Noturus trautmani

Scioto madtom
Noturus trautmani (Taylor, 1969)

In 1969, William R. Taylor, curator at the National Museum of Natural History, first described the Scioto madtom catfish, *Noturus trautmani* [**Taylor 1969**]:


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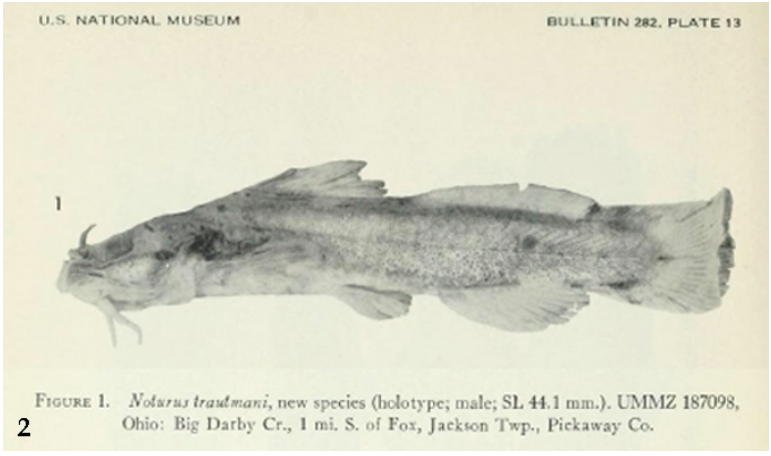
"*Noturus trautmani* is known only from one locality in Big Darby Creek, a tributary of the Scioto River, Ohio. This species is named for Dr. Milton B. Trautman, an outstanding ichthyologist and Ohio naturalist, who collected the types and has studied the fish and fauna of Big Darby Creek intensively."

The male holotype was "…collected from Big Darby Creek, 1 mile south of Fox, southeastern Jackson Township, Pickway County, Ohio, November 4, 1943…" The 16 other specimens examined were all collected by Trautman in the fall and early winter, at the same location (two in 1943, one in 1945, and 13 in 1957). Trautman collected two additional Scioto madtom in 1957, which Taylor did not examine [**Taylor 1969**]. Specimens provided to Taylor ranged from 23.2 to 44.1mm in length. Trautman never saw a mature adult Scioto madtom [**USFWS 1976**].

In a 1976 interview Trautman spoke about finding Scioto madtom and the delay in its description [**Smith 2014, USFWS 1976**]:

DR. TRAUTMAN: Well, this ripple, the Siota Mad tong [?] is a place where we have taken seventeen or nineteen specimen. It was virtually no bigger than this small room. I had been seeing the area from 1922 to 1946, I believe, somewhere in there. You can find it in The Fishes of Ohio, and never taken one. I



needed to get some varying darter color descriptions for the fish book. So I went down there with a man named Cunningham, and all of a sudden he caught two specimens of [unintelligible name]. And I couldn't tell if it was [unintelligible]. I said, "Now something has happened here". I put them in a jar and I was so busy working on the fish book that I hadn't too much time going to study them. Mary and I went down there about the twenty-eighth of December. She stood in a two-foot snow bank and the temperature was hovering around zero. I went out in the ripple, the pools had about six inches of ice on them, but the ripples were open. I took my seine[sic], which froze as I brought it up. I was catching darters for color descriptions. I was working in November and December on the darters. Up came one of these, and I had been throwing these Darters over into the snow. And when they hit the snow, the cold just brought out the color magnificently. Mary dumped then in a cooler, and they retained their color. And when we got home, where it was warm, and she could write, she usually took about three big tablet sheets for each species. I said, "Here is one of those funny looking catfish". I decided not to throw it. I took and put it in a bottle. It got me interested. I thought that I would take time out and study that thing, and I couldn't compare it to anything. And I said to Mary, "This thing looks like a new species, but I just don't have time to do anything with it". Well then, William Ralph Taylor, I had heard, was going to monograph the genus [unintelligible], which he rightly called the "Touris" [?]. He asked for much of my material. I sent him up hundreds of specimens, including these and I didn't say anything to him. I wanted to see if he saw something funny about that. And he came back and said, "I can't identify this thing". And this is the way it happened. Had I had the time, I would have described it of course, but I was too busy with other things.

INTERVIEWER: The Latin specific name bears your name "Noturus Trautmani" that was named in honor of you because you were the first to discover it.

DR. TRAUTMAN: Yes. Normally there is such as thing as professional etiquette. If you collect an undescribed species, and somebody is going to monograph that species, if you've got that species ready to describe, which I didn't have, why you described it and he would include it in his monographic revision. But I didn't have it ready for description. I turned it over to him. Then he described it. Well, professional etiquette almost makes a person. [**USFWS 1976**]

Scioto madtom has not been observed since Trautman's last collected specimen in 1957 [**USFWS 2009**]. Trautman described surveying Big Darby Creek in 1960:

"I had the nicest group of students I have ever had. They were so wildly enthusiastic, it was sometimes pathetic, and we just seined the living daylights out of that stream, and we never got a one! We would start ten miles upstream, and then come down. I have a theory that possibly we don't know as much about the upper reaches of Big Darby as we do about the lower reaches, around my ripple. I have a theory that this thing migrates far upstream somewhere to spawn and we haven't found that spawning area yet. When the creek gets low as it does in extreme droughts, like in 1930 when the ripple was only about five feet wide, why, these things have to come down there." [**USFWS 1976**]

Beginning in 1970 and over the course of the next thirty years, Dr. Ted M. Cavender (Ohio State University Museum of Biological Diversity and Trautman's protégé), conducted annual fish surveys in Big Darby Creek and failed to collect any Scioto madtom [**Cavender 1999, USFWS 1988, USFWS 2009 get individual references, Ferenchik 2013**]. In 1973 U.S. Congress passed the Endangered Species Act "to protect and recover imperiled species and the ecosystems upon which they depend", recognizing that our rich natural heritage is of "esthetic,

ecological, educational, recreational, and scientific value to our Nation and its people" [**USFWS 2013**]. On September 25, 1975, only 6 years after Taylor's description, Scioto madtom was officially placed on the "endangered" list, meaning it was "in danger of extinction throughout all or a significant portion of its range" [**USFWS 1975**, **USFWS 2013**].

In his 1976 interview Dr. Trautman was asked: "Some people who are not familiar with natural science, or do not care about the natural world, they could counter with the question, "Why should we try to save this one small species of Madtom, what's the worth of it?" To which Dr. Trautman responded: "Well, that's ninety-nine percent of the population. Yes, there are several ways, but the most logical one is to admit that this thing has no economic importance. But, that we have as a nation, exploited all of our natural resources, some to a very great degree. We have killed off the passenger pigeon, the Carolina parakeet, and other animals like that. Also the red wolf, and other small animals. The time has come I believe that this has got to cease, if we want to save our natural environment. And I can think of no better place to start, that on this little catfish."

In 2009 the U.S. Fish and Wildlife Service reported: "Scioto madtom was included in cursory reviews initiated February 27, 1981…July 22, 1985…and November 6, 1991. These reviews resulted in no change in the listing classification of endangered…The exact cause of the Scioto madtom's decline is unknown, but was likely due to modification of its habitat from siltation, suspended industrial effluents and agricultural runoff." [**USFWS 2009**]

"The early nineteenth century settlers of the Darby Plains in west-central Ohio were well acquainted with the numerous prairies in the area. These open grasslands provided striking contrast to the surrounding closed forests which covered most of the Ohio country. Because of the very flat terrain and slow drainage most of the prairies were covered with water for extended periods each year. These prairies and accompanying soils had developed over thousands of years since the continental glaciers had retreated from the area. However, as settlers and their progeny learned to drain and cultivate the prairie lands, the face of the landscape became changed so thoroughly that within a century almost all vestiges of the original wet prairies were obliterated." [**King 1981**] In addition to habitat loss, competition from the northern madtom (*Noturus stigmosus*), first observed the same year as the last Scioto madtom was collected, may have also contributed to this fish's decline [**USFWS 1988**, **USFWS 2009**].

In its 2009 5-year report, USFWS recommended delisting Scioto madtom as an endangered species due to its extinction. **[USFWS 2009**] In 2013, 70 years after Trautman's first collection in Big Darby Creek and 56 years after Taylor's description, Scioto madtom (*Noturus trautmani*) was officially listed as "extinct" in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species [**IUCN**].

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Neofelis nebulosa

Clouded Leopard of Formosa (Taiwan)
Neofelis nebulosa (Griffith, 1821)

Until 2006, the clouded leopard was considered a single species *Neofelis nebulosa* (Griffith 1821) with four subspecies: two from mainland Southeast Asia: *N. n. nebulosa* (Swinhoe 1862) in southeast Asia and China, *N. n. macrosceloides* (Hodgson 1853) in India, Nepal, Sikkim, and Bhutan, and two from the islands of Taiwan: *N. n. brachyurus* (Swinhoe 1862) and the Indonesian islands of Borneo and Sumatra: *N. n. diardi* (Cuvier 1823) [**Kitchener 2006**]. However, molecular genetic testing [**Buckley-Beason 2006 and Wilting 2007**] combined with detailed analyses of their fur color and pattern, [**Kitchener 2006**] and analysis of the craniodental characteristics, [**Christiansen 2008**] all concluded that the Indonesian island's clouded leopard is actually a distinct, new species (*N. diardi)*, separate from that of the mainland clouded leopard *N. nebulosa* [**WWF 2007**]. In contrast, molecular genetic testing also revealed that the regionally extinct Formosan (Taiwan) clouded leopard is actually genetically identical to the mainland's clouded leopard *N. nebulosa* [**Buckley-Beason 2006**]


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How could the clouded leopard from the island of Taiwan be the same as the mainland clouded leopard? "The Tso-chen Man is the earliest Paleolithic human fossil finding in Taiwan, dating back to about 25,000 years ago, categorized as *Homo sapiens sapiens* of the late Pleistocene, being the same species as modern humans. It was named for its excavation site in the Tsai-liao River basin of Tso-chen, Tainan county. In addition to skull and teeth fossils, abundant animal fossils of the early South China region were also found in this area. It is concluded that during the glacial period of Pleistocene, Taiwan had been connected with mainland China by land, so animal groups migrated from South China to Taiwan and the Paleolithic humans also followed, initiating the prehistoric culture of the Paleolithic Period in Taiwan." [**NatTaiwanMuseum**]

In 1821 British naturalist Edward Griffith provided the first description of the clouded leopard as a new species "*Felis nebulosa*", using a single sketch by Major Charles Hamilton Smith, who had seen the animal at the Exeter Exchange, on the Strand in north London, sometime around 1817 [**Griffith 1821**]. Six years later (1827), as part of his translation of Baron Cuvier's "The Animal Kingdom Arranged in Conformity with its Organization" Griffith wrote the following about the clouded leopard:

"In our collection of drawings are three figures from a curious and unique specimen, which was for some months in the possession of Mr. [Stephen] Polito at the Exeter 'Change. Mr. [Charles Hamilton] Smith also took a hasty sketch of the same; and Mr. [Edwin Henry] Landseer made another. We have engraved this animal from the last mentioned drawing under the name of the Nebulose or Clouded Tiger, in reference to the peculiarity of the spots or rather patches, that covered its skin. It acquired the name among the keepers at the menagerie, of the Tortoiseshell Tiger…He was said to have been brought from Canton…The specimen in question was taken into the country with an itinerant exhibition, and died there, and so little attention did Zoology, at that time receive there, that, as far as it appears, its skin was cut up to make caps for the keepers, an no vestige of the animal is now known to remain. " [**Griffith 1827**]

Clouded leopards from the island of Sumatra were imported for exhibition at the Exeter Exchange, one in 1815 and another in 1824, but both died shortly after their arrival [**Christiansen 2010**]. It would not be until 1862 that English naturalist and consul to Formosa (Taiwan) Robert Swinhoe would provide the first description of what he believed to be a new species, the "Formosan leopard" (*Leopardus brachyurus*): [**Swinhoe 1862**]

"This is another animal from the distant wilds of the interior, whose skins the savages bring to the borders to barter with the Chinese. I have seen two or three skins, all of which agree in the one peculiar feature, the shortness of the tail. It belongs, in general appearance and style of colouring, to the long-tailed Leopard group, of which I have examined four specimens in the British Museum, marked *L. macrocelis*, one being from Sumatra and the other three from India. I have also examined a closely allied species from Tibet, *L. macrocelides*, Hodgs. In the paleness of its yellow fur, and in the disposition of its markings, the Formosan is again here more nearly allied to the Tibetan; but the shortness of the tail in one species (only about one-half the length of that of the other) is quite sufficient character to distinguish it. I have unfortunately only flat skins in my possession, and therefore cannot give particulars as to measurement. In size it is rather smaller than *L. macrocelides*, but agrees with it almost entirely in markings. Its tail, however, is only 1¾ feet long, more bushy, and is distinctly banded with black.

Like most of its allies, this animal is nocturnal in its habits. It commits great havoc among the Deer, for which it lies in ambush. It fears the approach of armed savage, and never attacks man until provoked."

Eight years later (1870), after gaining access to more specimens, Swinhoe determined that the Formosan clouded leopard was not a new species, but rather a subspecies of the Asian continent's "Clouded Tiger". The newer specimens did not have the previously "characteristic" short tail:

"The acquisition of a skull and a properly stuffed animal during my sojourn to Formosa satisfactorily proves that the insular form of "Clouded Tiger" is merely a small race of that of the Continent. My specimen was a male and measured from the snout to the root of the tail 28 inches, tail 23. Its head is small and its feet large. It is of rich buff ochre color, with deep black spots and markings. Underparts nearly white, with large brownish-black markings.

A large flat skin of a female, brought at the same time was of a paler and yellower tinge; and that of a younger animal was brighter still, with a green wash over the yellow, the fur being longer and shaggier than in the two adults." [**Swinhoe 1870**]

None of the future descriptions of the Formosan clouded leopard would ever be based on records of a live animal [**Chiang 2007**]. The last recorded sighting was reportedly in August of 1983 in the east coast of Taiwan, in "… Nantawushan where, …a young clouded leopard, whose back molars had not yet erupted, was found by Mr.

Chang Wan-fu of Tunghai University in a hunter's snare (see *China Post* 26 August 1984). The specimen was borrowed from the owner of the snare, stuffed and photographed." [**Rabinowitz 1988**] Chang also "…discovered several pieces of clouded leopard skin in the village of the Peinan aborigine tribe." [**TaiwanInfo 1984**]

In 1986, wildcat expert Alan Rabinowitz led the first major survey looking for the Formosan clouded leopard [**Rabinowitz 1988**]. Having successfully surveyed the clouded leopard in Borneo earlier that year, Rabinowitz learned that "The solitary and nocturnal behaviour of this cat makes it difficult to observe, and this is compounded by the fact that the clouded leopard is partly arboreal and does not leave prominent signs, in the form of faeces and scapres along the trails." [**Rabinowitz 1987 and Rabinowitz 1988**] In Dawu, Taiwan he opted instead, to interview aboriginal hunters, forestry officials, and villagers. Of the 70 individuals interviewed, 33 reported having seen a clouded leopard but only 7 had seen one within the previous five years (1981-1983); most accounts dated back to the Japanese occupation of Taiwan (1895-1945). Regarding Chang's 1983 Formosan clouded leopard story, Rabinowitz described it as appearing reliable, but indicated that he himself had not substantiated it.

Three years after Rabinowitz's survey (1989), Kurtis Pei approached the newspaper requesting to look at Chang's 1983 photograph only to find that "…they purge their archives after five years, and a recent purge included the image of the leopard." [**Perry 2009**] He then followed up directly with Chang, who reported having lost the only surviving copy. [**Perry 2009**] Experienced in the hunting systems of Taiwanese aboriginal tribes, Pei suspected that the photo was actually that of a Bornean clouded leopard, because Taiwanese aborigines did not use deep pits lined with sharpened bamboo stakes, like the one depicted in the photograph. [**Pei no date**, **and Perry 2009**] If Pei's theory is correct, then the last record probably dates back to approximately 1900 when Japanese anthropologists Torii Ryūzō and Mori Ushinosuke were in Taiwan, studying the aborigenes. Torii Ryūzō photographed a Taiwanese Rukai aborigine wearing a clouded leopard fur jacket [**Ryūzō, Undated**], and Mori Ushinosuke is believed to have been the only non-aboriginal to have ever seen a live Formosan clouded leopard **[Chiang 2007, Yang 2000, Perry 2009]**. No other "sightings" in the 20th century have been substantiated.

Fifteen years after Rabinowitz's survey, Po-Jen Chiang and his research team led an extensive survey of southern Taiwan, spending two to three weeks a month investigating the status of the Formosan clouded leopard and its prey in the Tawu Mountain Nature Reserve. [**Chiang 2007**] The three-year survey (2001-2004) included 232 hair snare stations and 377 camera trap sites, with at least 13,354 camera trap-days. Chiang wrote:

"Average number of camera trap days to get one clouded leopard picture in other Southeast Asian countries ranged from 113 to 879 camera trap days…In some places, clouded leopards were successfully photographed with as few as 8 to 24 camera trap sites…The study area is the largest and the most contiguous block of suitable habitat for clouded leopards left in Taiwan, yet no clouded leopards were found suggesting that the Formosan clouded leopard may be extinct, or at the brink of extinction, not only in the study area, but also in all of Taiwan…It is very probably that clouded leopards are extinct in Taiwan due to the historical pelt trade of clouded leopards, loss of lowland habitat, prey depletion, and hunting."

Chiang reviewed the history of the Formosan clouded leopard pelt trade and wrote [**Chiang 2007**]: "The earliest record of "leopard skin" in Taiwan was in the 7th century when Taiwan aborigines wore bear or leopard skins as substitutes of armor (histories from an ancient book "Sueisu A.D. 636" summarized in Chiang 1985)…" Thirteenth century records documented the export of clouded leopard fur and meat: "…when traders in Penghu

islands, isles between Taiwan and Mainland Asia, traded in dried leopard meat from the aborigines of Taiwan and sold to China..." Wearing clouded leopard pelts by the Taiwanese aborigines was recorded by the Chinese who may have also used them as a replacement for tigers, "…for medicinal or luxurious purposes…[and] Since tigers may be harder or more expensive to get in China, this could induce heavy demand on clouded leopards in Taiwan." Chiang found that documents mention "tigers" in Formosa "…during the Dutch Rule period in the 1600's…" Leopard pelts in northern Taiwan were "…hard to acquire and more expensive than the pelts of the different mainland leopards", such that 18th and 19th century history books on northern Taiwan "…described the custom tax for leopard pelts in Hsia-Men, an important port in southeastern China for Taiwan to import goods into China." During the Japanese occupation (1895-1945) aborigines hunted clouded leopards and sold the pelts to Japanese soldiers **[Chiang 2007]**. Therefore, historical records account for over 1300 years of pelt trade and illegal hunting as unsustainable pressures on the island's clouded leopards. This is in addition to pressures of habitat loss (deforestation) and prey depletion over 400 years of colonization by the Dutch, Spanish, Chinese, and Japanese.

Chiang continued his detailed survey of Taiwan and in 2013, this research led to the clouded leopard's official designation as "regionally extinct" in Taiwan: [**Chiang 2014**, **IUCN, Platt 2013**]

"During 1997–2012 we conducted a nationwide camera-trapping survey and assessed the availability of prey and habitat for the clouded leopard *Neofelis nebulosa* in Taiwan. We surveyed 1,249 camera-trap sites over 113,636 camera-trap days, from the seashore to an altitude of 3,796 m and covering various types of vegetation. No clouded leopards were photographed during 128,394 camera-trap days, including at 209 sites in other studies, confirming the presumed extinction of clouded leopards in Taiwan…both clouded leopards and their major prey populations have suffered habitat loss and hunting pressure as a result of timber harvesting and human encroachment. Thus, habitat loss and prey depletion are the two main factors driving the extinction of the clouded leopard in Taiwan…As genetic…and morphological research…did not identify clouded leopards in Taiwan as a distinct subspecies, animals from mainland Asia could be utilized for reintroduction. As wildlife conservation is a priority issue there, and considering the ongoing recovery of habitat and prey, Taiwan could become a global refuge for clouded leopards."

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Numenius borealis

Eskimo Curlew

Numenius borealis

The Eskimo Curlew, Great Auk, Passenger Pigeon, and Labrador Duck are three North American birds that have passed into memory. Through over-hunting and through the exploitation of an easy protein source as sustenance for a growing nation---one whose success brought further habitat loss--we've wrought the ultimate demise of these species. In the following passage from John J. Audubon's *Birds of America*, Audubon describes the Eskimo Curlew as an endless resource; a persistent anachronism we now recognize helped whitewash the reality we painfully face. Analog visions of the past are giving way to genetic and digital records; to new forms of cataloguing life's history. I hope we can adapt our nature to the life that surrounds us, as we struggle against millennia of instinct to use, or remake, nature in our images of perfection.

– Joseph Rossano

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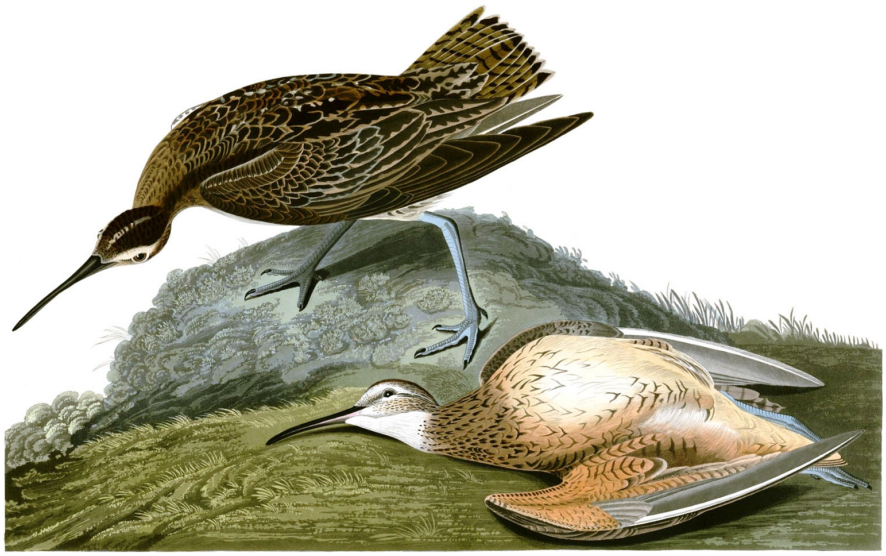
"I regret that I am unable to present a complete history of the Esquimaux Curlew. It is true I might somewhat enlarge my account of its habits, were I to borrow from others, but as I have resolved to confine myself to the results of my own observation, unless in certain cases, in which I always take care to give my authorities, I hope you will be pleased with the little which I have to offer. □□

Previous to my voyage to Labrador, I had seen only a single bird of this species, which was kindly given me by my learned friend WILLIAM OAKES, Esq. of Ipswich, Massachusetts, who had procured it in his immediate neighbourhood, where, as I have since ascertained, the Esquimaux Curlew spends a few days in early autumn, while on its way southward. During their short stay in that State, they are met with on the high sandy hills near the sea-shore, where they feed on the grasshoppers and on several kinds of berries. On this food they become fat, so as to afford excellent

eating, in consequence of which they have probably acquired the name of "Dough-bird," which they bear in that district, but which is also applied to several other birds. How this species manages to cross the whole extent of the United States without being seen after leaving Massachusetts, is to me very wonderful. On one occasion only have I ever had a glimpse of it. I was in company with my learned and generous friend JOHN BACHMAN of Charleston, on one of the islands on the coast of South Carolina, whither we had gone with the view of watching the Long-billed Curlews (Numenius longirostris). It was at the dawn of a fine day, when a dense flock of the northern Curlews passed to the southward, near enough to enable us to ascertain the species, but so swiftly, that in a few minutes they were quite out of sight. □□

On the 29th of July, 1833, during a thick fog, the Esquimaux Curlews made their first appearance in Labrador, near the harbour of Brag d'Or. They evidently came from the north, and arrived in such dense flocks as to remind me of the Passenger Pigeons. The weather was extremely cold as well as foggy. For more than a week we had been looking for them, as was every fisherman in the harbour, these birds being considered there, as indeed they are, great delicacies. The birds at length came, flock after flock, passed close round our vessel, and directed their course toward the sterile mountainous tracts in the neighbourhood; and as soon as the sun's rays had dispersed the fogs that hung over the land, our whole party went off in search of them. □□

I was not long in discovering that their stay on this coast was occasioned solely by the density of the mists and the heavy gales that already gave intimation of the approaching close of the summer; for whenever the weather cleared up a little, thousands of them set off and steered in a straight course across the broad Gulf of St. Lawrence. On the contrary, when the wind was high, and the fogs thick, they flew swiftly and low over the rocky surface of the country, as if bewildered. Wherever there was a spot that seemed likely to afford a supply of food, there the Curlews abounded, and were easily approached. By the 12th of August, however, they had all left the country. □□



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In Labrador they feed on what the fishermen call the Curlew-berry, a small black fruit growing on a creeping shrub, not more than an inch or two in height, and so abundant, that patches of several acres covered the rocks here and there. When the birds were in search of these feeding-grounds, they flew in close masses, sometimes high, at other times low, but always with remarkable speed, and performing beautiful evolutions in the air. The appearance of man did not seem to intimidate them, for they would alight so near us, or pass over our heads at so short a distance, that we easily shot them. While on wing, they emitted an oft repeated soft whistling note, but the moment they alighted they became silent. They ran swiftly along, all in the same direction, picking up the berries in their way, and when pursued, would immediately squat in the manner of a Snipe or Partridge, sometimes even

laying their neck and head quite flat on the ground, until you came within a short distance, when, at the single whistle of any one of the flock, they would all immediately scream and fly off, rambling about for awhile, and not unfrequently re-alighting on the same spot. Now and then, however, their excursion would last a long time, they would rise high in the air, make towards the sea, and, as if aware of the unfavourable state of the weather for pursuing their southward course, would return. □□

They continued to arrive at Bras d'Or for several days, in flocks which seemed to me to increase in number. I saw no Hawks in their rear, and I was the more astonished at this, that at that period Pigeon Hawks and other species were pretty abundant. □□

They rose from the ground by a single quick spring, in the manner of a Snipe, when they would cut backward, forward, and all around, in a very curious manner, and would now and then pause in the air, like a Hawk, remaining stationary for a few moments with their head meeting the wind, when immediately afterwards they would all suddenly alight. In calm and fair weather, they were more shy than at other times. While on their passage across the Gulf, they flew high in close bodies, and with their usual speed, by no means in regular lines, nor in any order, but much in the manner of the Migratory Pigeon, now and then presenting a broad front, and again coming together so as to form a close body. □□

Those which we procured were extremely fat and juicy, especially the young birds, of which we ate a good many. Mr. JONES, an old settler of Bras d'Or, and his son, shoot a great number every season, which they salt for winter food. They informed us that these birds pass over the same tract about the middle of May, on their way northward, and that they never found them breeding in their neighbourhood. Little difference could be observed at that season between the males and females, or between the old and young birds."

John James Audubon, *Birds of America* from an 1840 "First Octavo Edition" of Audubon's complete seven volume text.

1. Rossano, Joseph Gregory. Photographed by C.B. Bell III.
2. Eskimo Curlew, *''Numenius borealis''*, hand-colored engraving. From *Birds of America,* 1827-1838. John James Audubon (author, artist, 1785-1851)

Rhinoderma rufum

Northern Darwin's Frog
Rhinoderma rufum (Philippi, 1902)

The genus *Rhinoderma* contains only two species, both endemic to the temperate rain forests in central-southern Chile: the Southern Darwin's frog *Rhinoderma darwinii* and the Northern Darwin's frog *Rhinoderma rufum* [**Bourke 2012**].


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In 1841, Duméril & Bibron, described the Southern Darwin's frog and named it *Rhinoderma darwinii* in honor of Charles Darwin [**Duméril & Bibron, 1841**]. Darwin had collected the specimen during the second voyage of the H.M.S. Beagle, exploring the island of Lemuy on the Chiloé Archipelago, in Southern Chile [**Chancellor 2009**]. Around 1861-1862, German ornithologist Christian Ludwig Landbeck collected the first specimen of the Northern Darwin's frog in Vichuquén, central Chile [**Soto-Azat 2013a**]. Forty years later (1902) his collaborator German-Chilean zoologist Rudolfo Armando Phillipi {Krumweide} published the first description of this frog: the new species "*Hemenicus rufus*" [**Phillipi 1902**]. Unfortunately, because of "…the loss of the type specimen, its confusing original description, and physical similarities shared by both species", seminal books on Chilean amphibians, failed to acknowledge Phillipi's *Hemenicus rufus* as a species distinct from the Southern Darwin's frog **[Bourke 2012; Cei 1962; Donoso-Barros 1970]**.

In 1975, Formas re-evaluated Darwin's frogs. Based on developmental and morphological differences, he concluded that they were in fact, distinct species and the Northern Darwin's frog name was updated to *Rhinoderma rufum* **[Formas 1975]**. At that time, *R. rufum* may have still been abundant in Chile, with "…838 *R. rufum* specimens deposited in different museums, collected by two wildlife collectors from the same area in Chiguayante over the period 1975-1979." [**Soto-Azat 2013a**] However, only five years later, in 1980, Penna and Veloso would be the last to see the Northern Darwin's frog in the wild [**Penna and Veloso 1900**].

Soto-Azat et al.'s 2013 comprehensive study "*The population decline and extinction of Darwin's frogs*", the authors reported [**Soto-Azat 2013a**]:

"All known archived *Rhinoderma* specimens were examined in museums in North America, Europe and South

America. Extensive surveys were carried out throughout the historical ranges of *R. rufum* and *R. darwinii* from 2008 to 2012. Literature review and location data of 2,244 archived specimens were used to develop historical distribution maps for *Rhinoderma* spp. Based on records of sightings, optimal linear estimation was used to estimate whether *R. rufum* can be considered extinct. No extant [living] *R. rufum* was found and our modelling inferred that this species became extinct in 1982 (95% CI, 1980–2000)."

Multiple factors may have contributed to the Northern Darwin's frog's extinction including over-extraction at some localities, loss of habitat (i.e., reduction of the natural forest for its use in wood and paper products, pine and eucalyptus plantations, agriculture and urbanization) and volcanic events [**Soto-Azat 2013a]**. However, as Soto-Azat and others have noted, none of these threats adequately explains the Northern Darwin's frog's (*R. rufum*) rapid extinction from its entire historical distribution or the Southern Darwin's frog's (*R. darwinii*) rapid decline, including in undisturbed habitats.

In 1998, Berger et al, first reported chytridiomycosis as a fatal cutaneous disease in anurans (frogs or toads) and hypothesized that this infection was associated with mass mortality events and recent amphibian population declines in Australia and Panama **[Berger 1998]**. In 2004, Weldon et al evaluated 697 archived specimens of three species of *Xenopus* frogs collected from 1879 to 1999 in southern Africa [**Weldon 2004**]. The authors reported that the earliest case of chytridiomycosis, caused by the fungal agent *Batrachochytrium dendrobatidis* (*Bd*) they found was in a 1938 African clawed frog (*Xenopus laevis)* specimen. What could *Bd* infected African clawed frogs have to do with amphibian population declines throughout the world?

In 1934, it was discovered that injections of pregnant women's urine, with high gonadotropin levels, induced ovulation in *Xenopus laevis,* thus, suitable as a biological human pregnancy test **[Shapiro 1934**, **1936]**. Beginning in the mid-1930's thousands of the African clawed frogs were caught in the wild and exported from Africa, initially for use in the human pregnancy bioassay and later for use in scientific research (i.e., immunology, embryology, molecular biology) [**Weldon 2004**]. "As an indication of the numbers involved in this trade, 10,866 frogs were distributed in 1949, of which 3,803 (35%) were exported, and of the 20,942 frogs distributed in 1970, a total of 4,950 (24%) were shipped abroad." [**Weldon 2004**; **Inland Fisheries 1949**, **1970**]. The African clawed frog *Xenopus laevis* was introduced to central Chile in the early 1970's including in 1973 when an "unknown number of frogs were dumped into Caren Lagoon close to Santiago International airport" [**Jaksic 1998**]. By 1985, five years after the Northern Darwin's frog was last seen in the wild, there was evidence of a feral population [**Tinseley 1996**].

In 2010 Solis et al published the first report of chytridiomycosis in an African clawed frog *Xenopus laevis* in Chile [**Solis 2010**]. In 2010 and 2011 Bourke and colleagues reported chytridiomycosis infection with *Bd* in three native Chilean species: the Southern Darwin's frog (*R. darwinii),* the gray wood frog *(Batrachyla leptopus),* and the four-eyed frog (*Pleurodema thaul)* [**Bourke 2010, 2011**]. Most recently (2013) Soto-Azat et al examined 662 museum specimens and found that 6 (0.9%) were positive for *Bd* infection including 1/266 Northern Darwin's frogs, 4/289 Southern Darwin frogs, and 1 four-eyed frog/107 other anuran from the same geographic region [**Soto-Azat 2013b**]. The authors wrote: "Although we examined similar numbers of frogs that had been collected prior to 1970 and post-1970, all six *Bd* positive archived amphibians were collected from 1970 to 1978 inclusive: a time coincident with the onset of the global amphibian population decline phenomenon, including the disappearance of *R. rufum*…"

Darwin's frogs are the only amphibians where the males incubate the tadpoles in a specialized vocal pouch [**Jimenez 1872** [**Jorquera 1972, 1974**] ; **Formas 1975**. This unique reproductive strategy may help explain how differences in exposure to *Bd* impacts potential for infection in each of Darwin's frogs. Soto et al hypothesized:

"*Batrachochytrium dendrobatidis* is a waterborne pathogen and stream-living has been identified as a risk factor for Bd-associated declines [**Bielby 2008**]. *Rhinoderma darwinii* has evolved to develop an extreme case of parental care in which the species does not depend on water bodies for tadpole development [**Goicoechea 1986**]. In contrast, while *R. rufum* tadpoles spend their first two weeks of development in the vocal sacs of their male parents, they are then released into water as larvae where they live for the next approximately 120 days until metamorphosis takes place [**Jorquera 1981**]. This association of *R. rufum* with streams in central Chile could render this species even more susceptible to population declines and extinction due to chytridiomycosis."

The International Union for Conservation of Nature (IUCN) Red List of Threatened Species' most recent (2010) listing for *R. rufum* is: "Critically Endangered" but "possibly extinct in Chile" **[Veloso 2010]** This listing was based on a 2008 assessment, preceding the studies discussed above, including the 2008-2012 survey reporting no sightings of *R. rufum* throughout its historical range, or the 2010-2013 studies with new evidence of chytridiomycosis infection in one introduced and four native anuran species including the Northern Darwin's frog, *R. rufum* in Chile [**Soto-Azat 2013 a, b; Solis 2010, Bourke 2010, 2011**].

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1. Rossano, Joseph Gregory. Photographed by C.B. Bell III.

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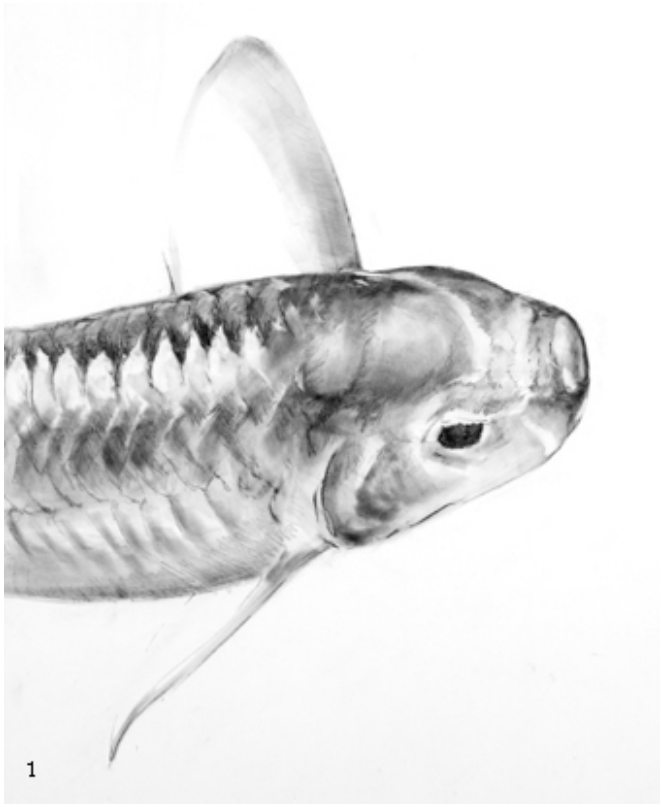
Cyprinocon arcuatus

Santa Cruz (Monkey Spring) Pupfish
Cyprinodon arcuatus (Minckley and Miller, 2002)

In 2002 Wendell L. Minckley and Robert R. Miller described the Santa Cruz pupfish (*Cyprinodon arcuatus*) based on a holotype specimen (UMMZ 162700) collected by Miller on April 27, 1950, at a pond fed by Monkey Spring, tributary to Santa Cruz River, (Gila River basin), 12 kilometers north-northeast of Patagonia, Santa Cruz County, Arizona. [**Minckley 2002, CA Acad Sci 2015**] These small pupfish (from ½ to 2 inches in length) probably existed throughout the upper Santa Cruz River basin in Arizona and Sonora, but seem to have become restricted to Monkey Spring sometime after 1927. [**Minckley 2009**] Monkey Spring was "…a constant temperature spring that was isolated from Sonoita Creek by a 20-foot high travertine wall." [**Weedman 1997**] Eleven years after Minckley and Miller's description, the Santa Cruz pupfish was officially listed as "extinct" in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. [**NatureServe 2013**]

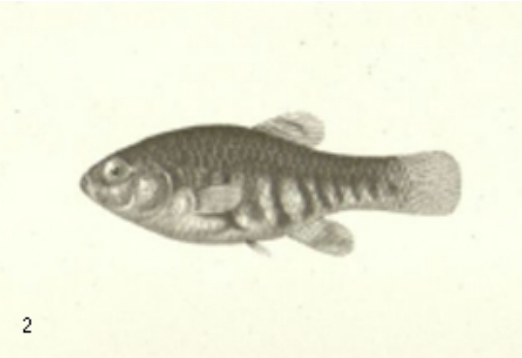


In 1851 Pierre Jouy collected a Santa Cruz pupfish specimen at the "drainage of a small lake or pond, Santa Cruz River, Arizona…" [**Smithsonian 2014**] Initially, the Santa Cruz pupfish, along with all other Arizona pupfishes, was considered one species: the "desert pupfish" (*Cyprinodon macularis)* [**Minckley 1973, Weedman 1997**]. Spencer F. Baird and Charles Girard first described *Cyprinodon macularis* in 1853, from specimens collected by John H. Clark in the Rio Gila during the United States and Mexican Boundary Survey. [**Baird and Girard 1853, Evermann 1889**] The following year, with the 1854 Gadsden Purchase, the U.S. agreed to pay Mexico $10 million for a 29,670 square mile portion of Mexico that would become the southern U.S. border of Arizona and New Mexico and provide the land necessary for the southern transcontinental railroad **[USDOS-Gadsen Purchase]**.

"Before water development (and even now) the West was dry and the image of fishes living in the desert an impossible one. Nevertheless, across the spread of the West, one finds canyon-bound rivers, isolated lakes (some with interesting chemistries), wet meadows, and spring heads. In these improbable settings in that arid land, one found some 170 species of fresh water fishes (v.

600 east of the Rockies)." [**Lynch 1993**] In 1904, only 50 years after the Gadsden Purchase, F.M. Chamberlain, (assistant with the old U.S. Bureau of Fisheries) outlined the major causes of the depletion and extinction of fish life in Arizona. [**Miller 1961**] Miller incorporated, updated, and summarized these in his 1961 "Man and the changing fish fauna of the American Southwest":

"Interference by man with delicate and complex ecological balances has had dire consequences in many parts of the world. Perhaps nowhere else in North America has the upset of natural condition been more strikingly reflected by biotic change that in the arid Southwest. Particularly in southern Arizona. Overwhelming evidence indicates that modern man, rather than climactic change has been the chief agent in producing the observed changes. Removal of vegetation by overgrazing and forest cutting has been the most important single cause of erosion. The deterioration of the native fish faunas can also be plausibly attributed to construction of dams, water diversions, pollution, mining operations, use of toxic chemicals, depletion of ground water, and introduction of alien species." [**Miller 1961**]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Almost 30 years later (1989) Miller specified: "Extinctions of 3 genera, 27 species, and 13 subspecies of fishes from North America are documented during the past 100 years." More than one factor contributed to the decline and extinction of 82% of the fishes, these included physical habitat alteration (73%), introduced species (68%), chemical habitat alteration (including pollution) (38%), hybridization (38%), and overharvesting (15%). [**Miller 1989**]

The Santa Cruz Monkey Spring pupfish too succumbed to extinction. "This…species occurred in abundance in the [Monkey] spring and an extensive ciénega formed by its outflow. Attempts to impound and deepen the ciénega apparently "broke the seal", which resulted in draining of the marsh (Minckley 1973). The pupfish remained abundant in the spring until the large mouth bass were introduced in 1968 and 1969. Minckley (1973) reported that a few pupfish escaped predation by large mouth bass until late 1969, when the species was extirpated in its natural habitat…Captive stocks of Monkey Spring pupfish failed in 1971 thus eliminating any hope for survival of Arizona's only single-spring endemic fish species." [**Miller 1989**]

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1. Rossano, Joseph Gregory. Photographed by C.B. Bell III.
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Diceros bicornis longipes

Western Black Rhinoceros or West African Black Rhinoceros

Diceros bicornis longipes (Zukowsky, 1949)

"To quiet, steady-going people in England there is an idea of cruelty inseparable from the pursuit of large game. People talk of 'unoffending elephants', 'poor buffaloes', 'pretty deer', and a variety of nonsense about things which they cannot possibly understand."

"There is no time when a man knows himself so thoroughly as when he depends upon himself, and this forms his excitement." -Sir Samuel Baker

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With this quote by one of the most renowned big game hunters of the 19th century, H. Karl W. Kumm opens a chapter recounting his own "most successful day" of shooting in the Shari Valley, on May 20, 1909:

"A rhino pair, evidently out for their afternoon walk, seemed much disturbed at our invading their domain. Their mischievous little eyes looked in our direction. They gave several grunts, evidently concerting with each other whether it would be advisable to play with us. I had my rifle in my hand, but in the rifle there were only soft-nosed cartridges, not very safe missiles for the attack of those thick hides. I jumped up to the tree on which my boy hung and hauled at his leg, explaining to him that I wanted a hard-nosed bullet. In a moment I had one, jammed into the chamber of my rifle, and just when the two had decided to look at us more closely. I caught the first one with a front shot that penetrated his heart and killed him on the spot. Without a sound he subsided, sitting down on his haunches, his legs stretched out in front, and his head resting between his forelegs. Two more grunts his companion gave and then came towards me. With frantic haste I hauled again at the leg of my boy, telephoning up to him that I wanted at least two more cartridges. I got them, pushed them into my rifle, and just as the beast went at full tilt past the tree behind which I was hiding. I got him behind the shoulders. Round he spun and came for me again, and that time I put in a bullet close to the eye, which evidently destroyed his thinking powers. His forepart trying to stop and his hind part coming on made him turn a complete somersault, and with a squeal he lay dead, the whole happening not more than 150 yards away from the tent. Within a couple of minutes my boys were all round me, and rejoiced in the feast ahead of them. It was 4 o'clock

when I went back to the tent for my tea, having secured two buffaloes and two rhinos within less than an hour." – [**Kumm 1910**]

On January 9, 1911 Adolf Friedrich, Duke of Mecklenburg-Schwerin and leader of the German Central African Expedition of 1910-1911, hunted a female black rhinoceros near Mogrum, in the Schari (Chad) area [**Adolf Freidrich 1913; Zukowsky 1949**]. It would be almost 40 years (1949), before this specimen's large skull would serve as the holotype for Ludwig Zukowsky's official description of the Western black rhinoceros: *Diceros bicornis longipes,* one of four subspecies of African black rhinoceros (*Diceros bicornis*). [**Zukowsky 1949**]

In the 20th century, the Western black rhinoceros (*D. b. longipes)* population and range declined from an estimated 3000 animals in Central Africa (1900) to only 10 animals in Cameroon (1999) [**Planton 1999**]. By 1930, only 500 animals remained and the population was considered to be on its way to extinction [**Blacou 1958**]. Strong protective measures were implemented, the population rebounded, and by 1970 there were an estimated 1800 Western black rhinoceros in Central Africa, almost half of them in Cameroon. "Poaching pressure escalated during the 1970s and 1980s as a result of the rising demand for rhino horn in Asia and the Middle East...These years were also marked by economic and political instability in a number of range states, which presented commercial poachers with a virtual free hand to hunt rhinos with little likelihood of apprehension." [**Emslie 1999**] As a result, in the 1980's Western black rhinoceros was eradicated in Central Africa and Chad, and reduced to a population of 200 animals in Cameroon. [**Planton 1999**] By 1985, only 110 Western black rhinoceros remained; by 1999 only 10 were left.

A 2001 survey estimated that only eight Western black rhinoceros were left in northern Cameroon [**Emslie 2002**; **Kock 2002**]. The estimate was based on findings such as "…freshly browsed branches, a tree rubbing post, a bedding area, and fresh spoor" in addition to confirmation of other credible sightings by trackers. No Western black rhinoceros were actually seen. By the next survey in 2006, the Western *D.b. longipes* was presumed extinct:

"From 25 January to 8 June 2006, the NGO Symbiose and veterinarians Isabelle and Jean-François Lagrot with their local teams patrolled the distribution area of *Diceros bicornis longipes* in northern Cameroon to assess the status of the last population of the western black rhino subspecies. Over 46 field patrols were organized in the area situated roughly between Faro National Park on the western border and Bouba Ndjida National Park on the eastern border, totaling over 2500 km of patrol effort. Using historical data, results of previous surveys, information from a network of villagers and cooperation with trophy-hunting guides, the fieldwork carried out during the dry season concluded that no reliable sign of rhino presence was found to attest to the survival of the western black rhino. The estimation of around 30 individuals produced by Symbiose in August 2004 was based on fake rhino tracks, which some of the trackers had made to preserve their jobs. Following this survey, the African Rhino Specialist Group of the International Union for the Conservation of Nature, Species Survival Commission, modified the official status for *D.b. longipes.* Thus far classified as Critically Endangered with 5 confirmed individuals in 2001, it has now been declared Probably Extinct. Symbiose continued the survey through the rainy season until the end of 2006. Despite 23 additional field patrols, no reliable sign of rhino presence was found." [**Lagrot 2007**] "The last rhino sighting was reported as occurring at the end of 1998 in Hosere Makat [Cameroon]… The results of a WWF and Ministry of Wildlife and Forest transect survey in Benoué National Park in May 2006 also found no sign of rhino presence (Gilles Atoga, WWF, pers. comm. 2006)." [**Lagrot 2007**]

In 2011, *Diceros bicornis longipes* was officially listed as "extinct" in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species [**IUCN-Emslie 2011**].

Modern man is solely responsible for the Western black rhinoceros' extinction and for the ongoing threat of extinction to the rest of the African rhinoceros. The modern African rhinoceros appeared approximately 17 million years ago [**SDZ 2013**] evolving into two separate species (black and white rhinoceros) two million years ago [**George 1989**]. "Rhinoceros swarmed in the countries north of Lake Chad in the days of the Romans. This fact was reported by the exploring Roman expedition under Septimus Flaccus, sent south of Fezzan [Lybia] toward Lake Chad at about A.D. 10." [**Johnston H 1909**] "Early in the 19th century the black rhinoceros was the most numerous of the world's rhino species, with several hundred thousand animals roaming the African continent from central-west Africa to the slopes of Table Mountain in the far south...as European influence over land use and trade strengthened, the black rhino was hunted relentlessly across most of central-west and eastern Africa." [**Emslie 1999**] During the 19th century approximately 850,000 rhinoceros roamed in Africa [**SDZ 2013**]. However, between 1849-1895 East Africa may have traded 11,000 kg/year of rhinoceros horn, or 170,000 black rhinos [**Martin 1982**].

Beginning in the 20th century, heavy hunting pressure for their horns led to a rapid decline in their numbers. Theodore Lefebvre, alone, is said to have hunted 400 black rhinoceros [**Pfeffer 2005**]. "In southern Africa only two breeding populations of about 110 animals had survived by 1933. In Kenya, approximately 1,000 black rhinos were shot between 1946 and 1948 by a game control officer and his colleagues who were preparing the Makueni area for agricultural settlement (Brett 1993)." [**Emslie 1999**] "Despite this onslaught, it has been estimated that there may still have been as many as 100,000 black rhino in Africa in 1960...by 1970…only 65,000 black rhinos were left..." [**Emslie 1999**] Since 1977, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has prohibited "…commercial international trade in rhinos and their products, and derivatives, including hunting trophies. " [**Milliken 2012**]

Emslie wrote [**Emslie 1999**]: "Over the centuries, all species of rhino have been shot as 'vermin', as hunting trophies, and for their meat. They have been cleared from land destined for human settlement and their habitats have been degraded through land management practices and human encroachment. Rhino skin has been used for shields and good luck charms, and even blood, urine, bones, and dung have been used in traditional medicines and potions to reduce fevers, headaches and other illnesses (Martin and Martin 1982, Leader-Williams 1992). Without doubt, demand for rhino horn has been primarily responsible for the catastrophic decline in rhino numbers, particularly in the second half of the 20th century." [**Emslie 1999**] Between 1960 and 1995 there was a 98% decline in the black rhinoceros population, from 100,000 down to 2410 animals, due to large scale poaching [**SDZ 2013**].

Leader-Williams reviewed the long history of international rhinoceros horn trade [**Leader-Williams 1992**]. Rhinoceros horn was used in Chinese medicine as early as 200 B.C.-200 A.D. (Martin and Martin 1982; But et. al., 1990), to "reduce fevers, headaches and other illnesses…" During the Ming (1368-1644) and Ching (1644-1911) dynasties, they were also used for ornamental purposes, fashioned into "…beautiful cups, plates, bowls and figurines" and "…drinking vessels [which] had the added advantage of being able to detect alkaloid poisons in an age when such poisons were a major means of treachery." In the 1950's Chairman Mao Zedong promoted the institutionalization and standardization of Chinese medicine, turning it into a high-profile part of the national healthcare system [**Taylor 2005**]

Martin *et. al.*, [**Martin 1997**] summarized the history of the rhinoceros horn trade in Yemen where it is sought "… for the manufacture of an artifact which for centuries has been the most potent symbol of Yemeni culture – the *jambiya*…dagger-like knives with curved blades, worn daily by many Yemeni men as part of their traditional dress, and whose origins date back thousands of years. In Sanaa's National Museum is a fifth or sixth century B.C. bronze statue of a man with a *jambiya* tucked into his belt."

Before mid-20th century, the type of *jambiya* or the way it was worn, was a sign of the individual's societal status: "Traditionally, the *Qadis* (judges) and *Sayyids* (descendants of the Prophet Mohammed) wore the *jambiya* to the right, while those of moderate social standing wore it in a central position, and those of lower status to the left. Those who could not claim a tribal origin, or who were of low social status, were not supposed to wear a *jambiya* at all." Now, most *jambiyas* are worn in the center, so "…the quality and value of a *jambiya* is significant and denotes a person's wealth…[and]…the most prestigious element of a *jambiya* is a good rhinoceros horn handle… Considered both beautiful and durable, rhinoceros horn is worked by only the most skilled craftsmen of *jambiya* handles who earn twice as much as those using cheaper materials, and may take anything from half a day to three days to complete one handle." Martin adds: "Three average-sized *jambiya* handles can be made from a rhinoceros horn weighing 1.5kg. About five handles can be made, however, from a 2kg rhinoceros horn and for this reason the larger, anterior horns of African species are preferred and more valuable. Rhinoceros horn handles normally weigh from 100g to 200g and thus over 60% of a horn is shed as chips and shavings by the carver, the percentage being greater for smaller horns." "Authentic" *jambiyas* sell for $50,000-$100,000 each [**Al-Wesabi 2013**].

The "…longstanding main *jambiya* family, which has also been the main dealer and importer of rhinoceros horn in Yemen, reports importing approximately 250 to 300kg during the 1950's…and about 400kg in 1960 and 1961." In 1970, following the conclusion of an eight-year civil war and "…the opening of North Yemen to the outside world…along with the increase in oil prices in the gulf, led to a marked improvement in the standard of living among North Yemenis…a very large number [who] could now afford to buy prestigious *jambiyas* with rhinoceros horn handles…" From 1969-1977, an average of 2878kg of rhinoceros horn were imported each year (8750 *jambiya* handles with a peak in the mid-1970's of 12,000 handles/year). During that time, North Yemen accounted for "… 40% of all the rhinoceros horn on the world market...more than any other nation in the world at that time." In 1982 rhinoceros horn imports were banned in Yemen. "…the Yemeni's traders claimed total volume of 36,000 kg of horn represents the death of a minimum of 12,750 rhinos [between 1970 and 1986]." [**Martin 1987]** "By the late 1980's, North Yemen's average import volumes…had fallen to under 500kg per year…due to dual effects of declining numbers of rhinoceros in Africa with the expansion of East Asian interests in the horn trade, with East Asians able to offer double the price per kg for rhinoceros horn to traders in Africa by 1988." [**Martin 1997**].

The 21st century will likely mark the extinction of the African rhinoceros. In a 2012 report, Milliken noted that it is now Vietnam who "…since 2003 has rapidly grown to become the world's largest recipient of both legal and illegal sources of horn from South Africa. [**Milliken 2012**] Ironically, "…Viet Nam's own vestige rhino population, the rarest of all extant subspecies, was only rediscovered as recently as 1988, but by 2011 was recognized as extinct." [**Milliken 2012**] The price of rhino horn has increased from approximately $800 USD/kg in the 1990's to $65,000 USD/kg in 2013 (more than gold, heroine, or cocaine) [**Anderson 2014**]. By the time it gets to Asia, a single horn can be worth $500,000 USD, spurring a lucrative market for the illegal trade [**Daily Mail 2014**].

Vietnam's rhino horn market traditionally focused on its use for purported medicinal purposes, which most

recently have expanded to unsubstantiated claims of its effectiveness as a cure for cancer, in cancer prevention, and as an aphrodisiac. Increasingly, a new affluent generation is using it as a post-binging hangover cure. "[Rhino horn] is considered effective in treating symptoms that can accompany the new lifestyle expectations of the rich – a lot of drinking, eating and drugs, which create body heat and which some believe can be eradicated by consuming rhino horn powder (mixed with rice wine) (Ammann, 2011) [**Milliken 2012**]." Now "rhino horn with wine is the alcoholic drink of millionaires"…"like a luxury car" (Smith, 2012b). [**Milliken 2012**]

As the number of Vietnamese millionaires has grown 150% in the last five years [**Guilford 2013**], rhino horn has become a symbol of social status, sought after as a rare and expensive commodity. As Milliken notes "…young, affluent, habitual users of rhino horn are, generally speaking, the most superficial, one could argue mindless, consumers in Viet Nam, but probably account for the greatest volume of rhino horns consumed in the country today… Indeed, social status is enhanced or reaffirmed by joining this exclusive, if not flippant, club of rhino horn users in Viet Nam." [**Milliken 2012**] Also "…rising income and a strong desire to flaunt new money and success amongst friends and business partners, may be a more important factor driving the trade with Vietnam…'The new rich want luxury goods that are rare, exotic, and expensive as indicators of their success' (ENV, 2012)." [**Milliken 2012**]

"Initially, the primary focus of criminal activity was directed at acquiring rhino horns through legal trophy hunting, augmented by a concerted effort to purchase privately-owned and generally unregistered rhino horn stocks illegally." [**Milliken 2012**] More recently, however, this has expanded to acquiring rhino horn through illegal means involving the trophy hunt industry with "pseudo-hunting", in addition to sophisticated criminal networks burglarizing museums, taxidermists, game reserves, auction houses, and private collections.

In some African countries, trophy hunting is legal and highly profitable. In South Africa, hosting over 9000 trophy hunters annually, and employing over 70,000 people, it translates to a $744 million USD/year industry, making it "…the single most lucrative form of commercial land use." [**Parker 2014**] Rhinoceros trophy hunting prices have ranged from approximately $100,000 USD [**Parker 2014**], to a 2014 $350,000 USD bid for a permit to hunt a black rhino in Namibia. [**Howard 2014**] Increasingly concerning is "pseudo-hunting" which has recently emerged as another challenge. "Non-traditional" Vietnamese hunters, who did not know how to shoot or who were not interested in having their trophies mounted, began to flock South Africa as "trophy hunters" around 2003. In 2012, after 400 white rhinoceros hunts, South Africa suspended issuance of hunting permits to Vietnamese hunters. [**Milliken 2012]** "It is estimated that since 2003, Vietnamese hunters have paid more than USD22 million to hunt rhinos in South Africa." [**Milliken 2012**]

A criminal wave of rhinoceros horn theft has recently swept through Africa and Europe. In South Africa, between 2002-2010, 65 rhinoceros horns (21.5kg) were reported stolen [**Milliken 2012**]. Since 2009, an Irish traveler family from Rathkeale, in Limerick, Ireland, is believed to be responsible for rhinoceros horn burglaries at over 100 museums and auction houses across Europe [**DailyMail 2014**].

Most alarming is the escalation of illegal killing of rhinoceros for their horns (poaching), which since 2006 began to emerge as another arm of criminal activity. Growing evidence of rhinoceros "…killed by a single shot from a high-caliber weapon characteristically only used by wildlife industry professional or, less frequently, have been darted with immobilization drugs and had their horns removed…and other evidence that has even suggested the presence of helicopters at crime scenes, represents a completely "new face" in terms of rhino poaching…

[underscoring] the emergence of corrupt game industry insiders into rhino poaching. Rogue game ranch owners, professional hunters, game capture operators, pilots and wildlife veterinarians have all entered the rhino poaching crisis…[**Milliken 2012**] National middleman dealers, wildlife industry insiders, Africa-based Asian syndicate dealers, and embassy personnel have also become active participants.

The most recent figures indicate that in 2012 there were an estimated 5081 black (no *D. b. longipes*) and 20,429 white rhinoceros left in Africa [**Emslie and Knight 2014**]. Following Zimbabwe's independence in 1980, rhinoceros poaching escalated and remained unabated in that country until 1994 at which time, it started shifting to South Africa, at a rate of about 13 rhinoceros/year or 1/month [**Milliken 2012**]. Between 1990-1999, 129 rhinoceros were poached in South Africa. In the following decade (2000-2009), 351 animals were poached with 205 of them poached between 2008 and 2009. In the first half of this decade alone (2010-2014), 3,668 rhinoceros were poached in South Africa, 1215 in 2014 alone. [**Platt 2015].** Records indicate that in the first three weeks of 2015, 49 rhinoceros were already poached [**Platt 2015].**

In 2014, Emslie and Knight noted: "…it is estimated that, continentally, poaching has been growing by 38.76% a year from 2008-2013. If continental poaching continues to escalate exponentially at this rate, modeling predicts… that the tipping point (when rhino numbers start to decline at a continental level) could be reached sometime between 2014-2016…Furthermore, if poaching continued to increase exponentially at this rate rhino numbers are predicted to drop to less than 10,000 (by over 60%) by the end of 2019 and reach 0 the following year." Extrapolated projected times to extinction under the two more conservative arithmetic modeling scenarios were no more encouraging: 2024-2028 (if an additional 351 rhinos are poached /yr) and 2027-33 (additional 225/yr)." [**Emslie and Knight 2014**].

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1. Rossano, Joseph Gregory. Photographed by C.B. Bell III.

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Hesperia meskei pinocayo

Rockland Grass Skipper Butterfly
Hesperia meskei pinocayo (Gatrell & Minno, 2003)

In 2003 Gatrell and Minno identifed the lower Florida Key's Rockland grass skipper butterfly (*Hesperia meskei pinocayo*) as a unique subspecies of Meske's skipper butterfly (*Hesperia meskei)* **[Gatrell and Minno 2003]**. W.H. Edwards described the nominate Meske's skipper butterfly (originally named *Pamphilia meskei*) in 1877 using a single Bastrop County, Texas specimen from Otto von Meske's private collection **[Edwards 1877].** For the Rockland skipper butterfly's description, Gatrell and Minno examined 36 Florida specimens collected between 1973 and 1983, housed in both museum and private collections. They wrote:


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"One of the most recent treatments of this segregate was by Minno and Emmel (1993) in *Butterflies of the Florida Keys*. In the species account, they state that the Keys population seems to represent an unnamed subspecies. Why this segregate has never been described is not fully known, however, one reason is that various lepidopterists have talked of doing so over the last 40 years and others held off from describing it out of professional courtesy. But none have done so. Now, not only have the decades passed by, but also, this taxon has nearly passed into extinction. The authors believe it is imperative that this unique and now very rare insect, receive formal status as a taxonomic taxon to better assure that it is afforded any and all protection that it may require. This official status can also help in promoting searches for it on the mainland and reintroduction efforts if needed." **[Gatrell and Minno 2003]**

The Rockland skipper butterfly's formal designation as a unique subspecies in 2003 came late: three years after it was last seen in Everglades National Park (2000) and four years after it was last seen in Big Pine Key, Florida (1999) **[Warren 2013]**. In 2006 Minno and colleagues began conducting monthly to bimonthly surveys of the Rockland pine forests and seaside jungles of the Florida Keys and southern Miami-Dade County to tally butterfly

relative abundance and species diversity **[Minno 2011]**. The survey was scheduled to take two years, but none of the experts could find the butterflies of interest, in any stage of life, so the survey was extended to 6 years **[Morgan 2013].** In the final 2012 report to the U.S. Fish and Wildlife Service, it was recommended that the Rockland skipper butterfly be presumed extinct.

The major cause or causes of the decline and loss of the butterfly populations in Florida remain uncertain. "Many variables have been implicated in the overall decline…including habitat loss and fragmentation, chemical contaminants, exotic ants, illegal collecting, and climate change. Mosquito control insecticides have been frequently blamed for the decline. However, the butterflies have also disappeared from vast areas where no spraying occurs or where it is extremely limited, such as Biscayne National Park and Everglades National Park." **[Minno-2012]**

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Macrobrachium leptodactylus

Freshwater Shrimp from Java

Macrobrachium leptodactylus (de Man, 1879a)
Leptodactylus (thin, delicate, fingers/toes)

The Dutch arrived in Indonesia in 1598 "…as traders and inhabitants of trading posts…[but] soon became local sovereigns, and remained a colonial power until Indonesia became politically independent after World War II." [**Van Aken 2005**] Merchant Willem Lodewijckz made some initial recordings of the marine life, but the volumes of data gathered by the Dutch United East India Company (Vereenigde Oost-Indische Compagnie – VOC) during two hundred years of exploratory cruises and trading voyages were "…strategic information treated as a business secret", stored in the company archives [**Van Aken 2005**]. The VOC was "…formed in 1602 when the States-General of the United Provinces, the highest authority of the Republic of the Netherlands, persuaded several competing Dutch spice-trading firms to incorporate into a single trading company…[with the] authority in the trade zone between South Africa and Japan to conduct trade, erect fortifications, appoint governors, keep a standing army, and conclude treaties in its name…Between 1602 and 1796 the VOC sent almost a million Europeans to work in the Asia trade on 4,785 ships, and netted for their efforts more than 2.5 million tons of Asian trade goods." [**TANAP**] The VOC held the monopoly on the spice trade (i.e. nutmeg, cinnamon, clove, pepper), expanded to silk, porcelain, and other textiles, becoming the world's first multinational corporation and the first to issue stock [**World Oldest Share**]. In 1619, the VOC established a capital in Jayakarta (renamed it "Batavia" now Jakarta), Java. Following the VOC's bankruptcy, the new Dutch government's budget in the East Indies was severely limited: "The colonies had to pay for themselves and be profitable for the Netherlands, and science was not a good investment." **[Van Aken 2005**]. Therefore, it was the British, French, German, Austrian, and American ships and scientists that carried out most of the research through the end of the nineteenth century.

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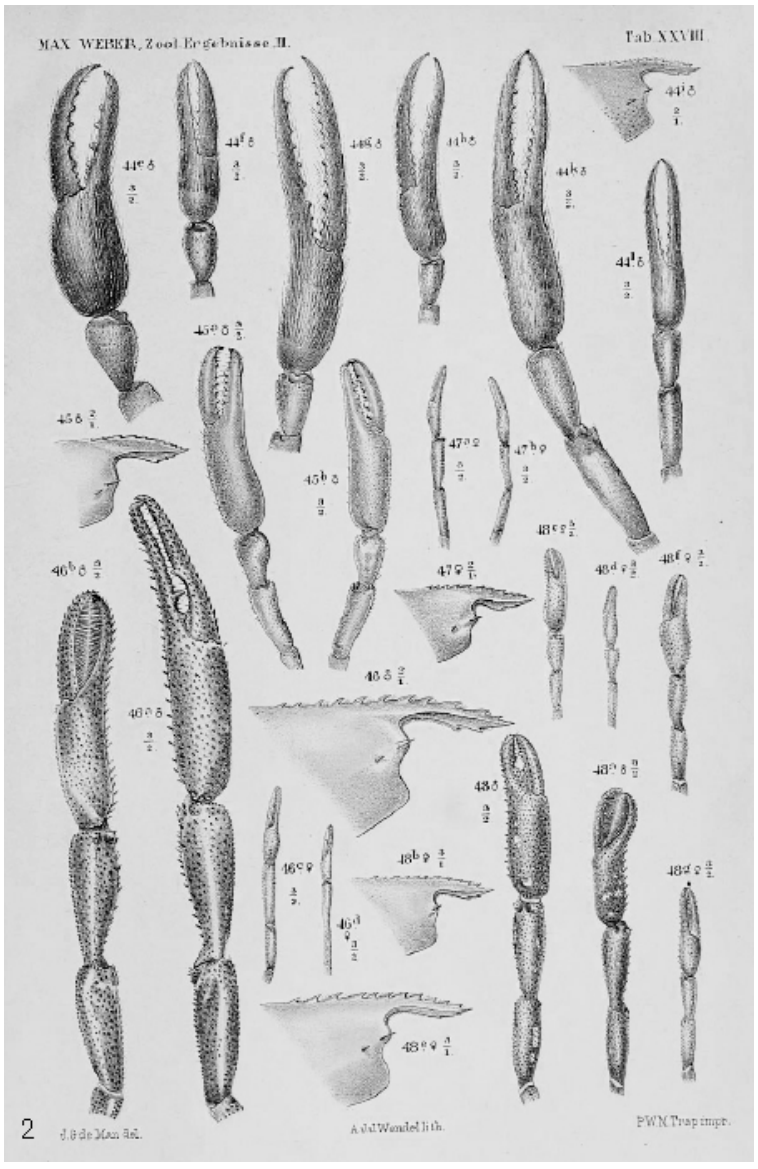
In 1887, Dutch-German zoologist Max Wilhelm Carl Weber (Max Weber) and his wife, marine botanist Anne Antoinette van Bosse, embarked on a two-year private expedition to the volcanic islands of Java, Sumatra, Celebes, and Flores in an effort to gain a better understanding of "… the difficult problem of the distribution of animals in the Indo-Australian Archipelago and their relation to either the Indian continent or Australia." [**Pieters 1993]** Weber collected 10 freshwater shrimp specimens from an unspecified location in Buitenzorg (Bogor Regency), Java (1888) and in 1892 Dutch zoologist Johannes Govertus de Man, described these as a new subspecies: *Palaemon pilimanus*, var: *leptodactylus* (now called *Macrobrachium leptodactylus*)

[**de Man 1892**]. These are the only *M. leptodactylus* specimens ever collected. In 2013, following 30 years of annual surveys without a single additional collection of this freshwater shrimp, *M. leptodactylus* was listed as "extinct" in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species [**de Grave - IUCN**]. The major threats to the species are believed to have been the Bogor regency's rapid urbanization and agricultural development.

With the Dutch institution of the "cultivation system" in the 1830's, Java was transformed into a colonial society focused on compulsory, large-scale production of government crops for export (i.e., coffee, sugar, indigo). Between 1837-1851, "…over 70 percent of agricultural families were producing export crops..." [**Ricklefs 1993**] In 1869, the Suez Canal provided the critical shortcut needed between Europe and Asia, which combined with better steamships and the telegraph, revolutionized Asia, with people, goods and ideas moving at unprecedented scales **[Pomeranz 2006].** In the Java, the Dutch moved beyond the spice trade to even greater agricultural development (i.e., cacao and rubber), rapid industrialization (i.e., tin mining and oil wells), and urbanization (e.g., new roads and railroads to transport these products to the coast for export) [**Pomeranz 2006]**. Concurrent with this, a rapidly increasing Java population was recorded.

Between the end of the 18th century and 1890, there was a five-fold increase in Java's population from approximately 5 to 23.6 million inhabitants [**Rickelfs 1993**]. Rickelfs writes: "Boomgard argues that opportunities for paid non-agricultural employment encouraged couples to marry earlier and to have more children. In the second half of the nineteenth century, when birth rates may have declined somewhat, this was more than offset by a decline in mortality (especially infant mortality) through successful vaccination against smallpox and the decreasing virulence of cholera and typhoid epidemics." [**Rickelfs 1993**] Over the next century, there was another six-fold increase in Java's population to 139.4 million inhabitants (2014), making it the most populous island in the world [**Wiki 2014**] . *M. leptodactylus'* type locality, the Bogor Regency, with an area of 2,710.62 km² has a population of 5.1million or 1,893.2 inhabitants/km² [**City pop 2014**]. Bogor, the city, with 949,066 inhabitants, has a population density of 12,571inhabitants/ km² at the city center [Java **2010 Census**].



Environmental waste and pollution are an ongoing problem: "Some 300 of the 800

industrial companies operating in Bogor regency produce hazardous and toxic waste…about 100 of those 300 companies dump their waste at disposal sites in Nambo village, Gunung Putri, Bogor…in Bogor regency, …the vehicle emission rates went beyond the allowable limit…In Cibinong [capital of Bogor regency], for instance, the levels of carbon monoxide has reached an alarming level…" [**Jakarta Post 2001**] In Cinangka village in Bogor illegal lead-acid battery smelting resulted in a "…pollutant concentration of 100,000 parts per million (ppm) in the soil and with a human contamination of more than 60 milligrams of glucose per deciliter (mg/dl) in the blood of its children." [**Jakarta Post 2014**] The maximum "lead level of concern" is 400 ppm in soil and 10 mg/dl in humans; [**ATSDR/CDC website**] lead water concentrations between 0.1 and >40 mg/L are considered toxic to freshwater invertebrates such as *M. leptodactylus* [**EPA 1999, Cigerci 2010**]. Further complicating *M. leptodactylus'* story of extinction is the fact that some believe it may be a synonym for the "Chameleon shrimp" *Machrobrachium pilimanus*, originally identified in Sumatra and abundant throughout Indonesia.

Between 1877 and 1879, the Royal Netherlands Geographic Society organized a scientific expedition to map out the Hari River basin of Central Sumatra, to study its people, and the natural environment [**van Hasselt 1885**]. In 1879, Johannes Francoise Snelleman (expedition zoologist), collected 70 freshwater shrimp specimens "…in the river of Alahan-Pandjang, and five more specimens at Moeara-Laboe…" and de Man, described them as a new species: *Palaemon pilimanus* (now *M. pilimanus*) [**de Man 1879**]. In 1950, Lipke Bijdeley Holthuis, a Dutch zoologist born in Java, and the greatest expert in the study of crustaceans, described *Palaemonidae* specimens collected by Max Weber (expedition leader) and L.F. de Beaufort (director of the Zoological Museum in Amsterdam) during the Siboga (1899-1900) scientific expedition to the Netherlands East Indies, in addition to his evaluation of the specimens from the Rijksmuseum van Natuurlijke Historie at Leiden and of the Zoological Museum in Amsterdam [**Holthuis 1950**]. Holthuis was the first to consider *Palaemon (Macrobrachium) pilimanus* and *Palaemon (Macrobrachium) pilimanus*, var: *leptodactylus* to be the same species [**Holthuis 1950, Holthuis 1979]**. Johnson (1958 and 1964) and Chong (1989) reexamined the specimens, de Man's descriptions and drawings, and declared them to be two distinct species [**Johnson 1958, Johnson 1964, Chong 1989**].

Most recently, Ou and Yeo (1995) examined a large series of specimens of *M. pilimanus* collected from Bogor, Java, (type locality for *M. leptodactylus*) and wrote: "Examination of these specimens leads us to believe that *M. leptodactylus* may simply be a variant of the Javan "*M. pilimanus*" (sensu De Man, 1892). Javan specimens of "*M. pilimanus*" show consistent differences from the specimens from other localities and might well belong to a separate species. [**Ou and Yeo 1995**] Holthuis wrote: "The problem of the *M. pilimanus* complex is so complicated that only the study of an extensive material from numerous localities all over its range and the study of live specimens in their natural habitat, can make clear whether the extraordinary variability within this complex is caused by age, sex, environmental conditions, seasonal conditions, or by taxonomic differences (probably by a combination of some of these)." [**Holthius 1979**] DNA sequencing could help determine whether *M. leptodactylus* is the same species as, or a distinct species from *M. pilimanus* [**Liu 2007**]. Definitive determination of these as distinct species would support *M. leptodactylus'* classification as "extinct".

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1. Rossano, Joseph Gregory. Photographed by C.B. Bell III.
2. De Man J.G.(1892a) Decapoda des Indischen Archipels. In M. Weber, Zoologische Ergebnisse einer Reise in Niederländisch Ost-Indien, 2: 476-477, pl. 28: fig. 44K-i. Contributing Library: Smithsonian Institution. Contributing Library: Smithsonian Institution
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Chioniria coctei

Cape Verde Giant Skink (Coctau's Lizard)

Chioninia coctei (Duméril & Bibron, 1839)

The Cape Verde Giant Skink's *(Chioninia coctei)* story spans 650 years: from the Portuguese discovery (1456) and colonization of the Cape Verde Islands (1462), to the specimen's first recorded collection (1784), description (1839), last capture (1898), last sighting (1912), and extinction (2013). At one point *Choninia coctei* was most likely found throughout the Cape Verde archipelago of volcanic islands, approximately 350 miles off the western coast of Africa in the Atlantic Ocean. However, in recorded history, it has been found primarily on the two smallest islands, Iléhu Branco (1.2sq. miles) and Iléhu Raso (2.7 sq. miles), with one report that they existed in Iléhu Santa Luzia and bones reported to be found on Iléhu Sao Vicente and Iléhu Sao Anto. [**Schnirel 2004**]

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The discovery of the uninhabited archipelago was a result of Portuguese Prince Henry the Navigator's ongoing desire to find "…a sea route to the Spice Islands and cut out the Arabic and Venetian middlemen." [**Toler 2012**] The volcanic islands held lush valleys on which the Portuguese immediately instituted agriculture and introduced non-native species. However, the Cape Verde Island African slaves brought to cultivate its plantations, soon became much more profitable as part of the slave trade in the New World. For the next 300 years, the islands held a monopoly in slave trade and it was not until the abolition of slavery, and the beginning of the Portuguese Enlightenment that records of the flora, fauna, geology, and geography of the islands started to become available [**Halter 2005**].

Natural history collections in Portugal began in 1768 with the foundation of the Royal Botanical Garden and the Cabinet of Natural History of Ajuda, under the direction of Italian naturalist Domenico Agostino Vandelli [**Ceriaco 2012**]. In 1778, as part of the Portuguese Enlightenment, Vandelli began training his best, recently graduated naturalists from the University of Coimbra, for "philosophical journeys" (scientific expeditions), to the Amazon (Brazil), Mozambique, Angola, and Cape Verde [**de Mello 2010; Mateo 2012**]. Five years later, the naturalists embarked on their individual journeys with the objective of mapping out the Portuguese territories, collecting the best zoological, botanical, and mineral specimens that would create a great Museum of Natural

History in Lisbon, and identifying new potential sources of wealth for the kingdom [**Mateo 2012, Raminelli 2012**].

João da Silva Feijó, a young Brazilian mathematician and naturalist, carried out his 11-year philosophical journey in the Cape Verde Islands. In 1784, Feijó sent Vandelli two large "lagartos" (lizards) from the Iléhu Branco [**Feijo 1784, Ceriaco 2012**]. Vandelli stored but did not label the specimens. In 1797, Feijó "…refers to the species as 'a large and fat kind of lizard', with a skin 'covered with fish scales', and used by the locals to make footware, pointing out that the species only occurred on one of the uninhabited islets west of the island of São Nicolao." [**Feijó 1797, Ceriaco 2012, Carreira 1986**] Following the Napoleonic invasion of Portugal (1807), general Junot, signed an order granting professor Étienne Geoffroy Saint-Hillaire permission to meet with Vandelli, select the best specimens from the Cabinet of Natural History of Ajuda and send them immediately to Bernard Germain Lacépède, curator at the Muséum national d'Histoire naturelle in Paris [**Mateo 2012, Ceriaco 2012**]. In 1809, Saint-Hillaire selected two "lagartos" mounted specimens: one would wait 30 years to get formally described (Duméril and Bibron, 1839); the other would be presented to the to the Netherlands' Leiden Museum (1838) and end up misidentified for 175 years, as a Round Island Skink - *Leiolopisma telfairii* (Desjardin, 1831) from the Indian Ocean's Islands of Mauritius. [**Ceriaco 2012**]

In 1839, André Marie Constant Duméril and G. Bibron described the Cape Verde Giant Skink and named it *Euprepes coctei,* in honor of Jean Theodore Cocteau, author of a seminal book on skinks [**Dumeril and Bibron 1839, Cocteau 1836**]. Without information on the type locality, their best guess was that it might have come from the coast of Africa. In 1867, José Vicente Barbosa du Bocage, curator of zoology at the National Museum of Lisbon, met with Duméril in Paris and examined the *Euprepes coctei* specimen [**Bocage 1873**]. The French refused to return the holotype to Portugal. Bocage began an active search to determine the species' place of origin and obtain new specimens [**Mateo 2012**]. Through his research, Bocage realized that the *Euprepes coctei* specimen in Paris was identical to three unmarked specimens he had recently found at the National Museum of Lisbon [B**ocage 1873**]. He narrowed his search to the Cape Verde Islands and through a variety of contacts, was finally successful at acquiring from Dr. Federico Hopffer, Cape Verde Islands' public health official, three live specimens from Iléhu Branco; two died shortly after arrival, the third lived another four years. [**Bocage 1873**] In 1873, almost a century after Feijó first collected his specimens Bocage reclassified the Cape Verde Giant Skink as *Macroscincus coctei*, published its type locality as Iléhu Branco, and in doing so, unknowingly opened the final chapter in the species' extinction. [**Bocage 1873**]

"During the nineteenth century the exotic animal trade emerged as an important part of empire building. Animal capture represented the conquest of distant and exotic lands and the display of exotic specimens, in the emerging zoological collections of Europe, acted as a demonstration of imperial might." [**Larson**] By 1877, only four years after Bocage's manuscript, Charles Jamrach, German naturalist and renowned wildlife dealer, had both live and mounted specimens of the Cape Verde Giant Skink available for sale at his East End menagerie in London, for 2 pounds each (comparable to half an ounce of gold). [**Mateo 2012**] Hundreds of specimens were captured on the Iléhu Branco and Raso, others in São Vicente and Santa Lucia, and sent to Europe. In 1891, M.G. Peracca of the Zoological Museum of Turin and interested in collecting for the vivarium at his private estate in Chivasso, received 40 specimens from Ilhéu Branco (26 were "rediscovered" in the Herpertological Collection of the University of Turin and 6 others at Treviso). [**Peracca 1891A, Peracca 1891b, Andreone 2000**]

The Cape Verde Giant Skink's extinction appears to be likely due to a combination of human interference (i.e.,

hunting for food, hunting locals making sandals, deforestation, overgrazing, extensive agriculture, introduced species, over-collection by natural history dealers) and natural factors (i.e., several severe droughts had lead to the death of over 40% of the human population, volcanic eruptions). [**Vasconcelos et al 2013, Schnirel 2004, Andreone 2000, Andreone 1998**] The Cape Verde Giant Skink "…was a specialized insular lizard, adapted to the environment and likely unable to recover in case of habitat disturbance and introduction of alien elements… selective collecting of adult specimens (possibly due to the demands of natural history museums), as well as low juvenile recruitment rate – which might have been reduced by predation of eggs and juveniles by introduced mammals (e.g. cats, dogs, and rats) – may have contributed to the extinction of this peculiar species." As early as 1873 Bocage commented on Iléhu Branco being used as a prison for local outlaws dropped there and left on their own, probably resorting to eating giant skink for survival. [**Bocage 1873, Andreone 2000**]. Twenty-three years later (1896) he commented on the unsustainable collection of specimens by naturalists. [**Bocage 1896**]

The Cape Verde Giant Skink was last seen in its natural habitat in 1912; only four years later it was already being spoken of as extinct and unfortunately multiple searches for it between 1969 and 2008 were unsuccessful [**Friedlaender 1913**, **Andreone 2000, Vasconcelos et al 2013**]. The species was listed as extinct in the first Red List of Cape Verde in 1996. [**Scheich 1996]** In 2010 as part of an integrative taxonomic revision of Cape Verdean skinks it was reclassified as *Chioninia cotei* and three years later (2013) it was listed as extinct in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. [**Miralles 2010, Vasconcelos IUCN 2013**].

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Macrognathus pentophthalmos

Sri Lanka Spiny Eel

Macrognathus pentophthalmos (Gronow [Gronovius], in Gray, 1854)

The story of the Sri Lanka spiny eel begins in the 17th century with the Dutch colonization of Sri Lanka (1658-1796). "*M. pentophthalmos* was probably the first freshwater fish illustrated from Sri Lanka, probably during [Johan] Nieuhof's sojourn on the island in the period 1660-1667" [**Pethiyagoda 2008**]. Nieuhof worked for the Dutch East India Company (Vereenigde Oost-indische Compagnie-VOC) in southern India, Sri Lanka, and China. His iconic drawing "*Pentophthalmos Nieuwhoffi*", was reproduced by Francis Willughby in 1686 and by Müller in 1774 [W**illughby 1686**; **Müller 1774]**. Mid-18th century (sometime between 1766 and 1775), Dutch naturalist Laurence Theodore Gronow (Gronovius) first described the Sri Lanka spiny eel in a manuscript that would remain unpublished until mid-19th century (1854) [**Gray 1854**].

Alwyne Wheeler, ichthyologist and curator at The Natural History Museum in London, re-examined and provided an historical account of the Gronovius fish collection [**Wheeler 1958**]. The following are relevant excerpts from his 1958 manuscript:

"…[Gronovius] spent much of his time studying his father's [Johan Frederic Gronovius] collections. His main interest was in zoology, and his published works are nearly all concerned with vertebrate animals, and particularly fishes."

"…the collections…were the work of both father and son…a large part of it was acquired as gifts from various naturalists in foreign lands with whom they were in correspondence."

In 1762, Johan Frederic Gronovius died and L.T. Gronovius acquired his father's collection. Wheeler wrote that Gronovius' prestigious civic appointments increasingly drew his attention away from zoological studies. His last publications, the first and second fascicles of Zoophylacium, were in 1763 and 1764, respectively [**Gronovius 1763-64**]. Gronovius died in 1777 and the Gronovius collections were sold in 1778. Among the collection Wheeler reported that there were three unpublished works "in varying stages of completion", including a collection of fish specimens and the related manuscript.

"The period in which the collection was made (which I regard as taking about forty years i.e. circa 1737-1777),

coincided with a peak of Dutch colonial expansion, and specimens were probably collected and brought back by the crews of the sailing ships, perhaps at the request of Gronovius, or maybe, only for sale to the curious."

"Although the fishes were included in the sale of the collection in 1778, they were not sold, and a[n] [unpublished] letter [from naturalist Pieter Boddaert to Sir Joseph Banks] dated 1791 (thirteen years after the death of Gronovius) shows that both the fish skins and the manuscripts relating to them were still in the possession of the sons and their guardians."

Boddaert described a collection of "…about 500 very well preserved dried fishes" which Gronovius' son had commissioned him to sell in England "…(because here [the Netherlands] natural history is dead, and France is too much occupied with revolutions and other troubles [the Napoleonic Wars])." Boddaert's letters from 1793 and 1794 reveal that while Banks accepted Boddaert's dedication of Gronovius' manuscript, Boddaert was unsuccessful in finding a publisher in London. Boddaert died two years later (1796). Wheeler did not find information regarding the fate of the collection from 1794 until its purchase by John Edward Gray on behalf of the British Museum in 1853:

"A little over a century ago a collection of fish skins preserved dry, and mounted on sheets of paper, was offered for sale in the auction rooms of Mr. Phillips of Bond Street, London. J. E. Gray, then Keeper of the Department of Zoology in the British Museum, viewed the collection and considering it " would be an advantageous purchase", acquired it at the sale. Subsequently, a manuscript which had been missing earlier was delivered to him. On examining the specimens he had decided that they could be dated to "about the time of Gronov", and having seen the manuscript he identified it, and the fishes, as part of Gronovius's own collection."

Gray's 1854: "*Catalogue of fish collected and described by Laurence Theodore Gronow, now in the British Museum, London*" constitutes the post-mortem publication of Gronovius' fish collection and manuscript, including his description of the Sri Lanka spiny eel: "Mastacembelus maxilla superior longissima acuminate: maculis ocellatis ad pinnam dorsalem", habitat Ceilons" [**Gray 1854**]. While Gronovius' description referenced Willughby's 1686 reproduction of Nieuhof's iconic drawing, "…no preserved specimens of fishes collected by Nieuhof…are known…" [**Pethiyagoda 2008**]

Surveys of the Sri Lanka spiny eel were reported early in the 20th century. Pethiyagoda et al., wrote that in 1910 Willey "…supplied a locality, 'Barave near Hanvella (on the Kelani River), to which Deraniyagala (1932) added nine locations in the Kelani, Maha, Malwatu, and Mahaweli drainages…" [**Pethiyagoda 2008; Willey 1910**; **Deraniyagala 1932**] Pethiyagoda included Deraniyagala's detailed description of the spiny eel's coloration:

"Colours [not] subject to much variation in Ceylon. Dorsally a reddish brown or olive with a median light stripe and a yellow lateral band from eye to tail above the lateral line. An indistinct row of light spots between these two light bands, which fade with age. In some young there is a faint light band from pectoral to tail. Sides greenish yellow ventrally salmon pink, yellow or white. Single fins usually dusky brown, dorsal with three to nine yellow or orange rimmed ocelli along its base above which is a longitudinal yellow stripe. The number of ocelli is not influenced by age, sex or locality. Anal often a uniform orange, or yellow, or with a yellow longitudinal band occasionally with one or two ocelli on its base. Caudal with short bars and spots of yellow. Pectorals orange or yellow."

Until 2008, the Sri Lanka spiny eel was believed to be the same *Macrognathus aral* (Bloch and Schneider, 1801) that

is abundant in India, Pakistan, Nepal, and Bangladesh [**Vishwanash 2010**]. In 2008, following a detailed morphologic and radiographic evaluation of four *Macrognathus* museum specimens with locality of Sri Lanka against 21 museum specimens with locality of India (n=18 *M. aral* and three *M. guentheri*), Pethiyagoda et al., determined that the Sri Lanka spiny eel was in fact, a new species, endemic to Sri Lanka, corresponding to the "*Mastacembelus pentophthalmos"* described by Gronovius and published posthumously by Gray in 1854 [**Pethiyagoda 2008**; **Gray 1854**]. Based on these findings, Pethiyagoda et al, updated the Sri Lanka spiny eel's taxonomic name to *Macrognathus pentophthalmos* (Gronow, in Gray, 1854; locality Ceilona = Sri Lanka) [**Pethiyagoda 2008**].

Deraniyagala in 1932 and Senanayake in 1980 reported the Sri Lanka spiny eel to be widely distributed throughout the island **[Deraniyagala 1932**, **Senanayake 1980**]. However, by 1991, Pethiyagoda's survey failed to yield a single specimen [**Pethiyagoda 1991]**. This prompted the Wildlife Heritage Fund to post illustrated "Wanted" posters "…in the stations of the principal ornamental fish export companies and inland fisheries centres in Sri Lanka, offering a reward of approximately US$ 180 for a single specimen…" [**Pethiyagoda 2008**] Follow up surveys by Pethiyagoda in 1999 and 2006 again failed to yield a single specimen **[Pethiyagoda 1999, Pethiyagoda 2006**]. The reason for the species' precipitous decline during the 1980's remains unclear. In 1994, Pethiyagoda "…listed several potential threats to Sri Lanka's freshwater fishes, including degradation of wet zone forests and swamps, pesticides, alien invasive species, exploitation, and hydrological alterations" but he and others believe that any combination of these could not adequately explain the disappearance of a once seemingly ubiquitous species [**Pethiyagoda 1994, Pethiyagoda 2008**].

The Sri Lanka spiny eel, *Macrognathus pentophthalmos,* has not yet been assessed by the International Union for Conservation of Nature Red List for "extinct" status. In 2008, Pethiyagoda et al, wrote: "Given that the species formerly occurred also in parts of Sri Lanka's conflict ridden north and east (areas in which sampling is now impossible), it is premature to consider it Extinct until it becomes feasible to locate possible populations throughout its former range." [**Pethiyagoda 2008**] In 2012, the National Red List of Sri Lanka updated the species' status from "Critically Endangered" (1994) to "Critically Endangered-Possibly Extinct" [**MOE 2012**].

In 2007, the Wildlife Conservation Society-Galle (WCSG) embarked on an island-wide, freshwater fish survey "… to find 92 species of 'true', or primary, freshwater fish found in Sri Lanka." [**Illankooon 2015**] "A team of 20, comprising the authors, specialists and volunteers traveled to almost every aquatic habitat-bar some in the north to obtain first-hand information and stunning, high definition images of the fish" [**Illankooon 2015**] As of October 2013, the ongoing survey had "…so far failed to collect any data on the Sri Lanka Spiny Eel." [**Sunday Times 2013**] However, on January 25, 2015, a Sri Lankan newspaper reporting on the conclusion of the WCSG survey stated that the "…team [had] managed to rediscover and capture an extremely rare picture of the spiny eel..." [**Illankooon 2015**] While the Sri Lanka spiny eel appears to be extant, it is still "extremely rare" and the ongoing threats to Sri Lanka's freshwater fishes could continue to threaten its extinction.

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1. Rossano, Joseph Gregory. Photographed by C.B. Bell III.

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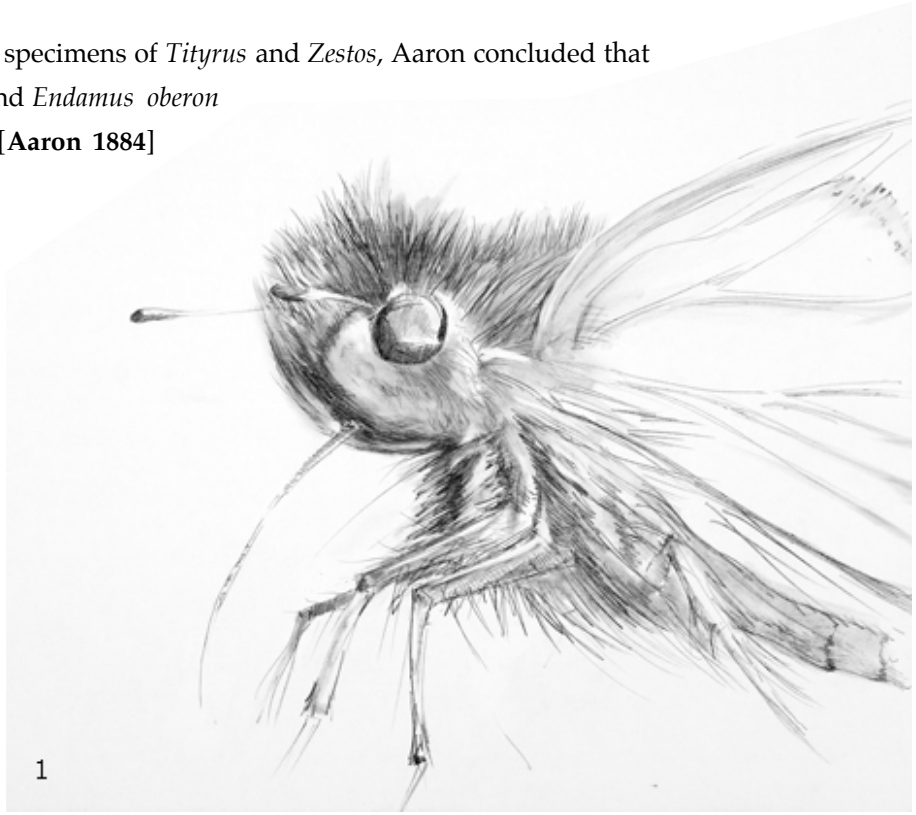
Epargyreus zestos oberon

Zestos Skipper Butterfly (Florida)

Epargyreus zestos oberon (Geyer, 1832) SYNTYPE of Endamus oberon (Worthington, 1881)

In 1819 Jacob Hübner (Germany) first listed the Zestos Skipper as *Proteides zestos*, without a description (a *nomen nudum*) [**Hübner 1819**]. He followed this, in 1826, with two illustrations of a female specimen from "Surinam" [**Hübner 1826**]. It was not until 1832, six years after Hübner's death, that his assistant, Carl Geyer, described *Proteides zestos* as a new species, but did not recount how the specimen was obtained or where it was housed. This holotype is presumed lost and erroneously attributed to locality of Surinam. In 1871, William F. Kirby, insect curator at the Museum of the Royal Dublin Society, assigned *Proteides zestos* to a new genus (*Telegonus zestos)* **[Kirby 1871]**. Ten years later, across the Atlantic, Charles E. Worthington (Chicago), evaluated 31 specimens collected in Marco Island, Florida in May 1881. He noted their resemblance to *Endamus Tityrus* and described them as a new species, *Endamus oberon* [**Worthington 1881**]. Worthington provided specimens to Henry Edwards, who described the Florida Rockland grass skipper butterfly and provided Eugene M. Aaron with an *Endamus oberon* specimen.

Following an evaluation of over 160 specimens of *Tityrus* and *Zestos*, Aaron concluded that *Proteides zestos*, *Telegonus zestos,* and *Endamus oberon* were all the same butterfly (1884). [**Aaron 1884**] Aaron wrote:


1

"Mr. Worthington's mistake in supposing his *Oberon* to be a new species was quite natural, and a mistake that any one who described with limited material from only one locality would be likely to make, especially as he probably had not access to Hübner's Sammlung. But what reason Mr. W.F. Kirby can give for placing these forms, so nearly devoid of constant colorational characters, in different genera of his catalogue...when their structural, or generic characteristics are identical throughout, is beyond our powers of conjecture. Their being so

placed, however, accomplishes good, inasmuch as it calls attention to the utter worthlessness of these genera as at present separated by cataloguers."

The butterfly had "…been in the possession of collectors, as from Florida, for many years", including a specimen in Aaron's collection, originally in Dr. Asa Fitch's collection, labeled "Florida, Sept.'53" and three specimens in the American Entomological Society provided by James Ridings prior to 1870. Aaron also acquired specimens from the Yucatan, the Dominican Republic, the Bahamas, and Cuba. Skipper specialist George Austin examined specimens of Zestos Skippers from throughout the Caribbean, in the Florida Museum of Natural History collection and concluded that the Florida population was a unique subspecies or perhaps a sibling species [**Minno 2010**]. Dr. Austin died in 2009, before completing the study.

Since the 1970's the butterfly population of southern Florida has been declining. [**Minno 2010**] Marc C. Minno wrote:

"Zestos Skippers were once locally common in coastal areas of southern Florida including Sanibel Island, Marco Island, Chokoloskee Island, Flamingo and Royal Palm Hammock in Everglades National Park, Miami, and throughout the Keys. They occurred along trails and at the edges of tropical hammocks but by the mid-1980s, Zestos Skippers had disappeared from the mainland. During the late 1980s they disappeared from the Upper Keys, although Buck Cooper saw one at Carysfort on northern Key Largo on October 12, 1997. The last known sightings of Zestos Skippers in Florida were at the Key West Tropical Forest and Botanical Garden on Stock Island by Mark Salvato in early July 2002 and by David Lysinger at the same location on January 23, 2004." [**Minno 2010**]

In August 2006 Minno, "…with funding from the United States Fish and Wildlife Service and the Florida Keys Mosquito Control District, began looking for Zestos Skippers and Meske's Skippers, as well as for other declining butterflies in southern Florida" [**Minno AB 2010**]. The survey was scheduled to take two years, but none of the experts could find the butterflies of interest, in any stage of life, so the survey was extended to six years [**Morgan 2013**]. In the final 2012 report to the U.S. Fish and Wildlife Service, it was recommended that the Zestos Skipper form Florida be presumed extinct.

The major cause or causes of the decline and loss of the butterfly populations in Florida remain uncertain. "Many variables have been implicated in the overall decline…including habitat loss and fragmentation, chemical contaminants, exotic ants, illegal collecting, and climate change. Mosquito control insecticides have been frequently blamed for the decline. However, the butterflies have also disappeared from vast areas where no spraying occurs or where it is extremely limited, such as Biscayne National Park and Everglades National Park." [**Minno-2012-SOE**]

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1. Rossano, Joseph Gregory. Photographed by C.B. Bell III.

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