BIOTA AMAZÔNIA 10 ANOS

Crossref Similarity Check
Powered by iThenticate

SCIENTIFIC NOTE

DOI: http://dx.doi.org/10.18561/2179-5746/biotaamazonia.v10n3p67-68

# Testing a recent ecological index to evaluate population ecology balance

*Mario Arthur Favretto*

*1. Universidade Federal de Santa Catarina, Campus Universitário, Bairro Trindade -Florianópolis - Santa Catarina, Brasil.*
*marioarthur.favretto@hotmail.com* *http://lattes.cnpq.br/4426273604550352* *http://orcid.org/0000-0001-8582-7493*

ABSTRACT

As anthropogenic effects on natural environments increase, it becomes increasingly necessary to verify the ecological balance of biological populations to propose conservation actions. This communication presents an recently described ecological balance index based on the Bornschein-Reinert ecological balance point concept. This index can be used for comparisons between populations of different areas or over time, with the advantage of being flexible, allowing the use of different ecological variables. This index had only been tested in hypothetical situations, therefore in the present study I have tested it for the first time with real data.

**Keywords**: environmental assessment; ecological index; anthropogenic effects; population ecology.

## Enzyme-producing fungi associated to aquatic macrophytes of the Negro river, Manaus

RESUMO

Com o aumento dos impactos antrópicos sobre o meio ambiente, torna-se cada vez mais necessário verificar o equilíbrio ecológico das populações biológicas como forma de propor ações de conservação ambiental. Esta nota apresenta um índice de equilíbrio ecológico recentemente descrito baseado no conceito de ponto de equilíbrio ecológico de Bornschein-Reinert. Esse índice pode ser usado para comparações entre populações de diferentes áreas ou de uma população ao longo do tempo, com a vantagem de ser um índice flexível, permitindo o uso de diferentes variáveis ecológicas. Esse índice havia sido testado apenas em situações hipotéticas; no presente estudo eu faço o seu primeiro teste usando dados reais.

**Palavras-chave**: avaliação ambiental, índice ecológico, efeitos antrópicos, ecologia populacional.

Evaluating the responses of different biological populations to constant human effects on the environment has gained increasing relevance. These effects are diverse, ranging from anthropogenic noise to fragmentation and loss of habitat (WINFREE et al., 2009; FAHRIG; RYTWINSKI, 2009; SHANNON et al., 2016). However, it is not always possible to simultaneously compare the effects of biotic and abiotic factors in a certain environment on biological populations.

At the level of biological communities, numerous factors are currently being investigated in environmental research, such as the indices of diversity, equitability, and dominance, used mainly in environmental impact assessment. However, the use of indices seems to be rarer at the population level. Even so, the use of these tools is of great relevance for ecological analyses, such as the various indexes proposed by Merrit et al. (2014) for studies with aquatic macroinvertebrates, which adequately reflect the reality observed in the field (FAVRETTO et al., 2018).

The Ecological Balance Index (EB) was created from the concept of the ecological balance point of Bornschein-Reinert (FAVRETTO, 2018). This ecological balance consists of the very low survival threshold of species in very dynamic and almost extreme environments, where selective pressures are intense and the behaviors and areas used by biological populations are highly restricted (FAVRETTO, 2018). Thus, faced with a wide possibility of areas that could be used by a species, a population is only successful in places with very specific characteristics.

This ecological concept emerged as a reinterpretation of several studies on birds in subtropical salt marshes in the coast of Paraná, southern Brazil, conducted over many years by Marcos R. Bornschein and Bianca L. Reinert, researchers for whom the name of the concept honors (FAVRETTO, 2018). These marshes — which are a newly recognized ecosystem (BORNSCHEIN et al., 2017) — are perfect for studying dynamic and highly restricted environments for fauna. Because, although there are large areas of marshes on the coast of Paraná, several species of birds — such as *Formicivora acutirostris*, *Tachuris rubrigastra*, and *Phleocryptes melanops* — use only very specific locations for survival and reproduction, with very specific phytophysiognomic characteristics, and these restrictions result in numerous reproductive losses for these species (BORNSCHEIN et al., 1995; BORNSCHEIN, 2001; REINERT et al., 2007; REINERT, 2008; CORRÊA, 2011; BORNSCHEIN, 2013).

This paper presents the ecological balance index (EB) proposed by Favretto (2018) as a dynamic index that allows the inclusion of as many variables as the researcher wants to analyze. This index consists of the sum of the natural logarithm of the numerical value of the variables used by the biological population, divided by the natural logarithm of the total value of these variables available in the sample environment for the population under analysis, multiplied by 0.1 (FAVRETTO, 2018):

$$EB = \sum \frac{\ln x_n}{\ln y_n}\, 0.1$$

$$EB = \sum \frac{\ln x_a}{\ln y_A} + \frac{\ln x_b}{\ln y_B} + \frac{\ln x_c}{\ln y_C} \ldots\, 0.1$$

It is possible to demonstrate this index using the data from Reinert (2006) on *Agelaius phoeniceus* (Aves: Icteridae) (Table 1). In this case, the present comparison will not be interpopulative, but interannual. The data available for use were abundance of males and females, quantity of active nests, and quantity of successful nests, variables reflecting the population dynamics of the species (Table 1).

**Table 1.** Data from the population of *Agelaius phoeniceus* in Rhode Island from 1982 to 1985, source Reinert (2006).

| Variable | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|
| **N males** | 14 | 11 | 9 | 9 |
| **N females** | 16 | 13 | 13 | 14 |
| **N total (males/females)** | 30 | 24 | 22 | 23 |
| **N active nests** | 32 | 32 | 22 | 28 |
| **N successful nests** | 7 | 6 | 12 | 7 |

In this case, the index is applied for each year, but the same could be done for different sample areas or populations. Thus, by adapting it to the variables used, we have the following:

$$EB = \sum \frac{\ln N\ males}{\ln N\ total} + \frac{\ln N\ females}{\ln N\ total} + \frac{\ln N\ sucessful\ nests}{\ln N\ active\ nests}\ 0.1$$

The results obtained for each year are as follows: 1982, EB = 0.2153; 1983, EB = 0.2079; 1984, EB = 0.2345; 1985, EB = 0.2126. Thus, the index has the advantage of integrating different variables for a global comparison of the status of the biological population over time. If we looked only at the population data, we would say that the best population status was in 1982, with a total of 30 individuals, and 1984 the worst, with 22 individuals; if we only observed the nests proportional to the total number of successful nests, then 1984 would have been the best year.

However, the index allows for these data to be integrated in the same equation by balancing the different variables for the analysis. Therefore, with the results obtained, it is possible to argue that the best year for the analyzed species was 1984 and the worse years were 1983 and 1985. These are the years in which, according to the results obtained, the *A. phoeniceus* population was excluded from a trend toward ecological balance.

There is an entire series of variables that allow a population to remain balanced or not in this type of intense ecosystem, such as available area and area used by the population, area affected or not by tides, greater or lesser amounts of food, density of vegetation, quantity of nests built by birds, and quantity of successful nests; all of these factors can be included in the index (BORNSCHEIN et al. 1995; BORNSCHEIN, 2001; REINERT et al., 2007; REINERT, 2008; CORRÊA, 2011; BORNSCHEIN, 2013). The ecological balance index emerges then as a way to compare all these variables in an integrated way and infer which populations are in greater or lesser ecological balance (FAVRETTO, 2018).

The index tested here and the concept of ecological balance point are still recent (FAVRETTO, 2018). They certainly can be improved, modified, or adapted. After all, the index itself is changeable and can accept many variables for ecological comparisons, but it is necessary to use the same variables for the comparisons between the samples. The index proves to be useful based on the hypothetical comparisons made by Favretto (2018) and using the field data from Reinert (2006). Its use is expected to contribute not only to ecological studies per se but also to conservation and environmental assessment in different ecosystems.

**Acknowledgments**

I would like to thank Editage (www.editage.com) for English language editing.

## References

BORNSCHEIN, M. R.; REINERT, L. B.; MACHADO-DE-SOUZA, T.; GOLEC, C.; WHITNEY, B. M.; FAVRETTO, M.A. Abundance, occurrence, and seasonality of the Subtropical Doradito (*Pseudocolopteryx acutipennis*) on the coast of Brazil. **The Wilson Journal of Ornithology**, v. 129, n. 1, p. 199-206, 2017.

BORNSCHEIN, M. R.; REINERT, B. L.; TEIXEIRA, D. M. Um novo Formicariidae no sul do Brasil (Aves, Passeriformes). **Série Publicação Técnico-Científica Instituto Nova Iguaçu de Pesquisa e Preservação Ambiental**, n. 1, p. 1-18, 1995.

BORNSCHEIN, M. R. **Biologia da conservação do bicudinho-do-brejo *Stymphalornis acutirostris* (Aves, Thamnophilidae)**. 2013. 238 f. Tese (Doutorado). Universidade Federal do Paraná/UFPR, Curitiba, 2013.

BORNSCHEIN, M. R. **Formações pioneiras no litoral centro-sul do Paraná: identificação, quantificação de áreas e caracterização ornitofaunística**. 2001. 226 f. Dissertação (Mestrado). Universidade Federal do Paraná/UFPR, Curitiba, 2001.

CORRÊA, L. **Influência da cobertura vegetal no tamanho de territórios de *Stymphalornis acutirostris* e análise da seleção de sítios de nidificação após insucesso reprodutivo**. 2011. 85 f. Dissertação (Mestrado). Universidade Federal do Paraná/UFPR, Curitiba, 2011.

FAHRIG, L.; RYTWINSKI, T. Effects of roads on animal abundance: an empirical review and synthesis. **Ecology and Society**, v. 14, n. 1, p. 21, 2009.

FAVRETTO, M. A.; ORLANDIN, E.; SANTOS, E. B.; ONGHERO-JUNIOR, O. Functional feeding groups and spatial variation of aquatic insects in a hydrographic basin of Southern Brazil. **Acta Biológica Catarinense**, v. 5, n. 3, p. 50-64, 2018.

FAVRETTO, M. A. On the Subtropical Salt Marshes of Brazil: discussions about a recently recognized ecosystem. In: BARNES, D.; ELLIS, C. (Ed.). **Salt Marshes: formation, ecological functions and threats**. New York: Nova Science Publishers, 2018. p. 49-72.

MERRITT, R. W.; CUMMINS, K. W.; CAMPBELL, E. Y. Uma abordagem funcional para a caracterização de riachos brasileiros. In: HAMADA, N.; NESSIMIAN, J. L.; QUERINO, R. B. (Ed.). **Insetos aquáticos na Amazônia brasileira: taxonomia, biologia e ecologia**. Manaus: Editora do INPA, 2014. p. 70-87.

REINERT, S. E. Avian nesting response to tidal-marsh flooding: literature review and a case for adaptation in the Red-Winged Blackbird. **Studies in Avian Biology**, v. 32, p. 77-95, 2006.

REINERT, B. L.; BORNSCHEIN, M. R.; FIRKOWSKI, C. Distribuição, tamanho populacional, hábitat e conservação do bicudinho-do-brejo *Stymphalornis acutirostris* Bornschein, Reinert e Teixeira, 1995 (Thamnophilidae). **Revista Brasileira de Ornitologia**, v. 15, n. 4, p. 493-519, 2007.

REINERT, B. L. **Ecologia e comportamento do bicudinho-do-brejo (Stymphalornis acutirostris Borschein, Reinert & Teixeira, 1995 – Aves, Thamnophilidae)**. 2008. 218 f. Tese (Doutorado). Universidade Estadual Paulista/UNESP, Rio Claro, 2008.

SHANNON, G.; MCKENNA, M. F.; ANGELONI, L. S.; CROOKS, K. R.; FRISTRUP, K. M.; BROWN, E.; WARNER, K. A.; NELSON, M. D.; WHITE, C.; BRIGGS, J.; MCFARLAND, S.; WITTEMEYER, G. A synthesis of two decades of research documenting the effects of noise on wildlife. **Biological Reviews**, v. 91, n. 4, p. 982-1005, 2016.

WINFREE, R.; AGUILAR, R.; VÁZQUEZ, D. P.; LEBUHN, G.; AIZEN, M. A. A meta-analysis of bees' responses to anthropogenic disturbance. **Ecology**, v. 90, n. 8, p. 2068-2076, 2009.