

# Malaysian-Dutch expedition unveils the mysteries of Mount Kinabalu

A personal account by Prof. Menno Schilthuizen

*In 2012, a large team of Malaysian and Dutch biodiversity experts collaborated in a joint expedition to the Crocker Range and Mount Kinabalu in Sabah. The expedition aimed to use DNA technology to resolve the question of whether the mountain is a “cradle” or a “last resting place” of unique species.*

Mount Kinabalu, piercing the clouds in the far distance, beyond the cityscape of Kota Kinabalu in Sabah, was one of the first things I saw as the driver from Universiti Malaysia Sabah (UMS) picked me up from the airport and took me to my new home back in January 2000. As a tropical biologist with a long history of research in Malaysia, it was a dream come true. For more than a decade, I had studied Malaysian insects and land snails from my home universities in The Netherlands, spending sometimes a few weeks or months at a time in Malaysia to take samples that I would then process in my Dutch lab. But that roundabout, cumbersome way of doing research, was finally over when I landed a position as an Associate Professor in the Institute for Tropical Biology and Conservation of UMS, and could run my research projects literally in my backyard.



*Everettia layanglayang*, a newly discovered snail species from the summit of Mount Kinabalu. Photo: Menno Schilthuizen.

For seven years I lived and worked there, built up a lab for conservation genetics and a mollusc collection, taught graduate and undergraduate courses in evolution, ecology, and conservation, and ran research projects funded by IRPA<sup>†</sup> and UMS. One of those projects focused on the land snails of Mount Kinabalu—sooner or later any Malaysian biologist will yield to her unique biodiversity. With my students Liew Thor-Seng and Tachaini Narainan, and in collaboration with Dr. Maklarin Lakim of the Research and Education division of Sabah Parks, who manage the state park and World Heritage Site, we surveyed the land snails of the Mountain, finding a grand total of 109 species, many of which were living only at the summit and were completely new to science [1,2].

Another Kinabalu project, which we collaborated with the Sabah Museum, Dr. Mustafa Abd. Rahman of Universiti Malaysia Sarawak (UNIMAS), and Louisiana State University, dealt with the White-Crowned Forktail, an emblematic forest bird, for which

we showed using DNA techniques that the Forktail living on mountaintops (not only on Kinabalu, but also many other tall mountains in Borneo) is a separate species, now known as the Borneo Forktail, *Enicurus borneensis* [3].

Still, paradoxically, it was only after I returned to The Netherlands and began working as a researcher at Naturalis Biodiversity Center in Leiden, that my Kinabalu projects blossomed. “Naturalis” is the new name for the Dutch National Museum of Natural History. Its collections consist of 37 million specimens, including many from Indonesia and other Southeast Asian countries. The Asian focus is also present among the over 100 biologists who work there: many have identified Asia, the global biodiversity hotspot, as their chief interest. Thus, the idea of organising a joint Malaysian-Dutch expedition was born. The team consists of Sabah Parks scientists Maklarin Lakim and Rimi Repin, Naturalis botanists Vincent Merckx and Constantijn Mennes, geneticists Kasper Hendriks

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Two members of the Crocker Range / Kinabalu Expedition sampling *Begonia* plants. Photo: Joris van Alphen

and Lisa Becking, and myself. We set up the Crocker Range/Kinabalu Scientific Expedition that took place in September 2012 and in which some 20 Malaysian and 20 Dutch biodiversity experts participated [4].

The aim of the expedition was not simply to do an inventory of the fauna found in the Crocker Range/Kinabalu region. We had a specific research question, born from the old snail and bird projects I had done at UMS. Many of the species of plants and animals that live on this 4,095 m tall mountain are endemic: they live only there and nowhere else on Earth, and how had they evolved? Some, like the Kinabalu buttercup (*Ranunculus lowii*), had probably blown in from cooler parts of the world, as no other buttercup species live in Borneo's lowlands. But others, such as the gigantic *Nepenthes rajah* pitcher plant or the mountaintop Friendly Bush Warbler (*Locustella accentor*) have related species living in the foothills. The obvious scenario was that they had become geographically isolated and split off as new species as the mountain began rising a few million years ago. However, the opposite would also be possible: that the highland endemics are actually relics from a cooler period, surviving on the summit and having gone extinct elsewhere.

The aim of our expedition was to get a handle on these various evolutionary scenarios using DNA sequences of various organisms. Each expedition member would, from its own favourite group of organisms (birds, stalk-eyed flies, mushrooms, rhododendrons

*etc.*) collect specimens from one or more Kinabalu endemics and several closely related species from the lowlands. To do this, during the expedition, we worked at eight separate stations, from the foot of the mountain to the summit, and including the hills of the neighbouring Crocker Range Park.

Then, our genetics team sprang into action. Being handed more than 4,000 specimens by all expedition members, Kasper Hendriks and Lisa Becking took DNA samples from these specimens and preserved these in ethanol or silica gel, and then ferried all to the Naturalis DNA labs. Here, using a semi-robotic setup, we sequenced the DNA of several genes of all these

samples. These data were then analysed by Kasper Hendriks, who used them to build evolutionary trees that revealed which species were old and which were new. By comparing new and old species, and their respective habitats, we are able to conclude the origins of certain organisms, i.e., whether they have evolved from ancestors living in lowlands or in highlands.

As I write this, we are putting the finishing touches to our analyses, and drafting a joint research paper with all participants as co-authors to be submitted to a major journal. In addition, many of the scientists who participated in the expedition have discovered new species among the specimens they collected, and publications are beginning to appear on the first of these [5].

For the unravelling the scenarios our studies support, I refer the reader to our upcoming papers. But for me personally, the most important result is that so many top-notch biodiversity scientists

from both my native and my adoptive country have joined forces to pull off a unique example of binational biodiversity research in one of the world's most amazing places, Mount Kinabalu in Sabah, Malaysian Borneo.

## REFERENCES

- [1] Liew, T.S., Schilthuizen, M. & bin Lakim, M. (2010). *Journal of Biogeography*, 37:1071-1078.
- [2] Liew, T.S., Schilthuizen, M. & J.J. Vermeulen, J.J. (2009). *Zoological Journal of the Linnean Society*, 157:515-550.
- [3] Moyle, R., Schilthuizen, M. Abdul Rahman, M. & Sheldon, F.H. (2005). *Journal of Avian Biology*, 36:96-101.

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[4] The participants were from Sabah Parks, UMS, Forest Research Centre (Sabah Forestry Dept.), UKM, Naturalis Biodiversity Center, Natuurmuseum Friesland, Wageningen University, and the Royal Belgian Institute of Natural Sciences.

[5] Kappes, H. (2013). *Contributions to Zoology*, 82:185-197.

### ABOUT THE AUTHOR

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### ABOUT MOUNT KINABALU, DID YOU KNOW THAT...



- The mountain is composed of igneous rock formed from magma that solidified below the surface of the Earth 10 million years ago.
- The Kinabalu Park surrounding the mountain has been a UNESCO World Heritage site since 2000.
- With over 5,000 species of plants, it is one of the richest plant regions in the world; It has over 800 species of orchids, over 600 fern species, and 13 species of carnivorous pitcher plants.
- Its rich biodiversity is due to:
  - i) Height of the mountain provides a variety of life zones with different temperature/climate;
  - ii) Past glacial and drought episodes encouraged diversity in plants' evolution;
  - iii) The soils are low in phosphates but high in iron and metals, a toxic combination for many other plants but ideal for Kinabalu's endemic plants.
- Its forest is home to orangutans, one of the world's four great ape extant genera. *Photos from Flickr (CC; top to bottom): Darren Pearce; Moss; Justin Elson.*

