Population Densities and Diet of Monitor Lizards (*Varanus indicus*) on Pagan, Commonwealth of the Northern Mariana Islands

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INTRODUCTION

The mangrove monitor lizard (*Varanus indicus*) is present on every island in the Marianas archipelago except Farallon de Medinilla, Guguan, Asuncion, Maug, and Uracas (Vogt and Williams, 2004). Questions exist if the mangrove monitor lizard is an endemic to the Marianas or an introduction facilitated by early Chamorro colonists (Pregill 1998). Mangrove monitor lizards have inhabited the Mariana Island for hundreds if not thousands of years (Pregill 1998). They are members of the Varanidae family, a group of carnivorous (with 2 exceptions) lizards which include the Komodo dragon (*Varanus komodoensis*) (Pianka and King, 2004).

On many islands in the Mariana Archipelago monitor lizards are the only medium or large sized predator (feral cats being another). Mangrove monitor lizard breeding behavior (McCoid *et al* 1991), home range (Vogt unpublished), and diet (McCoid and Witteman 1993, Martin *et al* 2008) have been documented in the Marianas. To date only, a single study documenting population density has been conducted (U.S. Fish and Wildlife Service, 2009).

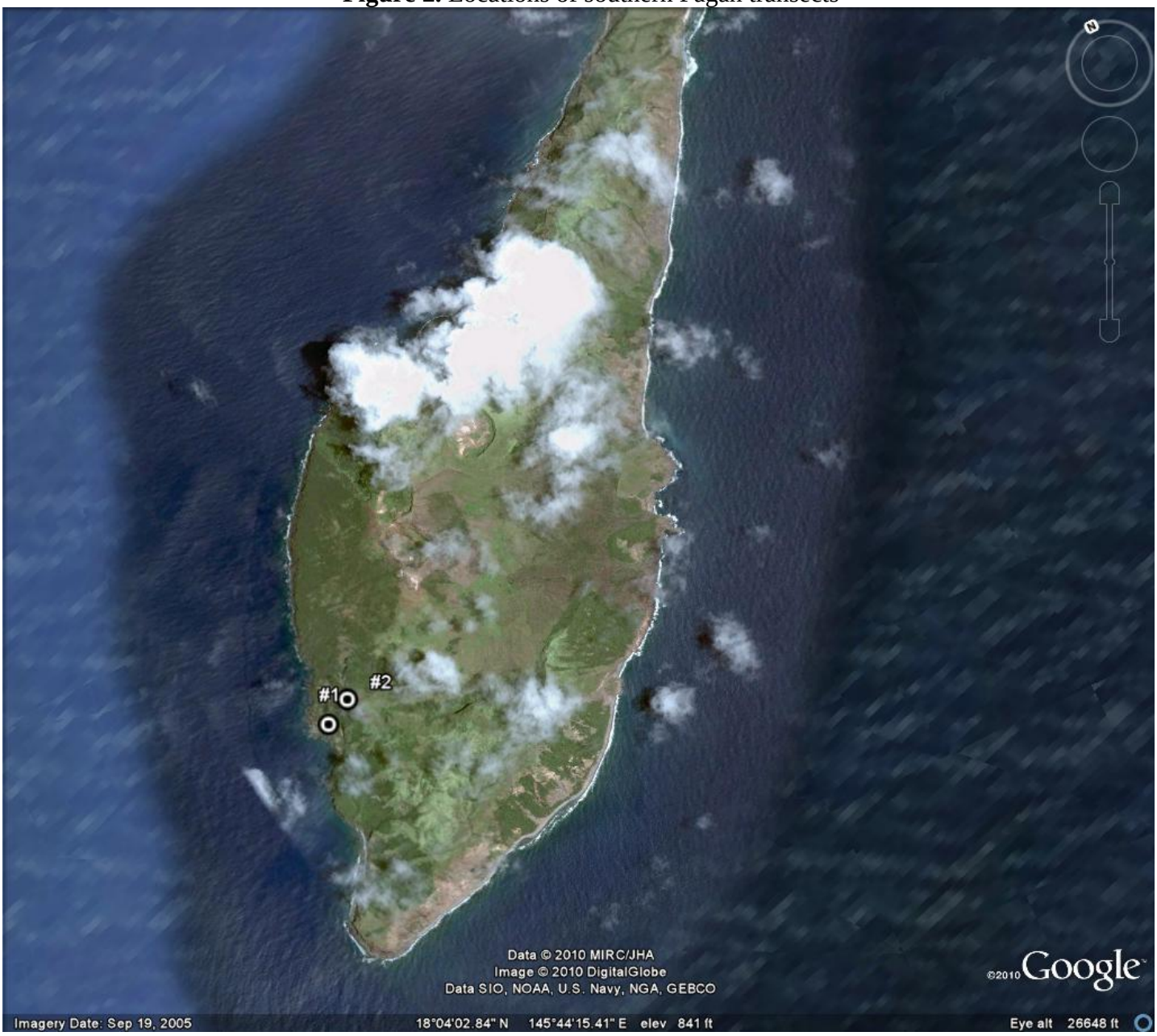
METHODS

A. Distance Transects

In 2008 and 2009 DISTANCE methodology (Buckland *et al* 2001) was successfully used to estimate the population densities of monitor lizards on the island of Aguiguan (U.S. Fish and Wildlife Service 2009). Surveys on Pagan using DISTANCE sampling were conducted between the 1st and 16th July 2010. Eleven transects (Figures 1 and 2) in the Northern, Central, and Southern parts of the island were slowly walked between 0900 and 1400. If a monitor lizard was sighted, the perpendicular distance from the mid-body of the observer to the mid-body of the monitor lizard was measured to the nearest centimeter (cm) with a tape measure. Since monitor lizards often move or flush, this point was estimated. After walking a transect in one direction, the observer waited 15 minutes and then returned along the same transect and recorded data again. The total transect length was therefore the round-trip distance of the transect (e.g. a 1000 meter transect was walked twice for a total transect length of 2000 meters). Distance transect data was analyzed with the analytical software, DISTANCE.

Figure 1. Location of central and northern Pagan transects

Figure 2. Locations of southern Pagan transects



B. Diet and Demographics

Monitor lizards were opportunistically collected with a .22 caliber air rifle, after the DISTANCE transects were surveyed. All lizards collected were weighed, measured [snout to vent length (SVL) and tail length (TL)], sex determined, and the body condition assessed. Stomachs were removed and the contents identified.

RESULTS

Population Density

Two monitor lizards were detected. The total distance for all transects walked was 36,397 meters. See Table 1 for transect locations, habitat types, transect lengths, and detection locations. There were not sufficient detections to calculate a population density.

Table 1. Distance Transects on Pagan

Transect	Location	Length (meters)	Habitat Type	# monitor lizards detected
1	Southwest side of island, near coast	2,196	Coconut forest	1
2	Southwest side of island on ridge between the two southern peaks	1,248	Native forest	0
3	Northern tip, Talague beach area	3,710	Coconut forest	0
4	Northern tip, bird count transect #7	1,190	Coconut forest	0
5	Central island, on escarpment	3,913	Grassland, sabannah	0
6	Top of central escarpment	1,220	Grassland, sabannah	0
7	Central island, ~1km south of central escarpment	2,550	Coconut and native forest mix	1
8	Central west side of island, ~100m north of runway	2,680	*Casuarina* forest	0
9	Central and east side of island. From runway to east side	10,020	Coconut forest	0
10	Central west side of island on road from runway to coastal lake	6,020	*Casuarina* forest	0
11	Central west side of island, old road south of the escarpment, going south	1,650	Coconut and native forest mix	0

Diet and Demographics

One monitor lizard was collected for stomach analyses. This individual was a male with the following morphological measurements: SVL - 475mm, TL - 748mm, weight - 1805 grams, and body fat weight - 26 grams. The stomach contained a single centipede (15 mm in length), a single roach, ~20 pieces cricket or grasshopper parts (legs and wings), and 2 juvenile monitor lizards tails (60 mm and 70 mm in length respectively).

DISCUSSION

The lack of monitor lizard detections was surprising. Similar surveys on Aguiguan Island (3 km south of Tinian) documented a mean detection rate of one lizard per 300 meters of transect (U.S. Fish and Wildlife Service. 2009). This is roughly 60 times higher than Pagan. While it is possible that monitor lizards were missed, the sampling effort for this study is high enough to support the conclusion that monitor lizard density is lower between sites utilizing similar methods. Sarigan Island also appears to have higher monitor densities than Pagan (Martin *et al* 2008, *pers. obs*.). It is possible that there are density gradients or localized conditions on Pagan that support higher monitor lizard densities and these areas were not sampled, however, given the total length of transects that were walked (36,397 meters), and the areas that were sampled more lizards were expected to be seen.

It is interesting to note that the main prey for the monitor lizards on Aguigan is roaches, and while the central and southern parts of Pagan have abundant roaches (pers. obs.) there are far fewer monitor lizards than Aguigan (U.S. Fish and Wildlife Service. 2009). It is possible that something is affecting juvenile survivorship of monitor lizards on Pagan, as the habitat appears adequate to support higher adult densities. However due to the lack of data one can only speculate as to why other nearby islands with similar habitat support higher numbers of monitor lizards.

Top level predators can substantially affect ecosystems, both directly and indirectly. The effect on the Pagan ecosystem exerted by monitor lizards is difficult to ascertain. Losos and Greene (1988) speculated that in terms of ecological effects, varanids (excepting the largest species) most closely mimic small foxes or some civet cat species. Their prey and foraging habits do put them in direct competition with the endangered Micronesian megapdode (*Megapodius laperouse laperouse*) (Jones *et al*. 1995) and consumption of megapodes by monitor lizards has been documented (Martin *et al* 2008). If native Marianas species did not in fact evolve with monitor lizard predation or competition, then removing the lizards should be ecologically beneficial, although exactly how one would accomplish that is unknown at this time.

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