Two species of grassquits—the indigenous Black-faced Grassquit *(Tiaris bicolor)* and the introduced Cuban Grassquit *(T. canorus)*—presently inhabit New Providence Island. A third species, Yellow-faced Grassquit *(T. olivaceus)* was also introduced but died out. This paper analyzes the relative abundance and distribution of the two species extant on the island using Christmas Bird Counts as the principal source of data.

Sympatry of Grassquits

on New Providence Island, Bahamas, Based on Analysis of CBC data

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New Providence Island

New Providence Island, including Paradise Island, is a mid-sized (80 square miles), densely populated (2,635 people per square mile) island in the north central Bahamas. Human pressure on the environment is increased by the more than 2.5 million tourists per year (Anonymous 2004). The island's habitat consists of 42 percent human-altered habitat, 18 percent mangroves, 17 percent pinelands, 9 percent open water or wetlands, 8 percent dry evergreen (coppice), 4 percent agriculture or golf course, and 2 percent coastal strand. (See the Appendix for a description of the habitats and the land cover mapping process.) In general, the eastern half of the island is largely human-altered habitat (urban and suburban development), and the western half has more pinelands and dry evergreen forest.

Release of Grassquits

On 23 March 1963 an aircraft carrying a consignment of 600 finches from Cuba to Spain made an emergency landing at Nassau. About 200 birds died before they could be released; the rest were set free for humanitarian reasons (Bond 1963, Green 1977, Anonymous 1989). Orris Russell, then Director of Agriculture and Fisheries, received four large crates of tightly packed birds from the Bahamas Humane Society. They contained approximately 300 Cuban Grassquits, a few Yellow-faced Grassquits, and some North American buntings. The birds were released in locations throughout New Providence, including the eastern district, the pine barrens, and Lyford Cay. In the eastern district they were released at St. Augustine's Monastery, Oakes Field, and the government experimental farm that was located where the Botanical Gardens are now (P. Dean pers. comm.[5]).

The Cuban Grassquits established a viable population. They were reported as fairly common in Nassau and eastern New Providence in 1966 (Brudenell-Bruce 1975), and they were a common visitor to bird feeders throughout Nassau in 1977 (Green 1977). There is no further report of their distribution

[5] *Bond (1963) states that at least three dozen Cuban Grassquits were released, but Dean, who was Bond's original source, says this number applies to only one release location.*

Anthony White is a retired U.S. Naval officer and active birder. He is a director of the Bahamas National Trust, the Ornithological Council, and the American Birding Association. He founded and compiles the Grand Bahama Christmas Bird Count.

John Bjerke is a statistician with U.S. Immigration and Customs Enforcement, where he studies the migration of people. He has devoted his spare time to bird populations and was compiler of the Washington, DC, Christmas Bird Count for 18 years.

Paul Dean is a retired airlines manager and the leading Bahamian birder. He has birded on New Providence for more than 40 years. He participated in the release of the grassquits in 1963 and has been a sector leader in all the New Providence Christmas Bird Counts.

Kathleen Sealey is dean of the College of Pure and Applied Sciences at the College/University of The Bahamas. She specializes in marine ecology and remote sensing; her contribution to the article was the land cover classification of New Providence.

Table 1. Christmas Bird Count totals for the two species of grassquit on New Providence Island. Totals that differ from those posted on the CBC web site are marked with an asterisk.

BLACK-FACED GRASSQUIT

Count No.	Date	NW	NE	SE	C	SW	Total
105	12/19/2004	2	0	3	10	12	27
104	12/14/2003	7	2	5	14	8	36
103	12/15/2002	4	1	9	20	9	43
102	12/16/2001	3	0	10	15	6	34
101	12/17/2000	22	1	7	18	33	81
100	12/19/1999	6	6	8	17	6	43
99	1/2/1999	8	8	3	23	5	47 *
98	12/27/1997	15	11	0	22	25	73
97	12/28/1996	11	16	6	8	18	59
96	12/30/1995	30	4	1	NA	21	56
95	12/19/1994	21	8	8	NA	8	45

CUBAN GRASSQUIT

Count No.	Date	NW	NE	SE	C	SW	Total
105	12/19/2004	7	25	6	7	0	45
104	12/14/2003	12	40	10	3	0	65
103	12/15/2002	3	29	28	13	0	73
102	12/16/2001	2	3	4	6	0	15
101	12/17/2000	12	12	11	39	0	74 *
100	12/19/1999	6	12	1	17	2	38
99	1/2/1999	4	0	11	50	0	65
98	12/27/1997	8	2	9	23	2	44
97	12/28/1996	18	9	9	0	2	38
96	12/30/1995	3	1	12	NA	30	46
95	12/19/1994	0	28	9	NA	1	38 *

PARTY HOURS

Count No.	Date	NW	NE	SE	C	SW	TOTAL
105	12/19/2004	8.5	9	10	9	8	44.5
104	12/14/2003	5	9	9.75	9	10	42.75
103	12/15/2002	7.5	8	10.75	9.5	8	43.75
102	12/16/2001	9.5	9	10.5	10.5	9	48.5
101	12/17/2000	8.75	9	10	10	10	47.75
100	12/19/1999	10.5	8	10.5	10.5	11	50.5
99	1/2/1999	10	9.5	10.5	10.5	8	48.5
98	12/27/1997	10.5	8	9	10.5	11	49
97	12/28/1996	8.5	11	10	8.5	11	49
96	12/30/1995	10.5	9.5	11	NA	11	42
95	12/19/1994	10	10	11	NA	8	39

Figure 1. Map of New Providence

and abundance until 1994, but the population appears to have been restricted to Nassau, eastern New Providence, and Paradise Island for about 20 years.

Yellow-faced Grassquits were released in small numbers at the same time and are reported to have established themselves in at least two locations on New Providence in 1966 (Brudenell-Bruce 1975). However, this species died out by 1977 (Green 1977). There has been no credible report since then, and this paper will not discuss the species.

Christmas Bird Counts

The only census that reflects the abundance and distribution of both grassquit species on New Providence is the Christmas Bird Count (CBC), which has been conducted annually since 1994. Count results are available at the National Audubon Society web site <www.audubon.org/bird/cbc>. The absence of a total for Black-faced Grassquit in the posted version of the 2 January 1999 count alerted us to the possibility that there were errors in count numbers as posted on the Audubon web site. We reviewed the tally sheets from the different sectors for each count and changed two other species totals as well as adding in the total for Black-faced Grassquit in the 2 January 1999 count (Table 1). We also noted that the number of Cuban Grassquits (15) in the 16 December 2001 count was unusually low; it is less than half of the next lowest number in the counts. We checked the weather and number of party hours on this count, and could find no explanation for this anomaly. Therefore we have treated the 16 December 2001 numbers for both species as outliers, and have not included this count in our analysis of trends. The count sectors are shown on Figure 1, a map of New Providence. (The count area was divided into four sectors in 1994 and 1995, and five sectors thereafter.)

[6] *We considered using the procedures outlined by Sauer and Link (2003) to compensate for variations in level of effort, i.e. party hours, but felt that it was inappropriate for the small amount of data we were processing and the relatively consistent level of effort.*

Abundance

In order to determine the population trends of the two species, we graphed their totals for all counts except the outlier, 16 December 2001, and compiled three-year moving averages (Figure 2). The trend-lines connecting the moving averages for each species illustrate population trends as reflected in the CBC[6]. By smoothing out normal year-to-year variability, these trend-lines may be a more accurate indicator of population trends than the raw data.

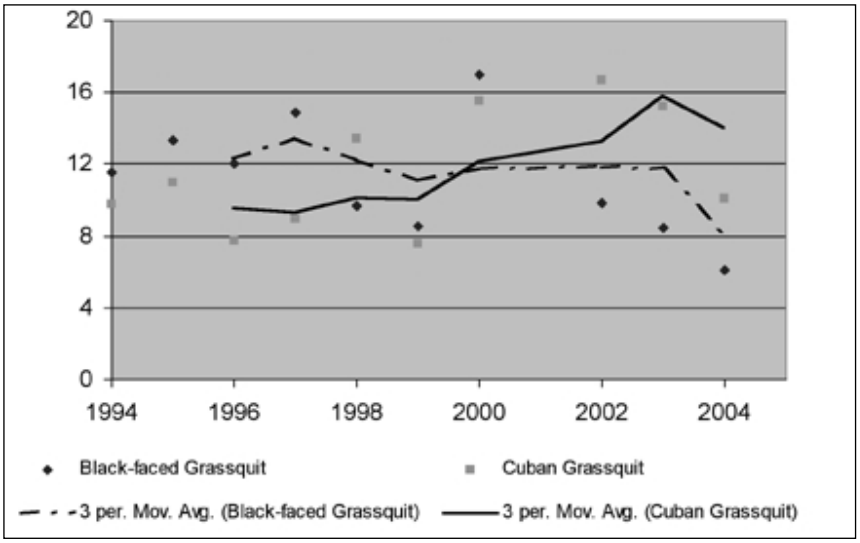
The trend-lines show that the Black-faced Grassquit population was fairly stable until 2003, while the Cuban Grassquit population was steadily increasing and, in fact, surpassed the Black-faced population around the year 2000. Lightbourn (2004) also noted an increase in the numbers of Cuban Grassquits. Both trend-lines declined in 2003 and 2004, but Cuban Grassquit continues to outnumber its congener.

Abundance by Sector

We also compiled three-year moving averages for each sector using birds per 10 party hours to increase the vertical scale for easier reading (Figure 3). These charts were prepared using the data from 1996 on, since the CBCs in 1994 and 1995 were conducted using only four sectors.

These graphs clearly illustrate that the greatest part of the population change has taken place in the northeast sector, where Cuban Grassquits have increased and Black-faced Grassquits have declined. There is an apparent increase of Cuban Grassquits in the southeast sector as well, but this is almost entirely the result of an unusually high count on 15 December 2002. Southeast sector totals for other years are consistent.

Figure 2. Population totals on Christmas Bird Counts.



Distribution

We overlaid the sector boundaries on a land cover map of New Providence and computed percentages of each sector containing the different land covers (Table 2). Seven types of land cover are found on New Providence.

We then correlated the average grassquit totals for each sector with the habitats found there (Table 3). We used a simple Pearson correlation analysis to examine the degree of association of each of the grassquits with the seven habitat types defined in Table 2 (using population counts and habitat proportions for each of the five sectors). Because there were no data from the Central Sector before 1996, this analysis is based on nine years of count data. Although the count total for 16 December 2001 was an outlier, the distribution of this count is similar to the distribution considering all the years. Therefore we have used it in the correlation analysis.

The correlation statistics indicate that Black-faced Grassquits have a moderately strong positive correlation with pinelands (r = .83) and wetlands (.88); they have a moderately strong negative correlation with human altered habitats (-.83). Each of those correlations is significant at the .10 level.

The analysis of Cuban Grassquits has been muddled by the apparent move in recent years out of the Central Sector with concentrations now in the SE and NE sectors. Analysis of the nine years of data indicates no significant correlations with any of the habitat types. However, if the Central Sector is not included in the analysis, then there is a moderately strong positive correlation with human altered habitats (r = .86) and a moderately strong negative correlation with pinelands (-.86).

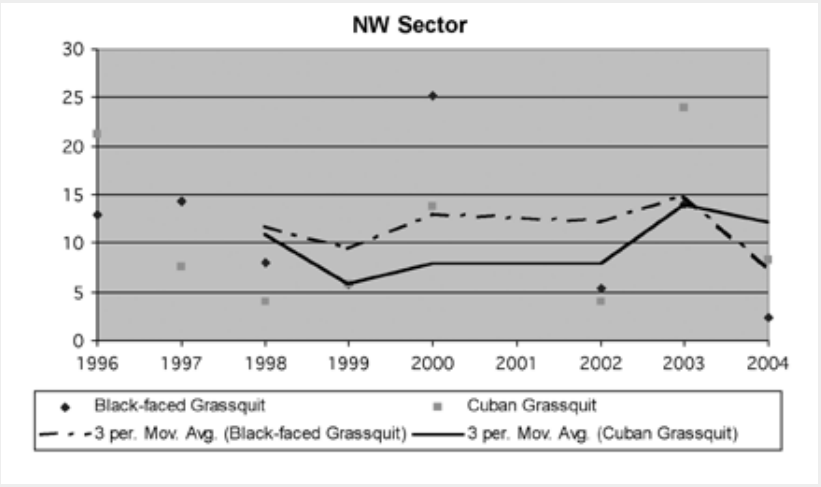
Discussion

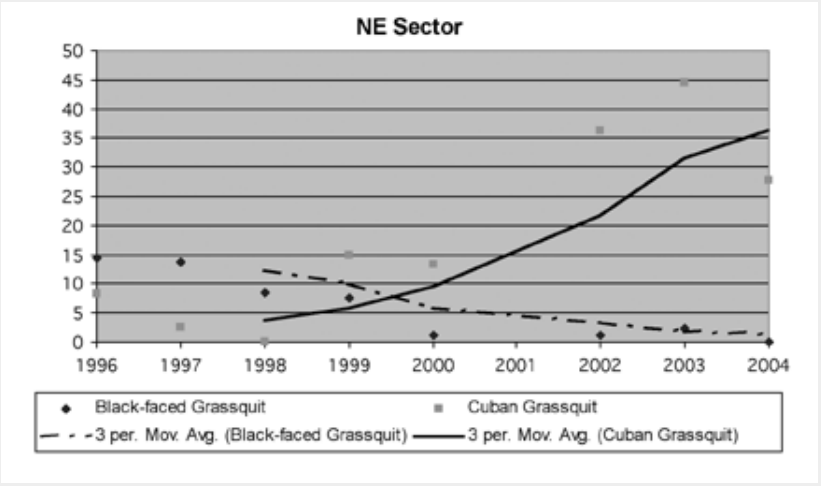
The Black-faced Grassquit is a small seed-eating bird found throughout the West Indies, except for the Cayman Islands, and in northern South America. On Cuba it is restricted to the northeastern cays. It has wandered to

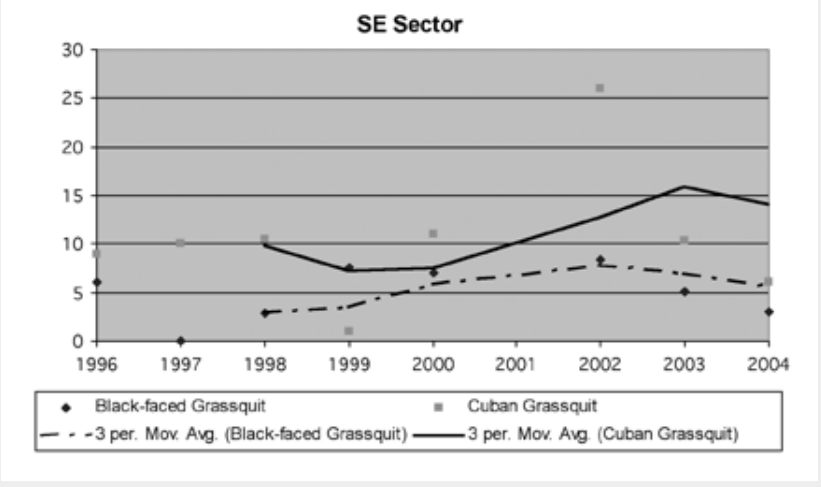
Male Black-faced Grassquit *(Tiaris bicolor)*, New Providence Island, Bahamas. Photo/Bruce Hallett

Male Cuban Grassquit *(Tiaris canorus)*, New Providence Island, Bahamas. Photo/Bruce Hallett

Figure 3. Three-year moving averages for each sector. ***continued on page 21***







Florida. It is not a popular cage bird, but it has bred in captivity. Its preferred habitat is open areas, including edge areas and suburban yards. It comes to feeders, but it is also seen in undeveloped areas, e.g. pinelands, where it is dispersed rather than concentrated. (Restall 2003, Restall and White 2003, Hallett in prep.)

Cuban Grassquit is a monotypic species endemic to Cuba. Its preferred habitat in Cuba is pine undergrowth, bushy areas, plantations, and farmland (Raffaele et al. 1998, Garrido and Kirkconnell 2000). It is a popular cage bird in Cuba, but aviculturists there have not established a sustaining captive population (Restall and White 2003). Its absence from more populated areas in Cuba may be attributable in part to regular collection for sale as a cage bird. On New Providence it is usually seen in suburban gardens or at feeders.

The birds' habits affect the accuracy of the counts. Black-faced Grassquits are hard to detect in the pinelands, and the Christmas Bird Count teams do not have sufficient personnel to cover these areas thoroughly. Cuban Grassquits, on the other hand, are relatively easy to count at feeders and in suburban yards. However, the total may be affected by a resident's failure to refill the feeder before count day. Given the significant and consistent level of effort as measured by party hours, we believe that the count data do not represent accurate estimates of the total population size, but that the trends shown in our analysis represent actual trends in the populations.

Conclusion

Urban and suburban communities on New Providence are expanding rapidly, and there are plans for future development in natural areas. The Black-faced Grassquit population is already declining, and with its preference for more natural habitat, our data suggest that its range will contract and there will be a further decline in its population. On the other hand, Cuban Grassquit

numbers are increasing. Since this species' preferred habitat is human-altered urban and suburban areas, our data suggest it will continue to increase in number and expand its range on New Providence.

Acknowledgments

We thank Carolyn Wardle and Neil McKinney for providing us with the CBC tally sheets. We thank Alexander Sprunt IV, Tony Hepburn, and Neil McKinney for their leadership in initiating and compiling the New Providence Christmas Bird Counts, and we thank all the participants in the Christmas Bird Counts. Their efforts made this study possible.

Literature Cited

Anonymous. 2004. Bahamas Information. *Bahamas Handbook 2004*. Etienne Dupuch Publications, Nassau, Bahamas.

Anonymous. 1989. Bird watching "takes flight." *Bahamas Handbook 1989*. Etienne Dupuch Publications, Nassau, Bahamas.

Bond, J. 1963. Eighth Supplement to *Check-List of Birds of the West Indies (4th edition)*. Academy of Natural Sciences, Philadelphia.

Brudenell-Bruce, P. G. C. 1975. *The Collins Guide to the Birds of New Providence and the Bahama Islands*. Stephen Greene Press, New York.

Garrido, O. H., and A. Kirkconnell. 2000. *Field Guide to the Birds of Cuba*. Cornell University Press.

Green, C. 1977. The exotic birds of New Providence. *Bahamas Naturalist* 2:11–16.

Hallett, J. B., Jr. In prep. *Introductory Guide to the Birds of the Bahamas and Turks & Caicos Islands*. Macmillan Caribbean, Cambridge, U.K.

Lightbourn, E. D. 2004. An analysis of the 2003 New Providence Christmas Bird Count. *Bahamas Journal of Science*. 11(2):24–30.

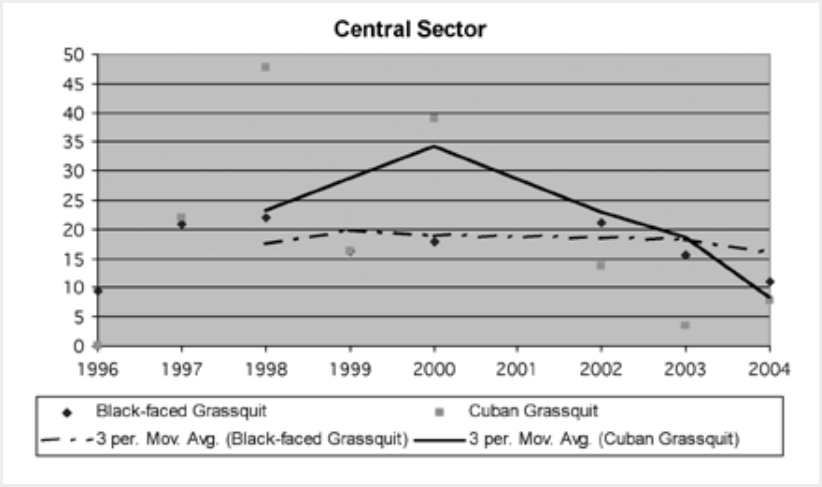
Raffaele, H. A., J. W. Wiley, O. Garrido, A. Keith, and J. Raffaele. 1998. *A Guide to Birds of the West Indies*. Princeton University Press.

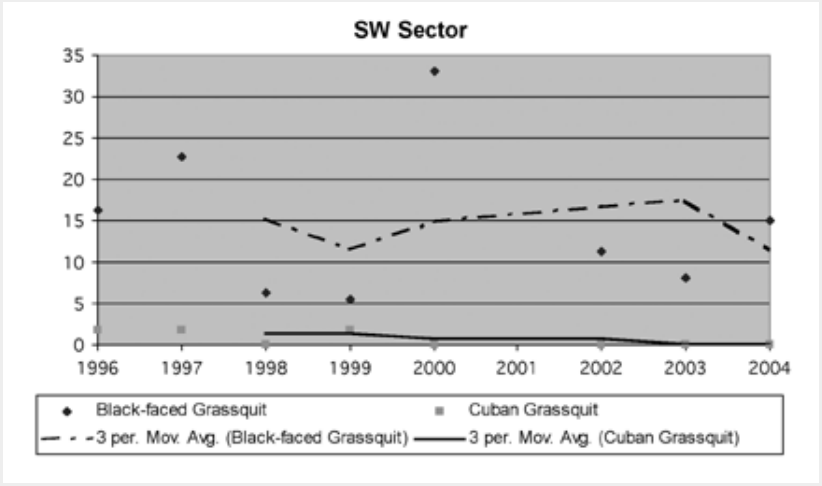
Restall, R. 2003. Breeding the Black-faced Grassquit, *Tiaris bicolor omissa*, with some notes on behavior. *Avicultural Magazine* 109(4):174–179.

Restall, R., and A. White. 2003. Advances in identification: Grassquits in the United States. *Birding* 35(4):356–366.

Sauer, J. R., and W. A. Link. 2003. Using Christmas Bird Count data in analysis of population change. *The 102nd Christmas Bird Count* (*American Birds* 56):10–14.

Figure 3. ***continued from page 20*** **Three-year moving averages for each sector.**





Appendix

Creating Land Cover Maps of New Providence From 2002 and 2003 Landsat 7 Imagery

Land cover maps of the vegetation communities and human-altered landscape of New Providence were created as part of a larger mapping initiative. The objective of land cover mapping of the Bahamian Archipelago is to characterize both landscapes and shallow seascapes, based on available Landsat Thematic Mapper (TM) satellite images, other remote sensed data, and a standardized vegetation classification system for the greater Caribbean region. The Bahamian archipelago land cover mapping project was developed by the Caribbean Vegetation and Landcover Mapping Initiative (CVLMI) and is supported by the U.S. Geological Survey EROS Data Center. The major steps undertaken by this initiative include the review of existing vegetation classification efforts and the development of a standard classification system for the Caribbean.

The land cover mapping integrates the mapping of vegetation (based on the developed standard vegetation classification system) with the mapping of marine benthic communities, and has relied exclusively on the Landsat 7 image analysis methods developed by the

EROS Data Center (EDC) in Sioux Falls, South Dakota. Each Landsat scene used is calibrated and re-projected to UTM Grid 18 as a standard projection. Calibration models were provided by the EROS Data Center and applied to each image to correct solar irradiance in the raw NLAPS data. For each image, the sun elevation, along with gain and bias information provided from the header file, were entered into the model as function definitions. The unsupervised classification process allowed assigning a habitat characteristic to the spectral values of each pixel in an image. Each calibrated image was run through the ERDAS *Imagine* version 8.6 unsupervised classification functions, for 25 classes and 75 iterations.

The specific habitat types that occur in the archipelago were defined, indexed, and included in this mapping process. A long list of very distinct and elaborate habitat descriptions was reduced to terrestrial and marine habitats (environments) that were both mappable and discernable from the Landsat images. The land cover maps were originally created to identify the amount of habitat fragmentation by human-altered landscapes, thus a coarse classification scheme applied over the entire archipelago, which can be refined further for future large-scale mapping projects.

The USGS mapping initiative focused on four islands: Abaco, Andros, Grand Bahama, and New Providence. These islands were the primary targets for testing the USGS land cover mapping models. Although there was a great deal of information collected from existing reports, there was also a need to collect new ground truth points. More than 800 ground-truthing points were collected for New Providence to help better define model discrimination between habitat classes (Table 4). Habitat definitions and the mapping process both require extremely high numbers of training points to assure accuracy. Ground truth points collected in the field are the most reliable data sets for use in the training models.

—Kathleen Sealey

Table 2. Land Cover types on New Providence.

Land Cover Class	Description
Human-altered landscapes	All buildings, roads, residential areas; this class includes Casuarina-dominated landscapes, as this tree is often associated with houses and development
Pinelands	Woodlands or forests with Caribbean pine, all understory types
Dry evergreen formations	All broadleaf evergreen forests and shrub thickets, referred to as "coppice"
Dense mangroves	Closed canopy areas of primarily red mangroves
Coastal strand (herbaceous)	Grassy and shrub dune areas
Agriculture/golf course	Continuous areas of one plant type
Deep water wetlands	Open water with no emergent vegetation

Table 3. Distribution of grassquits by habitat type.

BLACK-FACED GRASSQUIT

Sector	Average count 1996–2004	Human-altered Landscapes	Pinelands	Dry Evergreen	Dense Mangrove	Coastal Strand	Agriculture /Golf	Deep Water Wetlands
NW	8.67	24.1	25.8	8	21.1	3.2	6.8	11
NE	5	80.6	1.7	11.1	0.6	0.3	2.3	3.4
SE	5.67	64.4	4.5	8.4	15.2	0.9	0.4	6.2
C	16.33	23.1	25.3	4	28.6	2	3.1	13.1
SW	13.56	21.4	29.4	11	18	2.4	7.6	10.2
Pearson's Corr coeff.		-.83*	.83*	-0.55	.79	.56	.45	.88*

CUBAN GRASSQUIT

Sector	Average count 1996–2004	Human-altered Landscapes	Pinelands	Dry Evergreen	Dense Mangrove	Coastal Strand	Agriculture /Golf	Deep Water Wetlands
NW	8	24.1	25.8	8	21.1	3.2	6.8	11
NE	14.67	80.6	1.7	11.1	0.6	0.3	2.3	3.4
SE	9.89	64.4	4.5	8.4	15.2	0.9	0.4	6.2
C	17.56	23.1	25.3	4	28.6	2	3.1	13.1
SW	.67	21.4	29.4	11	18	2.4	7.6	10.2
Pearson's Corr coeff.	.36	-.41	-.59	-.02	-.45	-.67	-.10	

** Correlation coefficient significant at the .10 level*

Table 4. Terrestrial habitat mapping classes used in the Bahamian archipelago land cover mapping project.

Land Cover Class	Description
Creeks	Mangrove creeks and canals
Human-altered landscapes	All buildings, roads, residential areas; this class includes Casuarina-dominated landscapes, as this tree is often associated with houses and development
Bare sand (above water)	Beaches, exposed sand bar
Pinelands	Woodlands or forests with Caribbean pine, all understory types
Palm-dominated communities	Palm woodlands and shrublands
Dry evergreen formations	All broadleaf evergreen forests and shrub thickets, referred to as "coppice"
Coastal strand (herbaceous)	Grassy and shrub dune areas
Deep water wetlands	Open water with no emergent vegetation
Agriculture/golf course	Continuous areas of one plant type
Dense mangroves	Closed canopy areas of primarily red mangroves
Sparse mangroves	Open canopy areas of dwarf mangroves
Buttonwood	Wetlands with buttonwood as tallest strata and emergent vegetation