Borneo : a quantitative analysis of botanical richness, endemicity and floristic regions based on herbarium records

Raes, N.

Curriculum Vitae

Niels Raes was born on the 9th of March 1971 in Bladel, the Netherlands. At the age of 1 year he moved with his parents to Hapert, where he attended primary school. At an age of 12 years he went to the Pius X high school in Bladel where he concluded the VWO exam in 1990. The same year he started his study Biology at Utrecht University. In 1995 he had his first opportunity to do fieldwork in the tropics. Together with Menno de Lind van Wijngaarden, and under supervision of Dr. Renske Ek, he studied the impact of selective logging and beta diversity of lianas (climbing plants) in the tropical rain forests of Guyana, South America. In 1998 he obtained his MSc. degree in Tropical Ecology and Tropical Botany.

After his studies, Niels was first a computer teacher for adults at 'Bamboe Opleidingen' in Utrecht. It was here that he developed his computer skills, which proved beneficial for his PhD research later on. He left this job for one month, after an invitation of Dr. Bruno Bordenave to join a botanical exploration of the Kaw Mountains in French Guiana. The purpose of this exploration was to identify high conservation value areas within the ASARCO mining company concession. In these mountains they discovered a new plant genus named *Hekkingia* (species *bordenavei*) belonging to the Violaceae plant family.

In 2000 he was given the opportunity to continue his biology career at Utrecht University by participating in the EU funded liana research of Dr. Renske Ek. He returned to Guyana to continue the field research on lianas, this time supervising two MSc. students. After having successfully finished this project for Utrecht University he was unemployed for 9 months. During this period he developed, together with Dr. Renske Ek, the 'Climbers of Guyana'-website that contains the botanical descriptions and pictures of most lianas that occur in central Guyana.
At the end of 2002 a research proposal to study the impact of selective logging on lianas in Bolivia was granted by USAID. The next 9 months he conducted fieldwork in Bolivia under supervision of BOLFOR (Bolivia Forestal).

Then, in November 2003 he started his PhD project entitled 'Plant diversity of Borneo deduced from collection databases' at the National Herbarium of the Netherlands, Leiden University, which led to this thesis. Besides acquiring the statistical modelling skills leading to the patterns of biodiversity presented in this thesis, he also joined a botanical expedition to the 'Gunung Lumut Protection Forest'. This gave him the opportunity to see the real, beautiful, and threatened tropical rain forests of Borneo.

Publications

Raes, N., van Loon, E.E., Roos, M.C. and ter Steege, H. (subm.). The floristic regions of Borneo inferred from species distribution models.

Slik, J.W.F., Aiba, S.-I., Brearley, F.Q., Cannon, C.H., Forshed, O., Kitayama, K., Nagamasu, H., Payne, J., Paoli, G., Poulsen, A., **Raes, N.**, Sheil, D., Suzuki, E. (subm.). Forest Carbon and Biogeography: Explaining why Bornean Forests Possess 60% More Live Aboveground Biomass than the Amazon.

Slik, J.W.F., Aiba, S.-I., Brearley, F.Q., Cannon, C.H., Forshed, O., Kitayama, K., Nagamasu, H., Nilus, R., Payne, J., Paoli, G., Poulsen, A., **Raes, N.**, Sheil, D., Sidiyasa, K., Suzuki, E., van Valkenburg, J.L.C.H., Webb, C.O., Wilkie, P. and Wulffraat, S. (subm.). Wood specific gravity, stem density, basal area and aboveground biomass gradients and their environmental correlates in Borneos tropical forests.

Raes, N., Roos, M.C., Slik, J.W.F., van Loon, E.E. and ter Steege, H. (accepted). Botanical richness and endemicity patterns of Borneo derived from species distribution models. Ecography.

Raes, N., Mols, J.B., Willemse, L.P.M. and Smets, E.F. (accepted). Georeferencing specimens by combining digitized maps with SRTM digital elevation data and satellite images. Blumea 54(1).

Raes, N. and van Welzen, P.C. (accepted). The demarcation and internal division of Flora Malesiana: 1857- Present. Blumea 54(1).

Slik, J.W.F., **Raes, N.**, Aiba, S.-I., Brearley, F.Q., Cannon, C.H., Meijaard, E., Nagamasu, H., Nilus, R., Paoli, G., Poulsen, A.D., Sheil, D., Suzuki, E. , van Valkenburg, J.L.C.H., Webb, C.O., Wilkie, P., and Wulffraat, S. (accepted). Environmental correlates for tropical tree diversity and distribution patterns in Borneo. Diversity and Distributions.

Raes, N. and ter Steege, H. (2007). A null-model for significance testing of presence-only species distribution models. Ecography 30(5): 727-736.

Slik, J.W.F., Hovenkamp, P., Iqbal, M. and **Raes, N.** (2007). Structure, plant species diversity and plant species composition of the Gunung Lumut Protection Forest. In: Options for biodiversity conservation and sustainable use in lowland forest of southeast Borneo; Proceedings of a workshop organized on 19 May 2006 in Leiden, the Netherlands (Eds. Hans H. de Iongh, Gerard A. Persoon and Wawan Kustiawan), pp. 71-107. ISBN 978 90 5191 153 4.

Zagt, R.J., Ek, R.C. & **Raes, N.** (2003). Logging and Lianas – Tropenbos-Guyana Series 2003-1. Tropenbos International, Wageningen, The Netherlands.

Raes, N. & Ek, R.C. (2001). Climbers of Guyana – website. http://www.bio.uu.nl/~herba/lianas

Bordenave, B., **Raes, N.** & de Granville, J.-J. (2000). Etat Initial de la Vegetation Forestière de la Montagne de Kaw – 2. Convention IRD/ASARCO n° 9051.

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My interest for the tropics - with its exotic animals, like monkeys and colourful birds, the enormous trees, beautiful flowers, and extended coral reefs, but also with different human cultures - was raised at an early age. In 1995, the moment was finally there that I, together with Menno de Lind van Wijngaarden, was given the chance to do research in the tropical forests of Guyana. Our supervisor at Utrecht University, Renske Ek, gave us the opportunity to study the impact of selective logging on liana diversity in the tropical forests of Guyana. Working with local field assistants, (amongst others) Milton 'Suki' Allicock and Martin 'short man' Williams (who sadly passed away in 2001), gave me understanding of forest ecology not described in text books. While being friends during leisure time, they also provided me a glimpse on the Guyanese Amerindian culture. I would like to thank them, and the staff of the NHN-Utrecht (Paul and Hiltje Maas, Marion Jansen-Jacobs, Lubbert Westra, Bep Mennega, Jifke Koek-Noorman, and all others) for the support and the given opportunity to start a career as tropical botanical ecologist.

After having finished my MSc., I was able to continue to work as tropical ecologist by joining a botanical inventory of the Kaw Mountains in French Guiana led by Bruno Bordenave (2000), by returning to Guyana to continue the liana work of Renske Ek (2001), and by conducting liana research for BOLFOR in Bolivia supervised by Marielos Peña-Claros and Francis 'Jack' Putz (2003). Thank you for having provided these opportunities and support to continue my career. Not to forget Olaf Bánki, Tinde van Andel, and Renske Ek with whom we almost erected the 'Hubudi' foundation with the purpose to carry out consultancy biodiversity assessments, keeping my spirit up in times I was not employed as an ecologist.

Then in November 2003 I started my PhD at the National Herbarium of the Netherlands – Leiden University branch. Although sometimes difficult, I do appreciate the freedom given by my promotor Pieter Baas, and co-promotores Marco Roos en Hans ter Steege, to examine different strategies to tackle the problem of developing the high spatial resolution diversity patterns of Borneo which has finally resulted in the methodological approaches as I present them in this thesis. Notwithstanding that they were always available to give their advise and opinions on my lines of thought. Thank you for the advice, support, and trust.
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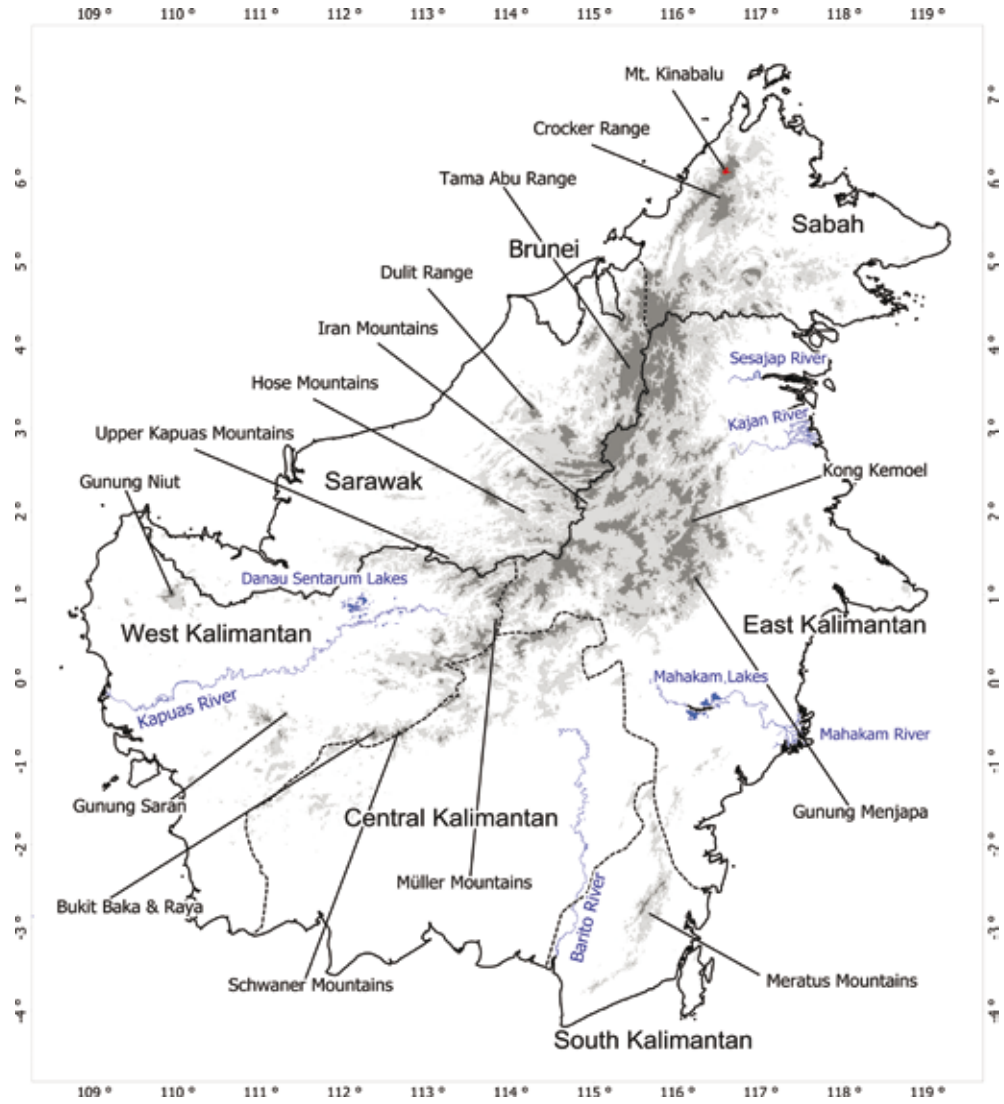
Mijn ouders kunnen hier ook niet ontbreken. Hoewel jullie bijdrage hoofdzakelijk indirect is geweest (afgezien van de wiskundebijles op het gebied van 'species-area relationships'), is deze daarom zeker niet minder belangrijk. Jullie hebben mij, mijn broer Coen en zus Susan grootgebracht met een liefde voor de natuur, reizen, en cultuur. Jaarlijks gingen we driemaal op vakantie, waarvan in de zomer zeker 5 á 6 weken. Een duidelijke bestemming was er nooit, en na 3 á 4 dagen ergens te zijn geweest ging onze 'ontdekkingsreis' weer verder. Zo hebben wij grote delen van Europa al op jonge leeftijd gezien. Wandeltochten gingen bij voorkeur buiten de gebaande paden, en toch kwamen we altijd weer uit bij het begin. Daarnaast heb ik mooie herinneringen aan de vistochten met mijn vader, waarbij het de sport was om de meest afgelegen stukjes rivier op te zoeken om daar te gaan vissen. Deze ervaringen hebben mij in belangrijke mate gevormd. Ook later zijn jullie mij op allerlei mogelijke manieren blijven ondersteunen. Hierdoor kon ik vol vertrouwen elke keer weer nieuwe uitdagingen aangaan, waaronder de meest recente - dit proefschrift. Ik wil jullie daar heel hartelijk voor bedanken.

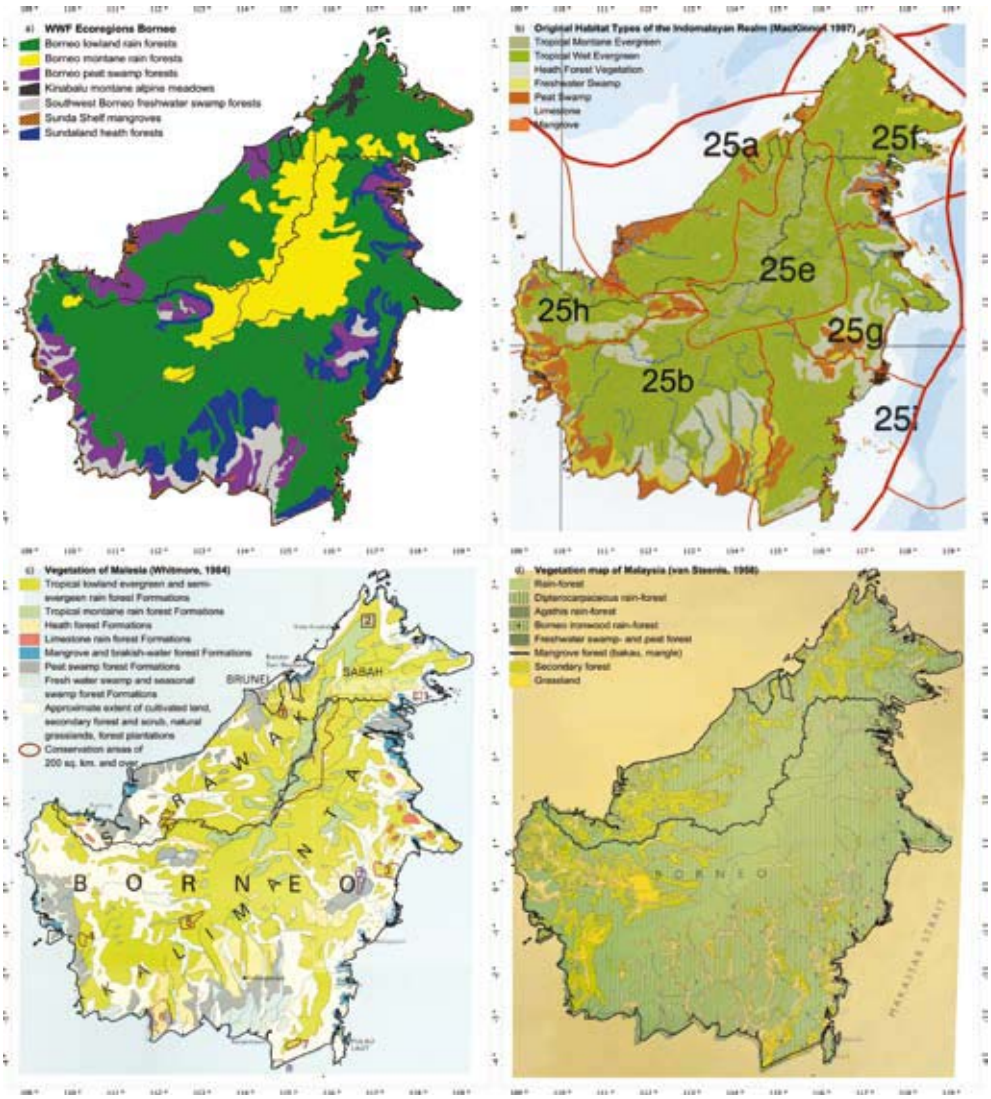
Then finally, I want to thank you – Linda – my love. You have supported and motivated me to finish my thesis. You had to withstand my grumpy moods when writing would not progress as fast as I had in mind, or when I received reviewer comments with the result that I had to rewrite part of the thesis and resulting papers (in the end improving the content). At important moments you showed genuine interest, or came up with welcome distractions and holidays which allowed me to clear my head. Thank you, and the many people who have contributed to my thesis but are not mentioned personally here.

Niels

Koompassia excelsa Taub. Picture taken in the Gunung Lumut Protection Forest East Kalimantan, Indonesia.



Map indicating the Bornean administrative provinces of Malaysia and Indonesia, the country of Brunei, the major mountain ranges and large rivers. Areas between 500-1000m in light-grey; areas above 1000m in dark-grey; Mt. Kinabalu in red (≥ 2600m) (derived from the SRTM 90m resolution altitude data (<http://srtm.csi.cgiar.org>)).



A) WWF ecoregions of Borneo; colours similar to floristic regions map (Chapter 5).

B) Detail from the 'Original Habitat Types of the Indomalayan Realm' of MacKinnon (1997).

C) Detail from the 'Vegetation of Malesia' map of Whitmore (1984).

D) Detail from the 'Vegetation map of Malaysia' of van Steenis (1958).

All maps in geographic projection.