not as intense or as frequent as in 1966; I saw only 3 attacks (EK-RH, 2; EK-EK, 1).

At the same place on 17 July 1970, Alexa Noble (pers. comm.) saw 7 juvenile and 2 adult Red-heads hawking. One conspecific perch supplant was seen. No kingbirds were present, but an Eastern Wood Pewee entered the area and chased Red-heads on 10 hawking flights. Red-heads returned the attacks twice. At another site with 2 juvenile woodpeckers, and EK attacked a hawking RH. Noble saw one attack by each of the flycatchers on Red-heads at different nearby sites on 18 July.

Of 70 encounters, 70% were flycatcher-on-woodpecker attacks which occurred almost always while woodpeckers were hawking, i.e. behaving like flycatchers. I believe the flycatching behavior provoked the attacks. Other reports of aggression between presumed non-competitors have been interpreted similarly (e.g., Austin and Russell, Condor 74:481, 1972; Mueller and Mueller, Wilson Bull. 83:442–443, 1971). Austin and Russell's cases involved tyrannids and were similar to ours in that attacks ensued only when flight behavior resembling hawking occurred. However, the pursued species, a sparrow and a wren, were not feeding nor were they potential feeding competitors. The woodpeckers we saw were presumably hawking the same prey as the flycatchers were. Because the tyrannids mainly attacked hawking woodpeckers and ignored ones perched nearby, I reject the idea that the actions were protective attacks on an image of a potential predator by notoriously aggressive birds.

The attacks may have been responses to fortuitous or inappropriate releasers (Selander and Giller, Bull. Am. Mus. Nat. Hist. 124:243–273, 1963; Lorenz, On Aggression, Harcourt, Brace and World, N.Y., 1966) which could waste time and energy and lower the fitness of the aggressor. Such behavior may persist because of negligible selective pressure (Austin and Russell 1972) or because of genetic swamping from allopatric areas (Selander and Giller 1963; Orians and Willson, Ecology 45:736–745, 1964; Murray, Ecology 52:414–423, 1971). On the other hand, the aggression may persist because it is advantageous. An individual which repelled images similar to its own could be favored if the apparent similarities manifested a significant use of critical resources such as habitat or food by the intruder (Miller, J. Anim. Ecol. 37:43–61, 1968; Reller, Am. Midl. Nat. 88:270–290). Only a more detailed study could differentiate among the possibilities.

Some information suggests the possibility for critical overlap between the flycatchers and Red-heads. They all overlap in range and habitat in forest-edges, groves, and open forests (Bent, U.S. Natl. Mus. Bull. 174, 1939; ibid. 179, 1942; Hespenheide, Auk 88:61–74, 1971; Jackson, Condor 78:67–76, 1976; pers. obs.). Pewees and Red-heads may share some feeding heights (Lederer, Ph.D. thesis, Univ. Illinois, 1972; Reller 1973; pers. obs.).

I made the observations while doing graduate research funded by the Department of Zoology, University of Illinois. Alexa Noble kindly shared her field notes. The Department of Entomology and Applied Ecology, University of Delaware, provided secretarial assistance. E. P. Catts, J. R. Karr, J. T. Linehan, B. G. Murray, Jr., R. W. and A. Rust, M. F. Willson, and 2 referees made useful comments on earlier drafts. This is Misc. Publ. No. 766 of the Delaware Agricultural Experiment Station and Publ. No. 453 of the Department of Entomology and Applied Ecology.—ROLAND R. ROTH, *Dept. of Entomology and Applied Ecology, Univ. of Delaware, Newark, 19711.* *Accepted 18 July 1977.*

Wilson Bull., 90(3), 1978, pp. 451–455

An analysis of Gila Woodpecker vocalizations.—Gila Woodpeckers (*Melanerpes uropygialis*) are conspicuous for their vocal behavior (Bent, U.S. Natl. Mus. Bull. 174, 1939). Bendire (U.S. Natl. Mus. Spec. Bull. 3, 1895) and Gilman (Condor 17:115–136, 1915) listed 2 types of calls for them: one was described as the species' "sociable" call and the second as a shrill "belly-aching" call.

The purpose of this study is to further describe Gila Woodpecker vocalizations and to analyze them spectrographically. Their location call (Call 1) is then statistically examined to determine which components are most variable among birds and therefore likely candidates for use in individual recognition. These results are compared to what is known for other groups of birds. Preliminary descriptions of Gila Woodpecker vocalizations and detailed information about the behavioral contexts in which they occur are presented elsewhere (Brenowitz, Auk 95:49–58, 1978).

I studied 9 pairs of Gila Woodpeckers at Red Rock, in Grant Co., New Mexico from 17 March 1973 to 20 March 1974. The study area consisted of several cottonwood (*Populus deltoides*) groves along the banks of the Gila River. This riparian zone extends less than 200 m from the river and borders on a narrow strip of irrigated farm land. Desert forms the remainder of the local habitat. Observation time was in excess of 400 h.

Vocalizations were recorded on a Uher 4000 Report-L tape recorder at a tape speed of 19 cm per sec with use of a Uher M514 microphone and, sometimes, a 61 cm diameter parabolic reflector. Analyses of vocalizations were carried out on a Kay Electric Company Sonagraph model 6061B with a model 6076C amplitude display and scale magnifier unit. Temporal components of calls were examined on sound spectrographs (frequency vs. time plots) produced with a wide band-pass filter setting and frequency components on spectrographs made with a narrow band-pass filter setting. Time and frequency measurements were made by placing transparencies marked with time and frequency scales over sound spectrographs. Three, randomly chosen sequences of Call 1 for each of 5 male birds were then compared in one-way analyses of variance. The specific components examined were: duration of the first note in the sequence, duration of the interval between the first and second notes in the sequence, and minimum and maximum frequencies of the first note in the sequence.

Call 1 presumably corresponds to the species' "sociable" call. It is composed of uniform vibrato notes with a simple temporal structure but a rich harmonic structure (Fig. 1a). It has been likened to a call given by Flickers (*Colaptes auratus*) and resembles both the "pulsed 'location' call" of Golden-fronted Woodpeckers (*Melanerpes aurifrons*) (Selander and Giller, Wilson Bull. 71:107–124, 1959) and the "Cha-aa-ah" call of Red-bellied Woodpeckers (*Melanerpes carolinus*) (Kilham, Wilson Bull. 73:237–254, 1961). Call 1 also shares structural and functional characteristics with the "Churr" call of Red-headed Woodpeckers (*Melanerpes erythrocephalus*) (Bock et al. Wilson Bull. 83: 237–248, 1971). Pairs moving independently about their territories locate each other with this call. This call also is the Gila Woodpecker's primary territorial display, and boundary disputes were often limited to prolonged exchanges of it from the location in dispute. Males gave this call more than did females ($N = 458$ for males, $N = 78$ for females).

The number of notes in a sequence was highly variable ($\bar{x} = 4.8$, $SD = 4.8$, $N = 48$). The duration of notes ranged from 0.18–0.38 sec ($\bar{x} = 0.24$, $SD = 0.04$, $N = 29$) and the interval between notes varied from 0.18–0.95 sec ($\bar{x} = 0.46$, $SD = 0.18$, $N = 27$). The minimum and maximum frequencies of notes ranged from 0.6–1.3 kHz ($\bar{x} = 0.9$, $SD = 0.2$, $N = 29$) and 1.1–2.3 kHz ($\bar{x} = 1.6$, $SD = 0.3$, $N = 29$), respectively. The length of notes differed significantly among birds ($p < 0.002$) while the interval be-

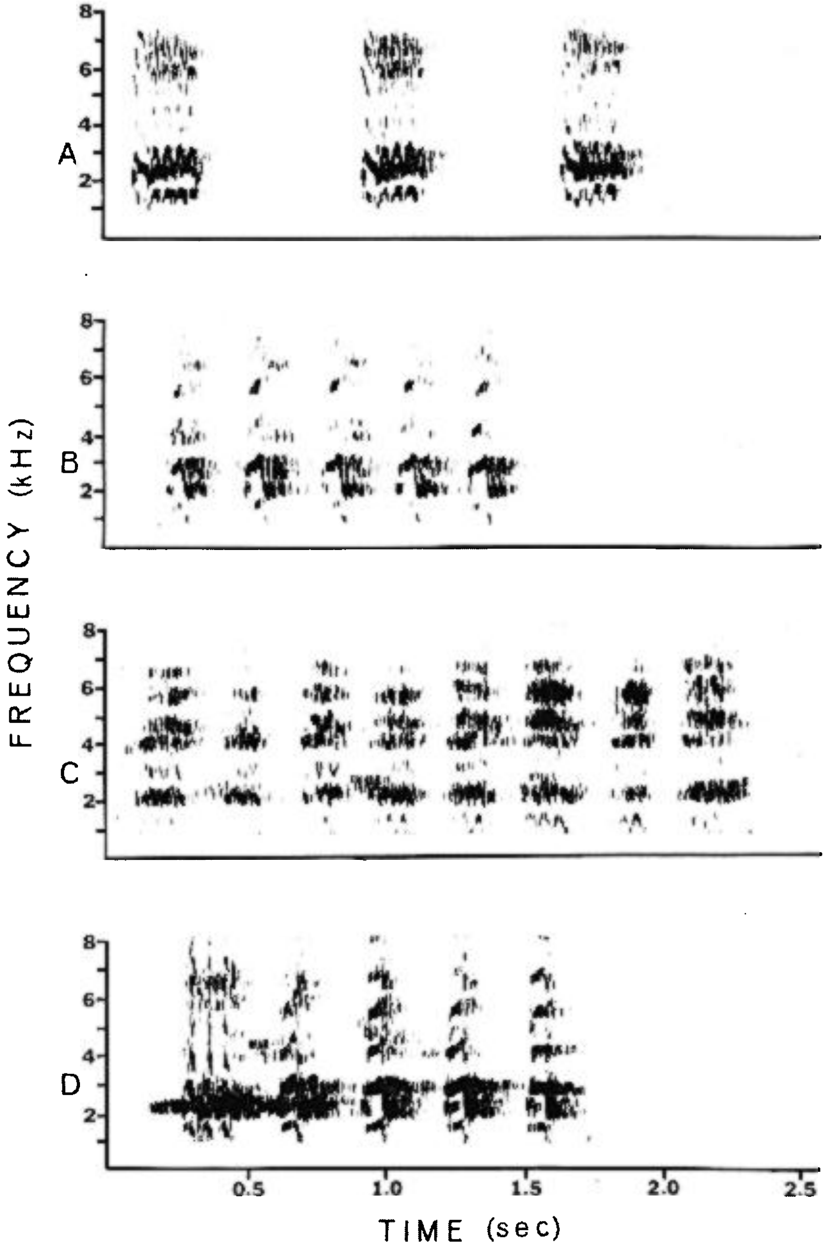

FIG. 1. Sound spectrographs of Gila Woodpecker vocalizations. 1a, Call 1; 1b, Call 2; 1c, Gravel Call; 1d, Combination Call.

tween notes did not ($p < 0.50$). The minimum frequency of notes differed significantly among birds ($p < 0.05$) but the maximum frequency did not ($p < 0.10$).

Call 2 is a series of sharp, "pip, pip" notes with a complex harmonic structure (Fig. 1b). It is most frequently given in response to disturbance by humans and following vocalizations of other species such as flickers and Starlings (*Sturnus vulgaris*). Females gave this call more than did males ($N = 48$ for males, $N = 109$ for females) and it appears to serve as a general alarm call. Call 2 is sometimes used in conjunction with visual displays in agonistic encounters.

The number of notes in a sequence varied considerably ($\bar{x} = 6.8$, $SD = 5.9$, $N = 46$). The duration of notes ranged from 0.08–0.14 sec ($\bar{x} = 0.10$, $SD = 0.01$, $N = 29$) and the interval between notes varied from 0.10–0.34 sec ($\bar{x} = 0.21$, $SD = 0.14$, $N = 29$). The minimum and maximum frequencies of notes ranged from 0.8–1.5 kHz ($\bar{x} = 1.2$, $SD = 0.2$, $N = 29$) and 1.3–1.6 kHz ($\bar{x} = 1.4$, $SD = 0.1$, $N = 29$), respectively. Call 2 was not examined for individual differences.

Gravel Call is composed of harsh rasping notes which are spectrographically similar to the notes of Call 1 although of shorter duration and with emphasis of different harmonics (Fig. 1c). The latter may explain its harsh sound. Gravel Calls were heard infrequently and only in situations in which Gila Woodpeckers appeared to be greatly agitated. One such instance involved the arrival of several Starlings in the nest cavity tree of a pair with young. This call was recorded too infrequently to permit a detailed analysis of it.

Combination Call consists of a first note similar to the notes of Call 1, followed by several notes similar to the notes of Call 2 (Fig. 1d). This may be an example of "ambivalent behavior" (Hinde, Animal behavior. A synthesis of ethology and comparative psychology, McGraw-Hill, New York, 1970), which is a single behavior containing components of conflicting tendencies (e.g., self-advertisement and alarm). I heard it only twice, both times while a male was being harassed by humans.

While some woodpeckers give as many as 13 different vocalizations (Ligon, Auk 87: 255–278, 1970), Gila Woodpeckers regularly use only 2. The 2 other calls in their repertoire, which are given only infrequently (Gravel Call and Combination Call), are either permutations or combinations of these calls. Despite these facts, vocalizations appear to be the Gila Woodpecker's most important form of communication. These calls could encode considerable information by variation in the number of notes in a sequence and also by variation in the intensity (sound pressure level) of notes. The behavioral context in which calling occurs (e.g., accompanying visual displays) can be altered as well.

In discussing individual recognition in passerines, Falls (Proc. 13th Int. Ornithol. Congr., pp. 259–271, 1963) indicated that there may be greater variance in frequency components than in temporal components of songs. Of the latter, the duration of notes may contain more variance than the interval between notes. Recently, Brooks and Falls (Can. J. Zool. 53:1749–1761, 1975) experimentally demonstrated that in White-throated Sparrows (*Zonotrichia albicolis*) individual recognition is based on frequency rather than temporal components of songs. There is evidence that the general rules concerning variance of passerine song components apply to Burrowing Owls' (*Athene cunicularia*) primary song, as well (Martin, Auk 90:564–578, 1973).

The most variable components of the Gila Woodpecker's location call (Call 1) are the duration of notes and the minimum frequency of notes, in that order. Information about an individual's identity may be contained in either the overall frequency sweep of its vibrato notes or in the minimum frequency itself. Based on the results presented here it appears that a temporal component (the length of notes) may be important in individual recognition in this picine species. In this respect, Gila Woodpeckers appear to resemble larids and alcids (Beer, Adv. Study Behav. 3:27–74, 1970). These findings suggest that they may use an alternate means of individual recognition than is found in passerines and owls.

I am grateful to J. D. Ligon for his help with this study. I would also like to thank S. Alexander who was invaluable in helping to analyze sound spectrographs and J. A. King who read an earlier draft of this manuscript. This research was supported by grants from the Josselyn Van Tyne Fund of the American Ornithologists' Union and the Student Research Allocations Committee of the Graduate Student Association of the University of New Mexico.—GENE L. BRENOWITZ, *Dept. Anatomy, The Medical College of Pennsylvania, 3300 Henry Ave., Philadelphia, 19035.* *Accepted 11 Jan. 1977.*

Wilson Bull., 90(3), 1978, p. 455

An aggressive encounter between a Pintail with a brood and a Franklin Gull. —Gulls are known to prey upon waterfowl nests (Odin, Auk 74:185–202, 1957). Recent studies, however, have shown that insular nesting ducks have high hatching success but low fledging rates when nesting in association with larids (Vermeer, Wilson Bull. 80: 78–83, 1968; Dwernychuk and Boag, Can. J. Zool. 50:559–563, 1972). Dwernychuk and and Boag (op. cit.) suggested that gulls provide protection for nesting ducks by mobbing potential avian egg predators, but that adult gulls kill newly hatched ducklings when their young are able to consume prey of such size. Most predation occurs while young ducklings are on open water.

On 21 June 1976 we observed an aggressive encounter between a female Pintail (*Anas acuta*) with a brood and a Franklin Gull (*Larus pipixcan*) near Boissevain, Manitoba. The brood of 5 downy young swam from emergent cover onto a pond of about 15 ha. Other dabbling ducks were present as were about 200 Franklin Gulls. Our attention was diverted from the brood momentarily, and although we did not see a gull attack the brood, a fight ensued. The Pintail hen held the gull in her bill, beat it with her wings, and kept it partially submerged for about 5 min. Meanwhile, the brood swam to a group of adult ducks and remained there in a tight group. No gulls attacked the brood in the absence of the hen. The Pintail returned to her young at the end of the fight and they re-entered emergent cover. The Franklin Gull, although not dead, had difficulty swimming and appeared to have suffered a broken wing. We suggest that some individual ducks do recognize gulls as being dangerous and give this observation as evidence of brood defense.—GEORGE HOCHBAUM AND GARTH BALL, *Canadian Wildlife Service, 501 University Crescent, Winnipeg, Manitoba.* *Accepted 30 Mar. 1977.*

Wilson Bull., 90(3), 1978, pp. 455–456

Canada Goose-Great Blue Heron-Great Horned Owl nesting associations.— While conducting nesting studies of Great Basin Canada Geese (*Branta canadensis moffitti*) along Rufus Woods Reservoir on the Columbia River in Okanogan and Douglas counties, Washington, we witnessed an interesting series of successful displacements of nesting Great Blue Herons (*Ardea herodias*) by Canada Geese. This appears to be the first such account of nesting displacements between geese and herons, although Craighead and Stockstad (J. Wildl. Manage. 25:363–372, 1961) observed different amounts of tree nesting by Canada Geese between years and felt this difference was due to a