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# BREEDING CHRONOLOGY OF MOTTLED DUCKS IN A TEXAS COASTAL MARSH

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Abstract.—The relationship between breeding chronology of Mottled Ducks (*Anas fulvigula fulvigula*) and wetland conditions at San Bernard National Wildlife Refuge was examined over a 3-yr period. Median nest initiation dates varied by as much as 68 d among years. Initiation occurred earlier in 1985 and 1987 versus 1986 ($P < 0.05$). Nesting initiation was not associated with winter and spring temperatures, but late nesting occurred in 1986 following low rainfall during fall and winter. Low rainfall caused low water levels in all marsh types. Water levels and wetland availability may influence nesting dates by limiting the food resources available to prenesting and nesting Mottled Ducks.

**CRONOLOGÍA REPRODUCTIVA DE *ANAS FULVIGULA* EN UN ANEGADO COSTANERO DE TEXAS**

Sinopsis.—A lo largo de un período de tres años se estudió la relación entre la cronología reproductiva de individuos de *Anas fulvigula* y las condiciones de un anegado en el Rufugio Nacional de Vida Silvestre de San Bernard. La fecha media de comienzo de la reproducción varió tanto como 68 d entre los tres años de estudio. Esta ocurrió más temprano en el 1985 y 1987 al compararse con el 1986 ($P < 0.05$). El inicio de la reproducción no se pudo asociar a las temperaturas del invierno y la primavera, aunque hubo anidamiento tardío en 1986 posterior a baja precipitación durante el otoño y el invierno. La poca lluvia causó bajos niveles de agua en todos los tipos de anegados. Los niveles de agua y disponibilidad de anegados, pueden influir en las fechas de anidamiento, al limitar la disponibilidad de recursos alimentarios a patos que anidan o estan por anidar.

Nesting chronology of waterfowl in temperate regions has been associated with spring temperatures (Cowardin et al. 1985, Hammond and Johnson 1984, Sowls 1955). Mallards (*Anas platyrhynchos*) and Northern Pintails (*Anas acuta*) arrive on their breeding grounds in early spring when wetlands are at least partly frozen and temperature directly affects the availability of wetlands (Sowls 1955).

Mottled Ducks (*Anas fulvigula fulvigula*) occur in the near-subtropical climate of the Texas and Louisiana Gulf coasts where wetlands are not subject to prolonged periods of freezing. Water levels and the availability of wetlands in the region are extremely variable, due to precipitation patterns and the unpredictable occurrence of tropical storms and hurricanes. I hypothesized that the availability of wetlands influenced the nesting chronology of Mottled Ducks. Therefore, precipitation patterns and water levels as they related to wetland availability should have been more closely related than temperatures to the nesting chronology of Mottled Ducks. I examined nest initiation dates and their relationship to habitat conditions at a single location, on the Upper Texas Coast over a

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3-yr period. My approach was to determine nesting chronology, examine its relationship to climatic factors (temperature and rainfall) and correlate climatic factors with wetland conditions.

## STUDY AREA AND METHODS

San Bernard National Wildlife Refuge, 10 km west of Freeport, Texas was the study area. The refuge boundaries encompassed approximately 9230 ha of coastal marshes and saline prairie adjacent to the Gulf of Mexico.

Mottled Ducks were counted using binoculars from a vehicle driven along a standardized, 7.2-km route. Each Mottled Duck was classified as paired, lone male, lone female or duckling, based on flock size, bill color and plumage characteristics. The minimum number of broods seen was determined by eliminating observations that might have duplicated a sighting on an earlier survey (Blankenship et al. 1953). Surveys were conducted biweekly February–September 1985 and 15 Jan. 1986–15 May 1987 beginning at sunrise or 2.5 h before sunset.

During each survey, water levels were recorded from staff gauges in impounded-fresh, brackish and saline marsh types. Temperature data for Freeport, Texas (the nearest recording station), were obtained from National Climatic Data Center (NOAA, U.S. Dept. Commerce, Asheville, North Carolina). Rainfall total was measured and recorded at the Refuge headquarters.

Pursuit flights were used as an indicator of nesting activity (Allen 1981, Baker et al. 1984), and were counted during 2-h periods beginning at sunrise. Counts were made biweekly from 30 Jan. to 30 Jun. 1986 and 9 Jan. to 1 May 1987 when visibility was greater than 1.6 km. All counts were made from a dike 3 m above an impounded-freshwater marsh. In a typical pursuit flight, a solitary male chased a paired female into the air and her mate followed; the display ended as the solitary male quit the chase and the pair rejoined (Heinroth 1911).

Nest searches were conducted each year, 1985–1987. Nests were located using a cable-chain device (Higgins et al. 1977) pulled between two "marsh buggies" or by observing Mottled Duck hens returning to nests. In 1985, searches were conducted 15–19 April and 17–18 June. On 17–18 Jun. 1985 we searched a small area of suspected use by renesters using two all-terrain cycles pulling a rope. Three searches were conducted at 4-wk intervals beginning 19 April in 1986 and 21 March in 1987. Approximately equal areas were covered during each search.

Nest initiation dates were determined by candling eggs (Weller 1956). At least two eggs from each nest were candled to determine the stage of incubation. Initiation dates were estimated by subtracting the incubation stage (d) and the number of eggs laid from the date the nest was found. Chronology was confirmed by visiting each nest on the projected hatching date, and by backdating broods using plumage descriptions by Stutzenbaker (1988).

Parametric statistics were not used for examining nest initiation dates because initiation and hatching dates were not distributed normally, and extremely early or late nests bias estimates of variance. Therefore, medians, 25th and 75th percentiles of initiation and hatching dates were used to characterize nest initiation dates. The median test included in the NPAR1WAY procedure was used to compare dates among years (SAS Institute 1988). Probabilities associated with pearson correlations ($r$) are based on $t$-approximations (Steel and Torrie 1980).

## RESULTS

*Breeding chronology.*—Pursuit flights were first observed in January each year, but peaked later (17 April vs. 20 March) and ended later (12 June vs. 15 May) in 1986 than in 1987. The interval during which pursuits were seen during each biweekly observation period began approximately 10 wk (67 d) earlier in 1987 than in 1986 (i.e., 17 Apr.–29 May 1986 and 20 Feb.–1 May 1987).

Nest initiation dates varied widely among years (Table 1). The median dates in 1985 and 1987 were 68 d and 43 d earlier, respectively, than in 1986. The 25th and 75th percentiles of nest initiation did not overlap among years (Fig. 1).

The first lone females and broods were observed earlier in 1985 and 1987. First lone females were observed 8 wk earlier in 1987 than in 1986 (2 May 1986, 6 Mar. 1987). First broods were observed on 6 May 1985 and 27 Jun. 1986. Only one brood was observed in 1987 (3 April) though every discovered nest ($n$ = 17) was successful. The last flightless broods were observed on 2 Jul. 1985 and 19 Sep. 1986.

Median hatching date of broods was 35 d earlier ($\chi^2 = 13.189$, $P < 0.05$) in 1985 (2 May, $n = 23$) than in 1986 (5 June, $n = 22$). The difference between hatching dates in 1985 and 1986 was similar whether determined by candling eggs or backdating broods (43 and 35 d, respectively).

*Climatic factors and wetland conditions.*—Nest initiation was latest in the year with the lowest total precipitation for the period October–February (i.e., 1985–1986). Cumulative and monthly precipitation recorded in these months was greatest in 1986–1987, followed by 1984–1985 and 1985–1986 (Fig. 2).

Mean daily temperatures February–May did not vary in relation to median nest initiation dates for Mottled Ducks. Mean daily temperatures were cooler during February 1986 and March of 1987, both years when nesting occurred early (Table 2). Temperatures were cooler in May 1986 in comparison to 1985 and 1987 ($P < 0.05$). Mean daily temperatures during April did not vary among years ($P > 0.05$).

Wetland availability was influenced by rainfall. The 2-wk rainfall totals preceding each survey, October–February 1986, were correlated ($P < 0.05$) with water levels recorded in impounded-fresh ($r = 0.58$, $n = 13$), brackish ($r = 0.78$, $n = 13$) and saline marshes ($r = 0.58$, $n = 12$). Unlike 1985 and 1987, most of the brackish marsh preferred by Mottled Ducks was completely dry during the late winter and early spring of 1986

TABLE 1. Median and range (d) of nest initiation dates of Mottled Ducks at San Bernard National Wildlife Refuge, Texas, 1985–1987.

| Year | *n* | Median[1] | Range |
|---|---|---|---|
| 1985 | 19 | 25 March | 25 |
| 1986 | 13 | 7 May | 42 |
| 1987 | 17 | 28 February | 35 |

[1] Median nest initiation dates differed among years ($\chi^2 = 25.74$, df = 2, $P = 0.05$).

(Grand 1988). Flood tides that occurred in early April 1986 inundated the entire brackish and saline marsh zones making them available again to prenesting and nesting hens. None of the nests found in 1986 was started before 2 April. By the same date in 1985 and 1987, 89% and 100%, respectively, of Mottled Ducks had begun laying.

## DISCUSSION

Poor detection of early nests in 1986 or late nests in 1985 and 1987 could have biased results. Heavy rains or predators could have destroyed many nests before they were discovered, biasing nest initiation statistics. Heavy rains did not occur at San Bernard during March of 1986 or April and May of 1985 or 1987, however. Predators are not likely to have destroyed all early nests in 1986, or all late nests in 1985 and 1987. Also, later sightings of first broods and lone females, and the later start of recurrent pursuit flights in 1986 support the observed nesting dates.

The level of pursuit flight activity by Mottled Ducks was an indicator of relative breeding chronology. Although I observed pursuit flights in January each year, before nests were initiated, they were infrequent until

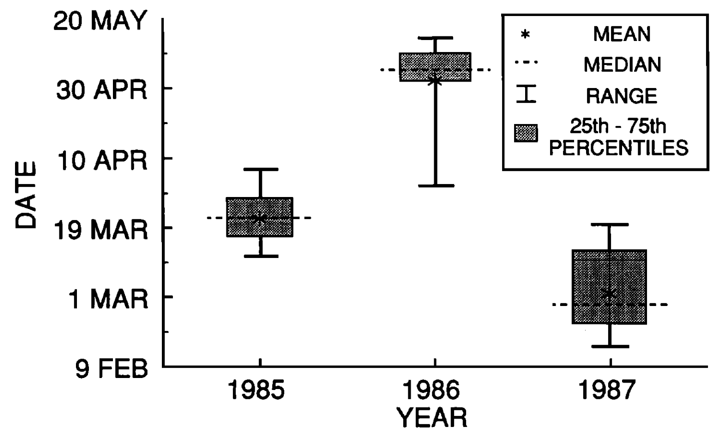


FIGURE 1. Mean, median, and range of nest initiation dates of Mottled Ducks at San Bernard National Wildlife Refuge, Texas, 1985–1987.

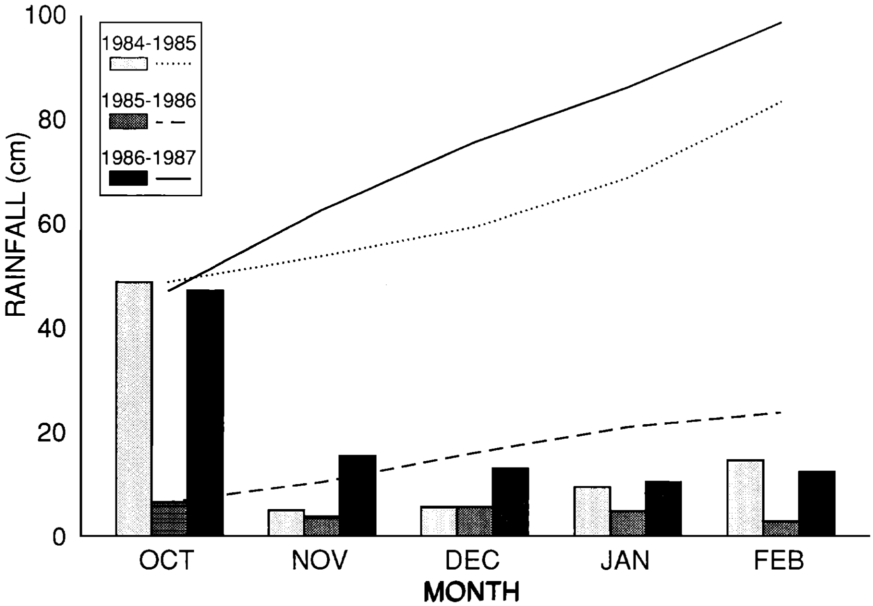


FIGURE 2. Cumulative (lines) and monthly (bars) rainfall October–February at San Bernard National Wildlife Refuge, Texas, 1985–1987.

laying began. The onset of regularly occurring pursuits and nest initiations was over 8 wk later in 1986 than 1987.

In most dabbling ducks the drakes accompany the hen until laying is completed (Sowls 1955), therefore lone females were assumed to be on recess from incubation or no longer nesting. Mottled Duck drakes may accompany the hen until the middle or later stages of incubation (Paulus 1984, Stutzenbaker 1988). The first sighting of lone females each year was just after the median of nest initiation, and occurred over 9 wk later in 1986 versus 1987.

Others have suggested a relationship between nesting dates of Mottled Ducks and rainfall, but presented only anecdotal data or related nesting

TABLE 2. Mean daily temperatures (C) at Freeport, Texas, 1985–1987.

| Month | 1985 | 1986 | 1987 |
|---|---|---|---|
| February[1] | 10.8b | 15.2a | 14.9a |
| March | 18.6a | 18.2a | 16.2b |
| April | 21.9 | 22.5 | 21.3 |
| May | 25.7a | 24.7b | 26.2a |

[1] Values followed by the same letter do not vary among years ($P > 0.05$).

dates to other factors. Singleton (1953) suggested that Mottled Ducks in Texas nested later in years of high spring rainfall. By contrast, late nesting occurred at San Bernard when water and precipitation levels were lowest. Baker et al. (1984) observed a 29-d difference in mean nest initiation dates between years, but attributed later nesting to cooler March temperatures. I observed a 68-d range among median initiation dates over 3 yr, but found no relationship to temperature. In fact, nest initiation occurred earliest in 1987 when March temperatures were lowest, and latest nesting occurred in 1986 when February temperatures were warmest. Furthermore, Baker (1983:10) said that rainfall totals and water levels were below normal in southwest Louisiana in the year he observed later nesting. Therefore, even though he attributed late nesting to cooler temperatures, nesting occurred later when winter water levels were low.

Nest initiation dates of some waterfowl in tropical and subtropical regions also vary with rainfall and water levels. In Australia, some ducks may not nest for many months and then begin soon after heavy rainfalls occur (Frith 1959). Laysan Ducks (*Anas laysanensis*) nest earlier when lake levels are higher, winters are milder and food is more available (Moulton and Weller 1984). In studies of migratory waterfowl, Kaminksi and Gluesing (1987), Heitmeyer and Fredrickson (1981), and Raveling and Heitmeyer (1989) found direct relationships between winter and spring habitat conditions (i.e., rainfall amounts and pond numbers) and recruitment in the following nesting season.

Drought may severely limit foods available to prenesting Mottled Duck hens causing them to delay nesting. Barzen and Serie (1990) suggest that Canvasback hens arriving on the breeding grounds in poor condition slow or suspend rapid follicle growth until food availability increases. Habitat conditions during late winter and spring may have the same albeit more exaggerated effect on Mottled Ducks. Nesting hens require abundant high quality foods to attain the nutrients necessary for egg production (Krapu 1979). Water levels influence the abundance and type of foods available to birds that feed in shallow, ephemeral or temporary wetlands (Krapu 1974, Swanson and Meyer 1977) such as those favored by breeding Mottled Ducks. If Mottled Duck hens are able to suspend follicular growth in early stages they could respond rapidly to improvements in habitat conditions and begin laying within days after adequate resources become available.

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## LITERATURE CITED

ALLEN, J. A. 1981. Nesting and productivity of Mottled Ducks in the marshlands of southwestern Louisiana. M.Sc. thesis. Louisiana State Univ., Baton Rouge, Louisiana.

BAKER, E. O., III. 1983. Nesting and brood rearing habits of the Mottled Duck in the coastal marsh of Cameron Parish, Louisiana. M.Sc. thesis. Louisiana State Univ., Baton Rouge, Louisiana.

———, P. MCKENZIE, AND P. J. ZWANK. 1984. Chase flights as an index to nest density in Mottled Ducks. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 38: 278–284.

BARZEN, J. A., AND J. R. SERIE. 1990. Nutrient reserve dynamics of breeding Canvasbacks. Auk 107:75–85.

BLANKENSHIP, L. H., C. D. EVANS, M. H. HAMMOND, AND A. S. HAWKINS. 1953. Techniques for brood production studies. Miss. Flyway Counc. Tech. Sect. Mimeo.

COWARDIN, L. M., D. S. GILMER, AND C. W. SHAIFFER. 1985. Mallard recruitment in the agricultural environment of North Dakota. Wildl. Monogr. 92.

FRITH, H. J. 1959. The ecology of wild ducks in inland New South Wales IV: Breeding. C.S.I.R.O. Wildl. Res. 4:156–181.

GRAND, J. B. 1988. Habitat use and social structure of Mottled Ducks in a Texas coastal marsh. Ph.D. thesis. Texas A&M Univ., College Station, Texas.

HAMMOND, M. C., AND D. H. JOHNSON. 1984. Effects of weather on breeding ducks in North Dakota. U.S. Fish and Wildl. Serv. Fish and Wildl. Tech. Rep. 1.

HEINROTH, O. 1911. Beitrage zur biologie, namentlich Ethologie und Psychologie der Anatiden. Verh. V. Int. Ornith. Kong., Berlin. 589–702.

HEITMEYER, M. E., AND L. H. FREDRICKSON. 1981. Do wetland conditions in the Mississippi Delta hardwoods influence mallard recruitment? Trans. North Am. Wildl. Nat. Resour. Conf. 46:44–57.

HIGGINS, K. F., L. M. KIRSCH, H. F. DUEBBERT, A. T. KLETT, J. T. LOKEMOEN, H. W. MILLER, AND A. D. KRUSE. 1977. Construction and operation of cable-chain drag for nest searches. U.S. Fish and Wildl. Serv. Leaflet 512.

KAMINSKI, R. M., AND E. A. GLUESING. 1987. Density- and habitat-related recruitment in Mallards. J. Wildl. Manage. 51:141–148.

KRAPU, G. L. 1974. Feeding ecology of pintail hens during reproduction. Auk 91:278–290.

———. 1979. Nutrition of female dabbling ducks during reproduction. Pp. 59–70, *in* T. A. Bookhout, ed. Trans. 39th Midwest Fish and Wildl. Conf. North Cent. Sect. The Wildl. Soc., Madison, Wisconsin.

MOULTON, D. W., AND M. W. WELLER. 1984. Biology and conservation of the Laysan Duck (*Anas laysanensis*). Condor 86:105–117.

PAULUS, S. L. 1984. Behavioral ecology of Mottled Ducks in Louisiana. Ph.D. thesis. Auburn Univ., Auburn, Alabama.

RAVELING, D. G., AND M. E. HEITMEYER. 1989. Relationships of population size and recruitment of pintails to habitat conditions and harvest. J. Wildl. Manage. 53:1088–1103.

SAS INSTITUTE. 1988. SAS/STAT user's guide, release 6.03. SAS Institute, Inc., Cary, North Carolina. 1028 pp.

SINGLETON, J. R. 1953. Texas coastal waterfowl survey. Texas Game & Fish Comm. Rep. Ser. 11.

SOWLS, L. K. 1955. Prairie ducks. Univ. Nebraska Press, Lincoln, Nebraska. 193 pp.

STEEL, R. G. D., AND J. H. TORRIE. 1980. Principles and procedures of statistics. McGraw-Hill, Inc., New York, New York. 633 pp.

STUTZENBAKER, C. D. 1988. The Mottled Duck, its life history, ecology, and management. Texas Parks and Wildl. Dept., Austin, Texas. 209 pp.

SWANSON, G. A., AND M. I. MEYER. 1977. Impact of fluctuating water levels on feeding ecology of breeding blue-winged teal. J. Wildl. Manage. 41:426–433.
WELLER, M. W. 1956. A simple field candler for waterfowl eggs. J. Wildl. Manage. 20: 111–113.

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## INTERNATIONAL COUNCIL FOR BIRD PRESERVATION

Results released by the International Council for Bird Preservation (ICBP) at the World Parks Congress in Venezuela show that over 20% of all bird species only occur in 2% of the world's land surface. This 20% includes over two-thirds of birds that are considered threatened. This figure was found by identifying 221 "hot-spots," where evolutionary and ecological factors have produced a high concentration of unique species. Further research shows that equally high percentages of unique species of other animals and plants occur in the same areas. This is the first time a comprehensive biodiversity analysis of this type has been done. A map of the "hot-spots" has been combined with a map of the world's protected areas, showing the huge inadequacy of parks systems in many parts of the globe. The 221 "hot-spots" should form a blue-print for protected area designation and other conservation efforts. For further information, contact Georgina Green, ICBP, 32 Cambridge Road, Girton, Cambridge CB3 0PJ, U.K. (Telephone: 0223 277218, Fax: 0223 277200).