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BREEDING AND STATUS OF THE GRENADA HOOK-BILLED KITE (*CHONDROHIERAX UNCINATUS MIRUS*)

Russell Thorstrom[1] & Desmond McQueen[2]

[1]The Peregrine Fund, 5668 W. Flying Hawk Lane, Boise, ID 83709.
E-mail: rthorstrom@peregrinefund.org.

[2]The Grenada Forestry Department, Forestry and National Parks Department, Ministry of Agriculture, Lands, Forestry and Fisheries, Queen's Park (HQ), St. George's, Grenada, W.I.

Resumen. – Reproducción y estado del Elanio Pico Ganchudo (*Chondrohierax uncinatus mirus*). – Del 2000 al 2006, estudiamos al Elanio Pico Ganchudo (*Chondrohierax uncinatus mirus*), una subespecie endémica y en peligro de la isla Grenada. Los elanios establecieron territorios y anidaron de Mayo a Noviembre, tiempo que coincide con el inicio de la estación lluviosa. Los elanios construyeron nidos de palitos en la copa o al final de ramas estrechamente bifurcadas en los árboles maduros y de edad avanzada. Los nidos fueron construidos a una altura promedio de 23,4 m sobre el suelo. Los elanios pusieron huevos de Junio a Septiembre. Los huevos eclosionaron de Julio a Octubre, y los jóvenes salieron del nido de Agosto a Noviembre. Documentamos 32 intentos de reproducción de Mayo a Noviembre 2000–2006, y 18 jóvenes salieron de 16 nidos exitosos con un total de 0,6 jóvenes volantones por intento de reproducción de cada pareja, y el éxito reproductivo total fue del 50%. Basado en el número de parejas con territorio, adultos no reproductores e inmaduros, estimamos el tamaño de la población del elanio de Grenada entre 50 y 75 aves. No observamos elanios durante una búsqueda realizada en Abril de 2006 en la pequeña isla de Carriacou, ubicada a 32 km al norte de Grenada.

Abstract. – We studied the endemic and endangered Grenada Hook-billed Kite (*Chondrohierax uncinatus mirus*) from 2000 to 2006. Kites established territories and bred from May to November, which coincides with the beginning of the wet season. Kites built stick nests on the top or end of narrow-forked branches in mature and older-aged trees. Nests averaged 23.4 m above the ground. Kites laid eggs from June to September. Young hatched from July to October, and fledged August to November. We documented 32 breeding attempts from May to November 2000–2006, and 18 young fledged from 16 successful nests with a total of 0.6 young fledged per breeding pair attempt and overall nest success was 50%. We estimated the Grenada kite population to be around 50–75 birds based on territorial pairs, nonbreeding adults and immatures. We had no kite sightings during a one-week survey in April 2006 on the small island of Carriacou, 32 km north of Grenada. *Accepted 10 December 2007.*

Key words: Grenada, Hook-billed Kite, *Chondrohierax uncinatus mirus*, population estimate, nests, productivity.

INTRODUCTION

The Hook-billed Kite (*Chrondrohierax uncinatus mirus*) is an endemic subspecies in Grenada (Blockstein 1988, Thorstrom *et al.* 2001). This poorly-known insular kite was considered extinct at one time (King 1981) but is currently regarded as endangered (Bierregaard

1994). In June 1980, at least eight birds were observed in Grand Anse, Beaton, and other areas of the southern dry woodlands; aspects of their feeding behavior were described and one pair was building a nest (Smith & Temple 1982). In July 1987, Blockstein (1988) had several sightings of kites from the drier southwestern part of the island too, and he estimated the population at 15–30 birds. Blockstein (1991) also observed approximately half as many kites in December 1989 and January 1990 as in 1987 during equal search time. This kite is known to occupy the southern part of the island but little is mentioned of it throughout Grenada or in the wetter higher forests, except for the report of a bird over wet forests north of Grand Etang, and another near Morne Fedon, at 600 m elevation in 1971 (O. M. Buchanan, *fide* Smith & Temple 1982).

During kite surveys in 2000, Thorstrom *et al.* (2001) not only found Hook-billed Kites in southern Grenada but also found kites nesting there; they observed several of them in the higher and wetter forests, and obtained information on their specialized diet of arboreal snails, nesting behavior, and distribution. This study summarizes information collected from 2000 to 2006 on territorial pairs, monitoring of nests and observations of breeding attempts of the Grenada Hook-billed Kite.

STUDY AREA AND METHODS

Grenada (12N, 61W) is the southernmost island of the Lesser Antillean Island chain, and lies approximately 140 km north of Trinidad. It is the largest of three main islands: Carriacou and Petit Martinique, lying to the north. Grenada is a small volcanic island 34 km long by 18 km wide, with a land mass of 312 km^2 with a small area of the north part of the island made up of limestone. The human population on the island is around 100,000 and is largely concentrated in the southwestern part of the island, in and around the capital city of St. George's. Topographically, it is mountainous and heavily forested with numerous streams and rivers. As a tall volcanic island, Grenada produces its own local weather, creating a range of climate variations from sea level to its highest point, St. Catherine, at 800 m. The temperature of Grenada at sea level is generally in the high 28–30°C with little seasonal, daily and locational variation, and ranges between 19–24°C in the mountains with very high humidity. Annual rainfall varies from approximately 1270 mm in the dry coastal area to 4060 mm in the higher central mountains. The dry season is from January to May and the wet season from June to December. About 75% of the annual average rainfall occurs during the wet season. Vegetation zones range from sea level mangrove woodlands (1.7%), cactus scrub (3.5%), deciduous forests (22.5%), evergreen forests (22.7%), montane rain forests (45.2%), palm brake (3.2%) and elfin woodlands (1.2%) on the summits of the highest mountains (Caribbean Conservation Association and Island Resources Foundation 1991).

During 2000, 2001 and 2002, we searched for kites from key sites overlooking forested and human-modified habitat, and by cars traversing every road at least once, nearly every road in the southern half of the island, and visiting selected areas by car in the north. Beginning in 2002, public transport was used to search areas known to have kites, known kite nesting areas, and searching new areas within walking distance of public transportation. From 2004 to 2006, kite searches were conducted from a motorcycle covering nearly all the roads throughout Grenada, and selecting suitable locations for good viewing from the network of roads on the island. In April 2006, DM also traveled to the island of Carriacou to search for Hook-billed Kites. Carriacou, 34 km^2, lies 32 km to the north. We used

TABLE 1. Nest sites, year of nesting attempts and number of young successfully fledged for Grenada Hook-billed Kites from 2000 to 2006.

Nest sites	Years	Total young fledged
Morne Rouge	2000, 2001, 2002	1, 2, 0
Woodlands	2000, 2003, 2004	0, 2, 0
Ray's Villa	2002, 2003	0, 0
Les Avocats	2001, 2002, 2003, 2004	0, 0, 1, 1
Palmiste Reservoir	2001, 2002	1, 0
Bel Air	2003, 2004	1, 1
Tufton Hall	2003	1
Dougaldston	2003	0
Concord	2003, 2004, 2006	1, 1, 1
Mt. Gay	2002, 2003	0, 0
Boca 1	2003	1
Boca 2	2003	0
Belvidere	2004, 2005, 2006	0, 0, 0
Café	2006	1
Mount Tout	2006	0
Hope Vale	2006	1
Mt. Hartman	2006	1
Total	32	18

8–10 x 35–45 binoculars, and 60 and 82 mm spotting scopes to identify distant kites and observing nests. Many observations were of kites in distant soaring flight. These birds were distinguished from the common resident Broad-winged Hawk (*Buteo platypterus*) on the basis of flight profile and behavior. Individual birds were identified by feather condition (broken, worn, or decayed), molt gaps (primaries, secondaries and rectrices), and sexually dimorphic plumage.

Observations at overlooks and suitable viewing locations lasted approximately 4 h depending on the weather and presence of kites. If kites were observed, we moved closer to identify kite activity and potential nests. Once a nest was located, it was observed from the most viewable and allowable distance tolerated by the kites. Nests heights and several nest tree diameter were measured after young had fledged or the nest failed. Each nest site coordinate was taken with a hand-held GPS unit. All map references refer to the 1988 Ordinance Survey maps, Grenada South (1:25,000) and North (1:25,000).

RESULTS

Territorial pairs and population estimate. From 2000 to 2006, we documented 17 Grenada Hook-billed Kites pairs with nests sites (Table 1) and observed five more pairs not associated with a nest or the nest couldn't be found; in total we documented 44 territorial birds.

We recorded a minimum of 15 individual kites in 2000, the first year of the study, to a maximum of 39 birds in 2004 (Table 2). On seven occasions, in May and June, at three nest sites, we observed immature-plumaged birds, possibly previous year young, being chased and driven away by attending adults during the early part of the breeding. We estimate the population at 50–75 birds, including 44 territorial birds and 10–30 non-breeders and immatures extant on the island. No kites

TABLE 2. Annual number of Grenada Hook-billed Kites observed and reproductive success during the breeding seasons 2000 to 2006.

Years	Kites observed (n)	Nests (n)	Young fledged (n)	Productivity (young fledged/ nest)	Successful nests (n (%)
2000	15	2	1	0.5	1 (50)
2001	22	3	3	1.0	2 (66)
2002	19	5	0	0	0
2003	31	10	7	0.8	6 (67)
2004	39	5	3	0.6	3 (60)
2005*	16	1	0	0	0
2006	25	6	4	0.6	4 (66)
Total		32	18	0.6	16 (50)

*Post-hurricane breeding season.

were observed by DM during a one-week survey of 36 h of observations on Carriacou in April 2006.

Nesting activities and nests. Kites began courtship and nesting activities during May coinciding with the start of the rainy season. Eggs were laid from June to September, young hatched from July to October, and young fledged from August to November. Young were still dependent on adults for food at the end of the rainy season in November and December.

Grenada Hook-billed Kites nesting areas ranged from the deciduous seasonal forests (n = 7 nests; e.g., Morne Rouge, Mt. Hartman), the evergreen forests (n = 7 nests; e.g., Concord, Palmiste Reservoir) and montane rain forests above 400 m (n = 3; e.g., Les Avocats, Belvidere). The 17 kite nest sites were distributed in the southern region (n=8 nests), western region (n = 6), and the interior (n = 3) (see FIG. 1). Kite nests were sparsely-built platform stick structures situated at the end of branches in the upper canopy, or on the upper branches in a fork in mature and older-aged trees. Nest height averaged 23.4 ± 10.1 m (SD) above the ground (n = 12 nests, range 12–40 m). At Morne Rouge the nest was reused 3 years, while nests at Ray's Villa, Les Avocats, Bel Air, Mt. Gay, and Concord were in the same nest trees, but different location. Nineteen Grenada Hook-billed Kite nesting attempts were in five tree species: 36.8% (n = 7) were in *Erythrina poeppigiana*, 21% (n = 4) in *Albizia niopoides*, 21% (n = 4) in *Cebia pentandra*, 10.5% (n = 2) in *Swietenia mahogani*, and 10.5% (n = 2) in *Bursera simaruba*. Three nest trees were 84, 171, and 186 cm in diameter at breast height.

Productivity of kites from 2000 to 2006. Grenada Hook-billed Kite nesting attempts were monitored from 2000 to 2006 (see Table 1). The first recorded nesting occurred in 2000, and nesting was documented for all years of this study. From 2000 to 2006, 17 nesting sites were identified and 32 nesting attempts were recorded. The number of nesting attempts varied from one in 2005 (post Hurricane *Ivan* and *Emily*) to a high of 10 in 2003 and the number of young fledging ranged from 0 in 2002 and 2005 to 7 in 2003 (Table 2). In 2002 and 2005, nesting was attempted, but all attempts failed.

In total, 18 young fledged from 32 nesting

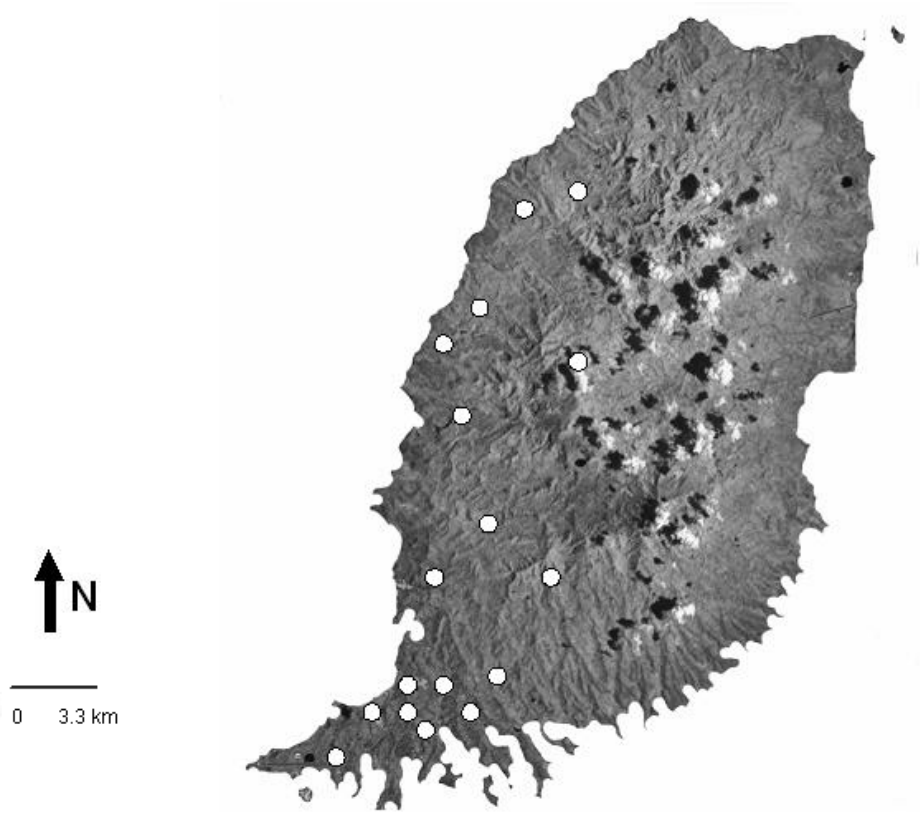

FIG. 1. Nest sites of Grenada Hook-billed Kites from 2000 to 2006 (small white circles represent kite nest sites).

attempts, for an overall productivity of 0.6 young fledged per successful attempts (Table 2). We did not document any second nesting attempts during this study. Two out of 16 successful nesting attempts fledged two young per nest, and the other 14 successful nests produced one young per nest. Nest success for the 7 years of this kite study was 50% (16/32).

DISCUSSION

The Grenada Hook-billed Kite shows much less distinctiveness in both genetic and morphological characters and this taxa is smaller in overall body size and has less variability in bill size and plumage coloration relative to mainland hook-billed kites (Friedmann 1934, Smith & Temple1982, Ferguson-Lees & Christie 2001).

Hook-billed Kites throughout the Neotropics have always been considered patchy and often uncommon to rare, and the most important factor for determining its presence is the abundance of tree snails (Smith 1988). The Grenada Hook-billed Kite population density has always been low (Bond 1961, Smith & Temple 1982, Blockstein 1988), and

it was once considered extinct (King 1981), but this endemic subspecies is still considered endangered (Bierregaard 1994). From 2000 to 2004, and during 2006, we recorded an increase in the number of kites observed in comparison to earlier years (Bond 1961, King 1981, Smith & Temple 1982, Blockstein 1988). Our study focused on kites only, and we searched throughout the island, whereas earlier reports and information were collected during limited periods and seasons, and focused only in southern Grenada or on another species (Smith & Temple 1982, Blockstein 1988). As a result, we observed kites in a broader range of habitat types and throughout the island (pers. observ., Thorstrom *et al.* 2001).

From surveys conducted during February and August 2000, the kite population was estimated to reach 40 individuals mainly from sightings in southern and western Grenada (Thorstrom *et al.* 2001). We do not know the number of immatures and nonbreeding adults not associated with territories in any given year in this island population, but suspect it to be between 10–30 birds. We did record seven young fledging successfully in 2003 and suspect maybe 10 young may fledged annually during a good breeding year on the island. In 7 years of surveys, monitoring and research, we estimate the Grenada Hook-billed Kite population to be in the order of 50–75 individuals with more than half being territorial and nesting pairs.

During this study, kites were observed nesting in previous year's sites, and several kites were found nesting in areas where they had only been observed during the nonbreeding season. Kites were also observed nesting in new areas they hadn't been documented in previous years. Average nest heights were similar between this study at 23.4 m and of 4 nests in Tikal National Park, Guatemala at 25.7 m (Marroquin *et al.* 1992), whereas nests in northern Mexico were shorter at 5–7 m, and in drier forests (Smith 1988).

Although kites were observed throughout Grenada, kite nests were predominantly found in the southern and western part of the island, with a few from the interior region (see FIG. 1). The eastern and northern side is flatter and has more humans and human-altered landscape, and a possible reason for fewer observations of kites and the lack of nests documented during this study.

We documented kites and nesting kites from sea level near Morne Rouge and Grand Anse (St. George Parish) to individuals nesting in the montane wet forests at altitudes above 400 m in Los Avocats (St. David Parish) and Belvidere (St. John Parish). Although we did not document any second nesting attempts, we believe it may be possible if a nesting pair failed early in their breeding cycle.

Due to its secretiveness and patchy distribution throughout the Neotropics, little information exists on nest success and productivity of this forest raptor. We are not sure why no young were produced in 2002, but believe predation and a small sample of three nests could be possible reasons. In 2005, no productivity occurred at the nests we monitored and we believe the breeding kite population was affected by the habitat devastation leading to possible prey reduction or availability from the hurricanes.

In Tikal National Park, Guatemala, Marroquin et al. (1992) observed four hook-billed kite nesting attempts with nest success at 50% and 0.5 young fledged per nest, and similar to the nest success and productivity we observed of 32 nesting attempts in Grenada.

During the first week of September 2004, Grenada was hit by hurricane "Ivan", a category 4 hurricane, destroying nests of kites and a majority of forested habitat: trees knocked down, major branches broken, and leaves stripped off branchs (pers. observ.). Again, in July 2005, hurricane "Emily" hit the island

causing more damage. The number of kites recorded in 2004 prior to the hurricanes "Ivan" and "Emily" was 39 birds, compared to 25 in 2006. This suggests that 35% of the kites had not been observed possibly indicating they may have perished during or after the two hurricanes hit Grenada. We believe these two hurricanes, destroying more than 50% of the forested habitats, impacted breeding activities of kites because of the reduced number of kites attempting to nest during the end of 2004 and only one pair was observed nesting during 2005. Unfortunately, this nest failed. This lack of nesting kites suggests that breeding was not possible for Hook-billed Kites in 2005 (e.g., no nesting attempts at Concord, Les Avocats, Belair Estate, Woodlands Estate), possibly due to low prey densities and availability, nesting habitat destruction, loss of adult birds, other unknown factors, or a combination of these factors. The observation of an immature kite following an adult male at the end of 2005 is an indication that at least one pair had bred successfully during 2005 (pers. observ.).

By 2006, the forests appeared to be regenerating and slowly returning to favorable nesting conditions for the kites (pers. observ.). Nesting activity had increase dramatically in 2006 when a total of six nesting attempts were recorded whereas only one was documented in 2005 with very few kites observed too.

The Grenada Hook-billed Kite population appears to be stable, but its endangered status should remain as they continue to lose nesting and foraging habitat due to the destruction and alteration of forests and woodlands .

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