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EFFECTS OF ECOTOURISM ON ENDANGERED NORTHERN BAHAMIAN ROCK IGUANAS (*CYCLURA CYCHLURA*)

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***Abstract.*—This study evaluated effects of tourist visitation and supplemental feeding on the Northern Bahamian Rock Iguanas (*Cyclura cychlura*) in the Exumas, The Bahamas. The study examined flight behavior and diet on islands that were visited versus those not visited by tourists. Iguanas on visited islands were less wary of human presence than those on non-visited islands. Unlike on non-visited islands, iguanas on beaches where they were fed by tourists consumed people-influenced items including trash (e.g., styrofoam, aluminum foil), non-native fruits and vegetables (e.g., grapes, tomatoes), and sand. Non-native fruits provided a higher liquid content diet than did native vegetation, which, when mixed with sand, created cement-like feces that may have medical consequences. Tourism has encouraged an increase in these iguana populations, but it is now clear that negative impacts, such as loss of wariness and dietary shifts shown in this study as well as possible demographic consequences, also are occurring. These adverse effects might be ameliorated by changed practices, but such changes must be instituted with full participation by local stake holders.**

Key Words.—Bahamas; behavior; conservation; *Cyclura cychlura*; diet; Northern Bahamian Rock Iguana; supplemental feeding; tourism

INTRODUCTION

Nature-based tourism (ecotourism) is becoming increasingly practiced around the world. Ecotourism can benefit conservation of species, habitats, and places, but can also increase risks to both local organisms and their habitats. Actual encounters with wildlife have proven to be an effective draw for tourists to ecotourism operations. Tour operators around the world have responded by adopting food provisioning of wildlife as a means of creating or improving human-wildlife encounters on their tours, particularly for viewing rare or elusive species. This style of tourism is somewhat controversial, as it depends upon a delicate balance between benefits and adverse consequences (Orams 2002). On the human side, benefits include income generated for local operators, and enjoyable, potentially educational experiences for participants. Additional benefits from tourist encounters include support provided for conservation both specifically and more generally. On the animal side, food provisioning can provide physical, reproductive, and survivorship advantages to species (Ozoga and Verme 1982; Brittingham and Temple 1988; Richner 1992; Rastogi et al. 2006), and has been used to benefit species residing in highly disturbed areas and to aid recovery of endangered species (Orams 2002; Green and Giese 2004). A downside is that close encounters with wildlife can be dangerous in that humans may be injured or killed by wildlife that has become habituated to human feeding (Hererro 1985; Kofron 1999; Burns and Howard 2003). Negative consequences to wildlife are more difficult to ascertain than are those to people because they are often subtle, complex and/ or dependent upon the magnitude and longevity of feeding (Smith 2001; Dunkley and Cattet 2003; Rode et al. 2007; Vignon et al. 2010).

Empirical studies aimed at deciphering the impacts of food provisioning by tourists have shown changes in behavior (e.g., Ram et al. 2003; Hodgson et al. 2004; Corcoran 2006; Laroche et al. 2007; Clua et al. 2010), physiology (e.g., Semeniuk et al. 2007, 2009; Maljković and Côté 2011), nutrition (Silva and Talamoni 2003), and community diversity (e.g., Hémery and McClanahan 2005; Ilarri et al. 2008) in a variety of species. However, reptiles are generally underrepresented in case studies of tourist impacts (Krüger 2005). The only documented case study of tourism food supplementation on lizards is Walpole's (2001) documentation of Komodo dragon numbers transitioning from artificially elevated densities at feeding sites back to normal levels after the feeding program ceased. While studies such as these are clarifying some of the issues surrounding food supplementation by tourists, the issue remains largely understudied, leaving resource managers and conservationists unsure of how to proceed (Orams 2002). It is important to continue and expand studies on this type of tourism, because cases have shown that targeted management can lessen or prevent tourism impacts without ceasing tourism altogether (e.g., Walpole 2001; de Sa Alves et al. 2009), which is important in areas where the economy is benefitted by tourism revenues.

FIGURE 1. Northern Bahamian Rock Iguana (*Cyclura cychlura*) from Flat Rock Reef Cay in the northern Exumas of The Bahamas. (Photographed by Kirsten N. Hines).

The Caribbean is composed of a series of island nations in which economies are heavily dependent upon tourism, and The Bahamas conforms to this trend with nearly half of its GDP derived from tourism (US Department of State. 2011. Background Note: The Bahamas. Available from http://www.state.gov/r/pa/ei/bgn/1857.htm [Accessed 1 April 2011]). The 120-mile long Exuma Island chain of The Bahamas has historically been a destination for cruisers and other relatively low impact visitation, but, at the encouragement of government, tourism, and related development, has been increasing steadily since the 1970's (Lowe and Sullivan-Sealey 2003; Knapp et al. 2011). One of the wildlife attractions of the Exumas is the Northern Bahamian Rock Iguana (*Cyclura cychlura*), which inhabits a few of the islands within the chain (Fig. 1). These lizards are endemic to The Bahamas and are listed as Vulnerable on the IUCN Red List (IUCN Red List of Threatened Species. 2010. *Cyclura cychlura*. Available from www.iucnredlist.org [Accessed 27 December 2010]). *Cyclura cychlura* in the Exumas occur in two disjunct populations, located in the north and south of the chain. They are genetically distinguishable from the population of the same species occurring on Andros Island (*C. c. cychlura*), but are not genetically distinguishable from each other despite traditionally being placed in separate subspecies, *C. c. inornata* in the north and *C. c. figginsi* in the south (Malone et al. 2003).

The northern population, called the Allen Cays Rock Iguana, naturally occurs on two islands in the Allen Cays area of the northern Exuma Islands and has been introduced to a few other islands in the area (Iverson et al. 2004a; pers. obs.). The southern population, called the Exuma Rock Iguana, occurs on a few islands in the central and southern Exumas. Both of these populations are visited on certain islands by independent boaters and boat tour groups from Nassau, New Providence (Allen Cays Rock Iguana); Staniel Cay, Exumas (Exuma Rock Iguana); and Georgetown, Great Exuma (Exuma Rock Iguana) with feeding of the iguanas as a main attraction. Other iguana-inhabited islands within each area are virtually unvisited due to their geographic inaccessibility, creating a natural experiment to study the effects of tourism.

The purpose of the present study was to evaluate effects of tourist visitation and feeding on iguana behavior, focusing on wariness and dietary habits. With respect to lizards, it is only the second case study of tourist food provisioning (after Walpole 2001) and is the first to focus on individual behavioral responses. The conservation implications of this study are discussed with the goal of contributing to management guidelines applicable both locally and globally.

METHODS

Background.—The islands occupied by Northern Bahamian Rock Iguanas in the Exumas are limestone outcroppings covered by seaside vegetation typical of the area (see Campbell 1982 for further description). In this study, islands frequented by tour groups and independent boaters were termed 'visited islands.' Islands having few to no visitors were termed 'non-visited islands.' Visitation rates vary among the different visited islands with the highest being up to 150 people a day and the lowest receiving 10–20 visitors on a non-daily basis (Iverson et al. 2006; Smith and Iverson 2006; pers. obs.). Tour operators generally provide grapes for feeding, but independent boaters offer accepting iguanas anything from fruits and vegetables to bread and meat products (pers. obs.). Visited islands have one or two main landing beaches where most visitors arrive to view and feed the iguanas (Fig. 2). Virtually all food provisioning occurs on these beaches. These were termed 'feeding beaches' for this study. Parts of the islands where supplemental feeding does not occur were termed 'non-feeding areas' for this study. Aside from the presence of accessible landing sites on visited islands, general island structure and vegetation were similar across visited and non-visited islands.

I included two clusters of iguana-inhabited islands in this study, one from the north and one from the south (Fig. 3). Each island cluster contained islands 3–10 ha in extent that were within 2.4 km of each other and included both visited and non-visited islands. The islands I selected included two visited and one non-visited island from the Allen Cays area, and one visited and two non-visited islands from the more southerly group, near Lee Stocking Island. I compared visited islands and the control group of non-visited islands to measure visitor effects. Similarly, to compare feeding areas versus non-feeding areas on visited islands, I

FIGURE 2. Tourists feeding Northern Bahamian Rock Iguanas (*Cyclura cychlura*) at the landing beach on Leaf Cay, northern Exumas of The Bahamas. (Photographed by Kirsten N. Hines).

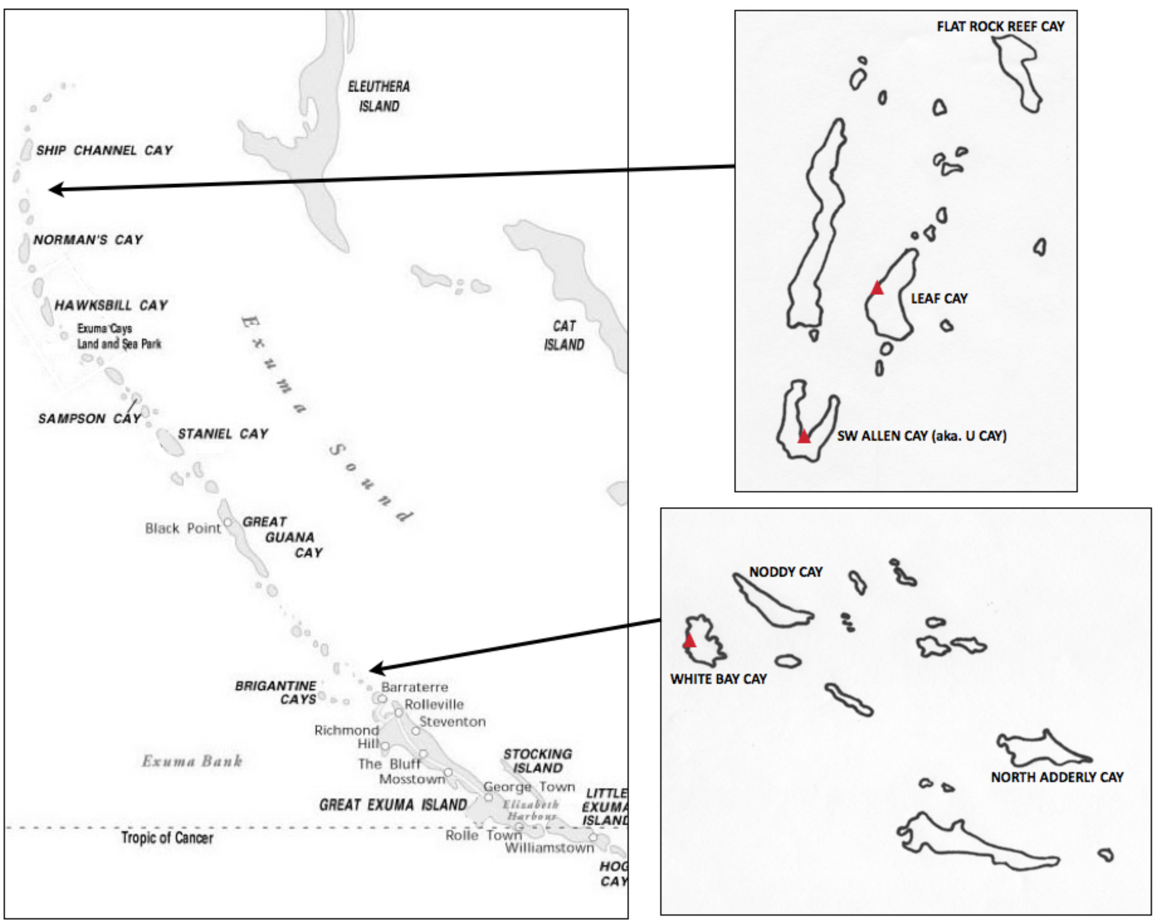

FIGURE 3. Study areas in the Exumas of The Bahamas. Islands included in the study are named in the inserts. Visited islands are indicated by red triangles placed on the feeding beaches.

collected data equally on feeding beaches and on non-feeding areas. I collected feeding area data directly on the feeding beaches. I collected non-feeding area data at least 20 m away from these beaches, past geographic transitions such as rocky areas or thick vegetation. I conducted fieldwork for this project 6–17 July 2009.

Wariness.—I used flight initiation distance and flight distance (Blazquez et al. 1997; Cooper 2005; Rödl et al. 2007) to measure wariness. I conducted all behavioral trials with the same field assistant. I consistently approached the iguana while my assistant consistently observed and recorded from the background. To limit potentially influential cues noted in other studies (Burger et al. 1991; Burger and Gochfeld 1993), I wore the same attire with no sunglasses and a baseball cap for all trials. I included all distant, resting adult iguanas encountered in situations suitable for observations in the study. Trials began when I made eye contact with the selected iguana and approached at a steady, medium pace along a straight line, avoiding tangential angles (Burger and Gochfeld 1990). As soon as the target animal began moving, I froze in place until the iguana ceased movement, marking the end of the trial. I measured flight initiation distance between my stop point and the point where the iguana originated its movement. I recorded flight distance as the shortest distance between the point where the iguana started moving to the point where it stopped. As possible, I conducted 24 trials on each island. On visited islands, I divided trials equally between feeding and non-feeding areas.

For analyses, I used Bartlett's test for homogeneity of variance to determine whether data could be pooled based on feeding category. I pooled flight initiation distance data and flight distance data for non-feeding islands (Bartlett's Test - Flight Initiation Distance: χ^2 = 4.14, P = 0.13; Flight Distance: χ^2 = 0.70, P = 0.71). I also pooled flight initiation distance data (χ^2 = 5.48, P = 0.06) on feeding islands. For flight distance on feeding islands, the variance differed significantly with Leaf and U Cays having comparable variance (χ^2 = 50.59, P = 0.44), but White Bay Cay differed from both Leaf (χ^2 = 6.71, P = 0.01) and U (χ^2 = 10.82, P = 0.001) Cays. I pooled Leaf and U Cay data for flight distance analysis, but compared White Bay Cay separately to the non-feeding islands and the other feeding islands. Pooling data accordingly, I compared feeding island versus non-feeding island categories and, for fed islands, feeding areas versus non-feeding areas using unpaired t-tests (α = 0.05).

Diet.—To study diet, I randomly collected 20 scat samples on each island. On visited islands, I evenly sampled feeding and non-feeding areas of the island. I dried samples for 24–48 h. I then sorted samples into natural or people-influenced categories, weighed them, and used the weights to calculate category percentages. I compared percentages using the Mann-Whitney U-test (α = 0.05).

***Shoreline*.**—Using Google Earth, I measured total island perimeter and the length of sandy shoreline for each island. Based on these measurements, I calculated percentage of sandy shoreline for each island. I compared the percentage of available sandy shoreline among islands using Spearman's Rank Correlation test.

RESULTS

Wariness.—Based on the sum of both wariness measures (Flight Initiation Distance [FID] and Flight Distance [FD]) for each island of the study, iguanas on

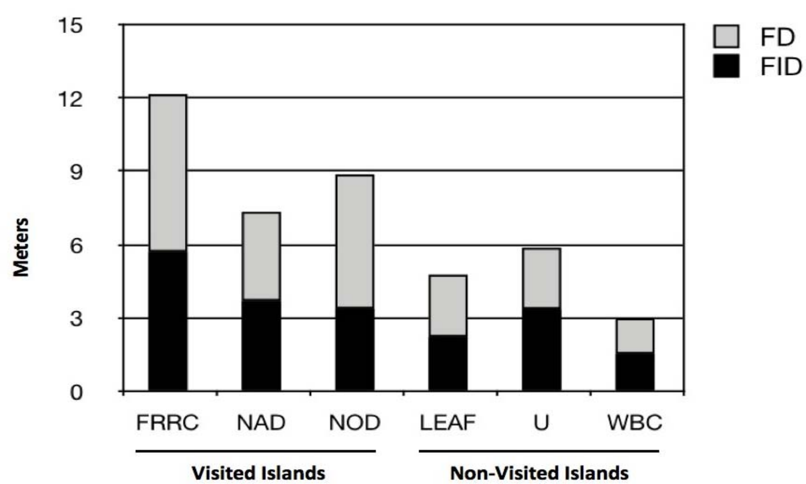

FIGURE 4. Total wariness of Northern Bahamian Rock Iguanas (*Cyclura cychlura*) on visited and non-visited islands in the Exumas, The Bahamas. Bar graphs show the two wariness measures (Flight Initiation Distance [FID] and Flight Distance [FD]) in meters (m) on each of the visited and non-visited islands of the study. FRRC = Flat Rock Reef Cay, NAD = North Adderly Cay, NOD = Noddy Cay, LEAF = Leaf Cay, U = U Cay, WBC = White Bay Cay.

Table 1. Natural and people-influenced items identified in scat of Northern Bahamian Rock Iguanas (*Cyclura cychlura*), arranged in order of observed frequency of occurrence (N = 117 scats).

Scat Item	Frequency (%)	Non-Visited Islands	Visited Islands
Natural			
Buttonwood (*Conocarpus erectus*): flowers, fruit, leaves, stems	41.7	X	X
Wild Dilly (*Manilkara bahamensis*): fruit, leaves, flowers, stems	40.0	X	X
Sandfly Bush (*Rhachicallis americana*): leaves, stems	33.3	X	X
Seven Year Apple (*Casasia clusiifolia*): fruit, leaves	14.2	X	X
Joewood (*Jacquinia keyensis*): fruit, leaves, stems	13.3		X
Bay Cedar (*Suriana maritima*): flowers, fruit, leaves, stems	10.8	X	X
Black Torch (*Erithalis fruticosa*): fruit	9.2	X	X
Thatch Palm (*Coccothrinax argentata* or *Thrinax morrisii*): fruits, twigs	8.3	X	X
Feathers	4.2		X
Sea Oats (*Uniola paniculata*): husks, leaves	4.2		X
Lignumvitae (*Guaiacum sanctum*): leaves	3.3	X	
Necklace Pod (*Sophora tomentosa*): leaves	2.5	X	X
Pigeon Plum (*Coccoloba diversifolia*): fruit, leaves	2.5	X	X
Rams Horn (*Pithecellobium keyense*): leaves	2.5		X
Darling Plum (*Reynosia septentrionalis*): leaves	1.7		X
Insect Exoskeleton	1.7		X
Land Hermit Crab (*Coenobita clypeatus*): leg	1.7	X	
Land Snail (*Cerion* sp.): shell	1.7		X
Seagrape (*Coccoloba uvifera*): fruit	1.7	X	
Turtle Grass (*Thalassia testudinum*): leaves	1.7		X
Wild Saffron (*Bumelia americana*): leaves, stems	1.7	X	
Blolly (*Guapira discolor*): leaves	0.8		X
Golden Creeper (*Ernodea littoralis*): leaves	0.8	X	
Prickly Pear Cactus (*Opuntia* sp.): spines	0.8	X	
Rock Iguana (*Cyclura cychlura*): shed skin	0.8		X
Sargassum Weed (*Sargassum* sp.): leaves, stems	0.8		X
Seashore Dropseed (*Sporobolus virginicus*): leaves	0.8		X
Strumfia (*Strumpfia maritima*): leaves	0.8	X	
White Calliandra (*Calliandra formosa*): leaves	0.8	X	
People-Influenced			
Sand	13.3		X
Grapes	4.2		X
Tomatoes	1.7		X
Aluminum Foil	0.8		X
Marine Crab	0.8		X
Marine Sponge	0.8		X
Seashell Fragments	0.8		X
Styrofoam	0.8		X

visited islands were less wary of human presence than those on non-visited islands (Fig. 4). Mean flight initiation distance was significantly shorter on feeding islands (FID = 2.36 m, 95% CI = 2.00–2.72 m) than on non-visited islands (FID = 4.25 m, 95% CI = 3.52–4.98 m; t = 4.66, df = 141, P < 0.001). Mean flight distance was also significantly shorter on visited islands (Leaf & U FD = 2.53 m, 95% CI = 2.06–3.05 m; White Bay FD = 1.45 m 95% CI = 1.05–1.86 m) than on non-visited islands (FD = 5.25 m 95% CI = 4.08–6.41 m; Leaf & U t = 3.67, df = 117, P < 0.001; White Bay t = 3.74, df = 93, P < 0.001). On White Bay Cay, flight distance was significantly shorter than on the other feeding islands (t = 2.74, df = 70, P = 0.008). I also tested feeding versus non-feeding areas separately for each visited island because there were no clear variance patterns. Leaf Cay iguanas displayed significantly shorter flight initiation distance in the feeding area (FID = 1.41 m, 95% CI = 1.07–1.75 m) than non-feeding areas (FID = 3.03 m, 95% CI = 2.20–3.85 m) of the island (t = 4.00, df = 22, P < 0.001). There were no other significant comparisons.

Diet.—Iguanas exposed to visitation differed from those not exposed to visitation, not only due to the food actually presented to them by visitors, but also in their consumption of other items (Table 1). Natural items found in scat (Fig. 5) included native vegetation (e.g., Buttonwood [*Conocarpus erectus*] leaves, and Wild Dilly [*Manilkara bahamensis*] fruit) and small quantities of dark soil as has been regularly and widely observed in scat samples over the last ten years (pers. obs.). People-influenced items (Fig. 6) included trash (e.g., styrofoam, aluminum foil), non-native fruits and vegetables (e.g., grape, tomato), marine fauna (e.g., swimming crab,

FIGURE 5. Natural scat items; Wild Dilly (*Manilkara bahamensis*) fruits and seeds (above) and Buttonwood (*Conocarpus erectus*) leaves (below). (Photographed by Kirsten N. Hines).

FIGURE 6. People influenced scat items: clockwise from top; swimming crab, sand, styrofoam. (Photographed by Kirsten N. Hines).

FIGURE 7. Scat with a cement-like coating of dried sand compared with a US quarter (29 mm diameter). (Photographed by Kirsten N. Hines).

marine sponge), and sand, often in large quantities dried to a cement-like consistency (Fig. 7). People-influenced items were only present in scat collected from feeding areas of the two most heavily visited islands. Of the scat samples collected on visited islands, 12.5% contained people-influenced items as opposed to 0% on non-visited islands (U = 1311, $Z = 2.04$, $P = 0.0414$). Within visited islands, 25.4% of scat samples collected in feeding areas contained people-influenced items versus 0% in non-feeding areas of the islands (U = 630, $Z = -2.95$, $P = 0.0032$). While some marine debris (e.g., marine flora and fauna) is occasionally ingested by iguanas regardless of humans, its incidence in scats on visited islands has substantially increased in the last 2–4 years (unpubl. data). I have only found sand in scat on visited islands (unpubl. data).

Shoreline.—There was no significant difference in the percentage of sandy shoreline on visited versus non-visited islands ($r_s = -0.32$, n = 6, $P > 0.05$).

DISCUSSION

Northern Bahamian Rock Iguanas in the Exumas regularly exposed to humans are less wary of people than those that rarely encounter people. This result was true for all visited island versus non-visited island comparisons and was also apparent in intra-island comparisons on Leaf Cay, one of the visited islands.

Iguana-based tourism in The Bahamas originated on Leaf Cay so this island has the longest history of tourist food provisioning and continues to receive the highest quantities of food at the most consistent rates (Iverson et al. 2006). Iguanas on Leaf Cay were least wary on the feeding beach, where they allowed human approach twice as near as did their counterparts in non-feeding areas of the island. Interestingly, flight distance did not differ significantly between Leaf Cay's feeding beach and other parts of the island. This suggests that while they are less wary of human approach, there is little to no deterioration of their escape pattern once alerted to potential danger.

This observed trend toward decreased wariness with increased visitation and food supplementation is worrisome. Studies of other iguanas have shown greater wariness in areas with higher predation risk, where anti-predator behavior is necessary (Blazquez et al. 1997; Rödl et al. 2007). In this case, iguanas that would benefit from greater wariness due to threats from humans or their pets do not follow this pattern. Although the Exumas are naturally land-predator free, iguanas on these islands face a risk from introduced predators, namely cats and dogs, as well as people. Easy beach access, associated with the less wary iguanas, increases the likelihood of non-native predator (e.g., cats or dogs) invasion and poaching by humans for consumption or the pet trade. The introduction of cats or dogs could rapidly decrease the iguana population on an island to near extirpation (Iverson 1978; Kruuk and Snell 1981). Concentration of iguanas in feeding areas and the increased susceptibility of those individuals to capture (Iverson et al. 2006) puts a greater proportion of the population at immediate risk and would expedite the depredation process.

In addition to increased predation risk associated with decreased wariness, iguanas in the feeding areas of visited beaches displayed a critical dietary shift. People-influenced items were observed in scat collected from feeding beaches on visited islands. People-influenced items did not occur in scat collected in non-feeding areas or on non-visited islands. Not only has repeated artificial feeding at feeding beaches encouraged consumption of human foods, but it also appears to have led iguanas to spend disproportionate amounts of time foraging on these beaches as opposed to vegetated interior habitats where they typically forage. As a result of being attracted to the beach, they ingest higher levels of marine debris, inedible trash items that have washed ashore or have been left by visitors and sand. Sand was only observed in scat from the feeding beaches of visited islands where it is consumed by iguanas foraging on the beach. It is not the availability of sand that influences the consumption of sand, as I found no differences in sand availability between visited and non-visited islands. The sand is particularly problematic as it mixes with the unusually high quantities of liquid provided by grapes (compared to drier palm fruits and leaves that naturally dominate their diet) to create a cement-like scat. These scats are much denser than natural scat, which are formed predominantly from leaves and native fruits, increasing the likelihood of constipation. Two examples of medical issues likely related to impaction, including a possible death, have been documented so far (Hines et al. 2010; Iverson et al. 2011) and there are likely others that have gone unnoticed.

Other, more subtle health consequences may also result from this dietary shift. Preliminary blood differences have been observed between animals captured on feeding and non-feeding areas of Leaf Cay (James et al. 2006). Further work is needed to evaluate the extent and nature of these differences, particularly since physiological changes in response to tourism, even without food supplementation, have been observed in other lizards. Romero and Wikelski (2002) noted suppressed stress hormone response in Galápagos Marine Iguanas (*Amblyrhynchus cristatus*) exposed to tourists, and Common Wall Lizards (*Podarcis muralis*) in touristed areas demonstrated deteriorated body condition and higher tick infection rates (Amo et al. 2006). In stingrays, food provisioning has been linked to hematological changes indicating health declines (Semeniuk et al. 2009) and altered fatty acid profiles (Semeniuk et al. 2007). Iguana-tourism in the Exumas is currently at a much smaller scale than the operations affiliated with these impacted stingrays, but given the dietary shift observed in this study, it is likely that health consequences will follow.

Long-term population-level consequences to the iguanas on visited islands are harder to determine. Ongoing population monitoring of the most heavily visited islands (Leaf and U Cays in the northern Exumas) suggests that these iguanas may have altered growth rate (Iverson et al. 2004b, 2006), survivorship (Iverson et al. 2006), and sex ratio (Smith and Iverson 2006). Causes of these demographic conditions has not been determined, but the fact that these are visited, tourist-fed iguanas is suggestive.

The results of the present study concur with others on fish (Milazzo et al. 2006; Semeniuk and Rothley 2008; Clua et al. 2010) and mammals (Koganezawa and Imaki 1999; Hodgson et al. 2004; Hsu et al. 2009), all of which note behavioral changes associated with tourism and feeding that have potentially negative consequences for the target species. These results suggest that, from the point of view of animal health alone, supplemental feeding should not occur. However, human social and economic benefits and pressures make the issue too complex for such a simplistic conclusion. In the case of the Northern Bahamian Rock Iguanas, for example, the tourism industry played a role in recovering numbers of the Allen Cays Rock Iguana from less than 100 on Leaf

Cay in the 1960's to about 700 now (John Iverson, pers. comm.) through supplemented food source and deterred poachers (Iverson et al. 2006). Although adverse effects have been demonstrated in this study, it is not clear where the tipping point is at which supplemental feeding becomes unalterably detrimental. Tour operators view this activity as a critical component of the success of their tours. Given that livelihoods are tied to these tours, local stakeholders should be invited to discuss potential solutions to issues such as those raised in this study: loss of wariness and dietary shifts. Establishment of ongoing dialogue will be essential as new issues are potentially unveiled and various management practices are tested. Options to consider might include limiting daily numbers of visitors or daily visits to landing beaches, controlling approach distance to reduce impacts on wariness, preventing predator introductions, altering tourist presentation of food to iguanas to discourage feeding in the sand, establishing sand-free feeding areas, confining visitors to specific areas, or allowing only tour guides to feed the animals. Any tourism practice alterations should be accompanied by behavioral and physiological monitoring of the iguanas to ensure that changes affectively address conservation concerns and are not accompanied by new problems.

Encouragingly, proper management of feeding by tourists has been shown to reverse impacts on wildlife without eliminating tourist interest. On Little Water Cay in the Turks and Caicos, an iguana feeding situation similar to that in the Exumas was transformed into a successful, non-feeding walking tour along a boardwalk where tourists still see iguanas and benefit from educational signage (Glenn Gerber, pers. comm.). Once feeding stations were eliminated in Komodo National Park, Komodo Dragon (*Varanus komodoensis*) foraging and group size patterns returned to pre-artificial feeding norms (Walpole 2001). The downsides were lowered dragon sightings by tourists and reduced tourist revenues to local villagers, but the tours did not cease, local attitudes toward tourism remained positive, and new methods were explored to address lowered sightings and revenues (Walpole 2001; Walpole and Goodwin 2001). In Brazil, conscientious management of an Amazon River Dolphin (*Inia geoffrensis*) feeding attraction contrasted with a less sustainable operation nearby suggests that proper control of food provisioning can limit impacts, at least behavioral ones, upfront (de Sá Alves et al. 2009). While these success stories are encouraging, it is important to note that there is no one solution for balancing the benefits and harms of tourism and food supplementation. Lessons from different case studies should be shared, but behavioral, physiological, and ecological impacts need to be assessed separately for each scenario to tailor management needs to the specific conservation issues at hand, including the particular situations in the Exumas.

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