



Nest fidelity of purple sunbird (*Cinnyris asiaticus*) on communal webs of a spider

Nest predation is a major cause of avian breeding failure and parent birds adopt various anti-nest predation strategies to increase the survival rate of offspring (Feng *et al.* 2019). Purple sunbird uses snake moults as nest-building material, which could be a tactic to avoid predation of eggs and hatchlings inside the nest (Vyas 2021).

Individuals of many migratory bird species tend to return to the same location each year for breeding. This breeding-site fidelity and natal philopatry are major determinants of the geographic distribution and population structure of avian fauna (Greenwood 1980, Greenwood & Harvey 1982). A study by Shitikov *et al.* (2012) on breeding-site fidelity of three species from the order Passeriformes: booted warbler (*Hippolais caligata*), whinchat (*Saxicola rubetra*) and yellow wagtail (*Motacilla flava*) gave us considerable information on the breeding site fidelity of migratory birds. Mishra (2014) found that sunbirds rear at least two broods in succession and often uses the same nest for breeding. The nest fidelity phenomenon in resident birds has not yet been systematically documented. Here we document nest fidelity in the purple sunbird and its commensal relationship with social spiders.

The purple sunbird is a widely distributed and very common sunbird species spread across the Indian subcontinent and Southeast Asia (Ali & Ripley 1983). They primarily feed on nectar, although they prefer invertebrates while feeding their nestlings. Purple sunbirds exhibit sexual dimorphism in their plumage pattern. The breeding season varies from place to place (Mishra 2014), usually late autumn (November) and early winter (January), when flowers are abundant (Gharidian *et al.* 2008). While breeding, female purple sunbirds build a hanging nest and lay 2 to 3 eggs. The purple sunbird performs unique nesting behaviour to maintain

its breeding success. They can construct a hanging pouch-like nest made of cobwebs on tree branches, bushes, and fences etc. Choice of nest site is influenced by various factors such as food supply, risk of predation, and nest ectoparasites that can affect the survival of the young (Khan *et al.* 2020). Therefore, some birds, maintain a high degree of fidelity towards nest sites and nests. This has several benefits including familiarity with foraging and shelter sites. Compared with changing nest sites, breeding in familiar surroundings may increase predator avoidance, parental health, and thus, breeding success (Feng *et al.* 2019). Therefore, high nest site fidelity is common for many monogamous birds (White *et al.* 1997). Laying eggs in a familiar nest increases the survival rate of offspring. Presently, purple sunbird comes under the least concern category of threat (IUCN 2019), although they may become impacted by activities such as rapid urbanization. This is the first descriptive study on purple sunbird nest fidelity or nest reuse of a nest built on the communal web of the social spider, *Stegodyphus sarasinorum* (Araneae: Eresidae).

The nest fidelity of the purple sunbird using the communal web of a social spider was studied from the fencing stone poles of a Sewage Treatment Plant (STP) in Mannampandal (11.1094603°N, 79.6953181°E), which uses a waste stabilization pond system to treat sewage from Mayiladuthurai district. It functions under the Tamil Nadu Water Supply and Drainage Board of Mayiladuthurai District, Tamil Nadu. The average temperature is 28.1°C and annual rainfall is 1109mm (Climate-data.org). The STP is surrounded by agricultural lands cultivated with large deciduous tree species such as teak, bamboo and large shrubs such as *Calotropis gigantea*.

The nest fidelity of purple sunbird was opportunistically observed from February 2020 to May 2020 (we couldn't monitor continuously due to pandemic curfew), without disturbing the birds, from 50 meters away from the nest (Table 1). The observations were made using the Nikon

Aculon Binocular (8×42) and photographed using the Nikon Coolpix P900 digital camera. The nest was examined only when the parental birds were not seen in the vicinity. To help understand the commensal relationship between the purple sunbird and the social spider, we analyzed posts on Facebook pages (e.g. Indian Birds, Spider India) from 2011 to 2021. We also used #purplesunbird on Instagram to see if there was any information regarding this relationship.

Table 1. Nest fidelity observations of a purple sunbird pair using the same nest in STP

Clutch	Sampling dates in year 2020
1 st clutch	February: 14, 16, 18, 21, 23, 25, 26, 27
2 nd clutch	March: 19, 21, 22, 28
3 rd clutch	April: 28, 29; May: 1, 4, 6, 8

The oval-shaped nest with two eggs, which were incubated by the female, was found in the middle of the communal social spider web. The entire nest wall was surrounded by the communal web except for the oval-shaped entrance. Interestingly, there was no antagonistic relationship between the spiders and purple sunbirds during all our opportunistic nesting observations. We observed a total of three clutches from the same purple sunbird pair using the same nest (Table 2).

Table 2. Breeding success of purple sunbird from three clutches in the same nest

Clutch	Clutch size	No. of eggs hatched	No. of fledglings matured
1 st	2	2	2
2 nd	2	1	1
3 rd	2	2	2

We retrieved 23 posts containing information about the commensal relationship between purple sunbirds and social spiders from various online forums between 2011 and 2021 (Appendix I). Among them, we found five different activities as part of this commensalism from eight locations (which include 22 records from various states of India and one from Sri Lanka) (Fig. 1). Most of the records are from Karnataka and Tamil Nadu regions (seven each). The five different parental activities in the commensal relationship were collection of nest materials, feeding the chicks, hunting the spiders, nest building and nest incubation (Table 3). In all the posts recorded, females participated in nest building more than males.

Table 3. Parental activities of purple sunbirds; F = female, M = male, B = both

Parental Activities	F	M	B	Total
Collecting nesting material	6	1	0	7
Feeding the chicks	0	4	0	4
Hunting spiders	1	1	1	3
Nest building	5	0	0	5
Nest incubation	4	0	0	4
Total				23

Mishra (2014) found that the selection of nest location for birds can be problematic since it can affect predation. The cobweb enveloping the purple sunbird nest also provides strength, flexibility, and protection from rain (Arya *et al.* 2020). Thus, the nest built on the communal web proved to be perfectly camouflaged and ensured protection from harsh weather conditions and from predators.

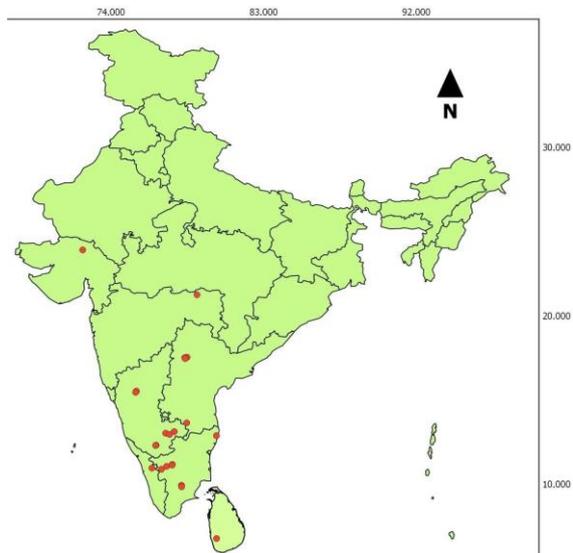


Figure 1. Locations of the commensal relationship between purple sunbirds and social spiders reported in India and Sri Lanka

According to Ali (2002), the nesting season of the purple sunbird is variable but is mostly from March to May. The birds that reproduced successfully are more likely return to the sites of that success (Kumar *et al.* 2020) and some even reuse their old nests for multiple breeding attempts within a breeding season (Feng *et al.* 2019). Our study recorded a total of three clutches laid in the same nest built on the communal social spider web from February 2020 to May 2020. Kumar *et al.* (2020) recorded purple sunbirds laying three successful clutches in the same nest built on a swing chain in the 2017 breeding season and four clutches, three in 2018 and one in 2019 in the same nest built on a

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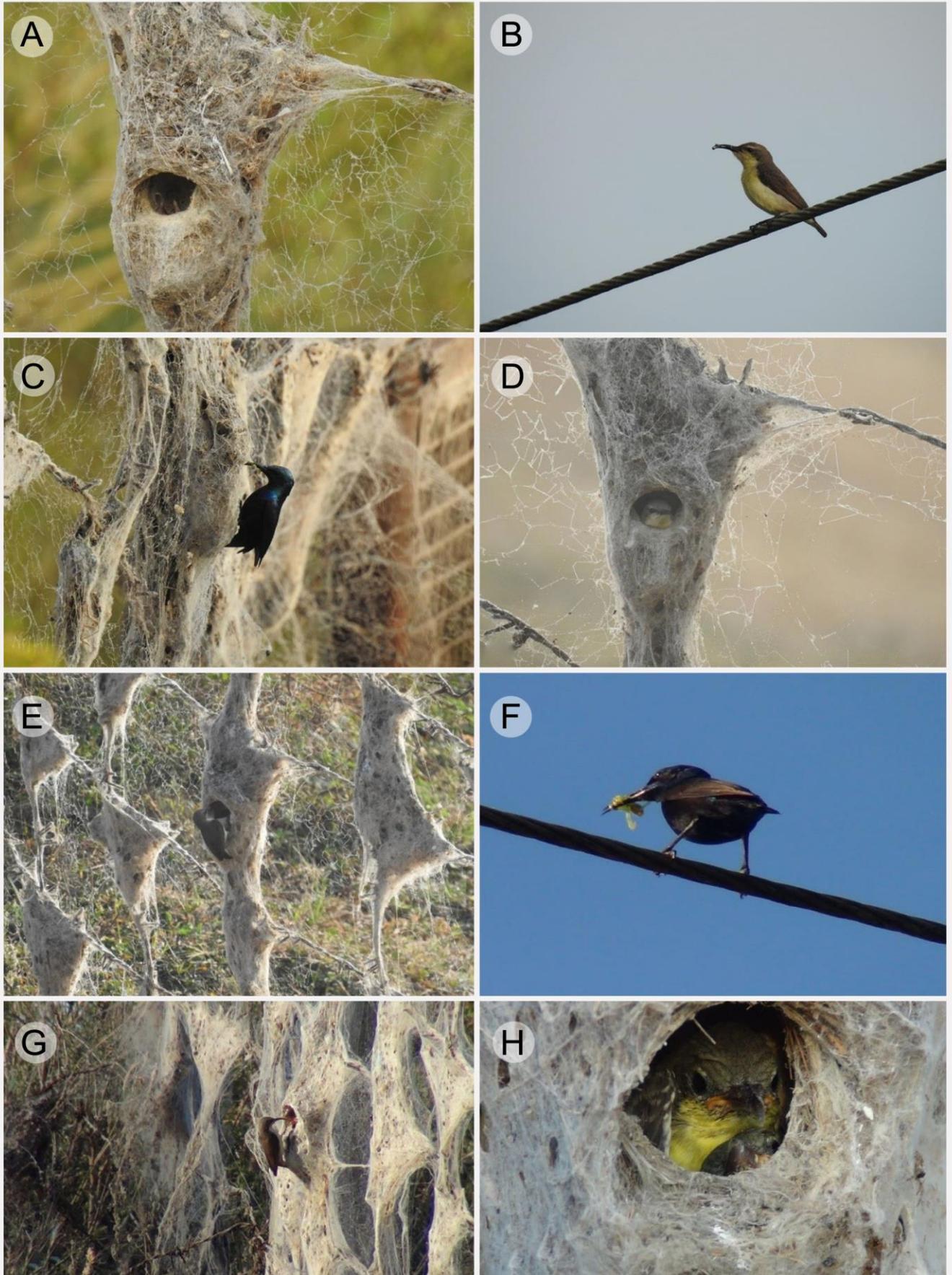


Figure 2. Three clutches of the purple sunbird nesting on the communal web of social spiders: (A) two nestlings found in the first clutch, (B) female parent waiting with the food on a wire above the nest, (C) male parent feeding nestlings present in the first clutch, (D) female parent incubating two eggs in the second clutch, (E) female parent feeding the nestling present in the second clutch, (F) male parent waiting with food on a wire above the nest, (G) female parent feeding, (H) female parent with two nestlings in the third clutch.

bicycle cable in a semi-urban area of Punjab. There have been no previous records of purple sunbirds using the same nest built on a web of communal social spiders. As far as we know this is the first study to record this phenomenon.

Feng *et al.* (2019) defined a nest as successful if it produced at least one fledgling, while a nest found damaged, containing broken eggshells or dead nestlings was defined as depredated. In our study, all three clutches were successful. Among the two eggs in each clutch, only one egg in the second clutch was unhatched. As we did not encounter any nest predation activity in all three clutches of the purple sunbird nesting on this communal web, the commensal relationship appears to have a strong survival value for this bird.

The 23 records from the public domain show that a commensal relationship between the purple sunbird and social spiders is common yet there are very few records in the scientific literature. There are many records of purple sunbirds using the web of social spiders as their nesting material but very few records of nest construction on the communal web itself. Abeywardhana *et al.* (2018) reported purple sunbirds building a nest as an extension of an Indian cooperative spider web on the Bushweed, *Flueggea leucopyrus* (Euphorbiaceae), in Ussangoda National Park, Sri Lanka. Kadam & Rajkumar (2020) documented purple sunbirds using the communal web of a social spider from SACON Campus in Anaikatty, Coimbatore. The data collected from the public forums also tells us that most of the nest building and incubation activities are done by females, but males join the female in feeding the chicks (Appendix I). In our study, we also recorded only females incubating the eggs.

Our study shows the high level of nest fidelity in purple sunbirds building a nest on the web of a social spider. We also found that purple sunbirds are prone to reusing the same nest within a breeding season and in some cases the next breeding season. Therefore, we strongly suggest that future studies examining the nests of purple sunbirds be conscious of the risk of disturbing these birds since they have an affinity with previous nesting sites and have strong nest fidelity. Our opportunistic study findings also highlight the need for studies on the breeding ecology of this least concern species. We also recommend further studies on the commensalism relationship between purple

sunbirds and social spiders in order to reveal the evolutionary significance of that association.

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Section Editor: Sumudu Fernando
- P. Selvaraj^{1,2} & S. Kamalanathan^{1,2}
- ¹ PG & Research Department of Zoology & Wildlife Biology, A.V.C College (Autonomous), Mannampandal, Mayiladuthurai 609305, India
² Salim Ali Centre for Ornithology & Natural History, Anaikatty (Post), Coimbatore 641108, India
E-mail: prachemist@gmail.com

Appendix I. List of commensalism activities between purple sunbirds and social spiders generated from social networking sites

Locality and date	Courtesy & referral site
1 Dethali/North Gujarat, India, APR 2015 Male purple sunbird collecting nesting material from communal web.	M. Shah: Facebook
2 Chennimalai/TamilNadu, India FEB 2015 Female purple sunbird collecting nesting material from communal web.	K. Shanmugam: Facebook
3 Unknown, JUN 2011 Female purple sunbird collecting nesting material from communal web.	P. Arjun: Facebook
4 Karnataka, India, JAN 2020 Both male and female purple sunbirds hunting spiders from the communal web.	V. Krishna: Facebook
5 Karnataka, India, DEC 2019 Male purple sunbird hunting spiders from the communal web.	V. Krishna: Facebook
6 Rishi valley/Andhra Pradesh, India, JAN 2021 Female purple sunbird incubating the nest built on the communal web of social spider.	V. Santharam: Instagram
7 Mysuru/Karnataka, India, MAR-2019 Female purple sunbird incubating the nest built on the communal web of social spider.	A.P.C. Abijith: SpiderIndia
8 Kerala, India, Nov 2016 Female purple sunbird building the nest on the communal web of social spider.	C.S. Kumar: Facebook
9 Karnataka, India, MAR 2014 Female purple sunbird collecting nesting material from communal web.	Arun: Facebook
10 Nagpur, India, NOV 2011 Female purple sunbird collecting nesting material from communal web.	A.C. Ketteringham: Facebook
11 Tirupur, Tamil Nadu, India, DEC 2020 Female purple sunbird incubating the nest built on the communal web of social spider.	S.R.N. Kumar: Instagram
12 Bangalore, India, MAR 2017 Male purple sunbird feeding the chicks present in the nest built on the communal web of social spider.	S. Pasumarti: Facebook
13 Bangalore, India, OCT 2012 Female purple sunbird building the nest on the communal web of social spider.	A. Haarith: Facebook
14 Madurai, Tamil Nadu, India, MAR 2020 Female purple sunbird building the nest on the communal web of social spider.	Sathish: Instagram