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GENERAL NOTES

Evidence for vocal learning in prairie grouse.—Vocal learning may be defined as the ability of an individual to develop or modify songs or calls through reception of external stimuli. The phenomenon has been studied primarily in passerines and parrots but may occur in other groups. Nottebohm (Am. Nat. 106:116–140, 1972), however, suggested that learning was restricted to only a few taxa and specifically mentioned galliforms as a group in which it was not expected. Reasons for this supposed absence included proximity to early avian ancestors (with the assumption that vocal learning is recently evolved), apparent genetic rigidity in domestic chicken (*Gallus* sp.) vocalizations (Schjelderup-Elbe, Z. Psychol. 92:60–87, 1923; Konishi, Z. Tierpsychol. 20:349–367, 1963), and simple syringeal structure.

In this paper I describe circumstantial evidence for vocal learning in Greater Prairie Chickens (*Tympanuchus cupido*) and Sharp-tailed Grouse (*Pedioecetes phasianellus*) and discuss its potential significance. The evidence comes from a study of behavior and isolating mechanisms between the species in northwestern Minnesota (Sparling, unpubl.).

Observations were made from blinds located on peripheries of 4 display grounds during the breeding seasons of 1975–1978. Additional observations were made on 1 F1 hybrid, 5 prairie chicken and 8 sharptail males raised in captivity from hatching. Display grounds were named for local landmarks and included the Pankratz (1 F1 hybrid, 14 prairie chicken males), Pembina (1 F1 hybrid, 1 sharptail and 22 prairie chickens), WTymp (1 F1 hybrid, 1 sharptail and 5 prairie chickens) and TJct (5 sharptails with an F1 hybrid visiting for 2 weeks in 1975). Of the birds discussed in this paper, all captives, all wild sharptails and 8 wild prairie chickens were individually banded. Although none of the F1 hybrids were banded, they could be readily recognized by plumage and behavioral peculiarities.

Vocalizations were recorded at 19 cm/sec with a Uher 4000 Report-L tape recorder and Uher omnidirectional and Sennheiser ultra-unidirectional microphones. A Kay Elemetrics Co. 7029-A sound spectrograph set at 20-2000 and 40-4000 Hz ranges, with wide and narrow band settings, was used for sound spectrograms. Playbacks were made with a Uher 4000 Report-L tape recorder and Nagra DH speaker-amplifiers set within the centers of territories.

Evidence for vocal learning came from 3 independent sources. First, all male prairie chickens were heard to imitate a 3-note call that was characteristic of hybrids. The call was initially heard in 1975 from male hybrids on the Pankratz and TJct display grounds and subsequently from all F1 hybrids throughout the study. However, it was not heard from prairie chickens until late May 1976 when 1 bird on the Pankratz display ground gave it. By late spring 1977 all male prairie chickens on the Pembina and most of those on the Pankratz and WTymp display grounds used it in agonistic encounters. All captive male prairie chickens housed with a subdominant hybrid male since hatching also gave the vocalization, but prairie chickens on grounds without hybrids were never heard to give it. Prairie chicken 3-note calls were similar to "whines" (Fig. 1, Table 1); the major differences between these calls and those of hybrids included number of notes per bout, mean note duration, strongest frequency and a pronounced chevron form of frequency modulation in 3-note calls. Presumably, prairie chickens either learned the 3-note call or modified their "whines" to match the hybrids'.

The second example of learning was found in the "coos" of the Sharp-tailed Grouse. "Coos" are often used in advertisement and function as tonic signals. They are characterized by note durations of 0.22 ± 0.08 sec and internote intervals of 3.40 ± 4.09 sec (N = 11 individuals and 306 sequences). In some playback experiments I altered the normal temporal pattern of "coos" so that 2 notes were joined and a third preceded these by 0.09 sec (Fig. 2). Note durations were 0.17 and 0.35 sec, respectively. Thus, both internote interval and

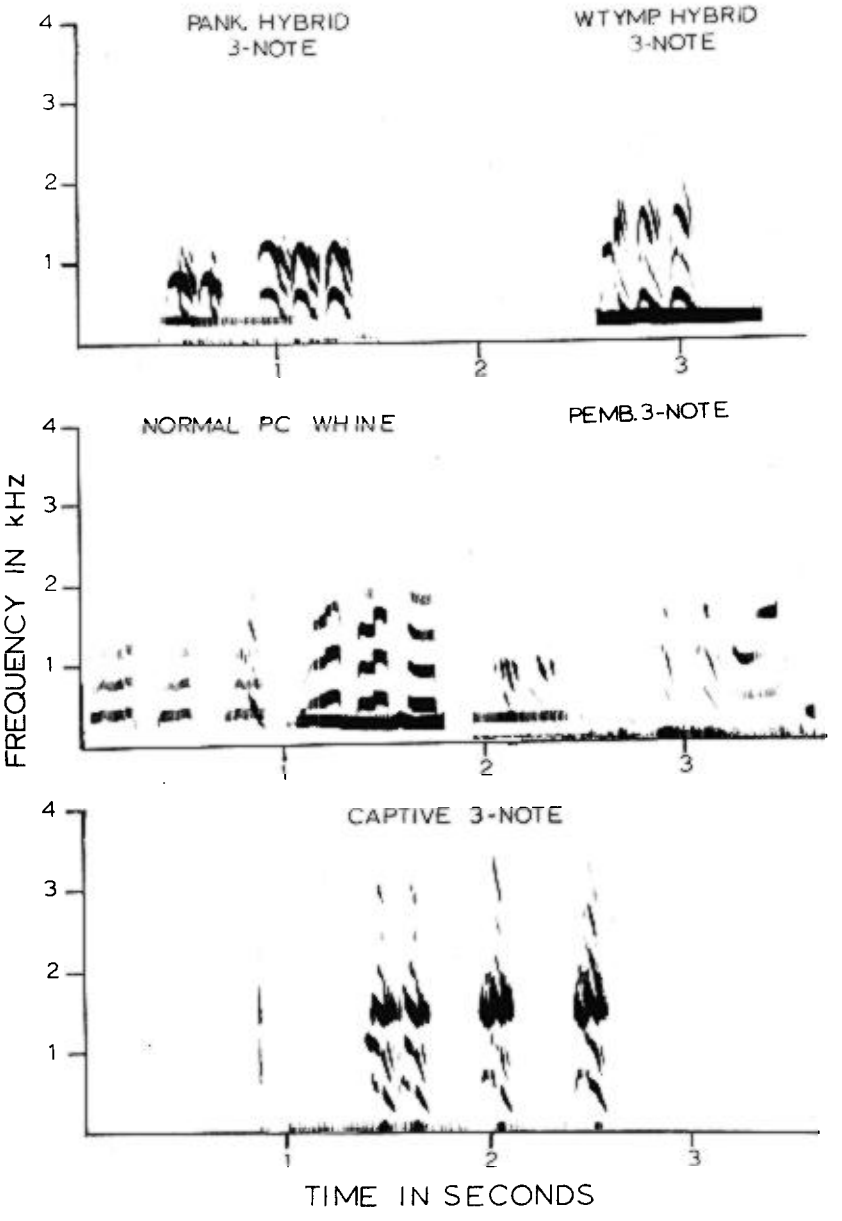

FIG. 1. Sound spectrograms of F1 (Pankratz and WTymp hybrid) and prairie chicken (Pembina and captive) 3-note calls and prairie chicken (Normal PC "whine") "whines." Dark lines near 300 Hz in Pankratz hybrid, WTymp hybrid and Normal PC "whines" are "booms" from other birds.

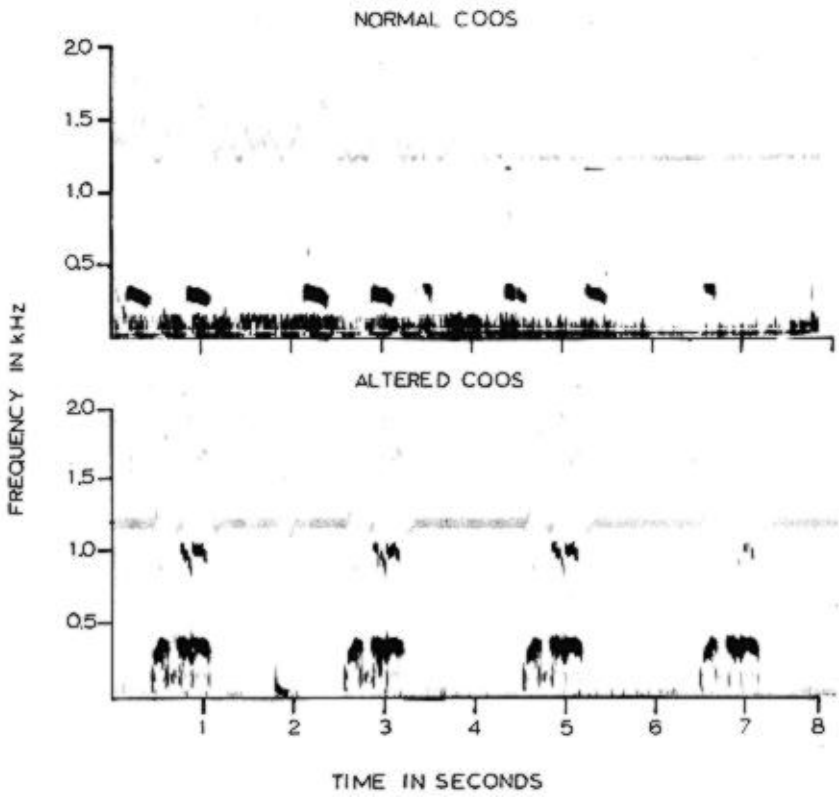

FIG. 2. Sound spectrograms of typical sharptail cooing and the altered playback of cooing. Light marks at top of sonagrams are amplitude displays.

note duration were outside the typical range for "coos." This altered sequence was played 8 times over a period of 5 days on the TJct display ground. During the sixth playback the male being tested mimicked the call so faithfully that his calls could not be distinguished from recorded ones.

The third example of learning was from hybrids. The Pankratz hybrid was on an all-prairie chicken display ground and, although he occasionally gobbled (a sharptail vocalization), most of his behaviors closely resembled those of prairie chickens. The WTymp hybrid, however, gave prairie chicken displays when confronting prairie chickens but switched to sharptail displays when fighting with the sharptail. Typical prairie chicken-like calls in this bird's repertoire were "whoops" and "cooms" (an abbreviated form of "boom"); sharptail vocalizations included "coos," "chilks" and "gobbles." The parentage of these hybrids was unknown but both appeared to be F1's based on their intermediate plumage.

Although the evidence presented here is not unequivocal, it indicates that prairie grouse may be able to learn some vocalizations and modify others through experience. Further

TABLE 1
CHARACTERISTICS OF 3-NOTE CALLS AND "WHINES" FROM HYBRIDS AND PRAIRIE CHICKENS

Characteristic		Pankratz hybrid 3-note (N = 9)[c]	WTymp hybrid 3-note (N = 20)	Prairie chicken 3-note (N = 34)	Prairie chicken "whines" (N = 42)
Number of notes	$\bar{x}$	3.24	3.33	2.83	9.24
	SD	0.01	1.03	0.39	9.10
Note duration[a]	$\bar{x}$	0.15	0.27	0.28	0.19
	SD	0.01	0.05	0.06	0.06
Internote interval[a]	$\bar{x}$	0.03	0.12	0.11	0.20
	SD	0.02	0.13	0.07	0.09
Strongest frequency[b]	$\bar{x}$	501	904	1547	989
	SD	52	190	17	542
Frequency modulation[b]	$\bar{x}$	338	258	122	281
	SD	43	199	63	155

[a] Temporal measurements in sec.
[b] Frequency measurements in Hz.
[c] Reported N are for number of sequences analyzed; 12 and 9 prairie chickens were used for 3-note calls and "whines," respectively.

research is needed before the importance of learning in these species is understood, but some speculation is possible. Vocal learning in these species suggests that their communicatory behavior is more plastic than predicted. Further, learning could promote dialect formation among display grounds which would facilitate recognition of strangers. This recognition may reduce overt aggression among regularly attending males. Interspecific territoriality could also be enhanced by imitation of heterospecific aggressive signals as suggested by the imitation of 3-note calls by prairie chickens and by behavioral switching in the hybrid.

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Common Redpolls using spruce seeds in northern Utah.—During winter in the United States and southern Canada, the Common Redpoll (*Carduelis flammea*) generally is considered a bird of open woodlands, weed patches, fields, and brushy fence rows, where