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SULAWESI (MINAHASA) LEPIDOPTERA AND PROJECT WALLACE, 1985

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ABSTRACT.– A summary of a trip to Sulawesi is given, along with results of the Lepidoptera species encountered during Oct 1985, as part of the Project Wallace Royal Entomological Society Expedition to northern Sulawesi during 1985. Features of the expedition are noted, as well as a discussion of some of the Lepidoptera fauna in the area. Minhasa surveying resulted in finding 2,265 moth species and over 200 butterfly species, many of which are endemic to Sulawesi.

KEY WORDS: Australia, beetles, biogeography, Borneo, Choreutidae, Celebes, Coleoptera, Diptera, diversity, Dumoga-Bone National Park, Geometridae, Homoptera, Hymenoptera, Indonesia, Java, Lasiocampidae, Lymantriidae, Moluccas, Noctuidae, Philippines, Pyralidae.

Fig. 1. Dumoga Valley near the national park. © J. B. Heppner (and all following figures).

The year-long 1985 Project Wallace expedition was organized by the Royal Entomological Society of London, England, to commemorate the anniversary of the Royal Charter award of 1885 and the 150th anniversary of the founding of the society. The expedition was named to honor Alfred Wallace (Fig. 3) and his work in Indonesia (Wallace, 1869), and thus focused on an intensive faunal and floral survey of a very unique area of Sulawesi, the Dumoga-Bone National Park of Minahasa (Fig. 4), northern Sulawesi (formerly called the Celebes). This extraordinary expedition included over 100 scientists from around the world, extensive financing from the Society, the British and Indonesian governments, and the active support of numerous other taxonomists who still now study, and for years to come, will study the extensive material collected during the 12 months of the survey.

Sulawesi is a large island east of Borneo, with a total land area of about 72,986 sq mi (189,034 sq km). The long narrow peninsulas that form an island shaped like a letter "k" have produced considerable isolation in each peninsula, such that Sulawesi can be looked at almost as 5 islands, with a highland center. Minahasa (Fig. 3) is perhaps one of the more interesting of these peninsulas, due to the proximity of the Philippines and the Moluccas, but the other areas of Sulawesi also have considerable endemicity. Maps showing old water levels during the Pleistocene (Heppner, 1989; Whitten, 1987), demonstrate that Sulawesi is just east of the old Sundaland shelf, and this persistant water gap even during the Pleistocene has prevented many plant and animal groups from locating on Sulawesi, and the

Fig. 2. Coastal scene near to Menado, Minahasa.

species that did get to Sulawesi have developed at least subspecies differences from mainland populations in most cases. Thus, diversity is less on Sulawesi, but endemic species and subspecies are much higher than for Sundaland. Wallace (1869) also made the area of great interest due to his theories of faunal region demarcations between the Oriental and Australian Regions, thus forming what is now called the Wallace line between Borneo and Sulawesi as the boundary from Sundaland, and as this marks the beginning of gradual change from Oriental fauna to Australian fauna as one moves from Sulawesi to New Guinea. Later workers refined the boundary lines even more.

The Dumoga-Bone watershed (Fig. 1) was chosen as the site of the expedition and survey headquarters since it was part of a newly formed national park. The Dumoga-Bone National Park has an area of 280,000 hectares (550,000 acreas), with elevations ranging from 200-1995m. The northern area of Sulawesi (Fig. 2, called Minahasa by the locals, also was known to harbor many endemic species of plants and animals, even more so than the rest of Sulawesi, which already has high endemism among Indonesian islands.

The vegetation of study sites at Dumoga-Bone and a nearby lake area, Lake Mooat (1080-1780m), is one of largely untouched tropical forest and montane forest. Intervening areas, such as most of the flat portions of the Dumoga Valley, are deforested and under agriculture (Fig. 1). The base camp (Fig. 10-11 was just at the edge of agricultural lands and the border of the remaining intact forest across the Toraut branch of the Dumoga River (Fig. 12-13). The forest near the base camp is not exceptionally rich in plant species (Knight, 1988) and has a large number of palms and rattans (Fig. 27). The forest is very humid and has many fungi (Fig. 23, 31, 39, 44-45), yet is seasonally somewhat dry and not a true rainforest as one thinks of in the Amazon or the Congo Basins.

There is a slight dry season from May to Oct, but rainfall is high most of the year (2000-3000mm) (Fig. 4). The Dumoga Valley is in somewhat of a rain shadow, and montane areas receive somewhat more rain than lowland areas in any case.

The Royal Entomological Society of London arranged all the details of the expedition, obtained necessary governmental cooperation, raised money, and expedited the transfer of supplies and scientists to Sulawesi, even obtaining the help of three rotating contingents of British Army personnel to help with camp maintenance and security. Our British "hosts" in the field were British Army regulars who had volunteered for this special and unusual assignment. The expedition, thus, probably was something like expeditions last century, when surveys had an army escort in remote regions. Not that the local Indonesians were unfriendly — our army "buddies" just kept the base camp running and resupplied it regularly. Three rotating teams of the British Army went on the expedition, each for a period of 4 months.

The local people actually are very friendly and have a great love of games. The army guys discovered this the first time they went to fill their Land Rovers and spare cans with gasoline in early January 1985. They did not watch the man pumping gas and soon enough gas was "pumped" to fill twice as much space as was available in the vehicles and all the gas cans. The army

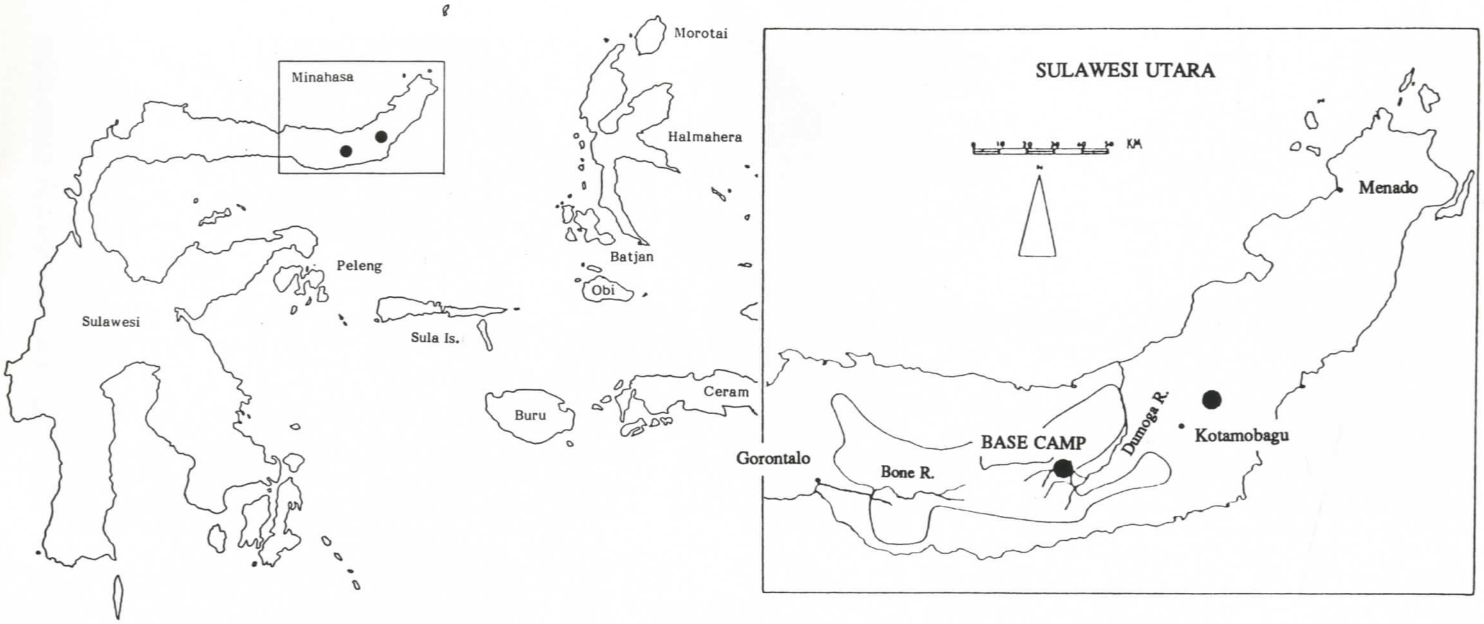


Fig. 3. Map of Sulawesi and nearby areas, with inset showing Minahasa (dots locate the base camp, left, and Lake Mooat, right) (after Heppner, 1989; Knight, 1982).

guys paid but they watched the pump meters next time like a hawk. The Indonesian gas station manager later would always say, "We no cheat, ha ha ha?!" So, every visit became another game to see if they could sell more gas to the army guys than they actually had room for. But, everyone enjoyed themselves. This story was told to me second hand but undoubtedly is true, although with some embellishment.

Indonesians are extremely polite and friendly people, who especially like to agree with you and have an answer to your every question. The traveller must be aware of this, particularly when asking directions. The average Indonesian will never tell you he does not know where such and such place is, or what road to take to get there; they will simply point in some direction. In this way you are happy to get an answer and they are not embarassed to tell you they actually had no idea where the place was or even knew what you were talking about. So, traveller beware. The BA guys had all this already figured out, however, and anyway they had all the local maps available, plus topographic maps from British Army headquarters in London, the latest satellite photos from NASA covering every inch of Minahasa, and even had local guides to make their own maps, so they never got lost. Right? — sure!

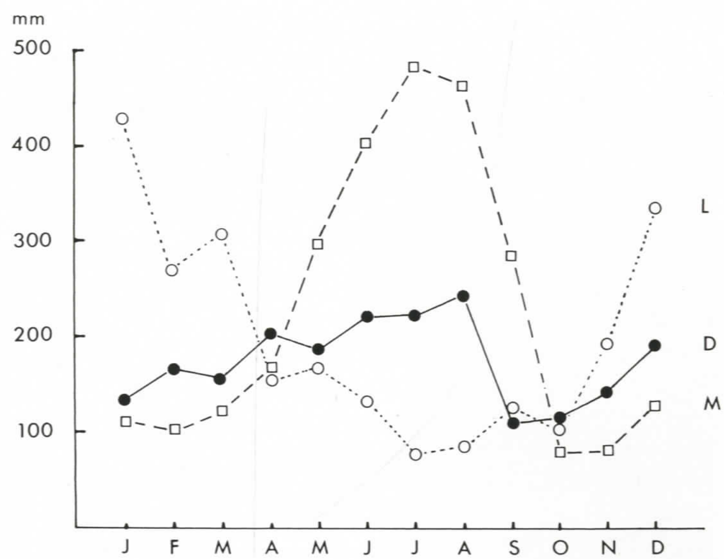


Fig. 4. Mean monthly rainfall for sites in Minahasa: D = Dumoga (annual mean = 2071mm), L = Lolak (annual mean = 2357mm), and M = Molibagu (annual mean = 2703mm) (after Knight, 1988).

Fig. 5. Lake Mooat (1048m elev.), part of Gunung Ambang Nature Reserve, about 20km NE Kotamobagu.

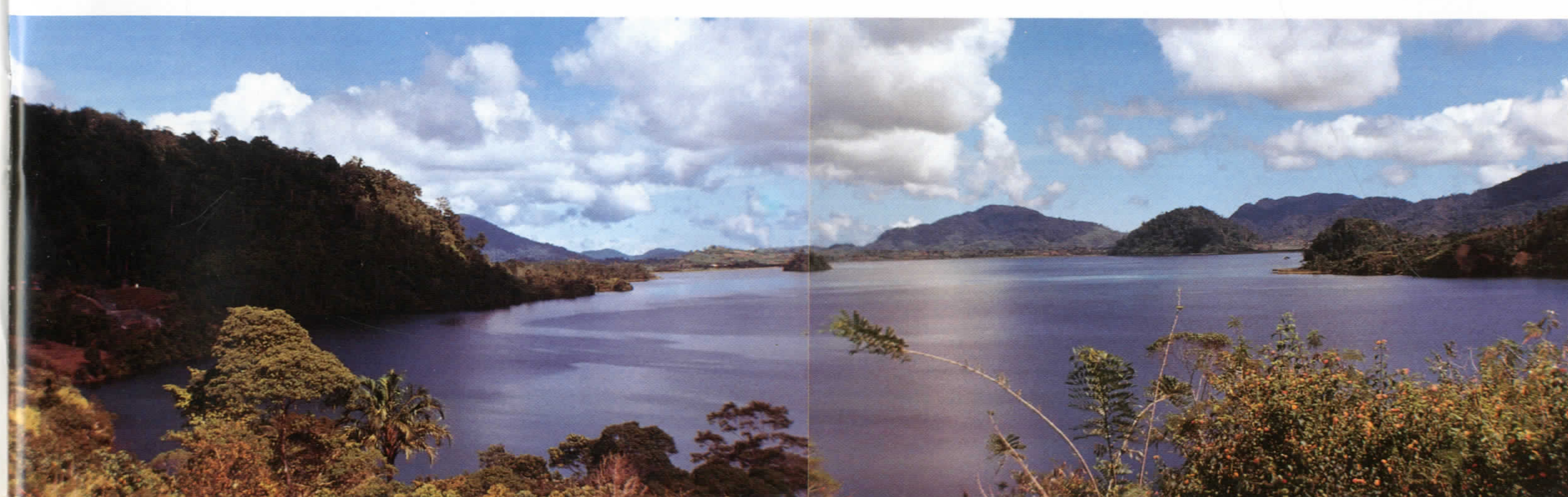


Fig. 6-11. Minahasa and Dumoga scences: 6. Coastal village near Menado; 7. Local children near Menado; 8. Typical houses and gardens in small villages, near Dumoga; 9. Village near Menado; 10. Project Wallace base camp headquarters at Dumoga National Park border; 11. Base camp buildings viewed east into deforested Dumoga Valley.

The BA guys were a great and enthusiastic team. By Oct they told me that they had already "rolled" two of the Land Rovers, and I did not learn what was left by the time the expedition ended in late Dec 1985. But, they got the job done. My first encounter with these wonder guys was a laid-back soldier (Australian?) who drove us from the lodge in Menado, capital of Minahasa (Sulawesi Utara), to base camp the day after my arrival from Jakarta, Java. He was most pleasant and easy going but as soon as we were loaded, and the three of us newly arrived scientists were on board, he took off like a bat out of h---. My attache case quickly flew out the back door that opened up after he floored the gas pedal, but it survived the crash landing without opening (made in America (?) by Samsonite). By the time we got to Dumoga he had run over only one chicken—he thought that was a record, since usually they got 2 or 3 chickens every time they left the base camp to get supplies. He noted that the local chickens were

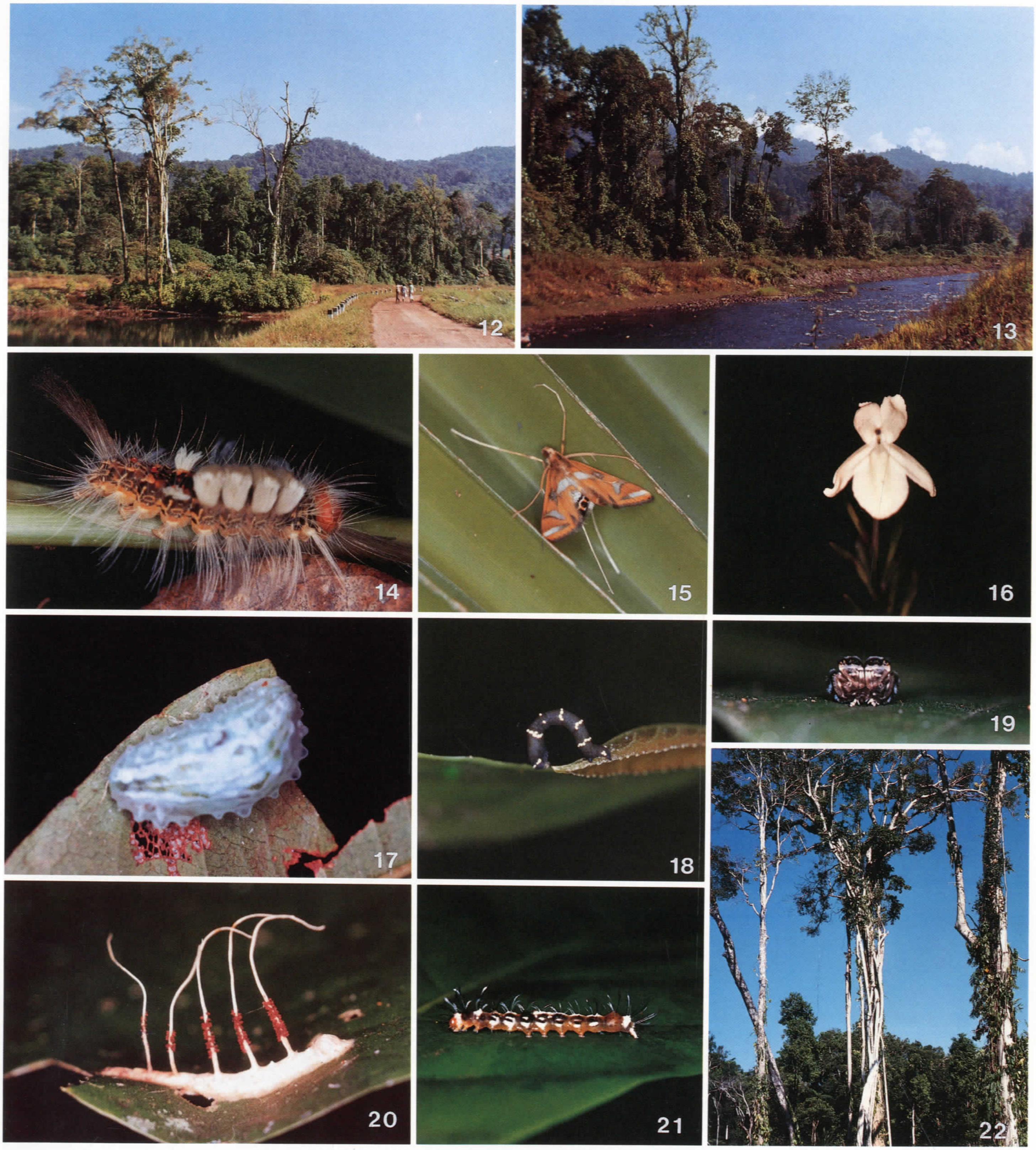


Fig. 12-22. Forest scenes and inhabitants at Dumoga: 12. Remnant forest trees at park border; 13. Toraut branch of Dumoga River at park border; 14. Larva of a tussock moth (Lymantriidae); 15. Adult aquatic moth (*Eoophyla* sp., Pyralidae); 16. Orchid; 17. Larva of a zygaenid moth (Zygaenidae); 18. Geometer larva (Geometridae); 19. Rear view of metalmark moth showing characteristic wing posture (*Brenthia* sp., Choreutidae); 20. Caterpillar with fungus; 21. Unknown larva (?Noctuidae); 22. Remnant forest trees at Dumoga.

of a peculiar breed that evidently had never seen cars before, since they had a habit of remaining in the middle of the road when the Land Rovers came, very unlike the experienced British chickens! (Of course, I did not call his attention to the fact that even British chickens probably could not accurately calculate the rate of speed of an approaching 80mph+ Land Rover in time to run fast enough to get out of the way!). The local children always came running out to wave when they heard the Land Rovers come roaring up the road, amazed no doubt at how fast they could go. In any case, they were very happy because since the British arrived they never in their lives had so much chicken to eat.

The BA guys told me their biggest thrill occurred only a month before my arrival. It seems that a group of American scientists present during September would each day commandeer one of the lucky BA guys to accompany them for collecting, since they needed a vehicle and driver to get to other collecting sites, and the first stop was always the local bar to load their huge ice chest with ice and beer. The BA guys thought it was just fantastic how these Americans could buy so much beer every day, and ice to cool it, too. They thought the Americans were loaded with money (actually they were loaded with beer!). Well, my grant did not allow such excesses, so after a few days when I did not act in the same way as the previous Americans, the BA team quickly stopped following my every move to see when I might order beer and ice. However, they still perked up everytime we were eating and I ordered a bottle of beer, since they mostly could only rely on the BA special brew—something like unsweetened Tang. My grant still allowed beer twice a day rather than only once a week, which still impressed the BA guys a little, but not going to any excess, they quickly lost interest in me and waited for the next American (sucker). Unfortunately, I believe no other Americans came to Dumoga after my departure. The Indonesians at the local bar, of course, were stupified at how these foreigners could buy so much beer, and even ice, when for them it was perhaps a once-a-month treat, since a bottle of beer cost about a day's wages for the average local farmer.

The supplies for the expedition were truly ponderable, the likes of which I had never heard of. An entire ocean-going barge, full of 50 tons of containerized supplies shipped from London, sailed the last stretch from Singapore to Menado. The only thing they did not bring along was rice. Nonetheless, if this had been an American expedition, there would have been air conditioning at the base camp, plenty of ice chests, and there definitely would have been running water, and probably one or two helicopters. Well, I guess you cannot expect everything.

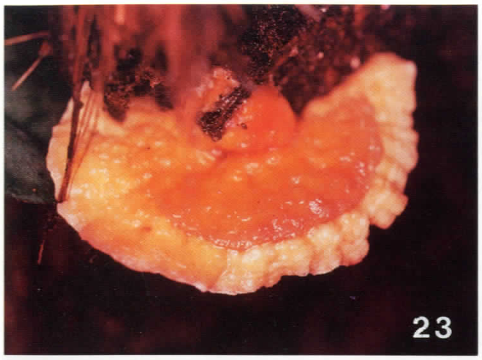
The Indonesian authorities in Jakarta and Sulawesi did not want the expedition to make local residents dependent on the extra income it generated, since it would last only for one year. That did not stop enterprising local children from earning something extra selling giant beetles. One did not see the giant *Chalcosoma atlas* (Linnaeus) beetles (Scarabaeidae) very often in the field, but somehow the local kids could obtain any number of live beetles. We paid them with some candy for each atlas beetle, but for the kids, that was a large amount (the BA guys always were telling me not to overpay them!), like "money from above" — rather literally since there were tons of beetles hiding in the tops of certain palms. So, one could obtain as many beetles as one wanted. By the time I arrived in Oct the kids were already worldly wise—they knew each new scientist would buy atlas beetles, seeing these fantastic large, live beetles for the first time, but then in a day or two would say "enough", having already purchased a couple of dozen beetles of a seemingly endless supply. This was a sign for the kids that they would have to wait for the next new "greenhorn" to arrive before they could peddle their ware of giant beetles again. One of the boys, though, was wise enough to diversify by bringing other insects of interest, and soon had a steady supply of candy.

The Indonesian authorities also did not want the expedition to disrupt local agriculture. This ultimately resulted in the lack of running water at the base camp, eventhough the Dumoga River is just 200m from the buildings. The British Army tried to explain to them that diverting some water to the base camp for tap water and showers would not remove net water from the supply for agriculture, since after going through the camp it would go back into the river, properly filtered (no sewage, of course). This failed to impress the local authorities, however, so no running water was available. The BA guys were, thus, mostly busy getting water from the river into cans to drive over to the base camp every day, and this water was not recycled into the river since it just went on the ground later. All of this used up more gasoline, which had to be bought in the nearby town, giving the local gas station vastly more revenue than they ever imagined, but how this "failed" to affect the local economy or local agriculture, by not having running water, is one of the mysteries of Indonesian logic. But everyone was happy, except the Army grunts.

The lack of showers at base camp did not faze the BA guys or most of the scientists, who dutifully took their baths in the cold river by the bridge to the forest. For my own part, being rather retiring and more modest, I just scrubbed down with a little water and a wet towel in the tub of the camp bathroom. The BA guys later made me feel more at home: not having running water even for the toilets, they rigged up an overhead water closet to flush the toilet—no matter that there was no water to run the thing, but it was a nice touch and did make it look more like a toilet in the good old USA.

The few women scientists would bathe discretely in the deeper water hole of the river, usually at dusk when I needed to set up my light traps for the night. I usually attempted to look the other direction when I crossed the bridge to the forest, but one late afternoon before dusk, when the new female German scientist went to try the bathing hole and stood up to display all her glory, well, my trip across the bridge was slower than usual and somewhat stumbling (I also did not have my camera with me, either). Of course, the local Indonesian farmers, who watched almost every evening from down the river, probably were even more amazed! (I do not believe the German woman knew about the Indonesian sightseers, but then again I do not know that she would have cared!). I usually have gone on field trips only with

Fig. 23-35. Forest inhabitants of Dumoga-Bone National Park: 23. Fungus; 24. Seed pods; 25. Tent caterpillars (?Lasiocampidae); 26. (same, pupa); 27. Ant nest under leaf (Formicidae); 28. Rattan stem with 2 inch spines; 29. Spider; 30. Flower inflorescence; 31. Fungus; 32. Froghopper (Fulguroidea) (ca. 2 x); 33. Grasshopper (Orthoptera: ?Acrididae); 34. Spider; 35. Small homopteran.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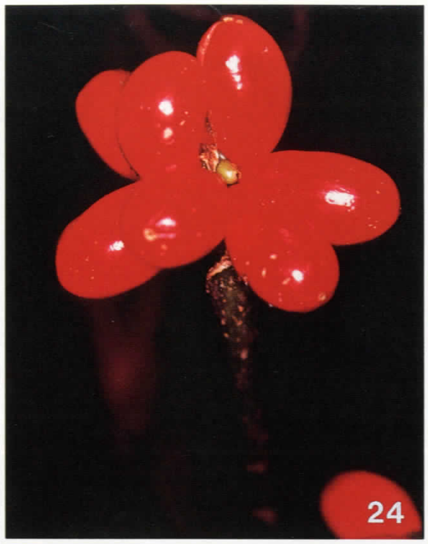
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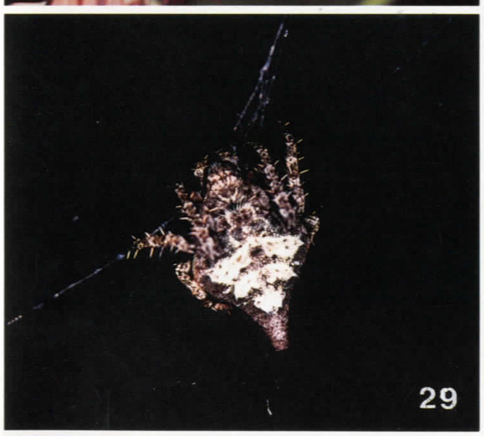
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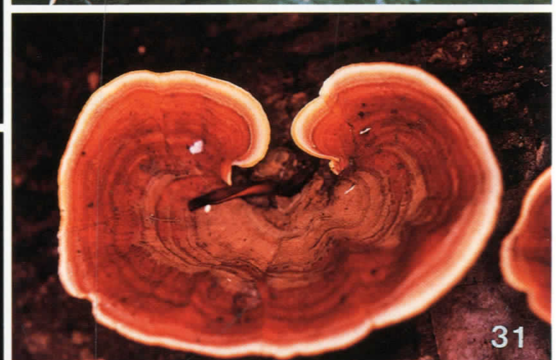
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Fig. 36-45. Forest inhabitants of Dumoga-Bone National Park: 36. A march fly (Bibionidae); 37. Beetle (?Tenebrionidae); 38. Weevils in palm stem (Curculionidae); 39. Fungus; 40. A fungus beetle (?Erotylidae); 41. A long-legged fly (Dolichopodidae); 42. Spider; 43. Parasitic wasp (Ichneumonidae); 44. Seed capsules on forest floor; 45. Fungus.

a small group, but I guess there are advantages to larger expeditions. Needless to say, the BA guys never intruded on the women's bathing but they were always eager to sit at the same table with them at dinner time. It was definitely not an American MASH camp but was all proper and honorable.

The biggest mystery I encountered with this British-run expedition was in the matter of the maps of the survey area and the names of various temporary camps and trails. What exactly is a "rintice"? In the USA we say "trail" for trails, not "rintice." They also had unusual field camp names, like "Ice Station Zebra" for one camp on a jungle hill — the area was hot as h---, so why they called this Ice Station Zebra is hard to understand. Some sort of British humor, I suppose. Actually, the elevation of the camp did involve cool winds during rainstorms that did make it feel like a cold and damp site to camp at. Another field camp demonstrated how temporary they were when one day in Oct a group of scientists using the camp was shocked by the loud crash of a giant tree at the camp. Had they been asleep there rather than collecting nearby, the tree would probably have fallen on someone. These huge old tropical trees can crash like that without apparent warning almost anytime, so one never knows for certain when they may fall, even though they look sturdy enough.

Among the many field camps, the most famous for Project Wallace researchers was the distant Poniki Camp, high atop Mt. Poniki, at 1995m elevation. During my limited stay at Dumoga, it did not seem worth the effort to spend 3-4 days trekking up and down Mt. Poniki, but for those staying 2-3 months at Dumoga, the sidetrip was a reasonable diversion. During Oct 1985 one group made the Poniki trip, and from their reports upon returning, it seemed to have been quite exciting. There were stories of giant leeches and grueling uphill climbs on slippery mud, as well as a cold summit camp. Most interesting of the reports was the startling of a mountain buffalo or anoa (*Bubalus quarlesi*), which proceeded to charge full speed downhill at the trekkers, upon being discovered in the bushes. Anoas are native wild cattle, mostly black in color, about the size of a small water buffalo. Fortunately, the bull did not hit anyone but the trekkers did have a wild time jumping out of the bull's way. They also luckily did not come across any of the babirusa (*Babyrousa babyrussa*) wild pigs with their huge tusks.

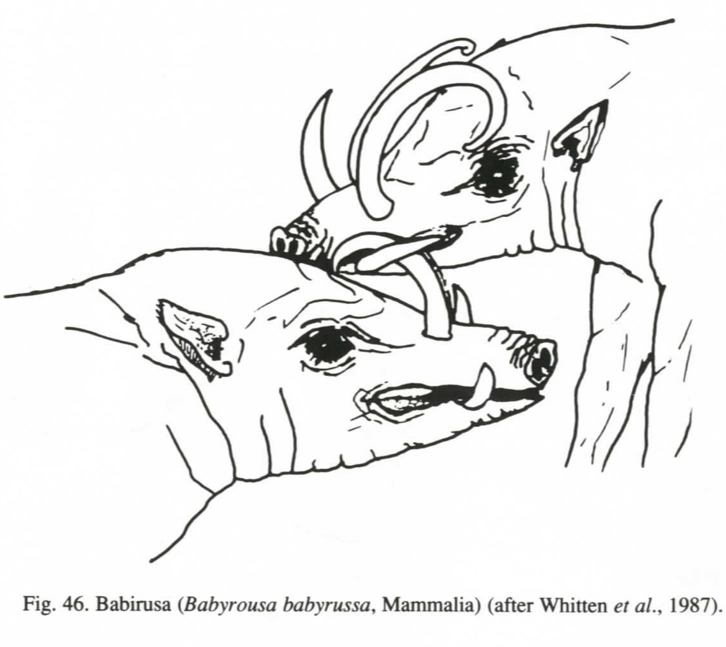

Fig. 46. Babirusa (*Babyrousa babyrussa*, Mammalia) (after Whitten *et al.*, 1987).

Table 1. Summary of Minahasa Peninsula Lepidoptera*

Family	Dumoga-Bone N. P.	Lake Mooat	Total Sp.
Adelidae	1	1	2
Tineidae	113	1	114
Psychidae	13	5	18
Lyonetiidae	1	--	1
Gracillariidae	49	--	49
Oecophoridae	26	--	26
Lecithoceridae	23	--	23
Blastobasidae	1	1	2
Coleophoridae	13	--	13
Momphidae	2	--	2
Cosmopterigidae	81	3	84
Gelechiidae	64	4	68
Copromorphidae	1	1	2
Carposinidae	--	1	1
Alucitidae	5	--	5
Glyphipterigidae	4	3	7
Plutellidae	1	1	2
Yponomeutidae	5	--	5
Argyresthiidae	--	1	1
Immidae	10	--	10
Thyrididae	14	2	16
Pyralidae	489	52	541
Pterophoridae	14	4	18
Choreutidae	13	--	13
Zygaenidae	1	--	1
Cossidae	15	--	15
Epipyropidae	1	--	1
Limacodidae	40	3	43
MICROLEPIDOPTERA	1,106	102	1,208
Callidulidae	1	--	1
Uraniidae	2	--	2
Epiplemidae	17	1	18
Geometridae	180	28	208
Thyatiridae	1	--	1
Drepanidae	12	--	12
Bombycidae	8	--	8
Lasiocampidae	5	--	5
Saturniidae	3	1	4
Sphingidae	13	1	14
Notodontidae	47	1	48
Lymantriidae	81	9	90
Arctiidae	131	17	148
Noctuidae	437	61	498
MACROLEPIDOPTERA	938	119	1,057
Butterflies	200	?	200
MINAHASA TOTAL	2,244	221	2,465

* Totals for Lake Mooat (Gunung Ambang N. F.) are only for locally endemic species not found at Dumoga-Bone N. P.

Well, all kidding aside, the expedition was a great scientific success. I have not seen any estimate of the total number of specimens collected by all participants for the year-long expedition, but it must be several millions, something which will keep taxonomists busy for many years. My own collecting resulted in several thousand Lepidoptera specimens, and uncounted thousands of smaller insects in alcohol samples saved from trap collecting.

A summary report on my survey results during Oct 1985 already has been presented in a previous paper (Heppner, 1989). Moth specimens from my own collecting resulted in a finding of 2,044 species, with another 221 other species from a nearby highland lake area, Lake Mooat, giving a total for the Minahasa areas surveyed of 2,265 moth species (see Table 1). All the findings for butterflies from my own work and that of others, particularly the work of R. Vane-Wright, London, resulted in a total of about 200 butterfly species for the area (over 450 butterfly species are known for all of Sulawesi). Even for butterflies the overall results seem low when compared to such an area as Rondonia, Brazil (Emmel and Austin, 1990), but many more of the Minahasa species are endemics. The moths follow the pattern of tropical diversity, with high endemics for Minahasa, and with the usual three dominant families in the tropics: Pyralidae (541 sp.), Noctuidae (498 sp.), and Geometridae (208 sp.) making up nearly half of the total (Heppner, 1989). Clearly, one month of intensive daily survey work could only discover a portion of the species that actually are present in Minahasa, perhaps over 5,000 species, yet the yearlong total came to about the same conclusion (Holloway, pers. comm.) as for my own month-long survey.

ACKNOWLEDGMENTS

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