

IH314: Nocturnal and diurnal emergence patterns in air-breathing mudskipper and rockskipper fishes in relation to resistance to evaporative water loss, Indonesia

At least five species of amphibious air breathing fishes are commonly found occupying rocky intertidal and/or mangal habitats on Hoga Island, southeast Sulawesi. Common and barred rockskippers (family Blenniidae) can be seen in tidepools during the day. Common and barred mudskippers are amphibious fishes that spend nearly all of their time on land regardless of tidal stage or time of day. In Hoga's mangal habitats the fishes are syntopic yet occupy well-defined zones in the mangal with very little overlap. Common mudskippers prefer open mudflats, often some distance from pools, and are exposed to dramatic daytime temperature increases, whereas barred mudskippers are typically found in shaded upper mangal regions within a meter or less of tidepools.

While the reasons behind the observed spatial partitioning are unclear, our previous work on these fishes has ruled out differences in diet, aerial and aquatic temperature tolerance, branchial-cutaneous oxygen uptake ratios, and hypoxia tolerance. Our current project looks at differences in water loss rate as well as tolerance to water loss as a possible explanation for the observed distribution patterns. In addition we will be investigating claims of other researchers that the barred mudskippers use evaporative cooling as a means to extend emergence times during low tide.

Specific questions addressed:

1. Do common and barred mudskippers show differing levels of water loss resistance?
2. What is the rate of water loss in each species?
3. At what desiccation level does each species lose the ability to right themselves when turned over?
4. How does wind speed effect evaporative water loss and body temperature in each species?
5. How might these factors singly or in combination dictate or reinforce habitat preference?

Methods:

Common and barred mudskippers (n=20 ea. spp.) will be collected during nighttime low tide from Hoga mangal areas and taken to the Hoga Island Research Center where they will be housed in 60-L habitats containing clean seawater over 3 cm of beach sand along with emergent palm fronds and driftwood.

Using standard gravimetric wind tunnel techniques cutaneous and total resistance will be determined for each species. Values will be statistically compared to their agar models to determine if resistance levels are significant. Student's t-tests will be employed to test for resistance differences between species.

In addition, body temperatures will be measured across a range of wind speeds to determine the extent to which these fishes may be able to take advantage of evaporative cooling while emerged. Rates of water loss during trials will be quantified by weighing fish at 10 minute intervals. After each weight determination fish will be rolled onto their dorsal surface to see if they retain the ability to right themselves. Once a fish has lost the righting response, the percentage of water loss relative to initial body mass will be calculated and the arithmetic mean of the collective points for each species taken as the water loss tolerance value for the species.

Students participating in this research project will need the following:

1. sturdy pair of dive booties
2. wetsuit
3. waterproof field notebook and pencils
4. Good waterproof dive torch
5. polarized sunglasses

All other necessary equipment and training will be provided by the field supervisor.

Reading List

Horn, M.H., Riegle, K.C., 1981. Evaporative water loss and intertidal vertical distribution in relation to body size and morphology of stichaeoid fishes from California. *J. Exp. Mar. Biol. Ecol.* 50, 273–288.

Wygoda, M.L., 1984. Low cutaneous evaporative water loss in arboreal frogs. *Physiol. Zool.* 57, 329–337.

Wygoda, M.L., 1988. Adaptive control of water loss resistance in an arboreal frog. *Herpetologica* 44, 251–257.

Young, J.E., Tracy, C.R., Christian, K.A., McArthur, L.J., 2006. Rates of cutaneous evaporative water loss of native Fijian frogs. *Copeia* 1, 83–88.