

Ecological Niche Theory: A Brief Review

Mina Khatibi^{1*}, Razieh Sheikholeslami²

ABSTRACT

In ecology, a niche is a term with a variety of meanings related to the behavior of a species living under specific environmental conditions. The ecological niche describes how an organism or population responds to the distribution of resources and competitors.

The ecological niche concept expresses the relationship of an individual or a population to all aspects of its environment. Studies on the relationship between human population and environmental resources have employed niche concept. Ecological niche comprehends all conditions necessary for an organism to exist.

Keywords: *Niche, Ecology, Environment, Organism*

What is ecological niche?

1. The position or function of an organism or a population within a biological and physical environment.
2. The area within a habitat occupied by an organism. The ecological niche is an organism position in the habitat (Online Psychology Dictionary, 2014).

The ecological niche concept, as proposed by Hutchinson (1957), expresses the relationship of an individual or a population to all aspects of its environment. Studies on the relationship between human population and environmental resources have employed niche concept (Adams, 2002; Hanazaki and Begossi, 2004; Cavallini and Nordi, 2005; Silva and Begossi, 2009).

According to Hardesty (1972), ecological niche comprehends all conditions necessary for an organism to exist. Considering the ecological niche, it can analyze each one of all interactions. For example, trophic or food niche (food relationship, such as species preferred and availability), spatial niche (climatic, chemical, and geographical factors, a species needs to survive), and behavior niche (way in which a species interacts with others, such as: foraging, activity period among others) (Raj, 2010).

¹ PhD Student, Department of Educational Psychology, Shiraz University, UAE Branch, Dubai, UAE

² Professor of Educational Psychology, Department of Educational Psychology, Shiraz University, Shiraz, Iran

*Responding Author

Ecological Niche Theory: A Brief Review

In ecology, a niche is a term with a variety of meanings related to the behavior of a species living under specific environmental conditions (Schoener, 2009). The ecological niche describes how an organism or population responds to the distribution of resources and competitors (for example, by growing when resources are abundant, and when predators, parasites, and pathogens are scarce) and how it in turn alters those same factors (for example, limiting access to resources by other organisms, acting as a food source for predators, and a consumer of prey).

Grinnellian niche

The ecological meaning of niche comes from the meaning of niche as a recess in a wall for a statue (Oxford English Dictionary, 2013), which itself is probably derived from the Middle French word *nicher*, meaning to nest (Lomolino, Riddle, Brown, 2009). The term was coined by the naturalist Joseph Grinnell in 1917, in his paper "The niche relationships of the California Thrasher" (Grinnell, 1917). The Grinnellian niche concept embodies the idea that the niche of a species is determined by the habitat in which it lives and its accompanying behavioral adaptations. In other words, the niche is the sum of the habitat requirements and behaviors that allow a species to persist and produce offspring.

Eltonian niche

In 1927 Charles Sutherland Elton, a British ecologist, defined a niche as follows: "The 'niche' of an animal means its place in the biotic environment, its relations to food and enemies" (Elton, 2001).

Hutchinsonian niche

The Hutchinsonian niche is an dimensional hyper, where the dimensions are environmental conditions and resources, that define the requirements of an individual or a species to practice "its" way of life, more particularly, for its population to persist (Schoener, 2009).

The niche concept was popularized by the zoologist G. Evelyn Hutchinson in 1957 (Hutchinson, 1957). Hutchinson wanted to know why there are so many types of organisms in any one habitat. Statistics were introduced into the Hutchinson niche by Robert MacArthur (1958) using the 'resource-utilization' niche employing histograms to describe the 'frequency of occurrence' as a function of a Hutchinson coordinate. Hutchinson's "niche" (a description of the ecological space occupied by a species) is subtly different from the "niche" as defined by Grinnell (an ecological role, that may or may not be actually filled by a species).

SUMMARY

1. The concept of the ecological niche relates a set of environmental variables to the fitness of species, while habitat suitability models (HSMs) relate environmental variables to the likelihood of occurrence of the species. In spite of this relationship, the concepts are weakly linked in the literature, and there is a strong need for better integration.

Ecological Niche Theory: A Brief Review

2. We selectively reviewed the literature for habitat suitability studies that directly addressed four common facets of niche theory: niche characteristics, niche interactions, community-wide processes and niche evolution.
3. We found that HSMs have mostly contributed to the study of niche characteristics, but the three other themes are gaining impetus. We discuss three issues that emerge from these studies:
 - (i) Commonly used environmental variables and their link with ecological niches;
 - (ii) The causes of false absences and false presences in species data, and associated issues; and
 - (iii) The three axes of model generalization (interpolation and extrapolation): environmental, spatial and temporal.

Finally, we propose a list of 12 recommendations to strengthen the use of HSMs for wildlife management.

4. Synthesis and applications. This selective review provides conservation biologists with a list of pointers to key niche-theory concepts and a wide palette of related HSM studies. It also brings together frameworks that are often separated: theoretical and applied ecology studies; botany, zoology and parasitology; and different HSM frameworks, such as Resource Selection Functions, Species Distribution Modeling, Ecological Niche Modeling, and Gradient Analysis. We hope that integration of all these slices of knowledge will improve the quality and reliability of HSM predictions (Hirzel and Lay, 2008).

CONCLUSION

Ecological psychology carefully examines the assumptions that sit behind research in perception-action. It has exposed fundamental problems with the subject-object dichotomy that is taken for granted by the received view. Affordance research is not just about how knowledge is acquired but about what there is to be known to begin with. It is thus applied research as much as it is theoretical. It is an active field, both in terms of theoretical development and in terms of the amount of empirical work that is being done (Dobromir, Dotov, Nie, de Wit, 2012).

What are some of the outstanding challenges that affordance research faces?

The concept was developed in the context of an ongoing dispute between the ecological and cognitivist traditions within psychology. Nowadays, however, the domains of perception and action are arguably dominated by the neurosciences. These retain the information processing metaphor of cognitivism (at least superficially) but are different enough to be considered a movement on its own.

Thus, there is a new and very powerful player on the scene and proponents of the ecological approach should determine their stance. It would be easy for a cognitive neuroscientist to appropriate the word affordance but misses its substance by simply talking about “action representations” stored in some cortical area (Dobromir, Dotov, Nie, de Wit, 2012).

Ecological Niche Theory: A Brief Review

Although more thoughtful attempts to develop an ecologically-motivated neuroscience do exist, it is yet to be seen if such attempts have any prospects. Further studies are required to critically evaluate the ethological niche theory in different populations.

REFERENCES

- Adams C, 2002. *Estratégias adaptativas de duas populações cablocas (Pará) ao ecossistemas de Várzea Estuarina e Estacional: uma análise comparativa*. Tese, São Paulo: Instituto de Biociências, Universidade de São Paulo.
- Cavallini M, Nordi N, 2005. Ecological niche of family farmers in southern Minas Gerais State (Brazil). *Braz Journal of Biology*, 65: 61- 66.
- Chase JM, Leibold MA, (2003). *Ecological Niches: Linking Classical and Contemporary Approaches*. University of Chicago Press. p. 7. ISBN 9780226101804.
- Dobromir G, Dotov DG, Nie L, de Wit MM, (2012). Understanding affordances: history and contemporary development of Gibson's central concept. *AVANT* Volume III, Number 2: 29-39.
- Elton CS, (2001). *Ecology*. University of Chicago Press. p. 64. ISBN 978-0226206394. Retrieved on May 14, 2014.
- Grinnell J, (1917). "The niche-relationships of the California Thrasher" (PDF). *The Auk* 34: 427–433. doi:10.2307/4072271.
- Hanazaki N, Begossi A, 2004. Dieta de populações de pescadores. In: *Ecologia de pescadores da Mata Atlântica e da Amazônia*. São Paulo: Hucitec, pp.149-166.
- Hardesty DL, 1972. The human ecological niche. *American Anthropologist*, 74: 458- 466.
- Hirzel AH, Lay GL, 2008. Habitat suitability modeling and niche theory: A review. *Journal of Applied Ecology* 2008,45: 1372–1381.
- Hutchinson GE, 1957. Concluding Remarks. *Cold Spring Harbor Symposia on Quantitative Biology*, 22:415- 422.
- Lomolino MV, Riddle BR, Brown JH, (2009). "The geographic range as a reflection of the niche". *Biogeography* (3rd ed.). Sunderland, Mass: Sinauer Associates. p. 73. ISBN 978-0878934867.
- MacArthur RH, (1958). "Population ecology of some warblers of northeastern coniferous forests". *Ecology*, 39 (4): 599– 619.
- Oxford English Dictionary. Retrieved on 8 June 2013.
- Psychology Dictionary: *What is ecological niche? Definition of ecological niche (Psychology Dictionary)* <http://psychologydictionary.org/ecological-niche/>. Retrieved on August 2, 2014.
- Raj K, 2010. Ecological niche theory. *J Hum Ecol*, 32(3): 175-182.
- Schoener TW, (2009). "Ecological niche". In: Levin SA, Carpenter SR, Godfray HC, et al., eds. *The Princeton Guide to Ecology*. Princeton University Press. pp. 3 ff. ISBN 9781400833023.
- Silva AL, Begossi A, 2009. Biodiversity, food consumption, and ecological niche dimension: a study case of the riverine populations from the Rio Negro, Amazonia, Brazil. *Environ Dev Sustain*, 11: 489-507.