

Ecological drivers of species radiations in the genus *Limia* (Teleostei: Poeciliidae) in the West Indies

community ecology # biodiversity



Limia sp. © R. Rodriguez Silva

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COUNTRY
West Indies

STUDENT
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EDUCATION LEVEL
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Context

The archipelagoes of the West Indies in the Caribbean represent geographically composite regions that provide ideal settings to study the evolution of a very distinctive biota. The combination of complex geological events and tropical climatic conditions has driven radiation processes that are not homogeneous for all groups in the Caribbean. This project examined the case of livebearing fishes of the genus *Limia* (Teleostei: Poeciliidae). In particular, the potential role of some ecological drivers in explaining the lopsided distribution of *Limia* fishes in the Greater Antilles was analyzed.

Objectives

- Develop an extensive review about the West Indian biogeography that highlights divergent diversification patterns observed in terrestrial versus aquatic groups.
- Assess the variation of tolerance to extreme temperatures as well as the thermal breadth for multiple species of *Limia* occurring in the West Indies and that occupy different altitudinal distributions.
- Evaluate the diet and feeding specializations of *Limia* through a comparative analysis based on data of the gut content of eight species.
- Assess whether sexual selection or natural selection may explain the presence of color polymorphism in *Limia vittata*, an endemic species to Cuba.

Methods

Literature search

In order to provide an objective scientific compilation that meets the goals of the review and also guarantees the reproducibility of the results, a literature search was conducted on the Web of Knowledge (Web of Science Core Collection database). A total of 890 article records were collected, published between 1900 and 2020 using the following key word combinations for the search: "West Indies biogeography" (238 records), "Caribbean biota" (153 records), "Caribbean islands colonization" (234 records), "adaptive radiations Caribbean" (128 records) and "Antilles biodiversity" (131 records). After each search using a specific key word combination, all available outcomes (publications) were assessed and scrutinized based on the topic of the study.

Variation of tolerance to extreme temperatures

The critical thermal method (Cowles & Bogert, 1944) was used to describe variation in temperature tolerance in adult fish of eight *Limia* species representing a total of 11 different populations. The climate index overlap across the study sites was also measured and the results of thermal niches were corrected to determine whether correlations in temperature tolerance among species were due to their shared evolutionary history or to other factors.

Diet analysis

The dietary data were obtained with the analysis of the stomach contents found in eight *Limia* species. Stomach contents were examined individually in the laboratory, and items were identified to the lowest possible taxonomic level using specific literature sources for algae and invertebrates. The proportions of each component of the diet were quantified according to the volumetric method established by Hynes (1950). Data on the volume of each particular food item was obtained through eye estimation in which the stomach contents were identified, separated and then squashed on a plate to a uniform depth (1 mm) and the area of the squash is measured. The feeding strategies of each species were determined according to the dietary composition.

*Sexual selection and natural selection in color polymorphism in *Limia vittata**

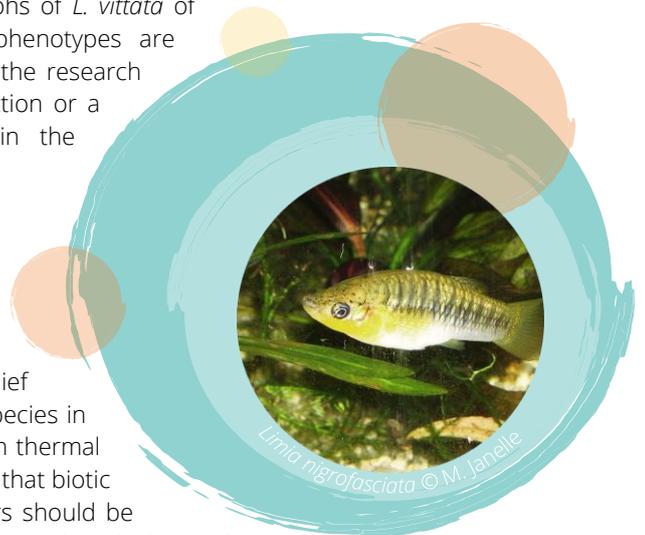
The role of sexual selection was investigated with two mate choice studies using traditional binary choice tests, looking at both female and male mate choice. For this, black spotted aquarium stocks were used because they have likely been selected by breeders to have more spots. In other words, if there are preferences to be detected, they can likely be found here. Furthermore, the role of habitat variation and natural selection in color polymorphism was investigated by comparing populations that live in environments with different salinity levels. To do this, information was collected about the frequency and geographic distribution of melanistic and non-melanistic morphs of *L. vittata* of natural populations in Cuba. The hypothesis that melanistic phenotypes are associated with habitats of different salinity was tested. Together, the research aimed at testing which mechanism (sexual selection, natural selection or a combination of both) may more likely contribute to maintain the polymorphism found in the Cuban *Limia*.

Results

Overall, the results show that species richness in the genus *Limia* is positively correlated with island size but also with the presence of elevations showing that not only island area but also mountainous relief may be important factors determining the number of freshwater species in the Greater Antilles. In addition, no association were found between thermal tolerance and the altitudinal distribution in *Limia* species, suggesting that biotic factors such as species interactions, diet specializations, and others should be taken into account when interpreting current distribution patterns. Even though the study showed that the majority of *Limia* species tend to be feeding generalists, some degree of diet specialization occurs in certain species from Hispaniola where the diversity of the genus *Limia* is remarkably higher compared to the rest of the Greater Antilles. Lastly, it was found that natural selection, determined by habitat variation in terms of salinity levels, is the most important factor in maintaining color polymorphism in *L. vittata*. Salinity levels could be indirectly responsible for maintaining different color morphs in this species, likely due to the regulatory effect of saline gradients on predation regimes.

About the research team

During his PhD, Rodet Rodriguez Silva was supervised by Dr. Ingo Schlupp from the University of Oklahoma. He also had the opportunity to collaborate with many other young Caribbean colleagues in his numerous field trips in the Dominican Republic (Patricia Torres-Pineda), Haiti (James Josaphat, Pierre Michard Beaujour and Wilson Celestine), Cuba (Manuel Iturriaga, Maikel Cañizares, Jans Morfe, Nayla García and Carlos Pedraza) and Jamaica (Kerri-Ann Bennett).





Publications

Rodriguez-Silva, R. & Schlupp, I. (2021). Influence of elevational gradients at local scale in populations of livebearing fishes of the genus *Limia* from the Greater Antilles. *Novitates Caribaea*. *Novitates Caribaea* 18: 46–62.

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