PHENOLOGY OF THE FIRST REPORTED CASE OF SAME-SEASON NEST REUSE IN ANNA'S HUMMINGBIRD

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ABSTRACT**:** Natural history observations of rare events can provide invaluable data about the range of variation in a trait or behavior. In birds, these fortuitous observations can help supplement scientific understanding of the timing and location of nesting behavior, events which are often difficult to observe. Reuse of cup nests is thought to be rare, but incidental reports document nest reuse both within and across breeding seasons. A chance instance of a female Anna's Hummingbird (*Calypte anna*) initiating a nest on our balcony in California was an opportunity to make detailed observations of nesting phenology with photos and videos. After successful fledging of this first nest, the same female immediately initiated a second nesting attempt in the same nest. To our knowledge, this is the first documented case of a female Anna's Hummingbird reusing a nest in the same season, and only the second case confirmed through direct observations in any hummingbird species.

An important decision birds must make is when and where to build their nests. In hummingbirds, the phenology of breeding and nesting is associated with the availability of nectar resources (McKinney et al. 2012). Multiple nesting attempts within a single breeding season are common, with later nests often being built near the first because nectar sources are nearby (Baltosser 1989). Within a single breeding season or across breeding seasons, female hummingbirds have been observed building an entirely new nest in the same area (Stiles 1973, Calder et al. 1983, Scarfe and Finlay 2001), reusing an old nest built by a different female (Barnard and Campbell 2007, Ward et al. 2021, Musschenga et al. 2022), or building a new nest atop an old nest (Bendire 1895, Triana and Sandoval 2011).

Reuse of cup nests is thought to occur infrequently. Use and weathering degrade the nests' structural integrity, making them challenging to reuse (Hansell 2000). Nest reuse may also incur fitness costs; for example, parasites from previous use of a nest may decrease the survival of later nestlings (Barclay 1988, Tomás et al. 2007). However, reuse of a nest may provide an energetic benefit by allowing earlier or additional nesting attempts in species such as hummingbirds, in which females perform all aspects of nest construction, incubation, and offspring care (Cockburn 2006).

Anna's Hummingbirds (*Calypte anna*) build nests and lay their two-egg clutch soon after the November–January winter rains (Clark and Russell 2020). Intensive natural history observations have provided important insights into the phenology of their breeding and nesting behavior (e.g., Kelly 1955, Legg and Pitelka 1956, Stiles 1973). We present detailed observations on a seemingly rare event in hummingbirds: within-season nest reuse by the same female. An Anna's Hummingbird nesting on our second-story balcony provided an opportunity for detailed observations of nest construction and

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nestling development. Days after successful fledging of her first brood, the same female laid a second clutch in the same nest. Here, we add to the rich record documenting Anna's Hummingbird nesting behavior by providing detailed photos, videos, and observations of a rare occurrence of nest reuse. In addition, we summarize our observations of nesting phenology, nest construction, and nestling development.

OBSERVATIONS

On 20 January 2023, we observed a female Anna's Hummingbird inspecting an unused metal hook on our second-story balcony in the College Terrace neighborhood of Palo Alto, California (37° 25′ 22″ N, 122° 09′ 02″ W). The hook was located underneath the balcony awning and was protected from the elements. By 22 January 2023 it was clear that the female was beginning to build a nest on the hook. The nearness of the nest (just beyond our sliding glass doors) allowed us to observe nesting phenology in detail (Table 1; Figure 1). All observations were made without disturbing the female or nestlings. Photos and videos were taken with an iPhone 15 Pro or Nikon D60.

First Nesting Attempt

From 22 January to 30 January, we observed the female build her nest with moss, plant material, spider webs, and small feathers (Figure S1 in the file Aguillon_Siegmund_supplement.pdf at https://doi.org/10.5061/dryad.rxwdbrvr2). We include several videos showing the stereotyped behaviors she used to build and shape the nest throughout this process (Files S1–S3 at https://doi.org/10.5061/dryad.rxwdbrvr2). While building, she often sat inside the cup, running her head and bill around the outside. She laid the first egg on 30 January and the second two days later on 1 February between 07:49 (when the nest contained 1 egg) and 08:31 (when it contained 2). We recorded her on the nest at 08:17 making undulating body movements, which we believe was her laying the second egg (File S4). Thus it was 12 days from her first inspection of the site to a full clutch of two eggs. We observed her on the nest at 20:58 on 30 January and believe she incubated her first egg overnight. She did not begin incubating during the day, however, until after laying the second egg. During the early stages of incubation, she continued nest-building behaviors as before (e.g., File S5), including building up the sides of the cup to be more vertical and adorning the outside of the nest with light green lichen (Figure S2).

Visible shadows appeared on the eggs by 14 February and became more pronounced over the following three days (Figure S3). Both nestlings hatched within a 26-hour period between 08:35 on 17 February and 10:12 on 18 February. Egg shells remained in the nest on the morning of 18 February but were absent by the following day. Although we cannot calculate the exact length of the incubation period, it was 19–20 days for the first egg and 18–19 days for the second egg.

Both nestlings fledged on 14 March (25–26 days after hatching), the first before 11:00 and the second between 16:10 and 16:16. Additional detailed observational notes on the behaviors of the female and the nestling that remained in the nest on this day are included in Text S1 at doi.org/10.5061/

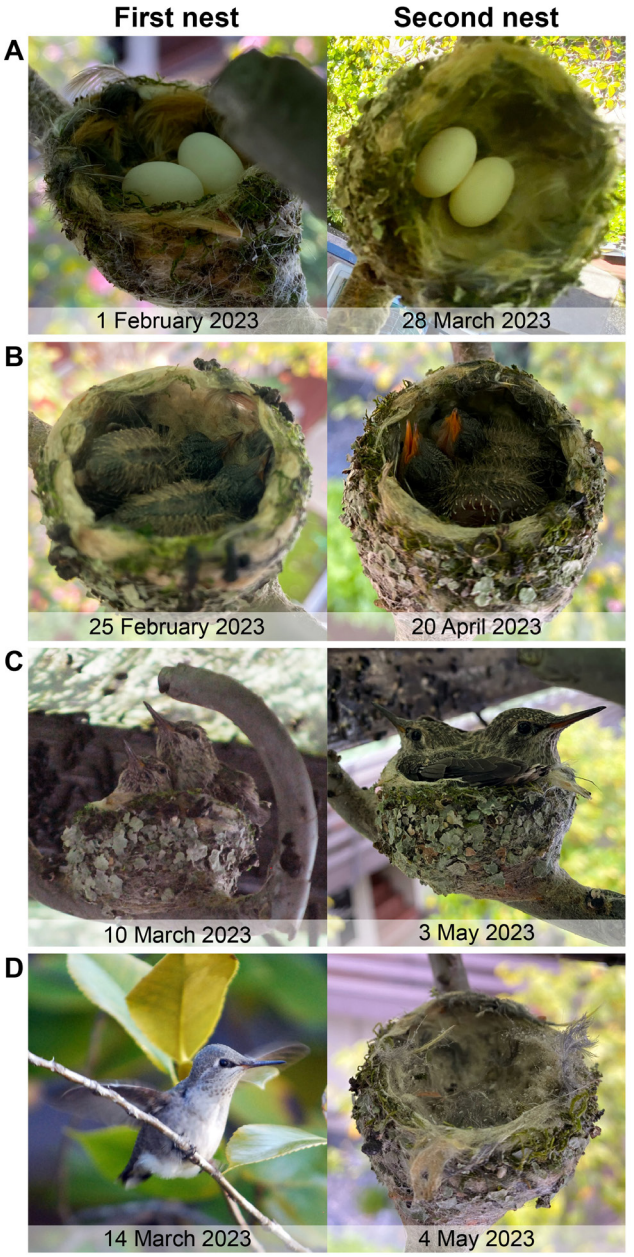

FIGURE 1. Various stages of development of the first and second broods of a female Anna's Hummingbird reusing a nest in Palo Alto, California, in 2023.

Table 1 Phenology of an Anna's Hummingbird Reusing a Nest in Palo Alto, California, in 2023

Event	Date	Details
First attempt		
Nest-site selection	20 Jan	Female inspects nest site.
Initiation of nest building	22 Jan	See Figure S1 and Files S1–S3 at https://doi.org/10.5061/dryad.rxwdbrvr2.
Laying of first egg	30 Jan	By 17:22; female incubates overnight.
Laying of second egg	1 Feb	Between 07:49 and 08:31, likely at 08:17 (see File S4).
Hatching	17–18 Feb	Both nestlings hatch between 08:35 on 17 Feb and 10:12 on 18 Feb.
Fledging	14 Mar	First nestling fledges by 11:00, while the second stays in the edge of the nest. Second nestling fledges around 16:16.
Last sighting	16 Mar	Both fledglings remain in nearby shrubbery being fed by the female (Figure S4).
Second attempt		
Female returns	17 Mar	Female is observed sitting in the nest and performing nest-building behaviors at 16:00.
Laying of second egg	28 Mar	Two eggs found in the nest at 11:11.
Hatching	11–13 Apr	First nestling hatches between 08:20 on 11 Apr and 08:08 on 12 Apr. Second nestling hatches between 17:27 on 12 Apr and 08:15 on 13 Apr.
Depredation of first nestling	3 May	One nestling goes missing from the nest between 07:30 and 17:51. Female continues to return for remaining nestling.
Depredation of second nestling	4 May	Second nestling goes missing from the nest between 07:45 and 08:15. At 08:37 and again at 08:51 the female returns to the nest looking for the nestling.

dryad.rxwdbrvr2. Over the following two days, the two nestlings perched in nearby vegetation (largely still, though sometimes beating their wings), and were regularly fed by the female (Figure S4). When the female returned to the area, the nestlings gave a high-pitched "seet" note to indicate their location, and she flew over to feed them. We did not see the fledglings again after 16 March.

Second Nesting Attempt

On 17 March at 16:00, and for the next 11 days, we observed the female return to sit in the nest for brief periods and perform various nest-building behaviors. Abruptly on 28 March at 11:11, we observed her sitting in the nest for an extended period during a rainstorm. Upon her departure, we noted two eggs in the nest. Because we were not expecting a second clutch, we do not have exact timing of when the first egg was laid. However, the abrupt change in behavior from nest building to incubating on 28 March suggests the second egg was laid on that same morning. We believe the same female laid both clutches for two reasons. First, the nest-building behavior for the second clutch began just a day after our last sighting of the female with her fledglings. As we never observed other female hummingbirds nearby during the entirety of the first nesting attempt, it seems unlikely that a new female could have discovered the empty nest so quickly. Second, the pattern of iridescent feathers visible on the female's throat appeared remarkably similar to those of the earlier female when observed from a similar angle (Figure 2, S5,

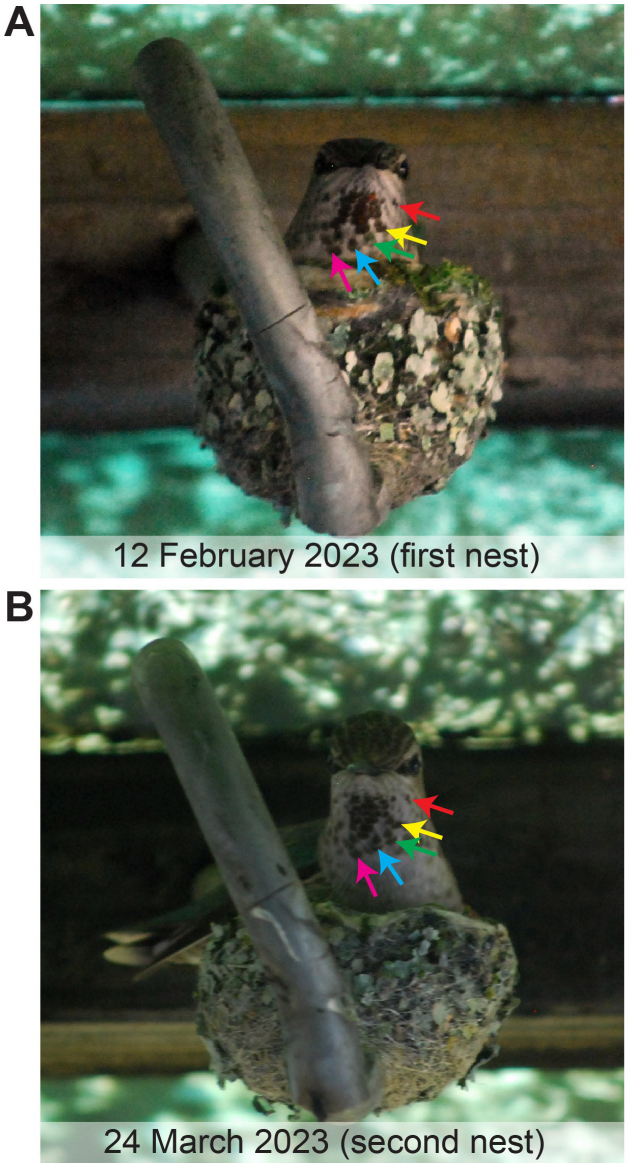

FIGURE 2. A, female Anna's Hummingbird incubating during an initial nesting attempt in Palo Alto, California. B, view from a comparable angle of the female incubating during the second use of this nest. Similar patterns in the iridescent feathers on the throat suggest this is the same individual in both nesting attempts. Colored arrows indicate identifiable feathers in both photos. For the original photos, see Figures S5 and S6 at https://doi.org/10.5061/dryad.rxwdbrvr2.

and S6). Unique throat markings have been used previously to confirm nest reuse in the same season in other hummingbird species (Ward et al. 2021).

Visible shadows appeared on the eggs by 8 April, and the first nestling hatched sometime between 08:20 on 11 April and 08:08 on 12 April. Egg shells remained in the nest on the morning of 12 April but were removed that afternoon, which suggests the egg likely hatched that day. The second nestling hatched between 17:27 on 12 April and 08:15 on 13 April. Only small eggshell shards remained by the following day, suggesting the female removed them rapidly after the nestlings hatched. Although we cannot calculate the exact length of the incubation period of the second clutch, it could have been as short as 16 days (if the first egg was laid one day before the second and hatched first) and as long as 19 days (if the first egg was laid two days before the second and hatched second).

Both nestlings disappeared from the nest in early May: the first between 07:30 and 17:51 on 3 May, the second between 07:45 and 08:15 on 4 May. After the first nestling vanished, the female returned to feed the nestling that remained in the nest. Despite searching the area, we did not find evidence that the nestlings fledged or fell from the nest and instead believe they were depredated. This seems supported by the female returning twice (at 08:37 and again at 08:51) looking for the second remaining nestling in the nest after it disappeared.

Nestling Development

For the first brood, we were able to observe the nestlings most days from 17 to 28 February (days ~1–11) and from 8 to 15 March (days ~19–26). For the second brood, we were able to observe the nestlings most days from 12 April to 3 May (days ~1–21). Both sets of nestlings reached developmental milestones on a comparable timeline.

At hatching, both sets of nestlings were brown to black on their dorsal side; when we observed them partially turned in the nest it appeared that they were pink on their ventral side. Bill color was yellow to yellow-orange. The nestlings had a paired row of downy feathers, neossoptiles, on their dorsal side (Figure 1B). By days 3–4, the nestlings were a more consistent dark color on their dorsal side, and after 7–8 days of development, the bill had started to develop dark patches and feather tracts were visible dorsally and on the head. Contour feathers started to emerge from dorsal feather sheaths by day 9 and from the head on day 11. In the second brood, feathers emerged progressively from the base of the head toward the bill over the next three days. By day 13–15, pin feathers of the primaries and secondaries were growing, and these feathers had started to emerge from their sheaths by day 18 (Figure 1C). In both sets of nestlings, on day 21, feather sheaths were still visible at the base of the bill, and some primaries and secondaries had not yet completely emerged. The second brood disappeared on this day.

In the first nest, we observed the nestlings preening, flapping their wings, and being fed by the female on day 22. By day 23, the nestlings were exploring their nest, including perching on the nest's edge. These behaviors continued in the afternoon on day 24, until shortly before the first nestling fledged. On day 25, we observed the remaining nestling frequently and identified the following behaviors: preening, scratching itself with its feet, defecating, calling with short chirps, beating its wings singly or with sustained wingbeats while in the nest,

beating wings to hover just above the nest, perching on the edge of the nest, and actively looking around. At one point, a wind gust pushed the nestling from the nest edge to the bottom of the hook on which the nest was built, and the nestling swung itself back into the nest. Nestlings from the first brood fledged with wing feathers incompletely emerged from sheaths (Figure 1D).

DISCUSSION

To the best of our knowledge, reuse of hummingbird nests within the same season has been reported rarely: it has been confirmed once through repeated observations in the Black-chinned Hummingbird (*Archilochus alexandri*) in Texas (Ward et al. 2021) and potentially once in the Swallow-tailed Hummingbird (*Eupetomena macroura*) in Brazil, identified through community-science observations (Turella et al. 2022). However, reuse of nests—within and across seasons—occurs commonly in Allen's Hummingbird (*Selasphorus sasin*), which regularly constructs new nests on top of old nests (Clark and Mitchell 2020).

Natural history notes such as ours have contributed substantially to the current knowledge about the phenology of Anna's Hummingbird's nesting (e.g., Kelly 1955), though more systematic studies have been essential to generalizing individual observations (e.g., Stiles 1973). Other observers have estimated stages of nesting phenology as follows: nest building for 3 days to 1 month, incubation for 14 to 19 days, and nestling development for 18 to 30 days (reviewed in Clark and Russell 2020). Kelly (1955) described stages of nesting in Alameda, California: nest building took 15 days, eggs were laid 1 and 3 days after the nest was completed, eggs hatched after ~16 days, and nestlings fledged at 25 or 26 days. Legg and Pitelka (1956) studied Anna's Hummingbirds near Santa Cruz, California, from 1953 to 1955 and reported nest building taking from 3 days to a month and egg laying over 2 days. Stiles (1973) observed nesting Anna's Hummingbirds near Los Angeles from 1966 to 1970 and estimated incubation to last 14–19 days, nestling development 18–23 days. Our observations agree with these times, with initial nest building taking about 10 days (though it continued after eggs were laid), eggs hatching after ~16–20 days, and nestlings developing for 24 or 25 days before fledging. Using our detailed observations, we could additionally pinpoint some of these key events to specific times of day. For instance, the second egg in the first nest was laid within the short interval between 07:49 and 08:31 (likely at 08:17), and nestlings from the first nest hatched within a 26-hour period, with the second nestling hatching between 08:35 and 10:12. Moreover, our photography allowed us to describe key aspects of the timing of the nestlings' development.

Several factors could have contributed to this female Anna's Hummingbird reusing a nest. The nest we observed was located in a suburban neighborhood with gardens, ornamental plants, and street trees that may have provided reliable floral resources (though we do not have observations of nectar feeding). California also experienced a historically high level of precipitation in the winter of 2022–2023 (particularly in central and northern California; DeFlorio et al. 2024), which may have increased both floral and insect resource availability during the breeding season we observed. Anna's Hummingbirds often renest near previous nests if flowers in bloom during the first nesting attempt remain

available (Stiles 1973), suggesting the high levels of precipitation could have aided the rapid initiation of a second clutch. The awning over the nest protected the female and her nestlings from rain, likely reducing structural degradation of the nesting material. Observations of nest reuse by Black-chinned Hummingbirds in a hardware store suggested that females had a high frequency of nest reuse across seasons after adding minimal new material in part because nests located inside the store were protected from the elements and remained intact (Ward et al. 2021). Similarly, Scintillant Hummingbirds (*Selasphorus scintilla*) built nests on top of each other across seasons on a protected porch (Triana and Sandoval 2011). Intriguingly, ours is the only other confirmed record of a single female reusing the same nest within the same season.

Despite the handful of observations of nest reuse across seasons or building on top of older nests, hummingbirds reuse nests infrequently. For example, Legg and Pitelka (1956) did not report nest reuse or nests built on top of one another in a study of 44 Anna's Hummingbird nests. Stiles (1973) reported that female Anna's Hummingbirds returned to perches regularly and often renested near the first nest, but did not mention reuse of nests.

Nest reuse can incur a variety of costs that likely could make this behavior uncommon. Besides the nest's structural integrity, the persistence of parasites, such as feather mites (Godoy et al. 2013), from previous nesting attempts (Barclay 1988, Tomás et al. 2007) and potential for predation (Otterbeck et al. 2019) are also important factors. If a predator discovers a nest, it may be more likely to prey upon subsequent nests in the same location. Although we observed just a single instance of nest reuse, it is worth noting that the first brood fledged, while the second was depredated. Predation of hummingbird eggs and nestlings is common (Stiles 1973, Baltosser 1986), with avian predators like the California Scrub-Jay (*Aphelocoma californica*) commonly depredating Anna's Hummingbird nests (Stiles 1982).

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