

Post-hatching maternal attendance in wild Burmese Pythons in southern Florida, USA

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Most non-avian reptiles exhibit a complete absence of parental care. In squamates, care is restricted to females, occurring in just 1% of oviparous lizards and 3% of oviparous snakes (Shine, 1988, 2003; De Fraipont et al., 1996). The most widespread form of parental care in egg-laying snake species consists of the female remaining with the eggs after oviposition (i.e., maternal care, brooding) and primarily occurs in the families Viperidae, Elapidae, Boidae and Pythonidae (Shine, 1988; Somma, 1990; Greer, 1997; Greene et al., 2002). Until recently post-hatching maternal care (see Alexander, 2018) was thought to be restricted to pit vipers; where mothers remain spatially aggregated with neonates, exhibiting antipredator defence during the time between birth and the first shed cycle of offspring (Shine, 1988; Greene et al., 2002; Hoss et al., 2014).

Here we report the first observations of post-hatching maternal attendance by free-ranging Burmese pythons (*Python bivittatus*) in their invasive range in southern Florida, USA (Guzy et al., 2023).

As part of a study to characterise reproduction and hatchling survival rates of Burmese pythons in southern Florida, we monitored nest attendance for two VHF radio-tagged adult female pythons in 2024 (Python #1 and #2), both surgically implanted with Holohil model AI-2 radio transmitters (32 g; Holohil Systems, Ltd., Ottawa, Ontario, Canada) following standard surgical procedures (e.g., Hale et al., 2017). The study took place in Big Cypress National Preserve, Collier County, Florida, USA, which is characterised as a low-elevation freshwater swamp dominated by cypress (*Taxodium* spp.), pine (*Pinus* spp.), and mixed prairie/marsh forest. These females were tracked weekly from their initial capture location (Fig. 1A–B). A third wild-caught gravid female Burmese python (Python #3) was captured on 26 April 2024 in Everglades and Francis S. Taylor Wildlife Management Area, Broward County, Florida, USA and monitored ex-situ for maternal behaviour. The python was placed in a semi-natural 4.8 × 2.4 m outdoor enclosure located at the University of Florida Fort Lauderdale Research and Education Center (Broward County, Florida) to record data associated with egg laying, brooding, and clutch survival in a controlled setting. The enclosure was constructed with a concrete foundation, enclosed with chain-link fencing overlaid with hardware cloth, with shade cloth fastened to the top to let in 50% sunlight (Fig. 1C). The substrate was a well-draining sandy soil with weedy vegetation growing within and a large water dish was provided with freshwater ad libitum. We used Reconyx (HyperFire 2) and Spartan (GoLive) cellular cameras at the oviposition sites for live monitoring and photo-documentation of the presence and behaviour of pythons.

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Figure 1. Nests laid by three adult female Burmese pythons (*Python bivittatus*). Two individuals (A, B) were free-ranging radiotagged pythons in Big Cypress National Preserve, Collier County, FL, USA and one individual (C) was a wild-caught gravid female from the Everglades and Francis S. Taylor Wildlife Management Area that was placed in an outdoor enclosure at the University of Florida Fort Lauderdale Research and Education Center in Broward County, FL, USA. Cellular trail cameras (e.g., 1A inset) were used to monitor pythons during brooding. Photos by A) Jacquelyn Guzy, B) Lisa McBride, and C) Brandon Welty.

Free-ranging Female #1. On 23 May 2024, we visually confirmed Python #1 (290 cm snout-vent length, SVL; 17.8 kg) had oviposited (Table 1) under a few inches of soil and a dense thicket of Toothed Midsorus Fern (*Telmatoblechnum serrulatum*) within a hardwood hammock. On 3 June 2024 a team of two set up cellular cameras (Fig. 1A) equipped with solar panels. To minimise interference to brooding behaviours by the female, we remotely monitored the nest hourly with cellular cameras from 23 May 2024 until 12 July 2024. Hourly data from the live feed indicated the female had remained at the oviposition site, coiled around the eggs, and engaged in muscle twitching and contraction at intervals of every 5–15 seconds, indicating facultative thermogenesis was occurring despite warm

ambient temperatures (18.3 —38.3 °C) for the duration of brooding (NOAAa, 2025; Guzy et al., 2025). On 11 July 2024, at 16:00 h, cellular cameras captured the first sign of a hatchling breaking the shell of an egg (i.e., pipping; Fig. 2B). By 17:00 h, the python was no longer on the nest and was absent from subsequent images (i.e., out of frame), while more hatchlings continued to pip, with at least three hatchlings visible (Fig. 2C). Python #1 returned to the nest 1 hour later as pipping progressed. Over the next 16 hours, until 10:00 h on 12 July 2024, she moved on and off the eggs, repositioning herself alongside and around the eggs (Figs. 2D–H), occasionally tongue-flicking. During this time, up to eight hatchlings were seen visibly pipping (Fig. 1B–C, G–H; Table 1). At 10:20 h on 12 July 2024, when

Table 1. Oviposition and pipping observations for three wild adult female Burmese pythons (*Python bivittatus*). Data are from two individuals that were free-ranging (Pythons # 1 and 2) in Big Cypress National Preserve, Collier County, Florida, USA and one wild-caught individual (Python #3) placed in an outdoor enclosure on the campus of the University of Florida Fort Lauderdale Research and Education Center, Broward County, FL, USA. Data generating Table 1 are available from Guzy et al. 2025.

Oviposition and pipping observations	Python #1	Python #2	Python #3
Snout vent length (cm)	295	464	270
Total length (cm)	330	517	308
Mass (kg)	17.83	83.7	18.1
Oviposition date	Unknown	Unknown	15 May 2024
First oviposition observation	17 May 2023	6 June 2024	NA
Incubation length (days)	at least 55	at least 53	56
Clutch size	24 (21 viable)	79 (64 viable)	31 (25 viable)
Date of first pipping observation	11 July 2024 (16:00)	28 July 2024 (18:36)	10 July 2024 (16:13)
Intervention date	12 July 2024 (10:24)	29 July 2024 (9:39)	12 July 2024 (12:08)
Number of hours female remained with hatchlings prior to intervention	18.4	16.2	41.9
Female present immediately prior to intervention?	Yes (on nest)	Yes (on nest)	Yes (next to nest)
Number of individual hatchlings seen in photos	8	4	2
Number of hatchlings that left nest prior to intervention	0	0	0
Number of pipped eggs prior to intervention	16	12	3

Python #1 was 5 m from the nest, we enclosed the eggs to prevent hatchling escape, ending the maternal care observation. Python #1 remained with her eggs for approximately 18 hours after the initial pipping event was recorded, until our intervention, and incubated them for approximately 55 days (Table 1); she did not return to the oviposition site after our intervention.

Free-ranging Female #2. On 6 June 2024, we visually confirmed Python #2 (464 cm SVL; 83.7 kg) had oviposited above ground, in a hardwood hammock, on a bed of Saw Palmetto fronds (*Serenoa repens*; Fig. 1B). On 24 June 2024, at 11:15 h, we set up two cellular cameras, and during this time the python left the nest, and returned to the nest the same day at 21:24 h. Cellular cameras were programmed to take photos every five minutes and we remotely monitored the nest via live feed on an hourly basis for the duration of brooding (24 June

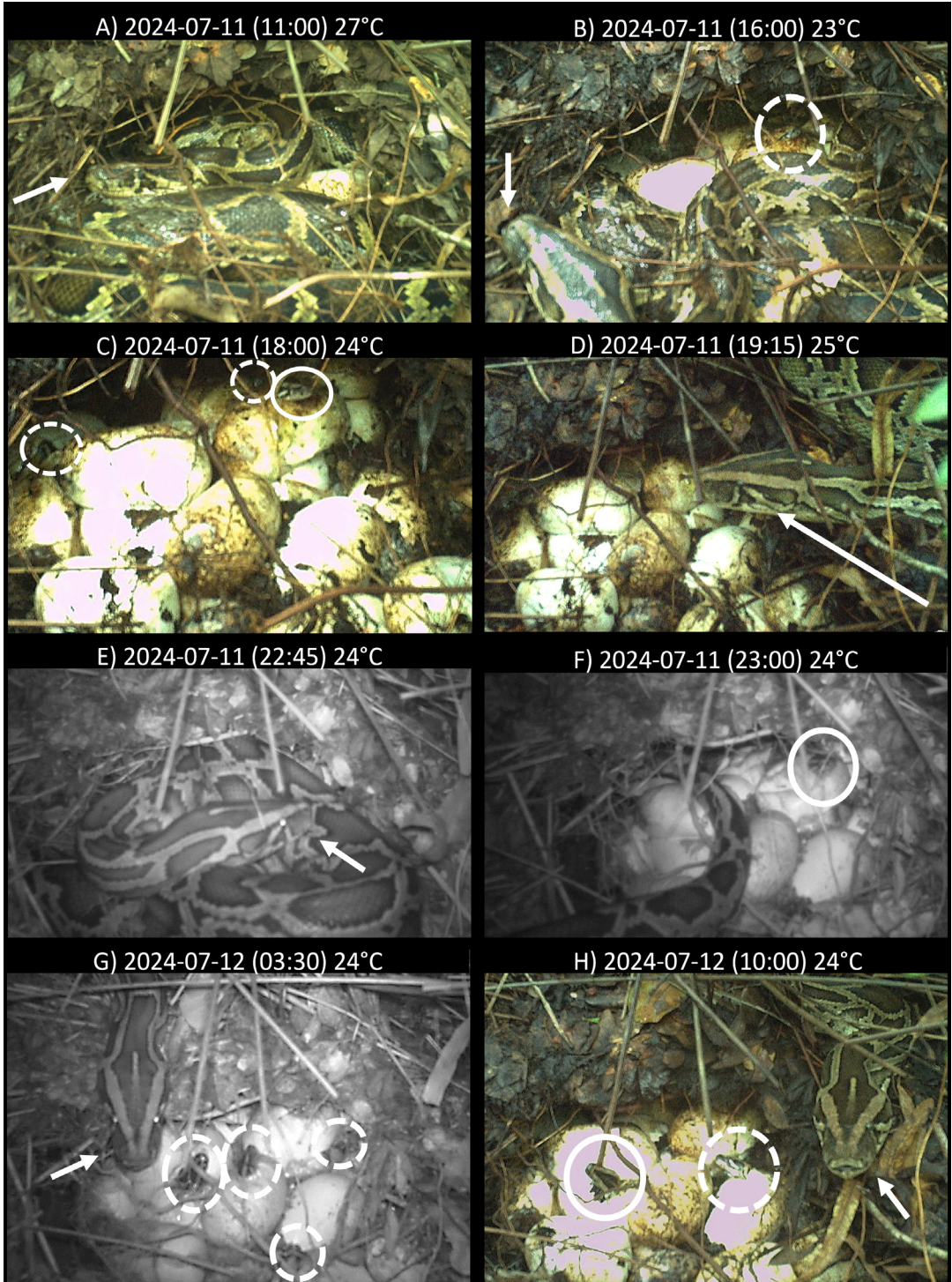
2024 until 29 July 2024). The live feed from the cellular cameras indicated the female remained on the nest, coiled around the eggs, engaged in muscle twitching and contraction at intervals of every 5–15 seconds, indicating facultative thermogenesis was occurring despite warm ambient temperatures of 21.1 to 38.3 °C for the duration of brooding (NOAA, 2025; Guzy et al., 2025). On 28 July 2024, at 17:26 h, and continuing through 29 July 2024 at 04:01 h, images document Python #2 actively moving around her nest, alternating between coiling loosely and tightly across all eggs (Fig. 3 A–E). At 18:36 h, Python #2 was observed engaging in shivering thermogenesis as the first hatchlings began to pip. Python #2 remained coiled around the eggs through the night, with additional hatchlings pipping and at least 4 individual hatchlings visible (Fig. 3) until the camera went offline at 04:06 h on 29 July 2024. On 29 July 2024



Figure 2. Time-series of brooding observations for a free-ranging adult female Burmese python (*Python bivittatus*; Python #1, white arrows indicate head of python) in Big Cypress National Preserve, Collier County, Florida, USA. Images are from cellular trail cameras positioned in front of the nest, that recorded female movements on (A, B, E) and off the nest (C, D, F, G, H) but remaining at nest as hatchling pipping (white circles) progressed over 18-hours from 11 July 2024 to 12 July 2024 (Table 1). Dashed circles indicate 8 separate individuals (B, C, F, G, H; Table 1), and solid circles are different views of repeat individuals. Python #1 attending hatchlings (G) and was seen tongue-flicking during progression of pipping (B, D, G, H). Photo source: Public Domain.

at 09:39 h, an intervention team approached Python #2's nest to prevent hatchling escape. During this time Python #2 moved off the nest and did not return. Prior

to intervention, Python #2 remained with her eggs for approximately 16 hours after pipping and incubated her eggs for an estimated 53 days (Table 1).



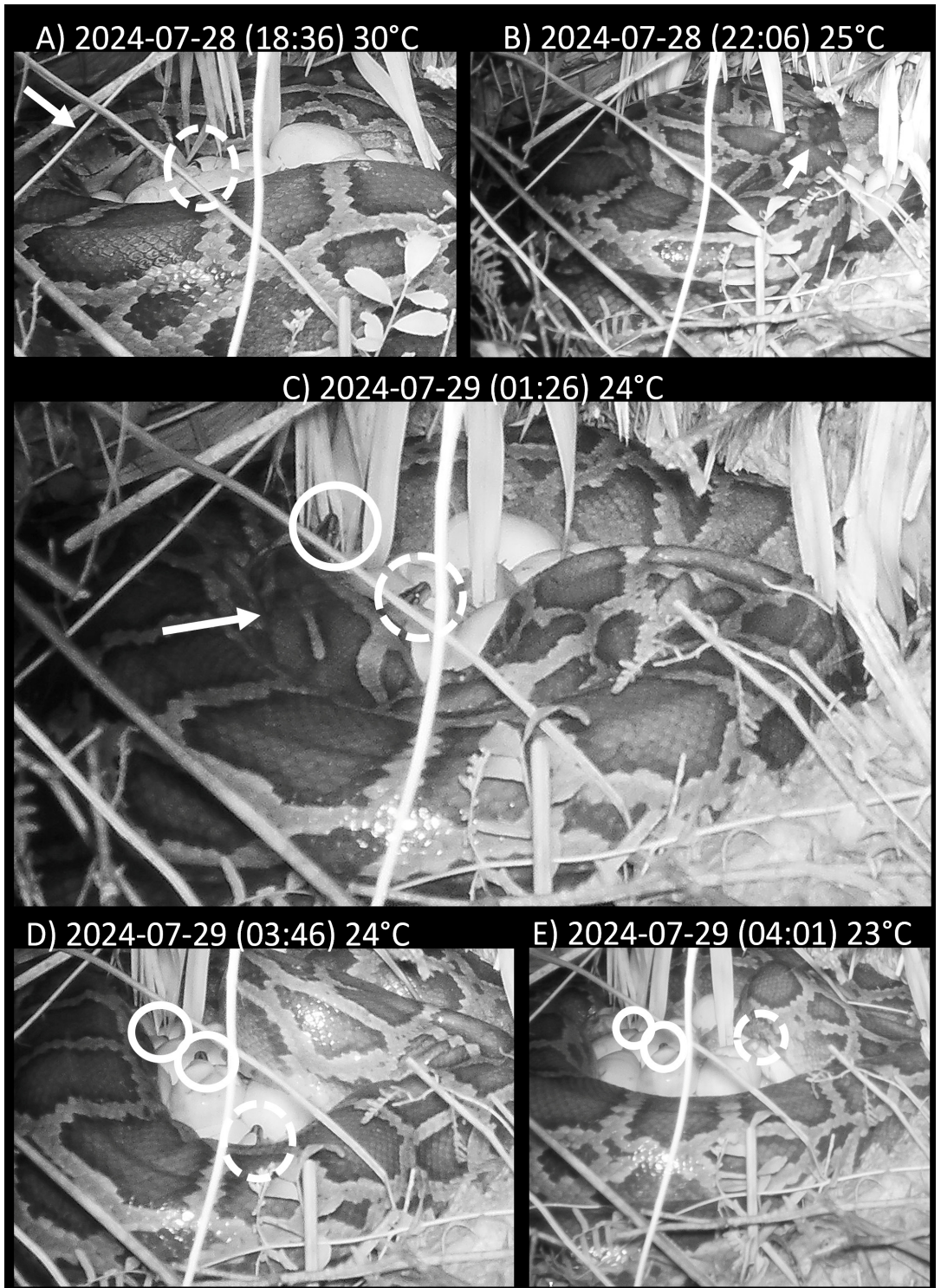


Figure 3. Time-series of brooding observations for a free-ranging adult female Burmese python (*Python bivittatus*; Python #2, white arrows indicate head of python) in Big Cypress National Preserve, Collier County, Florida, USA. Images are from a cellular trail camera positioned in front of the nest, that recorded female movements around the nest from tightly coiled (B) to loosely coiled (E) as hatchlings pipped (white circles, A, C, D, E) over a 16.2-hour time frame from 28 July 2024 to 29-July 2024 (Table 1). Dashed circles indicate 4 separate individuals, and solid circles are different views of repeat individuals. Photo source: Public Domain.



Enclosed wild-caught Female #3. A Spartan cellular camera was deployed on 10 May 2024 and remotely monitored hourly; 30-sec videos were recorded every two hours starting 21 May 2024. On 15 May 2024, Python #3 (270 cm SVL; 18.1 kg; Table 1) oviposited within a hide box (77 x 38 x 36 cm) and was observed coiled around eggs. Video footage documented facultative thermogenesis began as early as 16 May 2024 at 07:04 h. For the duration of brooding, video footage indicated the female remained on the nest, coiled around the eggs, engaged in muscle twitching and contraction, indicating facultative thermogenesis was occurring despite warm ambient temperatures of 27.8 to 37.2 °C for the duration

of brooding (NOAA, 2025; Guzy et al., 2025). On 10 July 2024 at 22:13 h a hatchling was visible, and emerged further by 11 July 2024, at 00:13 h (Fig. 4A–B). Later that evening at 18:13 h, a second hatchling was seen under Python #3's coils (Fig. 4C). On 12 July 2024 at 00:07 h, to prevent its escape from the enclosure, we removed a fully emerged hatchling and Python #3 was defensive, striking at the approaching person while remaining coiled around the clutch. By 01:06 h Python #3 began to move off the clutch and by 02:13 h, she had fully moved off the eggs. At 02:38 h she was observed next to the nest, within the hide box, tongue-flicking the eggs through 04:03 h (Fig. 4D). Prior to intervention,



Figure 4. Time-series of brooding observations for a wild-caught adult female Burmese python (*Python bivittatus*; Python #3; white arrows indicate head of adult female python) placed in an outdoor enclosure (see Fig. 1) on the campus of the University of Florida Fort Lauderdale Research and Education Center in Broward County, FL, USA. Images from a cellular trail camera positioned in front of the nest recorded female movements from tightly coiled on the nest (A), to loosening coils as hatchlings (white circles) began to pip (B, C), and as she moved off the nest (D) over 41.9-hours from 10 July 2024 to 12 July 2024 (Table 1). During this time up to 2 individual hatchlings were seen visibly pipping (white circles, A, C) and the adult female was observed tongue-flicking hatchlings (D). Dashed circles indicate 2 separate individuals, and solid circles are different views of repeat individuals. Photo source: Public Domain.

Python #3 remained with her eggs for approximately 42 hours after pipping, despite the presence of a second hide box offering a retreat and brooded her clutch for a total of 56 days (Table 1).

Using cellular cameras, we observed the entire brooding period for three wild female Burmese pythons (two free-ranging, one enclosed) in their invasive range in southern Florida. All three female pythons exhibited facultative shivering thermogenesis behaviour for the duration of brooding. While this behaviour has been well documented for captive Burmese pythons (Hutchison et al., 1966; Brashears and DeNardo, 2013), our observations add to the growing body of research documenting this behaviour in wild pythons (Snow et al., 2010; Currylow et al., 2025). These females brooded nests between 53–56 days and most notably, all three remained with their clutch as hatchlings began to emerge from eggs; staying with hatchlings for 16–42 hours before we intervened to prevent hatchling escape (Table 1).

Thus far, data on free-ranging nesting Burmese pythons are scarce, and in the invasive range, this is largely because removal, particularly of reproductive females, has been a main priority. Observations of free-ranging female Burmese pythons on nests have been limited to two individuals from Everglades National Park in southern Florida that were enclosed in monitoring structures once eggs were laid; both left nests three and 12 days prior to hatching (Hanslowe et al., 2016; Wolf et al., 2016). Two females of the closely related Indian Python (*Python molurus*), have been observed in Keoladeo National Park, India, leaving their nests 11–13 days prior to hatching and not returning (Ramesh and Bhupathy, 2010). Adding to these limited data, Smith et al. (2024) documented two free-ranging Burmese pythons in Sakaerat Biosphere Reserve, Thailand, leaving eggs unattended one to three days prior to hatching. Taken together, these observations suggest there is variation around the length of time female pythons remain with eggs at oviposition sites prior to hatching. Females may leave their eggs prior to hatching for physiological needs that may increase their survivorship such as feeding, hydration, or basking (e.g., Madsen and Shine, 1999), to shed ectoparasites (Ramesh and Bhupathy, 2010), or because of disturbance from humans or predators (e.g., Currylow et al., 2022). In captivity, there has been one report of a captive python remaining with the clutch as hatchlings emerged over the course of one week (Marshall, 1893) and two observations of captive female Indian pythons that left

the nest approximately three days prior to hatchling emergence (Schlott, 1935; Lederer, 1956). At the time of our intervention, all three females were either coiled around their eggs, or directly adjacent to the eggs, and it is unknown how long they would have remained with hatchlings without intervention. For example, recent work on free-ranging Southern African Pythons (*Python natalensis*) documented females remaining with their hatchlings for approximately two weeks post-hatching, alternating between brief bouts of basking on the surface and coiling around the hatched eggs, on which the hatchlings rested (Alexander, 2018). This same extended maternal attendance may occur with Burmese pythons and has potential implications of increased clutch and hatchling survival, both important drivers of population dynamics. Our observations provide the second report of maternal attendance of hatchlings in an oviparous snake.

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