ECO-PHYSIOLOGICAL VARIATION IN NEOTROPICAL FIDDLER CRABS: SALINITY TOLERANCE AND OSMOREGULATION

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Fiddler crabs are key components of Neotropical intertidal ecosystems, exhibiting notable physiological flexibility to cope with environmental salinity. However, their tolerance ranges and osmoregulatory strategies vary according to oceanic region, phylogenetic lineage, and habitat salinity. We investigated both salinity tolerance and osmoregulatory ability in 37 species distributed along the Pacific and Atlantic coasts of the Americas, integrating experimental and literature data. Prior studies have suggested potential contrasts in osmoregulatory capacity between these biogeographic regions. Clades inhabiting the Atlantic coast tend to display greater osmoregulatory ability than those on the Pacific coast, likely reflecting distinct intertidal habitat preferences. Nineteen species from Ecuador, the Galapagos, and Mexico were tested, experimentally, under controlled conditions: groups of ~5 individuals per species were exposed to salinities ranging from 0 to 100 ‰S for 5 days. Literature data were retrieved for 18 species from the Caribbean and North/Central/South America. Salinity tolerance range was defined as the difference between the lowest and highest experimental salinities (LC50) at which 50% of individuals survived the exposure period, estimated by Probit analysis. Generalized least squares models, controlling for phylogenetic covariance (Rho = 0.02), revealed that Pacific species exhibited significantly narrower salinity tolerance ranges (p<0.001) compared to Atlantic species (mean difference ≈34 units; AIC = 411). Higher habitat salinity was associated with increased tolerance amplitude (p=0.03), whereas lineage effects were not significant. Osmoregulatory assessments indicated considerable physiological flexibility in several osmotic niches. Neotropical fiddler crab species exhibited characteristic hyper- and hypo-regulatory patterns, reflecting active salt uptake and secretion mechanisms. However, we have found a particular finding of the osmoregulatory pattern of species from the Pacific coast of Ecuador, inability to hypo-osmoregulate. Overall, biogeographic region influences salinity tolerance range of Neotropical fiddler crabs, with Pacific lineages occupying narrower osmotic niches. Osmoregulatoy patterns likely reflect evolutionary histories associated with habitat salinity variability and degrees of terrestrially, with Atlantic clades possible inhabiting more dynamic and osmotically variable habitats. Our findings advance the understanding of eco-physiological strategies in fiddler crabs, highlighting contrasts between Atlantic and Pacific species that may reflect distinct biogeographic and evolutionary patterns.

Keywords: Biogeographic distribution; Crustaceans; Salinity challenge.