WATER REQUIREMENTS OF THE GROUND DOVE

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In California the Ground Dove *Columbina passerina* occurs in the Imperial and Coachella valleys, which have an extremely dry climate and high summer temperatures. Skutch (1956) observed that in Central America, where *C. talpacoti* is the Ground Dove of the rain forest, *C. passerina* is found in the more arid regions where cactuses are numerous. In southwestern United States this species is characteristically found in river bottomlands and areas where open ground alternates with tracts of willow, mesquite, or other scrub, usually not far from water (Bent, 1932; Grinnell and Miller, 1944).

Because of the heat and aridity of the areas that this dove inhabits, it is of interest to see whether or not it has physiological and behavioral adaptations permitting it to minimize its water consumption. The basic problems of water economy encountered by granivorous birds in arid habitats have been outlined by Bartholomew and Cade (1963).

METHODS

Ground Doves were captured in mist nets in citrus groves near Thermal, Imperial County, California, in November and December 1963 and February and April 1964. Eighteen of the 25 birds maintained in captivity were used in experiments. Some of the doves were highly excitable and tended to lose weight after handling. Only those which adjusted well to captivity and handling were used in experiments.

Doves were housed in a windowless room on a 12-hour daily photoperiod in individual wire cages measuring about 12 × 10 × 10 inches. Water was provided in a 100-ml graduated cylinder with an L-shaped drinking tube ⅜ inches in diameter, and a drinking device mounted near the cages was used to measure evaporation. Food consisting of millet seed with a water content of 9.85 per cent by weight, determined by drying to constant weight at 90-100°C, was provided during all experiments except the one involving 0.1 M NaCl. During this experiment the birds were fed a commercial seed mixture, principally of millet and canary seed; but on this mixture they ate the millet in preference to other seeds. Otherwise the doves were fed mixed bird seed with additions of dog-food meal and chicken mash. Temperature and relative humidity in the room were not controlled, but continuous records were kept with a Bendix recording hygrothermograph.

Birds were weighed to the nearest 0.1 g shortly before the lights came on, to minimize disturbance and to insure that they had a minimum of food in the alimentary tract. At the same time water levels were read to the nearest 0.5 ml.

In experiments testing drinking response to high ambient temperatures the birds were kept in a constant temperature chamber on a 12-hour daily photoperiod. They were observed through a covered window in the front of the cabinet. The birds were weighed and water levels read near the end of the dark period.

Initial body weight in all experiments was a bird's weight at the beginning of the first day of the experimental regimen, and subsequent measurements were taken at 24- or 48-hour intervals.

RESULTS

Temperature and humidity. Temperatures and relative humidities for most experiments are given in table 1. During experiments with constant ambient temperature the relative humidity in the cabinet ranged between 20 and 40 per cent, but

TABLE 1

TEMPERATURE, RELATIVE HUMIDITY, AND INITIAL BODY WEIGHTS DURING EXPERIMENTS

Experimental regimen	Period of experiment in days	Ambient temperature* (°C)	Relative humidity* (%)	Mean initial body weight (g)
Distilled water	10	22.6 to 23.4	49 to 54	38.0
0.1 M NaCl	5	23.1	50	41.0
0.15 M NaCl	4	23.8 to 26.0	40 to 41	36.6
0.2 M NaCl	4	26.1 to 27.3	49 to 54	39.3
No water	3	21.6 to 26.7	37 to 55	39.1
Distilled water	4	30	–	40.3
and constant	4	35	–	38.1
temperature	3	40	–	37.4

* Values represent means of readings taken at 2-hour intervals during the study period. Ranges consist of means for two separate experimental periods.

was not recorded continuously. During determination of minimum drinking requirements, temperature averaged 24.1°C and relative humidity 42.8 per cent.

Water deprivation. Figure 1 shows mean daily weight loss in birds deprived of water for up to three days. The rate of weight loss varied greatly, probably because some individuals stopped eating and lost weight considerably faster than those that

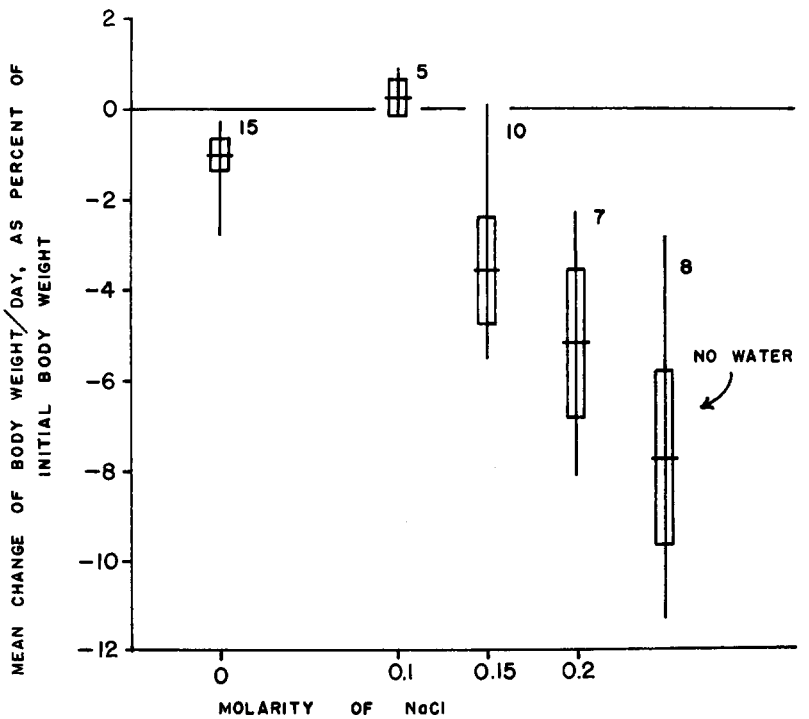

Figure 1. Change in body weight of Ground Doves drinking various concentrations of NaCl and without water. Horizontal line is the mean, vertical line the range, and the rectangle incloses the mean plus and minus two standard errors. Numeral indicates sample size.

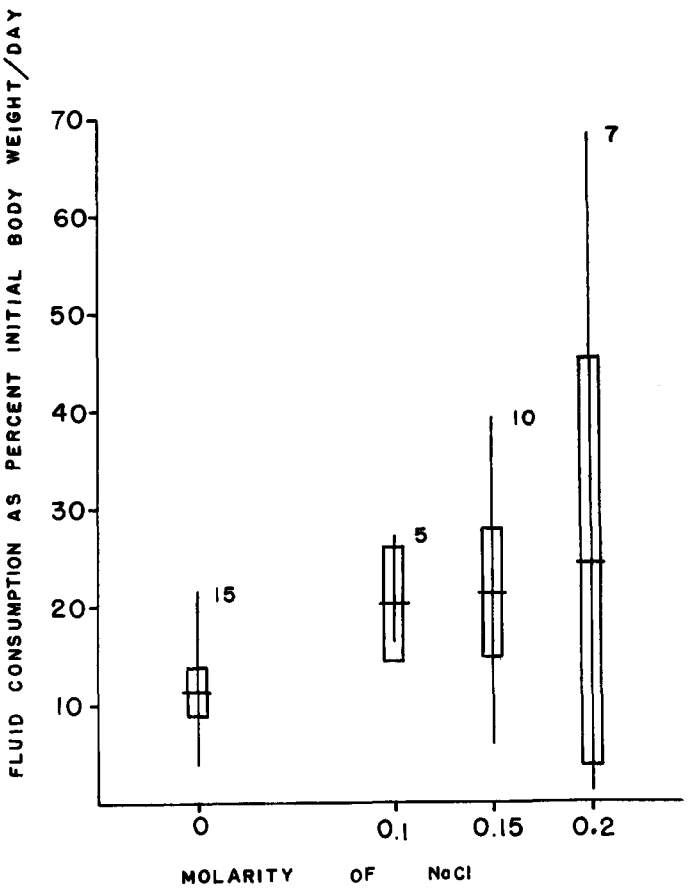

Figure 2. Fluid consumption of Ground Doves related to the NaCl concentration. Symbols as in figure 1.

continued to eat. Because no birds were deliberately allowed to die of water deprivation, nothing can be said about survival time without water.

Utilization of salt solutions. The effects of drinking various concentrations of NaCl solution on body weight and fluid consumption are given in figures 1 and 2. Ground Doves drinking 0.1 M NaCl held their weights better than those drinking distilled water. On 0.15 M most individuals lost weight steadily, but some could maintain weight at least as well as birds on distilled water. Probably 0.15 M NaCl is near the maximum salt concentration that this species can tolerate. With increasing salt concentration there was an increasingly variable drinking response (fig. 2); on 0.2 M some birds drank practically nothing while some drank more than 65 per cent of body weight per day.

Drinking in relation to ambient temperature. Figure 3 shows the performance of birds consuming distilled water at constant ambient temperatures of 23, 30, 35, and 40°C. At 40° the doves lost weight at a mean rate of 6.9 per cent of initial body weight per day.

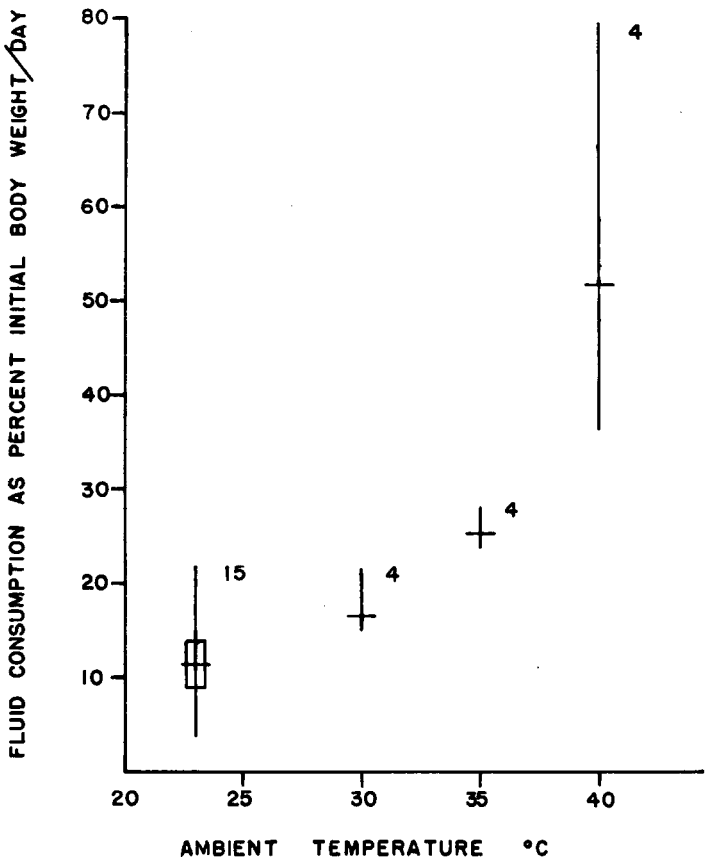

Figure 3. Consumption of distilled water by Ground Doves, related to ambient temperature. Symbols as in figure 1.

Minimum water requirement. The minimum distilled water consumption necessary for a Ground Dove to maintain its body weight over a period of at least three days was determined for four individuals by supplying measured amounts of water in a 25-ml drinking tube. The mean value (± SE) obtained was 9.7 ± 1.5 per cent of body weight per day (range 8.8 to 10.3 per cent).

Gular fluttering. At ambient temperatures of 40°C gular fluttering with the beak partly open occurred intermittently in alert, resting birds. At temperatures of 42.5° and higher, gular fluttering was practically continuous over the short periods of observation at these temperatures.

FIELD OBSERVATIONS

Observations were made on Ground Doves from November through April 1963–1964 in citrus orchards on Rancho Donarita near Thermal, where the experimental birds were captured. The doves foraged on open ground between the rows of trees, which were planted about 18 feet apart. The trees were dense and 8 to 10 feet tall. The doves frequently rested among the branches or on the ground beneath during the day and roosted in them at night. In February the population of Ground Doves on

100 acres of citrus was estimated to be approximately 156, based on the proportion of 20 color-marked individuals in sample counts. The doves foraged in pairs or loose flocks of up to 10 individuals. In March the population seemed to diminish somewhat, but some marked individuals remained in the area through the study period. During the winter the doves were most active from 0900 to 1100 and again between 1400 and 1600. In April, when there were nests with eggs and nestlings, Ground Doves remained active all day, even when air temperatures exceeded 38°C at midday.

The doves were always near water in irrigation heads, ditches, and reservoirs. I did not see any drink during the winter. On 15 April a single dove drank at a reservoir at 1542, air temperature 38°C; and at 1620 a male was captured with his crop full of water, indicating that some drink during the heat of the day. Unlike Mourning Doves (*Zenaidura macroura*), which tend to congregate at drinking places at regular times of day, Ground Doves were never seen gathered in flocks at water.

DISCUSSION

Ground Doves did not show any unusual physiological competence for utilization of salt water or for tolerance of reduced water intake. Their performance does not differ qualitatively from that of Mourning Doves studied by Bartholomew and MacMillen (1960), although the Ground Doves consumed generally smaller weight-relative quantities of 0.15 and 0.2 M NaCl. The ad libitum and minimum required distilled water consumptions of Ground Doves fall in the range of values for birds of this size listed by Bartholomew and Cade (1963), and come very near the curve for weight-relative evaporative water loss given by them.

It appears that the Ground Dove uses gular fluttering as a method of evaporative cooling at ambient temperatures of 40°C and higher. Bartholomew *et al.* (1962) found that the Poor-will (*Phalaenoptilus nuttallii*), and Lasiewski and Dawson (1964) found that the Common Nighthawk (*Chordeiles minor*) can employ gular fluttering for efficient evaporative cooling. Unlike many birds which only pant, these species using gular fluttering can dissipate heat at rates exceeding metabolic heat production at ambient temperatures higher than body temperature. It is tempting to speculate that the Ground Dove might also be able to withstand long exposure to high ambient temperatures by means of gular fluttering.

Perhaps the weight loss of the doves kept at a constant 40°C was due to an inability to make up water deficits incurred during the 12-hour dark period.

Considering these findings in relation to the field observations, it appears that the Ground Doves studied depend heavily on the presence in the habitat of water of low salinity for ordinary metabolic needs and for evaporative cooling. Unlike the Mourning Dove their daily movements ordinarily are restricted to a small area, and individuals presumably drink repeatedly during the day when air temperatures are high.

SUMMARY

The water requirements of the Ground Dove were determined by measuring ad libitum consumption of distilled water and of various concentrations of NaCl, by measuring rate of weight loss of birds deprived of water, by determining minimum consumption of distilled water needed to maintain body weight, and by measuring water consumption at ambient temperatures of 30, 35, and 40°C. The mean ad libitum consumption of distilled water was 11.4 per cent of body weight per day, and the mean minimum requirement of four individuals was 9.7 ± 1.5 per cent of body

weight per day. The maximum NaCl concentration that Ground Doves could utilize was near 0.15 M. With increasing molarity of NaCl from 0.1 to 0.2, drinking responses became increasingly variable. Ad libitum water consumption increased approximately threefold from 30° to 40°C. In the Coachella Valley where the experimental birds were obtained, Ground Doves appear to be sedentary and to occur only where water is close by. No unusual adaptations to scarcity of water were revealed. Evaporation by gular fluttering may be an important cooling mechanism for this dove in hot environments.

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