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Accepted for publication 2 March 1972.

DEVELOPMENT OF THERMO-REGULATION IN MALLARD DUCKLINGS

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Numerous investigators have found hypothermia caused by chilling and evaporative cooling in wet young birds. The development of thermoregulation in newly hatched birds was reviewed by Romanoff (1941). Nye (1963) worked with heat loss in the precocial wet, downy young of Mallards (*Anus platyrhynchos*) and Domestic Chickens (*Gallus gallus*) and found the ability to thermoregulate correlated to the water-proofing quality of their down. Ability to thermoregulate in duckling species has been correlated with environmental temperatures by Koskimies and Lahti (1964). They found ducklings of more northern nesting waterfowl able to maintain normal body temperatures for extended periods of time at a low ambient temperature whereas those of more southern nesting species did not.

METHODS AND MATERIALS

Mallard ducklings were taken from automatically controlled incubators immediately after hatching and placed in a temporary brooder. The temperature in the brooder was maintained between 35-40°C. Each duckling was individually marked by a series of web punches.

Each bird was subjected to one or more thermoregulatory experiments. Successive experiments in individual birds were separated by at least 12 hr to allow recovery from previous experiments. The elapsed times from hatching to the beginning of the trial periods were 0, 1, 2, 4, 8, 16, and 24 hr. Each trial consisted of three to five treatments run on different birds of the same age group. Experiments were also conducted on a wet and dry carcass for comparison.

The treatment lasted one-half hour, during which continuous recordings were made of a body and ambient temperature. Body temperature was taken by a thermistor placed down the esophagus and into the gizzard. A small, precooled box was used to confine the bird inside an environmental chamber. Ambient temperature inside the chamber was maintained at 1-2°C throughout the treatments. An Atkins multi-probe switch box (Atkins Technical Inc., Gainesville, Florida) and an Esterline Angus recorder (Esterline Angus Inc., Indianapolis, Indiana) were used to record temperatures.

RESULTS AND DISCUSSION

One-way analysis of variance was used to compare average slopes of various trials. Variances were found homogeneous. Ducklings age 0 and 1 hr; 2 and 4 hr and the dry carcass; and 4, 8, and 16 hr were not found significantly different from each other using Duncan's test for separation. The wet carcass

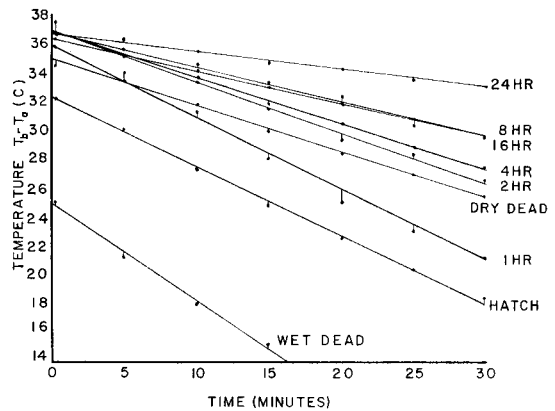


FIGURE 1. Difference between Mallard duckling body temperature and ambient temperature plotted at 5-min intervals. Duckling age in hours appears on the right. Lines represent the expected slope of cooling for that age. Data points are average of trial.

and 24-hr ducklings were significantly different from all other trials. Significance level was 0.90.

Mallard ducklings are near homeothermic 24 hr following hatching (fig. 1). Subsequent tests on 48-hr birds may well show them to maintain even more stable body temperatures during treatment than 24-hr ducklings. When exposed to cold, an initial slight drop in body temperature in young ducklings would be expected as Scott (pers. comm.) found in adult Mallards. It is doubtful downy young could thermoregulate over extended periods. Koskimies and Lahti (1964) stated that thermoregulation in young Mallards breaks down when exposed to low ambient temperatures for periods longer than used in these experiments. In the wild, young are brooded by the female for a large part of the first 24 hr and periodically thereafter. Mallard ducklings need some external heat source until 2 weeks of age (pers. obser.). However, their ability to thermoregulate for short periods without exogenous heat permits them to forage for a few hours without direct or indirect parental care before 2 weeks of age. This is an essential characteristic of the more precocial birds that receive no food from the parent.

The data represented in figure 1 indicate two major periods of change in the ability to maintain body temperature. One period of increased thermoregulatory ability occurs between 1 and 2 hr following hatching and the other between 16 and 24 hr. The ability to maintain temperature was similar between 2 and 4-hr groups and between 4, 8, and 16-hr groups, but changed between and after them. I believe the first period is probably due to increasing insulation values of drying down. The second period is due to physiological change in the individual occurring during this period. One hour after hatching ducklings were damp, insulation values were not yet at a maximum. At 2 hr, ducklings were dry and at 4 hr, the majority of

the birds were well fluffed out. Insulation values probably did not increase significantly from this point on. Therefore, physiological development probably accounts for increasing thermoregulatory ability after 4 hr of age. Yarbrough (1970) and Lagerspetz et al. (1966) suggest that ability to thermoregulate may be related to a state in neural development. By comparing heat loss of wet and dry duckling carcasses, it is apparent that evaporative cooling plays an important part in heat loss in wet downy young as was shown by Nye (1963). Birds at hatching and 1 hr after are wet or damp and lose heat by heat transfer and evaporative cooling. Newly hatched, wet ducklings can regulate body temperature somewhat because they maintain higher body temperature than dead, wet carcasses. They not only must overcome the evaporative cooling, affecting the wet carcass, but also are probably losing more heat by heat transfer because of peripheral blood circulation. Dry carcasses lose less heat than birds 2 and 4 hr of age for the same reason (fig. 1). Herried and Kessell (1967) found conductance greater for nearly naked nestlings than for dead, defeathered birds, as did Yarbrough (1970) in nestling Gray-crowned Rosy Finches (*Leucosticte tephrocotis*).

SUMMARY

Precocial young of waterfowl must be able to thermoregulate for short feeding periods as no direct parental help in feeding occurs. Reasonable stable body temperatures are maintained within 24 to 48 hr of hatching in Mallard ducklings. At hatch ducklings

have some ability to maintain body temperature. Further physiological development of thermoregulation seems to occur in steps.

Financial support was provided by the North American Wildlife Foundation and the Wildlife Management Institute. Experiments were carried out at the Delta Waterfowl Research Station, Delta, Manitoba, Canada. Computer analysis was done at Kansas State University, Manhattan, Kansas.

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Accepted for publication 27 July 1972.

DISPERSION OF FEMALE BLUE GROUSE DURING THE BROOD SEASON

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East of the crest of the Cascade Mountains in Oregon, Washington State, and British Columbia, many Blue Grouse (*Dendragapus obscurus*) move from wintering areas in montane coniferous forests to grassland or shrub-grassland breeding ranges at lower elevations. These areas are in high demand for grazing of domestic livestock, which alters the environment and may affect numbers of Blue Grouse (Marshall 1946; Zwickel 1958; Buss 1960; Hamerstrom and Hamerstrom 1961; Mussehl 1963; Zwickel et al. 1968). In the summer of 1968, an assistant and I studied Blue Grouse on heavily grazed and ungrazed areas in the Methow Valley, Washington, being interested mainly in the effect of different environments on numbers. The present paper is concerned with the dispersion of brood and lone (broodless) females on grazed and ungrazed areas, as patterns of dispersion may have important theoretical implications.

METHODS

Our general approach was to systematically search two areas, one *grazed* and one *ungrazed*, with trained pointing dogs from mid-May to early August. We recorded locations of all sightings of brood and lone females, with data from June, July, and August forming the basis of this paper. This period was chosen because it represents the brood period, peak hatch

having occurred in the last 7-10 days of May. Sightings in June are compared to those for July and August combined because we noted a distinct shift in the distribution of birds in early July, during a short period of very hot, dry weather. My assistant and I alternated study areas each day.

Ideally, a study of dispersion should be time specific, but this is nearly impossible with most species of vertebrates in natural populations. Data presented here represent, in each case, composite sighting locations over at least a month-long period. These represent a minimum of 19 different banded hens on the ungrazed area and 14 on the grazed, with an unknown number of unbanded hens on each. We were not able to reidentify individual hens so some repeat sightings of the same individuals are likely included in the analysis.¹ Densities of breeding birds were essentially the same on the two areas (Zwickel 1972).

One of our main observations concerns an analysis of the distribution of birds in relation to grassland, shrub-grassland, and thickets. For this analysis, any individual or group of Ponderosa Pine (*Pinus ponderosa*), Aspen (*Populus tremuloides*), or Wild Cherry (*Prunus* spp.) trees over 2 m high were considered as thickets. Birds were classified as associated with thickets if within 15 m of them. Shrub-grassland is referred to as *grassland* for purposes of analysis. Statistical analyses concerning the distribution of birds in relation to thickets were done with *Fisher's Exact Test* (Sokal and Rohlf 1969).

¹ The use of composite sightings of unidentified individuals over at least month-long periods makes the assumption that the samples were generally representative of the use of the environment by the respective populations during the time periods specified.