



Book review

The Butterfly Fauna of Sri Lanka. George Michael van der Poorten and Nancy E. van der Poorten. Lepodon Books. 2016. vi+418 pp; hardback; 21.6 cm × 28 cm. ISBN 978-1-771136-198-7. Price £50.

Sri Lanka is a small tropical island country, with a landmass area of approximately 65 000 km², located near the southern tip of India just north of the equator in the oriental zoogeographical region. Like most islands, its biota is of considerable biogeographic, evolutionary and conservation interest. Sri Lanka sits on the Indian tectonic plate, and its fauna has its closest affinities with the Indian subcontinent. The two countries are separated by only 30 km at their closest point (Adams Bridge, between Dhanushkodi and Talaimannar). The land bridge between Sri Lanka and India last closed about 10 000 years ago, by the shallow seas of the Gulf of Mannar and Palk Strait. Yet geographical isolation of the island has facilitated the evolution of a rich and diverse fauna, with distinct endemic elements and unique insect–plant associations, butterflies being no exception. Indeed, it is well known that Sri Lanka and the Western Ghats of India are of international significance because they comprise a biodiversity hotspot for conservation. In the face of a burgeoning population and concomitant loss of natural resources, Sri Lanka's natural wealth now presents formidable challenges for biodiversity conservation.

A major impediment in the conservation of island insects (or any landmass for that matter) is having a relatively complete inventory and identification guide of the fauna, supplemented with basic information on the distribution and ecology of each species. The last major reference tool to the butterflies of Sri Lanka was published more than 60 years ago, the influential *The Butterfly Fauna of Ceylon* Second Complete Edition by Lionel GO Woodhouse in 1949. The present work by the van der Poortens' aims to provide a modern and up-to-date textbook of the butterfly fauna of Sri Lanka that will not only replace Woodhouse's classic long out-of-print tome but also inspire the next generation of butterfly enthusiasts. This new book is extremely timely because nearly half of the islands' species (108 or 44% of 247 species of butterflies recorded from Sri Lanka) are currently facing extinction – their successful conservation management ultimately depends on having accurate scientific information on their taxonomy, distribution and biology that is widely accessible to an army of butterfly enthusiasts and amateur lepidopterists (citizen scientists). It is these citizen scientists who will assist land managers with the recovery of threatened species and implementation of management plans, such as data collection (spatial mapping and monitoring), mitigation of threatening processes and restoration of critical habitats.

A standout feature of this comprehensive book is that it combines a high level of scholarship with superb natural history and field biology. The text contains a substantial amount of scientific

information that is accurate and easy to read, providing the foundation for the conservation of butterflies on the island. The adults of all 247 species are illustrated with colour photographs taken in the field. The immature stages (egg, larva and pupa) and larval food plants are also illustrated and documented for 219 species, some for the first time. The colour photographs, of which there are about 3300 images, are of extremely high quality. The authors have done well to move away from the traditional approach of illustrating set museum specimens and have opted to show butterflies in their natural settings: for an identification guide this is not an easy task. The authors' solution is to show a range of habitus for each species (up to eight images) of freshly emerged specimens of both sexes from different angles so that diagnostic features on the dorsal and ventral surfaces of both wings are clearly visible and only include museum specimens where this is essential. For the more difficult groups, identification keys are provided, supplemented with illustrations showing characteristic features.

The introductory chapters cover the geography of the island, origin and evolution of the butterfly fauna and history of the study of butterflies in Sri Lanka (Chapter 1), the life of a butterfly, including life cycle, biology and behaviour (Chapter 2), conservation, including practical approaches needed to mitigate threats (Chapter 3) and an explanation of the species' accounts (Chapter 4). The taxonomic section, which makes up the bulk of the book, is organised into six chapters, one for each family, but the families are arranged alphabetically rather than following a systematic order based on phylogeny. So the HesperIIDae (Chapter 5) appear first, followed by the LycaenIDae (Chapter 6) and NymphalIDae (Chapter 7), while the RiodinIDae (Chapter 10) are preceded by PierIDae (Chapter 9) and PapilionIDae (Chapter 8). I found this a bit confusing because the arrangement of other ranks (e.g. subfamilies and tribes) within each family often follows the most recent published systematic classification. The species accounts include information on identification (wingspan, description and similar species), status, distribution and habitat, adult behaviour, immature stages and, for threatened species, conservation issues.

I found the sections dealing with biogeography, evolution, diversity and conservation of the butterfly fauna particularly interesting. The island has been divided into four geographic zones according to differences in rainfall and elevation: (1) a wet zone in the southwest (1900–5000 mm mean annual rainfall), which includes montane and submontane areas in the central highlands (1000–2500 m) and lowland areas (0–1000 m) comprising mainly wet evergreen forest; (2) an intermediate zone (1500–1900 mm mean annual rainfall) of mid-elevation hills (100–400 m) surrounding the central highlands that predominantly supports savannah woodland; (3) a dry zone (<1500 mm mean annual rainfall) in the northern half and eastern and south-eastern plains (0–300 m), which supports semi-deciduous forests; and

(4) an arid zone (<1200 mm mean annual rainfall) comprising two small areas on the northwest coast and southeast coast dominated by thorn scrub.

Although not enumerated, tallying the data listed in Appendix A indicates that the most diverse geographic area in terms of species richness is the wet zone with 206 species, followed by the intermediate zone (178 species) and then the dry zone (161 species). Not surprisingly, few species occur in the arid zone, with only 79 butterflies recorded. Because of the close proximity to peninsular India, endemism is low at 13% (31 species), although this rises to 46% if the 84 endemic subspecies are included and, with one exception, all 137 genera are shared with India (Western Ghats). The exception is the genus *Ideopsis*, containing a single species (*I. similis*), but it is considered that this butterfly was introduced to the island from Indo-China in the 1800s. Patterns of endemism show similar trends to species richness, with 29 species (plus an additional 69 subspecies) endemic to Sri Lanka recorded from the wet zone compared with 17 species (plus 60 subspecies) from the intermediate zone, eight species (plus 53 subspecies) from the dry zone and only three subspecies (plus 16 subspecies) from the arid zone. Interestingly, butterfly endemism is mostly confined to the southwest quarter of the island, with 21 species (or 68% of all endemic species) found only in the wet and intermediate zones, of which 13 species (plus a further 18 subspecies) occur only in the wet zone, often in montane areas.

It would be interesting to know the historical processes that have contributed to the southwest as an area of endemism for butterflies – is it due to incipient diversification and/or adaptive radiation or is it due to widespread range contraction resulting in a large number of relict taxa persisting within a refugium? Clearly, the wet zone is an area of exceptional importance for butterfly biodiversity, containing both high species richness and comparatively high levels of endemism. Many of these taxa are also under threat, particularly those restricted to lowland wet evergreen forest, which has been severely reduced in extent.

Perhaps more alarmingly is that the butterflies of Sri Lanka face an uncertain future. A recent evaluation of the conservation status using IUCN Red List criteria in 2012 revealed that more than half of the butterfly fauna (129 species) was considered to be of conservation concern, of which 108 species were classified as threatened with extinction (21 critically endangered, 38 endangered and 49 vulnerable). Like most areas of the world, the main threat facing butterflies on the island is habitat loss due to increased agriculture and urbanisation, followed by habitat degradation brought about by changes associated with invasive species, such as grassy weeds. I was staggered to learn that it is estimated that forest cover once covered 84% of the island, but now occupies only a mere 22%! Some habitat types, such as savannah woodland on the mid-elevation hills surrounding the central highlands, have been almost completely extirpated. Additional threats include misuse of pesticides and herbicides, overgrazing by domestic stock, illegal harvesting of timber and of course climate change and its interaction with other threatening processes.

The book concludes with a series of useful supplementary material (appendices) that include a checklist of species (scientific name and authorities, common name, endemic status and

distribution by climatic zone), an annotated list of scientific publications on the butterflies of Sri Lanka, lists of larval food plants and adult nectar sources, historical accounts on abundance from the literature and an impressive set of colour illustrations depicting the immature stages that run for 30 pages! A glossary, list of references, photographic and illustration credits and an index of scientific and common names of the butterflies complete the work.

I found few disappointing aspects of this book. Within the species accounts, the treatment on conservation could have been better organised into a single subheader (e.g. conservation status) rather than being split into two disparate paragraphs, one dealing with threat status evaluation and the other dealing with a range of issues such as evidence of decline, threatening processes and other comments. The larval food plants are subsumed under the subheader 'immature stages' or the subheader 'status, distribution and habitat' or sometimes both subheaders and thus are difficult to discern. I found the list of larval food plants at the end of the book (Appendix C) difficult to use for two reasons: first there is no mention of the family to which the plants belong, so related genera are frequently scattered, and second the common name of the butterfly is used at the expense of the scientific name making it hard for someone unfamiliar with local common names to know what those species are and to find them quickly in the book.

For the butterflies, common names are given priority over scientific names, which have the advantage of giving the book a very wide appeal for a local audience but are not satisfactory for an international audience. For example, 54 species (22%) of butterflies from Sri Lanka are shared with Australia, but only seven of these species have the same common name in current usage (and two of these include introduced species that have recently invaded either country: the Yellow-palm Dart *Cephenes trichopepla* endemic to Australia has now become established in Sri Lanka, and the Tawny Costa *Acraea terpsicore* endemic to India-Sri Lanka has now become established in Australia).

The Butterfly Fauna of Sri Lanka is a landmark publication and an essential reference for anyone interested in butterflies. However, it is more than an identification guide. It has been written for a wide audience that will interest professional lepidopterists, entomologists, butterfly enthusiasts, students and conservation biologists around the world, as well as the general public fascinated by these beautiful insects. The conservation message is loud and clear – the natural habitats of the island, and the butterflies and other insects that they support, are under increasing pressure from development as a consequence of human population growth. Thus, this book provides the foundation for conservation action as an authoritative account and a vehicle for the promotion of its unique island fauna. I have no doubt that it will inspire the next generation of butterfly enthusiasts and amateur lepidopterists to conserve its biodiversity.

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