BEHAVIOUR AND NATURAL HISTORY OF THE WEST INDIAN WHISTLING-DUCK *DENDROCYGNA ARBOREA* ON LONG ISLAND, BAHAMAS

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The West Indian Whistling-duck is a sedentary species, endemic to the West Indies. Threatened by hunting, habitat destruction and introduced predators, the bird is classified as vulnerable by the International Union for the Conservation of Nature (IUCN) with fewer than 10,000 individuals remaining. Despite its near-threatened status and wide range in the Caribbean, the biology of the species is poorly known. I studied the behaviour of the West Indian Whistling-duck during three summers (1993-1995) on Long Island and Hog Cay, Bahamas, to provide baseline ecological data for conservation planning and development of future research priorities. Breeding on Long Island occurred from February through July, with nesting peaks in April and June. Nests were leaf-lined depressions on the ground, each containing 6-10 cream-coloured eggs. Both parents incubated, alternating 24-hr shifts, and both cared for the young. In two cases, pair bonds lasted at least two years. Adults fed at an artificial feeding station and on natural wetlands; ducklings fed by diving and dabbling. Population means ranged from 513 to 1,071 birds for 1994 and 1995, respectively. Adults had a yearly survival rate of 64%. Brood size decreased between age-class I and just-fledged juveniles.

Keywords: Bahamas, Behaviour, Breeding Ecology, Feeding Ecology, Natural History, West Indian Whistling-duck.

The West Indian Whistling-duck *Dendrocygna arborea* is one of the least studied species of waterfowl *Anatidae*. Collar *et al.* (1992) summarised the small amount of published information about the species along with the personal observations of Caribbean ornithologists, but no intensive research has been conducted on the species. Although systematic surveys are lacking, many sources report a precipitous decline in numbers since the beginning of this century (Collar *et al.* 1992). The species has been extirpated from portions of its range, and it is currently listed as vulnerable by the IUCN (IUCN 1994).

The major cause of decline appears to be over-hunting (Collar *et al.* 1992). Although the ducks are protected by law in most parts of their range, enforcement is almost nonexistent, and poaching is widespread. The birds are also threatened by habitat loss due to wetland drainage, predation by introduced mammals including raccoons *Procyon lotor* and the Indian mongoose *Herpestes javanicus*, and pollution in the form of pesticide and fertilizer runoff (Collar *et al.* 1992). The species poses a particularly difficult conservation challenge, because populations are distributed widely over hundreds of islands and across dozens of political boundaries.

There is an urgent need for information on the ecology of the species if we are to understand its conservation needs and provide protection for the remaining populations. Habitat preferences and local movements on Long Island, Bahamas are described elsewhere (Staus 1998). In this paper, I report information on the biology of birds in the Long Island population.

Method

Study area

I conducted this study in June and early July 1993, and from May to August 1994 and 1995 on Hog Cay and the northern 20 km of Long Island, Bahamas. Hog Cay (23°36'N, 75°20'W) is a small (100 ha), privately owned island located off the northern tip of Long Island, dominated by sandy ground scrub vegetation. Mangroves *Rhizophora mangle* and *Avicennia germinans* occur on the northeast side of the island. There are two natural brackish ponds surrounded by mangroves, one artificial freshwater pond surrounded by natural vegetation, and two small concrete duck ponds. Up to 600 West Indian Whistling-ducks visit Hog Cay from Long Island to feed on cracked corn provided for them twice daily at a feeding station near the owner's residence (unpubl. data).

Long Island is an outer island in the southern Bahamas archipelago. It is 128 km long and 6.4 km wide at its widest point. The island is dominated by mixed broadleaf coppice vegetation. Mangroves grow along the west coast, and many small saline, brackish, and freshwater ponds are located in the interior. The island is mostly undeveloped with a total population of about 3,000 people, the majority of whom live on the southern half. Some cultivated crops such as corn and bananas occur throughout the island.

Capture and marking

I captured birds with mist-nets placed around the feeding station on Hog Cay. All captured birds were fitted with metal leg bands and a unique combination of UV-resistant coloured leg bands. Birds were sexed by cloacal examination. Juveniles were identified by the appearance of flank feathers that were striped in juveniles and spotted in adults. Four adult females and nine adult males were fitted with adjustable, back-mounted, radio transmitters weighing 20 g (Advanced Telemetry Systems, Isanti, MN). Transmitters had a life expectancy of five months and a range of up to 6.5 km.

I located birds throughout the day and night to learn about their habitat preferences and movements (Staus 1998). In addition, I spent six to 10 hours each week observing the behaviour of birds at the feeding station. Observations were made at approximately 15m from the station using binoculars and a 40 x telescope. The birds were habituated to humans, and no blind was necessary.

Nesting

Timing of nest initiation was determined by finding nests (n=3) and by back-dating observed broods (n=56) using the age-classes of Cain (1970) for Black-bellied *D. autumnalis* Whistling-ducks and assuming an incubation period of 30 days (Johnstone 1957). Light-coloured fledged juveniles with striped flank feathers were assumed to be about two months old (see Results).

Feeding: Brood

Feeding data were gathered opportunistically on one brood in 1995. Time budget data were collected by instantaneous scan sampling (Altmann 1974). The behaviour of both parents and all ducklings were scanned at an interval of five minutes during scanning periods of one to three hours. Because ducklings were not marked, they were pooled into one category and assigned the behaviour of the majority of ducklings at each scan. Adults were assigned one half of an observation in each behavioural category if their behaviour differed during any given scan. The following behaviours were recorded: 'foraging,' 'resting,' 'preening,' 'alert,' 'swimming' or 'other.'

Agonistic behaviours

Aggressive behaviour was recorded using focal animal sampling for marked birds feeding at the feeding station. Aggressive activities were recorded continuously for the focal animal (Altmann 1974). Data were taken on seven adult males and six adult females in 1994. The total number of aggressive interactions were pooled for each individual and divided by the total number of minutes they were observed, resulting in a rate of aggressive interactions/minute. A Wilcoxon Rank Sum test was used to compare frequency of aggression between males and females.

Population

I estimated population size using a modified Lincoln-Petersen capture-recapture model (Chapman 1951). I collected data during May and June of 1994 and 1995 by recording all marked individuals and the total number of ducks (marked and unmarked) visiting the feeding station during a two-hour interval in the evening. Adults and fledged juveniles were included in the count.

Mortality: Adult

I estimated adult survival rate over the three years of the study using the Jolly-Seber capture-recapture model and programme JOLLY (Pollock *et al.* 1990). Marked individuals were observed at the feeding station on Hog Cay. Flighted juveniles and adults were assumed to have equal survival rates, and were combined in the analysis.

Mortality: Brood

I observed broods opportunistically both on Hog Cay and Long Island during 1993-1995. I aged broods using criteria developed for black-bellied Whistling-ducks by Cain (1970). Class I broods (n=28) were 1-21 days, Class II broods (n=7) were 22-49 days, and Class III broods (n=1) were 50-56 days of age. In addition, just-flighted juveniles (>56 days) could be recognized by their striped flank feathers and lighter coloured plumage (n=20). Because broods were not marked, I avoided double-counting by identifying individual broods using a combination of location, age-class and number of ducklings. I used a one-way ANOVA to compare brood size among age-classes.

Results

Description

The plumage of adult West Indian Whistling-ducks is adequately described by Madge and Burns (1988). Males and females shared the same plumage and were usually indistinguishable in the field, although some marked males (n=4) and unmarked birds exhibited a distinct swelling under the tail, presumably attributable to the male phallus. O'Brien (1995) regarded this swelling as a reliable indicator of gender in West Indian Whistling-ducks on Grand Cayman. Measurements of culmen, bill length from gape, tarsus, keel, flattened wing chord, and weight are provided in Appendix 1. Males and females were generally similar in size, although males had a larger culmen (n=19, Mann-Whitney U-test, P=0.04) and females were heavier (n=11, Mann-Whitney U-test, P=0.08), possibly because they were accumulating fat reserves for breeding.

Juvenile plumage was similar to that of adults with the exception that flank feathers were striped in juveniles and spotted in adults, and juveniles were usually lighter coloured than adults (Madge & Burn 1988, pers. obs.).

Nesting

During the summer months, nesting peaks occurred in June of 1993 and 1994, and in April of 1995 on Long Island, and were not strongly related to rainfall (**Figure 1**; Pearson Correlation Coefficient = -0.15, P=0.6). The three nests found on the study site were located on the ground and consisted of a small leaf-lined depression beneath thatch palm *Thrinax microcarpa*, bay cedar *Suriana maritima*, and an unidentified dense bush. As in other Whistling-ducks (Delacour 1954), no down was added for nest lining or egg insulation. Nests

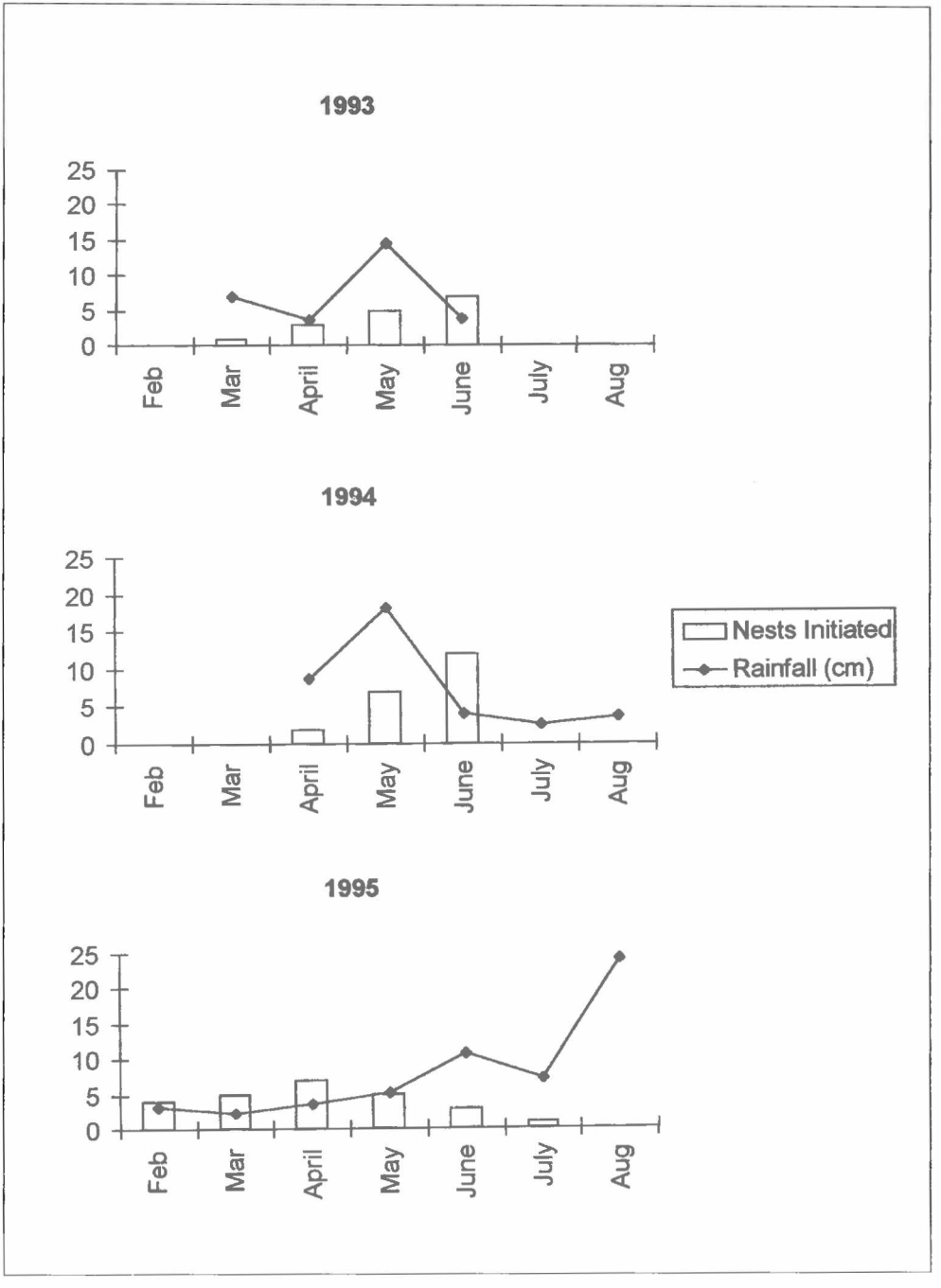

Figure 1. Breeding records and rainfall data for West Indian Whistling-ducks on Hog Cay and Long Island, Bahamas during the summers of 1993 to 1995. No information is available for Sept. through January.

Table 1. Partial record of nest attentiveness for a pair of incubating West Indian Whistling-ducks on Long Island, Bahamas.

	Nest Attentivness			
Day	Radio-tagged female	Time	Unmarked bird	Time
1	NEST FOUND			
2	NO DATA			
3	OFF	1215	ON	1300
4	ON	1415, 1725		
5	OFF	0800		
6	ON	0925, 1810		
7	OFF	1530		
8	NO DATA			
9	OFF	1115	ON	1115
10	ON	0815, 1140		
11	OFF	1330		

were located 400-1,200 m from ponds suitable for raising broods. Nesting has also been reported on small offshore islands, where risk of predation may be lower, and broods swim across several km of open ocean to ponds on Long Island (Bruno Dittmar, pers. comm.). Clutch size is generally reported to be 10-16 eggs (Collar *et al.* 1992), but the incubated clutches I examined contained six, seven, and 10 cream-coloured eggs with smooth shells. Measured eggs (n=18) averaged 58.1 mm long and 42.4 mm wide.

Breeding ecology

West Indian Whistling-ducks are assumed to breed monogamously and have long-term pair bonds. I observed two cases of two-year pair bonds in marked birds. Two of three radio-marked females nested in 1994. Telemetry locations revealed a distinctive pattern of one day on the nest followed by one day off. By visiting one of the nests on three days that the female was not incubating, I documented that a different bird, presumably the male, incubated on these days (**Table 1**). The radio-marked females appeared to incubate all day on their days 'on,' and spent days 'off' roosting in mangroves and feeding at the feeding station.

Both males and females cared for the young, accompanying the brood as they fed, often swimming alongside them. Sometimes, one parent remained alert at the edge of the pond while the other parent swam with the brood. This vigilance appeared to be a response to potential predators including Green Herons *Butorides virescens* and Yellow-Crowned Night Herons *Nyctanassa violacea* that perched in trees at the edge of ponds, watching the broods intently.

Parents appeared to defend small brood-rearing territories on ponds, and aggressively evicted intruding waterbirds including other West Indian Whistling-ducks and White-cheeked Pintails *Anas bahamensis bahamensis* by swimming towards them with bill open and wings extended. When approached by humans, families usually retreated into the vegetation. On several occasions, parents responded to my presence by engaging in a distraction display, beating both wings on the surface of the water or ground while the duckling(s) swam or ran to cover. Broods usually fed throughout the day.

Family bonds were strong and young stayed with parents for at least several weeks, possibly for several months after fledging. Family groups behaved like goose families, feeding together and threatening nearby individuals and family

groups. Many apparent family groups were seen at the feeding station with the juveniles in adult plumage. I observed one occurrence of allo-preening among family members in which birds nibbled on each other's head and breast and bowed to each other. All family members were in adult plumage, so I could not determine if both adults and juveniles were active in allo-preening.

Feeding: Adult

Use of the feeding station was greatest at dusk and dawn, and ducks fed most often on ponds during the night (Staus 1998). Marked birds relied heavily on cracked corn at the feeding station on Hog Cay; 34% of telemetry locations for radio-tagged birds were located there (Staus 1998). In addition to feeding at the station, adults flew to ponds or ephemeral wetlands to feed at dusk, usually in small flocks (presumably family groups) of three to five birds. Although up to 50 birds fed at a pond each evening, family groups remained spaced several metres apart as they fed. Birds in flight whistled and were answered by those already on the pond. Birds remained on ponds throughout the night, returning to roosting sites at dawn.

Adults on my study site fed by walking in shallow ponds and dipping their bills in the water, grazing on the lawn on Hog Cay, and tipping-up occasionally when swimming with broods. Birds also fed during the day on tidal flats near mangroves by walking and dipping their bills in small pools of water. An analysis of six fecal samples revealed small seeds and aquatic vegetation, but no invertebrate parts.

Feeding: Brood

Ducklings typically fed on ponds, and only rarely attempted to feed at the feeding station where they were aggressively evicted by adult ducks. Ducklings fed during the day by diving and dabbling at the edges of ponds; it is unknown whether they also fed during the night. The diversity and abundance of major invertebrate species in the ponds was low. Brood ponds contained water boatmen *Corixidae*, water beetles *Hydrophilidae* and scuds *Amphipoda: Gammarus spp.* and very low numbers of dragonfly larvae *Libellulidae*, damselfly larvae *Lestidae*, midges *Chironomidae*, crawling water beetles *Haliplidae* and predaceous diving beetles *Dytiscidae* (Staus 1997).

I observed one Class I brood with their parents for a total of 280 minutes in 1995 to examine diurnal time allocation while feeding on wetlands on Long Island. Ducklings fed about 50% of the time, spending most of the remainder of the day resting and preening (**Table 2**) while adults fed only 3% of the time.

Call notes

The most common call of West Indian Whistling-ducks is a shrill five-syllable Whistle uttered in flight and when feeding in groups, especially at the feeding station where hundreds of birds gathered to feed each evening, producing a characteristic chorus of Chittering and Whistling calls. There is often a low level of Chittering audible when the birds are in groups roosting or feeding. Single birds in flight or on the water Whistle presumably to make and/or keep contact with other birds.

Table 2. Percent of diurnal time (280 minutes) spent in various activities by two West Indian Whistling-duck adults and their Class I ducklings on wetlands on Long Island, Bahamas.

Mean (%)	Foraging	Resting	Preening	Alert	Swimming	Other
Ducklings	53	23	18	2	4	5
Adults	3	41	18	20	27	1

The Whistles of juveniles were much higher-pitched than those of adults. Juveniles also emitted a high-pitched Scream when handled in mist nets. Although an audible sex difference in pitch has been detected in the quiet Chittering calls of an adult pair of captives (F. McKinney pers. comm.), I was unable to identify the sexes by their calls in the field. Adults uttered a harsh high-pitched Peep continuously while raising the occipital tuft when they were nervous or alarmed, especially when the brood was present.

Agonistic behaviour

Adults on my study site were aggressive to each other, especially when with a brood, and when feeding at the feeding station. Families approached the station in a unified group, threatening individuals and other family groups. Parents often defended their young from attacks although with hundreds of birds visiting the 50 m^2 station each evening, parents and offspring sometimes became separated. Juveniles were especially susceptible to attack, and spent much of their time at the station avoiding conflicts with others.

A common threat display was the Head-low-and-forward (Johnsgard 1965) in which one bird stretched its neck out with the bill open towards another bird. Often the other bird retreated but, if not, the aggressor moved forward while still in the same posture, and sometimes pecked its opponent.

In the large flocks that gathered at the feeding station, a threatening bird often escalated to Jump-flap behaviour (Clark 1978) in which it jumped at an opponent with bill open and wings flapping. Threatened birds sometimes responded in kind, resulting in spectacular fights.

Group threats were common at the feeding station, especially among families with young that had just fledged. Families walked slowly and deliberately towards the station, single file, heads down, necks outstretched. If any family member was threatened or attacked, all others participated in defense, often in the form of Head-low-and-forward while moving towards the opponent.

Both sexes engaged in the threat displays described above, but observations of marked males (n=7) and females (n=6) at the feeding station (see Methods) revealed that males initiated significantly more (P=0.09) aggressive displays than females.

Population

Lincoln-Petersen population estimates revealed that yearly mean populations increased from 513 in 1994 to 1,071 in 1995 (Wilcoxon Rank Sum test, P=0.02).

Mortality: Adult

Of 11 birds banded in 1993, seven (64%) were observed in 1994 and three (27%) were seen in 1995. Of 34 birds banded in 1994, 21 (62%) were observed in 1995, and two were known to be dead. The Jolly-Seber capture-recapture model A (including both death and immigration) best fit my data, resulting in a mean yearly survival rate of 64% (SE=0.15).

Mortality: Brood

There were very few observations of broods in age-classes II (n=7) and III (n=1), so only age-classes I (n=28) and flighted juveniles (n=20) were included in statistical analyses. A one-way analysis of variance (ANOVA) revealed no differences due to years, so all data from 1993-1995 were combined. Mean brood size decreased significantly (P = 0.008; two-sample, one-tailed t-test) from 4.6 in age-class I to 3.5 in flighted juveniles (Table 3).

Discussion

Nesting

The breeding season appears to vary from island to island throughout the range of the species (Collar *et al.* 1992). In the tropics, breeding is often triggered each season by the occurrence of heavy rains that increase pond water levels and decrease salinities (Owen & Black 1990). However, I found no such

Table 3. Average brood size for different age classes of West Indian Whistling-duck ducklings on Long Island and Hog Cay, Bahamas from 1993 to 1995.

Age-class	No. of broods	No. of ducklings	Mean ducklings/brood (S.D.)
I	28	130	4.6 (2.0)
II[a]	7	16	2.8 (2.0)
III[a]	1	3	3.0 (0.0)
Just-fledged	20	69	3.5 (1.3)
Totals/means	56	218	3.9

[a] Due to small sample sizes, age-classes II and III were excluded from analysis.

relationship between nest initiation and rainfall on Long Island. Although I observed no broods or young juveniles during a one-week visit in November 1994, breeding is reported to occur nearly year-round on Long Island (Earl Wilson *pers. comm.*), and this appears to be the case for most islands in which breeding has been observed (Collar *et al.* 1992).

In other parts of the species' range, nests are recorded in tree cavities, on branches, and in clumps of bromeliads (Allen 1961, Bond 1961, Paterson 1972, Downer & Sutton 1990). It is possible that nests on Long Island were located on the ground because there were few trees large enough to provide suitable nesting cavities.

Breeding ecology

All species of Whistling-ducks are assumed to breed monogamously and have long-term pair bonds, although few long-term studies confirm this. Long-term pair bonds (up to 4 yrs) were confirmed in Black-bellied Whistling-ducks by Bolen (1971), but the two-year pair bonds in my study are the first documented cases of mate retention in wild West Indian Whistling-ducks.

The incubation pattern of one-day-on/one-day-off is believed to be characteristic of the genus (Johnsgard 1978). It has been documented for the Black-bellied Whistling-duck in Texas (Bolen & Smith 1979, Chronister 1985) and for a captive pair of Plumed Whistling-ducks *D. eytoni* in New South Wales (D'Ombrain 1945), but this is the first time it has been documented in wild West Indian Whistling-ducks.

Family cohesiveness may be similar to that reported in geese and swans in which young are known to associate with their parents for up to the fifth winter post-fledging (Evans 1979). Family groups were often observed at the feeding station with all members in adult plumage. In addition, captive West Indian Whistling-ducks at Cedar Creek Natural History Area in Bethel, Minnesota, were intolerant of their single offspring during the next breeding season, but were very tolerant of him after an unsuccessful breeding attempt. They roosted with him in a nest box and moved around the flight pen with him up to a year after fledging (F. McKinney, *pers. comm.*). Therefore, it is possible that family groups regularly remain together until the start of the next breeding season.

Social preening is reported to be characteristic of most species of Whistling-ducks including the West Indian Whistling-duck (McKinney 1965). The behaviour is particularly common in the White-faced Whistling-duck (Johnsgard 1978) and also has been reported in Plumed, Wandering, Spotted and Lesser *D. javanica* Whistling-ducks. However, social preening was very uncommon in this population of West Indian Whistling-ducks.

Feeding: Adult

Adult West Indian Whistling-ducks exhibited crepuscular and nocturnal feeding habits. Nocturnal feeding behaviour is rather common in waterfowl (Owen & Black 1990) being advantageous both for predator avoidance (Tamisier 1974) and for thermoregulatory reasons. Heat from feeding and digestion is produced during the relatively cool night keeping birds warm, and allowing them to rest and keep cool during the heat of the day (Jorde & Owen 1988). This may be particularly important for West Indian Whistling-ducks because of their subtropical and tropical distribution.

Other studies report that West Indian Whistling-Ducks tip-up or dive when feeding (Johnsgard 1965). Adults in my study occasionally tipped-up when swimming with broods, but never dived, possibly because most ponds in my study area were < 10 cm deep (Staus unpubl. data). The species is assumed to have an exclusively vegetarian diet, including grasses, seeds, pigeon plum fruits, aquatic plants, and the fruit of the Royal Palm *Roystonea sp.* (Todd 1979). They are reported to feed on crops such as corn and rice and are considered an agricultural pest in some areas, including the Bahamas (Buden 1987, M. Minnis *pers. comm.*). Ducks reportedly fed in corn fields on Long Island despite the reliable supply of corn on Hog Cay. This affinity for grain crops is shared by Black-bellied and Fulvous Whistling-ducks (*D. bicolor*). Both species make extensive use of rice fields throughout their ranges (Meanley & Meanley 1959, Kramer & Euliss 1986) and in Mexico Black-bellied Whistling-ducks consume mostly cultivated corn (Kramer & Euliss 1986).

Feeding: Juveniles

Ducklings may have consumed aquatic vegetation and/or invertebrates in the benthos, although the abundance of major invertebrate species was low. Both Bolen & Beecham (1970) and Bourne (1981) reported that Black-bellied Whistling-duck ducklings rely more heavily on plant foods (especially seeds) than other species of waterfowl, and this may also be the case for West Indian Whistling-duck ducklings. Ducklings attempted to feed at the feeding station, but were usually evicted by adult birds. However, ducklings readily consumed cracked corn at the station in the absence of other birds.

Time spent feeding (50%) was considerably less than the 62% average feeding time of pre-fledging waterfowl reported by Sedinger (1992). However, it is consistent with feeding rates of other ducklings that dive for their food (Joyner 1977, Gauthier 1987). It is possible that physiological constraints associated with diving limit foraging time in these species (Sedinger 1992).

Population

The increase in population from 1994 to 1995 may represent a trend toward an increase in ducks in this area, which may be the result of the provisioning program on Hog Cay. Corn is a high energy food with readily available carbohydrates for building up fat reserves (Baldassarre *et al.* 1983). This may increase reproductive success, thus leading to a growing population that may eventually reach a maximum threshold for northern Long Island and Hog Cay. Future research should determine if birds are dispersing from this population to southern Long Island or Great Exuma, located 25 km to the east.

Mortality: Adult

Adult West Indian Whistling-ducks have few natural predators in the Bahamas, but they are affected by several anthropogenic factors. Although protected by law, they are shot by poachers throughout most of their range, including the Bahamas. On Long Island, there are several reports of mortality due to collisions with automobiles and electric wires. Some also may be killed by introduced mammals such as domestic cats *Felis silvestris* and dogs *Canis familiaris*.

The survival rate (64%) in this population of West Indian Whistling-ducks was slightly

higher than the 48-54% annual survival rate reported for Black-bellied Whistling-ducks in Texas (Bolen & McCamant 1977) and similar to rates reported for some Northern Hemisphere species including Mallards, American Wigeon *Anas americana* and Black Duck *Anas rubripes* (Anderson 1975, Rienecker 1976, Krementz *et al.* 1987). However, the large standard error and wide confidence interval (0.3521-0.9206) suggest that this survival rate for West Indian Whistling-ducks should be interpreted with caution.

Mortality: Brood

Possible predators of ducklings included Yellow-crowned Night Herons, Green Herons, cats, dogs, rats *Rattus spp.* and Giant White Land Crabs *Cardisoma guanhumi.* These crabs are widely distributed in the West Indies, and sometimes prey on Bahama Parrot *Amazona leucocephala bahamensis* chicks (R. Gnam *pers. comm.*). There is circumstantial evidence that these crabs also may be egg predators (Staus 1997). Brood mortality also may result from exhaustion or drowning when parents attempt to lead broods long distances to wetlands. One marked bird lost all 10 of her ducklings when she attempted to lead them across 4 km of ocean between the nest on Hog Cay and a brood-rearing pond on Long Island. Such ocean crossings appear to be common in this population (B. Dittmar, *pers. comm.*).

The estimated clutch size for West Indian Whistling-ducks is 10-16 eggs (Collar *et al.* 1992), and averaged 7.7 (n=3) on my study site. Assuming that all eggs hatch, the average of 4.6 ducklings/brood in age-class 1 represents a loss of about five ducklings from the low end of the species estimate and three ducklings from my average. Therefore, it is likely that brood mortality in the first two weeks of life may be significant. A similar analysis for Black-bellied Whistling-ducks revealed a loss of about four ducklings/clutch (Heins-Loy 1986).

Status

Although the species is declining elsewhere in its range, the population of West Indian Whistling-ducks on Long Island, Bahamas appears to be healthy and growing in numbers. The supplemental feeding program on nearby Hog Cay and the lack of urban development and hunting in this area have probably contributed to this increase. Long Island is mostly undeveloped with a population of about 3,000 people. Sandy soil and dry conditions make most types of agriculture unprofitable and consequently wetlands have not been drained for this purpose. Most of the inhabitants of Long Island are fishermen, and little hunting occurs on the island (M. Minnis, *pers. comm.*). Populations in other parts of the species' range apparently lead a more precarious existence and studies are needed to determine status on each island, to identify what factors are leading to declines, and to develop appropriate management strategies to ensure the survival of the species.

I thank D. Sedlacek and N. Graham for excellent field assistance. M. Isaacs of the Bahamas Ministry of Agriculture provided research permits and Mr. and Mrs. P. Graham kindly allowed me to work on Hog Cay. The Bahamas National Trust, L. Gape, P. Maillis, M. and E. Lightbourn, C. Crissey and E. Wilson provided logistical support and assistance throughout this project. I am grateful to F. McKinney for his support and guidance, and for comments that greatly improved this manuscript. Funding was provided by Ducks Unlimited (Bahamas), Birdlife International, Dayton and Wilkie Funds for Natural History and Behaviour, Association of Field Ornithologists, and the World Nature Association.

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Appendix 1 Average measurements (and Standard Deviation) of male and female West Indian Whistling-ducks on Long Island, Bahamas.

	Male (n = 19)	Female (n = 11)
Culmen (mm)[a]	53.4 (1.5)	52.0 (1.8)
Bill (mm)	56.9 (1.1)	56.4 (2.3)
Left tarsus (mm)	71.4 (2.7)	69.8 (2.4)
Keel (mm)	88.2 (3.7)	84.6 (5.1)
Left wing (mm)	267.9 (9.0)	264.7 (8.8)
Weight (g)[b]	983.6 (108.8)	1063.7 (151.9)

[a] Mann-Whitney Rank Sum two-sample test, P = 0.04.

[b] Mann-Whitney Rank Sum two-sample test, P = 0.08.