THE NUMBER OF EGGS LAID BY COWBIRDS

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The number of eggs laid by an individual cowbird is difficult to ascertain in those species which deposit their eggs parasitically in the nests of other birds. It is practically impossible to follow an individual cowbird closely enough to find every egg laid in a season. Nevertheless, by utilizing several techniques, we have accumulated sufficient information to reach a tentative conclusion concerning the number of eggs laid by one individual.

In order to outline the background of the subject it seems desirable to review the literature in some detail. Friedmann's book (1929), from which the following is compiled, is a storehouse of information derived from extensive field work. The cowbird group contains several species distributed in the western hemisphere, and demonstrates the evolution of parasitism. Agelaioides badius, an Argentine species, is the most primitive and incubates its own eggs. However, it does not build its own nest but remakes old nests of other species to raise its young. According to Friedmann individual birds lay five eggs and are single brooded; the height of the breeding season is January or February. The next species in this evolutionary series is Molothrus rufo-axillaris which parasitizes only A. badius. It probably lays five eggs at daily intervals. A third species, Molothrus bonariensis, parasitizes many species of birds and occurs throughout South America. According to Friedmann the birds lay daily and several may use one nest. Hudson (cited by Friedmann) believed that each female laid between 60 and 100 eggs in a season, but Friedmann suggests that 6 to 10 is a more likely number.

Our North American Cowbird, *Molothrus ater*, is the best known species. The birds lay daily and Friedmann (p. 182) reported that two birds laid five eggs each and one bird laid four eggs. He is convinced that these individuals did not lay more eggs in that season. He sectioned the discharged follicles of the ovary of several females and found no more than five empty follicles present in any one ovary. Apparently he did not make serial sections of the entire ovary. Although this evidence suggests that only five eggs are laid in a season, there is, in contrast, a record, quoted by Friedmann, of a captive cowbird which laid 13 eggs in 14 days. It is suggested that the cowbirds are possibly in transition between the determinate and indeterminate types of oviposition. In the former type a definite number of eggs is laid whereas in the latter the number laid depends on various external conditions.

In addition to Friedmann's work, Nice (1937:164), while studying the Song Sparrow, obtained much information about cowbirds. Her data are not conclusive but do suggest her belief that cowbirds lay 3 or 4 sets with intervals of 6 to 12 days between sets. However, if we assume that each female lays only five eggs in each set and lays at daily intervals, Nice's table must be rearranged, leading to the conclusion that the interval between clutches is as short as three days.

Information concerning the number of eggs laid by an individual may be obtained by sectioning the entire ovary. The following data were obtained from the study of serial sections cut at 10 or 20 μ and stained in Mallory's triple stain. Before discussing the number of eggs it is necessary to mention the condition of the ovary. After ovulation the post-ovulatory follicle regresses through a series of histological changes as described by Davis (1942a). A study of the microscopic structure of the follicle permits a determination of the age of the follicle up to about five days. The histological changes are less distinct in older follicles and therefore the age in days can no longer be determined. However, the relative age can be stated. In studying the ovary one must be

careful not to confuse the burst atretic follicles (Davis, 1942b) with the postovulatory follicles.

The table gives the number (indicated by the total number of stage symbols) and stages (I-XIII) of the follicles for 11 individuals of *M. bonariensis*, and one each of *M. rufo-axillaris* and *A. badius*. Several more ovaries were sectioned but contained only unripe follicles or completely regressed postovulatory follicles. It should be remembered, as mentioned above, that the first 6 numbers refer to daily stages while the higher numbers merely denote histological stages of regression. The period of time between stage VI and VII is not known but is probably more than one day. Number I refers to eggs which burst out of the ovary at the time the bird was shot; these eggs were probably ready for ovulation.

Number and stage of postovulatory follicles present

Molothrus bongriensis															
No.														Date	Location of Egg
A6		IIC	IIIC	IVO	C V			VIII	IX	\mathbf{x}				Nov. 5	
A11	I	IIC	IIIC	IVO	2				IX					14	
A12		IIB	IIIB											14	shell gland
A13		IIA	IIIA	IVA	VA	VIA			IX	\mathbf{x}				15	oviduct
A16	I	IIB					VII	VIII					XIII	17	shell gland
A21		IIA	IIIA	IVA	VA		VII	VIII	IX					29	oviduct
A26									\mathbf{IX}					Dec. 7	
A33		IIA	IIIA	IVA	1									10	oviduct
A38		IIA				VII					ΧI			14	oviduct
A39		IIB									XΙ	$\mathbf{x}\mathbf{I}\mathbf{I}$	XIII	14	shell gland
A52		IIC	IIIC				VII	VIII						15	
Molothrus rujo-axillaris															
A42		II	ш	IV					IX	\mathbf{x}	ΧI			14	
	A gelaioides badius														
A53		II	III	IV	V	VI							XIII	17	albumen gland

Some general remarks concerning certain individuals are desirable. It is to be noted that in no case is there a continuous series of more than five eggs. A13 had just completed its second clutch, while A6 and A21 had one more egg to lay. A12 apparently is just starting its first clutch. In A21 there apparently was a short time between the two clutches; the interval is certainly two days and probably three. A39 apparently had a long interval between the two clutches. It should be noted that M. rufo-axillaris and A. badius lay more than one clutch, contrary to the information formerly available.

It will be noted that in the older clutches there are less postovulatory follicles than would be expected, since four or five eggs is the normal number per clutch. No explanation appears completely satisfactory. Several possibilities occur: (1) the first clutch may have fewer eggs than later clutches; (2) the laying may have been interrupted by environmental factors; (3) part of the ovary might have sloughed off, as has been recorded (Hutt, 1939; Parker and Kempster, 1940), thereby carrying some post-ovulatory follicles with it; perhaps this phenomenon is more common than suspected.

Summary and Conclusions.—A review of the literature concerning oviposition in cowbirds showed that due to the inherent difficulties of studying a parasitic bird the available information was inconclusive. However, certain data did suggest that four species of cowbirds (Agelaioides badius, Molothrus rufo-axillaris, M. bonariensis, and M. ater) lay eggs in clutches of four or five.

A histological study of serial sections of the entire ovary of 11 specimens of M. bonariensis and one each of M. rufo-axillaris and A. badius shows that these species lay eggs in clutches and that the maximum number of eggs per clutch is five.

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