Conservation Matters: Contributions from the Conservation Committee

Conservation and restoration for the endangered St. Francis Satyr

Nick Haddad

Department of Biological Sciences, Box 7617, North Carolina State University, Raleigh, NC 27695-7617
haddad@ncsu.edu

St. Francis' Satyr, *Neonympha mitchellii francisci*, has always been a mysterious butterfly. As my lab has unraveled its mysteries over more than a decade, we are learning about threats to the existence of this endangered butterfly and about opportunities for its recovery. (Left: Photo by Brian Hudgens)

I am most struck by four aspects of the mystery. First, by its late discovery in 1983 in a swamp on a military installation, Ft. Bragg in North Carolina. A relative of Mitchell's Satyr (*N. mitchellii mitchellii)*, it was determined to be different from the nominate subspecies, also Endangered, based on morphological features. Even as other populations of the species complex have been discovered in Alabama, Mississippi, and Virginia (while others in Ohio, New Jersey, and Wisconsin have been lost), genetic analysis continues to support the existence of multiple subspecies.

Second, its small population size has predisposed it to local extinction, with populations teetering on the edge. In the late 1980s, the single small population where the butterfly was discovered, thought to number around one hundred individuals, was itself lost and worry grew that the subspecies was extinct. Some populations that were discovered afterwards also blinked out.

Third, and perhaps most curiously, is its affinity for bombs. The subspecies is contained entirely within the borders of Ft. Bragg. In the area of the base that is accessible at most times to biologists and conservationists, the range of the butterfly was tiny, covering perhaps a few hectares of wetlands. In the mid-1990s, biologists uncovered one of the greatest surprises of the butterfly. They were granted access to artillery ranges, normally the sites of heavy bombing and widespread fires, and there they found a number of St. Francis' Satyr populations. Although no rigorous population estimates have been made in these ranges due to limited access, the numbers of butterflies observed on short visits imply that the population size inside these ranges is many times larger than outside. Why is it that these areas, which might seem initially to be chaotic and destructive, incompatible with rare and threatened animals and plants, are actually where the butterflies thrive?

This brings us to the fourth mystery of St. Francis' Satyr: its affinity for dynamic and unstable environments. The butterflies live in highly productive wetlands. Yet, in this region, wetlands either remain rivers or streams, or grow quickly on their borders to dense riparian forest. Either condition is incompatible with the butterfly. St. Francis' Satyr lives in open grassy wetlands. Walks across the sites are always adventures, and inevitably entail sinking ankle-, knee-, or even waist-deep into wet muck. Where land is stable and vegetation undisturbed, there are no suitable wetlands.

Nick Haddad standing at the edge of a canebrake occupied by St. Francis' Satyr in the interior of an artillery range at Ft. Bragg. (Photo by Beth Evans)

Unraveling this final mystery has led to deeper investigation of two forces that create environments habitable by this butterfly: beaver activity and fire. Beaver were once the dominant landscape architects across much of North America, damming virtually every small stream across the continent. After beaver abandon their ponds, a wet meadow forms. Here, the butterfly's food plants, sedges, grow densely, and a butterfly population can flourish. But these habitats are ephemeral; they quickly succeed to shrubs and then forest. Disturbance is a force both for good (habitat creation) and bad (butterflies do not survive flooding), and is absolutely necessary to sustain the butterfly.

Yet, there is another force that can maintain open wetlands even in the absence of beaver, and this explains the benefits of bombs. When I walk into an artillery range, I step into an ecologically different world, and I am struck by wide open views. This is not because of their devastation – these are pine woodlands like those standing outside ranges. The openness extends to wetlands along streams. Whether or not there are or were beaver, these open wetlands can be home to St. Francis' Satyr.

The force causing these woodlands and wetlands to be open is fire. Nearly annually, fires are set by flares or bombs that reduce trees and dense brambles in wetlands, permitting grasses and sedges to thrive. The implication is that regular burning in wetlands outside ranges should be included in management plans for the butterfly and other species dependent on early successional seres. Such management for fire or other forms of disturbance will benefit many threatened butterflies, including Fender's Blue, Karner's Blue, and Bartram's Scrub-Hairstreak, that we now know depend on it for populations to persist.

Given the forces needed to maintain the butterfly, it is not hard to construct its decline through recent centuries. As humans settled the landscape and converted forests to fields, they also removed the twin forces that the butterflies need to survive across the landscape: beavers were valued for their fur and later considered a pest to be eradicated, and fire was a force of destruction to homes and crops needing to be curtailed. As these forces were removed, St. Francis Satyr declined and retreated towards the last refuge of ecological disturbance – Fort Bragg's impact range.

My lab has monitored population sizes of St. Francis' Satyr outside artillery ranges since 2002, and two things have become clear. First, the population has never been large, hovering around 500 individuals for nearly a decade. Second, this butterfly lives in successional systems, and without disturbance local extinction is inevitable. New habitats have not been created and colonized since we began our work, and in the last five years a number of local populations have declined or become extinct. By 2012, the population outside artillery ranges numbered fewer than 100 individuals.

That low number points to the mistake we made. With perspective, I now realize that we were too cautious and gentle with the habitat of these butterflies. We have always known their habitat requires disturbance. We'd hoped that the disturbance would happen nearby, not within the places St. Francis' Satyr was flying. Nearly too late, and thanks to the efforts of Brian Ball and other biologists at Ft. Bragg, we started a more concerted effort at restoration.

Our efforts involve mimicking the environmental engineering efforts of beavers: we create dams and remove hardwoods. Although these words are easily written, in reality this effort entails rolling out hundred-foot-long coffer dams that are filled with water from the stream, and cutting hardwoods into pieces and hauling them out by hand. The sites are small, 30x30 m, but they have allowed us to complete restoration efforts and test their effects.

Nick Haddad's lab group restoring habitat for St. Francis' Satyr by removing hardwoods. (Photo by Nick Haddad)

In some ways, the effects or our restoration efforts were immediate and obvious. Sedges flourished, including species thought to serve as host plants for St. Francis' Satyr. They became the dominant plants visible across wetlands. More importantly, several sites that were near existing populations were colonized, albeit in small numbers.

Restored areas far from existing populations are unlikely to be colonized. Until St. Francis' Satyr habitat is much more extensive and connected, the only real hope of increasing their distribution is through translocation of individuals. Because populations are already so small and the majority of butterflies occur in restricted areas, we have recently turned our attention to captive-rearing as a means of providing livestock that could be used to seed unoccupied wetlands.

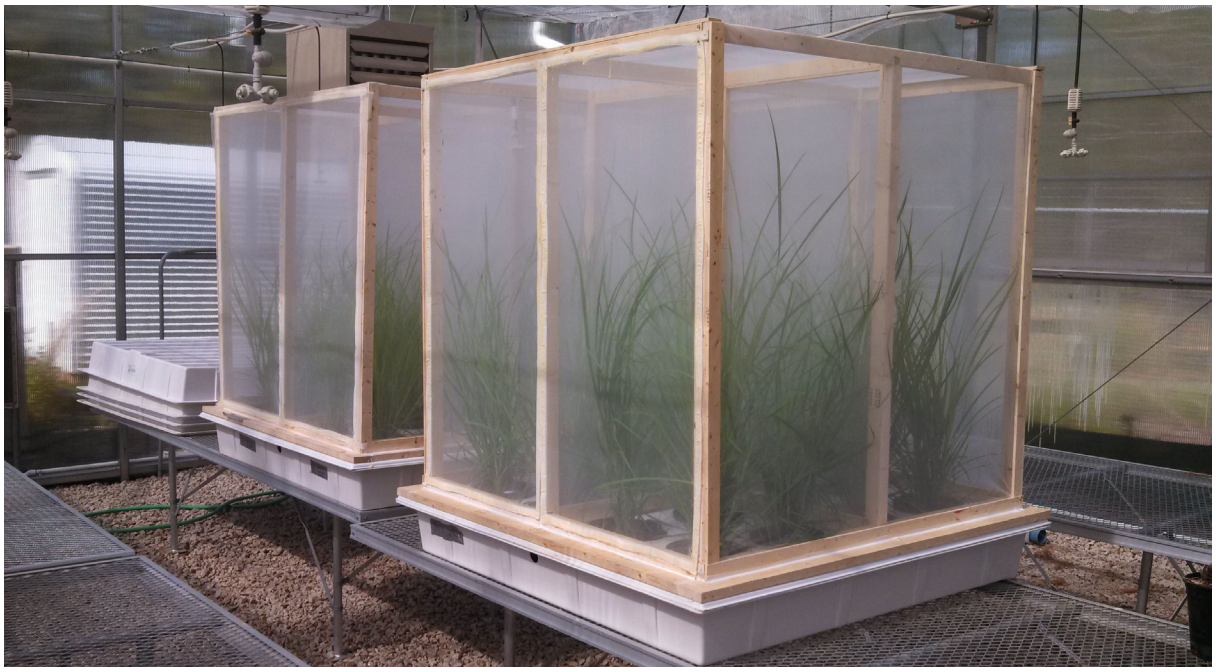
We have worked out many aspects of rearing. We collect wild females who oviposit before releasing them back into the wild. Most eggs hatch, and newly emerged larvae are placed on sedges grown in tubs that are then enclosed within

predator-free net cages. The ultimate fate of these adults is to be released in restoration sites. Before releasing them, we work to resolve our current biggest challenge: captive mating. This effort has been hampered by small numbers, irregular emergence, and, once male and female are paired, low rates of mating. One of our restoration sites is the locality of the population first discovered three decades ago, one that went extinct shortly after the butterfly's discovery. There we have released many of our captive-reared butterflies, about 20-40 individuals in each of the past three years. In 2014, this re-established population numbered 175 butterflies. Even more impressively, every butterfly observed outside artillery ranges in 2014 was in an area where habitat had been restored.

Restoration efforts should have been started a decade ago. Now that efforts have begun, it is clear the goal to maintain and increase populations of this butterfly is limited under the best conditions to small grassy wetlands. The task before us is to improve restoration techniques, target translocation more effectively, and expand from local to landscape-level restoration. Only when these goals are achieved will there be a stable and connected St. Francis' Satyr population.

Nick Haddad is William Neal Reynolds Professor of Biological Sciences at North Carolina State University. He is currently writing a book about his search for the world's rarest butterfly, including St. Francis' Satyr, to be published in 2016 by Princeton University Press.

St. Francis' Satyr (*Neonympha mitchellii francisci*): larva; pupa (both photos credit to Missy McGaw); marked adult that is part of a capture-recapture study to monitor its populations. (Photo by Nick Haddad)



Netted enclosures containing St. Francis' Satyr host-plants, *Carex mitchelliana*, and captive-reared larvae (photo by Erik Aschehoug)