Biol Invasions
DOI 10.1007/s10530-014-0730-1

INVASION NOTE

Tupinambis merianae as nest predators of crocodilians and turtles in Florida, USA

Frank J. Mazzotti · Michelle McEachern · Mike Rochford · Robert N. Reed · Jennifer Ketterlin Eckles · Joy Vinci · Jake Edwards · Joseph Wasilewski

Received: 5 May 2014 / Accepted: 22 May 2014

Abstract *Tupinambis merianae*, is a large, omnivorous tegu lizard native to South America. Two populations of tegus are established in the state of Florida, USA, but impacts to native species are poorly documented. During summer 2013, we placed automated cameras overlooking one American alligator (*Alligator mississippiensis*) nest, which also contained a clutch of Florida red-bellied cooter (*Pseudemys nelsoni*) eggs, and one American crocodile (*Crocodylus acutus*) nest at a site in southeastern Florida where tegus are established. We documented tegu activity and predation on alligator and turtle eggs at the alligator nest, and tegu activity at the crocodile nest. Our finding that one of the first two crocodilian nests to be monitored was depredated by tegus suggests that tegus should be further evaluated as a threat to nesting reptiles in Florida.

Keywords *Tupinambis merianae* · *Alligator mississippiensis* · *Pseudemys nelsoni* · *Crocodylus acutus* · Invasive species · Nest predation

Electronic supplementary material The online version of this article (doi:10.1007/s10530-014-0730-1) contains supplementary material, which is available to authorized users.

F. J. Mazzotti (✉) · M. Rochford · J. Vinci · J. Wasilewski
Department of Wildlife Ecology and Conservation, Fort Lauderdale Research and Education Center, University of Florida, 3205 College Ave, Davie, FL 33314, USA
e-mail: fjma@ufl.edu

M. McEachern · R. N. Reed
Fort Collins Science Center, U.S. Geological Survey, 2150 Centre Avenue, Building C, Fort Collins, CO 80526, USA

J. K. Eckles · J. Edwards
Florida Fish and Wildlife Conservation Commission, Fort Lauderdale Research and Education Center, 3205 College Ave, Davie, FL 33314, USA

Introduction

South Florida is vulnerable to invasion by nonnative reptiles because it has major sources of nonnative species from the pet trade (port of entry, captive breeders, and animal dealers), peninsula geography, subtropical climate, and large areas of disturbed habitats (e.g., ponds, canals, and levees). Argentine black-and-white tegus (*Tupinambis merianae*) are established in Miami-Dade, Hillsborough, and Polk counties, Florida (Enge 2007; Krysko et al. 2011; Pernas et al. 2012). *Tupinambis merianae* are habitat generalists and are observed in coastal areas, clearings, edges, and disturbed areas (see Enge 2007 for review). These lizards spend time in burrows including extended winter brumation periods (Abe 1995; Andrade and Abe 1999).

Tupinambis merianae exhibit a broad diet including vegetation, fruits, seeds, snails, arthropods, fish, birds and bird eggs, small mammals, amphibians, reptiles

Published online: 30 May 2014

and reptile eggs, and carrion (Achaval 1977; Donadío and Gallardo 1984; Cei 1986; Escalona and Fa 1998; Kiefer and Sazima 2002; Mourthe 2010; Silva and Hillesheim 2004; Toledo et al. 2004). Staton and Dixon (1977) considered tegus to be the main predator of spectacled caiman (*Caiman crocodilus*) eggs in the Venezuelan Llanos. This paper is the first report of nest predation by tegus on native crocodilian and turtle eggs in Florida.

Methods

Our study site was located in the Southern Glades Wildlife and Environmental Area (Miami-Dade County, Florida), which includes >12,000 hectares of seasonally flooded sawgrass marsh, marl prairie, and tree islands. Man-made water-management features such as canals, ditches, levees, and berms traverse the area. During the course of unrelated field activities in March 2013, we discovered one nest of an American crocodile (*Crocodylus acutus*) and one nest of an American alligator (*Alligator mississippiensis*) in areas where tegus were regularly observed. The American crocodile nest consisted of a cavity excavated from rocky spoil on a levee next to the C-110 canal. The American alligator nest was located on a spoil berm perpendicular to C-110 and was constructed of mounded vegetation, primarily bracken fern (*Pteridium aquilinum caudatum*).

We monitored the two nests using digital trail cameras of three different models (Bushnell Trophy Cam model 119467C, and Moultrie models M-880 and M-990) that have similar capabilities. We deployed four cameras around the crocodile nest on 15 April and monitored them until 19 August 2013. We monitored the alligator nest with three cameras from 10 June until 19 August 2013. We downloaded images and checked batteries at intervals of 7 days or less. One time per week we carefully opened the alligator nest to count eggs. We did not open the crocodile nest.

Results

We captured 50 images of at least one tegu at the crocodile nest on 9 days between 15 May 2013 and 21 July, but we did not capture images of nest predation (digging or removing eggs) by tegus or any other species. We confirmed that the nest successfully hatched with video showing an adult crocodile removing hatchling crocodiles from the nest on 30 and 31 July 2013 (Online Resource 1). After that observation, we conducted searches by day and night and found five hatchling crocodiles, nine successfully hatched eggs, and two failed eggs.

Fig. 1 *Tupanmbis merianae* leaving an American alligator nest on 11 August 2013 with an alligator egg in its mouth

When we discovered the American alligator nest on 10 June, it contained no alligator eggs but did contain 15 Florida red-bellied cooter (*Pseudemys nelsoni*) eggs. We did not capture any images of tegus removing turtle eggs, but we recorded video of at least one tegu actively exploring inside the nest at the exact location of the turtle eggs. After this observation we recorded no more tegu activity at the site of the turtle eggs. No turtle eggs were found when we opened the nest on 17 June 2013.

On 24 June 2013 we observed 30 alligator eggs in a cavity starting 10 cm below the top of the alligator nest. Video from 3 August 2013 showed tegus leaving the alligator nest with alligator eggs (Online Resource 2). On 12 August 2013, we observed a small round hole about the diameter of a tegu body immediately above the location of the alligator eggs. We opened the top of the nest and discovered that eight alligator eggs were left. Examination of still and video images (Fig. 1) confirmed that at least two tegus were removing alligator eggs from the nest. Between 12 and 18 August, we captured images of tegus removing 0–2 eggs per day until an examination of the nest on 19 August revealed no remaining alligator eggs. We did not capture images of any other nest predator during egg incubation.

Discussion

We have direct and circumstantial evidence that tegus depredated eggs of an American alligator and a Florida red-bellied cooter. We also have direct evidence that American crocodile eggs hatched successfully despite nest visitation by tegus. That the first nest containing a clutch of alligator eggs and a clutch of turtle eggs monitored within the introduced range of tegus in Florida was depredated by tegus suggests that tegus should be further evaluated as a threat to nesting reptiles in Florida.

Alligators, crocodiles, and turtles commonly nest on elevated areas such as levees and berms that are constructed by deposition of spoil (Deitz and Hines 1980; Mazzotti et al. 2007), and turtles and snakes nest in alligator nests (Kushlan and Kushlan 1980). Tegus in south Florida also use levees and berms as habitat (Pernas et al. 2012). Restoration of the Everglades ecosystem seeks to remove levees and berms that are currently impeding flow of water through the system (US Army Corps of Engineers 1999). Tegus are primarily terrestrial, so removing levee and berm nesting sites could reduce the potential for tegus to depredate nests.

The temporal pattern of nest depredation demonstrated by tegus observed in this study was similar to that of tegus depredating caiman nests in Venezuela (Staton and Dixon 1977), where tegus visited nests repeatedly rather than consuming a complete clutch in one visit. If nest sites are monitored frequently during incubation, the risk of predation could be reduced by trapping tegus that are visiting nests, or removing eggs from vulnerable nests.

Currently, tegus occur in the same habitats as a number of state- and federally listed species that could be affected by nest depredation. Eastern indigo snakes (*Drymarchon couperi*), Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*), and gopher tortoises (*Gopherus polyphemus*), all nest in one or both areas in Florida where tegus are established. More native species could be at risk if tegus expand their range in Florida. Nests of sea turtles, shore birds, and ground-nesting migratory birds could be threatened by tegus, as could mammals that nest near the surface of the ground, such as the endangered Key Largo woodrat (*Neotoma floridana smalli*).

Tegus have proven to be adaptable to a number of habitats in their natural range and in Florida (Enge 2007), and evidence suggests that they can successfully overwinter in Panama City (in the Florida Panhandle) at over 30°N latitude (http://myfwc.com/news/news-releases/2013/April/26/tegus/). Efforts by state and federal agencies to protect and restore native wildlife populations and habitats throughout Florida could be threatened unless containment of existing populations and prevention of new infestations are successful.

Acknowledgments This project was supported by the South Florida Water Management District, the Florida Fish and Wildlife Conservation Commission, the U. S. Geological Survey, and the University of Florida. E. Metzger III and C. Gillette brought the crocodile nest to our attention. We thank V. Briggs Gonzalez and J. Duquesnel for their help with checking nests and cameras, and K. Sommers, A. Woodward, and R. Harvey for their helpful comments on this manuscript. Monitoring of the crocodile nest was conducted under endangered species permit number TE077258-1 to the University of Florida and approved by the University of Florida Animal Research Committee approval number 002-11FTL. Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

References

Abe AS (1995) Estivation in South American amphibians and reptiles. Braz J Med Biol Res 28:1241–1247

Achaval F (1977) Lista comentada de los reptiles que habitan en la zona de influencia de la represa de Salto Grande. Seminario Medio Ambiente y Represas, Montevideo 1:173–181

Andrade DV, Abe AS (1999) Gas exchange and ventilation during dormancy in the tegu lizard *Tupinambis merianae*. J Exp Biol 202:3677–3685

Cei JM (1986) Reptiles del centro, centro-oeste y sur de la Argentina. Herpetofauna de las zonas áridas y semiáridas. Monografia 4. Museo Regionale di Scienze Naturali, Torino

Deitz DC, Hines TC (1980) Alligator nesting in north-central Florida. Copeia 1980(2):249–258

Donadío OE, Gallardo JM (1984) Biología y conservación de las especies del género Tupinambis (Squamata, Sauria, Teiidae) en la República Argentina. Revista del Museo Argentina de Ciencias Naturales "Bernardino Rivadavia" (Zoologia) 13:117–127

Enge KM (2007) FWC bioprofile for the Argentine Black and White Tegu (*Tupinambis merianae*). Florida Fish and Wildlife Conservation Commission report, Tallahassee

Escalona T, Fa JE (1998) Survival of nests of the terecay turtle (*Podocnemis unifilis*) in the Nichara-Tawadu rivers, Venezuela. J Zool 244:303–312

Kiefer MC, Sazima I (2002) Diet of juvenile tegu lizard *Tupinambis merianae* (Teiidae) in southeastern Brazil. Amphib Reptil 23(1):105–108

Krysko KL, Burgess JP, Rochford MR, Gillette CR, Cueva D, Enge KM, Somma LA, Stabile JL, Smith DC, Wasilewski JA, Kieckhefer GN III, Granatosky MC, Nielsen SV (2011) Verified non-indigenous amphibians and reptiles in Florida

from 1863 through 2010: outlining the invasion process and identifying invasion pathways and stages. Zootaxa 3028:1–64

Kushlan JA, Kushlan MS (1980) Everglades alligator nests: nesting sites for marsh reptiles. Copeia 1980:930–932

Mazzotti FJ, Brandt LA, Moler P, Cherkiss MS (2007) American crocodile (Crocodylus acutus) in Florida: recommendations for endangered species recovery and ecosystem restoration. J Herpetol 41(1):122–132

Mourthe IMC (2010) *Tupinambis merianae* (common tegu). Feeding behavior. Herpetol Rev 41:232–233

Pernas T, Giardina DJ, McKinley A, Parns A, Mazzotti FJ (2012) First observations of nesting by the Argentine black and white tegu, *Tupinamis merianae* in South Florida. Southeast Nat 11(4):765–770

Silva JSB, Hillesheim R (2004) *Tupinambis merianae* (tegu). Diet. Herpetol Rev 35:399

Staton MA, Dixon J (1977) Breeding biology of the spectacled caiman, Caiman crocodilus crocodilus in the Venezuelan llanos. Wildlife Research Report (U.S. Fish and Wildlife Service) 5:1–21

Toledo LF, Almeida Prado CP, Andrade DV (2004) *Tupinambis merianae* (tegu lizard). Fungivory. Herpetol Rev 35: 173–174

U.S. Army Corps of Engineers (1999) CERP Central and Southern Florida Comprehensive Review Study. Final Integrated Feasibility Report and Programmatic Environmental Impact Statement, Jacksonville District, U.S. Army Corps of Engineers, Jacksonville