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PRODUCTION OF THE REDHEAD (*NYROCA AMERICANA*) IN IOWA[1]

BY JESSOP B. LOW

NESTING of waterfowl on the outer edges of breeding ranges has not in the past received as much attention from game administrators as that in the central or optimum portions of the same breeding ranges. Because of certain conditions, both known and unknown, the peripheries of breeding ranges do not provide the most favorable conditions for nesting waterfowl. However, as management practices bring existing optimum breeding grounds near the limit of production, other areas of lower productive capacities must be recognized and brought under management. We realized at the inception of this investigation that Iowa marshes and lakes lay on the southern boundary of the Redhead breeding range and that we could not expect such nesting concentrations of ducks as have been reported from areas like the Lower Souris Refuge, North Dakota (Kalmbach, 1938) and the Bear River Refuge, Utah (Williams and Marshall, 1938).

This investigation had a two fold objective: (1) to ascertain the degree to which Redheads nested in Iowa, and (2) to make a nesting study of those Redheads breeding in Iowa. A definite unit area was chosen on which to carry out the nesting investigation, and an intensive search was made on this area for nests. The intensive search within a given area, although limiting the number of nests brought under observation, permitted a thorough investigation of all the available plant cover types, a procedure ordinarily not possible in the extensive search method.

The data for this paper were gathered during the spring and summer of 1938 as part of the waterfowl program of the Iowa Cooperative Wildlife Research Unit under the direction of Dr. George O. Hendrickson, Iowa State College, and Thomas G. Scott, U.S. Biological Survey. The investigation centered in northwest Iowa in the vicinity of Lost Island Lake, Clay and Palo Alto counties. Within a radius of five miles of Lost Island Lake lie six lakes and numerous marshes and

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sloughs constituting the largest remnant of duck breeding grounds now found in Iowa.

Nesting Habits

In contrast to the dry ground nesting habits of the puddle ducks in general and of many of the diving ducks, the nesting of the Redhead in Iowa is confined exclusively to stands of emergent vegetation within the shallow-water lakes and marshes. The nesting data for this paper were secured while wading or pushing a small boat through the marshes and sloughs. A periodic and methodic search was made of the nesting habitats during the months of May, June, and July to locate nests and to take data on nests already under observation. During the 1938 nesting season 42 nests were observed. In the five-year period of 1933 to 1937 Bennett (1938a) obtained data on 22 Redhead nests incidental to other work in this marsh area of Clay and Palo Alto counties. Two other nesting investigations in which the Redhead was considered were on the Bear River Refuge, Utah (Williams and Marshall, 1938), and on the Prince Albert district, central Saskatchewan (Furniss, 1938).

The nesting data on the Redhead in Clay and Palo Alto counties for the 1938 season were presented in Table 1. The height of the nest-building and egg-laying period was June 19 to 25, during which period one-third of the total nests observed were constructed. Of the 42 Redhead nests 23 (54.74 per cent) successfully produced young, and 19 (45.26 per cent) were unsuccessfully terminated. This nesting success for the Redhead is 13 per cent above that given earlier by Bennett (1938a). Kalmbach (1939) recorded the average nesting success of waterfowl as 60 per cent, which is 6 per cent above that obtained in this investigation of the Redhead.

Sixty-eight days (May 10 to July 16) elapsed from the time the first nest was located until eggs in the last nest under observation hatched. However, the first nest located contained 10 eggs, which at the rate of one egg a day indicated May 1 or earlier as the date on which egg-laying was begun. Bennett (1938a) reported a 59-day inclusive nesting season for the 22 nests under his observation. There were 384 eggs in 39 of the 42 nests under observation. The clutches averaged 9.85 eggs to a nest. Williams and Marshall (1938) found an average of 12.5 eggs to a clutch in Utah, while Furniss (1938) reported an average clutch of 9.33 eggs in Saskatchewan. Bent (1923) concluded that the Redhead deposits between 10 and 15 eggs in a clutch. There was a gradual tapering off in the number of eggs to a clutch as the end of the season approached. A total of 38.29 per cent (147 eggs) of the eggs hatched.

The size of the individual clutches appeared to have a definite relationship to the success and failure of the clutches. A greater per-

centage of smaller than larger clutches terminated successfully. This fact was borne out particularly by observations during periods of rapid rise in water level which showed that the larger clutches of eggs were not raised as rapidly as smaller clutches through the placing of new nesting materials under them by the female. It appeared probable that some of the smaller clutches were re-nesting attempts, since they were more prevalent later in the season; however, from data at hand this cannot be definitely shown. Smaller clutches toward the end of

Figure 1. Redhead nesting cover in Mud Lake, Clay County, Iowa. Hardstem bulrush is shown in the background; cattail, giant bur reed, sweet flag, and sedges in the foreground.

the nesting season indicative of re-nesting were also noted in the Blue-winged Teal (*Querquedula discors*) (Bennett, 1938b), in the Ring-necked Pheasant (*Phasianus colchicus torquatus*) (Errington and Hamerstrom, 1937), and in many other species.

The hatching period of the Redhead extended over 45 days (June 2 to July 16). The week in which most hatching took place was July 10 to 16, which was approximately 4 weeks after the period of heaviest

egg-laying (June 19 to 25). Bent (1923) recorded 22, 23, or 24 days as the incubation period of the Redhead.

Failure of eggs to hatch was attributed to the following causes: (1) destruction by flooding from heavy rain storms, (2) desertion, (3) the female leaving the nest before all the eggs had hatched, (4) infertility, and (5) predation. The instability of the water levels in the nesting habitats was the most destructive factor in 1938. Ten (52.6 per cent) of the 19 unsuccessful nests were flooded. Two very severe rain storms during the latter part of June raised the water in the lakes and sloughs 6 to 24 inches, depending on the size of the territory drained by the lakes and sloughs.

Nest desertion by the Redheads was relatively high. Eight nests (19.04 per cent) were deserted. The greatest single factor contributing to nest desertion was the deposition of eggs by several Redhead females in one nest. These compound sets were made at the beginning of the nesting season, presumably before some of the females had constructed their own nests. Although the nests of the 4 compound sets were well constructed and well filled with eggs, none were incubated. One other nest was deserted several weeks before it was located. One deserted nest containing one egg may have been abandoned as a result of human interference at too early a period in the history of the nest. Redheads under observation were fairly tolerant of human trespassing on the nesting habitat. Visits were made to some nest sites as many as six times for purposes of observation, and during the study no desertion from such interference was detected with the possible exception of the one nest cited above. It should be mentioned, however, that all possible precautions were taken to avoid any drastic disturbances that would give reason for desertion.

Another factor in the desertion of nests appeared to be the intolerance of the Redhead female of the Ruddy Duck (*Erismatura jamaicensis rubida*) and Mallard (*Anas platyrhynchos platyrhynchos*) eggs which were deposited in the Redhead nests. Ruddy Duck eggs were removed from 5 Redhead nests, presumably by the female Redhead. However, in 2 other Redhead nests Ruddy Duck and Mallard eggs were incubated with the Redhead eggs. None of these parasite eggs hatched, probably because of the difference in time in which the incubation of the eggs began.

Redheads, in common with other water birds, deposit their eggs in other birds' nests, including those of the Ruddy Duck, American Coot (*Fulica americana americana*), and the American Bittern (*Botaurus lentiginosus*). Two Redhead eggs deposited in an American Bittern nest hatched, but the young died soon after hatching.

When once begun, the egg-laying usually continued rather uniformly until incubation of the clutch started. In some nests, however, additional eggs were deposited from one to several days after incuba-

tion began, with the result that often the last deposited eggs were deserted in the nests when the female ducks left the nests with the juveniles which were first hatched. Occasionally eggs were deposited in nests after incubation had proceeded two or three weeks. In some cases it may have been the owners of the nests that laid additional eggs shortly after incubation began, but much later additions to the clutch were probably laid by other ducks. The length of time the embryo remained alive after incubation stopped apparently depended upon the stage of development of the embryo and upon weather conditions. By macroscopic examination of the eggs it was determined that some embryos were alive as long as four days after the female had left the nest. Of the total of 47 eggs left in the nests after the female Redheads had departed with their juveniles, 30 (64 per cent) contained either living or dead embryos.

Infertile eggs did not appear to be a matter of earliness or lateness in the nesting season. Seventeen eggs (4.42 per cent) from 9 nests were infertile. Evidence of eggs laid promiscuously before the nesting season began, as reported in the case of the Blue-winged Teal (Bennett, 1938b), was not observed in this study of the Redhead.

Considerable predation on nests and juveniles has been reported in waterfowl studies in some parts of the country (Kalmbach, 1938). Very little predation occurred on the Redhead nests and juveniles of the marsh area under study in 1938. The choice of nesting habitat of the Redhead in a large degree rendered the Redhead populations inaccessible to the common terrestrial predators. As discussed later in more detail, the nests of the Redhead were constructed above the water in emergent vegetation, and as a result the only predation possible was from bird and swimming predators. Of the former, the Eastern Crow (*Corvus brachyrhynchos brachyrhynchos*) was the most abundant bird predator, although the Marsh Hawk (*Circus hudsonius*) and the Great Horned Owl (*Bubo virginianus virginianus*) were also present. Errington and Breckenridge (1936) found the remains of only one duck, probably a young Blue-winged Teal, in 557 food items of the Marsh Hawk in the Ruthven, Iowa, area. Mink (*Mustela vison*) and the snapping turtle (*Chelydra serpentina*) were the only swimming predators capable of reaching the nests or juveniles of the Redhead. Question has arisen as to the possible predation habits of the muskrat (*Ondatra zibethica*) on the Redhead, but so far we have found no evidence of it. Pond turtles (*Chrysemys picta*) observed resting on Redhead nests did not molest the eggs or nests. In addition, mammal predators frequenting the land adjoining the marshes and potholes were the northern plains red fox (*Vulpes regalis*), common badger (*Taxidea taxus taxus*), long-tailed weasel (*Mustela frenata spadix*), prairie spotted skunk (*Spilogale interrupta*), striped skunk (*Mephitis*

mephitis), the domestic dog (*Canis familiaris*) and the domestic cat (*Felis domestica*).

Nesting Cover

The nesting cover of the Redhead in northwest Iowa was composed principally of hardstem bulrush (*Scirpus acutus*), river-bank sedge (*Carex riparia*) and cattail (*Typha* sp.). The preferred habitat consisted of emergent vegetation in the proportion of 40 per cent hardstem bulrush, 33 per cent river-bank sedge, and a number of minor plants comprising the remainder. Approximately 10 per cent of the total water acreage of the better habitat was free of emergent vegetation. More important among the minor plants were reed (*Phragmites communis*), giant bur reed (*Sparganium eurycarpum*), sweet flag

Figure 2. Redhead young one hour after hatching. Nest constructed of hardstem bulrush.

(*Acorus calamus*), river bulrush (*Scirpus fluviatilis*), smartweed (*Polygonum* sp.), arrowhead (*Sagittaria latifolia*), giant bulrush (*Scirpus validus*), and slender bulrush (*Scirpus heterochaetus*).

Thirty-eight per cent of the nests were located in stands of vegetation composed of both hardstem bulrush and river-bank sedge. These two plant species, composing over 70 per cent of the nesting cover,

held 60 per cent of the nests. The importance of the hardstem bulrush to nesting Redheads is further attested by the findings of Williams and Marshall (1938) in which 65 per cent of the Redhead nests on the Bear River marshes, Utah, were located in this type of vegetation.

Nest Construction

The Redhead nests were constructed in the emergent vegetation out in the water, and the eggs were maintained, in most instances, a safe distance above the water level by the constant addition of new building materials. A variety of different plants, depending largely upon the vegetative type in which the ducks located their nests, was used as nesting material. Redheads constructed their nests principally of 11 plant species. Some nests were composed entirely of one species, while

Figure 3. Cattail provides excellent nesting cover for Redheads. Round Lake, Clay County, Iowa.

others consisted of a mixture of plants. Dead, dry vegetation of the year previous constituted the largest percentage of nesting materials.

A consideration of the vegetation as it affected the productivity of the Redheads involved, among others, two important factors: (1) the availability of the vegetative cover, and (2) the use made of the available vegetative cover. The availability of the vegetative cover was ex-

pressed in acreage of each plant species present. The use made of the available vegetation was determined by estimation of the percentage of each plant species built into the nest and the numbers of nests located within each plant cover type. Based on the above factors the vegetation in order of importance to the Redheads was as follows: hardstem bulrush, riverbank sedge, bur reed, cattail, sweet flag, reed, and slough grass.

Detailed measurement of each nest under observation showed that the water depth preferred for nest construction was about 15 inches, although nests were located in water varying from 1 to 36 inches. The top of the nest was above the soil an average of 22 inches. In agreement with measurements given by Bent (1923), the nests averaged 16 inches in outside diameter and 7 inches inside diameter. While the depth of the cup or bowl of the nest varied considerably, the average of measurements were 3 inches.

The nests were constructed in the emergent vegetation out in the marshes an average of 70 yards from the high water mark. Nests varied from one yard to 250 yards, with an average of 60 yards, from large bodies of open water.

Redheads selected nesting sites having open accessible water either naturally or artificially supplied. The average distance to open water bodies over 10 feet in diameter was 35 yards. Sixty-four per cent of the nesting population under observation used the water provided by the clearings around muskrat lodges as the focal point for their nesting activities. In the duck-nesting investigations on the Bear River Refuge Williams and Marshall (1938) showed the greater number of Redhead nests was located within a few feet of open channels of water.

Sixty per cent of the nests were located in very dense vegetation containing above an average of 100 stalks of the cover plant to one-half square meter, and 40 per cent of the nests were located in medium dense vegetation containing between 50 and 100 stalks of the cover plant to one-half square meter.

The Redhead nests were built in the matted emergent vegetation or in clumps of the plants. Often the nest had no solid foundation other than the stalks of the plants, but more frequently, even though the nest was constructed in dense plant growth, the foundation of the nest went down to the soil. An interesting observation was the manner in which the Redheads added nearby vegetation to their nests in their attempts to raise the eggs above the rising water resulting from a heavy rain. The success or failure of the nest at this critical period depended largely upon the type of vegetation in which the nest was constructed. Hardstem bulrush appeared to be the most successful building material for these emergencies, probably because of the rapid rate at which nests could be constructed of it. Where the female had broken off the vegetation to add to her nest it was not an uncommon sight to

see nests, following a severe storm, situated in the middle of clearings six to ten feet in diameter.

The Redheads did not appear to be affected by other birds nesting in the immediate vicinity of their nests. American Coot and Pied-billed Grebe (*Podilymbus podiceps*) nests were located within a yard of Redhead nests without causing nest failure to any of the birds. The shortest distance between Redhead nests was 5 yards, although Rockwell (1911: 192) records 2 nests within 2 feet of each other.

Sixty per cent of the Redhead nests possessed an overhead covering. These cupolas were constructed by bending the vegetation down over the nest, or the nest was located in vegetation dense enough to provide such a covering without assistance from the ducks. Sixty-six per cent of the nests observed were constructed with 1 to 4 ramps or paths of piled vegetation leading from different sides of the nests to the water.

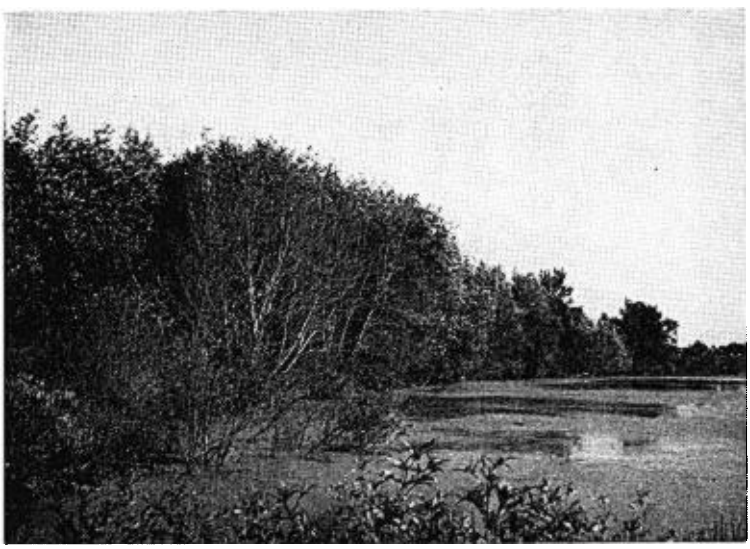

Figure 4. Protected bays as pictured above are favorite feeding haunts for both adult and juvenile Redheads. *Lemna* spp. form the principal floating plants; sago pondweed (*Potamogeton pectinatus*) and coontail (*Ceratophyllum dimersum*) are the most important submerged plants.

Juvenile Rearing Cover

The Redhead females reared their young in vegetation similar to that used as nesting cover. The broods were kept close to the tall bulrush, cattail, reeds, and other protective cover while feeding or playing. Rarely were juveniles observed over 50 yards from protective vegetative cover.

TABLE 1

1938 NESTING DATA ON THE REDHEAD IN CLAY AND PALO ALTO COUNTIES, IOWA

Vegetation in which the nests were located	Total nests	Successful nests	Unsuccessful Nests		Total eggs	Hatched eggs	Infertile eggs	Dead embryos	Eggs in unsuccessful nests
			Destroyed	Deserted					
Scirpus acutus	3 *(7.14)	3 (7.14)			32 (8.32)	25 (6.51)	1 (0.26)	6 (1.56)	
Scirpus acutus, *Carex riparia*	16 (38.09)	8 (19.04)	4 (9.52)	4 (9.52)	139 (36.20)	66 (17.19)	10 (2.60)	14 (3.65)	49 (12.76)
Scirpus acutus, *Scirpus fluviatilis*, *Carex riparia*	4 (9.52)	2 (4.76)	1 (2.38)	1 (2.38)	39 (10.15)	12 (3.13)		5 (1.30)	22 (5.72)
Scirpus acutus, *Carex riparia*, *Sparganium eurycarpum*	2 (4.76)	2 (4.76)			15 (3.91)	12 (3.13)	3 (0.78)		
Scirpus acutus, *Carex riparia*, *Acorus calamus*	3 (7.14)		2 (4.76)	1 (2.38)	27 (7.03)				27 (7.03)
Carex riparia	6 (14.28)	1 (2.38)	4 (9.52)	1 (2.38)	84 (21.87)	2 (0.52)	1 (0.26)	2 (0.52)	79 (20.58)
Carex riparia, *Phragmites communis*	2 (4.76)	1 (2.38)		1 (2.38)	13 (3.39)				13 (3.39)
Typha sp.	2 (4.76)	2 (4.76)			9 (2.35)	9 (2.35)			
Phragmites communis	3 (7.14)	3 (7.14)			14 (3.64)	10 (2.60)	1 (0.26)	3 (0.78)	
Spartina pectinata	1 (2.38)	1 (2.38)			12 (3.13)	11 (2.86)	1 (0.26)		
Totals	42 (100)	23 (54.74)	11 (26.18)	8 (19.04)	384 (100)	147 (38.29)	17 (4.42)	30 (7.81)	190 (49.48)

* Numbers in parentheses are percentages.

Plant species making up the most important rearing cover were located throughout the area of study in four plant communities. Hardstem bulrush and river bulrush growing together were used more extensively than other cover types. These plants grew best in water up to three feet deep and were found farther from shore than the remaining emergent plant species. A plant community consisting of river bulrush, giant bur reed, and sweet flag was second in importance as rearing cover and occupied a strip near the edge of potholes and marshes. Cattail and reed which grew in the same habitat were used to some extent as juvenile rearing cover. Sedges (*Carex riparia, C. atherodes*) growing with sweet flag and giant bur reed in the shallow water on the edges of potholes and marshes were used less extensively as a juvenile rearing cover.

Brood Counts and Production

In order to arrive at the number of young Redheads produced to a brood in 1938 it was necessary to determine the loss of juvenile ducks from predation and other mortality causes. This loss was determined by counting the numbers of juveniles to a brood observed throughout the rearing period. The average size brood of Redheads as determined from brood counts made throughout August was seven juveniles. From these brood counts it appeared that of the average clutch of 8.4 eggs in the successful nests 7 juveniles reached maturity and apparently entered the fall migration.

It was calculated by checking the numbers of pairs of Redheads on the area under study during the height of the nesting season and by counting the number of broods on the same area that not over 45 per cent of the nests were located. On this basis it was further calculated that on the total marshes and lakes about 90 Redhead nests were constructed. This represented an average of one nest to 16 acres of vegetation-covered marsh land. Since 54.74 per cent of the nests (49 nests) were successful and of each successful clutch 7 juveniles reached maturity, the total number of Redheads reared in the marshes and lakes of Clay and Palo Alto Counties in 1938 was about 340, or an average of approximately 3.8 young for each breeding pair of Redhead.

Summary

The investigation presents the available data on the extent and success to which the Redhead (*Nyroca americana*) nested in Clay and Palo Alto counties, Iowa, in 1938.

This investigation showed that the nesting season extended from May 1 to July 16 and that of the 42 nests under observation, 23 (54.74 per cent) were successful. Instability of the water levels, resulting in flooded nests, was the most destructive factor in the production of the Redhead. Of the 19 (45.26 per cent) unsuccessful nests 10 (52.63 per

cent) were flooded; 1 (5.26 per cent) was destroyed by Crows, and 8 (42.11 per cent) were deserted. Infertile eggs numbered 17 (4.42 per cent), while embryos were contained in a total of 30 (7.81 per cent) eggs left in the nests after the female had led the hatched ducklings away. Although 54.74 per cent of the nests were successful, only 38.29 per cent of the eggs successfully produced juveniles. As affecting the productivity of the Redhead, the most important plant species determined from this study were: hardstem bulrush, river-bank sedge, giant bur reed, cattail, sweet flag, reed, river bulrush, and slough grass.

Approximately 340 Redhead were reared in the water areas under observation and entered into the 1938 fall migration flight. This number represented an average of 3.8 juveniles reared to a breeding pair of Redheads, and an average of one nest to 16 acres of vegetation-covered marsh land.

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Department of Zoology and Entomology, Iowa State College, Ames, Iowa