DAVIS EXPEDITION FUND
REPORT ON

An expedition to Sulawesi, Indonesia, to collect wild gingers
January—March 2009

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Acknowledgements

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Figure 1. *Rice field, home garden and limestone cliffs at Bantimurung National Park.*

1. Overview

Expedition Title: Gingers of Sulawesi.

Travel Dates: Arrived in Indonesia on 3 January and left on 4 March 2009 (returned to Scotland on 30 March 2009).

Location: Sulawesi, Indonesia. Collections were made at several localities in five of the island's six provinces. The most distant localities were 877 km apart.

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Figure 2. *Marlina Ardiyani, Axel Dalberg Poulsen and Firdaus (from Herbarium Celebense, Palu).*

Aims:

- To document all species in the order Zingiberales in Sulawesi using standard herbarium techniques
- To focus on the ginger genus *Etlingera* for which a revision of Sulawesi species is in process
- To recollect material from type localities of species of which the types have been lost
- To train Indonesian botanists or students in collecting gingers in Sulawesi
- To transfer live material to botanic gardens for research and interpretation
- To publish taxonomic, ethnobotanical and conservation related information on ginger species

Research Permit and visa: Based at Herbarium Bogoriense, permits were sorted out in Jakarta 5–7 January 2009. The research permit was issued by the Ministry of Research and Technology (0002/FRP/SM/I/2009, valid for 60 days); the residenceship by Immigration in Bogor (KITAS 2C13AB0001-H, valid for 60 days). Letters from the Police, Ministry for Internal Affairs, and Forestry were obtained in the same period.

Days in Sulawesi: The principal investigator spent 49 days in Sulawesi of the 60 days permitted on the current visa for Indonesia.

2. Introduction

The plant family Zingiberaceae is an ecologically important component of the forest understorey in tropical rain forests. Many species are useful as food or medicine or have a potential as ornamentals; especially in SE Asia that harbours the highest diversity. Despite their abundance, few collections have been made because gingers are difficult to collect —they are often bulky and their flowers are short-lived and delicate. The paucity of good collections has led to neglect of the study of ginger taxonomy and distribution. Thus it is too early even to give a reliable estimate for the number of species in Indonesia, let alone for islands like Sumatra or Sulawesi.

The island of Sulawesi has a surface area of c. 175,000 km^2, and the highest mountain reaches 3440 m. Sulawesi is situated in the biogeographically interesting area called Wallacea which has a complicated geological historybecause it is the border region between two tectonic plates. About 30% of Wallacea's plant species are endemic (van Welzen et al. 2005). Due to under collecting, this number is likely to be higher. The number is in any case surprisingly high as Wallacea only appeared above sea level in the last 10–20 mill years (Hall 1998).

Collecting DNA samples of a group of organisms which is distributed on both sides of Wallacea, may elucidate the importance of this barrier to the evolution of organisms as well as when a radiation of species may have happened.

3. Aims and objectives of the expedition

The expedition reported on here is the sixth conducted by Axel Dalberg Poulsen in Indonesia; the first one took place in 2003 and all share the overall aim of exploring the poorly known ginger flora in Indonesia, one of the world's the most species rich countries with the ultimate aim of increasing public awareness and understanding of this natural resource.

The immediate objectives are to:

1) document the species of the ginger order in Sulawesi but especially
    a. on the ginger genus *Etlingera* for which a revision of Sulawesi species is in process
    b. at the known ginger type localities.
2) train Indonesian botanists, horticulturists or students in collecting and identifying gingers
3) transfer live plant available in botanic gardens of Bogor and Edinburgh in order to
    a. facilitate further studies for scientific purposes (description of new species, counting chromosome numbers, extracting DNA etc)
    b. interpret these highly attractive plants to the public.
4) publish information on species identification, species richness, distribution, and conservation status in internationally accessible publications, such as Flora Malesiana, scientific journals as well as popular books to the public document information on uses if available, but at the same time respect rights to indigenous knowledge.

4. Methods

Plants belonging to the order Zingiberales (in Indonesia including the families Costaceae, Heliconiaceae, Lowiaceae, Marantaceae, Musaceae, and Zingiberaceae) were documented using standard botanical methods for collecting of herbarium material. Each collection consists of dried plants with additional flowers and fruits in alcohol, a silica-dried DNA sample, and comprehensive photographs.

As we were constantly on the move, it was not practical to dry the herbarium material in the field and instead we used the Schweinfurth Method to preserve the collections temporarily with alcohol in newspapers and plastic bags until they, after posting to Bogor, could be dried in press there. Flowers and fruits pickled in the field were transferred to larger containers for storing.

The main focus was placed on gingers in a strict sense (Zingiberaceae) and especially on species of the genera *Etlingera* and *Alpinia*.

Fertile material preserved in spirit is essential for later identification. Field sketches and photographs are also important for identification but the general collector rarely does this which is why most existing collections deposited in herbaria are not very useful. To take live plants back for

cultivation, seeds are much easier to handle than rhizome cuttings. Seeds also ensure a much higher survival rate per collection made.

5. Itinerary and areas covered

A list of prioritized localities was made based on old collections including types. It had especially high priority to collect at the type localities where Sarasin, Warburg or Beccari had collected in the 19th century; collections that were the basis for Schumann's work (1899, 1904).

After spending Christmas and New Year in Denmark, I arrived in Jakarta on 4 January. The processing of all the necessarily letters and permits in Jakarta was completed exceptionally fast so Marlina Ardiyani and I could travel to Sulawesi on 11 January starting in Palu.

We spent 7 weeks in Sulawesi and used a combination of domestic planes and rental cars to move around. During the 7 weeks in Sulawesi we made collections in five provinces and at nine general areas (Fig. 3), the most distant localities being 877 km apart. The elevation of the collection ranged from 20 m to 2950 m and several vegetation types were encountered.

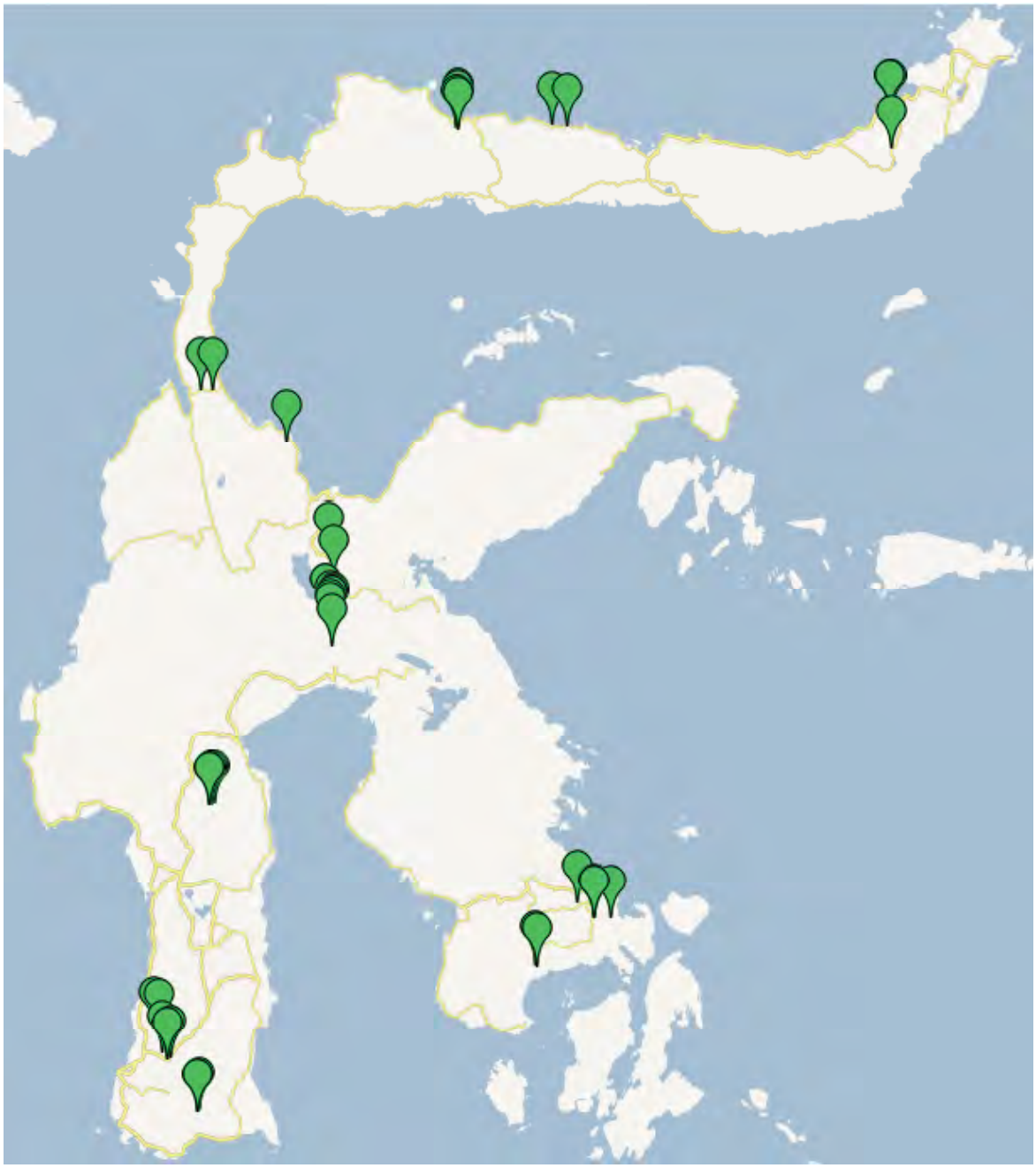

Figure 3. *Map of Sulawesi indicating sites where gingers were collected during fieldwork in January–February 2009. The most distant localities are 877 km apart (Google Maps).*

Some of the collections were just made along the road where some reasonable intact vegetation was still to be found. In the Latimojong Mountains, we took tarpaulins to the forest and camped there several days. At the national parks, we stayed in their guesthouses and walked from there. At Rantemario, Buol and Boyong, we stayed in private homes in villages nearest to the forest locality. To process collecting or export permits, we always had to visit the provincial capitals and there we stayed in hotels.

Marlina Ardiyani had to return on 16 February, whereas I continued and made the last collection in North Sulawesi (the northernmost marker in Fig. 3) on 25 February. I returned to Bogor on 28 February to process the collections and left Indonesia on 4 March. The permits for exporting seeds were immediately processed. The herbarium material was posted to Edinburgh later in March 2009 and arrived safely, whereas the live plant export was delayed for 2 months.

6. Immediate results

In total, 89 herbarium collections of gingers (see Appendix 4) were made on this trip from five provinces. It appears the collecting period for gingers in Sulawesi was well timed. The collections include very important material relevant for the ongoing revision of *Etlingera* of which a total of 37 species were made in Sulawesi underlining the richness of this genus there. It is striking that only one of the species of *Etlingera* known from Sulawesi also occurs on the neighbouring island of Borneo (Poulsen 2006) on the other side of Wallace's Line, underlining the importance of this biogeographical barrier. This also demonstrated the uniqueness of Sulawesi gingers though some species may turn out to be shared with Philippines, Moluccas or New Guinea to the north or east.

Other ginger genera were also collected including several new species of *Alpinia* (e.g. Fig. 10) and new generic records of *Plagiostachys* (Fig. 15) and *Elettaria*. We may have discovered a new species of *Globba* from Bantimurung National Park (Fig. 14), only the second species of *Globba* to be recorded from Sulawesi. The plant was not found in flower but rhizomes were immediately transferred and planted at Bogor Botanic Garden, and arrived in the greenhouses of The Royal Botanic Garden Edinburgh on 14 May 2009. These plants will hopefully flower later, so it will be possible to confirm the identity of the species.

As usual, the first set of the collections was deposited with Herbarium Bogoriense (BO); additional sets will be distributed by RBGE to other herbaria including AAU, CEB, E, SING.

Whenever possible we also collected local names and information on uses. *Ketimbang* is one of the most widely used local names for species of the genus *Etlingera* and most informants would describe their fruits as edible and sought after.

Seeds were exported with full permit on 4 March whereas there was a difficulty with the live rhizomes, for which were only given export permission two months later. Luckily, the horticulturists in Bogor Botanical Garden were in the meantime able to ensure their survival.

Plants of families other than those in the order Zingiberales, were collected on the number series of the counterpart, Marlina Ardiyani (Appendix 5). These were mainly from families of special interest to Herbarium Bogoriense or the RBGE, such as Balsaminaceae, Begoniaceae, Gesneriaceae, and Piperaceae — a total of 20 collections. Marlina has a special interest in the ginger genus *Curcuma* and collected several additional rhizomes back to Java for further propagation and studies. Later rhizomes of these plants may be distributed to Edinburgh.

Expected scientific outputs

The material collected will be fundamental to the successful completion of "*Etlingera* of Sulawesi" a project sponsored by The Sibbald Trust at the RBGE. The resulting book due in March 2010 will be of potential interest to botanists, anthropologists, horticulturists and others.

I have been invited as an open plenary speaker at the 5th International Symposium on the family Zingiberaceae, 6–9 July 2009, Xishuangbanna Tropical Botanical Garden, Yunnan, China. My presentation is entitled: "*Etlingera* of Sulawesi: species richness, distribution and conservation status" and will to a large extent be based on material collected in the recent expedition.

Figure 4. *Julianus Kinho from Manado Forestry Research Institute (right) and our driver and field assistant Tinus Sandaling coming down from Lolombulan Mountain the last day of collecting.*

An analysis of the DNA sequences from the present expedition combined with those from previous will contribute to our understanding of Wallacea for the evolution of gingers. The molecular analyses are currently taking place and the first results will be presented at the Southeast Asian Gateway Evolution (SAGE), 14–17 September 2009, Royal Holloway University, London, where I will give a presentation entitled 'The ginger genus *Etlingera* and Wallace's Line'. The meeting is international and multidisciplinary focusing on the geological history of Southeast Asian and biological diversity (past, present and future).

The collections of *Alpinia* (herbarium and DNA) are an important component of two current MSc projects by Yessi Santika in Bogor and Nicky Sharp at The Royal Botanic Garden Edinburgh. The projects are also likely to result in publications.

Benefits to Indonesian counterparts

Collections. The material collected during the fieldwork often represented the first proper documentation and is thus valuable for the herbarium collection. Following the regulations, the first set is deposited at Herbarium Bogoriense. Spare duplicates will also be deposited at the Herbarium Celebense in Palu to enable more easy access to botanists in Sulawesi.

Training aspects and capacity building: The staff and student from the Herbarium BO Marlina Ardiyani and Yessi Santika, staff from CEB (Palu) Mr Firdaus, Iqbal and other staff from Bantimurung NP, the students Gufrin and Agus Chahyadi from Haluoleo University and Julianus Kinho from the Manado Forestry Research Institute received informal training in collecting, and identification of Zingiberales in the field and Gufrin was sponsored to go to Herbarium Bogoriensis for training in drying, mounting, and curation of gingers.

Figure 5. *Axel teaching Gufrin, a biology student from Haluoleo University in Kendari, how to make a perfect ginger collection. Photograph: Marlina Ardiyani.*

At Haluoleo University we helped Dr I. Sahidin establishing a herb garden in the campus arboretum which contains many useful gingers. We checked the identification of species and Agus Chahyadi collected rhizomes simultaneous with all our collections made in the Southeast Province for future propagation in the herb garden and extraction of chemical compounds at Haluoleo.

Information of distribution of gingers: New records have been obtained for species of Zingiberaceae in Sulawesi. Several species new to science are likely to have been discovered but the literature and type material need to be consulted before this can be confirmed and followed up with the necessary publications. Some of these publications will be done jointly with Indonesian collaborators.

Presentations and public awareness: Seminar at Herbarium Bogoriense, Cibinong Science Centre, Jawa, 4 March 2009 entitled "*Etlingera* of Sulawesi" attended by about 50 people.

During the expedition, it was possible to follow every move of the expedition online: at every new collection locality, the longitude and latitude was texted to Europe and the new site uploaded on an interactive Google Map link visible on my home page: http://dalbergpoulsen.com/

7. Problems encountered

Itinerary: The initial plan of starting in Manado and finishing in Kendari, driving all the way had to be abandoned for two reasons:

1. Soon after arriving in Indonesia, we learned that, because of heavy rain, bridges had been washed away in the Western Province. Thus it was not possible to drive that way from Palu to Makassar. Luckily, the sites identified for ginger exploration in that province were of low priority.
2. The local counterpart from Manado, Theogives Lasut was supposed to have completed his PhD viva in November 2008 but when I left Indonesia in March 2009, his supervisors still had not agreed to the date for his viva. All this time he was on stand by and not able to join the field trip. Because Theo's presence was most desirable at Manado, we left that to the end of the trip.

Figure 6. *A difficult bit of road on the way to Buol.*

On the other hand it was not practical to do the route in reverse order starting in Kendari, as it would take too long until we would come across high priority sites. As a consequence we chose to

start in Palu where I could use the same field assistant and driver as last year and go to the high priority locality at Takulekayu. It also turned out to be more practical to fly to the provincial capital to process local permit letters before driving to the field sites in that province.

Before reaching Manado, I had been contacted by Julianus Kinho, a very interested and dedicated employee of the Manado Forestry Research Institute, who joined me in the northern localities and was a fine replacement of Theo.

Weather: The weather was generally worse than I have ever encountered in the tropics in my 20 years working there. While at Lombobatang there were continuous hurricane conditions the entire time. It was still possible to do the collection but much more difficult than normal. Also, as mentioned above, the plentiful rain resulted in landslides or flooded roads at three occasions though we were lucky and got through with only minor delays.

Permit processing: Whereas all processing of permits in Java went really smoothly, a few problems were encountered with the local BKSDA, especially in Kendari where they refused to give access to the Peninsula SE of Kendari just because I had not stated the exact name Tanjung Teropa. The director even refused to see us about it. This kind of attitude just results in data on rare species important for conservation not being collected at all.

After collecting in adjacent areas we did visit the reserve and saw no species of gingers that had not been documented already, so, the obstacle to access turned out to be of no consequence.

Export of ginger rhizomes: It went smooth to get the certificate to export the seed samples after leaving half at Bogor Botanic Garden. The plan was to include a few of the most important rhizome samples with the shipment of Papuan plants to RBGE by Louise Galloway and her team. Unfortunately, the processing of her export permit did not go as smoothly as mine. The reason why I did not just take the rhizomes myself was that I was staying two weeks in Asia and one week in Denmark on annual leave before travelling back to Edinburgh which the rhizomes would not have survived. On 14 May 2009, however, all plants arrived safely in Edinburgh.

Habitat of gingers: In Sulawesi, the natural forest habitat is under great threat in many places due to change of land use. It is obvious that the diversity of gingers (and other organisms) is larger than initially thought. As several species have very restricted range, it becomes also more important to conserve their natural habitats.

8. Recommendations

During our visit to the Reserve of Tanjung Teropa on the Peninsula SE of Kendari we were not allowed to collect anything but we saw several species of interesting *Begonia* and Gesneriaceae that could be targeted in a later expedition. It also appears that the mountain range along the north-facing coast of Central Sulawesi and Gorontalo would be an interesting area to explore.

We were very successful in finding gingers at Lolombulan Mountain near the village of Boyong Atas in North Sulawesi. This general locality was visited in September 1888 by the German botanist Otto Warburg, who collected several new species. Many of his collections became types but several were unfortunately destroyed in the Second World War. It is, however, a consolation that the type locality is still in such good condition which is entirely because it is protected by the local community. The search for neotype material of species collected by Warburg at Boyong is therefore likely to be successful.

Regarding the problems mentioned on permit processing, the forest department in Indonesia should develop a more positive attitude towards visiting scientists who are in fact trying to help and the resulting information of research could be crucial to management of natural resources in Indonesia. It would be a great help in the planning process of the foreign researcher to have **online access to a map of the conservation areas of Indonesia**, so that all areas of status can be correctly named in the locality list that is being submitted to RISTEK and later to the Forest Department.

More areas in Sulawesi should be conserved and agriculture discouraged on steep slopes. In my obligatory report to the Indonesian authorities, this as well as the need for an online conservation map has been pointed out.

9. Outcome summary and conclusions

The expedition resulted in 89 herbarium collections of outstanding quality. All flowers and fruits were pickled, DNA sampled, and the main sets are deposited at Herbarium Bogoriense and the Royal Botanic Garden Edinburgh with additional sets intended for Denmark, Singapore and Sulawesi herbaria. The collections will be useful in ongoing and future studies on Sulawesi gingers. Several of them represent new species and will underline the unique ginger flora of Sulawesi.

In addition, live plants have been exported as seeds and rhizome to the botanic gardens in Bogor and Edinburgh where they will be of similar value for taxonomic studies but also of great horticultural importance and a potential source of enjoyment to the visiting public when flowering. Additional collections of interest to the collaborating institutions were made of non-ginger families.

The counterpart, Marlina Ardiyani, was in charge of collecting non-gingers which will be important for ongoing taxonomic or phylogenetic studies.

The expedition also included in-service training of students and staff from several institutions in Indonesia. The follow-up presently taking place in Edinburgh on the live material is an ongoing part of training and capacity building in horticultural skills.

Even though several challenges were encountered, these problems were mostly overcome and most of the localities with high priority were visited. The work to secure scientific outputs is ongoing and the new material collected during the expedition will form a significant contribution to their contents. In conclusion, the expedition was a great success.

10. Literature cited

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Schumann, K.M. 1904. Zingiberaceae. In A. Engler, *Das Pflanzenreich IV*. **46**: 1–458.

van Welzen, P.C., Slik, J.W.F & Alahuhta, J. 2005. Plant distribution patterns and plate tectonics in Malesia. *Biologiske Skrifter* ***55***: 199–217.

Figure 7. *Marlina Ardiyani holding two shoots of* Cheilocostus sopuensis *(Poulsen et al. 2736).*

Figure 8. Alpinia aenea *from Karangan near the type locality (Poulsen et al. 2769).*

Figure 9. Alpinia aenea *from Karangan (2769); close-up of flowers.*

Figure 10. *A new species of* Alpinia *from Lombobatang (Poulsen et al. 2783).*

Figure 11. Alpinia eubratea *from the type locality at Takulekayu (Poulsen et al. 2739).*

Figure 12. Alpinia melichroa *from SE Sulawesi (Poulsen et al. 2767).*

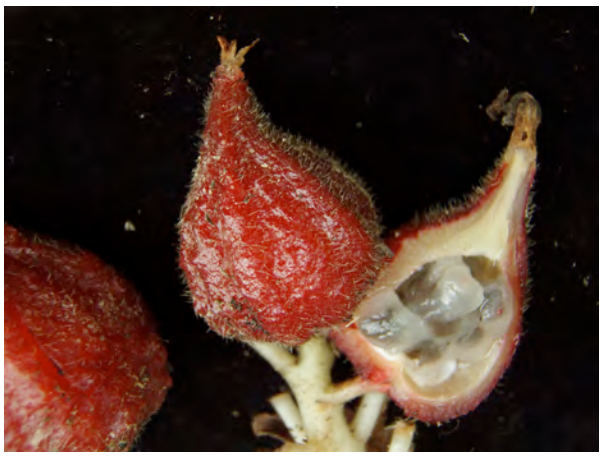

Figure 13. Alpinia melichroa *from SE Sulawesi (Poulsen et al. 2767).*

Figure 14. Globba *sp*. — A new record to Sulawesi *(Poulsen et al. 2767).*

Figure 15. Plagiostachys *sp. from Takulekayu (Poulsen et al. 2751).*

Figure 16. Phrynium longispicum *(Marantaceae) from Central Sulawesi (Poulsen et al. 2810).*

Figure 17. Rhododendron lagunculicarpum *from elfin forest at Rantemario (Marlina Ardiyani et al. 167).*

Appendix 1. List of the 89 herbarium collections by Poulsen et al. made during the ginger survey in Sulawesi 2009. First set of all are deposited at BO (Herbarium Bogoriense, Java) and duplicates distributed to Aarhus (Denmark), Edinburgh (Scotland), Palu (Sulawesi) and Singapore.

No.	Family	Species
2734	Zingiberaceae	Etlingera rosea B.L. Burtt & R.M. Sm.
2735	Zingiberaceae	Amomum
2736	Costaceae	Cheilocostus sopuensis (Maas & H. Maas) C.D. Specht
2737	Zingiberaceae	Etlingera
2738	Zingiberaceae	Elettaria
2739	Zingiberaceae	Alpinia eubractea K. Schum.
2740	Zingiberaceae	Etlingera
2741	Zingiberaceae	Etlingera
2742	Zingiberaceae	Etlingera
2743	Zingiberaceae	Etlingera
2744	Zingiberaceae	Etlingera
2745	Zingiberaceae	Etlingera
2746	Zingiberaceae	Alpinia
2747	Zingiberaceae	Alpinia
2748	Zingiberaceae	Etlingera
2749	Zingiberaceae	Etlingera
2750	Zingiberaceae	Elettaria
2751	Zingiberaceae	Plagiostachys
2752	Zingiberaceae	Etlingera
2753	Zingiberaceae	Etlingera
2754	Zingiberaceae	Amomum
2755	Zingiberaceae	Etlingera
2756	Zingiberaceae	Etlingera
2757	Zingiberaceae	Etlingera
2758	Zingiberaceae	Alpinia celebica K. Schum.
2759	Zingiberaceae	Alpinia monopleura K. Schum.
2760	Marantaceae	Donax canniformis (G. Forst.) K. Schum.
2761	Zingiberaceae	Zingiber zerumbet (L.) Sm.
2762	Zingiberaceae	Etlingera
2763	Zingiberaceae	Curcuma
2764	Zingiberaceae	Alpinia monopleura K. Schum.
2765	Zingiberaceae	Curcuma
2766	Zingiberaceae	Boesenbergia rotunda (L.) Mansf.
2767	Zingiberaceae	Globba
2768	Zingiberaceae	Etlingera
2769	Zingiberaceae	Alpinia aenea K. Schum.
2770	Zingiberaceae	Alpinia
2771	Zingiberaceae	Alpinia
2772	Zingiberaceae	Alpinia
2773	Zingiberaceae	Alpinia
2774	Zingiberaceae	Etlingera
2775	Zingiberaceae	Etlingera
2776	Zingiberaceae	Etlingera
2777	Zingiberaceae	Alpinia
2778	Zingiberaceae	Alpinia
2779	Zingiberaceae	Alpinia

2780	Zingiberaceae	Alpinia
2781	Zingiberaceae	Etlingera
2782	Zingiberaceae	Etlingera
2783	Zingiberaceae	Alpinia
2784	Zingiberaceae	Etlingera
2785	Zingiberaceae	Etlingera
2786	Zingiberaceae	Alpinia
2787	Zingiberaceae	Alpinia monopleura K. Schum.
2788	Zingiberaceae	Alpinia
2789	Zingiberaceae	Etlingera
2790	Zingiberaceae	Elettaria
2791	Marantaceae	Phrynium pubinerve Blume
2792	Zingiberaceae	Alpinia eremochlamys K. Schum. vel aff.
2793	Zingiberaceae	Etlingera
2794	Zingiberaceae	Alpinia
2795	Zingiberaceae	Etlingera
2796	Zingiberaceae	Alpinia
2797	Marantaceae	Stachyphrynium repens (Körn.) Suksathan & Borchs.
2798	Zingiberaceae	Amomum
2799	Zingiberaceae	Etlingera
2800	Zingiberaceae	Hedychium coronarium J. König
2801	Zingiberaceae	Etlingera
2802	Zingiberaceae	Etlingera
2803	Zingiberaceae	Alpinia
2804	Zingiberaceae	Amomum
2805	Marantaceae	Stachyphrynium latifolium (Blume) K. Schum.
2806	Zingiberaceae	Etlingera
2807	Zingiberaceae	Etlingera elatior (Jack) R.M. Sm.
2808	Zingiberaceae	Etlingera
2809	Zingiberaceae	Alpinia musifolia Ridl.
2810	Marantaceae	Phrynium longispicum (Warb. ex K. Schum.) Suksathan & Borchs.
2811	Zingiberaceae	Elettaria
2812	Zingiberaceae	Etlingera
2813	Zingiberaceae	Etlingera
2814	Zingiberaceae	Alpinia warburgii K. Schum.
2815	Marantaceae	Phrynium longispicum (Warb. ex K. Schum.) Suksathan & Borchs.
2816	Zingiberaceae	Amomum
2817	Zingiberaceae	Etlingera rosea B.L. Burtt & R.M. Sm.
2818	Zingiberaceae	Alpinia monopleura K. Schum.
2819	Zingiberaceae	Alpinia rubricaulis K. Schum.
2820	Zingiberaceae	Etlingera
2821	Zingiberaceae	Alpinia eremochlamys K. Schum.
2822	Zingiberaceae	Etlingera heliconiifolia (K. Schum.) A.D. Poulsen

Appendix 2. The 31 herbarium collections by Marlina Ardiyani et al. made during the ginger survey in Sulawesi 2009. Species of the genus *Curcuma* was collected by Marlina Ardiyani rather than Poulsen in cases where the collection was going to be a unicate and thus had to be deposited at BO. In other cases the duplicates were distributed to Aarhus (Denmark), Edinburgh (Scotland), Palu (Sulawesi) and Singapore.

No.	Family	Species
150	Begoniaceae	Begonia
151	Dioscoreaceae	Tacca palmatifida Baker
152	Begoniaceae	Begonia
153	Urticaceae	Elatostema
154	Urticaceae	Elatostema
155	Balsaminaceae	Impatiens platypetala
156	Urticaceae	Pilea?
157	Ericaceae	Rhododendron seranicum J.J. Sm.
158	Zingiberaceae	Curcuma aurantiaca
159	Gesneriaceae	Epithema
160	Lentibulariaceae	Utricularia striatula Sm. vel aff.
161	Balsaminaceae	Impatiens
162	Piperaceae	Peperomia
163	Gesneriaceae	Agalmyla
164	Begoniaceae	Begonia
165	Gesneriaceae	Cyrtandra
166	Melastomataceae	Sonerila
167	Ericaceae	Rhododendron lagunculicarpum J.J. Sm.
168	Zingiberaceae	Curcuma
169	Zingiberaceae	Curcuma zanthorrhiza
170	Zingiberaceae	Curcuma brog cf.
171	Zingiberaceae	Curcuma phaeocaulis
172	Zingiberaceae	Curcuma aurantiaca
173	Zingiberaceae	Curcuma longa
174	Zingiberaceae	Curcuma
175	Zingiberaceae	Hedychium
176	Zingiberaceae	Curcuma longa
177	Piperaceae	Piper
178	Zingiberaceae	Curcuma euchroma cf.
179	Zingiberaceae	Curcuma viridiflora cf.

Appendix 3. Final budget of ginger expedition to Sulawesi 2009. DKK = Danish kroner; GBP = Pound Sterling (£); IDR = Indonesian rupiah.

FUNDING AGENTS	Applied for	Granted		GBP
Augustinus (Denmark)	105,000.00	20,000.00	DKK	**2,421.07**
Blaxall Valentine Awards (England)*	4,430.00	2,000.00	GBP	**2,000.00**
Davis Expedition Fund (Scotland)	2,430.00	3,500.00	GBP	**3,500.00**
*Royal Horticultural Society Bursaries		**TOTAL FUNDING:**		**7,921.07**

OVERVIEW OF EXPENSES

CATEGORY	GBP
Accommodation	**841.43**
Assistants	**692.38**
Communication	**45.01**
Equipment	**571.97**
Permits	**156.98**
Per diem, Axel Dalberg Poulsen	**1,010.00**
Per diem, Indonesian (Marlina Ardiyani)	**1,110.00**
Shipping	**794.30**
Transport, in Indonesia	**1,371.41**
Transport, outside Indonesia	**1,868.74**
TOTAL EXPENSES:	**8,462.23**
BALANCE:	**-541.16**

Exchange rates were calculated based on actual credit card transactions of payment or ATM cash withdrawals using one of three Danish cards or a Scottish one. Fees per transaction varied 0–6 GBP depending on card and type of transaction and were included in the rate calculation below:

100 DKK = 12.105355 GBP
100 IDR = 0.006243 GBP

Comments to the final budget

The initial total budget of 8,310 GBP was not far from the actual. Some categories overshot the actual costs because:

1. No inoculations were required and stock of medicine was sufficient.
2. Insurance was covered by RBGE.
3. A satellite phone was not rented because the costs had gone up dramatically. This was considered not a serious breach of health and safety as we could mostly use normal mobiles.
4. Estimated costs for counterpart per diem were reduced dramatically because: Marlina only went to the field for 37 days and Theogives could not come at all. Because of that, c. 1,400 GBP were saved.
5. The official Danish rate of per diem is 450 DKK = 55 GBP but I claim here a less than despite the fact that I usually spent my allowance also to cover the undocumented expenses of food and transport of my companions, drivers and assistants.

The initial budget underestimated the actual costs because:

1. The Pound Sterling (GBP) seriously lost its strength against other relevant currencies.
2. The price of the flight out of Copenhagen just after New Year was higher than expected.

The budget for the application to Augustinus in 2007 was higher because it also proposed to include exploration in New Guinea. The budget to the RHS included 2,000 GBP to be self-sponsored. The Davis Expedition Fund decided to meet my application with 1070 GBP more than I applied for because they thought it unreasonable that I should fund myself. Due to this exceptional generosity, as well as for the reasons explained in points 1–4 above, the deficit is limited to 541 GBP.

Axel Dalberg Poulsen, Edinburgh, 1 May 2009.

Appendix 4. Complete breakdown of expenses of ginger expedition to Sulawesi 2009. Items sorted by date and receipts numbered accordingly.

No.	Category	Date	Item	Value	Currency	GBP
1	Shipping	13Nov	Posting Edinburgh–Indonesian Embassy	10.05	GBP	**10.05**
2	Permits	19Nov	Visa for Indonesia	50.00	GBP	**50.00**
3	Equipment	20Nov	Drawing paper	27.85	GBP	**27.85**
4	Equipment	18Dec	Slide film	54.50	GBP	**54.50**
5	Equipment	18Dec	Camera battery and casing	48.93	GBP	**48.93**
6	Equipment	18Dec	Slide film	68.47	GBP	**68.47**
7	Transport, out	19Dec	Flight Edinburgh–Billund	58.50	GBP	**58.50**
8	Transport, out	19Dec	Taxi Botanics to Edinburgh Airport	20.00	GBP	**20.00**
9	Equipment	29Dec	Pruner	89.95	DKK	**10.89**
10	Transport, out	03Jan	Flight Copenhagen–Jakarta	13,948.00	DKK	**1,688.45**
11	Communication	04Jan	Credit talk time	122,000.00	IDR	**7.62**
12	Equipment	05Jan	Trousers	207,200.00	IDR	**12.94**
13	Permits	05Jan	Research permit	572,500.00	IDR	**35.74**
14	Permits	05Jan	Travel letter from Police	50,000.00	IDR	**3.12**
15	Transport	05Jan	Taxi around Jakarta	115,000.00	IDR	**7.18**
16	Permits	07Jan	KITAS (processing of residenceship)	850,000.00	IDR	**53.07**
17	Equipment	08Jan	Field gear	615,940.00	IDR	**38.45**
18	Transport	08Jan	Flights Jakarta–Palu, 2 PAX	2,097,080.00	IDR	**130.92**
19	Communication	09Jan	Credit talk time	99,000.00	IDR	**6.18**
20	Permits	09Jan	Passport photographs	51,000.00	IDR	**3.18**
21	Equipment	10Jan	Plastic bags	230,000.00	IDR	**14.36**
22	Equipment	10Jan	Silica gel	80,000.00	IDR	**4.99**
23	Accommodation	11Jan	Mirah Sartika Hotel, 7 days	1,294,216.00	IDR	**80.80**
24	Transport	11Jan	Excess luggage	165,000.00	IDR	**10.30**
25	Assistants	12Jan	Food for field assistants	279,287.00	IDR	**17.44**
26	Equipment	12Jan	Ethanol	100,000.00	IDR	**6.24**
27	Accommodation	13Jan	Hotel Sentral, 2 nights, 1 pax	500,000.00	IDR	**31.22**
28	Accommodation	13Jan	Hotel Sentral, 2 nights, 1 pax	500,000.00	IDR	**31.22**
29	Transport	13Jan	Fuel	220,015.00	IDR	**13.74**
30	Transport	14Jan	Fuel	100,000.00	IDR	**6.24**
31	Accommodation	15Jan	Guest House, Pamona Indah, 2 N, 4 pax	510,000.00	IDR	**31.84**
32	Transport	15Jan	Fuel	100,000.00	IDR	**6.24**
33	Equipment	17Jan	Tarps	410,000.00	IDR	**25.60**
34	Accommodation	18Jan	Guest House, Melati Indah, 4 night, 4 pax	495,000.00	IDR	**30.90**
35	Transport	18Jan	Fuel	150,000.00	IDR	**9.36**
36	Shipping	19Jan	Posting specimens Palu–Bogor	754,000.00	IDR	**47.07**
37	Transport	19Jan	Rental car, Palu–Poso, 7 days	2,275,000.00	IDR	**142.03**
38	Accommodation	20Jan	Hotel Sentral, 2 nights, 1 pax	500,000.00	IDR	**31.22**
39	Accommodation	20Jan	Hotel Sentral, 2 nights, 1 pax	500,000.00	IDR	**31.22**
40	Transport	20Jan	Flights Palu–Makassar, 3 pax of 319000	957,000.00	IDR	**59.75**
41	Accommodation	21Jan	Hotel Darma Nusantara, 1 night, 2 pax	380,000.00	IDR	**23.72**
42	Equipment	21Jan	Ethanol	475,000.00	IDR	**29.66**
43	Transport	21Jan	Taxi, Makassar	410,960.00	IDR	**25.66**
44	Accommodation	22Jan	Hotel Darma Nusantara, 1 night, 2 pax	380,000.00	IDR	**23.72**
45	Permits	22Jan	Entry fee for Bantimurung NP	190,000.00	IDR	**11.86**
46	Transport	24Jan	Rental car, Bantimurng to Leanglonrong	300,000.00	IDR	**18.73**
47	Accommodation	25Jan	Guest House, Bantimurung NP, 3 N 3pax	300,000.00	IDR	**18.73**
48	Assistants	25Jan	Food for field assistants	664,413.00	IDR	**41.48**
49	Equipment	25Jan	Tent	350,000.00	IDR	**21.85**
50	Transport	25Jan	Taxi Bantimurng to Mandai	200,000.00	IDR	**12.49**
51	Accommodation	26Jan	Hotel Darma Nusantara, 2 nights, 2 pax	400,000.00	IDR	**24.97**
52	Transport	26Jan	Rental 4WD Maros–Karangan	1,350,000.00	IDR	**84.28**
53	Assistants	01Feb	Porters and guides, at Karangan	2,150,000.00	IDR	**134.23**

54	Transport	01Feb	Rental car, Rantelemo–Karangan	700,000.00	IDR	**43.70**
55	Assistants	03Feb	Food for field assistants	549,086.00	IDR	**34.28**
56	Equipment	03Feb	Field gear (matress and torch)	170,000.00	IDR	**10.61**
57	Accommodation	05Feb	Hotel Darma Nusantara, 4 nights, 2 pax	1,440,000.00	IDR	**89.90**
58	Transport	05Feb	Fuel	197,820.00	IDR	**12.35**
59	Assistants	08Feb	Field assistants, at Lembangbuneh	300,000.00	IDR	**18.73**
60	Accommodation	09Feb	Hotel Darma Nusantara, 1 night, 2 pax	360,000.00	IDR	**22.48**
61	Assistants	09Feb	Field assistant: Firdaus	2,500,000.00	IDR	**156.08**
62	Shipping	09Feb	Posting specimens Makassar–Bogor	950,000.00	IDR	**59.31**
63	Transport	09Feb	Flights Makassar–Kendari, 2 pax, –Palu 1	820,910.00	IDR	**51.25**
64	Transport	09Feb	Excess luggage	46,200.00	IDR	**2.88**
65	Transport	09Feb	Rental car, 5 days	1,800,000.00	IDR	**112.38**
66	Accommodation	10Feb	Hotel Athaya, 1 night, 1 pax, Axel	425,000.00	IDR	**26.53**
67	Accommodation	10Feb	Hotel Athaya, 1 night, 1 pax, Marlina	425,000.00	IDR	**26.53**
68	Transport	10Feb	Fuel	186,000.00	IDR	**11.61**
69	Equipment	11Feb	Batteries	163,000.00	IDR	**10.18**
70	Equipment	12Feb	Ethanol	137,500.00	IDR	**8.58**
71	Accommodation	13Feb	Hotel Santika Jaya	1,320,000.00	IDR	**82.41**
72	Assistants	14Feb	Field assistants, at Tatangge	550,000.00	IDR	**34.34**
73	Transport	15Feb	Flight Kendari–Makassar, Axel Poulsen	447,780.00	IDR	**27.96**
74	Transport	15Feb	Flights Kendari–Jakarta (MA); –Manado (ADP)	1,555,500.00	IDR	**97.11**
75	Accommodation	16Feb	Hotel Santika Jaya, 2 nights, 2 pax	1,034,000.00	IDR	**64.55**
76	Assistants	16Feb	Field assistants, Kendari	600,000.00	IDR	**37.46**
77	Transport	16Feb	Excess luggage	114,400.00	IDR	**7.14**
78	Transport	16Feb	Rental car, Kendari, 7 days	2,900,000.00	IDR	**181.05**
79	Shipping	16Feb	Posting specimens Kendari–Bogor	463,000.00	IDR	**28.91**
80	Accommodation	17Feb	Mando Bersahati, 2 nights	317,000.00	IDR	**19.79**
81	Communication	17Feb	Credit talk time	200,000.00	IDR	**12.49**
82	Equipment	17Feb	Ethanol	52,750.00	IDR	**3.29**
83	Equipment	17Feb	Batteries	57,500.00	IDR	**3.59**
84	Equipment	17Feb	Leech socks	252,000.00	IDR	**15.73**
85	Transport	17Feb	Fuel	50,000.00	IDR	**3.12**
86	Transport	18Feb	Fuel	150,000.00	IDR	**9.36**
87	Transport	19Feb	Fuel	136,000.00	IDR	**8.49**
88	Accommodation	20Feb	Homestay 1 night	200,000.00	IDR	**12.49**
89	Assistants	22Feb	Field assistants, Bonubogu	460,000.00	IDR	**28.72**
90	Transport	22Feb	Fuel	203,000.00	IDR	**12.67**
91	Accommodation	23Feb	Homestay Bunobogu, 3 nights	450,000.00	IDR	**28.09**
92	Accommodation	24Feb	Hotel Sewa, 1 night	100,000.00	IDR	**6.24**
93	Communication	24Feb	Credit talk time	103,000.00	IDR	**6.43**
94	Transport	24Feb	Flights Manado–Jakarta (Axel)	789,000.00	IDR	**49.26**
95	Transport	25Feb	Fuel	160,000.00	IDR	**9.99**
96	Accommodation	26Feb	Homestay Jimree Lintong, 2 nights	400,000.00	IDR	**24.97**
97	Shipping	26Feb	Posting specimens Manado–Bogor	1,204,000.00	IDR	**75.17**
98	Accommodation	27Feb	Mando Bersahati, 2 nights	444,000.00	IDR	**27.72**
99	Assistants	27Feb	Local counterpart Manado FRI	1,250,000.00	IDR	**78.04**
100	Transport	27Feb	Rental car, 10 days	3,000,000.00	IDR	**187.29**
101	Transport	28Feb	Airport bus x 4	120,000.00	IDR	**7.49**
102	Accommodation	01Mar	Mirah Sartika Hotel, 1 night	200,860.00	IDR	**12.54**
103	Transport	01Mar	Taxi Bogor–Cibinong	150,000.00	IDR	**9.36**
104	Communication	03Mar	Credit talk time	197,000.00	IDR	**12.30**
105	Accommodation	04Mar	Mirah Sartika Hotel, 3 days	602,580.00	IDR	**37.62**
106	Assistants	05Mar	Drying specimens, newspapers, Pak Nardi	387,500.00	IDR	**24.19**
107	Assistants	05Mar	Drying and sorting, 14 days, Yessi Santika	1,400,000.00	IDR	**87.40**
108	Shipping	16Mar	Posting specimens Bogor–Edinburgh	8,700,730.00	IDR	**543.20**
109	Equipment	23Mar	T-shirts, replace loss in field	300.00	DKK	**36.32**
110	Equipment	26Mar	Repair kit for mattress	49.00	DKK	**5.93**

111	Shipping	27Mar	Packing boxes	250,000.00	IDR	**15.61**
112	Transport, out	30Mar	Flight Billund–Edinburgh	315.63	DKK	**38.21**
113	Transport, out	30Mar	Flight Billund–Edinburgh, excess	360.00	DKK	**43.58**
114	Transport, out	30Mar	Taxi Edinburgh Airport to Botanics	20.00	GBP	**20.00**
115	Shipping	06Apr	Posting receipts: Bogor–Edinburgh	240,000.00	IDR	**14.98**
116	Equipment	09Apr	Film processing	113.00	GBP	**113.00**
						6,342.23
	Per diem					
117	M. Ardiyani	37	days of 30 GBP	1,110.00	GBP	**1,110.00**
	A.D. Poulsen	11	days of 25 GBP (Java)	275.00	GBP	**275.00**
	A.D. Poulsen	49	days of 15 GBP (Sulawesi)	735.00	GBP	**735.00**
				2,120.00	**GBP**	**2,120.00**

TOTAL EXPENSES: 8,462.23