

Surveys of Avifauna at Gunung Inas Forest Reserve in Kedah, Malaysia

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Abstract. Surveys of avifauna were conducted at Gunung Inas Forest Reserve in Kedah, which constitutes under the Central Forest Spine (CFS) ecological corridor named K-PL1: Ulu Muda Forest Reserve – Gunung Inas Forest Reserve. The surveys were carried out in September and October 2023. The objective of the study is to update the checklist of avifauna recorded at the Gunung Inas Forest Reserve. In this study, two study plots of one-hectare each were established and referred to as Gunung Inas Forest Reserve I (Gunung Inas FR I) and Gunung Inas Forest Reserve II (Gunung Inas FR II). The one-hectare size plot consists of 10 transect lines. A total of 10 mist nets were deployed at each site. The mist-nets were set for five consecutive nights per session, with two sampling sessions per site. In additions, direct observations were also conducted especially for nocturnal and canopy-dwelling species. A total of 47 individuals, comprising 31 species of avifauna (18 families) were documented. In this study, Gunung Inas FR I obtained a higher number of recorded avifauna species with a total of 22 species (15 families), whilst Gunung Inas FR II harbor least records with 16 species (12 families). There is an additional of 28 species recorded during these surveys in comparison to the previous studies, thus, giving the overall cumulative avifauna species recorded is 84 species. Through these results, it is shown that this fragmented forest under K-PL1 still resides by a vast array of avifauna species. Hence, it is hoped that the significance of Gunung Inas FR as a vital habitat for these flying vertebrates can be further emphasized, and appropriate conservation measures must be taken to safeguard their population.

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1 Introduction

The tropical rainforest of Malaysia holds a vast variety of habitats and ecosystems that sustain a high level of biodiversity including avifauna. To date, there are more than 800 species of avifauna are found throughout Malaysia. However, ongoing development has not spared Malaysia from considerable environmental impacts. Human activities, such as converting forests into agricultural land, urban areas, and industrial sites, have resulted in habitat degradation and forest fragmentation. This fragmentation disrupts the continuity of habitats, which can alter the natural composition of species [1]. Ultimately, this may lead to severe consequences, including habitat destruction and a decline in biodiversity, particularly for species that rely on forests.

Thus, the National Policy on Biological Diversity (NPBD) 2022-2030 has identified the vital need of ecological connectivity to protect habitats which are important for the viability of wildlife populations. To support the goal, the government has introduced an initiative called Central Forest Spine (CFS). CFS is a government initiative to connect, maintain, preserve and conserve fragmented forest areas in Peninsular Malaysia. Under this initiative, ecological corridors are identified to ensure there is a physical network of forests that are connected in the entire CFS landscape. Hence, offering a larger and continuous expanse of forest complexes for wildlife in Peninsular Malaysia. According to the current CFS masterplan namely *Pelan Induk Rangkaian Koridor Ekologi Central Forest Spine 2022*, a total of 39 ecological corridors were identified in Peninsular Malaysia. It comprises of 20 primary linkages (PL) and 19 secondary linkages (SL) involving eight states, namely Kedah, Perak, Pahang, Kelantan, Terengganu, Johor, Negeri Sembilan and Selangor [2]. The establishment of these ecological corridors could promote a sustainable balance between development and conservation, fostering coexistence and mutual benefits.

Gunung Inas Forest Reserve (Gunung Inas FR) is part of Banjaran Bintang Hijau, the third largest mountain range in Peninsular Malaysia. This forest reserve is in the district of Baling, Kedah. The forest coverage is 37,346 ha and comprises a combination of lowland dipterocarp, hill dipterocarp, lower montane and upper montane forests [3-4]. Gunung Inas FR is one of the identified fragmented forest reserves under the Central Forest Spine initiative. It is adjoining with Ulu Muda Forest Reserve and classified as primary linkage named K-PL1 or previously known as CFS1-PL5. This ecological corridor covers an area of 4,635ha [2]. Besides being an important water catchment area for Pedu, Muda, and Ahning Dams, this ecological corridor is also reported to hold the highest wildlife species as compared to the other identified ecological corridors, houses a rich array of species, including enigmatic wildlife such as the Asian elephant, Tapir and Great Hornbill [2].

Previously, studies on avifauna in Gunung Inas FR has been carried out by Shahrul Anuar et al. [5] and Yeap & Balu [6]. While there are reports on the avifauna of this forest reserve, the information remains limited and lacks sufficient study, particularly concerning understory bird species. Therefore, this study aims to update the list of avifauna species at Gunung Inas FR, focusing on understory species. This updated information could offer valuable data to decision-makers, particularly state and local authorities, for effectively managing the area as a crucial habitat for in-situ conservation of avifauna populations.

2 Materials and Methods

2.1 Study sites

The surveys were conducted at two plots, referred to in these surveys as Gunung Inas Forest Reserve I (Gunung Inas FR I) and Gunung Inas Forest Reserve II (Gunung Inas FR II). These plots were separated by Kuala Kangsar-Grik-Pengkalan Hulu road. Gunung Inas FR I (N 05°43'08.7", E 100°58'29.6") is located approximately 500m north from the road and adjacent to the rest and service area called R&R Gunung Inas, whilst Gunung Inas FR II (N 05°42'53.1, E 100°58'38.4") positioned about 300m south from the road and located adjacent to military facility named Kem Batalion 18 PGA Pengkalan Hulu. The average elevation of both plots is approximately 300m above sea level, and they are primarily covered with lowland forest trees.



Figure 1. Location of study plots at Gunung Inas FR, Kedah

2.2 Mist-netting

The surveys were conducted twice for each site: 1) 7-12 September 2023 and 7-22 October 2023. At each site, a 1ha (100m x 100m) plot was constructed comprising a total of 10 transect lines (A). The distance between each transect line were 10m intervals. Each survey site is equipped with a total of 10 mist nets (12 m x 2.6 m x 30 mm). These mist nets were placed randomly within the 1ha plot at the potential fly path and were set at about 0.5 m above ground. The nets were left open for five consecutive nights for each survey for 24 hours throughout the sampling session. The nets were checked every two hours, starting from 0630 to 1130 hours, then continue from 1630 to 2230 hours, daily. The cumulative trapping efforts were 200 net nights. Apart from mist-netting, visual observations and opportunistic sightings were also performed whenever possible to observe nocturnal and canopy-dwelling species, particularly.

All the captured species were placed in cloth bags for identification and then safely returned to their nearby habitat. Required morphological measurements, namely Tarsus (T), Bill Length (BL), Bill width (BW), Bill depth (BD), Head bill (HB), Total length (TL), Tail length (TA), Wingspan (WS), Wing length (WL) and live weight (g) including their body conditions for all captured species were recorded. Avifauna identification was carried out using Robson [7]. Representative samples of each species collected were photographed before preservation. Muscle samples were taken and stored in acetone. Specimens were then transferred into 70% denatured ethanol for storage. Voucher materials were deposited at the FRIM Zoological Collection in the Forest Research Institute of Malaysia (FRIM) for further reference.

3 Results and Discussion

Cumulatively, 47 individuals from 31 species of avifauna belonging to 18 families were documented at Gunung Inas FR during the surveys. Among the study sites, Gunung Inas FR I had the highest diversity of avifauna, recording 22 species, while Gunung Inas FR II followed with 16 species (Table 1).

The high avifauna diversity at Gunung Inas FR I may be linked to the extensive forest cover and low canopy openness in the area, which provides greater habitat complexity and favourable microhabitats and microclimatic conditions for various species [9]. Additionally, Gunung Inas FR I experiences less human disturbance, likely due to its challenging terrain, in contrast to Gunung Inas FR II, which is smaller and closer to human settlements and smallholdings.

In Gunung Inas FR I, avifauna that mainly devoured on insects were the most documented species. The presence of insects feeding birds may be associated with habitat conditions. Based on our observation, the area still possesses well-developed canopy structures and understorey secondary vegetation. According to Ewers et al. [10], this condition may support higher biomass density and invertebrate diversity. The availability of invertebrates as food resources may influence the presence of bird species. The placement of mist nets near a decaying tree stump, old logs, and across streams where insects like termites, ants and aquatic insects are present could also affect the results, as these birds may be trapped while foraging for their food. The prevalence of insectivorous birds also may suggest a healthy invertebrate population, indicative of a well-functioning ecosystem.

Furthermore, the Large Blue-Flycatcher (*Cyornis magnirostris*) from the family Muscicapidae was the most caught species in Gunung Inas FR I with five individuals and all of the individuals were caught during the second sampling session in October 2023. The result is aligned with Robson [7] and Puan et al. [8], who stated that this bird is an uncommon winter visitor of Peninsular Malaysia and is typically recorded in late September until April in understorey and midstorey lowland broadleaf forests. This finding may imply Gunung Inas FR I is a hospitable habitat for this migratory species with favourable shelters and resources for them to thrive. In addition, the distribution information on the occurrence of this bird in Malaysia is still scarce. Hence, this information could improve current distribution information of this species in the country as it is believed this might be the first report on the presence of this bird at Gunung Inas FR.

As for Gunung Inas FR II, Pycnonotidae is the family with the highest recorded species (three species). This may be correlated to the wide distribution and abundance of this avian family. According to Robson [7], Pycnonotidae is a family of medium-sized passerine songbirds commonly known as bulbuls. This family is distributed across most of Africa, into the Middle East, tropical Asia and the north, as far as Japan. Besides, all three species captured in Gunung Inas FR II are considered common in lowland forest and can be found in

various habitats such as broad leaves evergreen forest, secondary growth, scrub, plantations and forest edges [7-8].

Overall, the yield of avifauna species at Gunung Inas FR (Gunung Inas FR I and Gunung Inas FR II) is considered low. This was expected due to the short sampling duration, with only five-traps nights in each sampling session. Furthermore, Alwani et al. [11] and Robbins [12] also mentioned seasonality as another factor that may be linked to the number of species recorded. The continuous heavy rain, especially during the second sampling session, may have contributed to the reduction in the number of species recorded. It is supported by Robbins [12], Stewart [13] and Quinlan & Boyd [14], who mentioned that the weather can have a considerable effect on avian activity, net visibility and mist-netting success because high humidity makes the net more visible, resulting in lower bird capture.

Regardless of the low diversity records, most of the avifauna species recorded in these surveys are new additions to Gunung Inas FR. These surveys successfully recorded 28 additional bird species compared to earlier studies, bringing the total reported avifauna to 84 species in this forest reserve, based on previous and current research (Table 2). One of the additional species recorded is Brown-chested Jungle-Flycatcher (*Cyornis brunneatus*). The bird is classified as a Vulnerable (VU) species according to the International Union for Conservation of Nature (IUCN) Red List, and its population was threatened by the rapid and widespread deforestation across the habitats. The arousing number of avifauna species recorded at Gunung Inas FR during this study signifies Gunung Inas FR as an essential habitat for various avifauna, and with proper intensive surveys, the potential for new records is yet to be discovered. Hence, continuous surveys by enhancing the area of coverage, sampling technique, types of microhabitats and different seasonal cycles are recommended to gain a better representation of avifauna species in Gunung Inas FR. The wide-ranging information would facilitate the authorities to identify the ecological needs of these avian communities and enable the implementation of suitable conservation measures to ensure the forest reserve and its adjacent areas are secure for their population sustainability.

Table 1. List of avifauna species recorded at Gunung Inas Forest Reserve, Kedah

No	Families	Common Name	Scientific Name	IUCN	Gunung Inas FR I	Gunung Inas FR II
1	Aegithinidae	Green Iora	<i>Aegithina viridissima</i>	NT	*	
2	Alcedinidae	Black-backed Dwarf-Kingfisher	<i>Ceyx erithaca</i>	LC	2	1
3	Alcedinidae	Banded Kingfisher	<i>Lacedo puclhella</i>	LC		1
4	Alcedinidae	Rufous-collared Kingfisher	<i>Actenoides concretus</i>	NT	1	
5	Bucerotidae	Great Hornbill	<i>Buceros bicornis</i>	VU	*	
6	Columbidae	Emerald Dove	<i>Chalcophaps indica</i>	LC	1	1
7	Cuculidae	Red-billed Malkoha	<i>Phaenicophaeus javanicus</i>	LC	*	
8	Dicaeidae	Crimson-breasted Flowerpecker	<i>Prionochilus percussus</i>	LC	2	1
9	Dicaeidae	Orange-bellied Flowerpecker	<i>Dicaeum trigonostigma</i>	LC		1
10	Hirundinidae	Pacific Swallow	<i>Hirundo tahitica</i>	LC	*	
11	Laniidae	Tiger Shrike	<i>Lanius tigrinus</i>	LC		2
12	Monarchidae	Asian Paradise-Flycatcher	<i>Terpsiphone paradisi</i>	LC		1

13	Muscicapidae	Large Blue-Flycatcher	<i>Cyornis magnirostris</i>	LC	5	
14	Muscicapidae	Brown-chested Jungle-Flycatcher	<i>Cyornis brunneatus</i>	VU	1	
15	Muscicapidae	Siberian Blue Robin	<i>Larvivora cyane</i>	LC	1	
16	Muscicapidae	Chestnut-naped Forktail	<i>Enicurus ruficapillus</i>	NT	2	
17	Nectariniidae	Little Spiderhunter	<i>Arachnothera longirostra</i>	LC	1	2
18	Pellorneidae	Black-capped Babbler	<i>Pellorneum capistratum</i>	LC		2
19	Pellorneidae	Short-tailed Babbler	<i>Trichastoma malaccense</i>	NT	1	
20	Phylloscopidae	Arctic Warbler	<i>Phylloscopus borealis</i>	LC		1
21	Picidae	Rufous Piculet	<i>Sasia abnormis</i>	LC	1	1
22	Pycnonotidae	Black-headed Bulbul	<i>Pycnonotus atriceps</i>	LC		1
23	Pycnonotidae	Stripe-throated Bulbul	<i>Pycnonotus finlaysoni</i>	LC		1
24	Pycnonotidae	Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	LC	*	
25	Pycnonotidae	Red-eyed Bulbul	<i>Pycnonotus brunneus</i>	LC		1
26	Pycnonotidae	Ochraceous Bulbul	<i>Alophoixus ochraceus</i>	LC	4	
27	Timaliidae	Pin-striped Tit-Babbler	<i>Mixornis gularis</i>	LC	1	
28	Timaliidae	Chestnut-winged Babbler	<i>Cyanoderma erythropterum</i>	LC	1	
29	Timaliidae	Grey-throated Babbler	<i>Stachyris nigriceps</i>	LC	1	1
30	Trogonidae	Scarlet-rumped Trogon	<i>Harpactes duvaucelii</i>	NT	1	
31	Vireonidae	White-bellied Erpornis	<i>Erpornis zantholeuca</i>	LC	2	1
Total number of Species					22	16
Total number of Individuals					28	19
Total number of Family					15	12

IUCN: International Union for Conservation of Nature; LC= Least Concern; NT=Near Threatened; VU=Vulnerable
 (*) = Observation

Table 2. A compilation of avifauna recorded in Gunung Inas Forest Reserve from previous and current studies.

No	Families	Common Name	Scientific Name	IUCN	Shahrul Anuar (2009)	Yean & Balu (2017)	Present Study (2023)
1	Accipitridae	Oriental Honey-buzzard	<i>Pernis ptilorhynchus</i>	LC	/		
2	Accipitridae	Black Baza	<i>Aviceda leuphotes</i>	LC	/		
3	Accipitridae	Crested Serpent-Eagle	<i>Spilornis cheela</i>	LC	/		
4	Accipitridae	Bat Hawk	<i>Macheiramphus alcinus</i>	LC	/		
5	Accipitridae	Changeable Hawk-Eagle	<i>Nisaetus limaeetus</i>	LC	/		
6	Accipitridae	Blyth's Hawk-Eagle	<i>Nisaetus alboniger</i>	LC	/		
7	Accipitridae	Wallace's Hawk-Eagle	<i>Nisaetus nanus</i>	VU	/		
8	Accipitridae	Rufous-bellied Eagle	<i>Lophortyx keinerii</i>	LC	/		
9	Accipitridae	Crested Goshawk	<i>Accipiter trivirgatus</i>	LC	/		
10	Accipitridae	Chinese Sparrowhawk	<i>Accipiter soloensis</i>	LC	/		
11	Accipitridae	Japanese Sparrowhawk	<i>Accipiter gularis</i>	LC	/		
12	Accipitridae	White-bellied Sea Eagle	<i>Haliaeetus leucogaster</i>	LC	/		
13	Accipitridae	Lesser-Fish-Eagle	<i>Ichthyophaga humilis</i>	NT	/		
14	Aegithinidae	Green Iora	<i>Aegithina viridissima</i>	NT			x
15	Alcedinidae	Black-backed Dwarf-Kingfisher	<i>Cyx erithaca</i>	LC			x
16	Alcedinidae	Banded Kingfisher	<i>Lacedo puchella</i>	LC			x
17	Alcedinidae	Rufous-collared Kingfisher	<i>Acioides concretus</i>	NT			x
18	Bucerotidae	Black Hornbill	<i>Anthraccoceros malayanus</i>	VU		/	
19	Bucerotidae	Rhinoceros Hornbill	<i>Buceros rhinoceros</i>	VU		/	
20	Bucerotidae	Great Hornbill	<i>Buceros bicornis</i>	VU		/	/
21	Bucerotidae	Busby-crested Hornbill	<i>Anorrhinus galeritus</i>	NT		/	
22	Bucerotidae	White-crowned Hornbill	<i>Aceros comatus</i>	EN		/	

23	Bucerotidae	Wreathed Hornbill	<i>Aceros undulatus</i>	VU		/
24	Caprimulgidae	Malaysian Nighthjar	<i>Lyncornis temminckii</i>	LC	/	
25	Caprimulgidae	Great Eared-Nighthjar	<i>Lyncornis macrotis</i>	LC	/	
26	Columbidae	Spotted Dove	<i>Streptopelia chinensis</i>	LC	/	
27	Columbidae	Barred Cuckoo-Dove	<i>Macropygia unchall</i>	LC	/	
28	Columbidae	Emerald Dove	<i>Chalcophaps indica</i>	LC	/	/
29	Columbidae	Green Imperial-Pigeon	<i>Ducula aenea</i>	LC	/	
30	Columbidae	Mountain Imperial-Pigeon	<i>Ducula badia</i>	LC	/	
31	Cuculidae	Moustached Hawk-Cuckoo	<i>Hierococyx vagans</i>	NT	/	
32	Cuculidae	Indian Cuckoo	<i>Cuculus micropterus</i>	LC	/	
33	Cuculidae	Banded Bay Cuckoo	<i>Cacomantis sonnerati</i>	LC	/	
34	Cuculidae	Plainive Cuckoo	<i>Cacomantis merulinus</i>	LC	/	
35	Cuculidae	Asian Emerald Cuckoo	<i>Chrysococcyx maculatus</i>	LC	/	
36	Cuculidae	Violet Cuckoo	<i>Chrysococcyx xanthorhynchus</i>	LC	/	
37	Cuculidae	Square-tailed Drongo-Cuckoo	<i>Surriculus lugubris</i>	LC	/	
38	Cuculidae	Black-bellied Malkoha	<i>Phaenocophaeus diardi</i>	NT	/	
39	Cuculidae	Green-billed Malkoha	<i>Phaenocophaeus tristis</i>	LC	/	
40	Cuculidae	Raffles's Malkoha	<i>Phaenocophaeus chlorophaeus</i>	LC	/	
41	Cuculidae	Red-billed Malkoha	<i>Phaenocophaeus javanicus</i>	LC	/	/
42	Cuculidae	Chestnut-breasted Malkoha	<i>Phaenocophaeus curvirostris</i>	LC	/	
43	Cuculidae	Greater Coucal	<i>Centropus sinensis</i>	LC	/	
44	Dicaeidae	Crimson-breasted Flowerpecker	<i>Prionochilus percussus</i>	LC		x
45	Dicaeidae	Orange-bellied Flowerpecker	<i>Dicaeum trigonostigma</i>	LC		x
46	Estrildidae	White-rumped Munia	<i>Lonchura striata</i>	LC	/	

47	Falconidae	Black-thighed Falconet	<i>Microhierax fingillaricus</i>	LC	/		
48	Hirundinidae	Pacific Swallow	<i>Hirundo tahitica</i>	LC			x
49	Laniidae	Tiger Shrike	<i>Lanius tigrinus</i>	LC			x
50	Monarchidae	Asian Paradise-Flycatcher	<i>Terpsiphone paradisi</i>	LC			x
51	Motacillidae	Grey Wagtail	<i>Motacilla cinerea</i>	LC	/		
52	Motacillidae	Forest Wagtail	<i>Dendronanthus indicus</i>	LC	/		
53	Muscicapidae	Large Blue-Flycatcher	<i>Cyornis magnirostris</i>	LC			x
54	Muscicapidae	Brown-chested Jungle-Flycatcher	<i>Cyornis brunneatus</i>	VU			x
55	Muscicapidae	Siberian Blue Robin	<i>Larvivora cyane</i>	LC			x
56	Muscicapidae	Chestnut-naped Forktail	<i>Enicurus ruficapillus</i>	NT			x
57	Neectariniidae	Little Spiderhunter	<i>Arachnothera longirostra</i>	LC			x
58	Pellorneidae	Black-capped Babbler	<i>Pellorneum capistratum</i>	LC			x
59	Pellorneidae	Short-tailed Babbler	<i>Trichastoma malaccense</i>	NT			x
60	Phasianidae	Red Junglefowl	<i>Gallus gallus</i>	LC	/		
61	Phasianidae	Great Argus	<i>Argusianus argus</i>	VU	/		
62	Phylloscopidae	Arctic Warbler	<i>Phylloscopus borealis</i>	LC			x
63	Picidae	Rufous Piculet	<i>Sasia abnormis</i>	LC			x
64	Psittacidae	Blue-rumped Parrot	<i>Psittinus cyanurus</i>	NT	/		
65	Podargidae	Gould's Frogmouth	<i>Barrachostomus stellans</i>	NT	/		
66	Psittacidae	Blue-crowned Hanging-Parrot	<i>Loriculus galgulus</i>	LC	/		
67	Pycnonotidae	Black-headed Bulbul	<i>Pycnonotus arceps</i>	LC			
68	Pycnonotidae	Stripe-throated Bulbul	<i>Pycnonotus finlaysoni</i>	LC			x
69	Pycnonotidae	Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	LC			x
70	Pycnonotidae	Red-eyed Bulbul	<i>Pycnonotus brunneus</i>	LC			x
71	Pycnonotidae	Ochraceous Bulbul	<i>Alophoixus ochraceus</i>	LC			x

72	Rallidae	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	LC	/		
73	Rallidae	Ruddy-breasted Crane	<i>Porzana fusca</i>	LC	/		
74	Strigidae	Collared Scops Owl	<i>Otus lettia</i>	LC	/		
75	Strigidae	Barred Eagle-Owl	<i>Bubo sumatranus</i>	LC	/		
76	Strigidae	Brown Wood-Owl	<i>Syrinx leptogrammica</i>	LC	/		
77	Strigidae	Brown Boobook	<i>Ninox scutulata</i>	LC	/		
78	Timaliidae	Pin-striped Tit-Babbler	<i>Mixornis gularis</i>	LC			x
79	Timaliidae	Chestnut-winged Babbler	<i>Cyanoderma erythropteryum</i>	LC			x
80	Timaliidae	Grey-throated Babbler	<i>Stachyris nigriceps</i>	LC			x
81	Trogonidae	Scarlet-rumped Trogon	<i>Harpactes duvaucelii</i>	NT			x
82	Turnicidae	Barred Butongquail	<i>Turnix susciator</i>	LC	/		
83	Tytonidae	Oriental Bay-Owl	<i>Phodilus badius</i>	LC	/		
84	Vireonidae	White-bellied Erpornis	<i>Erpornis zantholeuca</i>	LC			x
Total number of Species				50		6	31
Total number of Families				14		1	18

IUCN: International Union for Conservation of Nature; LC= Least Concern; NT=Near Threatened; EN=Endangered
 (x): New additional distributional records

4 Conclusion

The results shows that Gunung Inas FR still serve as an important habitat to support the assemblages of this flying vertebrates population, including the threatened species. Hence, it is hoped that Gunung Inas FR and its green connectivity with neighbouring forested areas is conserved and protected through Central Forest Spine initiative to support the survival and existence of these avian communities.

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