

At approximately 5:00 a.m. on August 26, we were awakened by two owls calling from slightly different directions. There was a distinct difference in the pitch of the two calls, the quality of which was identical with that of those previously heard. A few minutes later, one of the birds flew directly overhead and perched atop a lodgepole pine approximately 30 yards away. In the beam of a lantern, the bird remained perched long enough to permit positive identification as a Great Gray Owl. Both birds called repeatedly, and a few moments later, the second bird glided directly overhead.

According to Grinnell and Miller (Pac. Coast Avif. No. 27, 1944:205-206), no Great Gray Owls have hitherto been reported from Mono County, California, on the east side of the Sierra Nevada.—STEPHEN L. BILLEB, *Department of Biology, San Francisco State College, San Francisco, California, August 18, 1961.*

**The Minimum Water Requirements of Mourning Doves.**—Since water appears to be one of the primary factors limiting the successful habitation of arid regions, it is desirable to learn as much as possible about the water economy of successful desert inhabitants. Mourning Doves (*Zenaidura macroura*) are conspicuously successful inhabitants of arid North America and are often seen under the most severe of desert conditions. This success appears, however, not to be attributable to any unusual physiological mechanisms in their water economy, but to their wide-ranging habits which allow them to visit potable surface water at least every few days (Bartholomew and MacMillen, *Physiol. Zool.*, 33, 1960:171-178).

Bartholomew and MacMillen (*op. cit.*) have previously studied the water economy of Mourning Doves but limited their investigations of water consumption to measurements of *ad libitum* intake. Recent work on the California Quail (*Lophortyx californicus*) suggests that the thirst mechanism of captive birds may not be geared to their actual water needs and that some species may habitually drink in excess of the amount required for maintenance of body weight (Bartholomew and MacMillen, *Auk*, 78, 1961:505-514).

In the light of these observations, the measurement of *ad libitum* water consumption is probably not a valid criterion of the amount of water actually required by a bird. The present study, therefore, undertakes to determine the minimum amount of water required for maintenance of body weight by Mourning Doves.

The 11 birds used were trapped in Rustic Canyon in the Santa Monica Mountains near the Los Angeles campus of the University of California in November and December, 1959. The birds were not segregated by sex and were housed individually in cages measuring 10 × 10 × 10 inches in a windowless room on a 12-hour photoperiod (lights on from noon to midnight). The flight feathers of the birds were clipped to facilitate handling. Mixed bird seed with a water content varying between nine and ten per cent as determined by drying to a constant weight at 100°C. was available at all times. Room temperature varied between 18° and 26°C.; relative humidity varied between 40 and 70 per cent. The birds were weighed to the nearest tenth of a gram on Mondays, Wednesdays and Fridays near the end of the dark period.

Water consumption was determined by the use of graduated cylinders equipped with "L"-shaped drinking tubes and containing distilled water. The water drunk was measured daily to the nearest 0.5 ml. The birds were trained to use the tubes by placing a watering cup nearby for several days. One drinking device was used to determine the rate of evaporation.

The minimum amount of water required daily for maintenance of body weight was determined by successively halving the previously determined *ad libitum* consumption until that amount was found below which each bird was unable to maintain a constant body weight.

The mean body weight of the 11 Mourning Doves used in this investigation, after several days of acclimation to laboratory conditions, was  $108.1 \pm 14.7$  grams (range, 91-144). The *ad libitum* distilled water consumption of these doves during seven days averaged  $6.9 \pm 0.9$  per cent of body weight per day. The birds showed a slight average gain of 0.1 per cent of initial body weight per day.

While determining the minimum daily water requirements the birds were kept on a restricted water ration for a period of 11 to 31 days (mean, 21.4). When placed on the minimum water ration, the birds typically showed an initial loss in body weight which was followed by a period of weight maintenance or weight gain. The figures for minimum water consumption were obtained during the last eight to ten days of this period of weight maintenance or weight gain. The minimum distilled water ration required by the 11 Mourning Doves for maintenance of body weight was

2.8  $\pm$  1.0 per cent of body weight per day (range, 1.6 to 4.6). While drinking this minimum water ration, the birds showed the same slight gain (0.1 per cent of initial body weight per day) as they did when their water supply was unrestricted.

After determining the minimum water requirements, ten normally hydrated Mourning Doves were deprived of drinking water altogether for a period of three days until mildly dehydrated (mean body weight 82.6 per cent of initial weight). Following this period of water deprivation, each bird was provided with an unlimited supply of distilled water in order to determine the initial drinking responses. Drinking was measured during the first minute after the dehydrated birds were provided with water and was found to average 10.8  $\pm$  2.7 per cent of body weight (range, 7.6 to 15.6). The birds invariably drank this amount in one or two draughts. No attempt was made to determine rehydration rates of previously dehydrated birds, but Bartholomew and Dawson (Ecology, 35, 1954: 181-187) report that dehydrated Mourning Doves with a loss up to 15 per cent of their initial body weight made up this loss within minutes after water was made available.

At room temperature the minimum amount of drinking water required daily by Mourning Doves for maintenance of body weight is about 41 per cent of that amount typically drunk when water is unrestricted (2.8 vs. 6.9 per cent of body weight per day, respectively). Bartholomew and Dawson (*op. cit.*) found that Mourning Doves kept without drinking water for 24 hours at 39°C. lost an average of 11.6 per cent of their original body weight; they report that the *ad libitum* distilled water consumption at this same temperature is 23.9 per cent of body weight per day. Assuming that the loss in body weight during this relatively short period was due primarily to loss of body water, it would thus appear that even under moderate heat stress Mourning Doves typically drink at least twice as much water as is required for weight maintenance. These data suggest, therefore, that in the laboratory Mourning Doves regularly drink more water than is required and that one must undertake studies of minimum water requirements in order to assess the real water needs of these birds. The possibility remains, however, that the *ad libitum* water intake of captive birds may more nearly reflect the greater water demands of normally active, non-captive birds.

The mean weight loss of Mourning Doves on a dry diet without drinking water is 4.8 per cent of initial body weight per day (Bartholomew and MacMillen, 1960), while the minimum water ration required for maintenance of body weight averages 2.8 per cent of body weight per day. These data strongly suggest that the rate of weight loss of birds deprived of drinking water is due only partially to a loss of body water; the most obvious additional avenue of weight loss during periods of water deprivation is cessation of feeding. Such a response would be particularly uneconomical in terms of water balance for not only would the Mourning Doves have no drinking water, but they would also decrease their intake of carbohydrate-rich seeds and thereby decrease metabolic water production. Although no measurements of food intake have been made during water deprivation, it seems probable that Mourning Doves stop eating while deprived of water. This cessation of feeding would in part explain the inability of Mourning Doves to subsist on metabolic water alone as the relationship between the theoretical metabolic water production and respiratory water loss might suggest (Bartholomew and Dawson, *Physiol. Zool.*, 26, 1953:162-166).

The ability of mildly dehydrated Mourning Doves to drink in one minute, and in one or two draughts, an amount of water equivalent to about 157 per cent of the daily *ad libitum* intake and about 386 per cent of the minimum daily requirement is consistent with field observations that Mourning Doves can satisfy their thirst in a single draught (Cowan, *Calif. Fish and Game*, 38, 1952:505-521). It would also appear from these data that Mourning Doves need to visit surface water only for a few minutes every day or so in order to maintain or regain a state of positive water balance.

Use of laboratory facilities and the helpful suggestions of Dr. G. A. Bartholomew are gratefully acknowledged.—RICHARD E. MACMILLEN, *Department of Zoology, Pomona College, Claremont, California, August 23, 1961.*

**Additional Data on Food of California Quail in Eastern Washington.**—In our earlier paper on food habits of the California Quail in eastern Washington (*Condor*, 62, 1960:473-477) part of the tabular material involving the more commonly represented plant foods was omitted by oversight. Accordingly we present herewith the data that supplement those of tables 1 and 2 of the earlier paper.