FIELD TECHNIQUES FOR DETECTION AND EVALUATION OF CROP GLAND ACTIVITY IN MOURNING DOVES

R. E. MIRARCHI,[a] Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061

P. F. SCANLON, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061

N. L. SCHAUER,[b] Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061

Abstract: Two field techniques were developed to detect and evaluate crop gland activity in live mourning doves (*Zenaida macroura*). An inexpensive, commercially-produced "inspection light" was successfully used as a crop examination device (CED). Crops of 45 adult and 40 juvenile doves of both sexes were examined by palpation and CED. There was a significant ($P < 0.001$) dependence of test score upon crop phase; a significant ($P < 0.001$) difference also occurred between test procedures used. Best results were obtained when palpation and the CED were used together. Under these circumstances, active, inactive, and developing or regressing crops were classified correctly 100, 96.5, and 77.8% of the time, respectively.

Proc. Ann. Conf. S.E. Assoc. Fish & Wildl. Agencies 32: 75-81

The mourning dove is a popular species among consumptive and nonconsumptive users of the wildlife resource. Mourning doves nourish their young with a milk-like substance regurgitated from the crop. Crop "milk" production is accompanied by anatomical changes in the crop wall of both parents which are readily observable with the naked eye in dissected specimens.

Current research on webless migratory birds funded by state and federal agencies has focused on the significance of late nesting in hunted members of the family Columbidae. Research is underway to examine the relationship between crop gland activity and reproductive activity. Consequently, field techniques for detection and evaluation of crop gland activity in living columbids have become increasingly necessary. Ziegler (1971), for example, used a cystoscope to establish the existence of a daily crop cycle in breeding band-tailed pigeons (*Columba fasciata*).

The objective of this study was to develop field techniques to detect and evaluate crop gland activity in live mourning doves. This project was funded by the Accelerated Research Program of the U.S. Fish and Wildlife Service in conjunction with the Virginia Commission of Game and Inland Fisheries. Technical assistance and advice from W. Morehead, C. Gooch, and D. Steffen is gratefully acknowledged.

MATERIALS AND METHODS

Field Techniques

The feasibility of using endoscopic equipment for field examination of mourning dove crops was first investigated. Secondly, an inexpensive, simple, portable apparatus which could be transported easily in the field was designed from various electrical components. The device consisted of a portable battery packet which could be switched on and off, a length of wire which extended from the batteries and was attached to a miniature lamp, and a piece of flexible plastic tubing attached at the lamp base and which encompassed the first 7-8 cm of wire. The plastic tubing provided the stiffness necessary to insert the lamp inside the crop. Total cost per unit was $8.50. A commercially-made

---

[a]Present address: Department of Zoology-Entomology, Auburn University, Auburn, AL 36830.

[b]Present address: Anaerobe Laboratory, V.P.I. & S.U., Blacksburg, VA 24061.

inspection light (AC/DC Electronics, Morton Grove, Ill., Fig. 1), also was tested for use as a potential crop examination device (CED). The light was functionally similar to the device developed during the project. The cost at the time of experimentation was $3.25 complete with batteries, but without plastic tubing. Plastic tubing was not necessary due to the stiffness of the wire connecting the lamp to the battery packet. Finally, crops were palpated as being active or inactive by noting if a noticeably raised ridge was, or was not present, respectively, at the junction of the crop lobe and breast.

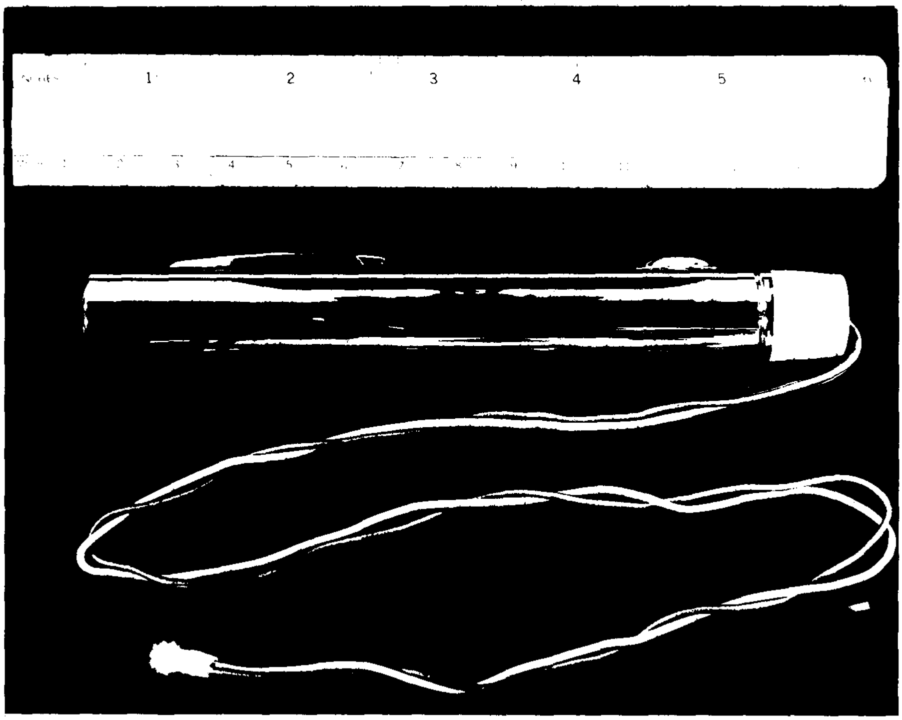

Figure 1. Commercially made "inspection light" (AC/DC Electronics, Morton Grove, Ill.) used as crop examination device (CED).

Crop examination consisted of feather removal from the crop lobe area, palpation of the crop lobes, and classification of the crop following insertion of the lighted lamp into the crop interior. Characteristic illumination patterns and light transmittance of different crop phases are illustrated in Fig. 2. Crops were classified in the following manner while using the CED:

1. *Inactive* – light transmitted through crop to exerior was of uniform intensity throughout the entire crop;

2. *Developing or regressing* – light transmitted through crop to exterior showed a slight reduction in intensity in lobe region compared to the mid-line crop region. Area of reduced light transmittance did not extend to mid-line;

3. *Active* – light transmitted through crop to exterior was greatly reduced in intensity in lobe region compared to the mid-line crop region. Area of reduced light transmittance extended to mid-line.

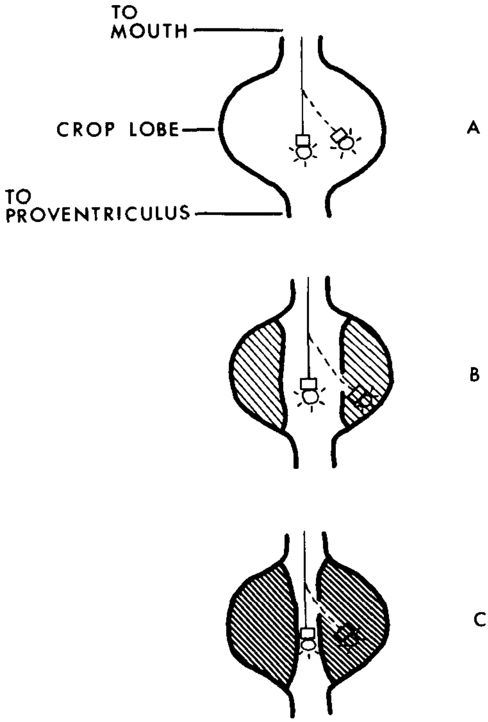

Figure 2. Characteristic illumination patterns and light transmittance of (A) inactive, (B) developing or regressing, and (C) active crops when crop examination device (CED) was used.

Mourning doves were trapped on the university farms during August and September 1977 and all adults and those juveniles which had replaced primary feathers 6 to 10 were held for examination. All doves were transported to the laboratory, held overnight in indoor cages, and were provided with water, but not feed, to allow for normal digestion of all crop contents. Each morning after the wild doves were trapped, beginning at 0830 hours, the crop of an adult nonbreeding dove from the captive colony was examined as previously described. This dove, which served as a control, was known to have no crop activity and allowed inspection of an inactive crop prior to examination of the wild birds. Crops of wild-trapped doves then were examined as previously described and each dove was sacrificed immediately thereafter. Each crop in the sacrificed specimens was classified as inactive, active, or developing/regressing based on criteria outlined by Mirarchi (1978). The results of crop classification post-sacrifice then were compared with the data obtained by palpation and CED examination.

Statistical Analysis

Data were analyzed using a 3-way G-test of independence and *a priori* tests of partitions as described by Sokal and Rohlf (1969:601). Dove crops were classified according to crop phase, CP (Inactive, I; Developing or Regressing, D/R; and Active, A); Test Score, TS (right or wrong classification when compared to post-sacrifice classification); and test device, TD (palpation or CED).

RESULTS

Equipment Investigated

Endoscopic equipment used by clinicians was found to be prohibitively expensive and complicated for field use and the original apparatus designed by the investigators lacked the portability to justify its added expense. The commercially-made inspection light, however, provided results identical to the device originally constructed from various electrical components and was less expensive. The commercially-produced CED was lightweight and could easily be carried in the investigator's pocket while in the field. Crop examination with the CED was best accomplished by two individuals (one holding bird, one examining crop) working together. The CED could be used by 1 individual, but this method was much less efficient when used without a holding device. One of 85 (1.2%) doves examined with the CED died as a result of trauma inflicted by the device.

Techniques Investigated

Results of tests conducted on mourning doves for the presence of crop-gland activity, when plapation and the CED were considered separately seemed to indicate a difference in success of crop classification between juvenile and adult age classes (Table 1). The test devices used and crop phase were found to be independent, but the test of independence between test score and crop phase was significant ($P < 0.001$) (Table 2). This significant test statistic was further subdivided into separate *a priori* constrasts in order to learn more precisely the nature of this lack of independence. Tests of score against 2 different crop phase combinations were significant (A vs. D/R, $P < 0.001$; I vs. D/R. $P < 0.01$). Additionally, significant tests of independence were found between têst device and test score ($P < 0.001$), and the 3-factor interaction between crop phase, test score, and test device. The overall test of independence (CP x TS x TD) also was significant ($P < 0.001$).

Table 1. Results of tests conducted on adult and juvenile mourning doves for the presence of crop gland activity, when palpation and a crop examination device were considered separately.

Age	*No. examined*	*Palpation score (PS)*	*Crop device score (CDS)*	*Post-sacrifice score*	*Percent error (+ or -) PS*	*Percent error (+ or -) CDS*
Adult	45	I[a] (28)[d]	I (22)	I (20)	+ 40.0	+ 10.0
		A[b] (17)	A (14)	A (16)	+ 6.3	- 12.5
		D/R[c] (0)	D/R (9)	D/R (9)	- 100.0	nil
Juvenile	40	I (38)	I (37)	I (37)	+ 2.7	nil
		A (2)	A (2)	A (2)	nil	nil
		D/R (0)	D/R (1)	D/R (1)	- 100.0	nil
Both	85	I (66)	I (59)	I (57)	+ 15.8	+ 3.5
		A (19)	A (16)	A (18)	+ 5.6	- 11.1
		D/R (0)	D/R (10)	D/R (10)	- 100.0	nil

[a]Inactive

[b]Active

[c]Developing or Regressing

[d]Numbers in parentheses represent sample sizes.

Table 2. Summary of 3-way G-test of independence and *a priori* tests of partitions conducted on dove crops using palpation and CED techniques.

Hypothesis tested[a]	*df*	*G-statistic*
TD x CP independence	2	0.068
TS x CP independence	2	18.911**
A vs. D/R[b]	1	12.661**
I vs. D/R	1	8.878*
TD x TS independence	1	11.698**
TD x CP x TS interaction	2	20.885**
TD x CP x TS independence	7	51.562**

[a]TD = Test Device; CP = Crop Phase; TS = Test Score.

[b]A = Active Crop; I = Inactive Crop; D/R = Developing/Regressing Crop.

* ($P < 0.01$).

** ($P < 0.001$).

Crop classifications were 100% (15/15) correct when palpation, jointly with the CED, indicated an active (+) crop (Table 3). Similarly, crop classifications were 96.5% (55/57) correct when palpation and the CED both indicated inactive (-) crops. Developing or regressing crops were found 75% (6/8) of the time at necropsy when palpation indicated an inactive crop (-) and the CED showed a developing or regressing crop phase. These data can be pooled further to show that when palpation indicated an

Table 3. Results of tests conducted on adult and juvenile mourning doves for the presence crop gland activity, when palpation and a crop examination device were considered in combination.

Crop score pre-sacrifice			*No. (%) scored post-sacrifice*		
No. examined	*PS*[a]	*CDS*[b]	*I*[c]	*D/R*[d]	A[e]
15	+	A	nil	nil	15 (100.0)
2	+	I	nil	1 (50.0)	1 (50.0)
2	+	D/R	nil	nil	2 (100.0)
1	-	A	nil	1 (100.0)	nil
57	-	I	55 (96.5)	2 (3.5)	nil
8	-	D/R	2 (25.0)	6 (75.0)	nil
Totals					
I	66	59	57	---	---
D/R	0	10	---	10	---
A	19	16	---	---	18

[a]Palpation Score (+ = Active; - = Inactive).

[b]Crop Development Score.

[c]Inactive.

[d]Developing or Regressing.

[e]Active.

active (+) crop and the CED indicated *any type of activity*, crops were correctly classified as *active* 100% (17/17) of the time. Similarly, when palpation indicated an inactive crop (-) indicated *any type of activity*, crops were correctly classified as *developing* or *regressing* 77.8% (7/9) of the time.

Test results, when palpation and the CED were considered in combination (Table 3), compared to results obtained when palpation and the CED were considered separately (Table 1), indicated substantial differences at some crop phases. Classification of inactive crops resulted in an error rate of -3.5% (combination) compared to 15.8 (palpation), and 3.5 (CED) % error rates (separately). Similarly, classification of active crops resulted in an error rate of 0.0% (combination) compared to 5.6 (palpation), and -11.1 (CED) % error rates (separately). Classification of D/R crops resulted in an error rate of -22.2% (combination) compared to -100.0 (palpation), and 0.0 (CED) % error rates (separately).

DISCUSSION

Equipment Investigated

The commercially-produced CED (Fig. 1) is recommended for use in future field examinations of mourning dove crops. Crop examination with the CED by one investigator probably could be facilitated by using a sleeve or jacket to hold experimental birds during examination. Such holding devices have been used successfully with different sized birds (Fredrickson 1970; Ziegler 1971; Evans and Kear 1972; Bolen et al. 1977). Additionally, use of emetics as described by Tomback (1975) should clear the crop of food materials for examination without the necessity of holding doves for extended periods. Emetics should be used with caution, however, since doves feed nestlings by regurgitation and the effects on nestlings fed by emetic-dosed parents are unknown.

One dove died during examination as a result of a ruptured blood vessel. A large hematoma was observed in the carotid-jugular region at necropsy. Such injuries can be minimized by careful insertion of the CED lamp into the esophagus. The control bird was examined numerous times without apparent ill effect. Feathers plucked from the breast of the control bird were replaced in 3 weeks.

Techniques Investigated

The apparent difference in success of crop classification between juvenile and adult age classes was a sampling artifact. Larger numbers of adult than juvenile doves with active and D/R crops were examined which biased the results. A larger number of D/R crops sampled in the adult age class increased proportionally the percent error of palpation score for inactive crops, since D/R crops usually palpated as inactive (Table 3). Consequently, data of both age classes were pooled for statistical analysis.

The dependence between test score and crop phase indicated some crop phases were classified with more accuracy than others. This dependence was apparent when results obtained by palpation and with the CED were compared across crop phases (Table 1). Percentage ererors differed markedly by crop phase when palpation ($A < I < D/R$) and the CED ($D/R < I < A$) were used separately. This relationship was verified by the *a priori* tests of partitions presented in Table 2. The significant differences that occurred when classifications of the extremes in the range of stages of crop activity (A or I) were compared to D/R crop classifications indicated that these extreme phases of crop activity were more easily detected than the D/R crop phases.

The dependence between test device and test score indicated that test accuracy at various crop phases was different depending upon the technique used (Table 2). This difference was appreciable when palpation and the CED were used separately (Table 1). The significant 3-factor interaction was not surprising since test scores were very dependent upon crop phase and test device used. The advantage of using palpation and the CED together is obvious when the data of Table 1 and Table 3 are compared.

We feel the best results in such future investigations would be obtained by using palpation and the recommended CED in combination. Additionally, the CED should be disinfected prior to field examination of each bead to prevent spread of disease organisms such as *Trichomona gallinae* or *Poxvirus avium* that may be present in the mouth, esophagus or crop. Proper use of a holding device and emetics should facilitate the entire procedure.

LITERATURE CITED

Bolen, E. G., J. S. Loven, and B. W. Cain. 1977. A holding sleeve for waterfowl. J. Wildl. Manage. 41(4):789-790.

Evans, M., and J. Kear. 1972. A jacket for holding large birds for banding. J. Wildl. Manage. 36(4):1265-1267.

Frederickson, L. H. 1970. A nylon belt for holding birds. Bird-Banding 41(3):242-243.

Mirarchi, R. E. 1978. Crop-gland persistence, parental care, and reproductive physiology of the mourning dove in Virginia. Ph.D. Thesis. Virginia Polytechnic Insstitute and State Univ., Blacksburg. 249 pp.

Sokal, R. R., and F. J. Rohlf. 1969. Biometry. W. H. Freeman and Co., San Francisco. 776 pp.

Tomback, D. F. 1975. An emetic technique to investigate food preferences. Auk 92(3):581-583.

Ziegler, D. L. 1971. Crop-milk cycles in band-tailed pigeons and losses of squabs due to hunting pigeons in September. M.S. Thesis. Oregon State University, Corvallis. 48 pp.