METHODS ARTICLE

HaviStat© v2.2: Application to estimate preference for habitat and resources

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Abstract

HaviStat© v2.2 is available in Spanish and English. In this version reported errors and recommendations from v1.0 were fixed and implemented. HaviStat© allows users to perform the necessary mathematical, statistical and graphical procedures required to preliminarily infer use, selection, and preference for habitat/resources, and to estimate the niche breadth of species. In this new version radial diagrams, 22 indexes and 3 confidence intervals for animal preference evaluation, and 8 indexes for niche breadth estimation are available.

Keywords: habitat; preference; HaviStat©; indexes; confidence intervals.

Introduction

Selection and preference for habitat/resources are topics of great importance in natural resource management and evolution. Patterns of habitat selection form an important base to study evolutionary processes as individuals able to select and use necessary resources will be also likely to have the highest fitness in between populations (Nielsen et al. 2013). The study of this topic also allows inference of ecological requirements, conditions and resources necessary for species' survival, development and reproduction, and helps to explain their abundance, distribution (Manly et al. 2002, Davis & Stamps 2004), and how evolutionary strategies persist through time (Davis & Stamps 2004). When habitat preference is analyzed by partitions of space (i.e. same habitat in different locations or sizes) and/or time (i.e. hours of the day, how many times

per day, week) it is possible to find evidence to explain how species of the same guild or genus coexist and occupy niches that overlap in terms of resources and conditions (Vidus-Rosin et al. 2011).

Despite its importance the study of habitat preference is still controversial and difficult, primarily due to the dispersion of information in literature, and the large variety of mathematical and statistical methods developed. HaviStat© was created to address this issue (Montenegro & Acosta 2008) and is currently used by researchers from 40 different universities in 13 countries (e.g. Argentina, Spain, Ukraine, Brazil and México) as well as by undergraduate and graduate students. HaviStat© aims to be a comprehensive compilation of simple mathematical models to evaluate animal selection/preference, rather than a program to incorporate the latest trends for the evaluation of animal behavior (i.e. mechanistic modeling), as many of these methods are currently considered computationally intensive, difficult and impractical for large datasets and which require considerable expertise to implement and interpret (Beyer et al. 2010). HaviStat© compiles existing indexes and confidence intervals for evaluation of habitat preference and selection (for detailed information please see the reference section inside the program) in a practical way, but does not include probabilistic approaches such as those developed by Manly et al. (2002), Keating & Cherry (2004), Cañadas et al. (2005), Aarts et al. (2008), Fukuda & Hiramatsu (2008) and Lele (2009); or more complex models aiming to integrate animal movements and habitat preferences simultaneously as those presented by Rhodes et al. (2005), Christ (2008), Horne et al. (2008) and Fieberg (2010). However, HaviStat© allows scientists to efficiently screen large sets of data for any emerging biological pattern and to create bases for more extensive research or sophisticated modeling techniques.

Methodology

This application is the result of a wide literature review, where we have selected and organized the most important information on this topic. By using the reference section of the program, researchers will be able to understand and properly use the different indexes and confidence intervals implemented in this version, and get a solid understanding of the theoretical bases and experimental design to study this topic. The application is written in Visual Basic as macros designed to be compatible with Microsoft Office Excel© 1997 or later, and works best over Microsoft Office Excel© 2010 (OS Windows©). The interface consists of seven sheets; Data, Breadth Indices, Preference Indices, Saved Indices, Graphics, References and Manuals. The page "Data" is the principal interface of the application, where all the mathematical and graphical analyses can be executed (**Figure 1**). For details of how to use each of the pages and their options please refer to the User's Manual inside the program. To execute the application it is necessary to allow the use of Macros inside the "HaviStat© v2.2" workbook by *clicking* "Enabling Contents" when the file is open. Additionally a PDF reader (e.g. Adobe) is required in order to access the references and manuals. The versions 1.0 and 2.2 of this software are available for free download (see Suppl. 1 for instructions) on the webpage <http://miseryukyu.com/MISE%40University_of_the_Ryukyus/Data_sets.html> or by request to the e-mail address <havistat@gmail.com>.
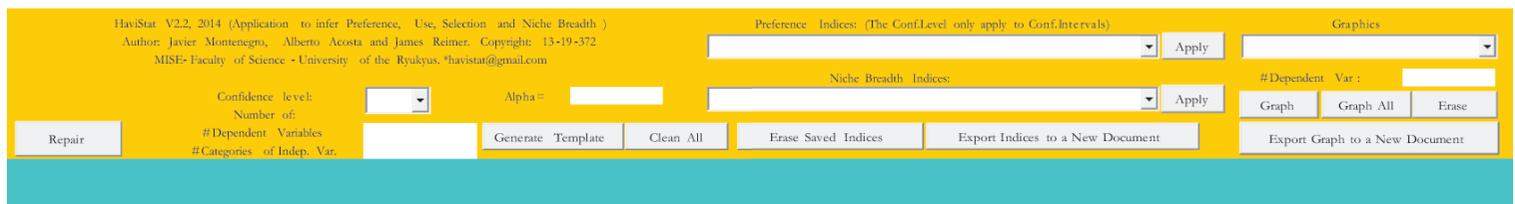

Fig. 1. "Data" sheet of HaviStat© v2.2, the principal page of the application.

Results and Discussion

HaviStat v2.2 interface and manuals are available in English and Spanish and new ways to estimate niche breadth and habitat/resources preference were implemented. Additionally, as requested by users of HaviStat© v1.0, in this new version confidence intervals show the expected use instead of the expected probability of use in the results matrix, and the explanations of the index and confidence intervals have been clarified. The graph sections can also be fully exported along with the data to new documents outside of the HaviStat© v2.2 workbook. The audio-visual manuals were eliminated in the second version, but a new and more concise manual with a remodeled and updated reference section is presented. The reference section includes direct links to the original information, and equations of each index are included in the application; and a new way to present data using radial graphs was also implemented.

The improvements in HaviStat v2.2 were performed with the aim to increase functionality. For example, the fact that the expected ratio of use is now shown in the output of the confidence intervals provides a better understanding of the colors code employed in the outputs for users. In this version all analyses can be fully exported outside the application, allowing users to process different datasets without altering results of previous analyses. Having radial diagrams as a graphical option allows users to compare and contrast for each habitat/resource, observed use and potential availability simultaneously for several species. Additionally, the implementation of this type of graphical analysis makes it possible to use HaviStat© to identify species potentially undergoing competition via exploitation or competitive coexistence processes by showing evidence on the tendencies of habitat selection/preference and niche differentiation between closely related or competing species (**Figure 2**).

HaviStat is particularly useful for scanning large datasets (test-proven with a matrix of 100 x 100, and theoretically as many cells and columns as Microsoft Excel© allows) to look for patterns of preference and selection. From this point researchers could incorporate more sophisticated analyses with software such as "R" (environment for statistical computing and graphics <http://www.r-project.org/>) or the package "adehabitat" (Calenge, 2006; <http://cran.univ-lyon1.fr/web/packages/adehabitat/>), which includes a basic Geographic Information System manager, and apply different methods for analyses of wildlife radio-tracking data.
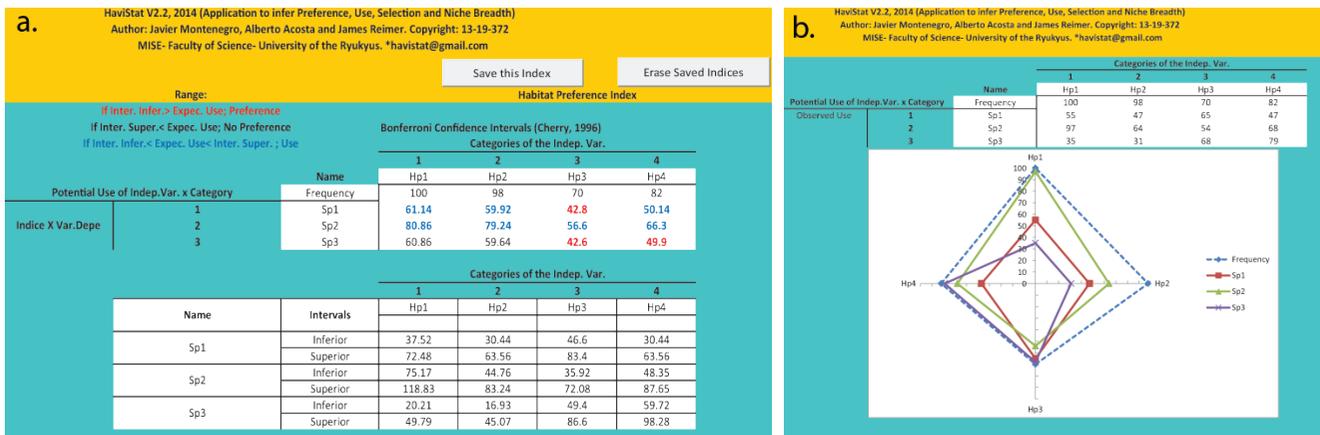
Fig. 2. Some of the new implementations for HaviStat© v2.2. a) Boferroni confidence intervals showing results interpretation in colors and the inferior and superior boundaries of the interval; b) Radial diagram simultaneously showing how different species use four categories of habitat.

Conclusion

HaviStat© v2.2 is freeware designed to perform basic analyses of niche breadth, habitat preference and use. The application includes 25 ways to evaluate animal preference, 22 indices and 3 confidence intervals, and 8 indices to evaluate niche breadth. This application compiles most of the indices in the literature, and it is also clear, specific, practical, and designed with a user-friendly interface. Furthermore, the software does not require installation, and includes literature and manuals to properly guide the user through the application. HaviStat© represent a valuable tool for education and basic research of habitat selection/preferences rather than a platform for in-depth modeling of animal behavior. The advantages of this application over similar software are that it is free, does not require any programing skills, is implemented within a familiar environment (Microsoft Excel), was designed to be highly intuitive, and gives easy access to reference information.

Acknowledgements

Conflict of Interest

The authors declare that they have conflicts of interest, and for this reason the entire review process and approval of the paper was handled and edited by Luz Teresa Valderrama (co-editor).

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HaviStat© v2.2: Aplicación para estimar la preferencia por hábitat y recursos

Resumen. HaviStat© v2.2 está disponible en español e Inglés. En esta versión los errores y recomendaciones reportados para la versión v1.0 fueron corregidos e implementados. HaviStat© permite a los usuarios realizar los procedimientos matemáticos, estadísticos y gráficos para inferir de forma preliminar uso, selección and preferencia por hábitat/recursos, y estimar la amplitud de nicho de las especies. En esta nueva versión se incluyen diagramas radiales, 22 índices and 3 intervalos de confianza para evaluar preferencia animal, y 8 índices para estimar amplitud de nicho también están disponibles.

Palabras clave: hábitat; preferencia; HaviStat©; índices; intervalos de confianza.

HaviStat © v2.2: Aplicativo para estimar a preferência em habitats e recursos

Resumo. HaviStat© v2.2 está disponível em espanhol e inglês. Nesta versão os erros e as recomendações referenciados na versão v1.0 foram corrigidos e implementados. HaviStat© permite aos usuários realizar os procedimentos matemáticos, estatísticos e gráficos para inferir de forma preliminar o uso, seleção e preferência por hábitat/recursos e estimar a amplitude do nicho das espécies. Nesta nova versão, estão disponíveis, diagramas radiais, 22 índices e 3 intervalos de confiança para avaliar a preferência animal, e 8 índices para estimar a amplitude do nicho.

Palavras-chave: habitat; preferência; HaviStat©, índices; intervalos de confiança.