Variable Water Levels and Wood Duck Recruitment in Kentucky

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Abstract: Recruitment in prairie duck populations is correlated with annual wetland conditions, but a similar relationship has not been demonstrated for wood ducks (*Aix sponsa*). Therefore, we studied the influence of variable water levels on wood duck recruitment at Sloughs Wildlife Management Area in western Kentucky during 1988 and 1989. In 1989, when water levels were higher ($P < 0.0001$), nest initiation was earlier, the nesting season lasted approximately 3 weeks longer, and mean brood sizes were greater ($P < 0.05$). Results suggest high water levels should be maintained during years of drought.

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Cowardin et al. (1985) considered nesting effort to be an important correlate of hen success in mallard (*Anas platyrhynchos*) recruitment. The length of the nesting season might influence recruitment because nesting effort decreases during years of low water conditions (Rogers 1964, Krapu et al. 1983, Afton 1984, Cowardin et al. 1985). Krapu et al. (1983) and Hammond and Johnson (1984) determined that water conditions are a major influence on the length of the nesting season in prairie-nesting ducks.

Although the length of the wood duck nesting season is constrained by latitude (Haramis 1990), spring weather also might influence season length (Grice and Rogers 1965, Bellrose 1980). Similarly, low wetland conditions may also influence the duration of the nesting season and affect brood survival (Haramis 1990). The objective of this study was to examine possible relationships between water levels and wood duck recruitment.

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Methods

Our study was conducted during 1988 and 1989 on the Jennyhole and Highland Creek Units at the Sloughs Wildlife Management Area (WMA) in Henderson and Union counties, Kentucky. The area lies in the flood plain of the Ohio River and is inundated annually (Jacobs 1981). Most of the area is bottomland hardwood forest composed primarily of oak (*Quercus* spp.), ash (*Fraxus* spp.), hickory (*Carya* spp.), hackberry (*Celtis* spp.), and sycamore (*Platanus occidentalis*). The study area is described in Vrtiska (1991).

Daily water depths (U.S. Army Corps Eng., unpubl. data) were obtained for the Uniontown Lock and Dam pool, located 7 km downstream from Sloughs WMA on the Ohio River. A paired *t*-test (SAS Inst. 1985) was used to test the null hypothesis that daily water depths did not differ between years during 1 January to 1 July.

Nesting data were obtained from radio-tagged hens ($N = 2$), incidental nest searches ($N = 6$), and nest box checks ($N = 28$). Incubation stage (Weller 1956) and number of eggs were recorded for all nests inspected. Nest sites were revisited soon after the anticipated hatching date to record the number of hatched eggs and the number of ducklings that left the nest. Nests that contained >15 eggs were classified as dump nests (Morse and Wight 1969, Clawson et al. 1979), and only the eggs at the same incubation stage were used to determine clutch size.

Size and age (Gollop and Marshall 1954) of broods were recorded during early morning and afternoon counts and as encountered. Stationary counts were conducted for 1 hour beginning at sunrise (Rumble and Flake 1982). Flush counts (Rumble and Flake 1982) were conducted during several afternoons in 1989 because broods were difficult to observe during stationary counts. All observed broods were aged according to Gollop and Marshall (1954), and location and date also recorded.

Nest initiation dates of wood ducks were determined by back-dating clutches (clutch size + stage of incubation) and by using known-aged broods (mid-point of age classification + mean clutch size + 30 days incubation) for broods observed. The temporal distribution of nest initiation was tested with a Chi-square test of homogeneity (Daniel 1990). Between year differences in the number of ducklings at next exodus was tested using the Mann-Whitney-Wilcoxon Rank Sum statistic (Daniel 1990). Between year differences in average brood size of all broods observed and for broods observed during counts were tested using 2-way analysis of variance (SAS Inst. 1985) with year and age class as the main effects.

Results

Mean pool depth, an indicator of water conditions, was greater in 1989 (9.1 m) than in 1988 (6.1 m) ($P < 0.0001$) (Fig. 1). Flood stage (11.3 m) was exceeded

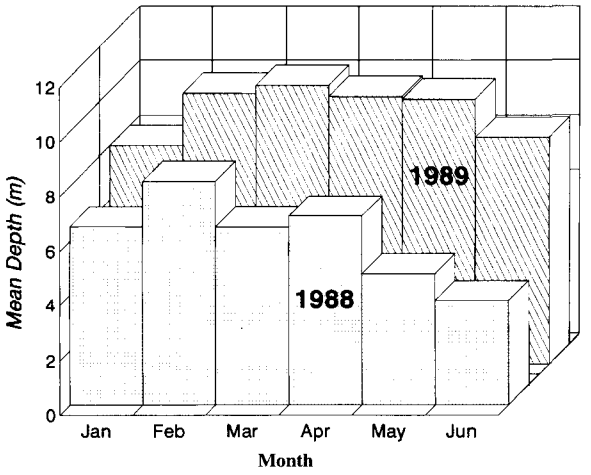

Figure 1. Mean monthly pool depth at Uniontown Lock and Dam, Kentucky, during 1 January to 1 July 1988 and 1989.

once in 1988, and water only partially inundated the study area. However, the area was completely inundated in February and April 1989 and partially in March and June. In 1988, all ephemeral wetlands were dry by the first of June and, by August, water levels in permanent wetlands had decreased 30–60 cm from April levels. In contrast, all wetlands retained water throughout the summer in 1989.

Eleven nests and 45 broods were observed in 1988, and 25 nests and 21 broods were observed in 1989. Nest initiation in 1988 peaked during the week of 17 April (Fig 2). No nests were initiated after 15 May. In 1989, nest initiations peaked during the end of March and beginning of April (Fig 2). However, a second peak occurred in early May (Fig. 2), and nests were initiated until early June. The nesting season was approximately 81 and 117 days in 1988 and in 1989, respectively; a 44% increase in nesting season length. Temporal distribution of nest initiation was different between years ($X^2 = 19.59$, $P < 0.01$).

Mean brood size was greater in 1989 for all broods observed (F = 9.82, 1,60 df, $P < 0.01$) and for broods observed during surveys (F = 6.02, 1,46 df, $P < 0.02$). There was also a difference in brood size between age classes for all broods observed (F = 3.77, 2,60 df, $P < 0.05$) but not for broods observed during surveys (F = 2.08, 2,46 df, $P > 0.1$). The estimated mean number of ducklings leaving the nest was 8.4 in 1988 and 9.8 in 1989 but was not different between years ($P > 0.1$) (Table 1). Mean size of all broods observed and broods observed during surveys declined as duckling age increased (Table 1).

Discussion

Nesting seasons in this study were shorter than those for areas of equal latitude reported by Haramis (1990). Lack of detection of early nesters and the back-dating of broods probably decreased the accuracy of estimating nesting season length. Nonetheless, the relative differences in nesting season lengths between years was evident.

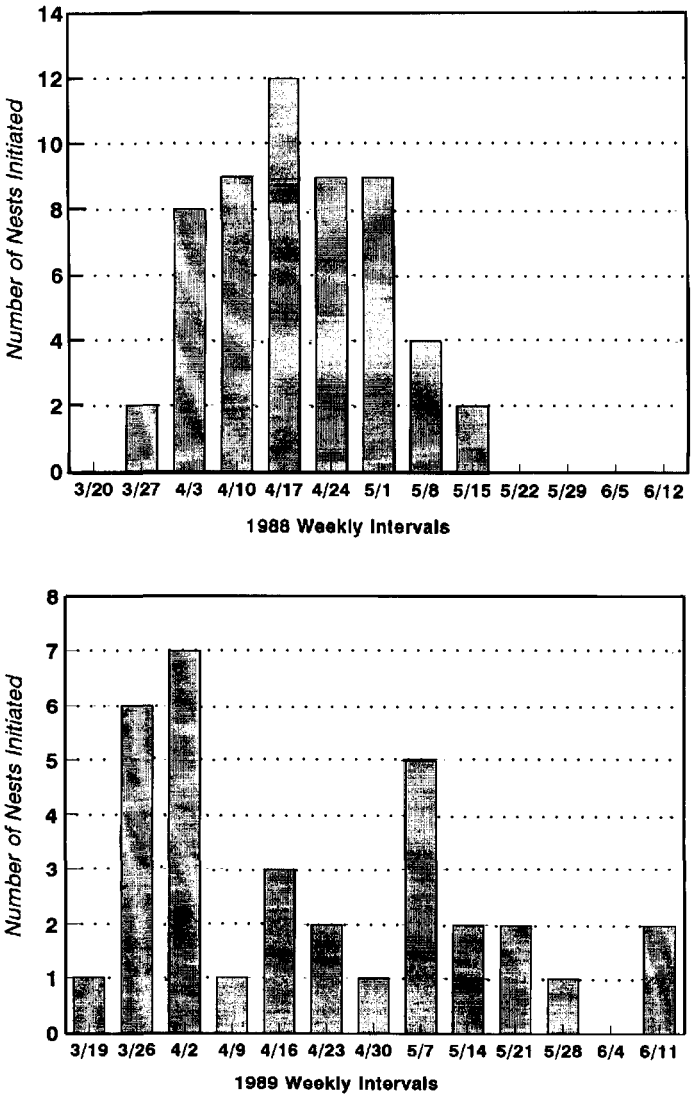

Figure 2. Dates of wood duck nest initiation (totals for 7-day periods beginning on dates shown) for 1988 and 1989 at the Sloughs Wildlife Management Area, Kentucky.

Acquisition of sufficient numbers of invertebrates for egg production in wood ducks is a time-consuming endeavor (Drobney 1990), and shallow-water areas are important feeding sites for wood ducks (Drobney and Frederickson 1979, Drobney 1990). Food availability was probably enhanced by increased water levels in 1989, which increased the number of shallow-water feeding areas. Areas not available

Table 1. Number of broods (N) and mean brood size ($\bar{x} \pm$ SE) of wood ducks observed at Sloughs Wildlife Management Area, Kentucky, during 1988 and 1989.

Age of brood[b]		1988[a]			1989		
		N	$\bar{x}$	SE	N	$\bar{x}$	SE
Nest exodus		11	8.4	1.2	25	9.8	2.3
Class I	All[c]	21	6.4	0.6	8	8.6	0.8
	Surveyed[d]	14	6.3	0.8	4	8.0	0.6
Class II	All	20	5.4	0.7	7	7.7	0.8
	Surveyed	18	5.3	0.8	6	7.5	0.9
Class III	All	4	3.3	1.3	6	6.2	0.6
	Surveyed	4	3.3	1.3	6	6.2	0.6

[a] Mean brood sizes greater in 1989 ($P \leq 0.05$) for all broods observed and for broods observed during surveys.
[b] Age of broods based on Gollop and Marshall (1954).
[c] Mean brood sizes for all broods observed.
[d] Mean brood sizes for broods observed only during surveys.

for foraging in 1988 were available in 1989 because of recurrent flooding during the nesting season. Also, higher water levels limited human access to the area during periods of flooding. Females could augment their nesting effort through undisturbed foraging for invertebrates. Therefore, female wood ducks could meet the energetic demands of egg-laying over a longer period of time.

The length of the nesting season influences the potential for hens to renest after failed or successful nest attempts (Bellrose 1980, Fredrickson and Hansen 1983). Although actual recruitment rates of ducklings from double clutches is not known, double brooding is known to increase production (Fredrickson and Hansen 1983, Kennamer and Hepp 1987, Moorman and Baldassarre 1988, Thompson and Simmons 1990). A 44% increase in nesting season length seemingly would augment recruitment potential at Sloughs WMA, but no double brooding data were collected.

Differences in mean brood sizes in this study also support the hypothesis that water levels affect brood survival. Lower water levels in 1988 may have concentrated broods and possibly increased their susceptibility to predation. Broods in 1988 were observed more often in open water areas whereas broods in 1989 were observed in shallow water at the edge of the sloughs (Vrtiska 1991). Consequently, predation by bowfin (*Amia calva*) and largemouth bass (*Micropterus salmoides*) may have been greater in 1988.

Management Implications

Management planning for optimal wood duck production should consider water conditions during wood duck nesting and brood rearing periods, especially during years of drought. Wildlife managers should maintain higher water levels during the nesting season to increase wood duck recruitment (Vrtiska 1991).

Literature Cited

Afton, A. D. 1984. Influence of age and time on reproductive performance of female lesser scaup. Auk 101:255–265.

Bellrose, F. C. 1980. Ducks, geese and swans of North America. Stackpole Books, Harrisburg, Pa. 543pp.

Clawson, R. L., G. W. Hartman, and L. H. Fredrickson. 1979. Dump nesting in a Missouri wood duck population. J. Wildl. Manage. 43:347–355.

Cowardin, L. M., D. S. Gilmer, and C. W. Shaiffer. 1985. Mallard recruitment in the agricultural environment of North Dakota. Wildl. Monogr. 92 37pp.

Daniel, W. W. 1990. Applied nonparametric statistics, 2nd ed. PWS-Kent Publ. Co., Boston, Mass. 635pp.

Drobney, R. D. 1990. Nutritional ecology of breeding wood ducks: a synopsis for wetland management. Pages 77–82 *in* L. H. Fredrickson, G. V. Burger, S. P. Havera, D. A. Graber, R. E. Kirby, and T. S. Taylor, eds. Proc. 1988 North Am. Wood Duck Symp., St. Louis, Mo.

——— and L. H. Fredrickson. 1979. Food selection by wood ducks in relation to breeding status. J. Wildl. Manage. 43:109–120.

Fredrickson, L. H. and J. L. Hansen. 1983. Second broods in wood ducks. J. Wildl. Manage. 47:320–326.

Gollop, J. B. and W. H. Marshall. 1954. A guide for aging duck broods in the field. Miss. Flyway Counc. Tech. Sect. Minneapolis, Minn. (mimeo).

Grice, D. and J. P. Rogers. 1965. The wood duck in Massachusetts. Mass. Div. Fish. and Game Fed. Aid Proj. Rep. W-19-R. 96pp.

Hammond, M. C. and D. H. Johnson. 1984. Effects of weather on breeding ducks in North Dakota. U.S. Fish and Wildl. Serv. Tech. Rep. No. 1. 17pp.

Haramis, G. M. 1990. The breeding ecology of the wood duck: a review. Pages 45–60 *in* L. H. Fredrickson, G. V. Burger, S. P. Havera, D. A. Graber, R. E. Kirby, and T. S. Taylor, eds. Proc. 1988 North Am. Wood Duck Symp., St. Louis, Mo.

Jacobs, E. H. 1981. Soil survey of Union and Webster Counties, Kentucky. U. S. Dep. Agric. Soil Conser. Serv. 126pp.

Kennamer, R. A. and G. R. Hepp. 1987. Frequency and timing of second broods in wood ducks. Wilson Bul. 99:655–662.

Krapu, G. L., A. T. Klett, and D. G. Jorde. 1983. The effect of variable spring water conditions on mallard reproduction. Auk 100:689–698.

Moorman, T. E. and G. A. Baldassarre. 1988. Incidence of second broods by wood ducks in Alabama and Georgia. J. Wildl. Manage. 52:426–431.

Morse, T. E. and H. M. Wight. 1969. Dump nesting and its effect on production in wood ducks. J. Wildl. Manage. 33:284–293.

Rogers, J. P. 1964. Effect of drought on reproduction of the lesser scaup. J. Wildl. Manage. 28:213–222.

Rumble, M. A. and L. D. Flake. 1982. A comparison of two waterfowl brood survey techniques. J. Wildl. Manage. 46:1048–1053.

SAS Institute, Inc. 1985. SAS user's guide: basics, version 5 edition. SAS Inst., Inc., Cary, N.C. 956pp.

Thompson, S. C. and S. B. Simmons. 1990. Characteristics of second clutches in California wood ducks. Pages 171–177 *in* L. H. Fredrickson, G. V. Burger, S. P. Havera, D. A. Graber, R. E. Kirby, and T. S. Taylor, eds. Proc. 1988 North Am. Wood Duck Symp., St. Louis, Mo.

Vrtiska, M. P. 1991. Nest productivity, brood survival, and habitat use of wood ducks (*Aix sponsa*) at the Sloughs Wildlife Management Area, Kentucky. M.S. Thesis, Eastern Ky. Univ., Richmond. 105pp.

Weller, M. W. 1956. A simple field candler for waterfowl eggs. J. Wildl. Manage. 20:111–113.