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ERIK S. MUNSON, *College of Natural Resources, Univ. of Wisconsin, Stevens Point, Wisconsin 54481.* (Present address: *Dept. of Ecology, Ethology, and Evolution, Univ. of Illinois, Champaign, Illinois 61820.*) *Received 8 Oct. 1991, accepted 15 Feb. 1992.*

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Dominance relationships of dabbling ducks wintering in Yucatan, Mexico.—Evolution of dominance behavior in waterfowl may be related to variation in the ability to obtain needed resources (e.g., food). This idea has been used to support hypotheses explaining differential distribution of the sexes (Nichols and Haramis 1980, Hepp and Hair 1984) and inter- and intraspecific variation in pairing chronology (Paulus 1983). Knowledge of dominance in nonbreeding Anatinae is based on data obtained from temperate areas. Among Nearctic Anatinae, however, large numbers of Blue-winged Teal (*Anas discors*), Northern Pintails (*A. acuta*), Northern Shovelers (*A. clypeata*), and American Wigeon (*A. americana*) winter in the Neotropics (Bellrose 1980), where ecological conditions (most notably temperature) differ. Ducks wintering in the Neotropics may have reduced energetic demands because of mild temperatures (Thompson and Baldassarre 1990). Therefore, dominance patterns and/or pairing chronology might differ in the Neotropics as compared to more northerly wintering areas. We examined aggressive behavior of waterfowl wintering in Yucatan, Mexico, to determine if dominance patterns in the Neotropics are consistent with previous explanations of the effects of dominance on pairing chronology and differential distribution of the sexes.

Study area and methods.—We conducted our study in the Laguna de Celestun (Celestun Estuary) on the west coast of the Yucatan Peninsula near the village of Celestun, Yucatan (Thompson 1989). Celestun Estuary is part of the Yucatan Lagoons wetland complex, which is largely restricted to the north coast of the Yucatan Peninsula. The Yucatan Lagoons are a major wintering area for Nearctic Anatinae, where during 1970–1988 the total number of wintering waterfowl varied from a high of 320,325 in 1979 to a low of 43,930 in 1982 (Baldassarre et al. 1989). Data were collected from 7 October to 13 March, 1986–1987 and 1987–1988. Observations were made using focal individual and ad libitum sampling of randomly selected, unmarked Blue-winged Teal, Northern Shovelers, Northern Pintails, and American Wigeon (Altmann 1974). We used a 15–60× spotting scope to observe eight focal individuals of each species during each of four daily time blocks of equal length on two of every three days. Days were defined as 0.5 h before sunrise to 0.5 h after sunset. Individuals were observed for 5 min each from five widely separated blinds or from a parked vehicle. Individuals were selected by pointing a 15–60× spotting scope toward a flock and selecting the bird closest to the center of vision. Flocks were selected by partitioning the area around the observation site into four equal zones and randomly selecting, without replacement, one zone per time block. Species selection was randomized within blocks, and sampling days were assigned randomly, without replacement, to blinds. Ad libitum sampling was used to record observations of aggressive interactions not involving focal birds (Thompson 1989). Sex ratios were determined every 7–10 days by recording the species and sex of all individuals within 100 m of a given observation blind.

All intra- and interspecific aggressive interactions were recorded, for which four levels of intensity were categorized as (1) Supplant—one individual moved into an area and the other moved away without confrontation, (2) Threat—open bill threats and jabs with the bill, (3) Chasing—one bird rushed another, causing it to move rapidly away, and (4) Fighting—biting and striking with the wings (modified from Paulus 1983, Hepp and Hair 1984, Alexander 1987). For each interaction, we recorded species, sex, and pair status of both participants, winner and loser, initiator of interaction, activity associated with the encounter, and the activity of both participants immediately following the encounter. Pair status was determined using criteria outlined by Hepp and Hair (1983) which were sustained proximity to a member of the opposite sex, inciting by the female, following of a particular male by a female, and male defense of the female. We estimated the percentage of all females that were paired each month by determining the pair status of females chosen for focal individual sampling and calculating the percentage of individuals that were paired.

We used *G*-tests (Sokal and Rohlf 1969) to determine if observed frequencies of initiating or winning an encounter differed from expected values in relation to individuals of dissimilar pair status or sex. We considered a species/pair status/sex group to be dominant over another group if they won more interactions than expected by chance (Hepp and Hair 1984, Alexander 1987).

TABLE 1
AGGRESSIVE INTERACTIONS OBSERVED AMONG SPECIES OF DABBLING DUCKS WINTERING IN YUCATAN, MEXICO, 1986–1988[a]

Species attacking	Species attacked				
	BWT[b]	NS	NP	AW	Total
Blue-winged Teal	556	25	13	0	594
Northern Shoveler	49	248	46	4	347
Northern Pintail	18	19	418	3	458
American Wigeon	2	18	0	123	143
Total	625	310	477	130	1542

[a] Total time (h) of focal individual sampling: BWT 368, NS 383, NP 275, AW 147.

[b] BWT = Blue-winged Teal, NS = Northern Shoveler, NP = Northern Pintail, AW = American Wigeon.

Results.—Of 1542 agonistic encounters observed, 87.2% were intraspecific (Table 1) and 97.1% were between birds of similar pair status. However, few individuals of each species paired while in Yucatan. For example, of 4417 Blue-winged Teal and 4951 Northern Shovelers observed during focal sampling, none were paired during winter (Oct–Mar), and only 2.5% of 3300 female Northern Pintails had paired by February. Among American Wigeon, females were first observed paired in December (6.0%; N = 447), 11.0% were paired in January (N = 82), 22.0% in February (N = 480), and 32.0% in March (N = 311). For each species, there was no difference (ANOVA; $P > 0.05$) between years in patterns of aggressive behavior. Encounters involving two groups of paired birds were rare (N = 6). Most aggressive interactions for each species were associated with feeding activity (54.7–80.6%), which suggests that competition for food may have been a proximate cause for aggression. To test this, we compared the percentage of encounters associated with each activity to expected values based on the proportion of diurnal time spent in each activity. For all species, the proportion of encounters associated with each activity differed (*G*-test; $P < 0.001$) from expected values, and interactions associated with feeding were more frequent than expected (feeding = 40.9–45.1% of diurnal activity; Thompson and Baldassarre 1991). The remaining interactions involved birds that were locomoting (11.0–23.1%), preening (3.0–8.2%), resting (1.7–5.0%), and courting (0.4–3.9%), but no obvious patterns were apparent for activities other than feeding. Encounters were brief (1–2 sec), and the losing individual almost always moved only a few (1–3) m away, performed a comfort movement (wing flap or stretch), and then resumed its previous activity. Among all species, threats were the most common

TABLE 2
PERCENTAGE OF EACH TYPE OF AGONISTIC BEHAVIOR OBSERVED IN DABBLING DUCKS

Species	Supplant	Threat	Chase	Fight
Blue-winged Teal	16.9	62.0	7.7	13.4
Northern Shoveler	11.3	71.3	14.6	2.8
Northern Pintail	18.4	56.6	9.8	15.2
American Wigeon	7.8	74.5	16.7	1.0

TABLE 3

OBSERVED SEX RATIOS OF WATERFOWL WINTERING IN YUCATAN, MEXICO, 1986–1988

	Species			
	BWT[a] (19)[b]	NS (19)	NP (20)	AW (10)
Total birds observed	1172	2830	2072	364
Percent males	75.7	64.6	84.4	66.8
Ratio males : female	3.1:1	1.8:1	5.4:1	2.0:1

[a] See Fig. 1.

[b] Number of samples.

agonistic display (56.6–74.5%), whereas the frequency of other displays varied among species (Table 2). Supplanting was probably under-recorded because it often was a subtle interaction.

Among all species, when pair status of participants was similar, the initiator won more interactions than expected by chance (Blue-winged Teal 91.2%, Northern Shoveler 94.7%, Northern Pintail 91.2%, American Wigeon 99.0%; $P < 0.001$). Females were more likely to initiate an intersexual encounter (56.1–61.5%; $P < 0.01$; Tables 3, 4) and, except for American Wigeon, won more interactions than expected (females won 57.2% Blue-winged Teal, 53.7% Northern Shoveler, 56.3% Northern Pintail; $P < 0.05$). Male and female American Wigeon won similar ($P > 0.05$) numbers of interactions (i.e., females won 46.0%), but sample size was small (N = 26). All encounters between birds of dissimilar pair status (N = 44) were intraspecific, and all were initiated by paired individuals. Paired males won 23 of 24 ($P < 0.001$) encounters with unpaired birds (19 of 20 with males, 4 of 4 with females), and paired females won 19 of 20 ($P < 0.001$) encounters with unpaired birds (13 of 14 with males, 6 of 6 with females).

Except for American Wigeon, participation by sexes in aggressive interactions differed ($P < 0.01$) from expected values. Female Blue-winged Teal, Northern Shovelers, and Northern Pintails participated in a greater proportion of interactions than expected, based on their proportion in the population. Male-male interactions in these species were less frequent,

TABLE 4

FREQUENCY OF AGGRESSIVE INTERACTIONS OBSERVED BY SEX AND EXPECTED VALUES BASED ON POPULATION SEX RATIOS

	Species							
	BWT[b]		NS		NP		AW	
Interaction	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.
Male-male	173	212	95	102	262	290	42	45
Female-female	54	22	52	31	43	10	16	11
Male-female	55	68	43	56	43	54	17	23
Female-male	88	68	55	56	60	54	27	23
G-scores	48.7***		15.6**		65.3***		4.6	

[a] Expected frequency = (proportion of first sex in population) × (proportion of second sex in population) × (total observations) (Hepp and Hair 1984).

[b] See Fig. 1.

** $P < 0.005$; *** $P < 0.001$.

TABLE 5

OVERALL PARTICIPATION IN AGGRESSIVE INTERACTIONS OBSERVED AND EXPECTED VALUES CALCULATED USING POPULATION SEX RATIOS OF MALE AND FEMALE WATERFOWL

	Species							
	BWT[b]		NS		NP		AW	
	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.
Male	489	560	288	317	627	689	128	136
Female	251	180	202	173	189	127	76	68
G-scores	34.3***		7.34*		32.01***		1.38	

[a] Expected frequencies = (proportion of sex in population) × (total observations) (Hepp and Hair 1984).

[b] See Fig. 1.

*** $P < 0.001$, * $P < 0.01$.

and female-female interactions more frequent than expected. Similarly, except in Northern Shovelers, female-male (female initiated) interactions occurred more often, and male-female interactions occurred less often than expected. Deviations from expected values were relatively greater in Blue-winged Teal and Northern Pintails, species exhibiting more biased sex ratios. This is supported further by comparing the overall participation in agonistic activities for each sex (Table 5).

Discussion.—Our data are similar to those of other studies of dominance behavior in nonbreeding Anatinae in that paired birds dominated unpaired birds, although few individuals paired during winter in Yucatan. Of more significance, however, was the lack of male dominance in Yucatan. For example, Hepp and Hair (1984) reported that in six species of dabbling ducks wintering in North Carolina, including three common to our study (American Wigeon, Northern Pintail, Northern Shoveler), males won more intersexual aggressive interactions than expected by chance and thus were dominant to females. In contrast, we found that females won more encounters than males (except American Wigeon) and were more likely to initiate an encounter than expected based on their proportion in the population. Ducks that initiate aggressive encounters usually win, which suggests that individuals assess the dominance status of other flock members, and only initiate encounters when they are likely to be successful (Patterson 1977). Consequently, we conclude that, except for American Wigeon, dabbling duck females are dominant to males in Yucatan.

Explanations for these patterns are unclear, because the costs and benefits of dominance rank are certainly complex (Hepp 1989). However, that male ducks wintering in Yucatan might be of lower dominance rank than males wintering at more northern latitudes could be expected if behavioral dominance plays a role in the differential distribution of wintering birds. For instance, Gauthreaux (1978:30) suggested that if the non-breeding range of a species is geographically disjunct from the breeding range, dominants should acquire those areas of highest quality closest to the breeding grounds. Subordinates, therefore, might be forced into areas farther from the breeding grounds or into habitats of lesser quality, especially when food is limited (Hepp 1989). Thus, if dominant ducks (i.e., high ranking males; Hepp and Hair 1984, Alexander 1987, Perry et al. 1988) are distributed farther north in winter than subordinates (i.e., unpaired females and low ranking males), females in Yucatan may be subordinate to males wintering at northern latitudes but of higher or equal (i.e., American Wigeon) rank than sympatric low ranking males, and thus dominant to them. Therefore, we believe the dominance patterns we observed are consistent with the hypothesis that dominance can influence the differential distribution of the sexes because females, by wintering in Yucatan, could successfully compete for needed resources.

In many species of ducks, males predominate in northern areas during winter (see Hepp and Hair 1984), but the sex ratios in Yucatan do not support the prediction that females, because they are generally subordinate to males, predominate in southerly wintering areas. Indeed, sex ratios of dabbling ducks in Yucatan were similar to, if not more male-biased than, those reported from more northern areas (Bellrose et al. 1961, Hepp and Hair 1984, Miller 1985). This is interesting because, with the exception of Blue-winged Teal, Yucatan is near the southern extent of the wintering range for species in this study. Blue-winged Teal winter well south of Yucatan, and patterns may differ for teal wintering farther south. However, as noted by Hepp and Hair (1984:256), the hypothesis that dominance influences distribution does not predict the direction of dispersal. Rather, several factors (e.g., habitat suitability) probably interact to influence the distribution of sexes (Ketterson and Nolan 1983, Hepp 1989). Hepp (1989) demonstrated that age influenced the effect of sex on dominance rank of American Black Ducks; adult females were dominant to juvenile males but not to adult males. This may imply that juvenile males were more prevalent in winter populations of ducks in Yucatan than they are at more northern latitudes. We collected data from a limited number of ducks killed by hunters each year to test this idea. Combining years, the age ratio (adults to juveniles) for Blue-winged Teal was 74:36 for males and 39:43 for females and for Northern Pintails it was 7:11 for males and 7:14 for females. However, without data on American Wigeon and Northern Shovelers and more information on Pintails, the age ratio information is inconclusive.

In contrast to Yucatan, Hepp and Hair (1983:678) noted that >84% of American Wigeon wintering in North Carolina were paired in January, and >96% of Northern Pintails and Northern Shovelers were paired in February. Chronology of pair formation in Blue-winged Teal is not well documented, but observations indicate that pairing begins in late December or early January and continues until March (see Bluhm 1988, and others cited therein). Glover (1956) reported that 60% of Blue-winged Teal were paired upon arriving in northwest Iowa during late March.

Rohwer and Anderson (1988) reviewed potential costs and benefits of early pair formation and emphasized that pairing ultimately may benefit the female through protection by the male and increased dominance rank. Dominant birds also may be more successful at obtaining nutrients (if they are limiting) than subordinates, and thus may be in better condition and better able to survive stress associated with food shortage (Patterson 1977, Caraco 1979, Paulus 1983). In Yucatan, the few individuals that did pair were dominant to unpaired birds, which suggests that paired females should gain advantages similar to those potentially accrued by paired birds in other areas (i.e., farther north). However, females in Yucatan may not be willing to pair, if they are already dominant or equal in social status to males and thus probably have at least equal access to resources and do not need male protection. We believe that female dominance and lack of pairbonding in Yucatan relates to proposed female benefits and male costs of pairing in waterfowl but that patterns in the Neotropics are different from those in more temperate areas.

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JOHN D. THOMPSON AND GUY A. BALDASSARRE, *Environmental and Forest Biology, State Univ. of New York, College of Environmental Science and Forestry, Syracuse, New York 13210.* (Present address JDT: *Max McGraw Wildlife Foundation, P.O. Box 9, Dundee, Illinois 60118.*) *Received 21 Aug. 1991, accepted 1 Feb. 1992.*

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Dynamics of a year-round communal roost of Bald Eagles.—Communal roosts of Bald Eagles (*Haliaeetus leucocephalus*) occur regularly outside of breeding season and have been described in detail (Fitzner and Hanson 1979, Keister and Anthony 1983, Crenshaw and McClelland 1989). However, year-round Bald Eagle roosts have been studied only recently (Chester et al. 1990, Buehler et al. 1991). I describe here the results of 188 h of observation at a year-round communal roost of Bald Eagles in southern Florida.

Everglades National Park (ENP), located at the southern tip of the Florida peninsula, is home to a large, stable breeding population of Bald Eagles (ca 50 breeding pairs/year, Curnutt and W. B. Robertson, Jr., unpubl. data). The climate is sub-tropical with mean temperatures of 26.8°C in August and 18.9°C in January. Eagles nest in two major areas: Florida Bay, a shallow 1600 km^2 estuary, and the extensive mangrove forests of the park's Gulf coast. Nesting activity (nest building) begins in late November and ends (young fledged) in late March (Curnutt 1991). Bald Eagles have been known to use the southern end of the Miami Rock Ridge pinelands as a roosting site since they were discovered there in the early 1960s by A. Sprunt, IV, and W. B. Robertson, Jr. The southern terminus of the pinelands is nearly 20 km north of Florida Bay, the nearest Bald Eagle nesting and foraging habitat, and is dominated by mature slash pine (*Pinus eliottii*) with an understory kept open by natural and planned fires. During aerial surveys of the pinelands, I determined that roosting activity was concentrated in an area of ca 20 ha where the southern tip of the pine forest intersected the Main Park Road (MPR). The vegetation between the roost area and Florida Bay is dominated by dry *Muhlenbergia* prairie, red mangrove (*Rhizophora mangle*), and coastal prairie (Craighead 1971).

I observed the roost from atop a van on the MPR. I alternately parked and drove within 0.5 km of the road-pines intersection in order to count eagles. This allowed me to observe and count eagles perched at the edges and within the stands of pines. I observed the roost three consecutive evenings and the following mornings near the middle of each month from March 1990 through February 1991. The March 1990 observations were used to test and refine methods and are not included in analyses. I conducted evening observations from at least 1 h before sunset to 0.5 h after sunset and morning observations from 0.5 h before sunrise to 4 h after sunrise or until the last known eagle departed the area, whichever was later. I noted the direction of flight (bearing) and estimated altitude of each eagle seen flying. Times (to the nearest minute) were recorded for eagles entering or leaving the roost area. Trees in which I saw eagles perched were identified to species, noted as living or dead, and assigned to one of the following categories of relative height: above canopy, canopy height,