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HISTORICAL AND CURRENT STATUS OF THE CATTLE EGRET (*BUBULCUS IBIS*) IN THE U. S. VIRGIN ISLANDS, AND MANAGEMENT CONSIDERATIONS

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Abstract: Christmas Bird Counts, other historical data sources, and recent data from the U. S. Virgin Islands demonstrated that Cattle Egrets (*Bubulcus ibis*) were most abundant on agricultural and developed St. Croix where they first arrived in 1954-1955, considerably less numerous on developed St. Thomas (where they are concentrated at Mangrove Lagoon and the adjacent landfill), and least numerous on undeveloped St. John. Most Cattle Egret breeding colonies have been located in rural mangrove wetlands. However, breeding colonies and roosts that have formed in highly modified xeric forest in two urban areas on St. Croix since the 1980s have introduced local damage control issues, even though the total number of breeding pairs on St. Croix may have decreased. Management recommendations for alleviating damage and hazards by Cattle Egrets are available for four sites on St. Croix, three in urban areas (Frederiksted, Protestant Cay) and one in a rural area (Henry E. Rohlsen Airport).

Key words: abundance, breeding, *Bubulcus ibis*, Cattle Egret, colony sites, distribution, management, mangroves, St. Croix, surveys, U. S. Virgin Islands, waterbirds

Resumen: ESTADO ACTUAL E HISTÓRICO Y CONSIDERACIONES DE MANEJO DE LA GARZA GANADERA (*BUBULCUS IBIS*) EN LAS ISLAS VÍRGENES DE EEUU. Los conteos navideños de aves, otras fuentes históricas de datos y datos recientes en las Islas Vírgenes estadounidenses demuestran que la Garza Ganadera (*Bubulcus ibis*) fue más abundante en la agrícola y desarrollada isla de St. Croix, cuando llegaron por primera vez en 1954-1955, menos numerosa considerablemente en la desarrollada isla de St. Thomas (donde están concentradas en Mangrove Lagoon y en los basureros adyacentes) y menos numerosa aún en la subdesarrollada isla de St. John. La mayoría de las colonias de cría de la Garza Ganadera se encuentran localizadas en manglares. Sin embargo, las colonias de cría y los sitios de descanso que han creado en los bosques xéricos altamente modificados en dos áreas urbanas de St. Croix desde los 80s han introducido temas sobre el control del daño local, aunque el número total de parejas nidificando en St. Croix puede haber disminuido. Recomendaciones de manejo para aliviar el daño y las amenazas que esta especie está provocando están disponibles para cuatro sitios en St. Croix, tres áreas urbanas (Frederiksted, Protestant Cay) y un área rural (Henry E. Rohlsen Airport).

Palabras clave: abundancia, aves acuáticas, *Bubulcus ibis*, colonias, cría, distribución, Garza Ganadera, Islas Vírgenes de EEUU, manejo, manglares, muestreos, St. Croix

Résumé : STATUT HISTORIQUE ET ACTUEL DU HÉRON GARDE-BŒUFS (*BUBULCUS IBIS*) DANS LES ILES VIERGES AMÉRICAINES ET IMPLICATIONS POUR LA GESTION. Les données historiques dont les comptages de Noël et des données récentes obtenues dans les Iles Vierges américaines montrent que les Hérons garde-bœufs (*Bubulcus ibis*) sont plus abondants sur l'Ile agricole et développée de Sainte-Croix qu'ils ont colonisée en premier dans les années 1954-1955, mais beaucoup moins nombreux sur l'île développée de Saint-Thomas où ils se concentrent dans les environs de Mangrove Lagoon, et le moins abondant sur l'Ile de Saint-John qui est peu développée. La plupart des colonies de nidifications et les dortoirs ont été trouvés dans des zones rurales humides de mangrove. Cependant, les colonies et dortoirs qui se sont installés dans les années 1980 dans le forêt xérique dégradée de deux zones urbaines de Sainte-Croix ont conduit à des enjeux de contrôle des dégâts locaux occasionnés, même si le nombre total de couples nicheurs a diminué à Sainte-Croix. Des plans de gestion pour contrôler les dommages et les risques dus au Héron garde-bœufs sont disponibles pour 4 sites dont 3 en zone urbaine (Frederiksted, Protestant Cay) et un en zone rurale (Henry E. Rohlsen Airport).

Mots-clés : abondance, *Bubulcus ibis*, colonies, distribution, études, gestion, Héron garde-bœufs, Iles Vierges américaines, mangrove, nidification, oiseaux d'eau, St. Croix

THE HISTORICAL AND RECENT STATUS of the Cattle Egret (*Bubulcus ibis*) in the United States Virgin Islands has not been well documented since they first colonized St. Croix in the mid-1950s (Arendt 1988). Cattle Egrets forage in open grassy habitats dominated by agricultural land (especially for animal husbandry), short grassy meadows such as lawns adjacent to ballparks, and in open refuse tips

that also provide food. Consequently, Cattle Egrets would be expected to be relatively more abundant and widely distributed on agricultural and developed St. Croix than either St. John or St. Thomas, and more numerous on developed St. Thomas than undeveloped and forested St. John. Cattle Egret populations on St. Croix have recently come into potential conflict with species of higher conservation concern (e.g., the St. Croix Ground Lizard *Ameiva polops*; McNair 2003, McNair and Coles 2003) and other resources of interest such as historical sites in urban areas where roosts or breeding colonies may be a nuisance.

The territorial government of the U. S. Virgin Islands through the Division of Fish and Wildlife (DFW) currently includes general recommendations for integrated damage control (Platenberg *et al*. 2005). Earlier plans and recommendations were developed for controlling Cattle Egrets and Laughing Gulls (*Larus atricilla*) at the Henry E. Rohlsen Airport and Anguilla Landfill on St. Croix, where some Cattle Egrets were shot in 1978 and the early 1990s (Seubert 1978, Boyd 1992, 1993, Boyd and Hall 1993). Additional Cattle Egrets were shot recently (January 2004) at Protestant Cay, an islet just off Christiansted, St. Croix (DFW unpubl. data). These local but lethal damage control actions lacked accurate island-wide population estimates and reliable monitoring protocols to assess their effects on the Cattle Egret. The purpose of this study is to provide base-line data on historical and recent population estimates for the Cattle Egret to help formulate future management strategies concerning damage control issues of this species. The only other island in the eastern Caribbean where colonization by the Cattle Egret since initial settlement has been described is Barbados (Krebs *et al*. 1994).

METHODS

We searched for published data on Cattle Egrets in the literature, including Christmas Bird Counts (CBCs) and unpublished data in DFW files. Museum collections were not useful since most of these data pre-date the arrival of Cattle Egrets in the U. S. Virgin Islands (USVI). In addition to general observations, F. W. Sladen (FWS) and D. B. McNair (DBM) also collected data on breeding colonies and some roosts of Cattle Egrets on St. Croix during the 1980s and since 2002, respectively. These counts of birds, pairs, or nests at breeding colonies are the maximum number present from any one visit during the period sampled. During these surveys most wetlands on St. Croix were visited repeatedly (at least once a month), enhancing the likelihood of detection of an already conspicuous species. St. Croix rainfall from 1982 to 1989 ranged from 65.3 to 124.2 cm which encompassed "dry" and "wet" years (data from the U.S. Department of Agriculture Agricultural Research Station at Kingshill). Rainfall from 2002 to the present included a 50-year rainfall event throughout the USVI during mid-November 2003 (means of 40-55 cm depending on exact location), which followed a prolonged drought for approximately the preceding 1.5 yr. Site names in the USVI follow McGuire (1925), and in addition on St. Croix, Imsand and Philibosian (1987), McNair (2006), and McNair *et al*. (2006). A site is a discrete geographic entity (e.g., Southgate Pond, Great Pond) that may include adjacent habitat (e.g., associated beach berm).

CBCs are typically used to examine the relative abundance of species at large geographic scales (Bock and Root 1981). This study uses five CBCs (two on St. Croix and one each on St. Thomas, St. John, and an offshore cay; Table 1) through the winter of 2003-2004 to examine the relative abundance of the Cattle Egret at a small geographic scale. Disregarding Cockroach Cay off St. Thomas, which is surrounded by the Caribbean Sea, more than half of the area on the St. Croix East End CBC is open water. Raw count data within the 24-km diameter circles of each CBC were not standardized (standardization by party-hours yielded similar though less robust results) because Cattle Egrets are a highly social species which normally occur in flocks and have a highly skewed, clumped distribution (Bock and Root 1981). Spearman's rank correlation tests were used to assess the association between annual changes and counts of Cattle Egrets on three of the five CBCs (one count on each of the three main islands) and the Kruskal-Wallis test was used to compare differences in rank abundance on these three CBCs. Tests for significance were set at $\alpha = 0.05$.

RESULTS

NON-BREEDING INFORMATION

Cattle Egrets reached the USVI at St. Croix in 1954 (Bond 1959), although the first detailed documentation was in February 1955 when a flock of 26 birds fed with cattle at a pasture in the West End (Seaman 1955). Cattle Egrets were first reported on St. John in 1964 (Arendt 1988) and later on St. Thomas (exact date unknown). Single flocks up to 200-220 birds foraging in livestock pastures have been

Table 1. List of Christmas Bird Count (CBC) circles, year (winter) of first and last count for each circle, and total number of years counts have been conducted in each count circle in the United States Virgin Islands.

Count Circle Name	First Count	Last Count	Number of Years
St. Croix, East End	1986-1987	2003-2004	8
St. Croix, West End[a]	1972-1973	2003-2004	22
St. John	1976-1977[b]	2003-2004	27
St. Thomas	1976-1977	1991-1992	16
Cockroach Cay	1980-1981	1980-1981	1

[a]also named just St. Croix
[b]first CBC eliminated because of insufficient observer effort

regularly recorded on St. Croix since the 1970s (Seubert 1978, Boyd 1992; DBM unpubl. data). The largest number of birds reported at the main airports was 200 in April 1992 on St. Croix (Boyd 1992) and 45 on 22 May 1995 on St. Thomas (J. Pierce unpubl. data).

Roost counts.—The first nocturnal roost counts of the Cattle Egret on St. Croix were just off the south coast at Manning Bay in the late 1970s when J. Yntema reported up to 1000-2000 birds in red mangroves (*Rhizophora mangle*), although these estimates included the breeding colony at this site (Seubert 1978). These mangroves did not survive Hurricane Hugo in 1989. Over 100 birds formerly roosted in the interior at Castle Burk Pond in the 1980s until Hurricane Hugo demolished most of the tall trees at this site (FWS unpubl. data). This pond was located close to a roadside survey route in an agricultural area where Cattle Egrets also sharply declined following this hurricane (Wauer and Wunderle 1992). Counts in the interior since 2002 have included the Carambola Golf Resort Gate Pond where 120-200 Cattle Egrets typically roosted until most birds left this site (now ≤ 40 birds) after the 50-year rainfall event of mid-November 2003 (DBM unpubl. data), even though the habitat was undisturbed. Counts of roosting birds (excluding breeders) since 2002 along the coast in highly modified xeric forest at an urban site in Frederiksted have regularly ranged from 200-350 Cattle Egrets, both before and after the 50-year rainfall event of November 2003.

Nocturnal roost counts of Cattle Egrets in red mangroves at Mangrove Lagoon, St. Thomas, regularly exceed 100 birds and may range as high as 300, although these estimates also include the breeding colony at this site (J. Pierce unpubl. data). The most recent daytime count on 6 February 2004 included only 20 roosting birds (excluding the breeding colony). Otherwise, the highest number of Cattle Egrets on St. Thomas reported away from the airport or Mangrove Lagoon was 30 birds on 1 April 2003 at Turpentine Run (daytime roost), 100 m from the northern edge of Mangrove Lagoon (F. E. Hayes unpubl. data). On St. John, about 25 birds roost year-round at Coral Bay (L. Brannick-Trager and W. Henderson pers. comm.).

Aerial counts.—Aerial counts of Cattle Egrets have only been conducted at St. Croix, where Boyd (1993) estimated 1500-2000 birds on 24 January 1993. This estimate included breeding as well as non-breeding birds.

Christmas Bird Counts.—CBCs (which may include breeding birds) were not initiated on St. Croix until the winter of 1972-1973 (Table 1). The median count of Cattle Egrets on the West End count has been 317 (range: 15 to 1202) and on the East End count has been 10 (range: 0 to 71), 3% of the median on the West End count. Christmas Bird Counts were not initiated on St. John or St. Thomas until the winter of 1976-1977. The median count of Cattle Egrets at St. John has been 28 (range: 13 to 63) and at St. Thomas has been 42 (range: 8 to 225). These median counts are 9% and 13%, respectively, of the median count on the St. Croix West End CBC which was significantly greater than the other two counts (Kruskal-Wallis $H = 25.5$, $P < 0.001$). The number of Cattle Egrets on these three CBCs did not significantly change over time from the early to mid-1970s to the present (St. Croix: $r_s = 0.34$, $P = 0.11$; St. John: $r_s = 0.23$, $P = 0.26$; St. Thomas: $r_s = -0.20$, $P = 0.45$).

BREEDING INFORMATION

Cattle Egrets probably nested on St. Croix as early as May 1956, although Seaman (1958) first

Table 2. Counts of Cattle Egrets on five Christmas Bird Count (CBC) circles in the United States Virgin Islands since the winter (December-January) of 1972-1973 through 2003-2004.

	Counts				
Year (winter)	St. Croix, East End	St. Croix, West End	St. John	St. Thomas	Cockroach Cay[a]
1972-1973		53			
1973-1974		26			
1974-1975		230			
1975-1976		325			
1976-1977		333	2[b]	22	
1977-1978		699		162	
1978-1979		1202	30	225	
1979-1980		27	37	45	
1980-1981		108	18	30	0
1981-1982		404	15	128	
1982-1983		29	35	50	
1983-1984		15	29	27	
1984-1985		398	21	82	
1985-1986		147	36	39	
1986-1987	8	199	20	35	
1987-1988	71	574	29	8	
1988-1989	68	967	21	10	
1989-1990			29	98	
1990-1991			17	32	
1991-1992			20	112	
1992-1993			30		
1993-1994			21		
1994-1995			13		
1995-1996			36		
1996-1997			24		
1997-1998			37		
1998-1999			44		
1999-2000	12	308	25		
2000-2001	1	334	49		
2001-2002	0	262	63		
2002-2003	0	474	27		
2003-2004	24	679	27		

[a]this count circle included a total of eight offshore cays
[b]the first count on the St. John CBC was eliminated because of insufficient observer effort

confirmed breeding in a mixed-species heronry at the former Krause Lagoon on 23-30 April 1957 when he found three or four active Cattle Egret nests in red mangroves. This colony later grew to include approximately 30 Cattle Egret pairs (Seaman 1993).

Other documented historical breeding sites (before 2002) in tidal wetlands on St. Croix have been in red mangroves at Manning Bay Lagoon (February 1978, 1982-1983, 1985), St. Croix Renaissance Park (formerly St. Croix Alumina, a part of Krause Lagoon Remnant; 1985-1986, 1989, June 1993), near the Fairplain River Mouth adjacent to the Anguilla Landfill (January 1993), the Salt River Estuary since at least the late 1970s, including Sugar Bay and adjacent Triton Bay (1970s and

Table 3. Number of birds or active nests of Cattle Egrets from 1982 to 1989 at St. Croix, United States Virgin Islands.

Site	Year	Date	Birds	Nests
Green Cay	1982	19 June		120
Manning Bay Lagoon	1982	31 July		300[a]
Green Cay	1983	8 May		n[b]
	1983	28 May		30[c]
	1983	13 Aug		265[d]
Manning Bay Lagoon	1983	19 June	669	255
Green Cay	1984	6 May		n[b]
Altona Lagoon	1984	26 Nov		b[e]
Altona Lagoon	1985	3 Jan	600	331
	1985	26 Feb		n[b]
Green Cay	1985	16 Apr		n[b]
	1985	3 May		209
	1985	19 May		280
	1985	2 June	320[f]	
Manning Bay Lagoon	1985	4 May	300	313[a]
St. Croix Renaissance Park	1985	4 May		366
	1985	27 Nov	100	n[b]
	1985	29 Nov	162	78
Green Cay	1986	17 March		71
Altona Lagoon	1986	13 March		233
St. Croix Renaissance Park	1986	5 Feb		123[a]
	1986	8 May		n[b]
Frederiksted	1986	12 Feb		35
Southgate Pond	1988	30 Apr		87
Altona Lagoon	1989	2 May		n[b]
	1989	23 Oct	40	18
	1989	23 Nov	60	24
St. Croix Renaissance Park	1989	28 Apr	200	n[b]
	1989	2 May	200	n[b]
Frederiksted	1989	28 Apr		15
	1989	2 May		n[b]
UVI Wetlands Reserve	1989	28 April	7	3

[a]not all nests were active
[b]nesting, but nests not counted
[c]minimum count of nests (from boat)
[d]nests not occupied; count is number of empty nests present; colony no longer active except for the presence of a few fledglings
[e]nest-building
[f]count includes 230 juveniles

1980s) and at Salt River Marina (part of Sugar Bay) after Hurricane Hugo in the 1990s and 2000s (Seubert 1978, Scott and Carbonell 1986, Wauer 1990, Boyd 1993, Boyd and Hall 1993, Knowles 1996, Gassett *et al*. 2000; FWS unpubl. data; W. J. Tobias pers. comm.), and in white mangroves (*Laguncularia racemosa*) at Altona Lagoon near the Buccaneer Hotel before and immediately after Hurricane Hugo (1984, 1986, 1989). Cattle Egrets have also nested at two seasonal salt ponds, at Southgate Pond in red mangroves in 1988 (Scott and Carbonell 1986, Sladen 1992) and at the University of

Table 4. Number of breeding pairs or active nests of Cattle Egrets from 2002 through July 2004 at St. Croix, United States Virgin Islands.

Site	Number of breeding pairs					
	2002 Jan-Jun	2002 Jul-Dec	2003 Jan-Jun	2003 Jul-Dec	2004 Jan-Jun	2004 July
Altona Lagoon					5	
Alucroix Channel	30				50	?
Frederiksted	100	70	110	50	150	?[a]
Great Pond					156	
Protestant Cay	35	12	56	23	190b	15
Salt River Marina	40	20	75	35	80	30
Total	205	102	241	108	470[c]	?

[a]colony destroyed on 12 July by the St. Croix Animal Shelter through sub-contract from Wildlife Services (USDA); some birds returned within 1-2 days to begin nest-building; no lethal control of adults occurred at this colony

[b]ca. 450 birds (all age classes) were killed by shooting and euthanasia of young after removal from nests at the colony from 14-16 January 2004; birds did not return to begin nest-building until early June, more than five months after substantial numbers of adults were killed at this colony

[c]total excludes two new colonies (Altona Lagoon, Great Pond) which were only established after Cattle Egrets were eradicated at Protestant Cay in January 2004

Virgin Islands Wetlands Reserve in black mangroves (*Avicennia germinans*) in 1989 and into the 1990s.

Cattle Egrets first nested in xeric forest on the southwestern portion of Green Cay 3-6 m up in geiger trees (= orange manjack *Cordia rickseckeri*) from 1982 to 1986. This site is a rural area. Cattle Egrets were not documented to breed in highly modified xeric forest in urban areas until 1986, when they nested in a single West Indian mahogany (*Swietenia mahagoni*) at Frederiksted (where birds usually nest and roost in different trees; Imsand and Philibosian 1987; DBM pers. obs.), a site they have continuously occupied to the present even though their nests (and contents) were destroyed in July 2004. Cattle Egrets also nested in highly modified xeric forest in an urban area at Protestant Cay beginning ca. 2000 (Hotel-on-the-Cay staff pers. comm.).

Most historical colony sites on St. Croix lack breeding population estimates except during the 1980s when one to four colonies (from a total of seven different sites) were active each year (Table 3). Norton (1983) reported that 884 Cattle Egret nests were discovered on St. Croix during June 1983, but provided no further details. A minimum of 575 simultaneously active nests were present at several colonies in 1985, and many counts of simultaneously active nests each year were greater than 300 nests regardless of whether it was a "dry" or "wet" year. In the early 1990s, the Fairplain River Mouth colony contained 179 active nests (about 500 birds) in about 25 red mangroves on 23 January (Boyd 1993, Gassett et al. 2000). Approximately the same number of birds was present at Krause Lagoon Remnant in June 1993 when the Fairplain River Mouth colony presumably relocated to this site (Boyd and Hall 1993).

An estimated 205 pairs of Cattle Egrets nested at four saltwater sites in 2002, 241 pairs at three saltwater sites in 2003, and 470 pairs again at the same four sites (plus two more sites that were colonized after birds were eradicated at Protestant Cay) in 2004. The highest numbers occurred after the 50-year rainfall event of mid-November 2003 (Table 4). The number of breeding pairs was lower during the latter half of the year in 2002 and 2003 (similar to the pattern in the 1980s; Table 3). Four sites were tidal red (or white) mangrove wetlands in rural areas (Altona Lagoon, Alucroix Channel, Great Pond, Salt River Marina) and two sites were in highly modified xeric forest in urban areas (Frederiksted, Protestant Cay) where birds nested in mahoganies. The Alucroix Channel site (part of St. Croix Renais-

sance Park) was not colonized in 2002 until a small colony of Great Egrets (*Ardea alba*) established a colony there. Cattle Egrets eventually outnumbered all other ardeiids that nested at the Alucroix Channel site, but birds left the colony site after May 2002 (perhaps because of human disturbance). The settlement pattern was similar in 2004, except that birds remained longer.

At St. Thomas, Cattle Egrets have nested since at least the early 1980s at Mangrove Lagoon where the number of breeding birds in one large manglar of red mangroves has ranged from 20-40 pairs (J. Pierce unpubl. data). The most recent count on 6 February 2004 included 20 active nests (R. Platenberg unpubl. data). Cattle Egrets have never been documented to breed on St. John.

Discussion

Originally from Africa, the Cattle Egret began one of the most dramatic and best documented avian range expansions to occur in the Western Hemisphere during the 20th century (Arendt 1988, Krebs *et al.* 1994). They continued their western and northern spread from northeastern South America to the Caribbean in the 1950s and 1960s; birds in the USVI probably first arrived from Puerto Rico. This study of Cattle Egrets in the USVI conformed with expectations: Cattle Egrets are much more abundant on St. Croix than in the northern USVI because of their association with animal husbandry and other agricultural practices which have declined since the early 20th century but are still prevalent on St. Croix. Cattle Egrets were also more numerous on developed St. Thomas, where the proximity of Mangrove Lagoon to the landfill has concentrated them, than on undeveloped St. John. Cattle Egrets have rarely been reported on undisturbed cays in the USVI because the habitat is usually unsuitable (scrub and rock) for foraging or nesting birds. Except off St. Croix at Green Cay before Hurricane Hugo (this study), Cattle Egrets have not nested on undisturbed cays that contain suitable vegetation, even though other ardeiids on occasion have formed colonies on several cays in the USVI (e.g., Stevens Cay off St. John; Nichols 1943). The only cay where Cattle Egrets have nested in the USVI is developed Protestant Cay, and only recently. Cattle Egrets may have nested on these two nearshore cays because they are much more numerous on St. Croix compared to the northern USVI where cays are nonetheless abundant (Dammann and Nellis 1992).

It is difficult to surmise how the status of other colonial ardeiids of conservation concern in the USVI may have changed in response to this massive colonization event, even though competition from Cattle Egrets has had some deleterious consequences (nest site displacement, reduced nest success) for some ardeiids breeding in mixed colonies in eastern North America and western Europe (Werschkul 1977, Burger 1978, Bennetts *et al*. 2000, Dami *et al*. 2006). This includes the Snowy Egret (*Egretta thula*) and Little Blue Heron (*Egretta caerulea*), which regularly breed on St. Croix (ca. 35-40 pairs annually), where they typically nest in mixed-species heronries. Only the Great Egret and Black-crowned Night-Heron (*Nycticorax nycticorax*) have nested in colonies without Cattle Egrets since 2002, along the south coast of St. Croix.

Ground counts on CBCs and at breeding colonies have undoubtedly underestimated the total number of Cattle Egrets in the USVI, especially at St. Croix. Protestant Cay is included within the St. Croix West End count circle but Cattle Egrets were not counted at Protestant Cay during the five most recent years. The single aerial count of all birds on St. Croix in 1993 may have provided a better population estimate than ground counts, but also underestimated numbers because it was restricted to the vicinity of the coastline (F. Boyd pers. comm.). Counts of the number of active nests at breeding colonies plus simultaneous counts at nocturnal roosts (including additional birds roosting at breeding colonies; Krebs and Hunte 1989) should provide a more reliable estimate of the total population, but simultaneous counts require multiple observers. Weather phenomena such as tropical cyclones and heavy rainfall events can directly or indirectly affect bird numbers at breeding colonies and nocturnal roost sites, and should be accounted for in future population monitoring.

Breeding populations of the Cattle Egret had not been adequately surveyed in the USVI before 2002, except during the 1980s when they nested in greater numbers most years, suggesting the number of birds may have declined. Since 2002, the breeding population doubled during a 'wet' year compared to two 'dry' years, suggesting numbers are limited by food rather than nest-site availability (Wong and Young 2006). Local food abundance probably influences colony distribution which is rather evenly spaced on St. Croix (cf., Barbados; Krebs *et al*. 1994). Food scarcity may account for absence of colonies in the East End of St. Croix. Although Cattle Egrets had commenced breeding on St. Croix when the recent surveys began, they frequently breed year-round in the USVI with a peak coinciding with other native

colonial ardeiids from February to June (Raffaele 1989, FWS unpubl. data, DBM unpubl. data). Thus, we did not overlook breeding colonies of Cattle Egrets on St. Croix and their low numbers in the northern USVI suggests that we did not overlook breeding colonies there. About four Cattle Egret colonies per annum are currently the norm on St. Croix (similar to the 1980s), one on St. Thomas, and none on St. John (where mangroves at Coral Bay would probably be the most likely breeding site; L. Brannick-Trager pers. comm.).

Cattle Egrets have nested only in coastal environments in the USVI, most frequently in tidally-influenced mangrove wetlands. Cattle Egrets also first nested (and roosted) in mangrove wetlands on other islands in the Caribbean (Riven-Ramsay 1981, Arendt 1988, Krebs *et al*. 1994) and they have still nested (and roosted) only in mangrove wetlands in the northern USVI. Cattle Egrets have switched colony sites at tidal mangrove wetlands on St. Croix in response to natural disturbance from Hurricane Hugo. In the Salt River Estuary, birds moved from Sugar and Triton bays to a remnant patch of taller studier red mangroves at the Salt River Marina.

Cattle Egrets began breeding in xeric forest on St. Croix in the 1980s, first at a pristine rural area (Green Cay), then at several urban areas in highly modified xeric forest (cf., Barbados; Krebs *et al*. 1994). This switch preceded Hurricane Hugo so the absence of sturdy tall mangroves at wetlands was not the driving impetus. After Cattle Egrets were eradicated at Protestant Cay in January 2004, a small colony reformed in white mangroves at Altona Lagoon where birds had not nested until shortly after Hurricane Hugo and a large colony formed in red mangroves at Great Pond which was the only major tidally-influenced wetland on St. Croix where Cattle Egrets had not been documented to nest. Post-Hugo changes in wetland vegetation at Great Pond, especially the dramatic increase in red mangroves, would nonetheless have favored occupation of this site by breeding Cattle Egrets as the trees matured although subsequent tropical cyclones in the 1990s may have reduced the availability of favorable mangroves at other sites. Regardless, this anthropogenic-induced switch from Protestant Cay to Altona Lagoon and Great Pond is the first demonstrated from xeric forest to mangrove wetlands.

Ordinarily, the switch of Cattle Egret breeding colonies from mangrove wetlands (and Green Cay) in rural areas to highly modified xeric forest in urban areas would diminish conflict or potential conflict with species of higher conservation concern because most threatened species do not occupy urban areas. However, the switch from rural to urban areas would generally be expected to increase potential Cattle Egret conflicts with humans.

MANAGEMENT RECOMMENDATIONS

The Cattle Egret is one of two migratory birds in the USVI (and Puerto Rico) classified by the United States Fish and Wildlife Service (USFWS) that may require population control or suppression (Nunez-Garcia and Hunter 2004). Wildlife damage control of the Cattle Egret requires special permits because they are protected under the USFWS Migratory Bird Treaty Act of 1918 and are not listed as "vermin" in the U. S. Virgin Islands Indigenous and Endangered Species Act of 1990. Species that habitually carry diseases harmful to man can be listed as "vermin." Cattle Egrets, however, have not been documented to be a vector for diseases potentially harmful to humans in the USVI. Thus, other reasons must exist to justify a legitimate long-term action plan for damage control for the Cattle Egret in the USVI, especially if lethal control measures are to be considered and used. Any removal of Cattle Egrets, their eggs, or young require a depredation permit issued by the USFWS, humane disposal (euthanasia), and a National Environmental Policy Act (NEPA) document is frequently required if killing >50 birds.

Accurate island-wide population estimates and a reliable monitoring protocol must form the basis of an acceptable plan which should be coordinated by DFW with action plans of other agencies (Wildlife Services of the United States Department of Agriculture, Office of Airport Safety and Standards of the Federal Aviation Administration). Responsibility for public notices and hearings pursuant to any damage control action plan on the part of any of these agencies and cooperators in the USVI is the responsibility of DFW. Detailed recommendations for four sites on St. Croix (Henry E. Rohlsen Airport and Anguilla Landfill; Protestant Cay; Petersen Library and Dorsch Theatre in Frederiksted; Aldershvile in Frederiksted) that may require or have required damage control action plans for Cattle Egrets are available from DFW. These recommendations address concerns about the globally endangered St. Croix Ground Lizard (*Ameiva polops)* which occurs on highly modified Protestant Cay (McNair 2003, McNair and Coles 2003), where Cattle Egret predation may contribute to a cascading effect of threats these lizards must surmount to survive.

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