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Evolution in the News

News Article: <http://phys.org/news/2016-06-fish-common-thought.html>

# Works Cited

Cooke, T. J. (2016). (Fig. 4C), a trend that was generally comparable to the abundance. *International Journal of Organic Evolution*.

The study was conducted to create a phylogeny on the families of fish that live or can survive mostly on terrestrial habitats. There are 33 families in which fish display amphibious behavior. The researchers created their own phylogeny based on other scientific journals to compare with from their actual findings. They determined that there were four factors on why a fish would emerge from the water:

1. Fish in fringe habitats could explore other environments, i.e intertidal zones.
2. Fish can voluntarily strand themselves to avoid hypoxia, a very common cause for emergence.
3. Fish that live close to substrate are more likely to be better suited for an emergence compared to pelagic fish.
4. Fish that do not rely on mobile prey might be more readily able to transition to a terrestrial environment.

The study was focused on the family Blenniidae, which have a portion of genera exhibiting amphibious behavior. The study observed the behavior of several closely related lineages. They discovered that at low tide and at high temperatures, blennies retreat to moist rock holes above the water line. The tides, however, can limit their mobility so they reported that the fish was able to be in a terrestrial environment for brief periods usually during favorable terrestrial conditions.

“Once amphibious behavior was identified, we assigned a

broad classification of the level of terrestrial activity exhibited

by species: those reported to voluntarily strand themselves on

land as water bodies recede (e.g., ebbing tides or ponds evaporating)

were classified as “mildly amphibious, passively emerge,”

those that actively leave water for short periods (minutes; e.g., to

lunge at terrestrial prey or circumvent terrestrial obstacles) were

classified as “mildly amphibious, actively emerge,” those that

leave water and were active on land for extended periods (hours)

were classified as “amphibious,” while those that spent the vast

majority (or all) of their time out of the water and were highly

terrestrially active were classified as “highly amphibious.”

Under the Salarinii division of Blenniidae, the researchers surveyed 7 geographic locations, in Guam, Okinawa, Taiwan, Rarotonga, Tahiti, Mauritius and Seychelles. DNA from the mitochondrial and nuclear genome was collected from blenny specimens. The researchers constructed three different trees: Maximum Likelihood, Bayesian Inference, and Coalescence- based Species- Tree estimation. A custom written R function was used to count the number of independent evolution transitions from highly amphibious to mildly amphibious lifestyle. The mildly amphibious species that were focused on was the E. striatus and P. labrovittas, in Guam. The highly amphibious species surveyed were Alticus arnoldrum.

The results concluded that many tropical fish were observed to have mild amphibious behavior, but many other fish species in colder climates have been observed as well. It seemed as though climate was not a specific predictor of amphibious behavior. There was a significantly few cases of carnivorous amphibious genera than expected.

“The influence of tide and air temperature was equivocal for *E.*

*striatus* with the null, tide, and temperature models all receiving

comparable support (*\_*AICc \_ 2.0; Table 1A). The effect

sizes were largest for the influence of tide, which suggested peaks

in activity at mid-tide (Fig. 4B) similar to that of the highly terrestrial

species *A. arnoldorum* (Fig. 4A). However, the magnitude

of the effect of tide was not large (*t <* 2; Table 1) and

the null model was the best-supported model overall. Results

for *Praealticus labrovittas* were clearer with overwhelming support

for the influence of temperature on emergence behavior (Table

1B): activity out of water increased with temperature up to

approximately 28°C and then decreased at higher temperature

(Fig. 4C), a trend that was generally comparable to the abundance

of the highly terrestrial species *A. arnoldorum* at the same sites

(Fig. 4A).”

The field observations and phylogenetic trees inferred at least 3- 7 convergences on a highly terrestrial lifestyle. The data suggests that many aquatic fish might still exhibit a possibility for terrestrial activity under specific conditions. It is likely that being an amphibious fish is more common than previously recorded.

It’s also worth noting that there is an apparent cluster of amphibious behavior in the most ancient fish lineages: the lobefinned lungfish and several ancient ray- finned fishes. They are considered the closest living relatives to early tetrapods. The data shows that the crossing over to land interface is not evolutionary exceptional, but it is in the case of fish.

Blenny fish have overcome obstacles such as locomotion, respiration, and ability to reproduce in order to emerge. The researchers noticed that the families whose fish exhibit the typical benthic cylindrical body shape that could facilitate that locomotion. They speculate that the main drivers for this amphibious behavior is due to predation and competition, but it is difficult to test this hypothesis. Blennys face less predation out of water due to their cryptic camouflage.

“It has also been argued that freshwater habitats have been

important transitional environments for promoting shifts between

aquatic and terrestrial habitats because they represent low predation

and low competition environments (Vermeij and Dudley

2000). We found no evidence for this in our study.”

The amount of freshwater and salt water fish that exhibited this behavior was nearly the same. The only difference would be if a particular area had intertidal zones, which is an important environment associated with amphibious behavior in extant fish. Intertidal zones fluctuate widely in abiotic conditions. Increased water temperatures also reduce the amount of dissolved oxygen in the water and can lead to hypoxia. Experimental manipulations of increasing and decreasing water temperature has both show to induce emergence behavior in captive fish.