operational and practical visual image of that information. The obtained results prove that the study of the sampling effort using *ordinary kriging* method is robust and accurate on identifying gaps (under or no sampled areas) and a helpful tool to fulfil them. Although beginning to be representative of the Portuguese fauna, the lacertid collection of the Museu Bocage needs major improvements given that it still does not illustrate the actual distribution of lacertid lizards in Portugal. In order to stand for modern standards, when complementing the existing collection we must take into account not only the information provided by the analysis but also conservationist concerns (not killing animals) and the establishment of co-partnerships with congener institutions as well. Nowadays Museums have the duty, more than ever, to keep their collections well housed, cared for and accessible to the scientific community.

Key words: Sampling effort, Lacertids, Portugal, Museu Bocage

Resumen: Evaluando el esfuerzo de muestreo de las colecciones de museos de historia natural: el caso de los lacértidos portugueses de las colecciones del Museu Bocage.-El último catálogo de las colecciones de Reptiles del Museu Bocage se remonta a 1972. Las colecciones se perdieron durante un incendio hace 25 años, de modo que era necesario evaluar el esfuerzo de varios donantes que ofrecieron al museo una nueva colección. La evaluación del esfuerzo de muestreo es importante para obtener información (tanto en origen como en cantidad) sobre las numerosas muestras de especies de lacértidos presentes en el museo y brinda una imagen operacional y práctica de dicha información. Los resultados obtenidos prueban que el estudio del esfuerzo de muestreo empleando un simple método de "*kriging*" es robusto y preciso en la identificación de las lagunas (areas infra-muestreadas o no muestreadas), así como una herramienta útil para llenarlas. Si bien está comenzando a ser

[1] Centro de Biologia Ambiental/Faculdade de Ciências da Universidade de Lisboa. C2-P3. Campo Grande. 1749-016 Lisboa, Portugal. Corresponding author: Antunes, P.; e-mail: *pedromfsa@yahoo.co.uk*

representativa de la fauna portuguesa, la colección de lacértidos del Museu Bocage necesita de mejoras ya que aún no ilustra adecuadamente la distribución actual de los lacértidos en Portugal. En orden a cumplir con los modernos estándares, cuando se complete la colección existente debemos tener en cuenta no sólo la información proporcionada por el análisis, sino también los intereses conservacionistas (no matar animales), así como el establecimiento de acuerdos de cooperación con instituciones congéneres. Hoy en día los museos tienen el deber, más que nunca, de conservar sus colecciones adecuadamente almacenadas, cuidadas y accesibles a la comunidad científica.

Palabras clave: Esfuerzo de muestreo, Lacértidos, Portugal, Museu Bocage

Resum: Avaluant l'esforç de mostreig de les col·leccions de museus d'història natural: el cas dels lacèrtids portuguesos de les col·leccions del Museu Bocage.- L'últim catàleg de les col·leccions de rèptils del Museu Bocage es remunta a 1972. Les col·leccions es van perdre durant un incendi fa 25 anys, de manera que era necessari avaluar l'esforç de diferents donants que oferiren al museu una nova col·lecció. L'avaluació de l'esforç de mostreig és important per obtenir informació (tant en origen com en quantitat) sobre les nombroses mostres d'espècies de lacèrtids presents en el museu i ofereix una imatge operacional i pràctica d'aquesta informació. Els resultats obtinguts proven que l'estudi de l'esforç de mostreig emprant un simple mètode de "*kriging*" és robust i precís en la identificació de les llacunes (àrees infra-mostrejades o no mostrejades), així com una eina útil per omplir-les. Tot i que està començant a ser representativa de la fauna portuguesa, la col·lecció de lacèrtids del Museu Bocage necessita millores ja que encara no il·lustra adequadament la distribució actual dels lacèrtids de Portugal. Amb la finalitat de complir amb els estàndards moderns, quan es completi la col·lecció existent hem de tenir en compte no tan sols la informació proporcionada per les anàlisis, sinó també els interessos conservacionistes (no matar animals), així com l'establiment d'acords de cooperació amb institucions congèneres. Avui en dia els museus tenen el deure, més que mai, de conservar les seves col·leccions adequadament emmagatzemades, cuidades, i accessibles a la comunitat científica.

Paraules clau: Esforç de mostreig, Lacèrtids, Portugal, Museu Bocage

INTRODUCTION

In the process of complementing a Natural History Museum Collection, one of the major tasks to accomplish is to endow the Museum with specimens (or proofs of their existence) that will fulfil existing gaps (distribution patterns, microhabitats, class ages, etc.). When it is done in accordance with established goals, the evaluation of the sampling effort is a powerful tool for both the management, and the establishment of acquisition policies in Museums.

The well-known fire of 1978, withdrew Museu Bocage from otherwise natural growth and development. Thus, the present collection, although recent and mainly formed during the decade that followed the fire had been lacking revision until today.

The conditions in which the collection was found and the lack of a continued taxonomic and systematic

work (concerning the Herpetological collection) lead us to study the sampling effort.

Specimens were collected between 1972 and 1996, although the effort was mainly centred between 1978 and the late 1980's. This was certainly due to an exceptional effort right after the fire to re-establish a collection rather than a well-oriented acquisition policy.

MATERIAL AND METHODS

The maps constructed represent space variation of the quantity - surfaces and counter curves – of the samples (mainland Portugal only). We globally analysed the information referring to all lacertid species considering specimens on one hand and lots on the other. Species by species analyses was not possible due to data scarcity on many of them.

Additional comparisons were made between collections before (data from CRESPO 1972; 1975) and after (data from ANTUNES *et al.* 2003) the fire.

The present collection has approximately 900 Portuguese specimens assigned to 10 species (7 genera). *Lacerta dugesii*, *Podarcis bocagei* and *Podarcis hispanica* are the more representative taxa in the collection. However, *Lacerta dugesii* was not included in the analyses since this species is absent from mainland Portugal (only an introduced population has been described at Lisbon; SÁ-SOUSA, 1995). *Acanthodactylus erythrurus*, *Psammodromus algirus*, *Psammodromus hispanicus*, *Lacerta lepida*, *Lacerta monticola*, *Lacerta schreiberi* and *Podarcis carbonelli* are also included in the collection.

Maps were constructed superimposing a UTM 50x50 km grid over a map of mainland Portugal using Microstation 95 Version 05.05.01.65 © 1995, Bentley and Modular GIS Environment Coordinate system Operations (MCSO) Version 07.00.03 © 1999, Intergraph.

An algorithm was used an *ordinary kriging* method then to process the central co-ordinates of each UTM cell and the lot/specimen number respectively, and then draw the surfaces and the counter curves representing the abundance samples (lots/specimens). The processed data was then represented in a three-dimensional system of co-ordinates x, y and z. x and y are the central co-ordinates of each cell and z the sum of lots (or specimens) from that cell. The software used was Surfer, Version 7.0 © 1993-99, Golden Software, Inc.

The *kriging* method is a geostatistical technique also known as B.L.U.E., *Best Linear Unbiased Estimator*, which uses the auto-correlation calculus between points, producing a nonbiased estimate of the minimum variance. Theoretically, no other method can produce better estimates. The *ordinary kriging* (used in the present case) assumes that local measures are not necessarily close to the population average, using solely the neighbouring points for the estimates (ISAAKS & SRIVASTAVA, 1989).

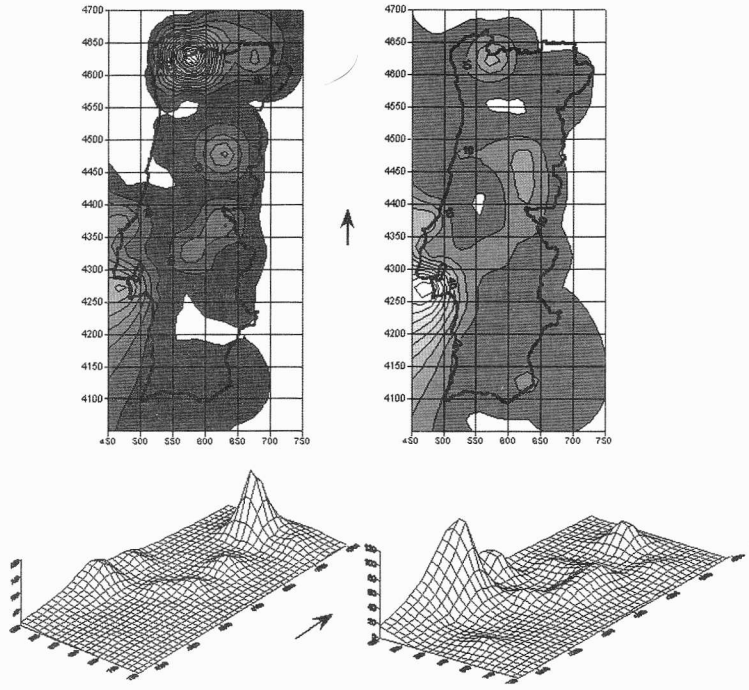

Figure 1. Abundance of the lacertids in the collection of Museu Bocage by *specimens*. Top: Counter curves with superimposed Portugal map – lighter colour means more abundance. Bottom: surface maps. Left: Present collection. Right: Before the fire. Arrows head to North

RESULTS AND DISCUSSION

The graphics representing the abundance variation of the specimens /lots of the lacertids collection of the Museu Bocage (for mainland Portugal) are presented in Figures 1-2. As we can see in Figures 1-2, a huge variation exists in the number of lots and specimens across the country. We observe an almost non-existence of samples across the country, contrasting with peaks for samples coming from particular spots. These are: Peneda/Gerês and Montesinho Mountains (North), Estrela Mountain (Centre), High Alentejo, North Region of Lisbon, Lisbon/Setúbal area, and at a smaller scale from Alentejo Coast Line and part of the Algarve. It is worth mentioning that in the case of *lots* we can see two huge peaks – Peneda/Gerês and Lisbon/Setúbal, corresponding to a high variety of species or sampling operations. On the other hand, in the analysis of *specimens*, the Peneda/Gerês (North) shows a far greater peak than the others, corresponding to a great number of specimens in the Museum collection. When reporting to the collection at the time of the last revision (CRESPO, 1972; 1975), we can see that the overall pattern is, basically, the same as before. The collection was even smaller

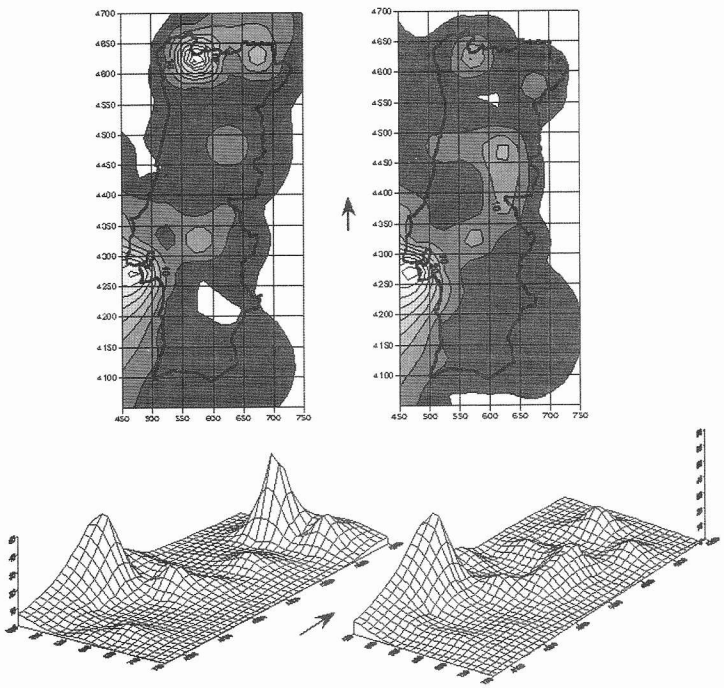

Figure 2. Abundance of the lacertids in the collection of Museu Bocage by *lots*. Top: Counter curves with superimposed Portugal map – lighter colour means more abundance. Bottom: surface maps. Left: Present collection. Right: Before the fire. Arrows head to North

although with a more balanced representation of the areas sampled.

Although the distribution and abundance of lacertids is not consistent across the country, we know by experience that lacertids exist all over Portugal. Therefore, the number and the distributions of the samples presented in Figures 1 and 2 should not correspond to the real distribution pattern (as we already suspected) and are therefore artificial. In their majority, the samples were collected by scientists of the Lisbon Faculty of Sciences during their field works. Consequently, the cells for which there are more lots/specimens are the ones that involved more fieldwork.

In order to complement the collection, the future sampling effort (in order to be optimised and rational) must take into account the information provided by the global analysis on the samples of the existing lacertids. This global analysis, as we have well seen, characterises the effort already made. Information on the different behaviour, use of space and time, etc., of each species must be considered. Also, working in co-ordination with natural reserves, and rapidly detecting other

institutions with complementing collections will be important.

We must also consider the legitimate ethics and conservationist concerns. Notwithstanding, there is room for improvement. No animal is nowadays killed to increase the collection. Nowadays' standards include gathering of additional information (animal works, photos, etc). These may even be, legitimately, a replacement of the animal itself in future Collections. The loss of biodiversity has ethical and aesthetic implications besides economic and social costs. The improvements made in trying to understand the processes of creation and maintenance of surrounding environment enabled us to be more aware of the need to preserve wholesale biodiversity. Besides, it gives us the necessary basic tools to make our decisions sound. Although conservation policies are multidimensional, the scientific knowledge is the basic principle for our policies.

One of the more broadly shared values for studying and conserving wholesale biodiversity may be the scientific study of Natural History Museums-based collections. Hence, those institutions have the duty to keep their collections well cared for, housed and accessible to the scientific community.

REFERENCES

ANTUNES, P.; VICENTE, L. & CRESPO, E. G. (2003): Portuguese Lacertids in the Collections of the Museu Bocage. *Arq. Mus. Boc. Nova Serie*, Vol. III, 18: 441-502.

CRESPO, E. G. (1972): Répteis de Portugal Continental das colecções do Museu Bocage. *Arq. Mus. Boc.*, 2ª sér. 3 (17): 447-612.

— (1975): Aditamento aos catálogos dos répteis e anfíbios de Portugal Continental das colecções do Museu Bocage. *Arq. Mus. Boc.*, 2ª sér. 5 (3): 479-497.

ISAAKS, E. H. & SRIVASTAVA, R. M. (1989): An Introduction to Applied Geostatistics. Oxford University Press, New York, 561 pp.

SÁ-SOUSA, P. (1995): The introduced Madeiran lizard, *Lacerta* (*Teira*) *dugesii* in Lisbon. *Amphibia-Reptilia* 16: 211-214.