

GEOGRAPHIC VARIATION IN THE GRAY KINGBIRD

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Abstract.—We analyzed patterns of geographic variation in 11 measurements of 369 Gray Kingbirds (*Tyrannus dominicensis*) from 10 localities. In both sexes, kingbirds from migratory populations had longer wings and larger bills than those from non-migratory populations. In addition, there was significant sexual dimorphism in wing and tail length, as well as in some measures of bill size and wing shape. We interpreted the sexual differences in wing and tail length and shape to reflect sexual differences in courtship displays and territorial defense. The differences in bill size may reflect adaptations for niche partitioning, as the bill size dimorphism tended to be greatest in localities where Gray Kingbirds were the only *Tyrannus* present.

VARIACIÓN GEOGRÁFICA EN *TYRANNUS DOMINICENSIS*

Sinopsis.—Analizamos el patrón de variación geográfica de 11 parámetros tomados de 369 individuos de *Tyrannus dominicensis* pertenecientes a 10 localidades diferentes. Aves de ambos sexos, de poblaciones migratorias, mostraron tener las alas y el pico más grande que individuos de poblaciones no migratorias. Además encontramos un dimorfismo sexual significativo en el largo del ala y rabo, como también en algunas medidas del tamaño del pico y forma del ala. Interpretamos que el dimorfismo en el largo y forma de las alas y el rabo, es reflejo de diferencias sexuales en el patrón de cortejo y la defenza territorial. Las diferencias en el tamaño del pico podrían ser una adaptación para la segregación de nicho, ya que este dimorfismo tendió a ser mayor en localidades en donde la especie era el único representativo de su género.

The Gray Kingbird (*Tyrannus dominicensis*) breeds from the southern Atlantic and Gulf coasts of the United States, south through the West Indies to the islands off South America (the Netherlands Antilles east to Trinidad and Tobago), and occasionally in arid coastal regions of Venezuela and perhaps Colombia. Individuals breeding in the northern parts of this range (United States, Bahamas, Jamaica and Cuba) migrate south to northern South America in winter, but Gray Kingbirds are generally resident from Hispaniola eastward (American Ornithologists' Union 1983, Bond 1985, Brodkorb 1950, Hilty and Brown 1986, Voous 1983).

Brodkorb (1950) studied geographic variation in this species. He resorted his specimens into five different subspecies, and measured birds taken throughout the year. The subspecies described by Brodkorb are not generally recognized today (Mayr and Short 1970, Voous 1983), and it is generally agreed that the geographical variation, particularly in bill shape, is not well understood (Voous 1983). Here we describe patterns of geographic variation and sexual dimorphism in the species.

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Hypotheses

Size variation.—Bergmann's Rule, the tendency for individuals of a species to be relatively large in the coldest, or coldest and driest parts of the species' range, is the most commonly described pattern of geographic variation in size in birds (James 1970, Zink and Remsen 1986). However, we cannot assess size variation in Gray Kingbirds because we have no measure of body size. Weights were not indicated on enough of the specimen labels for us to use them as a measure of body size; of the features we could measure on the museum specimens available, tarsus length might reflect body size, but others (measures of wing, tail and bill size) probably are little correlated with body size (Freeman and Jackson 1990, Rising and Somers 1989). Ornithologists have frequently used wing length as such a measure, but that is precluded in this study because *T. dominicensis* is migratory in part of its range and sedentary in others. Generally, within a species or among closely-related species, individuals from non-migratory populations have smaller wings, relative to body size, than those from migratory populations [e.g., *Passerculus sandwichensis* (Rising, pers. obs.) and in *Vireo* (Barlow, pers. comm.)], and, indeed, Brodtkorb (1950:334) notes that Gray Kingbirds that migrate have relatively longer wings and shorter tails than do those that do not.

Sexual selection.—Commonly, size dimorphism in animals appears to have evolved as a consequence of intrasexual aggression or mate choice, that is, of sexual selection. In many birds, males defend territories, nest sites and mates from other males, and in such species males are commonly larger than females. Alternatively, in species where males have acrobatic aerial displays, such as many shorebirds and hummingbirds, so-called reverse dimorphism (males smaller than females) is common (Jehl and Murray 1986), presumably because smaller males are better able to perform such acrobatic displays. Little has been written on the courtship and territoriality of *T. dominicensis*. Bent (1942:31) cites Audubon's (1840) account of the courtship, which indicates that both sexes do aerial displays during courtship, and Smith (1966) describes the "Wing Flutter" display, typical of *Tyrannus*, for *T. dominicensis*. Although both sexes perform courtship displays, in kingbirds in general only the males engage in territorial defense and the "Tumble Flight" display associated with it, and typically male *Tyrannus* are more aggressive toward conspecifics than females (Smith 1966). There is no reason to suspect that the behavior of *T. dominicensis* is substantially different from that of better-studied *Tyrannus* (Smith 1966), and male *T. dominicensis* have the modified outer primary wing feathers that are characteristic of adult male kingbirds (Pyle et al. 1987). This probably reflects a special role of these feathers during courtship and territorial displays of male *Tyrannus* in general. Assuming that male *T. dominicensis* engage in territorial fights more frequently than females, we predict that males will be larger, on average, than females, particularly with regard to wing length, both because it doubtless reflects overall body size to some extent as well as flying ability. Alternatively, we could argue, as did Jehl and Murray (1986) for shore-

birds, that acrobatic displays select for relatively small males, but this seems less likely to us because the Tumble Flight displays of *Tyrannus* do not appear to be as acrobatic as those of some shorebirds and hummingbirds.

Niche partitioning.—Van Valen (1965) postulated that the variability in structures used for obtaining food will be greatest in populations where the diversity of different types of foods available is greatest. This is the so-called “niche variation hypothesis.” The diversity of food available is influenced both by the kinds of foods present and by the amount of competition for those foods. Where the amount of food is potentially limiting, intraspecific competition for it is of selective importance. Where sympatric species use similar foods, interspecific competition may also be important. However, intraspecific competition is probably more important than interspecific competition even in crowded communities because the niche overlap of conspecifics must be greater than that of non-conspecifics, and if both individuals of a pair feed on their territory, their overlapping requirements may be to their mutual detriment. The magnitude of this effect depends on resource availability and the extent to which the requirements of the male and female overlap, and presumably selection to reduce intersexual competition would act to exaggerate a difference that evolved as a consequence of sexual selection (Jehl and Murray 1986, Price 1984). Island populations of melanerpine woodpeckers, and other populations that are allopatric with other woodpecker species of similar size, show significantly more dimorphism in bill size than do populations that are sympatric with congeners (Selander 1966). A similar situation pertains in southwestern *Picoides* woodpeckers (Short 1971), and has been described in other populations of birds, especially those found on islands (Lack 1971).

The Gray Kingbird is found throughout the Caribbean region, and is the commonest West Indian flycatcher. On many islands, it is the only *Tyrannus* found, whereas on others it is sympatric with one or two other species. The Tropical Kingbird (*T. melancholicus*) is found on Grenada, Trinidad and in the Netherlands Antilles; the Fork-tailed Flycatcher (*T. savana*) is of irregular occurrence in the Netherlands Antilles; the Giant Kingbird (*T. cubensis*) is found on Cuba and the Isle of Pines, and formerly on Great Inagua; the Loggerhead Kingbird (*T. caudifasciatus*) is found in the Bahamas, Cuba, the Isle of Pines, the Cayman Islands, Jamaica, Hispaniola and Puerto Rico (but not the Virgin Islands; Raffaele 1989). The Giant Kingbird is decidedly larger than the Gray Kingbird, is uncommon and tends to be found in woodlands and pine forests, whereas the Gray Kingbird is generally found in more open habitats. It is, thus, probably not in significant competition with *T. dominicensis*. The Loggerhead Kingbird likewise is more of a woodland species than the Gray Kingbird, although it can be seen in open country where Gray Kingbirds are found (Bond 1985, Raffaele 1989). In the Netherlands Antilles the Tropical and Gray Kingbirds, and the Fork-tailed Flycatcher have similar habits, but the Gray Kingbird is far more common than the other two

species (Voous 1983). The Gray Kingbird is sympatric with the Eastern Kingbird (*T. tyrannus*) in Florida. However, in the United States the Gray Kingbird breeds in mangroves and other bushes or trees in the salt marsh, and the Eastern Kingbird nests inland (Brodkorb 1950), so there is virtually no ecological overlap between the species.

All kingbirds forage primarily by sallying from a perch and catching flying insects. The bird's bill size probably influences the sizes and types of insects taken (Hespenheide 1964). If interspecific competition for food is significant for Gray Kingbirds, we predict that there will be more dimorphism in bill size in populations of Gray Kingbirds that are allopatric with other *Tyrannus* than in those that are sympatric with other congeneric species, especially *T. melancholicus* and *T. caudifasciatus*.

MATERIALS AND METHODS

This research was initiated by the late D. I. MacKenzie, who borrowed specimens in adult plumage from several of the large North American collections (listed in Acknowledgments). He took the following 11 measurements (see Table 1) with dial calipers on 369 specimens: wing length, the chord of the closed wing from the wrist joint to the tip of the longest primary wing feather; wing tip to 4th, wing tip to 5th and wing tip to 10th, the distances from the tip of the wing to the tip of the 4th, 5th and 10th primary feathers, respectively; outer tail length and inner tail length, the distance from a point of insertion between the two middle rectrices and the longest outer and longest inner tail feather, respectively; tarsus length, the diagonal distance from the mid-point of the posterior junction of the tibiotarsus and tarsometatarsus to the distal edge of the last undivided scute at the juncture of the tarsometatarsus and the base of the middle toe; total bill length, the chord of the bill from the point where the integument of the forehead meets the culmen; bill length (from nares), the chord of the bill from the anterior margin of the nares; bill width, at the anterior margin of the nares; and bill depth, the distance perpendicular to the long axis of the bill from the culmen to the lower edge of the ramus at the anterior margin of the nares.

The vast majority of the specimens measured from resident populations were collected in November–March whereas those from migratory populations (Great Inagua, Bahamas, Florida) were collected in April–August. Migratory Gray Kingbirds molt their remiges and rectrices on their wintering grounds, and their molt is complete by mid-March. The molt of the sedentary individuals is more protracted, and individuals in their first winter may retain some juvenal feathers. Any such birds were excluded from these analyses. Thus, feather wear may be more advanced in our migratory samples than in our resident ones. As well, some of the individuals from the resident populations may be wintering migratory birds.

For analyses of geographic variation, we divided the specimens into 10 different populations, nine from West Indian islands (or groups of islands) and one from Florida (Fig. 1). In some instances, geographically proximal

islands were pooled to increase sample sizes, and of the total sample, 54 specimens were eliminated from analyses either because they were missing several measurements or because they could not be logically pooled with one of these samples. The West Indian samples used were as follows: the Netherlands Antilles; Trinidad; Lesser Antilles (including Grenada, Montserrat, St. Lucia, Antigua and Guadeloupe); the Virgin Islands (including St. Eustatius and St. Croix); Great Inagua; Cuba (including the Caymen Islands); Hispaniola; Puerto Rico; and the Bahamas (New Providence Island, Crooked Island, Cat Island, Grand Bahama and Great Abaco). Sample sizes and averages are listed in Table 1.

We used two way analyses of variance (ANOVA) (sorted by sex and locality) (SPSSX; ANOVA) (SPSSX 1986) to elucidate univariate patterns of geographic variation. For these analyses only the largest six samples were used. There were at least 11 birds of each sex in these six.

To examine multivariate patterns of geographic variation, we used discriminant functions analyses (DFA) (SPSSX 1986). For the DFAs, missing values were estimated using multiple regression, calculated on the two measurable variables that best predict the missing one; we omitted individuals that were missing more than two measurements. We analyzed sexes separately, and used only samples where $N > 11$. For the DFAs we pooled Trinidad with the Lesser Antilles. This restricted the DFA to seven samples of males and six of females, and a total of 315 individuals (189 males and 126 females).

We used Mantel's test to compare matrices of phenotypic differences (DF1 and DF2 scores of males) with a matrix of minimum geographic distances and a matrix of the reciprocals of geographic distances. These tests indicate whether or not patterns of phenotypic variation simply reflect the geographic distances among the localities; the reciprocals emphasize patterns of variation among geographical close localities (Mantel 1967). NTSYS-PC, version 1.50, program MXCOMP (Rohlf 1988) was used for Mantel's tests; 1000 random permutations were done for each test.

We assessed sexual dimorphism in each variable in the six largest samples using ANOVA, and multivariately using DFA. We did two sets of DFA analyses, one using all 11 variables and the other using just the four bill measurements.

RESULTS

Size variation.—The two-way ANOVA (Table 2) showed that there was highly significant interpopulational variation in all 11 variables measured. As well, there was significant sexual dimorphism in wing length, two measures of wing shape (wing tip to 4th and wing tip to 5th), both measures of tail length, bill width and bill depth. Specifically, in all samples, males had significantly longer wings and tails than females. Without a known measure of body size, it cannot be determined whether this reflects larger body size of males, or relatively longer wing and tail feathers in males, perhaps associated with male flight displays. There was, however, no sexual dimorphism in tarsus size, indicating that there

TABLE 1. Localities, sample sizes, and mean values (mm) of 11 measures of male and female Gray Kingbirds.

Variable	Locality													
	Trinidad			Netherlands Antilles			Lesser Antilles			Virgin Islands			Puerto Rico	
	M	F	M	M	F	M	M	F	M	F	M	F	M	F
(Number)	4	5	8	2	19	18	23	11	37	28				
Wing length	114	111	113	112	113	116	116	114	115	112				
Tip to 10th	10	10	11	11	10	10	10	10	10	10				
Tip to 5th	2	4	2	3	3	4	3	3	3	4				
Tip to 4th	18	19	19	19	19	21	19	19	19	19				
Outer tail	94	89	95	99	92	93	96	93	96	91				
Inner tail	84	80	83	86	83	84	85	84	85	82				
Tarsus length	18.9	18.4	17.9	18.6	18.8	18.8	18.6	18.3	18.1	18.2				
Bill length	32.3	31.2	30.9	31.3	32.7	32.7	30.9	30.9	30.1	30.1				
Bill (nares)	22.1	21.4	21.2	21.5	23.1	22.7	21.0	20.7	20.4	20.3				
Bill width	11.7	11.0	10.9	11.3	12.3	12.0	10.9	10.9	10.6	10.7				
Bill depth	8.8	8.6	8.0	8.7	9.2	9.0	8.3	8.5	8.1	8.3				

TABLE 1. Extended.

Variable	Locality											
	Hispaniola		Cuba		Great Inagua		The Bahamas		Florida			
	M	F	M	F	M	F	M	F	M	F		
(Number)	33	14	7	3	25	23	17	5	18	15		
Wing length	113	110	115	112	120	117	118	116	118	113		
Tip to 10th	9	9	9	9	9	9	10	9	9	9		
Tip to 5th	4	4	3	4	4	5	4	4	3	4		
Tip to 4th	20	19	20	20	22	21	22	20	22	20		
Outer tail	91	89	89	85	94	90	93	91	93	87		
Inner tail	80	79	78	77	84	81	82	82	83	80		
Tarsus length	17.9	18.2	18.0	18.3	18.3	18.4	18.1	18.8	18.7	18.6		
Bill length	29.2	29.5	29.9	30.0	31.6	31.8	31.6	31.1	31.7	30.6		
Bill (nares)	19.8	19.9	20.1	20.2	21.5	21.5	21.5	21.5	21.6	20.8		
Bill width	10.2	10.4	10.5	10.6	10.8	11.1	10.9	11.0	11.0	10.9		
Bill depth	7.9	8.0	8.2	8.5	8.6	9.0	8.7	8.6	8.9	8.9		

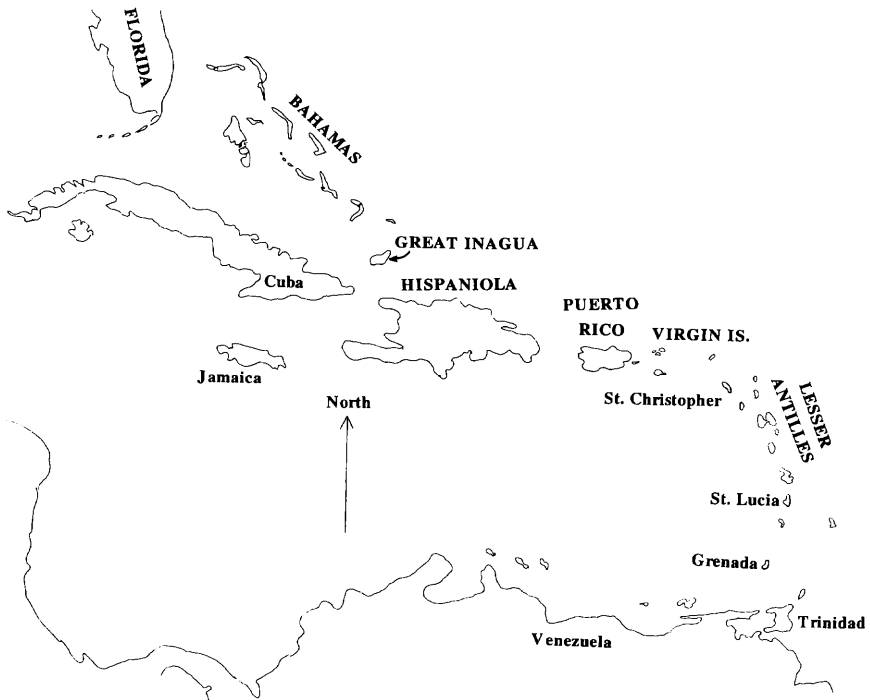


FIGURE 1. Map of the Caribbean region showing the locations from which Gray Kingbirds (*Tyrannus dominicensis*) were measured. The names of the largest samples are in capital letters.

is little if any overall difference in body size between the sexes. Females tended to have wider and deeper bills than males (Tables 1 and 2). The interaction term shows that there was significant geographic variation in the amount of sexual dimorphism in total bill length and two measures of wing shape (Table 2).

In the DFA of males from the seven largest samples, there were four highly significant discriminant functions ($P < 0.001$). However, 63% of the total among group variance was explained in the first function and 23% by the second, and only an additional 9% and 4% by the next two, respectively. DF 1 was positively correlated with all measures of bill size and wing length; DF 2 was also positively correlated with measures of bill size, especially bill width and the measures of bill length. Individuals from Great Inagua, the Bahamas and Florida, that is the migratory populations, had large DF1 scores and thus were relatively large in these measurements (see also Table 1). The individuals from the Lesser Antilles also had large scores for DF1, as well as large scores for DF2. Otherwise, there was no clear pattern of geographic variation. Overall, 66% of the individuals were correctly classified by the discriminant functions. These classification results (Table 3) show that the individuals fell into two

TABLE 2. Results of ANOVA of geographic variation among Gray Kingbirds from six regions.

Variable	Significance		
	Among regions (df = 5)	Between sexes (df = 1)	Interaction (df = 5)
Wing length	***	***	ns
Wing tip to 4th	***	***	*
Wing tip to 5th	***	***	*
Wing tip to 10th	***	ns	ns
Outer tail length	***	***	ns
Inner tail length	***	***	ns
Tarsus length	***	ns	ns
Total bill length	***	ns	*
Bill (from nares)	***	ns	ns
Bill width	***	*	ns
Bill depth	***	***	ns

* $P < 0.05$.** $P < 0.01$.*** $P < 0.001$.

virtually completely distinct groups, Antilles-Virgin Islands-Puerto Rico-Hispaniola and Great Inagua-Bahamas-Florida, that is, into migratory individuals and non-migratory ones. Only two of the 129 non-migratory birds were placed with the migratory ones, and only three of the 60 migratory individuals were classified as non-migratory.

In the DFA of the six samples of females there were three highly significant ($P < 0.001$) discriminant functions, and a fourth significant one ($P < 0.003$). The first explained 47% of the variation among groups, the second 37%, and the third and fourth about 7% each. Unlike the males, only measures of wing shape, wing tip to 4th and wing tip to 5th were highly correlated with the first DF, whereas measures of bill size and wing length were highly positively correlated with DF2. As with the males, migratory vs. non-migratory individuals were separated on the DF1 axis, with females from migratory populations tending to have more pointed wings than those from non-migratory ones. Birds from the Lesser Antilles and Puerto Rico tended to have large bills. Overall, 77% of the females were correctly identified by the discriminant scores; only two of the 38 migratory birds from Great Inagua and Florida were incorrectly identified as non-migratory ones, and only three of the 88 non-migratory ones were identified as migratory individuals (Table 4).

The correlations among matrices of phenotypic differences (DF1 and DF2 scores) and geographical differences were low, the largest (and only statistically significant) one being -0.47 ($t = 1.78$; $P = 0.04$), between DF1 scores for females and the reciprocals of geographic difference. These results indicate that patterns of phenotypic variation are essentially independent of geographic distances, even though they are not independent of geographic position.

TABLE 3. Actual vs. predicted group membership (number with percentage in parentheses) of male Gray Kingbirds.

Actual group	N	Predicted group membership						
		Lesser Antilles	Virgin Islands	Puerto Rico	Hispaniola	Inagua	Bahamas	Florida
Lesser Antilles	18	13 (72)	0 (0)	3 (17)	2 (11)	0 (0)	0 (0)	0 (0)
Virgin Islands	19	0 (0)	10 (53)	9 (47)	0 (0)	0 (0)	0 (0)	0 (0)
Puerto Rico	49	1 (2)	5 (10)	34 (69)	9 (18)	0 (0)	0 (0)	0 (0)
Hispaniola	43	0 (0)	0 (0)	8 (19)	33 (77)	1 (2)	1 (2)	0 (0)
Great Inagua	25	0 (0)	0 (0)	0 (0)	0 (0)	14 (56)	9 (36)	2 (8)
Bahamas	17	1 (6)	0 (0)	1 (6)	0 (0)	5 (29)	9 (53)	1 (6)
Florida	18	0 (0)	0 (0)	1 (6)	0 (0)	1 (6)	3 (17)	15 (67)

Sexual dimorphism.—The wings of males were significantly longer than those of females in all six of the largest samples (Table 5). This is consistent with the hypothesis that males are selected to have relatively longer wings either for aerial displays or for territorial defense. Males also had significantly longer tails (especially the length of the outer-most tail feathers) than females in all samples, save the Lesser Antilles (Table 5). This, too, might be of significance in their aerial displays. Perhaps males are simply generally larger than females, but the absence of dimorphism in tarsus length (Table 5) suggests that this is not the case; tarsus size in birds that have similar behavior may be an indicator of body size (Rising and Somers 1989). The results also indicate that males may tend to have a more forked tail (difference between outer and inner tail feather length) than females. Certainly such dimorphism is pronounced in some other *Tyrannus* (*T. forficatus* and *T. savana*). Wing shape, as reflected by the distance from the wing tip to the tip of the 5th primary, was also dimorphic in three of the populations (Table 5), with females tending to have more pointed wings. The values of this measure, however, were small (Table 1), and doubtless subject to relatively high measurement error, and thus this apparent difference should be viewed with caution.

There was significant dimorphism in bill length only in the Florida population, where males had longer bills than females. In the Great Inagua sample, females had significantly wider and especially deeper bills than males, and female bill depth was significantly greater than males in the Puerto Rico sample as well (Tables 1 and 5).

In the discriminant functions analyses using all 11 variables, there was significant sexual dimorphism in four of the five largest samples (Table

TABLE 4. Actual vs. predicted group membership (number with percentage in parentheses) of female Gray Kingbirds.

Actual group	N	Predicted group membership					
		Lesser Antilles	Virgin Islands	Puerto Rico	Hispaniola	Inagua	Florida
Lesser Antilles	22	16 (73)	1 (5)	4 (18)	1 (5)	0 (0)	0 (0)
Virgin Islands	11	0 (0)	8 (73)	2 (18)	1 (9)	0 (0)	0 (0)
Puerto Rico	34	0 (0)	6 (18)	25 (74)	2 (6)	0 (0)	1 (3)
Hispaniola	21	0 (0)	0 (0)	5 (24)	14 (67)	1 (5)	1 (5)
Great Inagua	23	0 (0)	0 (0)	1 (4)	0 (0)	20 (87)	2 (9)
Florida	15	0 (0)	1 (7)	0 (0)	0 (0)	0 (0)	14 (93)

6). Using only the four bill variables, however, there was significant dimorphism only in the Great Inagua sample, in which 35% of all of the variation in bill size was due to sexual dimorphism. Fig. 2 shows histograms of the DFA scores based on the four bill measures. Although the discriminant functions are somewhat different among the six analyses, in general birds with the largest DF scores had the largest bills. On Great

TABLE 5. Results of ANOVA between sexes of 11 measures in the six largest samples of Gray Kingbirds.

Variable	Allopatric with other <i>Tyrannus</i>			Sympatric with other <i>Tyrannus</i>		
	Lesser Antilles	Virgin Islands	Great Inagua	Puerto Rico	Hispaniola	Florida
Wing length	***+	**+	***+	***+	**+	***+
Wing tip to 4th	**+	ns	ns	ns	ns	**+
Wing tip to 5th	ns	ns	**-	***-	ns	**-
Wing tip to 10th	ns	ns	ns	ns	ns	ns
Outer tail length	ns	**+	***+	***+	**+	***+
Inner tail length	ns	ns	***+	***+	ns	**+
Tarsus length	ns	ns	ns	ns	ns	ns
Total bill length	ns	ns	ns	ns	ns	**+
Bill (from nares)	ns	ns	ns	ns	ns	*+
Bill width	ns	ns	*-	ns	ns	ns
Bill depth	ns	ns	***-	*-	ns	ns

* $P < 0.05$.
 ** $P < 0.01$.
 *** $P < 0.001$.
 + Males > females.
 - Females > males.

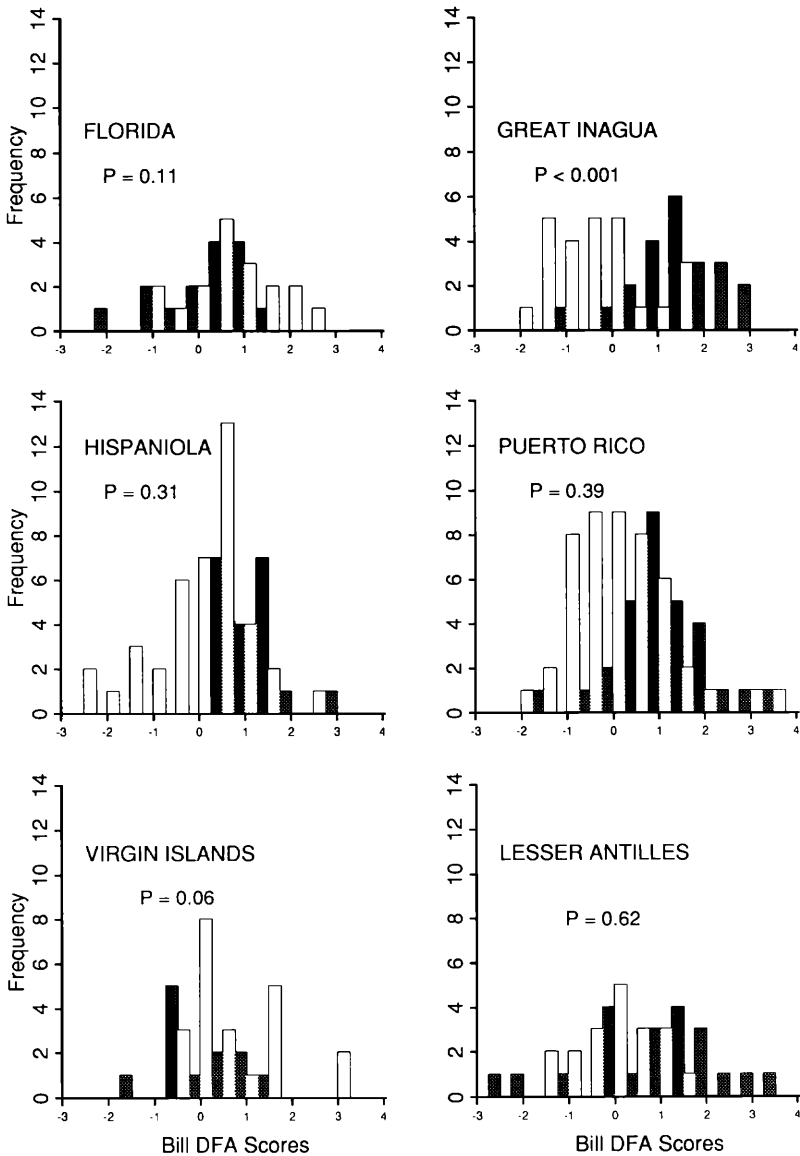


FIGURE 2. Histograms of the discriminant function scores based on four measures of bill size of male (open) and female (shaded) Gray Kingbirds (*Tyrannus dominicensis*) from the six largest samples. Although the six analyses differ in detail, in general individuals to the right have relatively large (or long and narrow) bills whereas those to the left have relatively small bills.

TABLE 6. Summary of DFA between sexes of Gray Kingbirds using all 11 variables and four bill variables (numbers are canonical correlations squared and explain the proportion of the total variation that is between sexes).

Sample	All variables	Bill variables alone
Lesser Antilles	0.62*	0.08 ns
Virgin Islands	0.66**	0.26 ns
Great Inagua	0.74***	0.35***
Puerto Rico	0.41***	0.05 ns
Hispaniola	0.26 ns	0.08 ns
Florida	0.78 ***	0.23 ns

* $P < 0.05$.

** $P < 0.01$.

*** $P < 0.001$.

Inagua, the only locality examined in which there is significant bill dimorphism, females had larger bills than males. There was also this tendency, albeit not significant, in the samples from Hispaniola and Puerto Rico as well.

DISCUSSION

There was significant geographic variation in Gray Kingbirds. The discriminant functions analyses showed that the most striking pattern of geographic variation was between migratory and non-migratory Gray Kingbirds, the latter having significantly longer wings, longer bills and more pointed wings than the former. Recall, however, that the non-migratory individuals were generally collected earlier in the year than the migratory ones, so this result may be an artifact of the date of collection. This seems unlikely, however, because the feathers of migratory individuals should be, if anything, more worn than those of the non-migratory ones (and hence would be expected to have shorter, not longer, wings), and seasonal differences could not explain the differences in bill size. Also, the fact that virtually all individuals were correctly identified as to migratory status suggests that the winter-collected samples were made up of resident individuals not admixed with substantial numbers of wintering migrants.

With the data at hand, it is difficult to know whether the migratory individuals have wings that are longer *relative* to their body size, or whether they are perhaps simply larger than the non-migratory birds. If tarsus length can be taken to be a measure of body size, as it can be in some species (Rising and Somers 1989), the largest individuals (from the relatively large samples) are from the Lesser Antilles, Virgin Islands and Puerto Rico, and the smallest from Hispaniola, the Bahamas and Florida. This indicates that it is relative wing length, not absolute wing length, that differs between the migratory and non-migratory birds.

Male Gray Kingbirds were larger than females with regard to wing length, tail length and (in one population) bill length. Females had greater bill depth than males (in two populations). There was no sexual dimor-

phism in tarsus length, suggesting that there is little or no dimorphism in "body size." Dimorphism in wing length and tail length perhaps reflects the behavioral differences between sexes. The bill size dimorphism was most striking in the sample from Great Inagua, one of the sites where Gray Kingbirds are the only tyrannid. As well, bill dimorphism was nearly significant in Florida and the Virgin Islands, where *T. dominicensis* is either allopatric, or effectively so, to other *Tyrannus*. On the other hand, dimorphism was the least in the samples from Puerto Rico, Hispaniola and the Lesser Antilles. *T. dominicensis* is sympatric with *T. caudifasciatus* in the first two localities, but is the only *Tyrannus* in the Lesser Antilles. These results, thus, could be taken to show weak support for the niche variation hypothesis, although such an interpretation is obviously tentative, and it is clearly desirable to have more large samples, especially those of birds from Trinidad and the Netherlands Antilles where *T. dominicensis* apparently closely overlaps with *T. melancholicus*.

Brodkorb (1950) recognized five subspecies of *T. dominicensis*, *T. d. dominicensis* (Hispaniola, Puerto Rico, Virgin Islands), *T. d. fugax* (U.S. and Bahamas, including Great Inagua), *T. d. sequax* (Cuba, Isle of Pines, s. Bahamas and perhaps Jamaica), *T. d. tenax* (Netherlands Antilles) and *T. d. vorax* (L. Antilles). He used differences in size and proportions, for the most part, to describe these subspecies, but noted that *T. d. vorax* has darker gray upper parts than the others. On the basis of size and shape, our results would seem to justify the recognition of only two subspecies, migratory and non-migratory Gray Kingbirds. The type specimen of *T. d. dominicensis* is from Santo Domingo, and hence the name *dominicensis* has priority for the non-migratory Gray Kingbirds. The type associated with the next oldest name, *vorax*, is from Martinique. Thus, on the basis of size, both *dominicensis* and *vorax* refer to non-migratory *T. dominicensis*. Brodkorb (1950) proposed the name *fugax* for the Gray Kingbirds from the U.S. and Bahamas, and this name has page priority over the other subspecies (*T. d. sequax* and *T. d. tenax*) that he proposed. The type specimen of *T. d. fugax* was collected on Cedar Key, Florida. Thus, *T. d. fugax* is an appropriate name for the migratory individuals. Pending examination of additional material, we suggest that birds from Cuba, the Isle of Pines and Jamaica be placed in *T. d. fugax*, and those from the Netherlands Antilles in *T. d. dominicensis*, or in *T. d. vorax* if the color difference is judged sufficient grounds for recognition of that subspecies.

ACKNOWLEDGMENTS

We thank Nancy Flood, Ned Johnson and Richard Snell for their many helpful comments. We also appreciate the cooperation of the curators of the following collections who kindly allowed MacKenzie to measure their specimens: Field Museum of Natural History, University of Kansas Museum of Natural History, University of Michigan Museum of Zoology, and the Royal Ontario Museum.

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Received 13 Mar. 1990; accepted 28 Sep. 1990.