

Hatchability, clutch position, and hatching sequence in Mallards.—Kendeigh (Auk, 80: 453, 1963) has shown for the altricial House Wren (*Troglodytes aedon*) that a clutch hatches in the sequence in which the eggs were laid. To our knowledge, no such data are available for precocial species, though it is known that hatching occurs during a brief span of time. Presented here are data on hatchability and the association between clutch position and hatching sequence for artificially incubated Mallard (*Anas platyrhynchos*) eggs.

Experiments were conducted at the Delta Waterfowl Research Station during spring and summer in 1965, 1966, and 1967. Each afternoon in 1965 we checked 90 nest boxes used by resident free-winged Mallards and marked the fresh eggs. The clutches were collected the day after the last egg was laid and incubated artificially in a Jamesway still-air incubator at 37.5°C and 70–80 per cent humidity. They were hand-turned four times daily. All eggs from a clutch were incubated together and, upon pipping, were placed in an individual hatching tray (9 × 9 cm). Data were obtained for the period, in hours, from the time an egg was placed in the incubator until the ducklings hatched.

In 1966 progeny from the 1965 hatch were placed in seven 4- × 8-m breeding pens with piles of straw and other vegetation available for nest sites. Each breeding pen, containing one male and three females, was inspected each afternoon and eggs were handled similarly to those in 1965. In 1967 progeny from the 1966 hatch were placed in 14 2- × 4-m breeding pens, each containing one male and two females. Techniques were similar to those used in 1965 and 1966, except that clutches were collected on the 6th afternoon after the last egg was laid rather than on the 2nd afternoon.

Table 1 gives percentage hatchability by years. Hatchability of eggs collected from nest boxes in 1965 was significantly ($P \leq 0.01$) higher than for eggs handled in the same manner but collected from breeding pens in 1966. When the 1966 and 1967 hatchabilities are compared, the significantly ($P \leq 0.01$) greater percentage in 1967 indicates that the increased time clutches were allowed to remain with the hen was an influencing factor. While we recognize that years and treatments are confounded in these comparisons, observations from other clutches suggest that hatchability may be increased by natural incubation during the early phases of embryonic development. Length of incubation period and emergence times are discussed in detail by Prince (Inheritance of fecundity and embryonic and juvenile growth in Mallard ducks, unpublished Ph.D. dissertation, Blacksburg, Virginia Polytechnic Inst., 1968).

A correlation between position in the clutch and time to hatching was calculated for each clutch from which seven or more ducklings hatched. The correlation coefficients were converted to z values, tested for heterogeneity (all were homogeneous),

TABLE 1
HATCHABILITY OF ARTIFICIALLY INCUBATED MALLARD EGGS AND THE CORRELATION
BETWEEN ORDER OF LAYING AND HATCHING

Year	No. fertile eggs	Ducklings hatched		Relationship between order of laying and hatching	
		No.	Per cent	No. clutches	r
1965	140	96	69	7	0.89 ¹
1966	228	118	52	10	0.89 ¹
1967	426	316	74	29	0.91 ¹

¹ $P \leq 0.01$.

and pooled to give an average correlation for each year (Snedecor, Statistical methods, Ames, Iowa State Univ. Press, 1956). As shown in Table 1, the correlations between order of laying and hatching time were significant ($P \leq 0.01$) and positive each year, indicating that the first eggs laid were first to hatch. Comparisons of average correlations among years show a close similarity and demonstrate that 80 per cent of the variation observed in hatching sequence is due to the position of eggs in the clutch.

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Starlings bred in captivity.—During the spring of 1967 the author succeeded in breeding a single pair of captive Starlings (*Sturnus vulgaris*). The birds were captured as adults during the winter of 1965–66 among some 100 Starlings used for anti-fertility studies by the Department of Conservation at Cornell University, Ithaca, New York. Following their use in a bait-acceptance trial, about 50 birds were placed in outdoor flight cages where they remained for more than a year. On 5 May 1967 an adult male and an adult female were removed from this group cage and placed in an aviary cage 8 feet long, 6 feet wide, and 6 feet high, sheltered by a partial roof and containing an empty wooden nesting box and several perches. A quail breeder ration and water were provided ad libitum, and nesting materials of straw, assorted green vegetation, and pine needles were also added.

At the time the pair were separated out from the main cage, their bills resembled those of wild Starlings in breeding condition as reported by Wydoski (Auk, 81: 542, 1964), except that they were a creamy-yellow instead of bright yellow. This fading of bill color, which I have noted in all other Starlings in captivity, may reflect some dietary deficiency.

Between 5 and 13 May the birds built in the nest box a 6-inch nest almost entirely of pine needles, except for a few pieces of green vegetation at the very bottom. They used none of the straw, and whether both members of the pair took part in nest-building is unknown.

Periodic examination of the nest showed that little or no material was added to the nest after 13 May. On the morning of 24 May, the nest cup contained a single egg, and on 27 May the last of a clutch of four eggs was laid. Subsequent observations at almost daily intervals showed incubation ensuing normally. On the morning of 7 June three young had hatched, and the fourth hatched shortly thereafter on the same day. When the box lid was raised, the nestlings stretched out their necks, gaped, and cheeped faintly.

Commencing on 31 May, a high-protein mash was placed in the cage as a source of high energy nestling food, but though the adults ate this mixture (by weight, 20% cereal, 20% tripe, 20% cod, 15% beef lungs, 10% cottage cheese, 10% cooked eggs, 5% beef liver), they did not feed the nestlings. By 8 June all four young had died. Their weights all fell within the range Kessel (Amer. Midl. Naturalist, 58: 298, 1957) reports for Starlings weighed within one day of hatching.

Previous attempts by the author to breed freshly captured Starlings have failed. Of three such pairings, none tried to build a nest. Apparently acclimatization for an