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THE CONTRIBUTION OF STEPHEN JAMES JOHNSON TO THE STUDY OF AUSTRALIAN BUTTERFLIES

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Abstract

A summary is given of the life of Dr Steve Johnson (13 April 1950 - 16 December 2014) and his contribution to the knowledge of Australian butterflies. It includes analyses of his publications and his private collection, now lodged in the Museum of Tropical Queensland, Townsville, and photographs of some aspects of his work. He collected mainly in Cape York Peninsula and Torres Strait, made many new species records for Australia and discovered many new life histories.

Introduction

Stephen James Johnson (Fig. 1) was born on 13th April 1950 at Wynnum, third child to Stella and Arnold, younger brother to Bruce and Helene and soon to be older brother to Ian, Estelle and Elizabeth (Fig. 2). His childhood years were spent at Hemmant, then a semi-rural suburb of Brisbane. He attended Wynnum State Central High School until grade 4 and Church of England Grammar until matriculation in 1968. He was a keen sportsman and achieved full colours as a member of the undefeated first XV (Rugby Union) in 1967 and 1968 and a member of the first 8 (Rowing) in 1967 and 1968.

He failed to matriculate in 1967 (due to his sporting activities), repeated Senior and started at the University of Queensland in 1969, where he studied Veterinary Science, graduating in 1973.

Steve's professional life included private veterinary practice at Kingaroy before joining the Queensland Department of Primary Industries as a veterinary officer. He was stationed at Warwick Meatworks for five years before moving to Townsville in 1979 as a Veterinary Entomologist at the Oonoonba Veterinary Laboratory, which he subsequently headed until his early retirement in 2004.

His premature death in December 2014 brought to a close a productive contribution to the science and knowledge of Australian butterflies from a generous and erudite person.

Publications of S.J. Johnson and citation in this paper

All Steve Johnson's publications on Australian butterflies are listed and numbered in a Bibliographic Appendix to this paper. These papers are cited by boldface number in the following text. Other publications referred to in this paper are listed in the References and are cited in the text by author and date. Steve also made significant contributions to veterinary science, in particular on arboviruses. These publications, 30 in number, are also listed in the appendix but are not referred to in the text.

Fig. 1. Stephen James Johnson (13 April 1950 - 16 December 2014).

Fig. 2. The Johnson family in the early 1980s. Steve's parents Arnold and Stella seated centre. Their three sons (L to R) Steve, Bruce and Ian at rear, behind daughters Helene (L) and Elizabeth. Children at front are Steve's two children Sarah and Matthew with Helene's daughter Pip in centre. Arnold encouraged and supported Steve and Ian in their butterfly interests from a young age and sometimes accompanied them on remote field trips.

Early life in Brisbane

Like many active boys in the era before television, Steve wandered the fields, paddocks and swamps of greater Brisbane, collecting birds' eggs with brother Bruce, catching snakes, swimming in Bulimba Creek, diving off Hemmant Railway bridge and shooting sparrows for the Council bounty for pocket money. His constant companion was mischief. Steve was able to channel his boundless energy into rowing and football at school. As a robust second rower, rugby suited his less than genteel manner and, as his Dad described it, he went at it like a bull at a gate. Sport proved detrimental to his academic outcome in 1967 but, like most very bright people, he was able to turn this around in 1968 and matriculate. Steve's life changed in an even more positive way in 1967 when he met Bronwyn Clarke. They were inseparable and married in 1972. She became his loving wife, mother of his children (Sarah and Matthew) and unswerving supporter and confidant. For 38 years she was Neddy to his Jim (following Steve's love of the Goons).

While butterflies had featured briefly as a child, it was the necessity of his brother Ian to prepare a butterfly collection for a high school zoology class in 1969 that started a passion in Steve that lasted the rest of his life. He became an obsessive collector and observer of butterflies, very soon developing a focus on learning their habits and their life histories. While studying for his Veterinary degree, he would frequently visit the University of Queensland Insect Collection (housed at that time in the Agricultural Sciences Building, adjacent to the Veterinary Sciences Building). According to Geoff Monteith, the then Curator, Steve would arrive at lunch time (or during lecture breaks) to peruse the butterfly collection and discuss all things butterfly, occasionally accompanied by his father Arnold, known to most as Gator – one of the nicknames applied by Steve. It was a feature of his behaviour that almost everyone got a nickname, like it or not. Even then Geoff was very aware of Steve's unforgettable personality and exuberant approach to butterflies. Was he aware that his own nickname was Fangs?

Steve's time at Warwick saw a major expansion of his collecting interests and the development of woodworking skills that enabled him to make his own drawers and cabinets. For the rest of his life he prepared his own material, constructed his own drawers and cabinets and refined the design. He also designed and built collecting boxes and other equipment that accompanied him on field trips everywhere. Over time, his woodworking skills and tools expanded significantly and it was part of his love of butterflies that he was able to house his specimens in high quality storage facilities that he had built himself.

Moving to the tropics

Shifting to Townsville in 1979 was a significant milestone in Steve and Bronwyn's life and created many new opportunities for not only their respective professional careers, but also for Steve's growing passion for

tropical butterfly discovery. He had already completed a significant butterfly collecting trip to Iron Range and the McIlwraith Range of Cape York Peninsula in 1976 and another to Iron Range in 1978 (with his father, Murdoch De Baar and Darryl Washbourne), when they camped in Cook's Hut (Fig. 3), the famous butterfly hunters' dwelling and legendary abandoned home of former prospector and road maintenance man Reg Cook. Now Steve was in an even better location to expand his knowledge of Australian tropical butterflies. It was also how I came to know him.

Fig. 3. Cook's Hut at Iron Range, now demolished: (a) its exterior in 1980 (Photo by Alan Walford-Huggins); (b) from left, Arnold 'Gator' Johnson, Steve Johnson and Murdoch De Baar pinning specimens in Cook's Hut, 1978 (Photo by Darryl Washbourne).

Our paths had crossed even before we met. In 1976, Steve and his father had a grand adventure, their first trip to Cape York Peninsula and Iron Range. In that same year I also went to Cape York Peninsula and the McIlwraith Range. We both ended up at some point catching butterflies at Peach Creek, but that was something we only discovered later.

We first came together through the pages of *The Australian Entomologist* (then known as the *Australian Entomological Magazine*), where I read a 1979 paper by Sands, De Baar and Johnson **(32)** on the discovery of *Hypochrysops cleon* Grose-Smith, 1900 in Australia and he read a brief note by myself (Valentine 1979) on some northern Queensland butterflies. Over the next thirty years there were many original articles published by Steve and I, sharing the senior authorship: we jointly authored 30 peer-reviewed papers on Australian butterflies. On the strength of that first piece, Steve turned up at my office at James Cook University on the 21st February 1980. I was from a

farming background in Western Australia and had entered academia with appointment as lecturer in Geography at JCU in 1975. I had developed a passion for nature as a boy and first discovered butterflies when I started research on tropical rainforests in northern Queensland. I set out to use them as cues to the environment but soon came to enjoy them in their own right. Steve and I immediately established a rapport and a partnership that persisted until his death. My diary notes: '*Steve Johnson - ex Warwick, now with DPI, Oonoonba - came out to Uni. Very keen collector with 10 years experience. Plan some trips together.*' Steve Johnson became my close friend - my best mate - for 35 years, half my life. We undertook many trips together of thousands of kilometres by 4WD vehicle, by aircraft and by helicopter over many parts of Australia.

Steve was a genuine pioneer in the study of Australian tropical butterflies and was the most accomplished observer of butterflies in the field that I knew. Much of our knowledge of Australian tropical butterflies is due to Steve's observations right across the continent. He was not just an expert but was always generous with his knowledge; dozens of people benefitted from his personal assistance. In preparing this account I have received numerous comments from others about how kind and helpful Steve was to them. He shared his knowledge willingly and he gave strong personal support to everyone he met. Every request was responded to quickly and generously. Steve was a very positive person himself and he shared that with others, finding a way to acknowledge good work by them.

Steve was prolific in writing up his observations and was an excellent author. He later was a first-rate editor and referee for publications.

For Steve and I the relationship transcended butterflies. Our families were drawn in to numerous picnics and camping expeditions that, for some reason, always took us to excellent butterfly places. Our children played together under the watchful eyes of their mothers, Bronwyn and Valerie, while their fathers were off stalking butterflies. Some places were close to home around Townsville but others required the two families to take extensive trips - to Iron Range and to Rocky River and to other places on Cape York Peninsula. Steve's children Matt and Sarah and our daughters Polly, Leonie and Kate were good friends and all loved the farm environment of Oonoonba Veterinary Laboratory where the Johnson family lived.

While based in Townsville, Steve not only completed his BSc in Entomology at the University of Queensland (including a stint full time back in Brisbane), graduating in 1984, but he commenced and completed a PhD in Veterinary Entomology at James Cook University, graduating in 1989. His PhD thesis, *Studies of Stephanofiliariasis in Queensland*, was based on abattoir, field and laboratory studies and is a major contribution in the field. Since completion it has been downloaded from the James Cook University online library a total of 553 times (as at June 2015) and is still being accessed frequently. As an

indication of its global significance, downloads include those by researchers in the USA (100), Australia (73), Indonesia (56), India (50), Germany (45), China (21) and Bangladesh (21). In keeping with his collaborative approach, Steve Johnson's professional publications in the field of veterinary entomology include a total of 30 refereed papers with 42 different co-authors (excluding his butterfly papers; see Appendix). The main focus of Steve's professional work was in blue tongue viruses and the risks to the Australian sheep and beef industries. He was a very significant participant in the sentinel herds established as part of national biosecurity arrangements, involving regular monitoring of small herds across the tropics in order to detect the possible arrival of arboviruses. Several major projects he managed required extensive field work across the northern tropics, from Western Australia to Queensland.

The focus of Steve Johnson's butterfly work

While there had been significant work on butterflies in tropical Australia from the very early years of European settlement, there had been few resident collectors since Frederick Parkhurst Dodd resided in Kuranda (Monteith 1991). Steve brought a substantial scientific knowledge base that was very effective in revitalizing the biological studies of Australian tropical butterflies. In the early years his focus was exploratory: field studies in locations where little was known about the butterfly fauna. Cape York Peninsula continued to be a major drawcard, with almost every trip producing new material and new observations. But, in addition, Steve explored local environments in the Townsville and Cairns region and planned specific searches in regions wider afield in tropical Australia.

As his knowledge and familiarity with Queensland butterflies advanced, Steve began to look further afield, both within the tropics (in Western Australia and the Northern Territory) and also in the southern States. But his primary focus remained the tropical species and their habitats. A typical trip to Iron Range during the 1980s might involve three weeks camped in the rainforest, with tarps for weather protection and everything required for collection. Cook's Hut, often used by visiting biologists to Iron Range and now demolished, was used occasionally but generally not and all camping needs had to be brought in with the vehicle, including fuel. In those days it was a three-day effort to get there from Townsville, with very rough roads beginning at Mt Carbine, where the bitumen ended. Winching was often required to cross flooded creeks and boggy areas. Major effort was needed at the large Wenlock and Pascoe Rivers on the final stage of the trip and crossing the several fords on the Claudie River was rarely easy. Each trip required shovels, chainsaws and winches just to get there and in the earliest years fuel was barged in to Lockhart River.

Being the person he was, Steve was often drawn in to provide free veterinary services for the local community at Lockhart River during his field trips. That

also involved neutering the many unmanaged dogs in the township at the request of the council and local people.

Field methodology

Collecting specimens at Iron Range was usually focused along the bush tracks and mining roads, including the tops of Lamond and Phillip Hills. Particularly long net handles had been made by Steve to try and access the higher canopy areas - these poles were carried on the vehicle roof tops secured by stockings, collected for that purpose from female friends and relatives. With Steve's typical wit these poles had to have a name and became the gorgonzolas - with reference to how 'high' they could reach. Even with these long extensions many butterflies were out of reach, a continuing frustration for decades. Another focus was to use hilltops or adult leks to try and collect specimens. At Iron Range, Phillip and Lamond Hills, plus other high points and ridges, worked very well for many species. In the case of the many *Philiris* Röber species (Lycaenidae), it was noted that adults aggregated on certain very tall trees and could be collected using the long pole extensions, sometimes aided by standing on top of the vehicle roof-rack. During the three week camp, butterfly collecting occurred along the roads, which were walked every day multiple times. At that time there were many flowers that attracted adults and enabled easy collecting.

One approach that Steve adopted was to search for juvenile stages. Any female was a good target to watch and wait. Typical female oviposition behaviour, fluttering around plants for example, would elicit a reprieve from the net and some careful observation. Rewards were not common but did allow a number of new life histories to be obtained. That nearly always required multiple steps of identifying the plant, acquiring a specimen for the purpose-built shade houses back in Townsville and then, on later trips, searching plants for juvenile stages of the butterfly to take back for captive rearing. Occasionally, if small plants were evident in the bush they might be dug up and taken back with larvae or eggs intact. Or, if the plant was already well known and occurred locally in the Townsville region, the juvenile forms might be taken back with enough bagged material to last the journey south. For example, larvae on mistletoe sometimes may be readily transferred from one species to another. Sometimes larval stages could be found by simply observing evidence of feeding marks on the plants or, in the case of Hesperiidae, looking deliberately for larval shelters. On other occasions, adult females would be collected and bagged with any known or suspected larval food plant to try and induce oviposition.

Adult specimens, once collected, were always set in the field. Steve normally set each specimen on the day it was caught and avoided placing it in a paper triangle for later setting. To this end, he designed and built large setting boxes with several foam boards that would take many specimens set in the field (Fig. 4). These were generally given high priority in the packing of the

vehicle. In more recent years, when 12-volt refrigerators were used, specimens were sometimes kept fresh or even frozen for the journey home.

Fig. 4. Steve Johnson setting butterflies on Dauan Island in 2004. The polystyrene foam boards fitted into a specially made rugged box that was essential kit on every field trip. The silky oak pin boxes (foreground) were made to carry setting equipment securely.

During the field trips at Iron Range, a list of species collected and observed was made. It was not unusual to record over 120 species during a three-week field trip and there was an attempt to improve the list each visit. I think the maximum recorded was 128 species in three weeks. Another dimension to his Iron Range work was the adaptation of canopy traps, following a design from Mike Barnett who had used them in Uganda. These were suspended under the canopy, baited with rotting fruit and other delights, and proved very effective for *Charaxes latona* Butler, 1865 and a number of other nymphalids (Fig 5).

Iron Range has strong challenges for collecting and two species illustrate this well. The hesperiid butterfly *Rachelia extrusa* C. & R. Felder, 1867 was initially collected in Australia on the slopes of Mt Tozer by Geoff Monteith (Atkins 1975) and very few specimens were known until Steve collected males from a tree canopy near the second crossing of Gordon's Creek. For the next two decades all specimens collected were from this exact same site and all were males. It was clear that this was a lek for males. Females were discovered later at other rainforest-edge sites, including specimens reared by Steve from the McIlwraith Range **(45)**. The lycaenid butterfly *Hypochrysops cleon* Grose-Smith, 1900 was first found by Steve at Iron Range on a treetop

from a ridge just south of the old track up Phillip Hill **(32)**. Since that time all other specimens of this species have come from that same treetop, except for the only two females known, collected by David Lane and myself in 1984, near the first crossing of Gordon's Creek (unpubl. obs.). There are still no other females known but males continue to lek at the original tree. Specimens of many species from Iron Range (Fig. 6), in collections across Australia, have been made possible by Steve's discoveries.

Fig. 5. *Charaxes latona* (Nymphalidae: Charaxinae): (a) specimen perched in the canopy at Iron Range, photographed from Steve's cherry picker; (b) Steve with one of the fruit-baited traps hauled to the canopy to catch *Charaxes* and other nymphalids.

Using historical records and environmental data

Steve was a great advocate of learning from earlier workers and would frequently consult the literature or talk to other butterfly people to gain an insight on how to learn more. A good example was the work on the life history of the Moth Butterfly, *Liphyra brassolis* Westwood, 1864 (Lycaenidae). The published observations and F.P. Dodd's speculations (Dodd 1902) were studied carefully and collection data from others then was used to refine the search. It was apparent that G.A. Waterhouse had found the species on Great Palm Island (Waterhouse 1932) and consulting with an Ingham fruit grower (Herb Bosworth) led to the conclusion that a careful search of old citrus orchards on Palm Island might be worthwhile. Having arranged for permission, the expedition proceeded with great success and resulted in the discovery of many larvae and pupae. Because direct evidence of butterfly larval carnivory was being sought, Steve set up a glass aquarium so that the feeding behaviour could be observed and photographed. This enabled the first photo of actual carnivory to be taken and published **(16)**.

Fig. 6. Steve Johnson and Peter Valentine at Iron Range, one of dozens of trips made over forty years (Photo by Andrew Rankin).

Another example of field planning was an attempt to predict maximum butterfly activity in the wet-dry tropics, especially in central Cape York Peninsula. There were good grounds to expect very high early wet season activity amongst butterflies that specialised in avoiding the dry conditions and Steve set up a target to visit Mt White, a well known hilltop location near Coen. The timing, it was reasoned, needed to be not long after the first major rainfall - presumed to break the diapause of adults or pupae. Such rain might also initiate fresh growth on potential larval food plants. Coordinating with a local cattle station owner, the situation was monitored and, in January 1988, the trip to Mt White was timed for 10 days after a major rain event. While conditions were appalling for field work (very hot and very steamy), the outcome was astonishing, with both a huge abundance of adult butterflies **(17)** and two new life histories recorded as a result - *Libythea geoffroy nicevillei* Olliff, 1891 **(18)** and *Graphium aristeus* (Stoll, [1780]) **(36)**.

The Torres Strait islands

A significant frontier for Steve was to investigate the butterfly fauna of the Torres Strait islands. This era of his work began in 1983, when Steve made a brief trip to Thursday and Darnley Islands **(4)**. Steve's quarantine work took him to Torres Strait occasionally and he developed connections that facilitated later butterfly trips. He was able to gain an occasional berth with customs and quarantine missions up the east coast and within the Torres Strait. While collecting samples for arbovirus work, he was also able to inspect the butterfly fauna. This part of his butterfly activity was further built up after his physician brother Ian undertook some medical work on Thursday Island in the 1980s and provided a knowledge base from which Steve could later explore the more remote islands, including Dauan in 1989. Visits to Murray and Darnley Islands (in 1993 and 1994 respectively) and Moa Island in 1993 **(38)** added to the Torres Strait exploration. Dauan became a favourite destination and was very prolific. Initially, the trips to Dauan involved a flight to Saibai and accommodation at the school and then persuading a local inhabitant to provide transport across to Dauan. After purchasing a drum of outboard petrol, a walk along the beach usually revealed an aluminium dingy, with the owner willing to provide the crossing. On one trip it was a pair of young boys who seemed to delight in ensuring the passengers (Steve and I) suffered the maximum impacts from wave thumps. Later, a ferry service was initiated and access became a little more reliable, but not much. On our 2004 trip the ferry had drifted and washed up on rocks the night before we were due to return to Saibai. After a fair delay the boat was retrieved and brought around for loading. The other passenger was the Dauan Council chair, Mrs Margaret Mau, which is probably why the vessel was made ready. By the time we reached Saibai we were up to our shins in sea water and sinking fast, just making the jetty in time with setting boxes held high.

An increase in species collected at Dauan occurred when Steve (and Ian) arranged helicopter support to get to the top of Mt Cornwallis, the island's central 275 m peak surrounded by vine thicket and suspected of being a good hilltop for collecting. It was here that Steve first collected the Map Butterfly, *Cyrestis achates nedymnus* C. & R. Felder, 1865, having seen it previously on one of the beaches in the same year it was originally collected (Lambkin and Knight 2005). In his last year of life, while badly impacted by the cancer, Steve went up to Dauan and camped overnight on the peak of Mt Cornwallis with his brother Ian. He always loved his time on this island.

Tropical Western Australia

Partly connected with his professional quarantine and biosecurity work on monitoring the tropical coastline for invading arboviruses, Steve was invited on a cruise through the offshore islands along the Kimberley coast in April 1991. Support included a helicopter to access some of the islands and Steve was able to sample many of the island butterfly populations **(5)**.

This also stimulated further his interest in exploration of this part of Australia and, to this end, Steve arranged for a fixed-wing aircraft to fly in to the Mitchell Plateau in the 1995 wet season. As space was at a premium, priority was given to butterfly collecting material, the inevitable setting boxes included. A bush pilot, John Collins, took us in to a remote airstrip and hired us his old 4WD vehicle, which he kept near the airstrip, so we could get around. We were the only people on the plateau at this time (the road was still closed). Because the plane was very small we had very little luggage. After the critical butterfly equipment we had room for a sleeping bag each, a gas stove and bottle, a billy and two plates. Setting butterflies was always a high priority, so Steve built a collapsible table that could fit into the plane so we had a work surface. The only food we could fit in was dehydrated - add water and boil type: the water came from a nearby creek. We would consume these packet meals having to imagine the bit of the instruction that said 'add steak' or 'add chicken'. Steve referred to his designer table as the 'have table, will travel' and it later made many more trips with us. The trip was a great success and was followed by further time at Kalumburu before a cyclone drove us out **(20)**.

Discovering cancer

Cancer became part of the Johnson family's life when his wife Bronwyn was diagnosed and treated for breast cancer in the mid 1990s. In 1998 Steve had an off-road caravan built and he began to use that with Bron to spend time in remote parts of Queensland, including Iron Range, looking for butterflies. In 2001 we took long service leave and, with our wives, spent three months in northwestern Western Australia, down the west coast and through the southwest. This was a combination butterfly trip and family enjoyment but, for a lot of the time, butterflies won. It was Steve's way of getting more time with Bronwyn and we completed useful butterfly observations also **(24)**.

In April 2004, Steve and I returned from a trip to Dauan Island in Torres Strait only to discover that Steve had been diagnosed with terminal cancer and was initially given only a few weeks to live. This devastating news caused an immediate shift to Brisbane, to be closer to family. Sadly, expectations to the contrary, it was Bronwyn who passed away first, a very sad loss. Subsequently, despite declining health, Steve was keen to get out into butterfly locations in other parts of Australia that he had not visited. He went on many trips, including Kangaroo Island (October 2004), Alice Springs (February 2005, with Grant Miller), Lockerbie Scrub (April 2005) and Tasmania (January 2006). During these ventures Steve was often very sick from his cancer; it was tough on him but he was determined to experience some of the local species in the wild. We also took several trips to Western Australia up until 2013 (two trips in that year for the Julimar form of *Neolucia agricola occidens* Waterhouse & Lyell, 1914 in March and *Ogyris subterrestris petrina* Field, 1999 in October). His brother Ian also spent a lot of time with Steve in his last few years, especially on trips to Torres Strait chasing new species and life histories.

The cherry picker innovation

No account of Steve's butterfly life can ignore the cherry picker innovation (Fig. 7). Over many years of our visits to Iron Range, on the long drive back to Townsville there would eventually be a reference to all the butterflies we could see up in the canopy of the rainforest but which we could not catch, despite our extension poles. Steve would eventually bemoan 'If only we had a cherry picker'. Following his diagnosis of cancer he concluded it was now or never and decided to have a cherry picker made to suit his purpose. Based on an Isuzu rigid truck, the tower reached to 20 metres with room for two people in the bucket. He drove it up from Brisbane to northern Queensland in June 2006 to try it out. We went to Cooktown and Shipton's Flat to test its suitability and gain some experience. In July that year, Steve drove it to Iron Range for its first field outing. It served well for many more years. We would drive it up at the end of the wet season and it would stay at Iron Range through the dry season, parked at the National Park headquarters between visits. Several trips to Iron Range were made each year, usually with one or more collectors joining Steve. These included Peter Wilson, Peter Samson, Kerrod Beattie, Grant Miller, Darryl Washbourne, David Lane, Bill Graham and others. I went with Steve on many occasions.

He also used the cherry picker in southern Queensland, on one occasion supporting an Entomological Society of Queensland field trip to Mt Glorious in April 2007. He gave rides to the canopy to a few people and helped a PhD student collect scale insects in the canopy (Figs 7a-b).

These trips with the cherry picker were much enjoyed by Steve and all who went with him. They did result in some excellent outcomes for his butterfly work. For example, after seeing the large high-flying nymphalid *Apaturina*

erminea (Cramer, 1779) on many occasions, the cherry picker enabled specimens to be collected as they rested at height on tree trunks (unpubl. obs.). Description of the complete life history of *Charaxes latona* Butler, 1865 (Fig. 5a) **(47)** was enabled after eggs were observed being laid on leaves in the canopy and subsequently collected. Work on other lycaenids that laid eggs high in the forest was also facilitated, including *Hypochrysops hippuris* Hewitson, 1874 **(22)**, *Hypochrysops elgneri* (Waterhouse & Lyell, 1909) **(30)** and *Philiris ziska* (Grose-Smith, 1898) **(29)**. In December 2008, a journalist and photographer joined Steve and I at Iron Range. They wanted a story on butterflies but in the end they loved the story of Steve. This story and photos appeared in the 2009 April/June edition of *Australian Geographic* (Van Tiggelin 2009). The journalist, John Van Tiggelin, had many positive things to say about Steve in the article. When I spoke with him at the time of Steve's funeral he described the Iron Range experience that year as his favourite assignment and Steve as his favourite character.

Fig. 7. Steve Johnson's cherry picker truck: (a) in use on an Entomological Society of Queensland field trip to Mt Glorious in April 2007; (b) Steve (on right) with student Ben Nomark searching for scale insects; (c) Steve (on right) with Peter Valentine high in the canopy at Iron Range in 2008. (Photos a and b by Noel Starick, c by Andrew Rankin).

Publications and influence

Steve was a prolific author and contributed a total of 47 peer-reviewed papers on Australian butterflies (see Bibliographic Appendix). His collaborative and supportive approach also meant that he published with many of Australia's most knowledgeable butterfly scholars. His co-authors number 15 and, while

the bulk of his publications were shared with me (30 papers), he also shared authorship more than once with four other authors and was a co-author with 10 other researchers. The publications include range extensions and habitat notes through many life history descriptions to several descriptions of new taxa (Table 1). Much of the focus was on Queensland but papers also covered Western Australia (both the south-west and the north) and the Northern Territory. The majority of Stephen Johnson's butterfly publications were in *Australian Entomologist*, which he also supported as a reviewer.

Significant work on the life histories of Australian butterflies covered many species but there were other contributions of lesser extent covering many other species. These were often published in papers covering biogeography or regional records of species.

Table 1. Butterfly species for which Steve Johnson made a significant published life history contribution. The relevant publications are shown in brackets after each species.

Family / Species	
HESPERIIDAE	RIODINIDAE
Allora doleschallii (C. Felder, 1860) **(7)**	*Praetaxila segecia* (Hewitson, 1861) **(31)**
Rachelia extrusa (C & R. Felder, 1867) **(45)**	LYCAENIDAE
Trapezites atkinsi Williams, Williams & Hay, 1998 **(44)**	*Liphyra brassolis* Westwood, 1864 **(16)**
Trapezites taori Atkins, 1997 **(23)**	*Hypochrysops elgneri* (Waterhouse & Lyell, 1909) **(30)**
Neohesperilla senta (Miskin, 1891) **(25)**	*Hypochysops polycletus* (Linnaeus, 1758) **(14)**
Hesperilla sarnia Atkins, 1978 **(15)**	*Hypochrysops miskini* (Waterhouse, 1903) **(35)**
Telicota brachydesma Lower, 1908 **(43)**	*Hypochrysops hippuris* (Hewitson, 1874) **(22)**
PAPILIONIDAE	
Graphium aristeus (Stoll, [1780]) **(36)**	*Philiris diana* Waterhouse & Lyell, 1914 **(40)**
NYMPHALIDAE	*Philiris ziska* (Grose-Smith, 1898) **(29)**
Taenaris artemis (Vollenhoven, 1860) **(10)**	*Deudorix epirus* (C. Felder, 1860) **(3)**
Melanitis constantia (Cramer, 1777) **(13)**	*Nesolycaena medicea* Braby, 1996 **(21)**
Orsotriana medus (Fabricius, 1775) **(13)**	
Charaxes latona Butler, 1865 **(47)**	*Catopyrops ancyra* (C. Felder, 1860) **(39)**
Libythea geoffroy Godart, 1824 **(18)**	

Steve Johnson was also the first to record several taxa from Australia, including *Paraduba metriodes* (Bethune-Baker, 1911) (Lycaenidae) **(11)**, *Charaxes latona* Butler, 1865 (Nymphalidae) **(6)**, *Melanitis constantia* (Cramer, 1777) (Nymphalidae) **(13)**, *Euploea netscheri* Snellen, 1889 (Nymphalidae) **(20)**, *Philiris azula* Wind & Clench, 1947 (Lycaenidae) **(9)**, *Hypochrysops cleon* Grose-Smith, 1900 (Lycaenidae) **(32)**, *Prosotas gracilis* (Röber, 1886) (Lycaenidae) **(20)**, *Nacaduba calauria* (C. Felder, 1861) (Lycaenidae) **(20)** and *Cethosia cydippe damasippe* C. & R. Felder, 1867 (Nymphalidae) **(27)**. In addition, Steve rediscovered *Taenaris artemis queenslandica* Rothschild, 1916 (Nymphalidae) at the Lockerbie scrub, Cape York Peninsula **(10)** and also helped rediscover *Tagiades nestus* (C. Felder, 1860) on Dauan Island in Torres Strait **(46)**. He contributed to our knowledge of many other species, including *Delias lara* (Boisduval, 1836) (Pieridae) **(28)**.

Although Steve was not focused on taxonomic work but rather encouraged and supported others in their endeavours, he did take the initiative in describing several taxa. These were *Hesperilla malindeva dagoomba* Johnson & Valentine, 1994 (Hesperiidae) **(19)**, *Hesperilla crypsargyra binna* Johnson & Wilson, 2005 (Hesperiidae) **(26)**, *Jalmenus notocrucifer* Johnson, Hay & Bollam, 1992 (Lycaenidae) **(8)** and *Jalmenus inous bronwynae* Johnson & Valentine, 2007 (Lycaenidae) **(24)**. The subspecific epithet *dagoomba* was chosen by Steve as an Aboriginal place name for Magnetic Island and his choice of *bronwynae* was to honour his wife.

Many of the species on which Steve Johnson made a significant contribution are shown in Figs 8 and 9.

The Johnson Collection at the Museum of Tropical Queensland

Steve Johnson put together, over many years, an outstanding collection of Australian butterflies. It is the product of over forty years of collecting, although most of the material was added after Steve moved to Townsville. Given the initial diagnosis of terminal cancer in 2004, with perhaps a few weeks to live, Steve arranged for the collection to go to the Museum of Tropical Queensland. The Johnson Collection, housed in drawers and cabinets built by Steve over the years, is one of the most comprehensive collections of Australian butterflies (Table 2, Fig. 10). Consisting of over 12,000 specimens, it covers all families and is missing only two genera and a handful of species (Table 2). Note that Steve did not include the five species only known from Christmas Island and the one species only known from Norfolk Island as part of the Australian Biogeographic Region. Of the missing species, Steve had seen two in the wild (*Prosotas gracilis* and *Tagiades nestus*) and had made several trips to Burrell's Trig in the Northern Territory in search of another, *Acrodipsas decima* Miller & Lane, 2004. The vast majority of the specimens in the collection were netted by Steve in the wild or reared by him from material he collected in the wild.

Fig. 8. Australian butterfly species strongly associated with Steve Johnson: (a) *Taenaris artemis*; (b) *Apaturina erminea*; (c) *Charaxes latona*; (d) *Melanitis constantia*; (e) *Liphyra brassolis* (♀); (f) *Graphium aristeus* (♂); (g-h) *Libythea geoffroy* (♂ & ♀). All of these species are from tropical Queensland, mostly Cape York Peninsula.

Fig. 9. Australian butterfly species about which Steve Johnson contributed significant new knowledge: (a-b) *Hypochrysops elgneri* (♂ & ♀); (c-d) *H. hippuris* (♂ & ♀); (e-f) *H. polycletus* (♂ & ♀); (g-h) *H. cleon* (♂ & ♀); (i-j) *Philiris diana papuana* (♂ & ♀); (k-l) *Nesolycaena medicea* (♂ & ♀); (m-n) *Nacaduba calauria* (♂ & ♀); (o) *Prosotos gracilis* (♀); (p-q) *Catopyrops ancyra* (♂ & ♀); (r) *Tagiades nestus* (♂); (s-t) *Allora doleschallii* (♂ & ♀); (u) *Telicota brachydesma* (♂); (v-w) *Rachelia extrusa* (♂ & ♀); (x) *Trapezites taori* (♀); (y) *T. atkinsi* (♂). All but one of these are from the Queensland tropics, the last from southwestern Australia.

Table 2. Details of the Johnson Collection at the Museum of Tropical Queensland. These totals do not include specimens Steve collected during 2015, which added a few more individuals from Dauan Island and Weipa but no new species.

Family	Specimens	Species	Species (and number) Reared	Australian species missing
Hesperiidae	3750	122	86 (1366)	*Tagiades nestus*
Papilionidae	303	18	16 (176)	None
Pieridae	867	36	21 (348)	*Appias celestina*
Nymphalidae	1867	83	46 (580)	*Euploea modesta, Junonia erigone, Lexias aeropa, Taenaris catops*
Libytheidae	26	1	1 (3)	None
Lycaenidae	5499	151	113 (2643)	*Acrodipsas decima, Nothodanis schaffera, Prosotas gracilis*
Totals	12,312	411	283 (5116)	9 species missing

Fig. 10. (a) Part of the Johnson Collection cabinets and drawers built by Steve Johnson; now in the Museum of Tropical Queensland; (b) Steve Johnson and Peter Valentine working on the Johnson Collection, Museum of Tropical Queensland, Townsville, 2009. (Photos by (a) Niel Bruce, MTQ; (b) Andrew Rankin).

Conclusion

Stephen Johnson is very well remembered by many in the Australian butterfly world. He personally supported all he met and shared his excellent knowledge with anyone who had an interest. He was generous in every way and an enthusiast for all things butterfly. A nice example was the 'birthday gift' to Grant Miller of a pair of *Pithecops dionisius* (Boisduval, 1832). Grant had been trying to find these for so long he had taken to calling them 'Mythecops'. Steve was similarly generous with specimens to others and many collections include excellent material with a label indicating S.J. Johnson as the collector. His premature death leaves a gap in our butterfly science, especially in northern Australia. My own life has hundreds of wonderful memories from our intertwined butterfly songlines.

Acknowledgements

In preparing this account I have benefited very much from the support of Steve's immediate family, especially his brother Ian and his son Matthew. Ian prepared a moving eulogy to Steve at his funeral and that provided me with much of the framework about Steve's early life. Ian was also able to fill in details about some of the more recent collecting trips to Dauan as well as his recollections of early trips to Iron Range. Many other butterfly people were pleased to share their recollections about Steve and I thank them all, in particular Geoff Monteith, Grant Miller, Peter Wilson, Don Sands, Kerrod Beattie, Trevor Lambkin, Darryl Washbourne, Ted Edwards, Steve Brown, Cliff Meyer, Max Moulds, David Lane, Mike Barnett, Bill Graham and John Young. Geoff Monteith has given much editorial assistance in preparing the text and illustrations.

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VARIABILITY IN THE ADULT COLOUR FORMS OF *THECLINESTHES ALBOCINCTA* (WATERHOUSE, 1903) (LEPIDOPTERA: LYCAENIDAE: POLYOMMATINAE) FROM COASTAL SOUTH AUSTRALIA

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Abstract

The brown form of *Theclinesthes albocincta* (Waterhouse, 1903), previously known only from 'inland form' populations occurring in arid or semi-arid regions of Australia, is recorded from coastal South Australia for the first time.

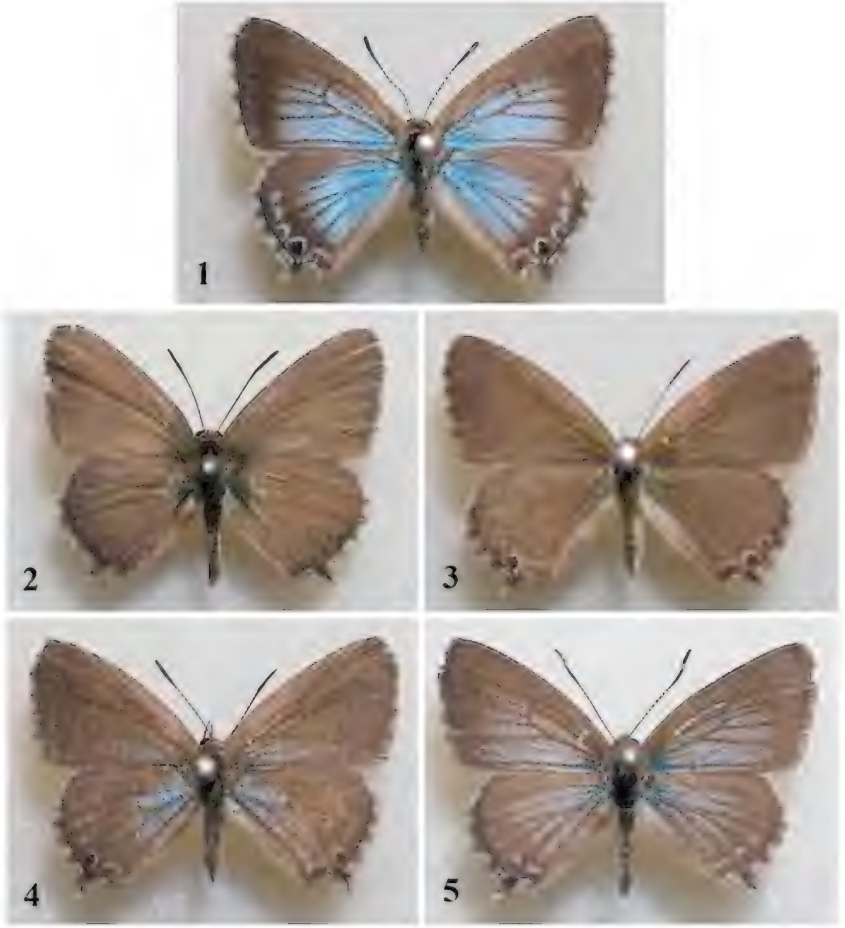
Introduction

Theclinesthes albocincta (Waterhouse, 1903) is endemic to Australia with a very wide but disjunct distribution (Common and Waterhouse 1981, Braby 2000). Braby (2000) recognised three forms of the butterfly, *viz*: the 'eastern form' recorded from Peak Downs near Emerald and 13 km west of Nebo (C.G. Miller pers. comm.) in central eastern Queensland; the 'inland form' recorded from the arid and semi-arid areas of Western Australia, Northern Territory, northwestern Victoria and central southwestern Queensland; and the 'southern coastal form' restricted to the coastal areas of South Australia.

All forms show seasonal variation but specimens of the southern coastal form and the eastern form can usually be separated from specimens of the inland form by having more extensive pale greyish blue scales on the upperside in both males and females (Braby 2000, Grund 2010). Grund (2010) noted that the blue form is only found in coastal areas and that a blue-brown hybrid population has been recorded from the Gawler Ranges, South Australia. To our knowledge, the brown form has not been recorded previously from southern coastal populations.

Results and discussion

On 21 February 2015, AMPS collected several eggs and larvae from *Adriana quadripartita* (Labill.) Muell. Arg. (Euphorbiaceae) growing in sandy areas near Meningie, South Australia. These were successfully reared by CEM in Brisbane, with 15 adults emerging between 22-31 March 2015. Of the 15 adults that emerged, nine (1 ♂, 8 ♀♀) were the greyish blue form (Fig. 1) typical of southern coastal populations, four (1 ♂, 3 ♀♀) were a brown form (Figs 2-3) with no greyish blue scales near the basal regions typical of inland populations, and the remaining two (2 ♀♀) showed intermediate colouration (Figs 4-5). Specimens of the brown form of the butterfly have also been reared or collected by the authors from Robe and from 6 km north of Malinong, in coastal South Australia.



Figs 1-5. Adult colour forms of *Theclinesthes albocincta* from Meningie, coastal South Australia: (1) typical blue form female; (2) brown form male; (3) brown form female; (4) intermediate female with minimal greyish blue basal scales; and (5) intermediate female with more greyish blue scales.

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POLYMORPHIC FORM *PALLESCENS* FEMALES OF *HYPOLIMNAS BOLINA* (LINNAEUS) (LEPIDOPTERA: NYMPHALDAE) FROM TONGA

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Abstract

Thirty polymorphic females of *Hypolimnas bolina* (Linnaeus, 1758) were collected from the Tongan islands of Tongatapu and 'Eua during May 1985 and April 2010. The abnormally large proportion of pale f. *pallescens* specimens, particularly from 'Eua, is discussed and 14 of these are illustrated.

Introduction

Hypolimnas bolina pallescens (Butler, 1874) is the subspecies found on the Pacific Ocean islands of Tokelau, Fiji, Tonga, Samoa (previously Western Samoa) and American Samoa (Tennent 2006). The name *pallescens* was originally used by Butler to describe a female *Hypolimnas bolina* (Linnaeus, 1758) from the Solomon Islands, as *Diadema pallescens* Butler. For the sake of clarity, the present author acknowledges that all specimens collected in Tonga presently belong to the subspecies *H. b. pallescens* but is referring only to the pale form of this subspecies, also called *pallescens*, in this paper.

The form name *pallescens,* along with numerous other names cited by Poulton (1924), Clark and Sheppard (1975), Lachlan (2014) and a number of other authors, have been used to describe some of the many different forms of the extremely polymorphic *H. bolina* females found on many of the Pacific islands and in other parts of its known range.

The present author visited the Kingdom of Tonga in May 1985 and April 2010. While conducting a survey of the butterflies of the island of 'Eua, approximately 18 km southeast of the main island of Tongatapu, during April 2010, it quickly became apparent that there was an unusually high percentage of very pale *H. b. pallescens* f. *pallescens* females to be found. The author had never seen such numbers of this unique female form on any Pacific island up to that time or more recently (Lachlan 2014).

Not a lot has been written about *H. bolina* from Tonga over the years. Four forms of *H. bolina* were listed as occurring there, including the pale forms, by Clark and Sheppard (1975) in their Localities Table under the name Friendly Islands, an old name for Tonga. Miller and Miller (1993) described *H. b. pallescens* as a common species and noted that 'Tongan females are highly variable' and 'display a bewildering range of forms'.

Surveys

In May 1985 the author collected several species of butterflies on the main island of Tongatapu, including three *H. b. pallescens* females. In 2010 an intensive survey of the nearby island of 'Eua was conducted from 10 to 18

April. It was primarily hot and sunny each day and a variety of butterfly species were encountered daily. Several *H. b. pallescens* females were seen and collected on each day of the survey along the forest roads and trails. As noted by Lachlan (2014), many of the very pale female *pallescens* appeared to fly quite rapidly and did not seem to alight as often as the other, darker forms. Therefore many additional specimens of this form, in particular, evaded capture.

Hypolimnas bolina pallescens (Butler, 1874)

(Figs 1-14)

Material examined. First survey: 9 ♂♂, 3 ♀♀, TONGA : 3 km east of Nuku'alofa, Tongatapu Is. 15-16.v.1985, R.B. Lachlan. (All in RBL collection).

Second survey: 13 ♂♂, 27 ♀♀, TONGA : 'Eua Island, 21°23'35.3"S, 174°56'42.5"W and 21°25'43"S, 174°56'45"W, 10-18.iv.2010, R.B. Lachlan. (All in RBL collection).

The different female forms collected during both surveys and their numbers are recorded in Table 1.

Specimen sizes. All measurements are set wingspans. The largest recorded was 75 mm (Fig. 3); the smallest recorded was 57 mm (Fig. 14). The average was 67.6 mm, (n = 30). The smallest specimen recorded is abnormally small for this species. The next smallest specimen was 62 mm. Thirteen specimens ranged between 66-68 mm. Eight specimens ranged between 70-75 mm.

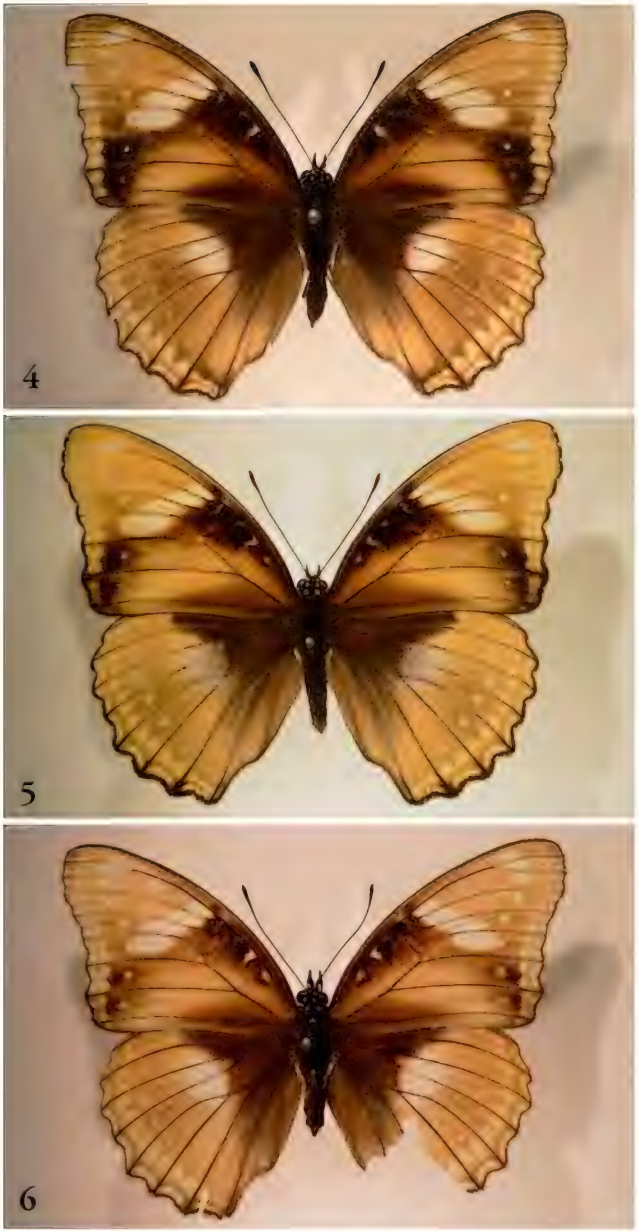
Table 1. Combined results for *Hypolimnas bolina pallescens* females from both surveys.

Form	Numbers collected / %
euploeoides	0 / 0
euploeoides-naresi	0 / 0
naresi	9 / 30
euploeoides-nerina	3 / 10
nerina	2 / 6.6
euploeoides-pallescens	1 / 3.3
pallescens	15 / 50

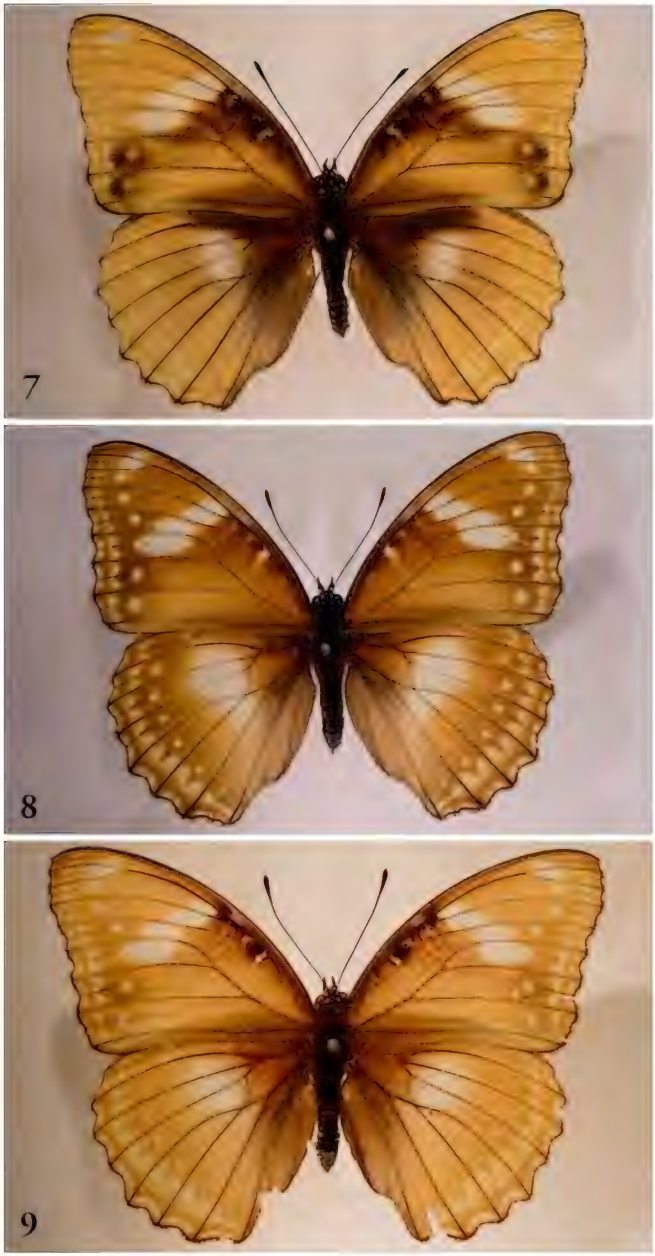
Discussion

Clark and Sheppard (1975) used the varietal names for the four main forms given by Poulton (1924) to group the four basic phenotypes of this extremely polymorphic species. They are: form *euploeoides,* a very dark, relatively plain form; form *naresi,* often male-like in appearance; form *nerina*, having a bright orange-brown variable patch two-thirds of the way along the inner border of the forewing; and form *pallescens*, with the base of the fore and hindwings tending to be dark brown (variable), the rest of the wing areas replaced with orange-brown (can be very pale and variable) and with white patches (variable in size) visible on the fore and/or hindwings.

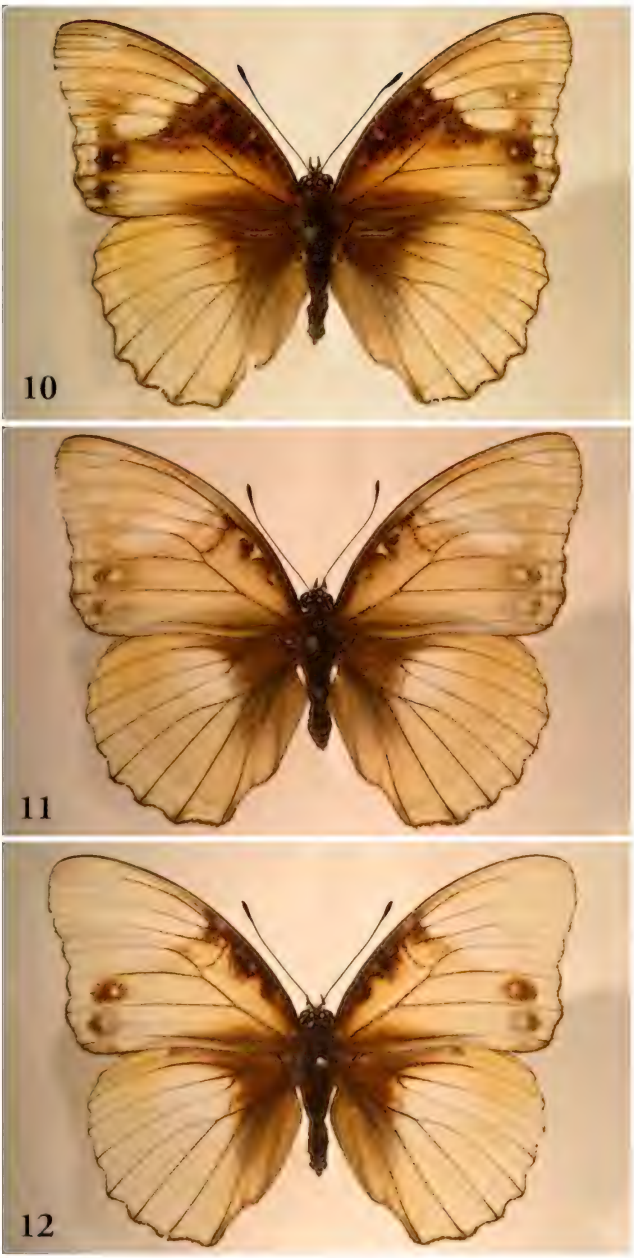
Figs 1-3. Females of *Hypolimnas bolina* from Tonga: (1) f. *euploeoides-pallescens*; (2-3) f. *pallescens*.



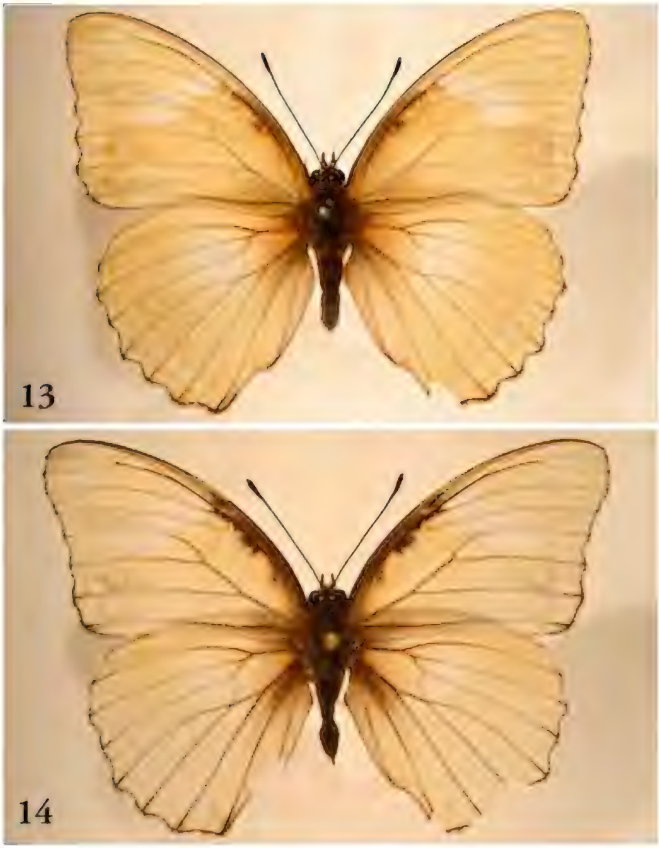
Figs 4-6. Females of *Hypolimnas bolina* from Tonga: f. *pallescens.*



Figs 7-9. Females of *Hypolimnas bolina* from Tonga: f. *pallescens.*



Figs 10-12. Females of *Hypolimnas bolina* from Tonga: f. *pallescens.*



Figs 13-14. Females of *Hypolimnas bolina* from Tonga: f. *pallescens.*

Clark and Sheppard (1975) also added three intermediate forms: *euploeoides-naresi, euploeoides-nerina* and *euploeoides-pallescens* but, for reasons unknown, they left out the intermediate form *euploeoides-naresi* from their very comprehensive Table 1 'Localities of the various forms of *H. bolina*'. In that Table they recorded the forms *naresi, nerina, euploeoides-pallescens* and *pallescens* from Friendly Is (Tonga).

The present author recorded three morphs of the form *euploeoides-nerina* (not recorded by Clark and Sheppard 1975) and, surprisingly, fifteen morphs of the form *pallescens.* This high percentage of form *pallescens* is significant and very unusual given that this form is not encountered very often, even in other Pacific countries where it has been recorded such as New Caledonia, Vanuatu, Fiji, Samoa, Tokelau and the Cook Islands. It is rarely encountered anywhere else. Tennent (2009) indicated an increasing number of female

forms in the southern islands of Vanuatu but the 25 *H. bolina* females he illustrated in colour did not show any individuals as pale as those collected in Tonga. Tennent (2006) was more specific when he stated that 'there is a considerable increase of [form] *pallescens*' in the southern Vanuatu islands of Tanna, Futuna and Aneityum.

It is interesting to note that Miller and Miller (1993) examined a collection of 26 female *H. b. pallescens* taken by D. Thomas in August-September 1986, mostly from Vava'u, north of Tongatapu, and described seventeen of the specimens as 'similar to, or even paler than, the one figured by d'Abrera (1977: 222) as typical of *pallescens*.' This represented 65% of the entire collection. The present author's recent survey also supports the fact that higher numbers of form *pallescens,* including very pale morphs, seem to be commonly encountered in Tonga, perhaps more than anywhere else in the Pacific region.

Acknowledgements

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REVIEW OF VARIATION IN *ACRODIPSAS CUPREA* (SANDS, 1965) AND *A. AURATA* SANDS, 1997 (LEPIDOPTERA: LYCAENIDAE), WITH DESCRIPTIONS OF A NEW SUBSPECIES OF *A. CUPREA* AND A NEW SPECIES OF *ACRODIPSAS* SANDS FROM INLAND SOUTHERN QUEENSLAND

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Abstract

Variation in *Acrodipsas cuprea* (Sands, 1965) and *A. aurata* Sands, 1997, both part of the *cuprea* species-complex, is reviewed. A new subspecies, *A. cuprea variabilis* subsp. n., from northern New South Wales and southeastern Queensland, is described and compared with nominotypical *A. cuprea cuprea* found from subcoastal New South Wales to Victoria. *Acrodipsas violacea* sp. n., a closely related species from southern inland Queensland, is described, figured and assigned to the *myrmecophila* species-group on the basis of morphology of the femora of both sexes.

Introduction

The genus *Acrodipsas* Sands, 1980 is a group of morphologically similar Lycaenidae assigned to the Tribe Luciini (Edwards 1996). All species are restricted to the Australian mainland. Little is known of their biology but evidence suggests that the larvae are predatory on immature stages of ants (Common and Waterhouse 1972, Samson 1989). Adult females emerge from the pupa with almost fully mature eggs (Sands 1979), unusual for Australian Lycaenidae. Two species-groups were recognised by Miller and Edwards (1978) and Sands (1979): the *myrmecophila* species-group, in which the adult legs are unmodified, and the *illidgei* species-group, in which the fore and hind femora are swollen and the mid tibia is greatly reduced. Geographical variation in *Acrodipsas cuprea* (Sands), a member of the *myrmecophila* species-group, was noted when the species was first described (Sands 1965). Many species are difficult to distinguish because of the rarity of the females and because of variation in the colour of adults, in this case of *A. cuprea* (Common and Waterhouse 1972, Sands 1979, 1997, Braby 2000, Eastwood and Hughes 2003a, Orr and Kitching 2010). Similar species, including *A. cuprea* and *A. aurata* Sands, are referred here to a '*cuprea* species-complex'.

Variation in males of *A. cuprea* includes distinct, obscure or absent coppery scaling of basal areas on the upperside of the forewings, or presence or absence of blue scales on the upperside of both wings (Braby 2000, Orr and Kitching 2010). Braby (2010) and Field (2013) referred to these males as copper, brown or blue 'forms' of *A. cuprea*. Variation in the extent of blue scaling on the upperside of females of *A. cuprea* and *A. aurata* is also considerable and in *A. aurata* the presence and extent of blue scaling may be seasonal (Sands 1997). Eastwood and Hughes (2003a) studied the DNA of mounted specimens from various populations and referred to the different forms as morphotypes. They also examined the phylogenetic relationships of

Acrodipsas spp., based on the study on DNA samples from dried museum specimens, and grouped the differing populations according to their molecular similarity (Eastwood and Hughes 2003b).

In this paper we discuss variation in the *cuprea* species-complex, including *A. aurata*, and revise the taxonomic identities of the previously recognised forms of *A. cuprea*. We describe the variable subspecies *A. cuprea variabilis* subsp. n. from northern New South Wales, coastal southeastern Queensland and the main Dividing Range from the New South Wales border to the Blackdown Tableland, Qld. We also describe and figure the new species *Acrodipsas violacea* sp. n. from inland southern Queensland and compare it with *A. cuprea variabilis*.

Abbreviations: AMS – Australian Museum, Sydney; ANIC – Australian National Insect Collection, CSIRO, Canberra; MCS – collection of Michael Sands, Brisbane; NMV – National Museum of Victoria; QM – Queensland Museum, Brisbane; RM – collection of Russell Mayo, Pomona, Queensland.

Acrodipsas cuprea cuprea (Sands)

(Figs 1-8)

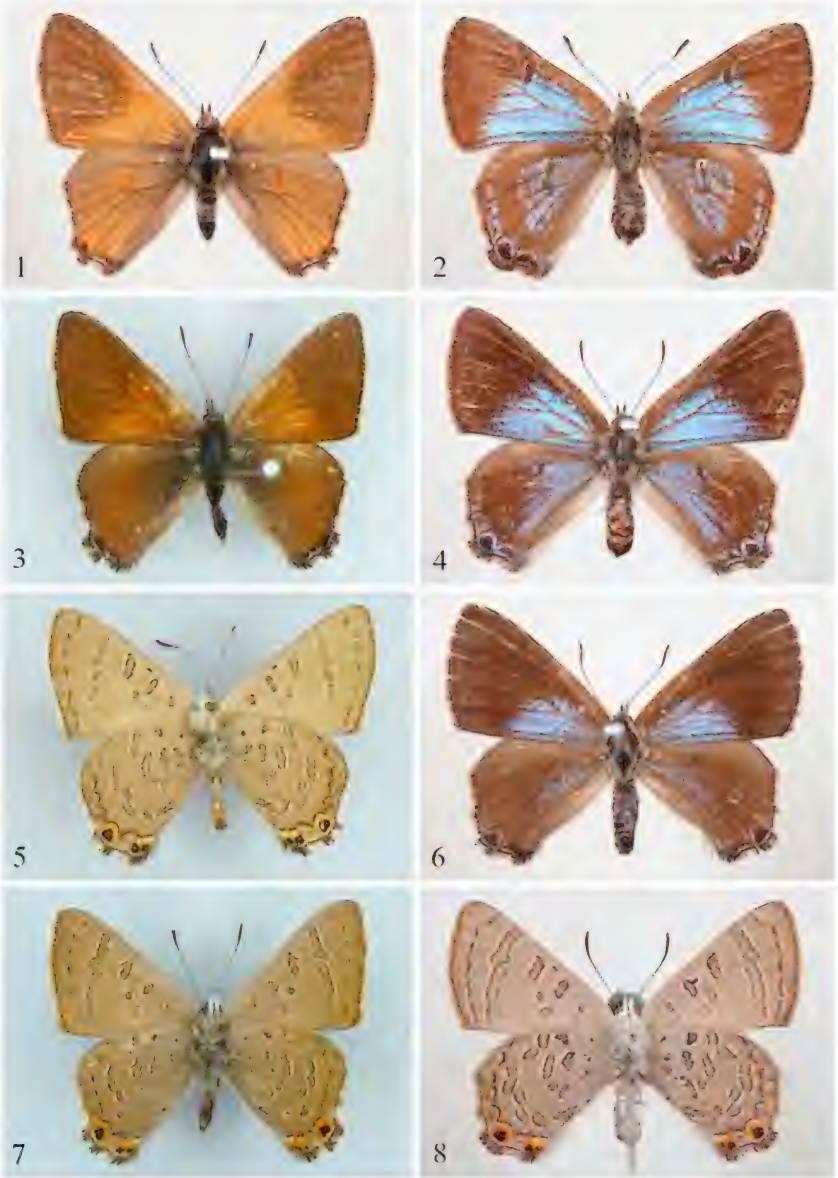
Pseudodipsas cuprea Sands, 1965: 69-71. Holotype ♂, New South Wales: Toronto, in AMS.

Acrodipsas cuprea (Sands): Sands 1979: 251-265.

Acrodipsas cuprea (Sands) copper form: Braby 2000 (Plate 43: 6a), Field 2013, Eastwood and Hughes 2003a.

Diagnosis. The uppersides of males of the southern subspecies, *A. cuprea cuprea*, are distinguished from other *Acrodipsas* species, including *A. brisbanensis* (Miskin) and *A. cuprea variabilis* subsp. n., by the well defined subtriangular coppery base to the forewings and the position of the postmedian bands on the underside of the forewings. The forewings are more strongly bowed than those of *A. c. variabilis*. On the underside of the forewings of both sexes, the postmedian bands are aligned or only slightly displaced at M_3 and CuA_2 in *A. c. cuprea* and *A. c. variabilis*, a useful characteristic for separating the southern subspecies *A. c. cuprea* from *A. brisbanensis*, in which there is strong displacement. Above, the upperside of both wings of females of *A. c. cuprea* are grey-black or black, with variable basal and subbasal areas of dark blue usually reaching the cells but not extending to the tornus of the hindwing. Females of *A. c. cuprea* are very similar to females of *A. c. variabilis* but the forewings of *A. c. variabilis* are usually broader and the areas of blue on the upperside are more extensive.

Variation. Males of *A. c. cuprea* can be distinguished from those of *A. c. variabilis* by the subtriangular coppery basal area of the forewings. This coppery area is well defined in *A. c. cuprea* but may vary in brightness and, in specimens from north of Newcastle, NSW, the area may be less well defined than in specimens from southeastern NSW and Victoria.



Figs 1-8. *Acrodipsas cuprea cuprea* (Sands): (1, 3) ♂♂ uppersides; (5, 7) ♂♂ undersides; (2, 4, 6) ♀♀ uppersides; (8) ♀ underside. Localities: (1) Stanwell Park, NSW; (2) Moe, Victoria; (3, 7) Newcastle, NSW; (4, 6, 8) Port Stephens, NSW; (5) Narara, NSW.

Males from between Boambee and Port Macquarie, NSW, have the basal coppery suffusions less clearly defined, whereas in males from Stanwell Park and Pambula, NSW, the coppery areas are clearly developed. The blue areas on the forewings of *A. c. cuprea* females are somewhat variable and may be restricted to the subbasal region of both wings or extend into the cell. The male genitalia of *A. c. cuprea* differ only slightly from those of *A. c. variabilis*, the valvae of the latter being slightly more slender apically and the apical fold slightly narrower than that of *A. c. cuprea*, but not as narrow as in *A. violacea*.

Distribution. Victoria: Western Gippsland and Warragul to the NSW-Victoria border (Field 2013); New South Wales: southeastern coastal and subcoastal ranges from Pambula to Boambee south of Coffs Harbour, westwards from the Hunter Valley to Denman and the main Dividing Range south of Ebor.

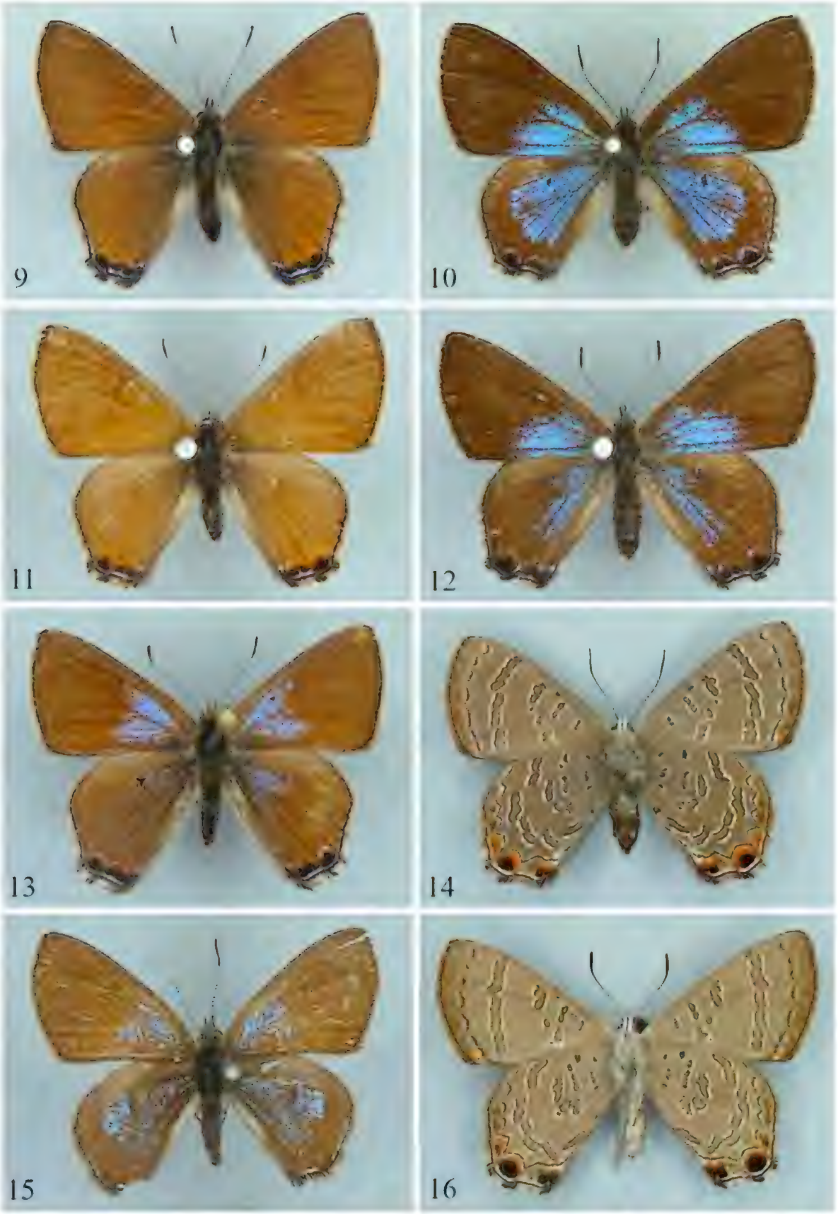
Biology. Immature stages are associated with the ant genus *Crematogaster* Lund and larvae are probably predatory on the immature stages of these ants (Braby 2000, Field 2013). Eggs of *A. c. cuprea* (figured by Field 2013) are similar to those of *A. myrmecophila* (Waterhouse & Lyell) (Sands 1979) and are said to be carried by ants into their nests (Field 2013). At Newport, NSW, *Crematogaster* sp. ants were seen tending eggs (Sands 1997) before carrying newly-hatched larvae into a hollow branch of a mature *Acacia implexa* Benth., already occupied by larvae of *Hypochrysops delicia delicia* Hewitson. In Victoria, 17 specimens of *A. c. cuprea* (initially thought to be *A. brisbanensis*) were reared from nests of *Crematogaster* sp. in senescing hollow branches of an *Acacia baileyana* (Field 1978 and L. Gooding pers. comm.).

Acrodipsas cuprea variabilis subsp. n.

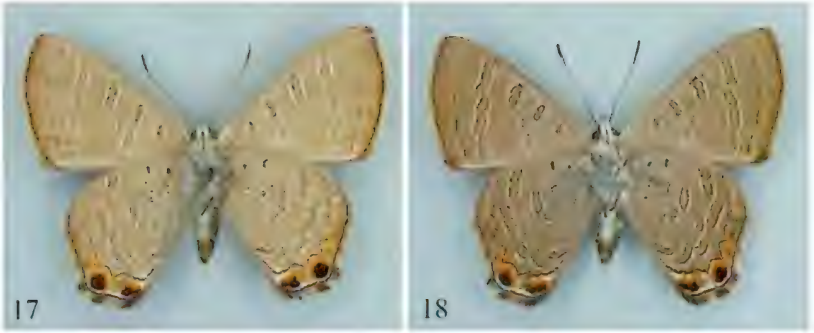
(Figs 9-18, 46-48)

Acrodipsas cuprea (Sands) 'brown and blue forms': Braby 2000, Field 2013, Eastwood and Hughes 2003a.

Types. Holotype ♂, labelled 'QUEENSLAND, Mt Ngungun, 253 m, Glasshouse Mtns Nat Pk, 26º53'59"S, 152º56'06E, 11 March 2005, M.C. Sands', 'Reg. No. T232286', in QM. *Paratypes*: QUEENSLAND: 1 ♀, Mt Tibberoowuccum, 232 m, 26º53'59"S, 152º56'06"E, 23 March 2003, M.C. Sands, Reg. No. T232287, in QM; 2 ♂♂, Mt Tibberoowuccum, 232 m, 26º55'S, 152º55'58"E, 26 January 2003, M.C. Sands, Reg. Nos. T232167 & T232168, in QM; 1 ♂, Mt Tibberoowuccum, 232 m, 26º55'S, 152º55'58"E, 23 February 2003, M.C. Sands; 1 ♀, same data except 2 March 2003, in AMS; 1 ♂, 1 ♀, Mt Tibberoowuccum, 232 m, 26º55'S, 152º55'58"E, 15 February 2003, M.C. Sands, in NMV; 1 ♂, Mt Maroon, 882 m, 28º12'2"S, 152º43'52"E, 15 December 2002, M.C. Sands; 1 ♂, 1 ♀, same data except 22 December 2002; 1 ♀, same data except 16 March 2003; 2 ♂♂, Bunya Mountains, 735 m, 4.8 km Nth Burtons Well, 26º47'58"S, 151º34'11"E, 9 February 2006, M.C. Sands; 1 ♂, Coochin Hills (west peak), 240 m, 26º47'58"S, 151º34'11"E, 03 September 2006, M.C. Sands; 1 ♂, Mt Tibberoowuccum, 232 m, 26º55'S, 152º55'58"E, 26 January 2003, M.C. Sands; 1 ♂, same data except 3 May 2003; 1 ♂, same data except 1 April 2006;



Figs 9-16. *Acrodipsas cuprea variabilis* subsp. n.: (9, 11, 13, 15) ♂♂ uppersides; (10, 12) ♀♀ uppersides; (14, 16) ♀♀ undersides. Localities: (9-10, 12-14, 16) Glasshouse Mountains, Qld; (11, 15) Toowoomba, Qld.



Figs 17-18. *Acrodipsas cuprea variabilis* subsp. n.: ♂♂ undersides, Glasshouse Mountains, Qld.

1 ♀, same data except 20 September 2003; 1 ♂, Mt Tibrogargan, 264 m, 26º55'37"S, 152º56'60"E, 3 January 2003, M.C. Sands; 1 ♂, North Stradbroke Island, Tripod Lookout, 27º26'24"S, 153º27'52"E, 20 September 2006, M.C. Sands; 1 ♂, Flinders Peak, 679 m, 27º48'47"S, 152º45'36"E, 1 December 2002, M.C. Sands; 1 ♂, Rocky Knob via Toowoomba, 580 m, 27º36'50"S, 152º02'14"E, 29 December 2004, M.C. Sands; 1 ♂, same data except 28 May 2009; 1 ♀, same data except 10 March 2005, all in MCS; 26 ♂♂, 9 ♀♀, Toowoomba, J Macqueen, dated 29-10-64 (1♂), 27-10-65 (1♂), 15 Nov 65 (1♂), 15-12-65 (1♂), 18-12-65 (1♂), 21-12-65 (2♂♂), 14-1-66 (1♂), 9-2-66 (1♂), 22-2-66 (2♀♀), 2-3-66 (1♂), 12-10-66 (1♂), 13-10-66 (1♀), 27-10-66 (1♀), 28-10-66 (2♂♂), 10 Nov 66 (1♂), 10-11-66 (1♂), 15-11-66 (1♂), 17-11-66 (1♂), 6 Feb 67 (1♂), 4-3-67 (1♂), 31-1-67 (2♀♀), 20-2-67 (1♀), 25-2-67 (1♀), 10 Oct 68 (2♂♂), 11-12-68 (1♂), 9 March 71 (3♂♂), 21-3-71 (1♂, 1♀); 1 ♀, Toowoomba, 2 Oct 66, D. Sands; 1 ♀, Mt Tinbeerwah, Noosa, 6 Sept. 82, R. Eastwood, all in ANIC; 1 ♂, Mt Cooroora, Pomona, 10 March, 2015, R Mayo; 1 ♂, Mt Cooroora, Pomona, 21 September, 2003, R Mayo; 1 ♂, Mt Tinbeerwah, Tewantin, 10 September, 2003, R Mayo; 1 ♀, Mt Tinbeerwah, Tewantin, 10 April 2003, R Mayo; 1 ♀, Mt Tinbeerwah, Tewantin, 24 August 2004, R Mayo; 1 ♂, Blackdown Tableland, 17 September 2006, R Mayo; all in RM. NEW SOUTH WALES: 1 ♂, Grafton, 10 Nov 1944; 1 ♂, Slaughterhouse Pinnacle, 29º44'S, 150º18'E, 28 xii 1994, H. (Mike) Groth, in ANIC.

Description. Male (Figs 9, 11, 13, 15, 17, 18). Antenna length (of holotype) 7.3 mm; shaft black with segmental bands white; club long, dorsally and ventrally dark brown-black, apex tipped with orange; head dorsally black, ventrally overlain with long white hairs scales; frons grey-black with narrow median white line and white line narrowly above eyes; eyes grey-black; palpi dorsally dark grey-brown, ventrally with patches of white scales, apex tipped white; thorax and abdomen dorsally grey-black, edged with long brown scales extending over wing bases, ventrally overlain with white hair scales; legs brown with fore and hind femora not swollen, tarsi brown, femur and tibia with long white hair scales, apical fore-tibial spines (modified setae) moderately developed, thickened basally, longer than spurs on tarsi. Forewing length (of holotype) 14.2 mm, costa and inner margin almost straight, apex

strongly acute, termen weakly bowed M_1-CuA_1, tornus obtuse; upperside dark brown, medium grey-brown or coppery brown, veins often dark brown, termen darker brown, submedian and postmedian areas occasionally with indistinct coppery areas reaching inner margin, often with some basal blue scales, cilia light brown. Hindwing costa almost straight, termen bowed between M_1 and CuA_1, squared CuA_1 to 1A+2A at tornus, inner margin straight; upperside grey-brown, darker towards base, often with some basal blue scales (rarely on coastal specimens), veins and termen darker brown, transverse apical cell bar on vein M_1 to M_3, dark brown; termen narrowly dark grey-brown; an oval black spot at termen between CuA_1 and CuA_2, two smaller spots between CuA_2 and 1A+2A, a narrow blue subterminal line M_3 to CuA_1 to tornus, extending broader CuA_1 to tornus separating black spots and dark termen; cilia light brown, black and broadly tufted at CuA_1, CuA_2 and at tornus, inner marginal fold light grey. Forewing underside, pale brown-grey with pale bands rarely indistinct, edged with dark brown then white, three transverse brown bands in cell, one narrow at base, broader and dark at mid cell, broadest between bases of M_1, M_2 and M_3; termen dark brown with subterminal subcrescentic line closer to tornus than termen, separated at veins R_1 to 1A+2A, a subparallel postmedian band R_1 to M_3, closer to termen at tornus, a submedian spot between CuA_1 and CuA_2 and band below cell beneath CuA_2. Hindwing underside, grey-brown with brown bands edged darker brown then white; termen dark brown, narrow at apex, broader at tornus, with subterminal crenulated pale brown line, parallel to termen except closer Rs to M_1, a median band between Rs and M_1, a postmedian band M_1 to tornus, displaced between veins with sections M_1 to M_3 and CuA_1 to CuA_2 closer to termen, section between 1A+2A and inner margin closer to 3A; a prominent subterminal black spot between CuA_1 and CuA_2; two black spots, sometimes merged, between CuA_2 and 1A+2A, both edged anteriorly and prominently with orange, spots separated from dark termen by narrow white line CuA_2 to tornus.

Male genitalia (Figs 46-48). Unmounted: vinculum + tegumen subcircular, slightly longer than wide in posterior view. Slide mounted: margins of socius strongly bowed, sociuncus lobe broad, uncus bifurcate, branches well separated at base; brachium long, slender, apical section *ca* twice as long as basal section; valva with base broadly oval, concave near midpoint, apical section subequal in length to basal section, apically narrower than at median fold, apex subsquared, tip pointed, outwardly directed, fold slender, weakly sclerotised; juxta U-shaped with relatively long apical arms; aedeagus basally broad, prezonal sheath rounded anteroventrally, zone narrow, postzonal sheath *ca* two-thirds length of prezonal sheath, curved ventrally near midpoint, slender, smooth, apically tapered to a point.

Female (Figs 10, 12, 14, 16). Antenna length (of allotype) 6.5 mm; head, palpi, thorax, abdomen and legs similar to male, palpi with second segment longer than male, abdomen considerably larger than male abdomen, ventral

surface of thorax, anterior surface of abdomen, femur and tibia with long white hair scales. Forewing apex obtuse, termen strongly bowed, tornus obtuse, uppersides of both wings brown-black with basal and submedian areas of medium to dark blue; forewing basal 1/2-2/3 blue, mostly filling cell, extending to mid inner margin or slightly beyond posteriorly; apical cell vein at bases of M_1 and M_2 dark brown-black; cilia white. Hindwing costa bowed, grey-brown, termen straight between M_1 and CuA_1, produced and squared between CuA_1 to CuA_2, slightly concave between CuA_2 and 1A+2A; above blue area from base to cell postmedian region, extending from cell to beyond inner margin, with transverse black cell bar between bases of M_1 and M_2, occasionally a series of subterminal crenulated blue markings from M_1 to 1A+2A, a large subtriangular black spot between CuA_1 and CuA_2, a narrow black spot or band between CuA_2 and 1A+2A, a narrow blue subterminal line M_1 to 1A+2A edging black spots termen at tornus; cilia white, black and broadly tufted at CuA_1, CuA_2 and tornus, basal half of inner marginal fold grey-brown, grading to dark brown towards tornus. Forewing underside, light brown with brown bands or spots narrowly edged with dark brown, then white; cell with transverse bands dark, narrow at base and at mid cell, a spot between subbases of CuA_1 and CuA_2, a subbasal band between CuA_2 and 1A+2A, a broad postmedian band, slightly displaced at M_1, closer to termen at tornus than apex, a narrow subterminal band, dark brown, somewhat crenulated, slightly closer to termen at tornus than apex; area between subterminal band and termen slightly darker brown, darker and narrower towards termen. Hindwing underside with basal and submedian narrow bands or dark spots, two at base of cell; mid and postmedian bands wider, sections M_1 to M_3 at cell apex and CuA_1 to CuA_2 closer to termen, section between CuA_2 and 1A+2A angled anteriorly towards base; two black spots separated at tornus, edged orange anteriorly, one a larger, oval spot between CuA_1 and CuA_2, the second a smaller spot at tornus overlying 1A+2A; spots at termen edged narrowly blue CuA_2 to tornus; a dark postmedian band, angled and closer to base at inner margin; inner half of marginal fold light grey; cilia light brown-cream, black and broadly tufted at CuA_1, CuA_2 and tornus.

Female genitalia. Slide mounted: apophyses anteriores slender, apically tapered, moderate in length; papillae anales broadly rounded, finely setose; ostium bursae small, U-shaped, weakly sclerotised, surrounded by broad U-shaped anterior wall of ostium; ductus bursae not sclerotised, membranous, broad, long, gradually expanded to merge with anteriorly rounded, membranous corpus bursae.

Comments. Males of *A. c. variabilis* are readily distinguishable from the nominotypical subspecies by absence or obscurity of the subtriangular coppery basal area on the upperside of the forewings. The ground colour of males of *A. c. variabilis* is usually much darker than that of *A. violacea*, but may vary from dark brown to coppery brown with occasional blue basal scales on both wings, mostly on specimens from the main Dividing Range.

The ground colour is similar to that of the upperside of *A. brisbanensis* (Miskin) but in *A. c. variabilis* the termen of males, although variable in shape, is more strongly bowed than in either *A. brisbanensis* or *A. c. cuprea*. The ground colour of females and areas of blue of *A. c. variabilis* are very similar to the nominotypical subspecies, but in *A. c. variabilis* the termen of the forewing in females is more strongly bowed than in either *A. c. cuprea* or *A. violacea*.

Male and female genitalia are similar to those of nominotypical *A. c. cuprea* (see Sands 1997). The apices of the valvae of males of *A. c. variabilis* appear to be slightly longer than in *A. c. cuprea* but not as slender as in *A. violacea*.

Variation. The forewings of small males of *A. c. variabilis* are often more strongly bowed than in larger specimens, accompanied by extraordinary variation in wingspans (♂♂ 16-24 mm, ♀♀ 17-28 mm), usually in specimens from the Glasshouse Mountains, where small males are unusually abundant.

The upperside of males of *A. c. variabilis* from Stradbroke Island is darker grey-brown than in specimens from the mainland and is not known to have areas of blue, whereas specimens from the Glasshouse Mountains and other mainland coastal areas occasionally have areas of blue on both wings. Blue basal scales are uncommonly seen on coastal specimens of males of *A. c. variabilis*. The ground colour of males from Toowoomba is sometimes light brown with basal coppery suffusions; this variation is also seen in specimens from other parts of the main Divide and from Blackdown Tableland. The upperside of males from the main Divide from Amiens and between Toowoomba and Blackdown Tableland (8%, n = 61) sometimes has blue scales, which rarely fill the cell of the forewing and do not extend to the postmedian region of the hindwing.

In males of *A. c. variabilis* the apical fore-tibial spines are more strongly developed than in *A. violacea*, but appear to vary according to the size of the specimen, with longer and basally broader spines on larger specimens.

The ground colour of females of *A. c. variabilis* is darker than that of *A. violacea* and the extent of blue on the uppersides of both wings is less extensive than the violet-blue areas of females of *A. violacea*.

Distribution. New South Wales: Grafton (Ramornie Trig) and northwards on the main Dividing Range to the NSW Border and west to Slaughterhouse Pinnacle; Queensland: coastal hills and southern ranges, including North Stradbroke Island, Mount Maroon, Flinders Peak, Glasshouse Mountains (including Mts Tibberoowuccum, Tibrogargan and Ngungun), Wild Horse Mountain, Coolum, Mt Tinbeerwah, Mt Cooroora, Pomona, Rainbow Beach, Main Dividing Range including Amiens, Mt Ferguson, Toowoomba, Kroombit Tops, Mt Moffatt, Carnarvon National Park (Monteith and Yeates 1986, 1988) and the Blackdown Tableland.

Biology. Unknown. Freshly emerged males have been observed resting on stumps (*ca* 1 m) infested with an ant, *Crematogaster* sp. (R. Mayo, pers. comm.). Females emerge with ovaries mature.

Acrodipsas violacea sp. n.

(Figs 19, 20-35, 43-45, 49-51)

Acrodipsas cuprea (Sands) 'brown and blue forms': Braby 2000, Eastwood and Hughes 2003a.

Types. *Holotype* ♂, labelled 'QUEENSLAND, Commodore Peak via Millmerran, 609 m, 27º56'15"S, 151º13'17"E, 17 September 2004, M.C. Sands', 'Reg. No. T232282', in QM. *Paratypes*: QUEENSLAND: 1 ♂, Commodore Peak, via Millmerran, 609 m, 27º56'15"S, 151º13'17"E, 27 September 2004, M.C. Sands, genitalia slide DPAS 77, Reg. No. T232284; 1 ♂, same data except without slide and 26 April 2005, Reg. No. T232283; 1 ♀, same data except 25 October 2004, MC & DPA Sands, genitalia slide DPAS78, Reg. No. T232285; 2 ♂♂, Dunmore via Dalby, SW of Cecil Plains, 9 Dec. 1984, M. De Baar, 224 M, Reg. Nos. T232169' & T232173; 2 ♂♂, Dunmore via Dalby, 11 Dec. 1987, M. De Baar, Reg. Nos. T232170 & T232171; 1 ♂, same data except 22 Dec. 1981, *A. cuprea* det D.P. Sands, Reg. No. T232172, all in QM; 1 ♂, Commodore Peak, via Millmerran, 609 m, 27º56'15"S, 151º13'17"E, 17 September 2004, M.C. Sands; 1 ♂, 1 ♀, same data except 19 September 2005; 1 ♂, same data except 31 October 2009; 1 ♂ same data except 24 September 2005; 2 ♂♂, Dunmore via Dalby, 9 Dec. 1984, M. De Baar; 1 ♀, Millmerran, 28 Mar. 1941, J. Macqueen; all in ANIC; 1♂, Dunmore Forest, 402 m, 16 km S.W. Cecil Plains, 27º37'30"S, 151º01'09"E, 31 October 2009, M.C. Sands; 2 ♂♂, Commodore Peak, via Millmerran, 609 m, 27º56'15"S, 151º13'17"E, 17 September 2004, M.C. Sands; 2 ♂♂, same data except 19 September 2005; 6 ♂♂, same data except 24 September 2005; 6 ♂♂, same data except 27 September 2004; 1 ♂ same data except 28 September 2004; 1 ♂ same data except 4 October 2008; 1 ♂, same data except 23 October 2004; 1 ♂, same data except 24 January 2006; 2 ♂♂, same data except 26 April 2005; 2 ♂♂, same data except 9 October 2004, M.C. & D.P.A. Sands, all in MCS.

Descriptions. The descriptions of adults and adult variation are based on specimens either unaffected by grease, or after grease has been removed by immersion of mounted specimens in ethyl acetate.

Male (Figs 20, 22, 24, 26, 28, 30, 32, 34). Antenna length (of holotype) 6.5 mm; shaft black with segmental bands white; club long, dorsally and ventrally brown-black, apex faintly tipped with orange; head dorsally black, ventrally overlain with long white hairs scales; frons black with narrow median white line and white line narrowly above eyes; eyes grey-black; palpi dorsally dark grey-brown, ventrally with patches of white scales, apex tipped white; thorax and abdomen dorsally grey-black, edged with long pale brown scales extending over wing bases, dorsally grey-black, ventrally overlain with white hair scales; legs (Figs 19, 51) brown with fore and hind femora not swollen, tarsi lighter brown, apical fore-tibial spines weakly developed, not thickened basally, not longer than spines on tarsi, femur and tibia with long

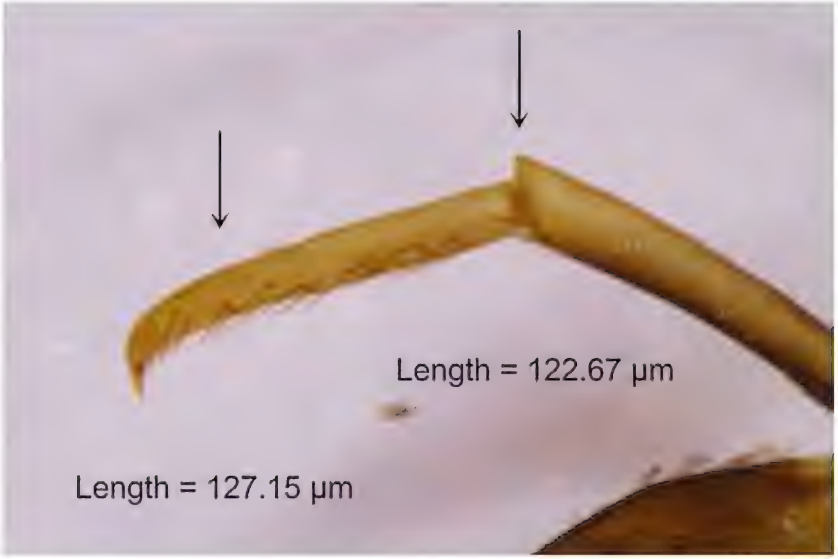
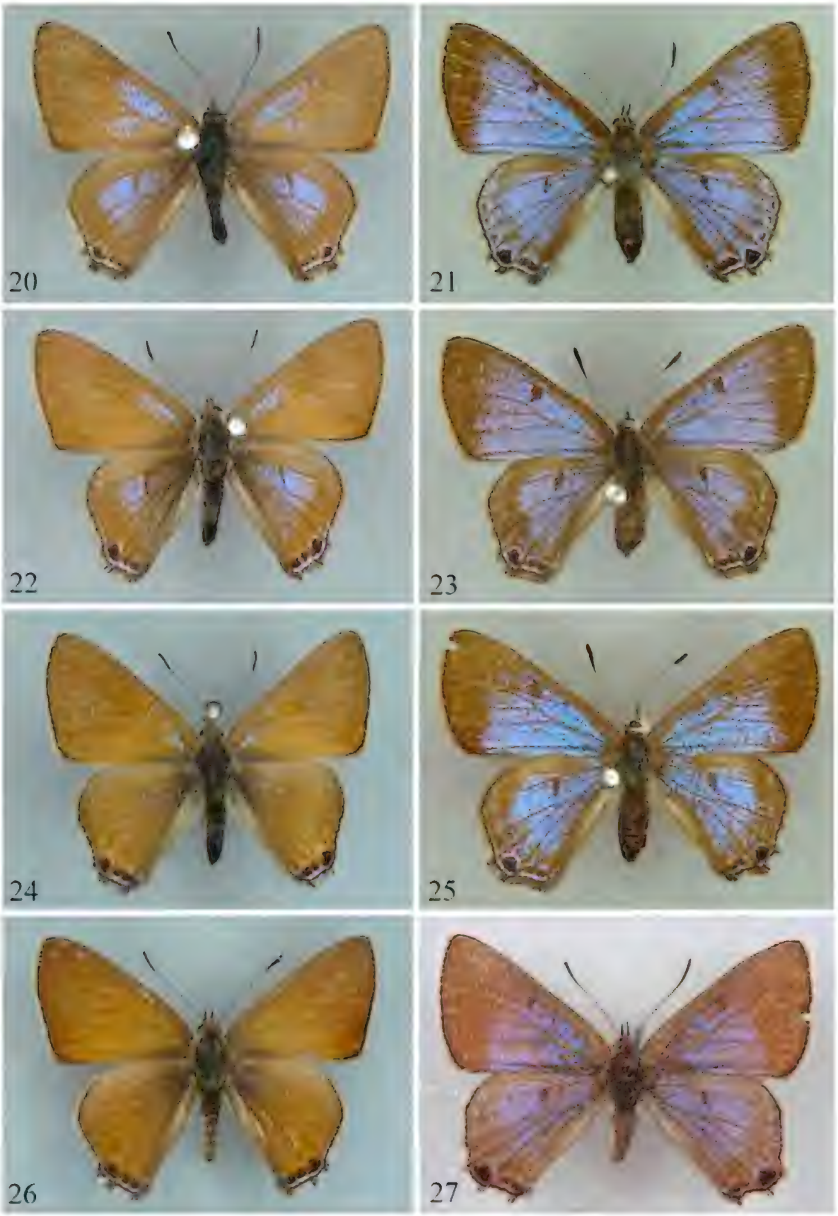
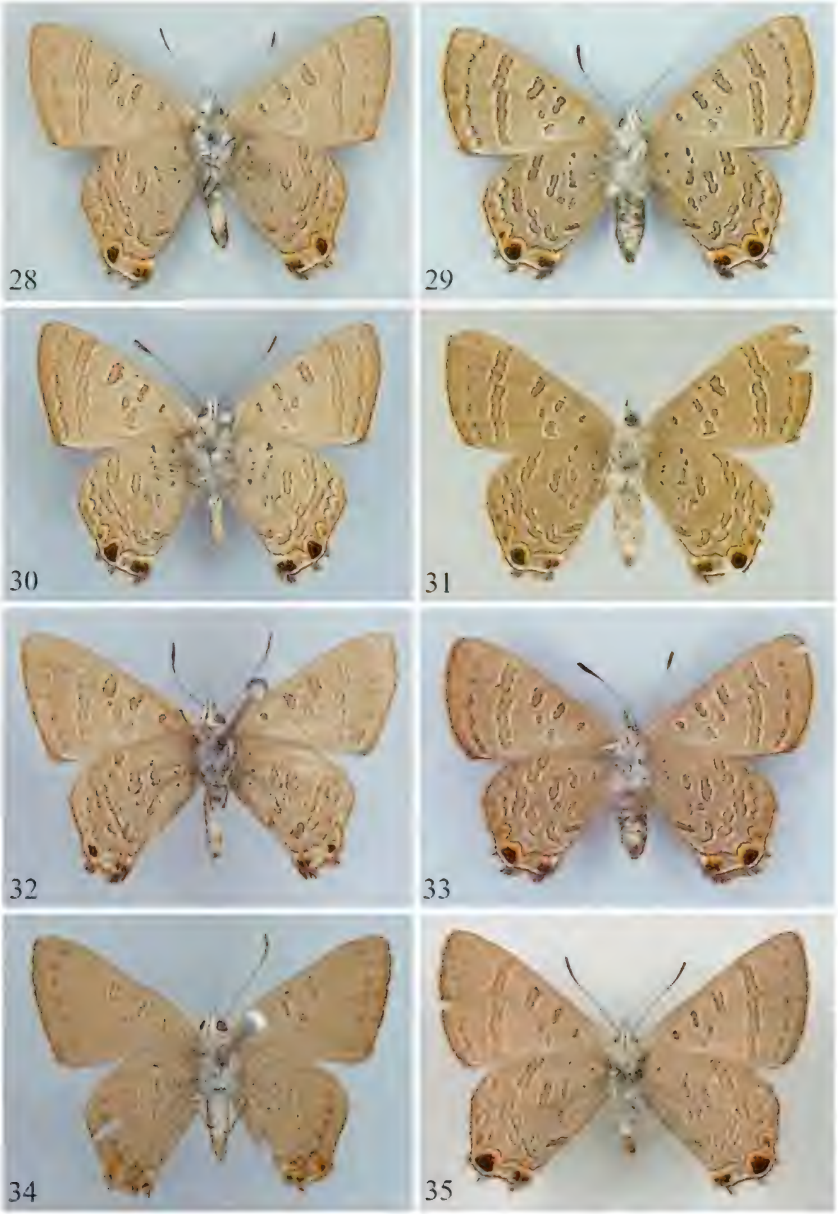


Fig. 19. *Acrodipsas violacea* sp. n.: male fore-tarsus and tibia and length of spines.

white hair scales. Forewing length (of holotype) 13.7 mm, costa and inner margin almost straight, apex acute, termen weakly bowed M_1-CuA_1, tornus obtuse; forewing upperside, basal half pale coppery brown extending to inner margin, grading to brown at subtermen, cell with variable scattered or dense blue-violet scales, extending below cell to base of CuA_2; subcostal vein and postcellular veins brown; termen narrowly dark grey-brown, broader at tornus; cilia cream. Hindwing costa weakly bowed, termen straight, angled at M_1, straight between M_1 and CuA_1, squared CuA_1 to 1A+2A at tornus, inner margin straight; upperside pale coppery brown, with variable areas of blue-violet in cell and most broadly in postmedian region M_1 to CuA_2, a transverse apical cell bar dark grey, darkest between M_1 and M_2, veins brown; termen narrowly brown-black, an oval black spot at termen between CuA_1 and CuA_2, two small spots between CuA_2 and 1A+2A, a narrow blue subterminal line separating black spots and termen, CuA_1 to tornus; cilia cream, black and broadly tufted at CuA_1, CuA_2 and tornus, inner marginal fold grey-brown. Forewing underside, pale brown-grey with pale bars or bands, edged darker brown then white, often indistinct except subterminal dark line, three transverse dark brown bars in cell, one narrow and darkest at base, broader and dark at mid cell, broadest and pale between base of M_1, M_2 and M_3; termen dark brown with subterminal brown line, closer to tornus than apex, not edged with white and interrupted at veins R_1 to 1A+2A, a subparallel postmedian band R_1 to M_3, pale or indistinct towards inner margin or absent between M_3 and CuA_2, two submedian spots, one between CuA_1 and CuA_2 and one below cell beneath CuA_2.



Figs 20-27. *Acrodipsas violacea* sp. n. uppersides: (20, 22, 24, 26) ♂♂; (21, 23, 25, 27) ♀♀. Localities: (20-25) Commodore Mountain, Qld; (26) Dunmore via Cecil Plains, Qld; (27) Millmerran, Qld.



Figs 28-35. *Acrodipsas violacea* sp. n. undersides: (28, 30, 32, 34) ♂♂; (29, 31, 33, 35) ♀♀. Localities: (28-29, 31-34) Commodore Range, Qld; (30) Dunmore via Cecil Plains, Qld; (35) Millmerran, Qld.

Hindwing pale brown with brown bands edged darker brown then white, often indistinct or absent from basal half of wing; termen dark brown with subterminal brown crenulated line, parallel to termen, except closer between Rs and M_1, a subparallel postmedian band costa to inner margin, sometimes indistinct or absent, displaced at veins with sections M_1 to M_3 and CuA_1 to CuA_2 closer to termen, section between 1A+2A and inner margin closer to 3A; a prominent subterminal black spot between CuA_1 and CuA_2; a black band or two merging spots CuA_2 and 1A+2A, edged anteriorly and faintly with cream-orange; black spots and subtornal black band separated from dark termen by narrow bluish white line from CuA_2 to tornus.

Male genitalia (Figs 43-45, 49). Unmounted: vinculum + tegumen subcircular, slightly longer than wide in posterior view, saccus expanded. Slide mounted: margins of socius strongly bowed, sociuncus lobe broad, uncus bifurcate, branches tapered, well separated at base, curved apically; brachium long, slender, apical section *ca* twice as long as basal section, apical point outwardly directed; valva with base broadly oval, concave before midpoint, apical section longer than basal section, tapered, narrowing at midpoint, subapical fold semicircular, weakly slerotised 2/3 distance from base, apex squared, tip outwardly directed; juxta with arms relatively long, apically curved inwardly, outwardly turned at base; aedeagus basally broad, prezonal sheath *ca* two-thirds length of prezonal sheath, postzonal sheath concave near midpoint (viewed laterally), curved ventrally, apically tapered to a strongly slerotised apex.

Female (Figs 21, 23, 25, 27, 29, 31, 33, 35). Antenna length (of allotype) 6.4 mm; colour of head, palpi, thorax, abdomen and legs similar to male, palpi with second segment longer than male, abdomen relatively large; ventral surface of thorax, anterior surface of abdomen, femur and tibia with long white hair scales. Forewing length (of allotype) 13.4 mm, apex obtuse, termen bowed, tornus obtuse; upperside broadly violet-blue from base to postmedian region and inner margin, sometimes extending between subtermen and termen, a prominent brown-black bar at apex of cell between M_1 and M_2; subtermen broadly brown from costa to tonus, broader at apex than tornus, termen narrowly dark brown, cilia cream-brown. Hindwing costa bowed, mostly at apex, termen straight between M_1 and CuA_1, produced and squared between CuA_1 to CuA_2, slightly concave between CuA_2 and 1A+2A; upperside broadly violet-blue from base to postmedian region, broadest at 1A+2A, apex of cell with prominent brown-black bar between bases of M_1 and M_2, subtermen broadly brown costa to tornus, a series of subterminal crenulated violet-blue markings enclosing dark brown from Rs to 1A+2A at subtornus; termen narrowly brown-black, a large subtriangular black spot between CuA_1 and CuA_2, a black band between CuA_2 and 1A+2A, a narrow blue subterminal line M_1 to 1A+2A edging black spots at tornus; cilia cream-brown, black and broadly tufted at CuA_1, CuA_2, broadest at tornus, inner marginal fold pale grey-brown, grading to darker brown towards tornus.

Forewing underside, pale grey-brown with brown bands or spots narrowly edged with dark brown, then white; cell bands darkest and merged at base, narrow and dark at mid cell, paler at cell apex, a spot between subbases of M_1 and CuA_1 and CuA_1 and CuA_2, postmedian band broad, closer to termen at tornus than apex, section between R_3 and R_{4+5} and M_3 to CuA_2 displaced towards base, subterminal band narrow, somewhat crenulated, slightly closer to termen at tornus than apex, area between subterminal band and termen brown with ground colour darker and narrower towards termen; hindwing underside basal and submedian bands narrower than postmedian band, cell basal, mid and apical bands progressively wider, postmedian band broad, sections M_1 to M_3 at cell apex and CuA_1 to CuA_2 closer to termen, section between CuA_2 and 1A+2A angled anteriorly towards base, two prominent subterminal black spots separated at tornus, edged orange anteriorly, one larger oval spot between CuA_1 and CuA_2, a second smaller spot at tornus overlying 1A+2A, spots edged narrowly blue, a dark postmedian band.

Female genitalia (Fig. 50). Slide mounted: apophyses anteriores slender, apically tapered, moderate in length; papillae anales broadly oval, finely setose; ostium bursae small, moderately sclerotised, shallowly U-shaped with out-turned arms, surrounded by U-shaped anterior wall of ostium, wider than long; ductus bursae not sclerotised, membranous, broad, gradually expanded to merge with small, anteriorly rounded, membranous corpus bursae.

Comments. The ground colour on the upperside of males of *A. violacea* is coppery brown, rather than the brown or dark grey-brown usual for *A. cuprea variabilis*. Violet-blue basal areas are mostly present in males of *A. violacea*, except for some specimens from the Dunmore area, where the upperside is uniformly pale coppery brown. The forewing termen of *A. violacea* is less bowed than that of *A. c. variabilis*, somewhat resembling the termen of *A. brisbanensis*. On the hindwing underside, the orange edging of the black spots near the tornus of *A. violacea* is paler than the orange of *A. c. variabilis* and in some specimens of *A. violacea* the orange edging is replaced by cream. The underside bands in males of *A. violacea* may be clearly marked, obscure or absent and the narrow subterminal brown band, interrupted by veins, may be the only postmedian marking on the forewing. In male *A. violacea* when bands are present on the underside, the white edging tends to be more clearly marked than in the bands of *A. c. variabilis*. On the legs of males, the apical fore-tibial spines are less developed when compared with *A. cuprea variabilis* and, although not longer than spines on the tarsi, appear to vary according to the size of the specimen, with more robust tibial spines occurring on larger specimens. The male genitalia are similar to those of *A. cuprea* and *A. aurata* (Sands 1997), but the apices of valvae of *A. violacea* are narrower than those of *A. c. variabilis* and resemble somewhat the shapes of valvae of *A. mortoni* Sands, Miller & Kerr (see Sands *et al.* 1997, fig. 12).

In *A. violacea* females, the violet-blue areas extend to the postmedian region or beyond and to the inner margin of both wings, whereas in females of *A. cuprea variabilis* the blue areas rarely extend beyond the cell. The ground colour of females of *A. violacea* from Millmerran and Commodore Peak is light to medium brown, with distinctive violet-blue areas extending beyond the cells of the upperside of both wings and reaching the postmedian region and subtornus, whereas in *A. cuprea variabilis* the ground colour is grey-black and the dark blue area is restricted to the basal half of the forewings. To date, no females of *A. violacea* are known from Dunmore for comparison with the females from Millmerran and Commodore Peak, which have extensive areas of violet-blue on both wings. Based on one specimen available for dissection, the female genitalia (Fig. 50) could not be distinguished from those of *A. cuprea*.

Variation. The upperside of males of *A. violacea* varies in the shade of the brown ground colour, the basal coppery areas on the forewings and subtornus of hindwings, the extent of blue scales and the prominence of cell and postmedian veins. Blue areas on the upperside of both wings are present on males of *A. violacea* from Commodore Peak, but are less extensive or absent on the few males known from Dunmore. The shade of light brown on the upperside varies and the underside of males is very variable, with median bands on the underside often indistinct or absent and, except for the prominent brown subterminal line, interrupted at the veins of both wings. Orange edging to the black spots near the tornus of *A. violacea* may be pale and in some specimens orange is replaced by cream. The violet-blue areas on the upperside of females of *A. violacea* are variable in extent but are much more extensive on both wings than the areas of blue of *A. cuprea variabilis*.

Distribution. To date, *A. violacea* has been recorded at Millmerran, Commodore Range and Dunmore, via Cecil Plains, and observed at Captains Mountain. Several males from Mount Moffatt may be this species but the absence of females from this locality prevents confident identification or designation of these as paratypes of *A. violacea*. Males of *A. cuprea variabilis* have been found at some inland localities where *A. violacea* and *A. cuprea* may prove to be sympatric when more material, particularly females, becomes available.

Biology. The habitats of this species are *Eucalyptus* and *Allocasuarina* woodlands on isolated inland ridges of southern Queensland, where males congregate to intercept unmated females that visit hilltops. Males of *A. violacea* are rapid in flight, resembling the behaviour of *A. brisbanensis* rather than that of *A. cuprea variabilis*. A female of *A. violacea* was collected from blossom by J. Macqueen on his property about 24 km south of Millmerran and females were observed (M.C. Sands) flying close to a hilltop around a dead tree (*ca* 7 m) supporting a colony of ants.

Larvae of *A. violacea* are likely to be predatory on the immature stages of ants and, as in the case with other freshly captured female *Acrodipsas* spp., the expanded abdomens of freshly emerged females contain many fully developed eggs.

Acrodipsas aurata Sands

(Figs 36-42)

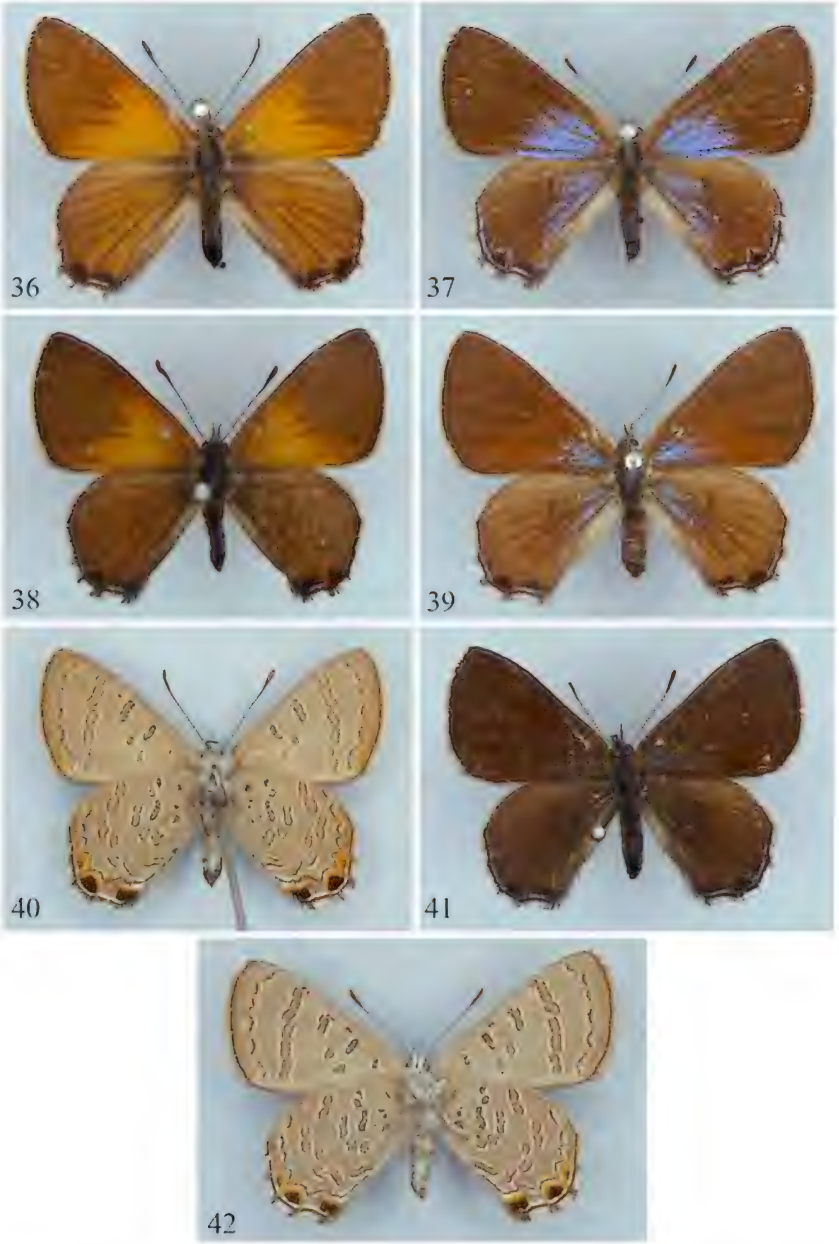
Acrodipsas aurata Sands, 1997: 339-344. Holotype ♂, Mount Ainslie, Australian Capital Territory, in ANIC Canberra.

Diagnosis. Sands (1979) noted distinctive features in the apices of valvae of male genitalia of specimens thought at that time to be a form of *Acrodipsas cuprea* from coastal and montane NSW. Subsequently, differences in wing patterns of both sexes, wingspan and shape of both wings, and male genitalia, enabled separation of *A. aurata* from *A. cuprea,* with recognition of *A. aurata* as a distinct species (Sands 1997).

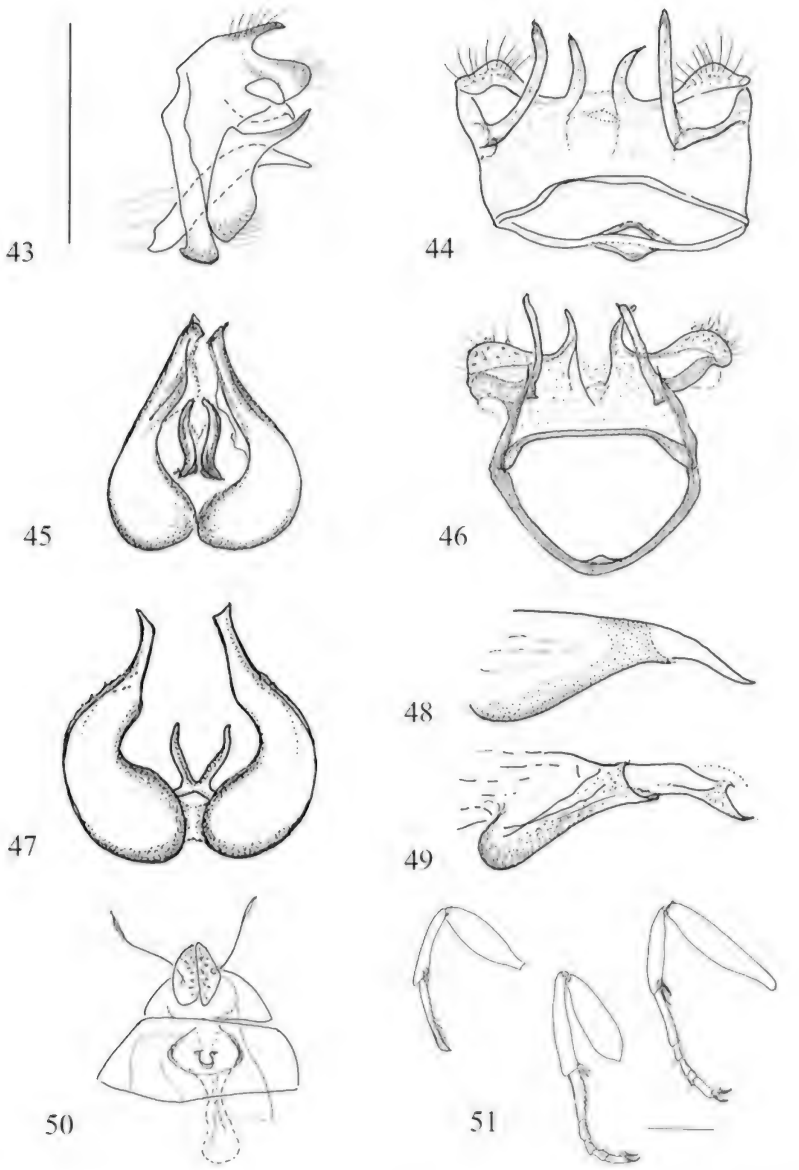
Variation. Some variation has been observed in males of *A. aurata*, mostly in the extent of the subtriangular coppery basal area of the forewing upperside, the prominence of dark postcellular veins and the presence of the coppery suffusions on the hindwing upperside (Braby 2000). Females from Canberra and the Southern Highlands of NSW vary considerably, with the ground colour varying from dark brown to grey-black on the upperside, sometimes with an indistinct subbasal coppery suffusion, and in the extent of basal blue scales (Dunn and Dunn 1991, Braby 2000). Females from the Blue Mountains, NSW, have more extensive blue areas on both wings, from the base to the cell or beyond, whereas in females from the ACT the blue scales are restricted to the base, obscure or sometimes absent, as in a coppery brown female from Mt Ginini, ACT (Sands 1997). In both sexes, the taxonomically important postmedian subcostal band, between veins R_2 and R_{4+5} on the underside of the forewing, is occasionally indistinct. Females from ACT exhibit seasonal variation in the extent of blue scales, with those collected in spring thought to have less blue than those collected in late summer or autumn (C. Meyer pers. comm.).

Distribution. Australian Capital Territory (> *ca* 580 m): including Canberra and Brindabella Range; New South Wales: Southern Highlands, including Queanbeyan, Cooma and Blue Mountains; Victoria: Pine Mountain (Field 2013). To date, *A. cuprea cuprea* and *A. aurata* have not been collected from the same hilltops despite their occurrence within several kilometres of each other in the Southern Highlands of NSW (E. Edwards pers. comm.).

Biology. An infertile female of *A. aurata* (originally thought to be *A. cuprea*), was induced to oviposit when confined with a colony of ants of the genus *Crematogaster* (Atkins 1984, Sands 1997). The larvae of *A. aurata* are likely to be predatory on immature stages of ants.



Figs 36-42. *Acrodipsas aurata* Sands: (36-39, 41) uppersides, (40, 42) undersides: (36, 38, 40) ♂♂; (37, 39, 41-42) ♀♀. Locality: Canberra, ACT.



Figs 43-51. *Acrodipsas* spp: (43-45, 48, 50-51) *Acrodipsas violacea* sp. n., (46, 47, 49) *A. cuprea variabilis* subsp. n.; (43-49) ♂ genitalia: (43) unmounted, lateral view; (44-51) slide mounted: (44, 46) sociuncus, (45, 47) valvae, (48-49) aedeagus; (50) ♀ genitalia; (51) ♂ legs. Scale bars = 1 mm.

As observed in other *Acrodipsas* species, mounted specimens, particularly males, are prone to become greasy. Females emerge with mature ovaries, as evidenced by large numbers of fully developed eggs in abdomens of freshly captured, unmated specimens. *Acrodipsas aurata* is associated with eucalypt woodlands of the ACT, Victoria and the Southern Highlands and Blue Mountains of NSW, where males congregate on hilltops and freshly emerged females visit the sites to mate.

Discussion

Our decision to recognise two subspecies of *A. cuprea* is based on the two taxa having discrete geographical distributions. Males of *A. c. variabilis* exist in several colour forms but the variation is not consistently linked to distribution; thus there is no justification for recognising other additional forms of *A. cuprea* as subspecies. However, this study does not fully resolve the identities of representatives from all populations considered to belong to subspecies *A. c. variabilis*, with insufficient females known from some localities where males have been collected, preventing a comprehensive overview of variation and distribution of *A. c. variabilis*. For example, a series of males from the Glasshouse Mountains can be divided into two groups, one with smaller wingspans and a more convex termen when compared with variation in other localities, but without other detectable morphological differences.

Recognition of *A. violacea* as a distinct species is based on the upperside coloration of males and females, the distribution, slight differences in the male genitalia and, in most male specimens, the relative lengths of spines on the tarsi and tibiae. While there is a superficial resemblance between the blue males of *A. violacea* and some males of *A. c. variabilis*, the few females of *A. violacea* available for study have more extensive areas of blue-violet than the areas of blue in females of *A. c. variabilis* and the ground colour of *A. violacea* is a considerably lighter brown. Differences between the length of fore-tibial spines on male forelegs of *A. violacea* and *A. c. variabilis* appear to be important, but the spine lengths can also vary according to size of the adult specimens. More specimens are required for detailed comparisons of slide-mounted material before this structural difference between the legs of the two species can be better understood. The decision to describe *A. violacea* as a distinct species, rather than as a subspecies of *A. cuprea*, took into account similar decisions made for separating several other closely related species of Lycaenidae. For example, Eastwood *et al.* (2008) elevated *Jalmenus eubulus* Miskin to specific rank as a species distinct from *J. evagoras* (Donovan), based on differences in the morphology, ecology and genetics of the two taxa. In so doing, the distributions of *J. eubulus* and *J. evagoras* were shown to almost overlap in some inland areas, while adults of some populations of *J. eubulus* were considered to be possibly hybridising.

We have seen a few specimens of male *Acrodipsas* from Toowoomba, Barakula State Forest and Cecil Plains that cannot be placed with certainty

with either *A. violacea* or *A. cuprea variabilis*. Other adults (in QM), collected by the late Murdoch De Baar from the Bunya Mountains, are clearly affiliated with the *cuprea*-species complex but cannot reliably be identified to species. When more material becomes available, particularly females, the two species *A. cuprea variabilis* and *A. violacea* may prove to be sympatric at some localities and hybridisation between the two cannot be ruled out.

Eastwood and Hughes (2003a, 2003b) studied the species relationships of the genus *Acrodipsas* using a base pair fragment from the 3'-end of CO1. They included a single specimen from Millmerran that did not differ in sequence from specimens from the main Divide and other inland localities, seemingly contradicting the decision to separate the new species *A. violacea* from *A. cuprea*. However, the haplotypes they derived for all specimens of *A. cuprea* differed only by a single or at most four nucleotides, indicating that this gene evolves too slowly to examine population structures and species-level relationships in the *cuprea* species-complex. To investigate this complex further, it would be advisable to examine multiple, more rapidly evolving genes, including nuclear genes. Future DNA studies on *Acrodipsas* spp. need to be combined with morphological studies and based on adequate numbers of both sexes.

Seasonal variation as seen in *A. aurata* might also occur in other species of *Acrodipsas* and, when sufficient specimens of both sexes become available, such seasonal effects on morphology will need to be considered in future taxonomic studies of this genus.

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REVIEW OF AUSTRALIAN *PHILIRIS* RÖBER (LEPIDOPTERA: LYCAENIDAE), WITH NOTES ON VARIATION AND DESCRIPTIONS OF TWO NEW SUBSPECIES FROM CAPE YORK PENINSULA

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Abstract

The taxonomic status of the Australian species of *Philiris* Röber and variation in their adult morphology are reviewed. *P. diana* Waterhouse & Lyell is shown to be a species distinct from *P. papuana* Wind & Clench, *P. lucina* Waterhouse & Lyell is shown to be a species distinct from *P. nitens* (Grose-Smith) and *P. innotata evinculis* Wind & Clench is formally synonymised with *P. innotata* (Miskin). Two new subspecies from Cape York Peninsula, *P. papuana kerri* subsp. n. and *P. azula johnsoni* subsp. n., are described, figured and compared with the nominotypical subspecies from mainland Papua New Guinea. Nine species or subspecies of *Philiris* are recognised as occurring in Australia: *P. diana*, *P. nitens* and *P. lucina*, all with Lectotypes newly designated, plus *P. fulgens kurandae* Waterhouse, *P. papuana kerri* subsp. n., *P. sappheira manskiei* Ring & Olive, *P. ziska titeus* d'Abrera, *P. azula johnsoni* subsp. n. and *P. innotata*.

Introduction

The genus *Philiris* Röber is a group of Lycaenidae limited in distribution to parts of the Australian Region, including tropical and subtropical eastern Australia, eastern Indonesia and Papua New Guinea, but the genus is not known to occur in the Solomon Islands. Based mainly on specimens lodged in the Natural History Museum, London, the genus was revised by Tite (1963) and referred to the Tribe Luciini by Tite (1963) and Eliot (1973). Subsequently, d'Abrera (1971) illustrated representatives of these specimens and included new Australian records of *Philiris* spp. by Kerr (1967); he also described a new subspecies, *P. ziska titeus* d'Abrera, from Cape York Peninsula. Edwards (1996) provided a revised synopsis of Australian Lycaenidae and included new records of *Philiris* spp. by Johnson and Johnson (1984), while Ring and Olive (1997) recorded an additional species (*P. sappheira* Sands) from northern Queensland, previously known only from mainland New Guinea. In a major work on the butterflies of Papua New Guinea, Parsons (1998) considered New Guinea to be the major centre of diversity of the genus *Philiris*, with 53 species recorded, and referred to species also known from Australia. More recently, Müller (2002, 2014) described new *Philiris* spp. from New Guinea, while Braby (2000) and Orr and Kitching (2010) published comprehensive accounts of most of the Australian species, including their life histories.

The male genitalia of *Philiris* spp. were shown by Tite (1963) to greatly assist identification of similar species, but some identifications have continued to be difficult because of variation in adult morphology, particularly in females (Forbes 1977). This variation has led to unsupportable descriptions of new taxa from New Guinea (*e.g.* by Wind and Clench 1947, Tite 1963) and difficulties in associating females with conspecific males.

Figs 1-8. *Philiris diana* Waterhouse & Lyell: (1-2) ♂♂, (3-8) ♀♀; (1, 3, 5, 7) uppersides, (2, 4, 6, 8) undersides. Localities: (1-4) Kuranda, Qld; (5-6) Paluma, Qld; (7-8) Lake Eacham, Qld.

Here, two new Australian subspecies of *Philiris*, *P. papuana kerri* subsp. n. and *P. azula johnsoni* subsp. n., are described and changes to the taxonomic status of *P. diana* Waterhouse & Lyell, *P. nitens* (Grose-Smith) and *P. lucina* Waterhouse & Lyell are noted, together with lectotype designations for these three species in order to ensure stability of their names. A lectotype is also recognised for *P. fulgens kurandae* Waterhouse. Variation in morphology and summaries of their biology, when known, are reviewed for each species.

Abbreviations: AM – Australian Museum, Sydney; ANIC – Australian National Insect Collection, CSIRO, Canberra; BMNH – The Natural History Museum, London; MCZ – Museum of Comparative Zoology, Harvard University, Cambridge, USA; QM – Queensland Museum, Brisbane; PNG – Papua New Guinea; Qld – Queensland; FWL – forewing length.

PHILIRIS RÖBER, 1891

Philiris Röber, 1891: 317; Druce 1897: 14; Druce 1902: 115; Waterhouse 1903a: 650; Waterhouse 1903b: 188-189; Waterhouse 1913: 699; Waterhouse and Lyell 1914: 76; Waterhouse 1924: xxvii; Waterhouse 1932: 137; Waterhouse 1937: 115; Tite 1963: 222-225; Hemming 1967: 358; Tite 1969: 58; d'Abrera 1971: 368; McCubbin 1971: 72; Common and Waterhouse 1972: 424; Eliot 1973: 429; Sands 1979: 127; Sands 1981b: 89; Parsons 1998: 361-362; Edwards 1996: 250.

Parachrysops Bethune-Baker, 1904: 369; Hemming 1967: 338; d'Abrera 1971: 349; Eliot 1973: 429; Parsons 1998: 361; = *Philiris*: syn. Müller 2014: 34.

Type species *Thecla ilias* C. Felder, 1860: 454. Subfamily Theclinae, Tribe Luciini, *Hypochrysops* section (Eliot 1973).

Philiris diana Waterhouse & Lyell, 1914

(Figs 1-8, 53)

Philiris diana Waterhouse & Lyell, 1914: 76; Waterhouse 1932: 138; Edwards 1996: 250.

Philiris diana diana Waterhouse & Lyell: Wind and Clench 1947: 6; Tite 1963: 235; Common 1964: 124; d'Abrera 1971: 370; McCubbin 1971: 172; Common and Waterhouse 1972: 425; Braby 2000 and 2010; Orr and Kitching 2010: 236.

Types. Lectotype ♂ (here designated), QUEENSLAND: labelled 'Kuranda Qld, Mch 07 F.P. Dodd', 'G. Lyell collection', 'Type male PHILIRIS DIANA Waterhouse and Lyell KL21453', in AM. *Paralectotypes* (here designated): 7 ♂♂, 7 ♀♀, with same locality data as lectotype but with dates and registration numbers as follows: 4 ♂♂, April 1907, KL21456; 2 ♂♂, April 1907, KL21459; 1 ♂, March 1909, KL21458; 1 ♀, April 1907, KL21455; 2 ♀♀, April 1907, KL21456; 2 ♀♀, April 1908, KL21457; 1 ♀, April 1907, KL21459; 1 ♀, 16 April 1902, KL21454, with R.E. Turner instead of F.P. Dodd, all in AM. The Lectotype bears a red label and was listed as the holotype, in the handwriting of G.A. Waterhouse, in a register of specimens held in AM.

Diagnosis. Both sexes of *P. diana* were adequately described and illustrated by Waterhouse and Lyell (1914). The brownish purple upperside of males of *P. diana* is distinctively lighter and duller than the purple ground colour of *P. papuana kerri* subsp. n., previously considered to be a subspecies of *P. diana*,

and the white patch on the forewing of males of *P. diana*, referred to by Waterhouse (1932), is more prominent than the obscure white scales similarly placed on *P. papuana kerri*. Females of *P. diana* are very variable in the extent of white areas on the upperside of both wings but the greyish violet suffusion on both wings is much more restricted than in *P. papuana*. The pale greyish violet suffusion on the upperside of the forewings may be obscure or absent in *P. diana*.

The male genitalia of *P. diana* were figured by Tite (1963). The valvae are similar to those of *P. papuana kerri* but the curved apical projection on the right valva (posterior view) is shorter (Fig. 53) than that of *P. papuana* (Fig. 54) and the short projection on the right valva of *P. diana* is broad basally, rather than the subtubular projection of *P. papuana*.

Sands (1981a) proposed the *diana* species-group for *Philiris* species with relatively large adults in which both sexes are without a black spot on the inner margin of the hindwing underside and valvae of the male genitalia are asymmetrical. The *diana* species-group was subsequently accepted by Parsons (1998).

Variation. FWL: ♂♂, 15.3-16.4 mm; ♀♀, 16.7-18.6 mm. In males, the white patches on the dull purple forewing and the white hindwing costa are variable (Waterhouse 1932). The forewing median patch between the bases of M_3, CuA_1 and CuA_2 occasionally extends between CuA_2 and 1A+2A (Waterhouse and Lyell 1914, plate 15) and, on the hindwing, the white area on the costa may extend from Rs towards M_1. Females of *P. diana* vary in the extent of blue basal scales and white on the upperside of both wings; the central area of white on the forewing may be confined to the median and postmedian region or extend to the subterminal region or inner margin, while on the hindwing the white area may be limited to the costa or may extend to postmedian and subterminal regions between M_1 and M_3.

Distribution. Northern Queensland: Lake Eacham (Atherton Tableland), Kuranda, Cairns and Paluma.

Biology. A pupa was found near Kuranda on the upperside of a leaf of *Litsea* sp., possibly *L. leefeana* (F. Muell.) Merr. (Lauraceae) (Braby 2000), and this is a probable larval food plant for *P. diana*.

***Philiris papuana papuana* Wind & Clench, 1947, stat. n.**

(Figs 9-14)

Philiris diana papuanus Wind & Clench, 1947: 6; Tite 1963: 235; Kerr 1967: 49-51; d'Abrera 1971: 370; McCubbin 1971: 72; Common amd Waterhouse 1972: 425; Sands 1979: 131; Parsons 1998: 362; Edwards 1996: 250; Orr and Kitching 2010: 236.

Philiris diana: Parsons 1991: 136-137; misidentification.

Type. Holotype ♂, PAPUA NEW GUINEA: Wau, Morobe District, in MCZ.

Figs 9-14. *Philiris papuana papuana* Wind & Clench: (9-10) ♂♂, (11-14) ♀♀; (9, 11, 13) uppersides, (10, 12, 14) undersides. Localities: (9-10) Musgrave River, Central Province, PNG; (11-14) Madang, Madang Province, PNG.

Diagnosis. The description by Wind and Clench (1947) was based on a comparison of the type specimen from Papua New Guinea with figures of male *P. diana* in Waterhouse and Lyell (1914) and Waterhouse (1932). Parsons (1998) figured the adults of both sexes.

The male genitalia of *P. p. papuana* were figured by Tite (1963) and Parsons (1998); the asymmetrical valvae were noted by Tite (1963) and figured by Sands (1979). Tite (1963) compared the male genitalia of *P. p. papuana* with

those of *P. diana*, describing the former as 'larger and stouter' than those of *P. diana*.

Sands (1981a) and Parsons (1998) included *P. papuana* in the *diana* species-group proposed by Sands (1981a).

Variation. FWL: ♂♂, *ca* 16.0-18.3 mm; ♀♀, 16.0-19.0 mm. Males of *P. papuana papuana* show some variation in the area of obscure white scales on the forewing, whereas females vary in the extent of white on the costa and the distribution of blue scales on the hindwing. In localities in southern Papua New Guinea, females from higher altitudes have more extensive areas of blue on the hindwing than in specimens from near the coast. However, these blue areas in *P. p. papuana* are not as extensive as those in *P. p. kerri*.

Distribution. Mainland Papua New Guinea and Papua Province, eastern Indonesia.

Biology. In Papua New Guinea, Parsons (1998) located larvae of *P. papuana papuana* feeding on *Litsea guppyi* (F. Muell.) F. Muell. ex Forman (Lauraceae).

Philiris papuana kerri **subsp. n.**

(Figs 15-20, 54)

Philiris diana papuana: Kerr 1967: 49-51; d'Abrera 1971: 370; McCubbin 1971: 2; Common and Waterhouse 1972: 425; Sands 1979: 131, Braby 2010: 34-35, Orr and Kitching 2010: 236; misidentifications.

Types. *Holotype* ♂, QUEENSLAND: labelled 'Claudie River Nth. Qld. 26.xii.71, D.P. Sands', 'Figured in *Butterflies of Australia*, CSIRO Publishing, M.F. Braby', in ANIC. *Paratypes*: 1 ♂, Claudie River, 1 May 1966, J.F.R. Kerr; 1 ♀, same data with additional label 'Metallotype *Philiris diana papuana*'; 1 ♂, West Claudie River e.p., 30 August 1999, D.P.A. Sands; 1 ♂, Lockerbie Scrub, Cape York, 9 Oct 76, D. Sands, ANIC database No. 32, 043995, Barcode of Life DNA voucher specimen: 11ANIC-05827 BOLD Proc. ID ANIC1827-11; 1 ♂, near Mt Lamond, Iron Range, 11 April 1971, AA, all in ANIC; 1 ♀, ABRS Area 2, 142°45'E, 11°40'S, Dividing Range, 15 km. W. Captain Billy Creek, Cape York Pen., 5-12.ii.1976, G.B. Monteith, in QM; 1 ♂, West Claudie R, Iron Range, XP, 27.ix.2000, R Mayo; 1 ♂, West Claudie R, CYP, XP, 4.ix.1999, R Mayo; 1 ♂, Phillip Hill, Iron Range, XP, 2.x.2003, R Mayo; 1 ♂, West Claudie R, XP, 14.ix.2001, R Mayo; 1 ♀, West Claudie R, Iron Range, XP, 1.x.2000, R Mayo; 1 ♀, West Claudie R, Iron Range, XP, 2 x 2000, R Mayo; 1 ♀, West Claudie R, Iron Range, XP, 31.viii.2000, R Mayo; 1 ♀, Gordon Ck, Iron Range, 22.viii.2001, R Mayo, all in Russell Mayo Collection, Pomona, Qld.

Kerr (1967) described a female specimen as a metallotype of *P. papuana*; the same specimen is here designated a paratype of *P. p. kerri*.

Description. Male. Antennal length (of holotype) 9.0 mm, shaft black with narrow white segmental bands, club dorsally black, apex dorsally edged and ventrally orange; eyes dark grey, edged white; frons white; thorax and abdomen dorsally dark grey, ventrally white; palpus white, apical segment

grey; tibiae and tarsi white with narrow black bands. Forewing length (of holotype) 15.0 mm, termen almost straight; upperside mauve-purple, an obscure postmedian whitish suffusion from cell vein and between M_3 and CuA_2 to postmedian area; termen narrowly black (*ca* 0.2 mm) from apex to tornus; cilia from apex to CuA_2 grey and from CuA_2 to tornus narrowly white. Hindwing upperside mauve-purple, costa from base, $Sc+R_1$, Rs to apex, grey; termen narrowly (*ca* 0.2 mm) black, wider from CuA_1 to tornus (*ca* 0.4 mm); inner margin fold grey-white; cilia narrowly white. Underside of both wings silvery white, forewing with obscure greyish median patch between CuA_1 and CuA_2; termen white, narrowly tipped black at vein ends M_3 to tornus, hindwing broadly black at vein ends CuA_1, CuA_2 and 1A+2A; inner margin without black spot; cilia white, except black at vein ends CuA_1, CuA_2 and 1A+2A.

Male genitalia (Fig. 54). Unmounted: vinculum-tegumen ring narrowly oval in posterior view. Slide mounted: sociuncus and vinculum broad, saccus expanded, socii stout, separated by a shallow U-shaped sinus, margins straight, obtusely angled at 2/3 edge, clothed with fine setae; brachia stout, inwardly curved, apically broad, tip inwardly tapered to a point; valvae relatively long, curved, unequal in length (posterior view: left valva longer than right), both basally broad, cone-shaped, subtriangular, with mid section long, slender, apices expanded and shapes asymmetrical with fine setae, apex of left valva (posterior view) with outwardly curved, tapered, sharply pointed beak-shaped projection, apex of right valva (posterior view) blunt, with single peg-shaped projection; juxta subcylindrical, with sclerotised ring surrounding aedeagus; aedeagus subcylindrical, prezonal sheath broadened, retracted cornuti with two slender strips of finely sclerotised spines; anal tube slender, moderately sclerotised.

Female. Antennal length (of paratype) 9.0 mm, shaft black with narrow white segmental bands, club dorsally black, apically tipped orange, ventrally orange; eyes dark grey, edged white; frons grey-brown; palpus white, apical segment grey; thorax and abdomen dorsally dark grey, ventrally white; tibiae and tarsi white with black bands. Forewing length (of paratype) 16.7 mm, termen bowed, apex obtuse; upperside costa, apex, termen and tornus broadly dark grey; area from base to cell, to inner margin and postmedian area, pale blue-mauve; a subcentral white oval patch between bases of M_3, CuA_1 and CuA_2, extending to subtermen. Hindwing upperside with apical half of costa white with greyish suffusion extending to Rs and M_1; a broad area from base and cell to subtermen and subtornus pale blue-violet, crossed by dark grey veins except at the apical cell bar; termen dark grey-brown (*ca* 5.0 mm); cilia white. Underside of both wings silvery white, forewing with small obscure greyish patch in median region; termen white, narrowly black between CuA_1, CuA_2 and 1A+2A and black at vein ends M_3 to tornus; inner margin white (without black spot); cilia white, except black at vein ends CuA_1, CuA_2 and 1A+2A.

Figs 15-20. *Philiris papuana kerri* subsp. n.: (15-16) ♂♂, (17-20) ♀♀; (15, 17, 19) uppersides, (16, 18, 20) undersides. Localities: (15-16) West Claudie River, Qld; (17-20) Claudie River, Qld.

Variation. FWL: ♂♂, 14.7-16.8 mm; ♀♀, 16.7-19.7 mm. Males are variable in the density of white scales on the forewing but the upperside of both wings is otherwise similar to *P. p. papuana*. Females of *P. p. kerri* show little variation in colour of the upperside (Figs 17, 19) but occasionally the blue areas extend to the termen at M_1 of the hindwing.

Comments. Recognition of *P. papuana kerri* as a separate subspecies is based on morphological differences in both sexes. The upperside of males of both

subspecies is similar, but the wingspans of *P. p. kerri* are usually slightly smaller (FWL *ca* 15.00-17.20 mm) than those of *P. p. papuana* (FWL *ca* 16.00-18.30 mm). The variable and often obscure whitish suffusion on the upperside of the forewing of males is usually more prominent on *P. p. kerri* than on *P. p. papuana*, where it is sometimes absent, and the hindwing costa on the upperside of *P. p. kerri* is paler than in *P. p. papuana*. The grey subbasal suffusion on the forewing underside of males of the two subspecies differs, with the median patch between CuA_1 and CuA_2 of *P. p. papuana* more extensive than that of *P. p. kerri* and reaching the postmedian region. The hindwing underside termen of *P. p. kerri* is mostly white with only black cilia at the margin, whereas in *P. p. papuana* the termen is narrowly black. The male genitalia of *P. p. kerri* do not differ significantly from those of *P. p. papuana*, figured by Tite (1963).

Differences between females of *P. papuana* from Australia and Papua New Guinea were referred to by Sands (1979), who noted that the blue areas on both wings [of *P. p. kerri*] were more extensive (Figs 17, 19) when compared with females of *P. p. papuana* (Figs 11, 13) from New Guinea. The wingspans of females of *P. p. kerri* are similar (FWL 17.0-19.5 mm) to those of *P. p. papuana.* The extent of blue on the upperside of both wings differs: in *P. p. kerri* (figured by Kerr 1967) blue areas extend to the postmedian and inner margin of the forewing and the subterminal area of the hindwing, but in *P. p. papuana* blue areas are limited to the basal half of the forewing and postcellular region of the hindwing.

Etymology. Named in honour of Emeritus Professor J.F.R. Kerr, in recognition of his many contributions to the study of Australian butterflies.

Distribution. Cape York Peninsula, northern Queensland: Lockerbie Scrub, Captain Billy Creek, Claudie River and Iron Range.

Biology. The life history of *P. papuana kerri* was described by Wood (1984). On Cape York Peninsula, the larvae fed on *Litsea breviumbellata* C.K. Allen (Lauraceae) and are not attended by ants (Valentine and Johnson 1997). Males of *P. p. kerri* frequently settle on the upperside of leaves up to eight metres above ground level, on trees growing at the edge of rainforest or in clearings near streams.

Philiris fulgens fulgens (Grosse-Smith & Kirby, 1897)

Holochila fulgens Grose-Smith & Kirby, 1897: 8.

Candalides fulgens (Grose-Smith & Kirby): Grunberg in Seitz 1921: 854.

Philiris fulgens fulgens (Grose-Smith & Kirby): Wind and Clench 1947: 8; Tite 1963: 242, d'Abrera 1971: 372; Parsons 1998: 365.

Type. Lectotype ♂, INDONESIA: Amboina, Maluku, in BMNH. A male was described and illustrated by Grose-Smith and Kirby (1897) and the male referred to by Tite (1963) from Amboina (Ambon), bearing a Hewitson label, is probably one of the syntypes. This specimen was designated the Lectotype by Parsons (1998).

Male genitalia. Figured by Tite (1963) and Parsons (1991, 1998).

Distribution. Indonesia: Ambon. Other subspecies have been described from Aru, Biak, mainland New Guinea and Papua New Guinea islands.

***Philiris fulgens kurandae* Waterhouse, 1903**

(Figs 21-26, 55)

Philiris kurandae Waterhouse, 1903a: 651; Waterhouse 1903b: 189-190; Waterhouse and Lyell 1914: 76; Waterhouse 1932: 138; Barrett and Burns 1951: 147.

Philiris fulgens kurandae Waterhouse: Tite 1963: 242; Common 1964: 122; d'Abrera 1971: 372; Common and Waterhouse 1972: 426-427.

Philiris fulgens (Grose-Smith & Kirby): Edwards 1996: 250; Orr and Kitching 2010: 236.

Types. Lectotype ♂ (here designated), QUEENSLAND: labelled 'Kuranda N.Q. Apr. 1902, 24th R.E. Turner', '*Philiris kurandae*. G.A. Waterhouse, Type ♂ KL21421', 'G.A. Waterhouse collection', in AM. *Paralectotypes* (here designated): 4 ♂♂, 5 ♀♀, with same locality and collector as lectotype but with dates and registration numbers as follows: 4 ♂♂, 1 ♀, Dec. 1901-Jan. 1902, KL21426; 1 ♀, Dec. 1901, KL21422; 3 ♀♀, Mch-April 1902, KL21427, all in AM.

When referring to *Philiris kurandae* in a register of specimens at AM, G.A. Waterhouse noted: 'Types ♂♀ Kuranda in Australian Museum'. The male referred to in the Register as the 'HOLOTYPE MALE' is here designated as the Lectotype.

Diagnosis. FWL: ♂♂, 14.2-15.1 mm; ♀♀, 14.0-16.3 mm. In all geographical populations of *P. fulgens* the extent of variation in both sexes is considerable. It is difficult to distinguish the nominotypical *P. f. fulgens* from Amboina, Indonesia, *P. f. bicolorata* Wind & Clench from mainland New Guinea and *P. f. kurandae* from Queensland. Further morphological studies are needed to validate the subspecific names for *P. fulgens*.

The characteristic 'two-tone' colour of the upperside of males of *P. fulgens* – dull purple forewings and sky blue hindwings – is unusual for Lycaenidae from the Australian Region (Waterhouse 1932) and elsewhere, but this pattern also occurs in males of *Hypochrysops thesaurus* (Grose-Smith) from mainland New Guinea.

Sands (1981a) proposed a *fulgens* species-group for *P. fulgens* and related species, accepted by Parsons (1998). The species and subspecies included in this species-group require taxonomic reassessment and consideration of the related species from Papua New Guinea referred to by Parsons (1998).

Variation. FWL: ♂♂, 13.3-15.0 mm; ♀♀, 15.0-16.7 mm. In males, slight variation occurs in the width of the dull black apex of the forewing of *P. fulgens kurandae* and the black termen edging the blue hindwing may also vary in width. Females are most variable in the extent of dull blue on the upperside, with these areas often restricted to the base of the wings, reaching the cell or, occasionally, extending to most of the wing and the subterminal regions of both wings.

Figs 21-26. *Philiris fulgens kurandae* Waterhouse: (21-22) ♂♂, (23-26) ♀♀; (21, 23-25) uppersides, (22, 26) undersides. Localities: (21-22) Palmerston, Qld; (23) Alice River, Qld; (24) Palmerston, Qld; (25-26) Kuranda, Qld.

Distribution. Northern Queensland: Lockerbie Scrub, Claudie River, Alice River, Rocky River, Cooktown, Cape Tribulation, Cairns, Palmerston, Ingham, Innisfail, Mission Beach, Paluma, Bluewater State Forest.

Biology. Eggs are deposited on foliage of the food plants (Wood 1984) and larvae skeletonise leaves when feeding on the underside. Pupae are attached between the bases of leaf veins of the food plants, which include *Cryptocarya mackinnoniana* f. Muell., *C. murrayi* F. Muell., *Litsea breviumbellata* C.K. Allen, *L. leefeana* (F. Muell.) Merr. and *Endiandra hypotephra* F. Muell. (Lauraceae).

***Philiris ziska ziska* (Grose-Smith, 1898)**

(Figs 27-30)

Holochila ziska Grose-Smith, 1898: 11.

Candalides pratti Bethune-Baker, 1908: 122; syn. Tite 1963: 243.

Philiris ziska (Grose-Smith): Tite 1963: 243-244; Kerr 1967: 49.

Philiris ziska ziska (Grose-Smith): d'Abrera 1971: 373; Parsons 1998: 371.

Types. Holochila ziska: *Lectotype* ♂, designated by Parsons (1998), INDONESIA: labelled 'Type', 'Kapaur', 'Type HT, Ziska Gr.Sm. Kapaur. Types ♂♀', 'Gen. 1961-245 G.E.T.', with genitalia slide, in BMNH.

Male genitalia. Figured by Tite (1963) and Parsons (1998).

Variation. Males of *P. z. ziska* (FWL *ca* 14 mm) are larger than males of *P. z. titeus* (FWL *ca* 12 mm) and the hindwing costa on the upperside, whilst usually white (noted by Grose-Smith 1898), is very variable and sometimes light brown, rarely as prominently white as the costa of male *P. z. titeus*. Females of *P. z. ziska* are also larger than those of *P. z. titeus* and the upperside of both wings has much smaller areas of white than those of *P. z. titeus*. Grose-Smith's (1898) description of *Holochila ziska* refers to a male but the female he described as *P. ziska* is a female of another species (Tite 1963).

Distribution. Mainland Papua New Guinea; Papua Province and neighbouring islands of eastern Indonesia.

***Philiris ziska titeus* d'Abrera, 1971**

(Figs 31-34, 56)

Philiris ziska (Grose-Smith): Kerr 1967: 49; McCubbin 1971: 72; Common and Waterhouse 1972: 427; Orr and Kitching 2010: 237.

Philiris ziska titeus d'Abrera, 1971: 373; Edwards 1996: 250; Braby 2009: 119-121.

Types. Lectotype ♂, designated by Braby (2009), QUEENSLAND: labelled (as per Braby 2009) 'CLAUDIE R. CAPE YORK, 1 MAY 1966', 'Specimen photographed by B. D'Abrera, 1970', 'B.M. Reg. No. 1966-587', '253', 'Holotype', '*Philiris ziska titeus*, D'Abrera, det. R.I. Vane-Wright, HOLOTYPE ♂'. *Paralectotypes*: 1 ♂, labelled 'CLAUDIE R. CAPE YORK, 2 MAY 1966', 'Specimen photographed by B. D'Abrera, 1970', 'B.M. Reg. No. 1966-587'. '255', 'Paratype, '*Philiris ziska titeus*, D'Abrera, det. R.I. Vane-Wright, PARATYPE ♂'; 1 ♂, labelled 'CLAUDIE R. CAPE YORK, 2 MAY 1966', 'Specimen photographed by B. D'Abrera, 1970', 'B.M. Reg. No. 1966-587', '255', 'Paratype', '*Philiris ziska titeus*, D'Abrera, det. R.I. Vane-Wright, PARATYPE ♂'; 1 ♀, labelled 'CLAUDIE R. CAPE YORK, 3 MAY 1966', 'Specimen photographed by B. D'Abrera, 1970', 'B.M. Reg. No. 1966-587', '254', 'Paratype', '*Philiris ziska titeus*, D'Abrera, det. R.I. Vane-Wright, PARATYPE ♀'; 1 ♀, labelled 'CLAUDIE R. CAPE YORK, 26 APR. 1966', 'B.M. Reg. No. 1966-587' (types collected by J.F.R. Kerr), all in BMNH.

D'Abrera (1971) did not contrast *P. z. titeus* with the nominotypical *P. z. ziska* when describing the Australian subspecies.

Figs 27-34. *Philiris ziska* subspecies: (27-30) *P. z. ziska* (Grose-Smith), (31-34) *P. z. titeus* d'Abrera; (31, 32, 35, 36) ♂♂, (33, 34, 37, 38) ♀♀; (31, 33, 35, 37) uppersides, (32, 34, 36, 38) undersides. Localities: (27-28) Lae, Morobe Probvince, PNG; (29-30) Sogeri, Central Province, PNG; (31-32) Claudie River, Qld; (33-34) Rocky River, Qld.

Diagnosis. Males of *P. z. titeus* (FWL *ca* 12 mm) from Queensland are smaller than those of *P. z. ziska* (FWL *ca* 14 mm) from Papua New Guinea, and the upperside of the hindwing costa of *P. z. titeus* is more broadly white than in *P. z. ziska*. The shining purple-blue ground colour of *P. z. ziska* and *P. z. titeus* and width of the black apex are similar. Median white scales on the forewing upperside of males of *P. z. titeus* may be absent, obscure or occasionally prominent (the late Murdoch De Baar pers. comm.) and, when present, more noticeable than in *P. z. ziska*. The male genitalia of *P. z. titeus* (Fig. 56) are similar to those of *P. z. ziska* but the characteristic projection from the valva is more rounded in *P. z. titeus*, the median sociuncus lobes are more produced and the aedeagus is longer and narrower. When compared with *P. azula johnsoni*, the purple-blue ground colour of male *P. z. titeus* is brighter than the dull violet-blue of *P. azula johnsoni* and the black forewing apex of *P. z. titeus* is narrower. The hindwing costa of *P. z. titeus* is white, whereas that of *P. azula johnsoni* is light brown.

Females of *P. z. titeus* (FWL *ca* 13 mm) are smaller than *P. z. ziska* (FWL *ca* 15 mm) and the areas of white are more extensive, often merging with greenish blue scales on the forewing, whereas on the hindwing of *P. z. ziska* the white area rarely extends beyond Rs. Females of *P. z. titeus* are very similar to those of *P. lucina* but may be distinguished by the position of the white area on the hindwing, that of *P. z. titeus* extending from the base to the postmedian region of M_3. Moreover, in *P. z. titeus* the white area near the base and from the costa to the cell often extends beyond the postmedian region, whereas in *P. lucina* the white area (although variable) is absent from the grey-black subbasal area of the wing and extends from beyond the cell to the postmedian region.

Sands (1981a) proposed a *ziska* species-group for *P. ziska* and related species. This proposal was subsequently accepted by Parsons (1998).

Variation. FWL: ♂♂, 12.2-14.0 mm; ♀♀, 12.3-13.7 mm. The median areas of white scales on the forewing upperside of males of *P. z. titeus* may be absent (resembling *P. z. ziska*), obscure or, occasionally, prominent (Samson and Johnson 2009) and located post-cell between the bases of M_1, M_2 and CuA_1 and rarely reaching the subterminal region. The white costa of the hindwing may also vary in width, sometimes extending from the wing base to the base of M_1 at the apex of the cell.

Distribution. Cape York Peninsula, northern Queensland: Iron Range, Claudie River and Rocky River.

Biology. The life history of *P. z. titeus,* described by Samson and Johnson (2009), is very similar to that of nominotypical *P. z. ziska* from Papua New Guinea (Parsons 1984). Larvae feed on the vine *Trophis scandens* (Lour.) Hook. & Arn. (Samson and Johnson 2009); they are not attended by ants. Pupation takes place under the base of leaves of the food plant.

Philiris azula azula Wind & Clench, 1947

(Figs 35-38)

Philiris azula Wind & Clench, 1947: 8-9; Tite 1963: 241; Parsons 1998: 371; Edwards 1996: 250.

Type. Holotype ♂, PAPUA NEW GUINEA: Wau, Morobe District, in MCZ.

Diagnosis. The pale, greyish blue colour of males of *P. azula azula* is distinctive and not seen in other *Philiris* spp. of similar wingspan from Papua New Guinea. The females of *P. a. azula* are similar to several other female *Philiris* spp. from Papua New Guinea, but the upperside is much darker than the single known female of *P. a. johnsoni* from Australia. The hindwing costa of females of *P. z. ziska* is usually prominently white, when compared with the greyish white costa of females of *P. azula azula*.

Sands (1981a) proposed that *P. azula* be included in a *ziska* species-group together with other related species. This was subsequently accepted by Parsons (1998).

Figs 35-38. *Philiris azula azula* Wind & Clench: (35-36) ♂♂, (37-38) ♀♀; (35, 37) uppersides, (36, 38) undersides. Localities: (35-36) Lae, Morobe Province, PNG; (37-38) Wau, Morobe Province, PNG.

Variation. FWL: ♂♂, 15.0-15.5 mm; ♀♀, 14.5-16.0 mm. In males of *P. a. azula* the width of the black apex on the upperside may vary slightly.

Females also vary slightly and may be similar to those of several other *Philiris* spp. from Papua New Guinea, including *P. ziska ziska*.

Distribution. Mainland Papua New Guinea and Papua Province, eastern Indonesia.

Biology. The life history of *P. a. azula* is not recorded. Adult females were observed near Lae, Morobe Province, Papua New Guinea, resting on foliage of *Streblus brunonianus* (Endl.) F.Muell. (Moraceae), but it is not known if this is a food plant for the larvae of of *P. a. azula*.

Philiris azula johnsoni **subsp. n.**

(Figs 39-44, 57)

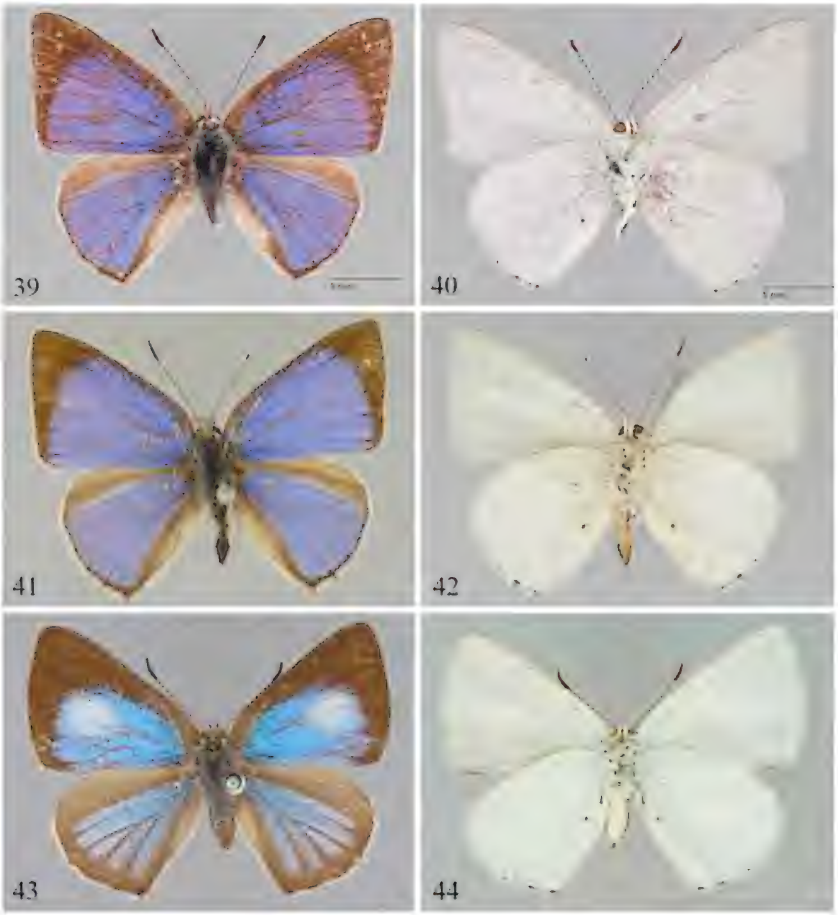
Philiris azula Wind & Clench: Johnson and Johnson 1984: 89-90.

Types. *Holotype* ♂, QUEENSLAND: labelled 'Gordon Creek, Iron Range Qld, 1-10.vii.1981, I.R. & A.J. Johnson', 'Figured in *Butterflies of Australia* (1999), CSIRO Publishing, M.F. Braby', 'Photog. Spm PS 2130', 'GENITALIA SLIDE No. 042', in QM. *Paratypes*: 1 ♀, labelled 'Mt. White Summit, Coen, N. Qld, 6 July 1976, G.B. & S.R. Monteith', in QM; 1 ♂, labelled 'Iron Range, Gordon Creek, 15-6-90, Bill Graham', in ANIC.

Description. *Male*. Antenna length (of holotype) 7.4 mm, shaft black with segmental bands white, club black, tipped orange dorsally, orange 2/3 apically; eyes brown, edged with white cilia; frons white; thorax and abdomen dorsally dark grey-black, ventrally white; palpus white, apical segment light brown; tibiae white with brown bands at apex of segment, tarsi banded white and brown. Forewing length (of holotype) 13.4 mm, apex acute, termen and inner margin almost straight; upperside base to subtermen and inner margin dull violet-blue, apex broadly brown-black to *ca* 1/3 forewing of costa; termen brown-black, broad at apex, narrower at tornus; cilia from apex to CuA_1 brown, CuA_1 to tornus narrowly white. Hindwing upperside dull violet-blue from base to median region and subtornus; costa, Rs and apex light brown; base of inner marginal fold light brown, dark brown towards tornus; termen narrowly dark brown, broader CuA_2 to tornus; Underside both wings silvery white, forewing unmarked except brown vein ends at termen; hindwing inner margin with brown-black spot on inner margin; termen white with brown flecks at vein ends CuA_1, CuA_2 and 1A+2A.

Male genitalia. Unmounted: vinculum-tegumen ring oval in posterior view. Slide mounted: sociuncus and vinculum narrow, saccus expanded, socii tapered with pointed median lobes, separated by a deep U-shaped sinus, margins weakly convex, clothed with fine setae; brachia slender, inwardly curved, apically more slender, tip inwardly tapered to a blunt point; valvae almost symmetrical, subtriangular, longer than wide with blunt subsquared apices, clothed apically with fine setae; juxta slender, subcylindrical, with slerotised ring surrounding aedeagus; aedeagus subcylindrical, prezonal

sheath broadly expanded anteriorly, postzonal sheath with retracted cornuti with two groups of finely sclerotised spines; anal tube slender, weakly sclerotised. The male genitalia were also figured by Johnson and Johnson (1984).



Figs 39-44. *Philiris azula johnsoni* Sands: (39-42) ♂♂, (43-44) ♀♀; (39, 41, 43) uppersides, (40, 42, 44) undersides. Localities: (39-42) Gordon Creek, Iron Range, Qld; (43-44) Mount White, Coen, Qld.

Female. Antennal length (of paratype) 7.3 mm, shaft grey-black with narrow white segmental bands, club dorsally dark brown-black, apically tipped orange-brown, orange 2/3 apically; eyes grey-brown edged white; frons grey-brown, edged white; palpus dorsally brown, ventrally white; thorax and abdomen dorsally light grey with long grey setae, ventrally white; tibiae and

tarsi white, broadly banded brown. Forewing length (of paratype) 14.5 mm, termen bowed, apex obtuse; upperside costa, apex, termen and tornus broadly grey-brown; area from base to cell, to inner margin and postmedian, light silvery blue; a subcentral white oval patch between bases of M_3, CuA_1 and CuA_2, extending to subtermen. Hindwing upperside with apical half of costa white and with greyish brown suffusion extending from apex to M_1; an area from base and cell to subtermen and subtornus pale blue-violet, greyish towards termen, crossed by dark grey veins; termen bowed, broadly (*ca* 1.5 mm) dark grey-brown; cilia white. Underside both wings silvery white; forewing with small obscure greyish patch in median region, termen and cilia white; hindwing white, inner margin with prominent submedian black spot; cilia white, except black at vein ends CuA_1, CuA_2 and 1A+2A.

Comments. The distinctive, weakly iridescent, lilac-blue colour on the upperside of both wings of *P. a. johnsoni* males distinguishes it from other Australian *Philiris* spp. When males of *P. a. johnsoni* are compared with *P. z. ziska*, the forewings of *P. a. johnsoni* are slightly narrower and the dark apex and termen is broader. The male genitalia of *P. a. johnsoni* do not differ significantly from those of nominotypical *P. a. azula*. Identification of the female specimen as a paratype of *P. a. johnsoni* is based on the antennae and the presence of a black spot on the underside of the inner margin of the hindwing. On the upperside, *P. a. johnsoni* differs from females of most other Australian *Philiris* spp. by the forewing white patch and more extensive areas of pale blue on both wings. The distribution of white and blue areas on the upperside resembles that of a small female of *P. papuana kerri,* but the shade of blue is different, the hindwing costa is grey rather than white and the black spot on the inner margin of the underside of the hindwing on *P. azula johnsoni* distinguishes it from *P. papuana kerri*, a species in which the underside hindwing spot is always absent.

Etymology. Named in honour of Stephen Johnson, in recognition of his many contributions to the study of Australian butterflies, especially in northern Qld.

Distribution. Cape York Peninsula, northern Qld: Iron Range, Claudie River and Coen. Only two males and one female have been collected to date.

Biology. The life history and food plant(s) of *P. a. johnsoni* are unknown.

***Philiris innotata* (Miskin, 1874)**

(Figs 45-52, 58)

Philiris ilias Felder, 1860: Waterhouse 1903b: 652; misidentification.

Pseudodipsas innotatus Miskin, 1874: 165.

Philiris ilias innotatus (Miskin): Waterhouse and Lyell 1914: 76; Waterhouse 1932: 137; Waterhouse 1937: 115.

Philiris innotatus evinculis Wind & Clench, 1947: 11; **syn. n**.

Philiris innotatus innotatus (Miskin): Tite 1962: 247; Common 1964: 124; McCubbin 1971: 72; d'Abrera 1971: 374.

Philiris innotatus evinculis Wind & Clench: Tite 1963: 248; Common 1964: 124; d'Abrera 1971: 374; McCubbin 1971: 72; Common and Waterhouse 1972: 428; Edwards 1996: 250.

Philiris innotata innotata (Miskin): Common and Waterhouse 1972: 427-428.

Philiris innotatus (Miskin): Edwards 1996: 250; Braby 2000: 683.

Philiris innotata (Miskin): Parsons 1998: 375-376; Orr and Kitching 2010: 236.

Types. Philiris innotata: Miskin's syntypes of *Pseudodipsas innotatus* from Brisbane have not been located (Hancock 1995) and specimens lodged in the Queensland Museum are not part of the syntypic series (S. Wright pers. comm.). In a register of specimens at AM, G.A. Waterhouse noted, when referring to *Philiris ilias*: 'Types ♂♀ Brisbane in Miskin Coll, Queensland Museum'. G.A. Waterhouse examined most of Miskin's types in July, 1910 (unpublished records, Australian Museum, Sydney; Hancock 1995) and referred to two males and one female of *Philiris innotata* but did not attach any labels to these specimens.

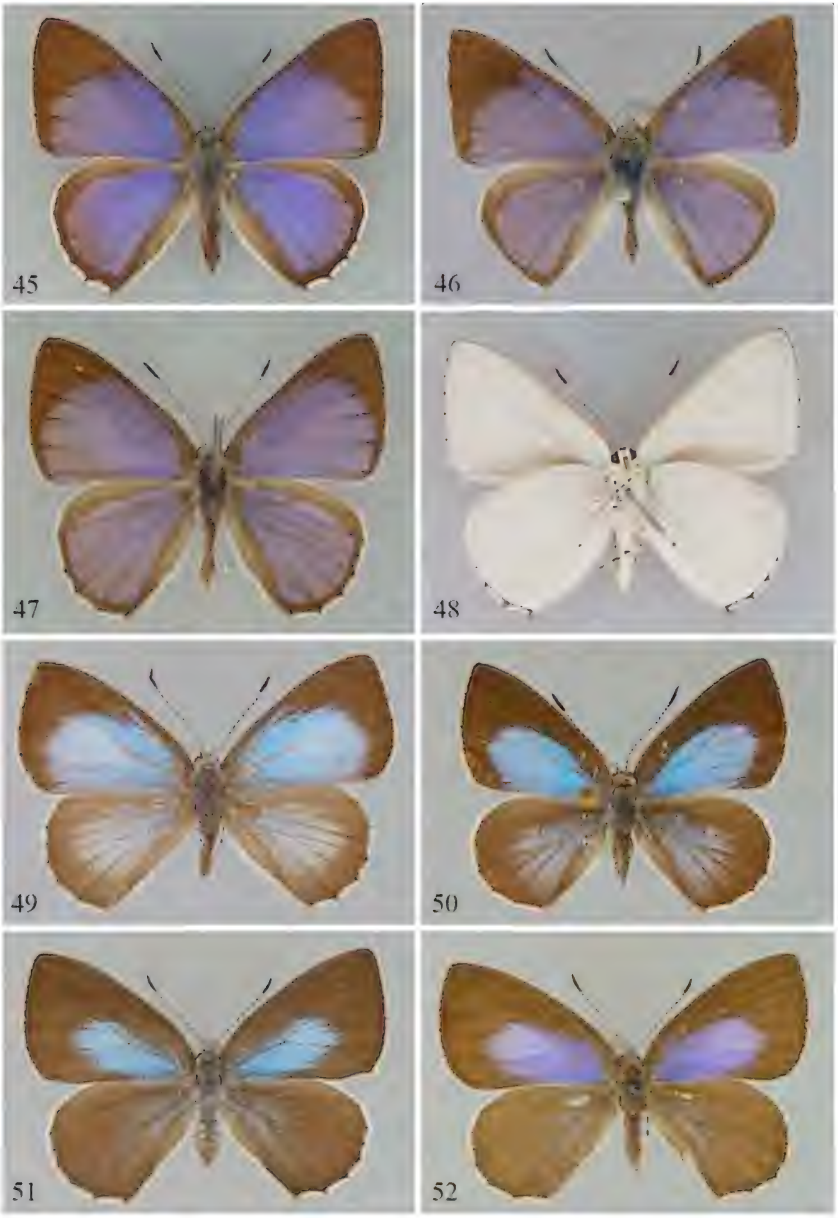
Philiris innotatus evinculis: *Holotype* ♂, QUEENSLAND: labelled 'Redlynch, North Queensland, Australia, August 14, 1938 (R.G. Wind)'; *allotype* ♀ with same locality and collector but September 17, 1938; 2 *paratype* ♂♂, 1 *paratype* ♀, same locality and collector but dated October 1, 1938, October 3, 1938 and August 14, 1938 respectively. Holotype, allotype and one paratype ♂ in Cornell University collection, one paratype ♂, one paratype ♀ in collection of R.G. Wind, Berkeley, California.

Diagnosis. The description of both sexes of *P. innotata* by Miskin (1874) was adequate and the male genitalia were figured by Tite (1963).

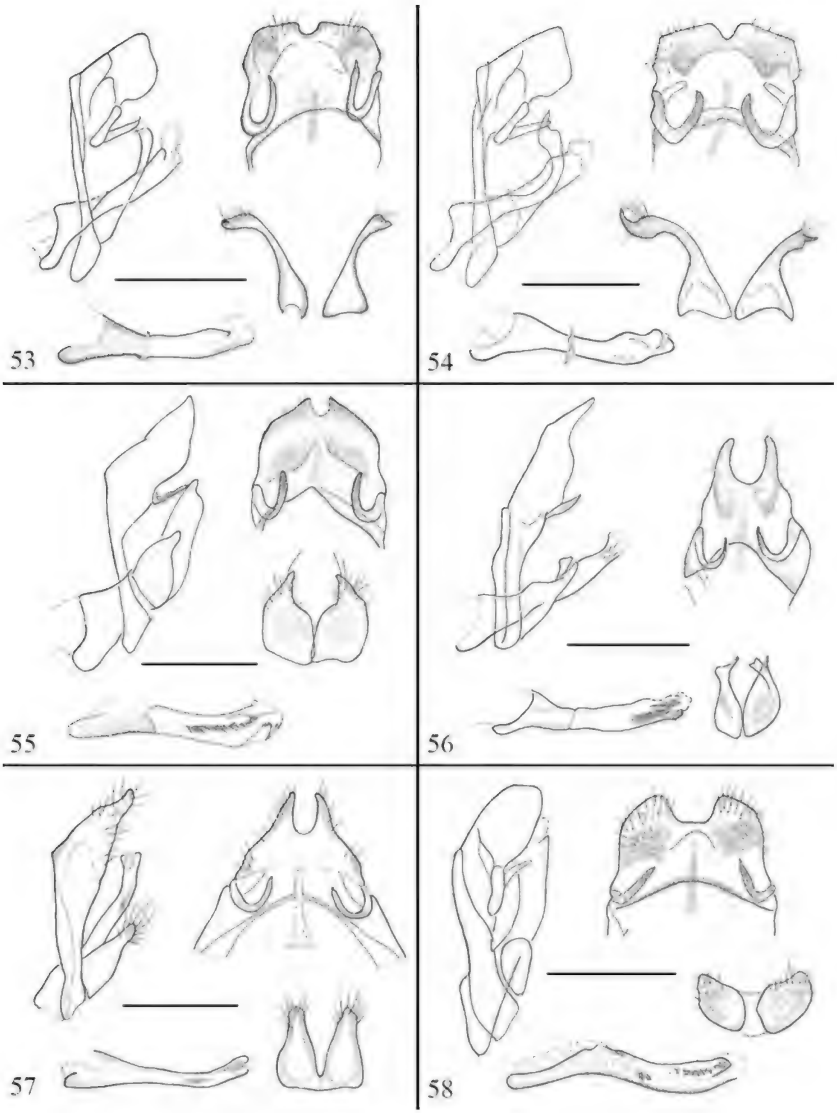
Both sexes of *P. i. evinculis* were described from specimens collected at Redlynch, Cairns, by R. G. Wind (Wind and Clench 1947). However, consistent differences (in colour and width of termen) between males from Cairns, Townsville and Magnetic Island, and those from Brisbane, are insufficiently distinct to justify separate subspecific rank. Not recognised as distinct in recent literature (and informally listed in synonymy by Braby 2010), *P. i. evinculis* is here formally synonymised with *P. i. innotata*.

Sands (1981a) proposed the *innotata* species-group to include several related species and this was subsequently accepted by Parsons (1998).

Variation. FWL: ♂♂, 11.7-13.5 mm; ♀♀, 11.7-14.2 mm. Males of *P. innotata* from Brisbane to Cooktown are variable in wingspan, shape of the forewing, extent of purple on the upperside and width of the black termen at the apex of the forewing. Males of *P. innotata* from the Claudie River are mostly smaller than those from Cairns and Townsville, the apex of the forewing is often more acute and the termen almost straight. In females, the extent of blue on the upperside of both wings is very variable and sometimes absent from the hindwing. When the blue area is extensive on the forewing, the veins of the forewing are sometimes white. Some females from northern inland Queensland have the most extensive areas of blue on both wings, possibly a result of extremes in temperature experienced during immature development.



Figs 45-52. *Philiris innotata* (Miskin): (45-48) ♂♂, (49-52) ♀♀; (45-47, 49-52) uppersides, (48) underside. Localities: (45, 48-50) Innot Hot Springs, Qld; (46) Coen River, Qld; (47) Brisbane, Qld; (51) Davies Creek, Qld; (52) Burleigh, Qld.



Figs 53-58. *Philiris* spp., male genitalia: (53) *P. diana* Waterhouse & Lyell; (54) *P. papuana kerri* Sands; (55) *P. fulgens kurandae* Waterhouse & Lyell; (56) *P. ziska titeus* d'Abrera; (57) *P. azula johnsoni* Sands; (58) *P. innotata* (Miskin). Images clockwise: lateral view, unmounted; slide mounted, posterior view, sociuncus, valvae & aedeagus. Scale bar = *ca* 1 mm for each species.

Distribution. Queensland: Cape York, Portland Roads, Claudie River, Coen River, McIlwraith Range, Cooktown, Cairns, Kuranda, Townsville, Magnetic Island, Great Palm Island, Mackay, Rockhampton, Gayndah, Maryborough, Kin Kin, Brisbane, Mt Tamborine, Burleigh Heads; New South Wales: Richmond River, Coffs Harbour, Port Macquarie. An undescribed subspecies of *P. innotata* has been recorded from the Eastern and Western Highlands of Papua New Guinea (Sands and Fenner 1978, Parsons 1998).

Biology. The life history is well known and the larval food plants are mostly sandpaper figs (*Ficus* spp: Moraceae), including *F. coronata* Spin, *F. fraseri* Miq. and *F. opposita* Miq. Larvae also feed on introduced figs, including the Indian *F. benghalensis* L. and Asian *F. carica* L. The feeding patterns produced by larvae of *P. innotata* on *Ficus* are distinctive and similar to those of several other *Philiris* spp. on other food plants, including *P. intensa* Butler in Papua New Guinea (Parsons 1998). In subtropical eastern Australia, larvae frequently compete for suitable leaves with larvae of the chrysomelid beetle *Ponerida semipullata* (Clark) (Sands and House 1990). In some areas, such as Magnetic Island and near Brisbane, the abundance of *P. innotata* may increase locally if the exotic *F. benghalensis* has been cultivated and where competitive herbivory by the larvae of *Ponerida semipullata* is absent.

Philiris nitens (Grose-Smith, 1898)

(Figs 59-66, 73)

Holochila nitens Grose-Smith, 1898: 107.

Philiris kamerungae Waterhouse, 1903a: 650; Waterhouse 1903b: 189; syn. Sands 1980: 82.

Philiris nitens (Grose-Smith): Waterhouse 1903b: 190; Edwards 1996: 250, Braby 2010: 34; Orr and Kitching 2010: 237.

Philiris kamerungae kamerungae Waterhouse: Waterhouse and Lyell 1914: 77; Waterhouse 1932: 137; Tite 1963: 240; Common 1964: 124; d'Abrera 1971: 372; McCubbin 1971: 72; Common and Waterhouse 1972: 425.

Candalides kamerungae (Waterhouse): Grunberg in Seitz 1921: 853.

Philiris nitens nitens (Grose-Smith): Tite 1963: 240; Common and Waterhouse 1972: 426; Sands 1980: 82.

Philiris nitens restricta Tite, 1963: 241; Common and Waterhouse 1972: 426; syn. Sands 1980: 82.

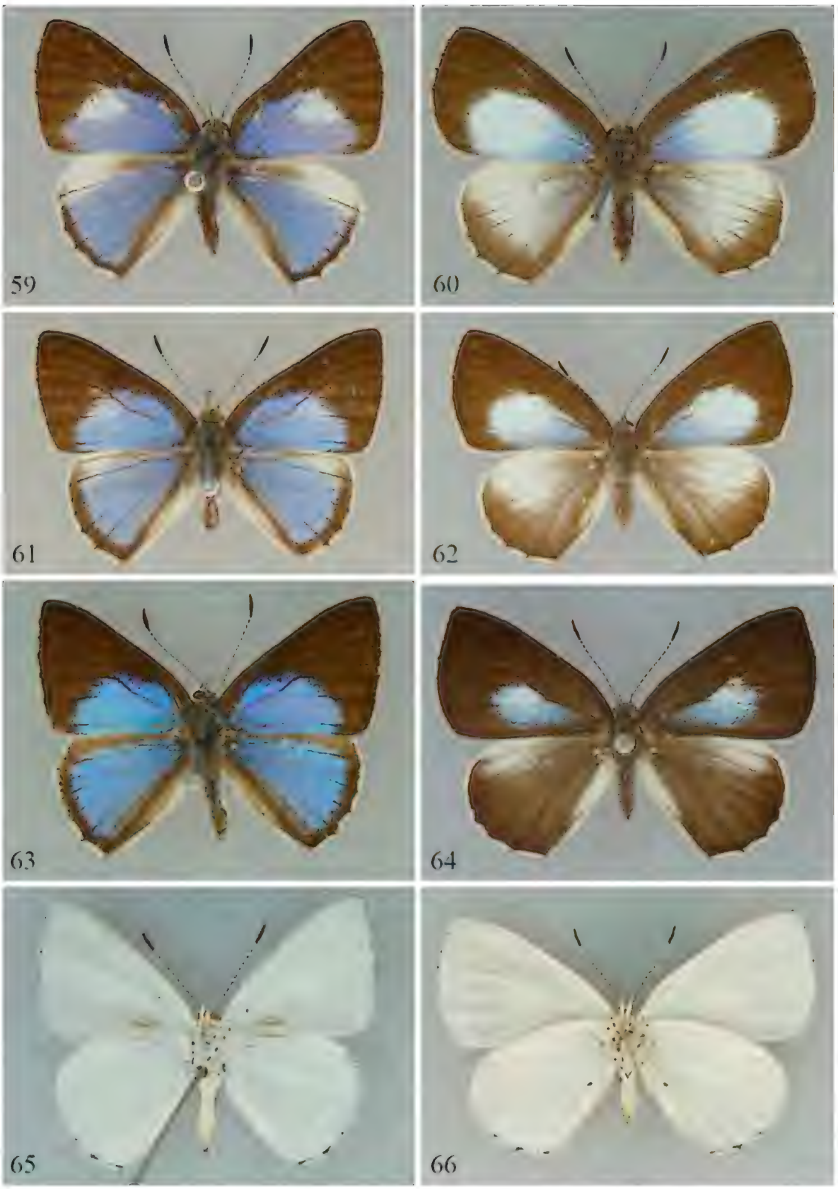
Types. Holochila nitens: *Holotype* ♂, QUEENSLAND: labelled '*nitens* Grose-Smith Type ♂', 'N. Queensld.', 'Gen. 1962. 436. G.E.T.', 'Rothschild bequest BMNH 1939-I' with genitalia slide, in BMNH.

Philiris kamerungae: *Lectotype* ♂ (designated by Peters (1971) 'by inference of holotype'), QUEENSLAND: labelled 'Kuranda, N.Q., Mar. 1902, R.E. Turner', '*Philiris kamerungae* type ♂, G.A. Waterhouse, KL21485', in AM. This specimen bears a red label and was listed as the holotype, in the handwriting of G.A. Waterhouse, in a register of specimens at AM. It was also listed as the holotype by Peters (1971) in his catalogue of types in the Australian Museum.

Philiris nitens restricta: *Holotype* ♂, QUEENSLAND: labelled 'Cedar Bay, S. of Cooktown (Meek)', 'Rothschild bequest BM. 1939-1', 'Gen. 1962 440. G.E.T.', 'Type HT', '*Philiris nitens restricta* Tite, Holotype ♂, BMNH Type No. RL 16843'with genitalia slide; *allotype* ♀, labelled 'Cedar Bay, S. of Cooktown (Meek)', 'Type AT', '*Philiris nitens restricta* Tite', 'ALLOTYPE ♀', 'BM Type No. RL. 16844', both in BMNH.

Diagnosis. The wingspans of males of *P. nitens* (FWL *ca* 12 mm) are similar to those of *P. sappheira manskiei* (FWL *ca* 12.5 mm) but slightly greater than those of *P. lucina* (FWL 11.5 mm). In both sexes the ventral surface of the antennal club of *P. nitens* is weakly tipped orange, but in *P. sappheira manskiei* and *P. lucina* the ventral apical half of the club is orange. Males of *P. nitens* can be distinguished from males of *P. sappheira manskiei* by the blue to purple-blue upperside areas, while the forewings are narrower and the hindwings weakly bowed; in males of *P. sappheira manskiei* the upperside areas are always bluish green, the forewings broader and the hindwings more rounded than in *P. nitens*. The blue areas of *P. nitens* males are also more extensive than the blue-green areas of *P. sappheira manskiei* males. The upperside of both fore and hindwings in male and female *P. nitens* usually have areas of white, unlike both sexes of *P. sappheira manskiei*, which are without any areas of white on the upperside. However, when areas of white are occasionally absent in males of *P. nitens*, the costa of the hindwing has whitish suffusions (Ring and Olive 1997) that are absent in *P. sappheira manskiei*. The hindwing black terminal band of *P. nitens* is subparallel to the termen, but in *P. sappheira manskiei* this band extends from the costa and from Rs to 1A+2A. The upperside of females of *P. nitens* has variable areas of white that are not present on the upperside of females of *P. sappheira manskiei.*

Areas of white on both fore and hindwings of *P. nitens* and *P. lucina* are often similar in the two species (Common and Waterhouse 1972) and females may be difficult to distinguish. Males of *P. nitens* can be distinguished from *P. lucina* by the darker blue or purple-blue areas on both wings in *P. nitens*, compared with the paler sky-blue areas on both wings in *P. lucina.* The forewing of males of *P. nitens* usually, but not always, has a suffusion of white scales or a prominent oval patch of white scales beyond the cell between the bases of M_3 and CuA_1, whereas in males of *P. lucina* there is a narrow strip of white scales from the bases of Rs and M_1 between cell and tornus and below CuA_1. On the hindwing of *P. nitens* males, the clear purple-blue area is bounded by a narrow grey-black terminal band, with or without a variable white area extending from mid costa to the apex and occasionally the termen at M_1, whereas in males of *P. lucina* the greenish blue area is crossed by dark veins. The grey-black terminal band of *P. lucina* is broad from Rs to the tornus, as well as on the apical half of the inner margin between 1A+2A. The basal half of the inner marginal fold of *P. lucina* is more prominent and more broadly white than that of *P. nitens*.



Figs 59-66. *Philiris nitens* (Grose-Smith): (59, 61, 63, 65) ♂♂, (60, 62, 64, 66) ♀♀; (59-64) uppersides, (65-66) undersides. Localities: (59) Bloomfield, Qld; (60-61) Kuranda, Qld; (63, 65) Innisfail, Qld; (64) Cairns, Qld; (62, 66) Josephine Falls, Qld.

In females of *P. lucina* the postmedian areas of white on the hindwing are crossed by dark postcellular veins, whereas the veins of *P. nitens* are not prominently darker than the ground colour. A darker apical cell bar on the hindwing of *P. lucina* at the bases of M_1, M_2 and M_3 assists in distinguishing females of *P. lucina* from those of *P. nitens*. Sands (1981a) proposed a *nitens* species-group to include *P. nitens* and related species, subsequently accepted by Parsons (1998). The male genitalia were figured by Tite (1963).

Variation. FWL: ♂♂, 12.2-13.0 mm; ♀♀, 12.3-14.8 mm. Males and females of *P. nitens* vary considerably in the extent of areas of white on the upperside of both fore and hindwings, due in part to seasonal effects and the temperatures experienced during immature development. For example, a female of *P. nitens* reared in Brisbane in June (Fig. 60) has much more extensive areas of white than specimens reared or collected during warmer months (J.F.R. Kerr pers. comm.). In males, the pale blue forewing usually has a variable small white median patch between the bases of M_3, CuA_1 and CuA_2, but the forewing is occasionally entirely pale blue or dark blue, without any areas of white. On the hindwing, the white costa of males also varies in extent and may be just visible or extend as far as M_1.

Distribution. Northern Queensland, from near Cooktown south to Bluewater Range, 24 km north of Townsville: 19 km S. of Cooktown (Ring and Olive 1997), Cedar Bay, Rossville, Mossman Gorge, Kuranda, Lake Placid, Cairns, Mission Beach, Innisfail, Herbert River, Ingham, Kirrama, Paluma, Mutarnee, Bluewater Range.

Biology. Larvae feed on *Macaranga involucrata* var. *mallotoides* (F. Muell.) L.M. Perry, and occasionally *Glochidion phillipicum* (Cav.) C.B. Rob. (Common and Waterhouse 1981) and *Macaranga tanarius* (L.) Muell. Arg. (L. Ring).

***Philiris lucina* Waterhouse & Lyell, 1913, stat. n.**

(Figs 67-72, 74)

Philiris kamerungae lucina Waterhouse & Lyell, 1914: 77; Waterhouse 1932: 138; Tite 1963: 240; Common 1964: 124; d'Abrera 1971: 372; McCubbin 1971: 72; Common and Waterhouse 1972: 425.

Philiris nitens lucina: Common and Waterhouse 1981: 464; Edwards 1996: 250, Braby 2010: 34.

Types. Lectotype ♂ (here designated), QUEENSLAND: labelled 'Cape York, 18 JLY 1910, H. Elgner', 'KL21517', 'G.A. Waterhouse collection'. *Paralectotypes* (here designated): 1 ♂, labelled 'Cape York, H. Elgner', 'KL21520'; 1 ♀, labelled 'Cape York, 22 Oct 1908, H. Elgner', 'Cape York, Q. 3:3:08, G.A. Waterhouse Coll. Elgner', and 'KL21518'; 1 ♀, labelled 'Cape York, 22 Oct 1908, H. Elgner', and 'KL21518'; 1 ♀, labelled 'Cape York, 3.8.10, H. Elgner', 'KL21521', all in AM.

The Lectotype, here designated, was listed as the holotype, in the handwriting of G.A. Waterhouse, in a register of specimens at AM.

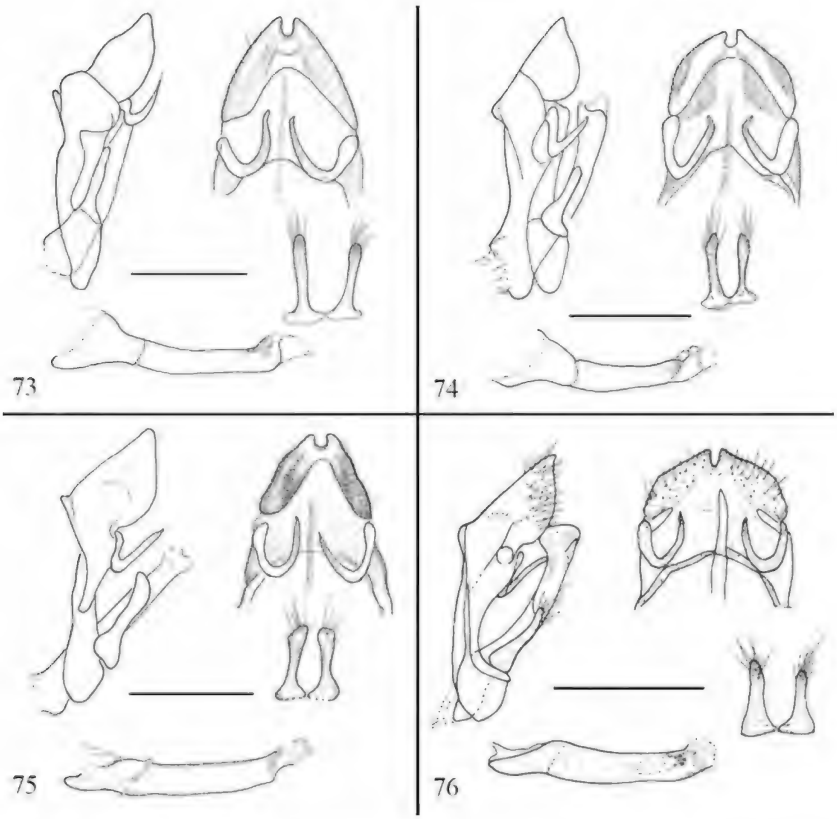
Figs 67-72. *Philiris lucina* Waterhouse & Lyell: (67, 69, 71) ♂♂, (68, 70, 72) ♀♀; (67-70) uppersides, (71-72) undersides. Localities: (67-69, 71) Claudie River, Qld; (70, 72) Iron Range, Qld.

Diagnosis. The pale shining blue areas and white patches on the upperside of males of *P. lucina* are somewhat similar to those of *P. scintillata* Sands from Papua New Guinea, but the wingspan of *P. lucina* is smaller and the male genitalia differ considerably from those of *P. scintillata* (Sands 1981b). When males of *P. nitens* are without white on the upperside, they may be similar to *P. sappheira manskiei* but are blue rather than blue-green. *Philiris lucina* can be distinguished from *P. nitens* by the more extensive orange on

the ventral surface of the antennal club and by the shorter valvae of the genitalia.

Females of *P. lucina* and *P. nitens* are readily distinguished from *P. sappheira manski* by the presence of white areas on the upperside of both species. In females of *P. sappheira manski* both wings have variable blue-green areas and are without the white areas that are always present in females of *P. lucina* and *P. nitens*.

The male genitalia of *P. lucina* (Fig. 74) and *P. nitens* (Figs 73) are readily distinguished from those of *P. sappheira manskiei* (Fig. 75) by the length and shape of the valvae (Ring and Olive 1997).



Figs 73-76. *Philiris* spp., male genitalia: (73) *P. nitens* Waterhouse & Lyell; (74) *P. lucina* Waterhouse & Lyell; (75) *P. sappheira manskiei* Ring & Olive; (76) *P. sappheira sappheira* Sands. Images clockwise: lateral view, unmounted; slide mounted, posterior view, sociuncus, valvae & aedeagus. Scale bar = *ca* 1 mm for each species.

Variation. FWL: ♂♂, 10.8-11.4 mm; ♀♀, 10.8-12.4 mm. In males, the extent of pale shining blue areas and white patches is variable and in females, on the hindwing, the extent of white may be restricted to the costa or extend almost to the apex.

Distribution. Cape York Peninsula, northern Queensland: Bamaga and Iron Range to the Rocky River. *Philiris lucina* is most abundant near Heathlands and near the Claudie River. *Philiris lucina*, *P. nitens* and *P. sappheira manskiei* are allopatric in distribution.

Biology. Larvae of *P. lucina* feed on *Macaranga involucrata* (Ring and Olive 1997). The life history is otherwise very similar to that of *P. nitens*.

***Philiris sappheira sappheira* Sands, 1980**

(Figs 76, 83)

Philiris nitens sappheira Sands, 1980: 82.

Philiris sappheira sappheira Sands: Ring and Olive 1997: 65; Orr and Kitching 2010: 236.

Type. Holotype ♂, PAPUA NEW GUINEA: Rouna Falls, Central Province, in ANIC.

Male genitalia (Fig. 76). Very similar to those of *P. s. manskiei* from northern Queensland but the valvae are not as prominently 'club-shaped' as in *P. s. manskiei*.

Variation. FWL: ♂♂, 12.5 mm; ♀, 13.5 mm. Males of *P. sappheira* may be distinguished from other species of similar size in the *nitens* species-group by the distinctive greenish blue areas and the absence of white on the upperside of both wings. Only one female (a paratype) of *P. s. sappheira* is known and confirmation of its identity will require more material, preferably when females are reared with males and confirmed to be conspecific, or by using DNA methods capable of discriminating closely-related taxa.

Distribution. Known from only the southern end of the Kokoda Track, Sogeri Plateau and Rouna Falls, Central Province, Papua New Guinea.

Biology. Unknown. Adults were collected near the embankments of shallow watercourses where a *Macaranga* sp. was abundant.

***Philiris sappheira manskiei* Ring & Olive, 1997**

(Figs 75, 77-82, 84)

Philiris sappheira manskiei Ring & Olive, 1997: 66-71; Braby 2010: 34; Orr and Kitching 2010: 236.

Types. Holotype ♂, QUEENSLAND: labelled 'McIvor River Road, 11 May 1994, L.R. Ring, xp *M. involucrata*', 'HOLOTYPE *Philiris sappheira manskiei*', 'ANIC Type Reg. No. 3330, genitalia slide No 3438', 'GART Exemplar und Etik-ketten dokumentiert specimen and label data documented 22.3.2002', + pupal shell on point, in ANIC.

Figs 77-84. *Philiris sappheira* subspecies: (83) *P. s. sappheira* Sands, (77-82, 84) *P. s. manskiei* Ring & Olive; (77, 79, 81, 83) ♂♂, (78, 80, 82, 84) ♀♀; (77-80, 82-83) uppersides, (81, 84) undersides. Localities: (78) 35 km NW Cooktown, Qld; (77, 79-82, 84) McIvor River, Qld; (83) Rouna Falls, Central Province, PNG.

Diagnosis. Males of *P. sappheira manskiei* differ only very slightly from males of *P. s. sappheira*, with the blue area of the hindwing of males extending to the postmedian region in *P. s. manskiei* but only to the median region in *P. s. sappheira*. The illustrated female in Braby (2004) is a paratype of *P. s. sappheira* from Papua New Guinea. This specimen of the nominotypical subspecies differs from *P. s. manskiei* by the extensive areas of white on the upperside of both wings.

The male genitalia were figured by Ring and Olive (1997) and compared with those of *P. nitens nitens* and *P. nitens lucina*.

Sands (1981a) proposed a *nitens* species-group for *P. nitens* and related species including *P. sappheira* and which now includes *P. s. manskiei*.

Variation. FWL: ♂♂, 10.8-12.8 mm; ♀♀, 12.7-13.3 mm. Females of *P. s. manskiei* may resemble female *P. moira* Grose-Smith (Forbes 1977) from Papua New Guinea, particularly in some forms when the forewing area of green is restricted. The extent of silvery greenish blue areas on the upperside of the forewing of females varies from an obscure narrow strip of greenish scales from the base to the cell, not reaching the inner margin (*e.g.* in Braby 2004), to an extensive oval and silvery green central area, extending from the base beyond the cell to the inner margin and postmedian region. The hindwing may be almost uniformly dark grey with paler costa, to light grey with obscure lighter grey scales in the central areas reaching the cell and postmedian region.

Distribution. Queensland: 39 km NW of Cooktown, 8 km SW of Mount Webb, McIvor River, 3 km NW of Hopevale, Cedar Scrub, Endeavour Falls, 3 km SE of Isabella Falls (ANIC, Ring and Olive 1997).

Biology. Larvae of *P. sappheira manskiei* feed on *Macaranga involucrata* (Ring and Olive 1997).

Discussion

Infraspecific variation in adult morphology, particularly that of females (*e.g.* Forbes 1977), has contributed to difficulties in associating sexes in several *Philiris* spp. from Papua New Guinea and without any evidence for seasonal variation. By contrast, variation in Australian species appears to be seasonal, evident in some species with allopatric distributions. Morphological variation, particularly the extent of white or blue scales, is thought to be induced by variation in temperatures (unpublished observations) during development; for example, females of *P. nitens* and *P. innotata* reared from immature stages during winter months are usually much paler, with more white or blue on the upperside respectively, than females reared during summer months. The extent of white areas on the upperside of both sexes of *P. diana* may also be temperature dependent.

Asymmetry in the male genitalia of some *Philiris* spp., in both shape and length of the valvae when viewed posteriorly, is known in other members of the *diana* species-group (*e.g. P. siassi* Sands: Sands 1979) and this unusual morphology is most easily observed when the genitalia are slide mounted. Moreover, the morphology of the male genitalia, including sclerites of the prezonal sheath, may vary with age of the specimen (for example, with freshly eclosed specimens when sclerotisation of the prezonal sheath is weakly developed) and the position of retractile cornuti in the aedeagus may also vary according to age.

Very little is known of the ecology of Australian *Philiris* spp. except for some larval food plants. The distribution of members of the *nitens* species-group is enigmatic, with all three species being allopatric in Australia and utilising the same food plant, *Macaranga involucrata*.

Acknowledgements

Sincere thanks to Peter Valentine, David Hancock, Graham Forbes, Russell Mayo and Ted Edwards for helpful discussions and for providing access to specimens for study and thanks are due to Bill Graham for depositing a paratype of *P. azula johnsoni* in the Australian National Insect Collection, Canberra. Special thanks to Albert Orr, John Kerr and Tim New for constructive reviews of the manuscript and to Susan Sands for preparing many of the genitalia illustrations. The late Murdoch De Baar provided much valuable information during earlier preparations for this review and loan of his specimens for study.

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A FURTHER RECORD OF *DANAUS CHRYSIPPUS CRATIPPUS* (C. FELDER, 1860) (LEPIDOPTERA: NYMPHALIDAE: DANAINAE) FROM THE NORTHERN TERRITORY, AUSTRALIA

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Abstract

A female *Danaus chrysippus cratippus* (C. Felder) is recorded from the Darwin suburb of Wanguri, Northern Territory, on 13 April 2015. This record represents only the third location for the species within Australian limits, the two others being the Black Point and Smith Point areas of Cobourg Peninsula, Northern Territory, and Thursday Island in Torres Strait, Queensland.

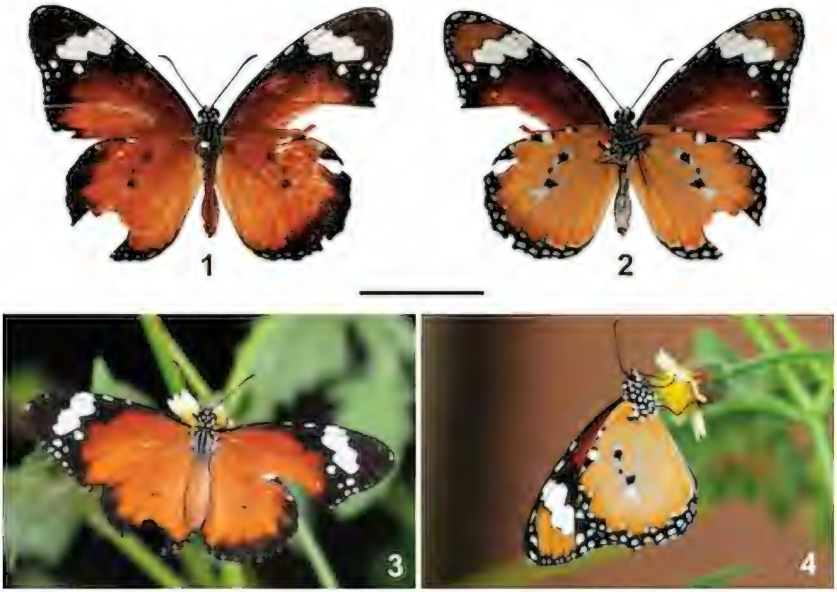
Introduction

The Plain Tiger, *Danaus chrysippus* (Linnaeus, 1758), is a polytypic species distributed widely in the Afrotropical and Oriental Regions (Smith 2014). In Australia, however, it is rarely encountered, being known previously only from the Black Point and Smith Point areas of Cobourg Peninsula, Northern Territory [a male collected in 1977 (Common and Waterhouse 1981) and 13 specimens collected in 2007 (Braby 2014, Braby *et al.* 2015)] and from Thursday Island in southern Torres Strait, Queensland [a female collected in 1995 (Lambkin 2009)]. All of these specimens were collected from January to April, which is typically the monsoon or wet season in northern Australia, and all specimens have been assigned to the subspecies *D. chrysippus cratippus* (C. Felder, 1860), which is restricted to the eastern half of Wallacea (Braby *et al.* 2015). Permanent breeding populations of the species do not appear to be established on the Australian mainland, with all previous records representing either vagrants from Maluku and/or the Lesser Sunda Islands, or progeny from temporary colonisations that failed to establish.

The species is taxonomically and phylogenetically distinct from the well known Lesser Wanderer, *D. petilia* (Stoll, 1790) (Lushai *et al.* 2005, Braby *et al.* 2015), and is distinguished from that species by the following six phenotypic characters (see Braby *et al.* 2015): (1) the upperside ground colour is uniformly tawny brown or dark orange-brown, with the forewing discal cell and basal area of cell M_3 diffusely contrasted in darker brown; (2) the underside ground colour of the forewing is uniformly rusty brown or dark orange-brown, with the discal cell and basal area of cell M_3 a darker shade of rusty brown; (3) the length of the white subapical spot in cell M_2 of the forewing is significantly longer; (4) the white subapical spot in cell M_3 of the forewing is always present and significantly larger; (5) the width of the black marginal band on the upperside of the hindwing is significantly narrower, often enclosing a few white submarginal spots, with the inner edge of the band usually lacking the rusty brown suffusion; and (6) the black marginal band on the underside of the hindwing is narrower and usually encloses only a single row of white spots or, if two rows of spots are present, the inner row of spots is smaller and generally less distinct and adjacent to the band.

Observations

At Wanguri, an outer northern suburb of Darwin, NT (12.373ºS, 130.886ºE), a female *D. chrysippus cratippus* was observed feeding on flowers of *Tridax procumbens* L. (Asteraceae) at 1130 hrs on 13 April 2015. The specimen (Figs 1-4) was in worn condition and was located near a shopping centre at the intersection of Gsell Street and Vanderlin Drive. At the time of observation I had no collecting equipment with me, but I was able to photograph and collect the specimen by hand. The female was kept alive for 48 hrs, fed with diluted honey-sugar solution and placed inside a plastic bag supplied with fresh cuttings of *Cynanchum carnosum* (R.Br.) Schltr. (Apocynaceae) in a shade house, but did not oviposit during this period.



Figs 1-4. Female *Danaus chrysippus cratippus* from Darwin, NT, showing: (1) upperside, (2) underside, (3-4) feeding from flowers of *Tridax procumbens*. Scale bar for Figs 1 and 2 = 20 mm.

Discussion

The specimen agrees with the diagnosis of Braby *et al.* (2015) in that it possesses all six phenotypic characters of *D. chrysippus cratippus* that distinguish it from *D. petilia*. The specimen was collected at the end of the wet season and presumably had arrived following the summer monsoon trade winds from Indonesia, which typically occur during December-March. Darwin is located approximately 200 km south-west of Black Point on

Cobourg Peninsula and a straight line drawn between these two locations is perpendicular to the direction of the monsoon trade winds, suggesting that the specimen was unlikely to have originated from Cobourg Peninsula.

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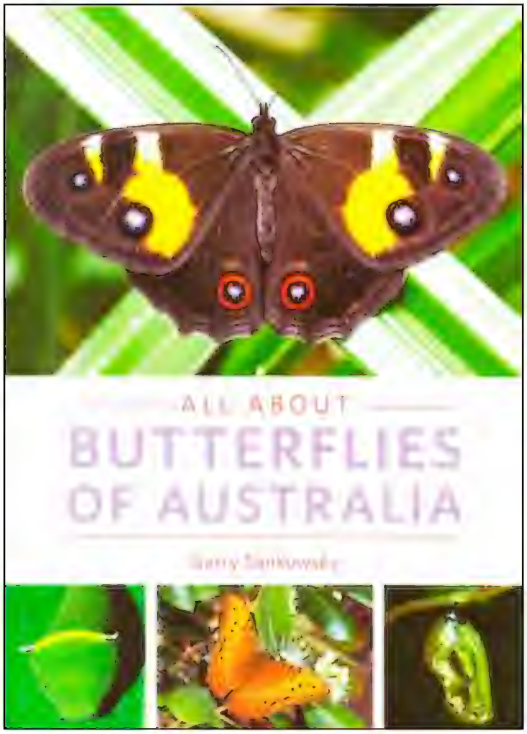
BOOK NOTICE

All about butterflies of Australia, by Garry Sankowsky. Paperback; 167 pp; ISBN: 9781921517433; $29.99. Available from: *http://www.publish.csiro.au/nid/18/pid/7532.htm*



This delightful book draws on the enormous experience of the author with butterflies in the field and is filled with hundreds of photographs of living butterflies and their life histories and food plants. Included are many snippets of information about living butterflies, their behaviour, breeding habits and preferences, seasonal quirks and migrations, mimicry and defences. Also discussed is the decline in butterflies due to factors such as clearing of the brigalow belt, decline in dry vine scrubs due to annual burn-offs and the steady invasion of natural habitats by aggressive introduced pasture grasses that are rapidly replacing the natural vegetation, including butterfly food plants, throughout Australia.

For further details see the *News Bulletin of the Entomological Society of Queensland*, Volume 43, Part 5, page 88 (August 2015).

TELICOTA SP. NR *KEZIA KEZIA* EVANS, 1949 (LEPIDOPTERA: HESPERIIDAE: HESPERIINAE) FROM DAUAN ISLAND, TORRES STRAIT, QUEENSLAND

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Abstract

Four specimens of a species of *Telicota* Moore, 1881 new to Australia are recorded from Dauan Island, Torres Strait: a male and female collected from blossom of *Citharexylum spinosum* L. and *Melaleuca* L. sp. respectively, and another two males collected while flying amongst tall grass in semi-shade under *Melaleuca* trees. Both sexes are illustrated, including the genital armature of a male that is closest in structure to that of *T. kezia kezia* Evans, 1949 from Papua New Guinea and *T. ohara ohara* (Plötz, 1883) from Papua New Guinea and Australia, while the external facies, except the male sex brand, best fit *T. k. kezia*. In addition, the specimens possess on the hindwing underside a postmedian band that is divided by black veins, a character shared with *T. o. ohara*. The male sex brand of the Dauan Island specimens is broader and more centrally placed in the dark central band of the forewing than that of *T. k. kezia*. Because the Dauan Island specimens do not match any described species, and due to their external similarity to *T. k. kezia*, they are referred to here as *T.* sp. nr *kezia kezia*. It is proposed that because of their similarities to *T. o. ohara*, they might share some relationship with this species and thus could share the same larval hostplant, *i.e. Flagellaria indica* L.

Introduction

Telicota Moore, 1881 is a genus of predominantly tropical skippers (Evans 1949) often referred to as darters or darts (Corbet and Pendlebury 1992, Braby 2000). The genus is wide ranging, occurring from Sri Lanka and India across south-east Asia, through Indonesia and New Guinea, to the Solomon Islands and Australia (Evans 1949, Corbet and Pendlebury 1992, Parsons 1998, Bascombe *et al*. 1999, Braby 2000, Tennent 2002). Species in the genus are characterised by their black and orange colouration, distinctive forewing sex brands in males and rounded forewings in females. They are moderate-sized skippers, with forewing lengths ranging from 14-17 mm in males and 15-19 mm in females (Evans 1949, Corbet and Pendlebury 1992, Parsons 1998, Braby 2000).

The genus is diverse with more than 38 species recognised by Parsons (1998), who suggested that there were 25 species in Papua New Guinea alone. Nine species are currently recognised in Australia (Braby 2000). The type species is *T. colon* Fabricius, 1775 from India (Evans 1949, Edwards *et al*. 2001).

Telicota species are found in a variety of habitats but predominantly occur in damp, swampy or estuarine areas, or along the margins of monsoon forest, rainforest or riparian forest (Parsons 1998, Braby 2000), although some species can occur in more open forest habitats (Parsons 1998, Braby 2000). Larval host plants of *Telicota* in Australia and Papua New Guinea include grasses (Poaceae), *Flagellaria indica* L. (Flagellariaceae) and sedges (Cyperaceae). In Queensland, several species are known from the islands of

Torres Strait (Waterhouse and Lyell 1914, Braby 2000), but little is documented on the species diversity of *Telicota* in the far north of the Strait, particularly from the islands close to the southern coastline of Papua New Guinea, *viz.* Dauan, Saibai and Boigu Islands.

While a study is currently underway documenting the *Telicota* species from these northern islands (TAL in prep.), between 2009 and 2015 three males and one female of a strikingly large species of *Telicota* were collected at the western end of Dauan Island. After examination of their wing patterns, including the male forewing sex brands, and their genital armature, it was found that the species was hitherto unrecorded from within Australian territory and best matched *T. kezia kezia* Evans, 1949, which occurs predominantly in New Guinea (Evans 1949, Parsons 1998). Two subspecies of *T. kezia* were described by Evans (1949): *T. k. kezia* from mainland New Guinea and the islands to the west, including Maluku (Evans 1949, Parsons 1998), and *T. k. lenna* Evans, 1949 from New Britain, Witu Island, New Hanover and New Ireland (Evans 1949). The type locality for *T. k. kezia* is Mt Mado, Buru, Maluku (Evans 1949). Currently, there appears to be nothing published on the habits and ecology of *T. kezia* (Parsons 1998). Interestingly, *T. k. kezia* appears to have a more restricted distribution than Evans (1949) and Parsons (1998) indicated, as the latter did not record it from the Bulolo-Wau Valley (Morobe Province) in the north-east of Papua New Guinea, despite a long period of butterfly sampling in the region (Parsons 1991).

Here I report the details of these specimens and their collection on Dauan Island, including field observations, and illustrate male and female adults and the male genital armature. In addition, I discuss the uncertainty surrounding their identification, together with why observations of this species on Dauan Island are infrequent despite a relatively robust collecting effort by butterfly enthusiasts over the last two decades or so.

The following abbreviations refer to repositories from which material has been examined: ANIC – Australian National Insect Collection, Canberra; CGMC – Collection of C.G. Miller, Lennox Head; TLIKC – Joint collection of T.A. Lambkin and A.I. Knight, Brisbane.

Abbreviations of collectors' names are: CGM – C.G. Miller; EJH– Sir Edward J.L. Hallstrom; TAL – T.A. Lambkin; WWB – W.W. Brandt.

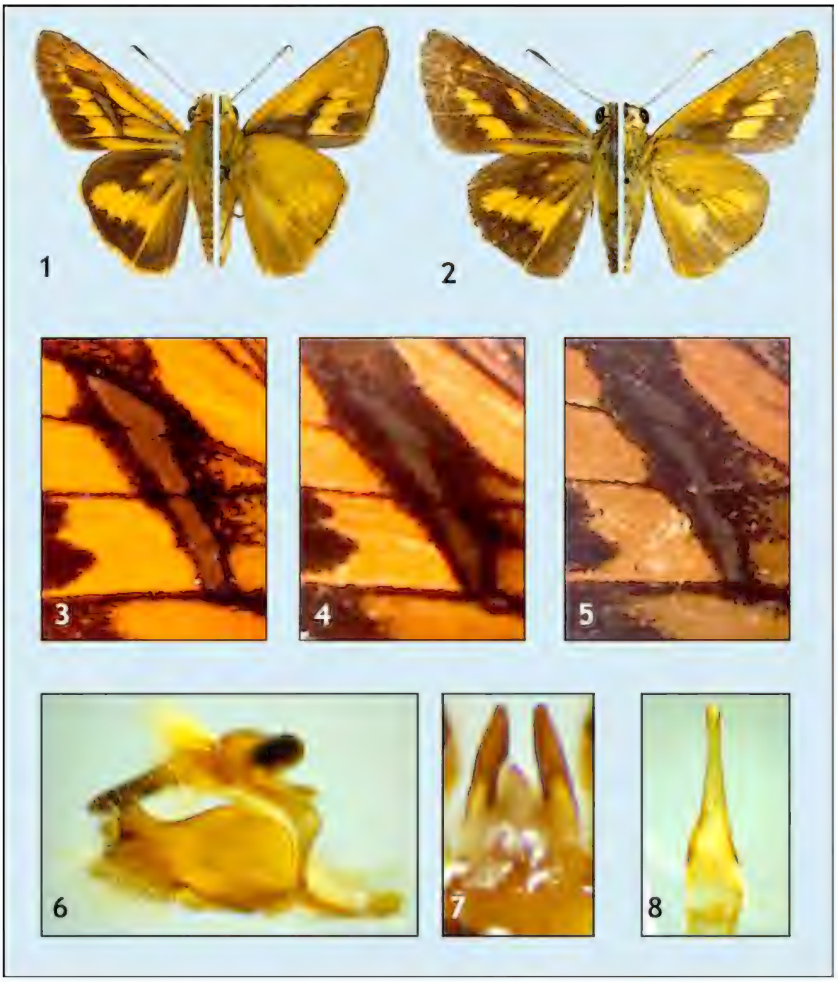
Material examined

Telicota sp. nr *kezia kezia* (Figs 1-8)

QUEENSLAND: 1 ♂, 1 ♀, Dauan Island, Torres Strait, 6.iv.2009 (♂), 13.i.2014 (♀), TAL (TLIKC); 2 ♂♂, same data except 18.iv.2015, 19.iv.2015, CGM (CGMC).

Telicota kezia lenna

PAPUA NEW GUINEA: 1 ♂, Rabaul, New Britain, 22.viii.1952, collected WWB, EJH (ANIC); 1 ♂, Keravat, New Britain, 14.xi.1952, collected WWB, EJH (ANIC).



Figs 1-8. *Telicota* sp. nr *kezia kezia* from Dauan Island, Torres Strait: (1-2) adults: upperside left, underside right [forewing lengths, in mm, in square brackets]: (1) ♂ 6.iv.2009 [19 mm] TLIKC, (2) ♀ 13.i.2014 [20 mm] TLIKC; (3-5) male sex brands LH forewing [sex brand lengths, in mm, in square brackets]: (3) 6.iv.2009 [5.5 mm] TLIKC, (4) 19.iv.2015 [5.3 mm] CGMC, (5) 18.iv.2015 [5.4 mm] CGMC; (6-8) genital armature [lengths of structures, in mm, in square brackets]: ♂ 6.iv.2009 TLIKC: (6) right valva, dorsal surface uppermost [1.5 mm]), (7) divided uncus dorsal view [1.5 mm], (8) phallus [1.8 mm].

Observations

Dauan Island is one of Australia's most northern islands, lying approximately 10 km from the southern coastline of Papua New Guinea. It is roughly 2.5 sq. km in size, with the bulk of the island being hills composed of exposed large granite boulders with, amongst these boulders, extensive patches of semi-deciduous monsoon forest. The highest of these hills is Mt Cornwallis (275 m), which is the dominant feature of the island. The bulk of the village on Dauan Island is situated at the northwestern end of the island.

The first specimen recorded of this Dauan Island *Telicota* was a male collected in April 2009 from blossom of *Citharexylum spinosum* L. (Verbenaceae) (fiddlewood) along the main street of the village. This plant is a common garden tree grown in the village and, at that particular time, the butterflies *Cephrenes moseleyi* (Butler, 1884) (Hesperiidae) and *Graphium codrus medon* (C. & R. Felder, 1864) (Papilionidae) were collected from the same blossom. The other three *Telicota* specimens were collected towards the western end of the village, the female in January 2014 from blossom of *Melaleuca* L. sp. overhanging the road and the remaining two males in April 2015 at the same location, but in tall grass in semi-shade under *Melaleuca*. As in most species of *Telicota*, the Dauan Island males recorded in April 2015 were observed flying rapidly in sunlit glades and settling on tall grass stems, and would frequently challenge males of other *Telicota* species for territory (C.G. Miller pers. comm.).

The four specimens collected are typical of *Telicota* in form, as per Evans (1949), but they differ from all other *Telicota* species recorded thus far from Australia in being much larger and roughly similar in size to *C. moseleyi*: *i.e.* male and female with forewing lengths of around 19-20 mm. The forewing uppersides of the Dauan Island specimens have almost no extension of the outer edge of the orange postmedian bands along the veins to the termen (Figs 1-2) and the hindwing undersides have a fuscous, tawny postmedian band that is divided by black veins. In addition, the sex brands of the three Dauan Island males appear slightly broader than in *T. kezia* males from Papua New Guinea (Parsons 1998: figs 391-393 and 395) and are placed more in the centre of the dark central band of the forewing (Figs 3-5).

The male genital armature of a Dauan Island specimen (in TLIKC) (Figs 6-8) is close to that illustrated as *T. kezia* by Parsons (1998) and, to a lesser degree, to those depicted by Evans (1949). It is also similar to that illustrated as *T. ohara* (Plötz, 1883) from Papua New Guinea (Parsons 1998), Hong Kong (Bascombe *et al.* 1999) and Australia (Braby 2000). The valvae (Fig. 6) and uncus (Fig. 7) of the Dauan Island specimen closely resemble those of the several specimens of *T. kezia* illustrated by Parsons (1998), while only the uncus matches the single example of *T. kezia* depicted by Evans (1949). The phallus (Fig. 8) was not illustrated by either author. Unfortunately neither

author indicated whether their drawings of the male genital armature were of *T. k. kezia* or *T. k. lenna*.

Discussion

Evans (1949) placed *T. kezia* and its allies (*T. ohara*, *T. ternatensis* Swinhoe, 1907, *T. sadra* Evans, 1949) into a group primarily based on the morphology of the genital armature, in particular on the pointed ends of the divided uncus. He indicated that the valvae of the four species were variable, even across subspecies within species, and thus species were difficult to separate using the structure of the genital armatures alone. Similarly, the genital armature of the Dauan Island male (Figs 6-8) has some similarities, particularly the valvae, with the armature of *T. ohara* (Evans 1949, Parsons 1998, Bascombe *et al*. 1999, Braby 2000).

Within the *Telicota* group in which Evans (1949) placed *T. kezia*, a distinctive feature of *T. kezia* is the shape and placement of the male forewing upperside sex brand. The sex brand of *T. kezia* meets vein 1A+2A approximately midway along its length between termen and base and forms an almost vertical line, relatively thin and grey-black in colour, lying in the outer edge of the dark central band, between veins M_3 and 1A+2A. The sex brands of the Dauan Island males differ in that they are broader and are placed centrally in the dark central band of the forewings (Figs 3-5). In addition, Evans (1949) indicated that the postmedian bands on the hindwing undersides in both sexes of *T. k. kezia* are fuscous and narrow, orange in colour and with distinctive black veins running through them. The postmedian bands on the hindwing undersides of the Dauan Island males match those of a *T. k. kezia* male illustrated by Parsons (1998) in width but are broader than those of *T. k. lenna* males illustrated by Evans (1949) and Parsons (1998) and in 2 ♂♂ of *T. k. lenna* examined in ANIC.

Except for the character and position of the sex brands of the three *Telicota* males from Dauan Island, their external facies closely resemble the illustration of a male *T. k. kezia* in Parsons (1998): a 'pale form' collected at Waidoro, Western Province, Papua New Guinea, which is approximately 43 km NE of Dauan Island. In addition, the size of the three *Telicota* males reported here from Dauan Island (Figs 1-2) is notable. Evans (1949) and Parsons (1998) specified that *T. k. kezia* males have a forewing length of 16-18 mm, smaller than the Dauan Island specimens, which have a forewing length of 19 mm (n = 3), although this might not be significant.

Taking into account size, overall wing pattern and character and placement of the male sex brands, it remains uncertain whether the Dauan Island material is *T. k. kezia* or another, closely related taxon. I cannot, therefore, place the specimens from Dauan Island confidently in *T. kezia* and thus refer to them here as *T.* sp. nr *kezia kezia*.

Evans (1949) indicated that *T. kezia* was the only member of his *kezia* group that has distinctive black veins running through the postmedian band of the hindwing underside. He further specified that *T. ohara* lacked this feature. Despite this, *T. o. ohara* is the only species of *Telicota* in Australia that does have predominately black veins running through the postmedian band of the hindwing underside (Braby 2000). The presence of this character in *T. o. ohara* and *T.* sp. nr *k. kezia* from Dauan Island (Figs 1-2) might indicate that the taxonomy of this *Telicota* group could be more intricate than Evans (1949) indicated.

Despite the intensity of butterfly collecting undertaken on Dauan Island over the past 20 years or so, it is surprising that only four specimens of this taxon have been collected. Based on Evans' (1949) assessment that *T. k. kezia* was related to *T. ohara* and my assessment that the two taxa share some similarities in their external facies and genital armature to *T.* sp. nr *k. kezia*, it is possible that *T.* sp. nr *k. kezia* might share the same hostplant as *T. o. ohara* recorded from mainland tropical Queensland (Braby 2000). If this is the case, then the larvae of *T.* sp. nr *k. kezia* might also be dependent on *Flagellaria indica*, which is a common component of the semi-deciduous monsoon forest on Dauan Island (Torres Strait Regional Authority 2013). If *F. indica* is the host plant of *T.* sp. nr *k. kezia* on Dauan Island, this might explain its apparent rarity, due at least in part to the butterfly primarily inhabiting the forest canopy where *F. indica* predominantly grows and where, in this habitat, *F. indica* can form impenetrable dense understories (Jones and Gray 1977, Williams 1979). Certainly, its southern congener, *T. h. ohara*, is also reported to be uncommon (Common and Waterhouse 1981) and infrequently observed (Braby 2000), perhaps due to its propensity to also inhabit the forest canopy. This could mean that *T.* sp. nr *k. kezia* is rarely observed outside the forest, particularly at ground level, much like *T. o. ohara*.

Parsons (1998) noted that W. Brandt, a butterfly worker in Papua New Guinea in the 1950s (his collection is housed in the ANIC), supposed that the taxon *T. k. lenna* was likely a distinct species. Parsons (1998) also suspected that, because *T. k. kezia* varied in its external facies and male genital structure across Papua New Guinea, there might be several species contained in *T. k. kezia*, which may begin to explain the unexpected size of the specimens collected on Dauan Island. For now, the four Dauan Island specimens are tentatively placed as *T.* sp. nr *k. kezia* until a more thorough revision is made of the *kezia* species-group, particularly in New Guinea.

Acknowledgements

I thank the local community councils and island Elders of Dauan Island, Torres Strait for allowing entry into their communities and providing assistance during time spent on their islands. Appreciation is given to E.D. Edwards (ANIC) and C.G. Miller for allowing access to specimens in their care. This paper partially fulfils the requirements for a Master of

Philosophy degree undertaken by the author at The University of Queensland, Brisbane.

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BOOK NOTICE

Tropical Queensland Wildlife from Dusk to Dawn, by Buck Richardson. Hardbound; 348 pp; ISBN: 9780957729018; $65 (including postage within Australia). Available from: *http://www.leapfrogoz.com.au/LeapFrogOz/Tropical_Queensland_Wildlife_from_Dusk_to_Dawn_Science_and_Art.html*

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For further details see the *News Bulletin of the Entomological Society of Queensland*, Volume 43, Part 5, page 89 (August 2015).

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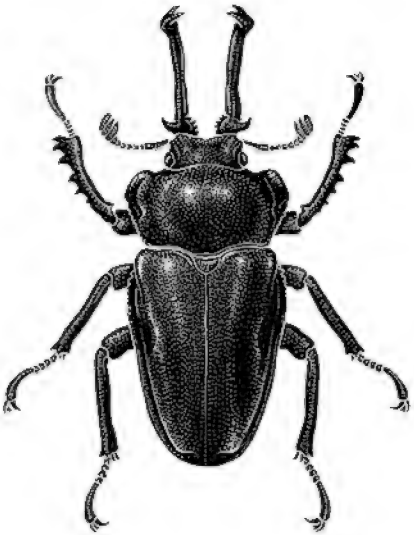

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