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Microhabitat Preferences and Disease Dynamics in Endemic Sympatric Slender Salamanders on Santa Cruz Island

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Abstract

Santa Cruz Island harbors two congeneric slender salamanders: the island-endemic *Batrachoseps pacificus*, and *Batrachoseps nigriventris*. Over two years, habitat transect and coverboard surveys were conducted, recording microhabitat characteristics, collecting morphometric data, and swabbing for the chytrid fungal pathogen *Batrachochytrium dendrobatidis* (*Bd*), a globally significant amphibian disease responsible for widespread declines and extinctions in amphibian populations worldwide. Results indicate spatial variation in population distribution and differences between species in body size and morphology. At syntopic sites, body size differed between the two species but not when comparing sites where only one species occurred. *Bd* was detected in over 25% of each species. Differences were detected in habitat use, with *B. nigriventris* being present more evenly across surveyed habitat types, and also across a broader range of microclimate. These findings suggest another explanation for disproportionate spatial distributions than microhabitat, and raise concerns about disease dynamics within this isolated island system, where even low prevalence pathogens like *Bd* could have disproportionate long-term impacts on endemic amphibian populations.

Introduction

Slender salamanders (genus *Batrachoseps*):
small, lungless salamanders

- Channel Islands Slender Salamander (*B. pacificus*): one of seven endemic vertebrates of Santa Cruz Island¹
 - Previously a single, wide-ranging species, now only describes Channel Islands endemic³
- Co-occurs with the Black-bellied Slender Salamander (*B. nigriventris*), a common species in coastal California.
- Sympatry in genus is uncommon: island is opportunity for study of coexistence
- Both species likely colonized the island via overwater dispersal (“rafting”) events²
- B. pacificus* is understudied, with limited information on population dynamics or habitat use
- Fungal infection from *Batrachochytrium dendrobatidis* (*Bd*) has resulted in amphibian extinctions worldwide
 - detected on preserved *Batrachoseps* from Santa Cruz Island as far back as 1973.⁷

Key inspiration for this study came from Dr. Samuel Sweet’s 1974 field expedition to Santa Cruz Island.

Research Focus and Objectives

- Examine microhabitat and macrohabitat preference between sympatric *Batrachoseps*.
- Quantify morphology differences between sympatric *Batrachoseps*.
- Assess presence and distribution of fungal pathogen *Batrachochytrium dendrobatidis* (*Bd*)



Methodology

Transect Surveys

- 60–100 m transects with 5 m search area on either side, selected with historical records
- Recorded salamander presence and environmental variables across habitat types

Coverboard Surveys

- Wooden coverboards deployed summer 2025 at 5 sites (4 boards per site)
- Sites selected to capture variation in habitat and species occurrence
- Boards checked during each field visit

Disease Sampling

- 2 swabs/individual; minimum one individual sampled per site per survey
- Samples analyzed by Briggs Lab at UC Santa Barbara

Morphology

- Dorsal and ventral images of each individual were taken in the field
- tpsDig2 was used to landmark animal features, which were read by R for analysis

Acknowledgements

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Results

Microhabitat Characteristics by Species

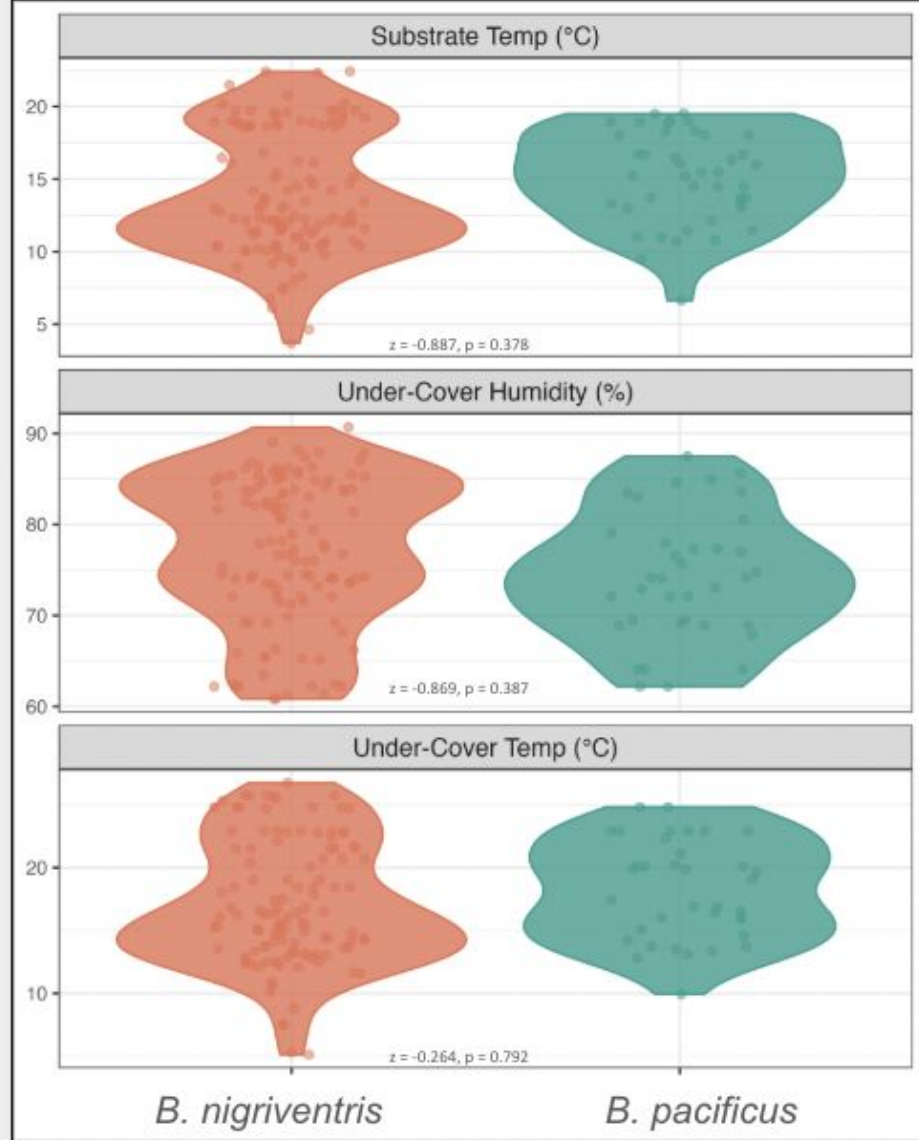


Figure 1. Microhabitat use by species under boards and natural cover. Species did not differ significantly in under-cover temperature, under-cover humidity, or substrate temperature (linear mixed models; all $p > 0.05$)

Macrohabitat Use by Species

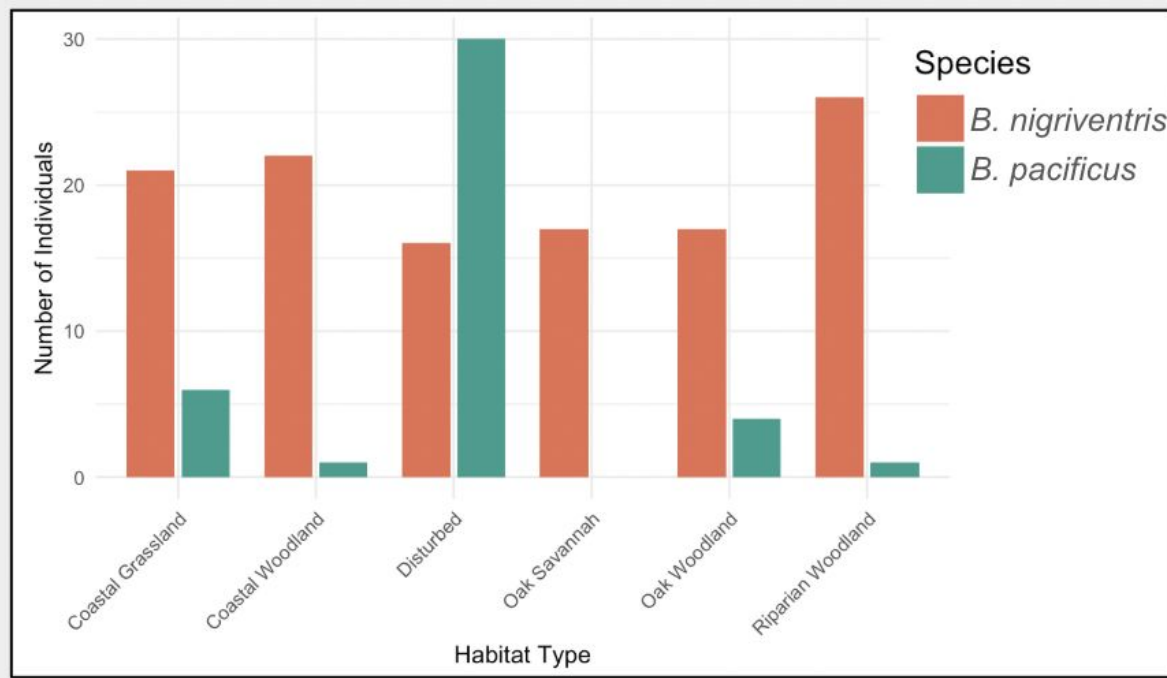


Figure 4. Bars indicate the number of *B. nigriventris* and *B. pacificus* observed across habitat types
A chi-squared tested determined that overall, both species showed non-random habitat associations, with consistent and statistically significant differences in occupancy across all habitat types examined (all $p < 0.05$).

Morphology

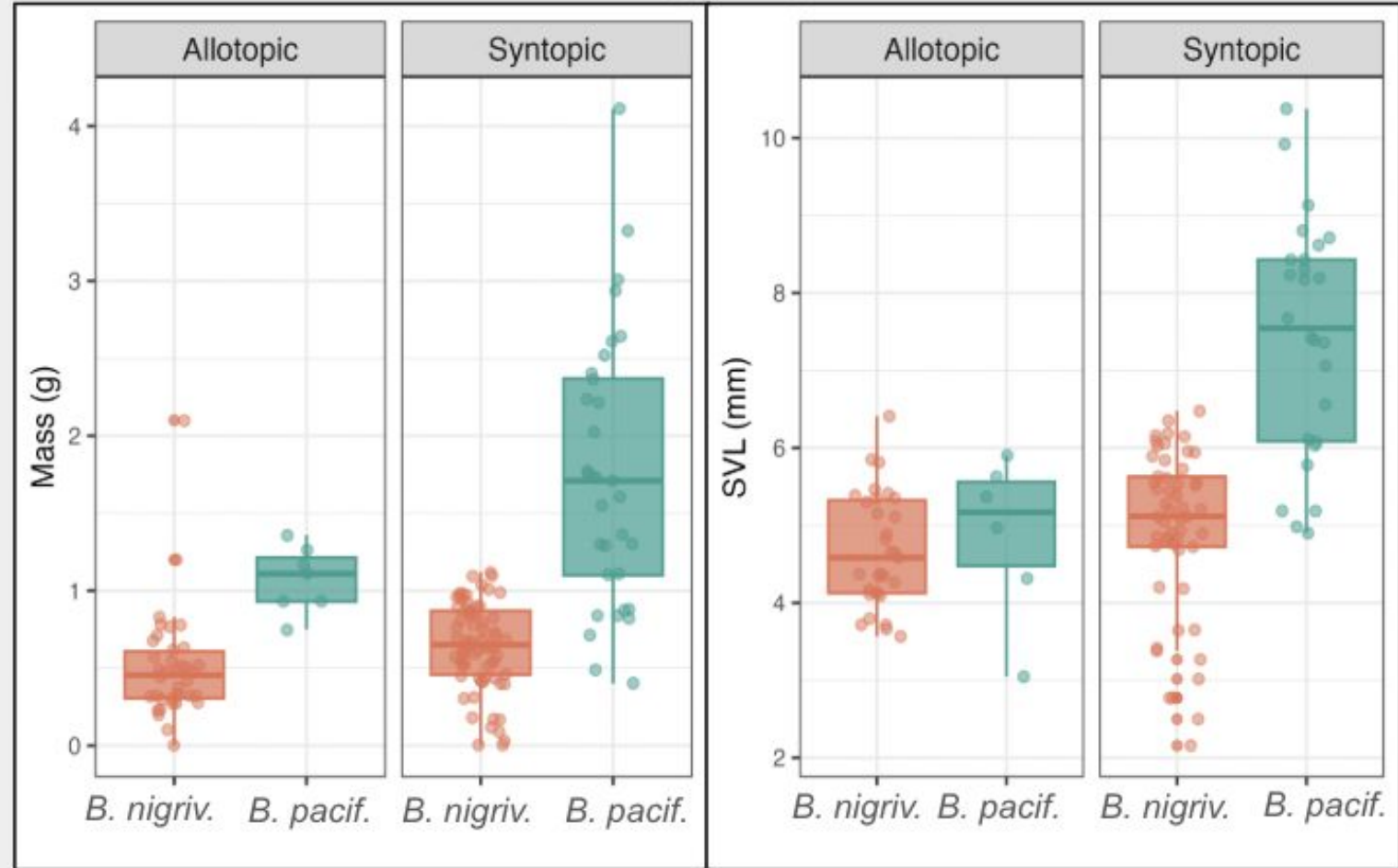


Figure 2a. Mass between species, allotopic and syntopic sites. Significant difference is observed between mass of different species, and of same species between sites (t-test, all $p < 0.05$).

Figure 2b. Snout-vent length between species, at allotopic and syntopic sites. Significant difference is observed between SVL of *B. pacificus* between allotopic and syntopic sites, and between species at syntopic sites (t-test, $p < 0.001$).

Batrachochytrium dendrobatidis (*Bd*) Presence by Species

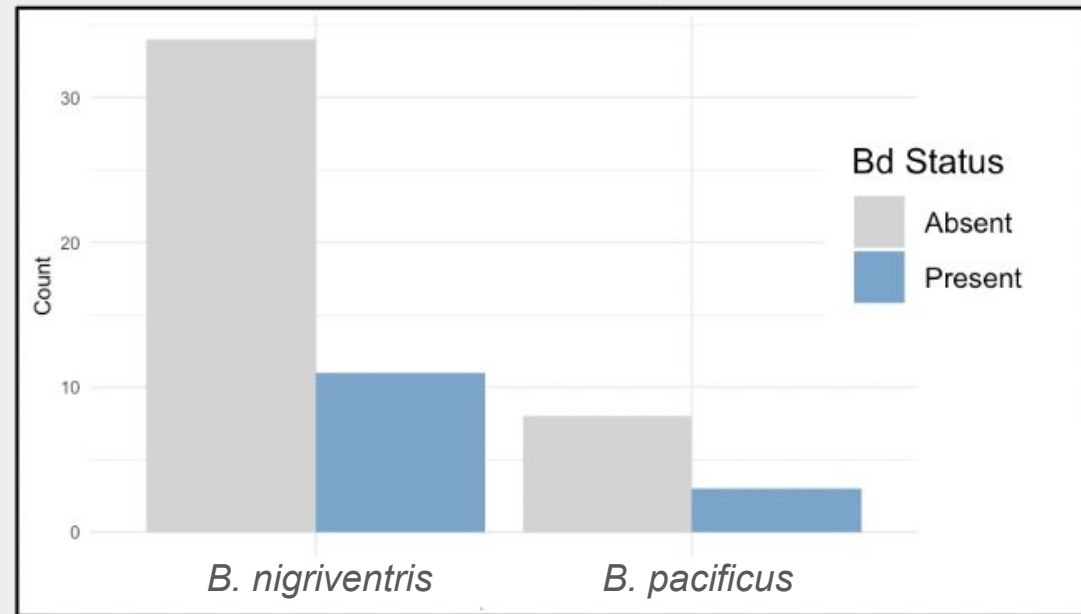


Figure 3. Comparison of *Bd* presence and absence between species, showing similar infection prevalence in *B. nigriventris* and *B. pacificus*.

Infection rate was 27% for *B. nigriventris* and 30% for *B. pacificus*, with an overall infection rate of 27%. Species did not predict *Bd* presence ($\chi^2 = 0$, $df = 1$, $p = 1$).

Discussion

Microhabitat Analysis

- No difference in microclimate preference was seen between the study species.
- B. nigriventris* occupies a broader microclimate niche for both temperature and moisture (Fig. 1). This is consistent with *B. nigriventris* as more generalist species, compared with *B. pacificus*.

Macrohabitat Analysis

- B. pacificus* was most abundant in human-disturbed habitats, while *B. nigriventris* was most abundant in riparian woodland. Chi-square results indicate that species distributions differed significantly across all habitat types
- B. nigriventris* appeared to be more evenly distributed across habitat types, suggesting broader habitat tolerance compared to *B. pacificus*, which exhibited stronger habitat specificity. These significant differences across all habitats ($p < 0.05$) support the conclusion that each species is associated with distinct habitat preferences (Fig. 4); consistent with *B. nigriventris* being generalist vs. *B. nigriventris*.

Morphology

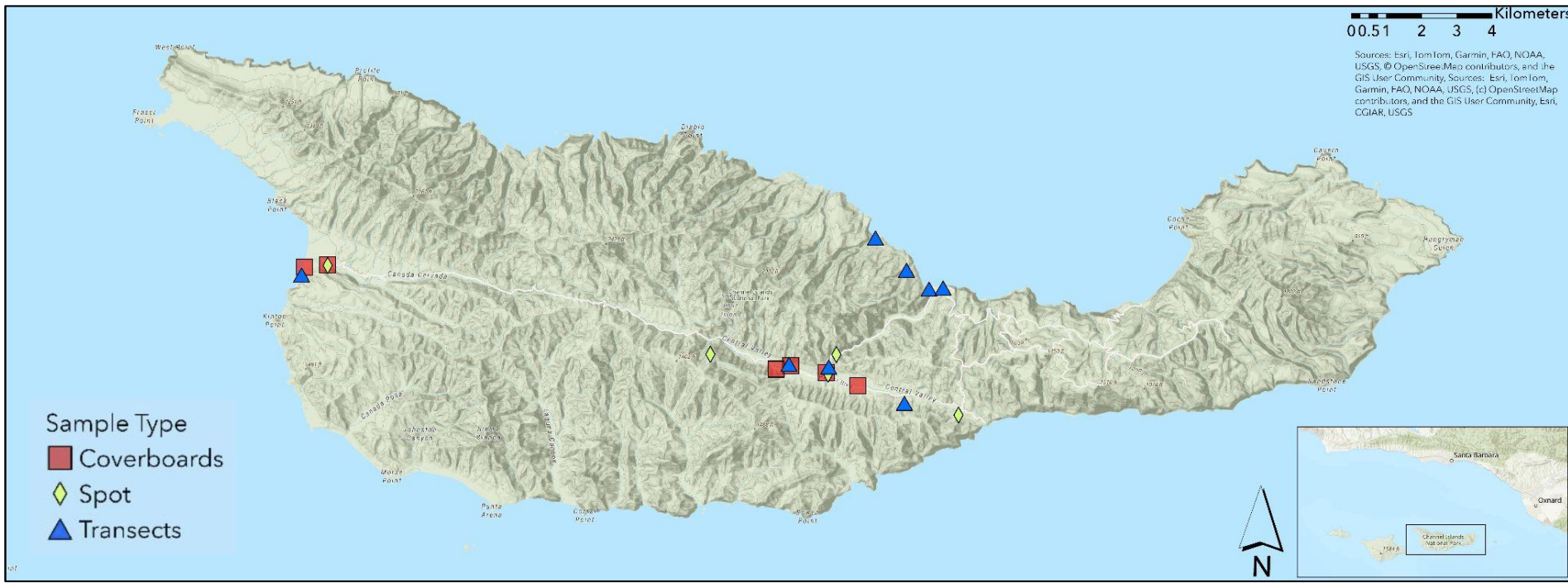
- Individuals of *B. pacificus* are significantly larger in snout-vent length and mass at sites where it co-occurs with *B. nigriventris* but not at allotopic sites (Fig. 2a, 2b).
- Size differences may have a role in species presence
- Microhabitat does not predict length or mass characteristics of salamanders but it is a hypothesized mechanism for population structure

Batrachochytrium dendrobatidis

- 14 of 51 individuals (~27%) tested positive for *Bd*; in previous study, only 17 out of 231 individuals (~7%) tested positive, suggesting higher overall prevalence compared to historical estimates
- Our data does not indicate a significant difference in susceptibility between species

Future Directions

- Implement continued, standardized seasonal monitoring for both study species
- Expand expanded sampling scheme to improve detection, consistency, and comparability across time and habitat type
- Inform management strategies based on ecological distribution and *Bd* prevalence



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