

# OBSERVATIONS OF A BARN SWALLOW BELLY-SOAKING DURING INCUBATION

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During July 2023 and July 2024, I observed a female Barn Swallow (*Hirundo rustica*) wet her brood patch and surrounding abdominal feathers at a nearby bird bath, then fly to her nest which contained a clutch of eggs. For both years she wetted herself when the temperature near her nest reached 37.7 °C and periodically continued to wet herself prior to incubating as the ambient temperatures continued to rise. The main function of belly-soaking, or feather wetting, appears to be for cooling eggs or young, which occurs in desert sandgrouse in Pteroclididae, in Pteroclitiformes, and in some families in Charadriiformes (Maclean 1975 and references therein, Schardien and Jackson 1979). Although belly-soaking has been observed a few times in female Purple Martins (*Progne subis*) brooding nestlings (Jackson and Schardien 1981), this is the first reported observation of it being used as a possible thermoregulatory behavior to cool eggs in swallows (Hirundinidae) or other passerines (Passeriformes).

I have observed for several years Barn Swallows nesting under my porch roof on my property 17.5 km west of Amado, Pima County, Arizona (lat 31.6466N, long 111.2356W, elevation 1073 m). The habitat is characterized as Upper Sonoran Desert grassland, where summer temperatures are very high and humidity is very low. A pair of Barn Swallows constructed 2 nests midway on the rafters of my north-facing porch, 22.8 m length x 3.4 m width x 2.9 m ceiling height, one nest on the east end and one nest on the west end. They, and most likely other pairs, have rebuilt and reused these nests for the past 10 years. Within a breeding season they use the east nest first, switch to the west nest if a second attempt at the east end fails, then move back to the east nest. Successful fledging occurred only in the past 4 years, and only from the east nest:

- 11 September 2021: 1 of 2 nestlings fledged
- 1 to 3 September 2022: 3 nestlings fledged
- 20 June 2023: 3 nestlings fledged
- 24 to 26 May 2024: 5 nestlings fledged (Figure 1)

Nest failures were due to eggs not hatching, or young nestlings falling prematurely out of the nest. Once, a nestling's leg became entangled in a long horsetail hair in the nest lining, and the bird dangled from the nest until it died. This type of mortality is rarely seen but has been reported by Knight 1980.

It wasn't until the 2023 breeding season that I noticed many times that the female Barn Swallow wetted her abdominal feathers at a bird bath located about 19 m from her second nest on the west end. After wetting her feathers, she flew directly back to the nest, and either perched briefly on the rim of the nest, facing outward, exposing her abdomen and sometimes panting (Figure 2), or went immediately into it, almost disappearing from view (Figure 3). She incubated 4 eggs from 27 July through 18 August (22 days). This nesting failed because the eggs did not hatch. The following year, on 12 June 2024, I observed the Barn Swallow wetting her feathers



Figure 1. Five nestling Barn Swallows prior to fledging, 24 May 2024. Photo by Kathleen Groschupf



Figure 2. Female Barn Swallow panting, with wet breast feathers and exposed abdominal brood patch, 15 June 2024. Photo by Kathleen Groschupf

when she started incubating 5 eggs in her east nest. I took ambient temperature readings from a weather thermometer mounted on a nearby shaded porch post and temperature readings of the ceiling directly above and to the side of her east nest using a Mannix MIR 300 Infrared Thermometer. The laser beam caused her to leave the nest, so I recorded temperature only when she left the nest of her own volition.

On 14 June 2024, at 1400 I noticed the female at the water bath and she quickly returned to her nest. She left the nest again at 1415, going directly to the water; the ambient temperature was 37.7 °C, at the nest it was 41.1 °C, above the nest it was 43.9 °C. She left the nest again at 1439, 1453, and 1523 flying directly to the water bath. At 1529 she left the nest again to go to the water bath and also sipped a little water.



Photo 3. Female Barn Swallow incubating eggs in nest, tail feathers on left, tips of primaries on right, 13 June 2024. Photo by Kathleen Groschupf

On 16 June 2024, between 1415 and 1500, when the ambient temperature at the nest was 40 °C I attempted to note the time when the female left the nest and when she returned to determine how long she left the nest unattended. This was difficult because she was able to drop quickly into the nest without my detection. She left the nest 7 times and during that hour of observation she went directly to the bird bath, splashed in the water, and returned in 10 sec, 8 sec, 9 sec, and 8 sec. Only one time did she not immediately fly to the water bath, being gone for about 2 min prior to landing at the water bath, then returning to the nest after 10 sec.

On 3 July, she brought a domestic chicken contour feather to the nest, and she appeared to be pushing it into the nest. Later, I looked into the nest, and the 5 eggs had been moved to the side and the feather was absent.

On 4 August, the pair renested in the west nest, which now had one egg in it. The east nest contained 9 eggs, suggesting the female laid 4 additional eggs and continued to incubate. The west nest temperature (38.9 °C) was cooler than the east nest temperature (43.9 °C), with the ambient temperature at 35.0 °C.

On 16 August 5 eggs were in the west nest, and the female continued to wet her feathers during the afternoon.

On 24 August there were 5 eggs in the west nest. At 1240, the temperature outside the nest was 36.1°C, and the ambient temperature was 31.7 °C degrees. The female was still at her nest, and her abdominal feathers looked disheveled, but not wet.

On 6 September I noted that the swallows had abandoned the nest earlier, shortly after 24 August. The female had probably incubated these eggs about 20 days. There are few data for incubation period in Barn Swallow, but it has been reported as 13 to 15 days in Kansas (Thompson 1961).

Incubation of eggs is most often thought as warming eggs to a temperature that promotes healthy development of the embryo. Birds use a brood patch using heat transferred from the brood patch to accomplish this. A constant temperature of eggs is maintained by increasing or decreasing the time spent incubating. The body temperature of Barn Swallows ranges from 37.8-44.0 °C, which varies throughout the day and season (Møller 2010). In this species, males do not have a brood patch, but will incubate eggs a few days at the start of incubation period, and females complete incubation using a single medial brood patch to keep a clutch of 3 to 6 eggs at a nest temperature presumably near 34° C. This nest temperature, measured by Huggins (1941) for 37 bird species representing 11 orders, suggests that most birds have similar thermal requirements for successful incubation. However, when ambient temperatures exceed the heat transferred from the brood patch the eggs need to be cooled, not warmed.

The necessity for cooling of eggs is not very common, as it is not required in temperate or frigid environments. Birds in hot, dry climates may have a need for it, and Maclean (1975) reported that belly-soaking or feather-wetting occurs in the sandgrouse (Pteroclididae, Pteroclitiformes) and 6 families in Charadriiformes (Charadriidae, Glareolidae, Recurvirostridae, Laridae, Sternidae and Rynchopidae), and stated that "Belly-soaking appears to be absent from all other orders of birds." Since that publication, Rynchopidae has been moved and ranked as a subfamily in Laridae, and Sternidae has been removed as a valid taxon with terns being placed in Laridae (Gill et al. 2025). Therefore, only 4 families in Charadriiformes exhibit the cooling behavior. Although one could argue that the female Barn Swallow was wetting her feathers to cool herself off, the benefit of her body's lowered temperature would be transferred to her eggs, too.

Another method for cooling eggs is to incubate them continuously. By keeping the brood patch next to the eggs, the eggs approximate the body temperature of the incubator during high and low temperatures, which in the case of Barn Swallows, would be lower than the ambient temperature. This method was reported by Yom-tov et al (1978) who observed prolonged incubation bouts and even prolonged incubation periods in the Dead Sea Sparrow (*Passer moabiticus*) which breeds in Israel where temperatures may exceed 45 °C at noon and humidity is less than 10%.

Finally, Afik and Ward (1989) observed that some species keep dead eggs in their nest while starting another clutch in the same nest. They found that the dead eggs had a heat-buffering capacity, absorbing some of the heat, thereby cooling the new set of eggs.

The female Barn Swallow exhibited multiple strategies to cool her eggs during very hot and dry nesting periods – primarily through belly-soaking or feather-wetting – a behavior not previously reported in Hirundinidae or Passeriformes. She also demonstrated prolonged incubation and may have used dead eggs as a heat buffer. These observations suggest that Barn Swallows in arid, high-temperature regions may adopt previously undocumented thermoregulatory behaviors to protect their clutches.

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