Thermal Panting in Domestic Pigeons, 
*Columba livia*, and the Barn Owl, *Tyto alba*

Wesley W. Weathers

Department of Environmental Physiology, Rutgers, The State University, 
New Brunswick, New Jersey

Received April 10, 1972

Summary. The respiratory frequency and gular flutter frequency of 12 domestic pigeons and one barn owl were determined during exposure to air temperatures of 35–50°C. In both species respiratory and gular flutter frequencies increased with increasing body temperature (*T*b) until maximum rates were obtained (Figs. 1, 4). In pigeons, the increase in respiratory frequency was preceded by a 0.5–1.4°C rise in *T*b. Gular flutter and panting occurred synchronously (Fig. 2), and mean maximum and minimum flutter rates were significantly different in the pigeon. These results demonstrate that under moderate thermal loads pigeons, and perhaps barn owls, do not pant at the resonant frequency of the respiratory system.

Introduction

Birds respond to thermal stress by increasing the rate of evaporative cooling. Increased evaporation is partially accomplished by a change in respiration from low frequency close-mouthed breathing to higher frequency open-mouthed panting. In most species of birds the frequency of ventilation (f) increases continuously with increasing body temperature (*T*b) during thermal loading. However, in some species, such as the domestic pigeon, *Columba livia*, and barn owl, *Tyto alba*, f has been reported to change abruptly from near resting levels to the maximal panting rate, a pattern analogous to resonant frequency panting in dogs (see Richards, 1970, and Dawson and Hudson, 1970, for reviews).

For birds to most effectively utilize the resonant properties of the respiratory system, moderate thermal loads should be compensated for by an alternation between low and high respiratory rates. Such a pattern of intermittent panting characterizes the response of dogs to moderate thermal stress. Experiments were performed to determine if pigeons and barn owls respond to moderate thermal stress by panting intermittently.

Materials and Methods

Twelve domestic pigeons (*Columba livia*) with a mean weight of 461.9 g ± 75.2 SD and one 585 g barn owl (*Tyto alba*) were used for this study. The birds were subjected to heat stress by placing them in a well ventilated cage inside a Honeywell Hotpack environmental chamber. Temperature within the chamber
could be controlled within ±1°C of the desired level. Relative humidity within
the chamber was continuously monitored with a Hygrodynamics humidity indicator,
and water vapor pressure ranged between 6.9–23.5 mm Hg. Body temperature was
monitored, to the nearest 0.1°C, with a thermistor temperature probe connected
to a YSI model 46 TUC telethermometer which was calibrated against a National
Bureau of Standards Thermometer. The thermistor probe was inserted through
the cloaca into the intestine and held in place by clipping the leads to the rectrices.
The frequency of ventilation was recorded from subcutaneous electrodes connected
to an impedance pneumograph (E and M Mk. IV).

Gular flutter rates were usually measured stroboscopically with an electronic
stroboscope (Strobatac, General Radio Co.). However, in three experiments, which
were designed to determine if respiration and gular flutter occurred synchronously,
gular flutter was measured by attaching 40-gauge Cu wires subcutaneously on
opposite sides of the throat. The voltages at the skin were then amplified and
recorded with a Grass model 7 polygraph.

The birds were not restrained during the experiments and they did not appear
to be hampered by the various electrodes and their leads. Before being subjected
to heating, birds were usually left in the dark within the environmental chamber
at 30°C until Tb and heart rate had stabilized.

Results

Responses of Domestic Pigeons. Subjecting pigeons to heating did not
result in an increase in f until Tb had increased 0.5–1.4°C. Further in-
creases in Tb were accompanied by an initial gradual increase in f to
approximately 100 breaths/min, followed by greater increases in f per
unit increase in Tb (Fig. 1). The transition between slow and fast phases
of increasing f with increasing Tb occurred at a mean Tb of 41.8°C (range:
41.3–42.9°C). The Tb at which the transition in the rate of change of f
occurred was consistent within individuals.

Gular flutter commenced only after Tb and f had risen markedly
(Fig. 1). The frequency of gular flutter increased with increasing Tb from
a mean minimum of 521 ± 17 flutters/min (SE) to a mean maximum
of 611 ± 17 flutters/min. The mean maxima and minima flutter rates
are significantly different (t-test; p < 0.05). The amplitude of movement
of the gular region varied directly with the frequency of flutter, and
gular flutter occurred synchronously with the respiratory movements
of the thoraco-abdominal mass (Fig. 2).

If pigeons were abruptly subjected to high thermal loads (45–50°C), Tb
increased rapidly and the transition between resting f and maximum
panting usually occurred within 5–10 min. However, when the ambient
temperature was gradually raised, such that Tb increased slowly, the
increase in f was likewise gradual (Fig. 3). By adjusting the thermal load
such that the appropriate Tb was maintained, pigeons could be induced
to pant at intermediate frequencies for protracted intervals. Such inter-
mediate panting rates are evident in Fig. 3 between minutes 185 and 250.

Responses of the Barn Owl. The responses of the barn owl to heating
were qualitatively similar to those of pigeons. The frequency of ventila-