

Highlights:

- Modeling interactions among invasive species
- Modern shipping redefines major ecological theory
- Lionfish exterminate prey
- Scientists test Darwin's ideas
- Floridian survey on invasive species

In this Issue:

Focal Species: Clawed Frogs	1
Science: 'Over-invasion'	2
Science: Modern Island Biogeography	2
Noteworthy: Lionfish Terminators	2
Science: Evolutionary Imbalance Hypothesis	3
Science: Bullfrogs in Yellowstone	3
Noteworthy: KY Carp Processing Plant	3
Noteworthy: Florida PIE Survey Results	4
Resources	4

Focal Species: African Clawed Frogs

Scientific names:

Xenopus laevis

Size:

2–5 inches (snout-vent)

Native range:

Southern and Sub-Saharan Africa

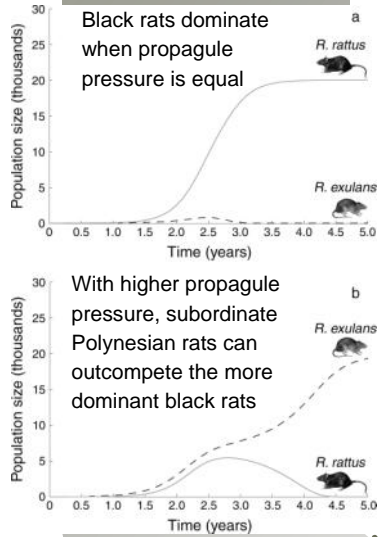


(Photo: Michael Linnenbach, Wikimedia)

African clawed frogs are somewhat flattened with smooth olive-brown skin that may have blotches or spots. These frogs have small heads, slender fingers on the forefeet, and extensive webbing and claws on the hindfeet. Both sexes vocalize and their call is a long, rapid, high-pitched trill. The unique pelvic structure of these frogs enables them to evade predators by diving backward rapidly and their skin contains toxins that may make them unpalatable to predators. African clawed frogs have long been popular as aquarium pets and as research subjects and have escaped captivity or been intentionally introduced in California, Arizona, Florida, and several other states in the U.S. as well as in Mexico, Chile, the U.K., France, and Israel. African clawed frogs are dependent on aquatic habitats but can aestivate during droughts and have been known to move overland by the thousands to find water. These frogs are able to survive in a wide range of aquatic habitats with a range of salinities (up to 40% seawater), pH levels (5-9), and temperatures (2 - 35+°C), but typically do not breed in flowing water and avoid large rivers. They thrive in temperate, Mediterranean climates such as California, are highly adaptable, and readily invade human-modified habitats. Invasive populations of these frogs compete with native species and prey on invertebrates, small fishes, and all life stages of native frogs but are capable of surviving for long periods without food. In addition to serving as hosts for a variety of parasites, these frogs carry the amphibian chytrid fungus without showing symptoms and are believed to be responsible for introductions of this disease in California. Because African clawed frogs can live for more than 12 years and are prolific breeders, capable of reaching sexual maturity in their first year, they can reach extremely high densities. At high densities, they can clog irrigation pipes and move overland to invade fish farms, where they eat both the fish and their food. Large infestations can increase water turbidity and their tadpoles can remove nearly all planktonic organisms in their vicinity. Management options are limited, although trapping can help to reduce clawed frog numbers and manage impacts. Preventive measures are in place in some areas such as Australia, where they are considered an extreme threat. [Learn More...](#)



Science: 'Over-invasion'



As the number of species introductions increases, invasive species often must interact with other invasive species. The nature of these interactions can vary greatly, ranging from predation or competition to the phenomenon known as 'invasional meltdown' that occurs when the presence of one invasive species increases the success of another. Researchers at the University of Auckland in New Zealand modeled the outcome of interactions among similar rat species under different scenarios based on population dynamics. They coined the term 'over-invasion' to describe the invasion of two species with a similar niche. Their results showed that when two species invade simultaneously, higher propagule pressure (i.e., number of individuals) can allow a normally subordinate species to outcompete a more dominant species. Similarly, when a population of a subordinate species is already well established, or 'incumbent,' that species may resist invasion by a more dominant species, particularly when the dominant species is controlled. These findings may have important implications for managing multiple invasive species to minimize impacts on natives. [Learn More...](#)

Science: Modern Island Biogeography

The Island Biogeography Theory describes the relationship between the size and geographic isolation of islands and the number of species found on an island. According to this theory, larger islands have more species, as do islands that are less geographically isolated. However, when a recent study published in *Nature* used data from introductions of Caribbean anole lizards to test this theory, they found that modern shipping practices have fundamentally altered these relationships. The relationship between island size and number of species has become stronger and more lizard species have successfully invaded larger islands with empty niches. However, modern shipping has virtually eliminated the relationship between geographic isolation and number of species. Instead, a relationship now exists between economic isolation and species richness, because economic isolation results in less shipping, fewer hitchhiking species, and fewer species introductions. [Learn More...](#)



Science: Lionfish Terminators

In the fastest finfish invasion in history, lionfish rapidly invaded the Atlantic and Gulf Coasts of North, Central, and South America and the Caribbean, devastating reef habitats with their highly predatory behavior. These voracious predators are found not only on shallow reef habitats but also in deeper waters, and they can survive a variety of conditions including brackish and low salinity waters. They prey heavily on native fishes, resulting in severe population declines. Typically, predator-prey interactions are density dependent. As the prey population decreases, predation decreases as the predators move on to better hunting grounds, adequate cover allows the surviving prey to avoid being eaten, and then prey population levels slowly recover. New research from Oregon State University suggests that invasive lionfish exhibit atypical predator behavior, and may hunt their prey to extinction. This terminator-like behavior may be due, in part, to the naiveté of native fishes that do not recognize invasive lionfish as predators. Protecting local populations by actively removing lionfish may be key to the survival of native species. [Learn More...](#)

Science: Evolutionary Imbalance Hypothesis

In 1859, Darwin wrote that because natural selection acts by competition, better tested species have "consequently been advanced ... to a higher stage of perfection or dominating power." Researchers at Brown and Syracuse Universities expanded on this idea to propose a new "Evolutionary Imbalance Hypothesis." According to this hypothesis, evolutionary imbalance between a "donor" and "recipient" region of a potentially invasive species can play an important role in predicting invasiveness. They used plant databases to compare phylogenetic diversity (PD) — unique lineages in a region — between between plant donor ranges and three recipient regions. They found that higher PD in the donor region resulted in significantly greater likelihood of success in the invaded recipient region. This hypothesis is also supported by historical data from marine species mixing when new pathways opened or were built between oceans. [Learn More...](#)



Iceplant from high-PD region invades lower-PD recipient region
(Photo: Jason Fridley)

Science: Bullfrogs in Yellowstone

Bullfrogs (*Lithobates catesbeianus*) are native to the eastern United States but have become a highly problematic invasive species in many other areas of the globe, including the western U.S. In 1999, bullfrogs were found in the Yellowstone River basin in Montana. They have since continued to expand their range there, although the impacts of this invasion are yet unknown. Because bullfrogs have been found mainly in ponds, impoundments, and other publicly accessible waters, scientists believe that they were likely introduced intentionally, perhaps as released pets or to establish a population for hunting. Researchers with the U.S. Geological Survey conducted surveys in 2010, 2012, and 2013 to determine the extent of the bullfrog invasion. Results of these surveys were published in the journal *Aquatic Invasions*. In 2010, bullfrogs were found in 37 miles of the basin, but by 2013 had expanded their range to 66 miles and the number of breeding sites had nearly quadrupled. These results illustrate how rapidly invasive bullfrogs can spread if allowed to do so unchecked and underscore the need for effective outreach campaigns to help prevent new introductions. [Learn More...](#)



(Photo: Jared Tuszynski)

Noteworthy: Kentucky Carp Processing Plant

Invasive Asian carp pose a significant ecological threat to aquatic ecosystems of the U.S. Four species of Asian carp — the black, silver, bighead, and grass carp — have invaded portions of the Mississippi River basin after inadvertent escapes from wastewater ponds where they had been introduced. Asian carp reduce abundance and diversity of native fishes, mussels, and other invertebrates while becoming extremely abundant — Kentucky fishermen reported harvesting 83,000 lbs. of carp in only two days of fishing on two lakes on the Tennessee River. An \$18.7 million project will build a new 75,000 square foot carp processing plant in Hickman, Kentucky that will turn harvested carp into fish meal, fish oil, fillets, and other products for global sale. However, a similar plant in Grafton, Illinois recently had to temporarily cease operations due to complaints from residents about the odor resulting from fish processing.



Jumping Silver Carp
(Photo: T. Lawrence, Great Lakes Fisheries Commission)

Noteworthy: Public Issues Education Survey

In July, the UF/IFAS Center for Public Issues Education (PIE Center) included questions about invasive species in their second annual survey on endangered species. The 515 Floridians who responded to the survey believed environmental conservation is an important issue, but were woefully uninformed on invasive species issues. Sixty-two percent of survey respondents indicated that they knew little about invasive species in Florida or how to prevent new species from being introduced. However, fifty-five percent of respondents would support a one percent sales tax increase to fund efforts to prevent new invasions or attempt to eradicate invasive species. Following the survey, the PIE Center hosted a free webinar on endangered and invasive species topics with Dr. Steve Johnson.

The Invader Updater is a quarterly newsletter focused primarily on providing information on invasive vertebrate animals in Florida and the southeastern U.S. and was first published in Winter 2009. This newsletter is produced by:

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Do you have questions, comments, or suggestions, or want to be added to the mailing list? Email monicaem@ufl.edu



Related Resources

- ◆ [Xenopus laevis](#) – USGS-Nonindigenous Aquatic Species
- ◆ [Xenopus laevis](#) – Global Invasive Species Database
- ◆ [Over-invasion of Invasive Species](#) – National Geographic
- ◆ James C. Russell, Nurul S. Sataruddin, and Allison D. Heard. 2014. [Over-invasion by functionally equivalent invasive species](#). Ecology 95:2268–2276.
- ◆ [Overseas Trade Alters a Lizard's Stocks](#) – New York Times
- ◆ Matthew R. Helmus, D. Luke Mahler & Jonathan B. Losos. 2014. [Island biogeography of the Anthropocene](#). Nature 513, 543–546.
- ◆ [Lionfish characteristics make them more 'terminator' than predator](#) – Science Daily
- ◆ [On invasive species, Darwin had it right all along, study shows](#) – EurekAlert
- ◆ [Bullfrog Invasion of the Yellowstone River](#) – USGS Newsroom
- ◆ [Kentucky is gearing up to process Asian Carp from the Mississippi River](#) – FishTacklingRetailer.com
- ◆ [Floridians passionate about, but puzzled by, endangered and invasive species, survey finds](#) – UF News
- ◆ [FWC Non-native Amnesty Day Events](#) (next scheduled: April 11, 2015 – Melbourne, FL)