

## **A Tribute to Nathalie Seenamah Nagalingum (1975–2022)**

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## A Tribute to Nathalie Seenamah Nagalingum (1975–2022)

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Allow me to tell you a little bit about the Nathalie Nagalingum I knew. It was at the August Botany 2000 meeting (“New Frontiers in Botany”) in the Oregon Convention Center (Portland, OR) where I first met Nathalie. At the time, she was a PhD student at the University of Melbourne in Australia and presenting a paper to the Paleobotanical Section of the Botanical Society of America (BSA) on “*Pteridophyte biogeography and evolution in the Cretaceous of southern Gondwana*”. I was a newly hired Assistant Professor at Duke University, NC and had just presented a paper to the Systematics Section of BSA entitled “*Horsetails and ferns are a monophyletic group and the closest living relatives to seed plants*”. At some point during the four-day meeting, we met up over coffee, and I remember how delightful it was to encounter such an enthusiastic fellow fern fanatic from so far away. Nathalie was ebullient talking about her research and future dreams, and when we said goodbye, she left a distinct impression of someone you wish you had a chance to get to know better.

Fortunately for me, an opportunity to know Nathalie better presented itself in 2003, when she graduated with her PhD “*Cretaceous ferns from Australia and Antarctica*” from Melbourne and was in pursuit of a postdoc. In my new position at Duke, I had recently been awarded, together with my colleagues Harald Schneider and Rick Lupia, a National Science Foundation Collaborative Research Grant to investigate the history of morphological evolution in heterosporous ferns. A primary goal of our collaborative research study was to generate a comprehensive phylogeny for these ferns with data from multiple genes, morphology, and developmental studies, and to incorporate morphological data from fossil taxa to reconstruct the evolutionary history of heterospory. Our proposal had budgeted for a postdoctoral fellow who could integrate fossil data into the morphological phylogenetic studies and analyze spore character evolution. Hence, my chance to reach out to Nathalie to determine whether she might be interested in joining us. To my delight, in August 2003, she was headed to Duke!

Nathalie was born in Melbourne on 17 March 1975 to Denise and Moorgessen Nagalingum who had immigrated to Australia from Mauritius, a tiny African island nation in the Indian Ocean, about 700 miles east of Madagascar. Nathalie’s early love for botany and her academic training at the University of Melbourne (BSc and PhD) prepared her well for her career. When Nathalie arrived at Duke to begin her postdoc, she hit the ground running. By July 2004, she was already reporting on our research at the “XI International Palynological Congress” in Granada, Spain, and at the “Ferns for the 21<sup>st</sup> Century Conference” at the Royal Botanic Garden in Edinburgh, Scotland (Nagalingum *et al.* 2004a). She also

presented at the “Botany 2004” meetings in Snowbird, Utah (Nagalingum *et al.* 2004b), and participated as a co-author on an abstract to the Annual Meeting of the Geological Society of America (Lupia *et al.* 2004). When published, this work (Nagalingum *et al.* 2006a), incorporating stunning scanning electron microscope images and explanatory drawings, presented a thorough comparison of reproductive structures across heterosporous ferns and a convincing reassessment of the homology of the sporocarp structure.

Although formally trained as a paleobotanist, Nathalie had no hesitation whatsoever when an opportunity arose for her to do research in our molecular lab. Working closely with my then graduate student, Eric Schuettpelz, Nathalie quickly became skilled at DNA extractions, PCR amplifications, and DNA sequencing. In no time she was aligning sequences, running sophisticated phylogenetic analyses of molecular data, and exploring how to use fossils to calibrate molecular divergences to provide geological dates for clade diversification. Nathalie’s results from a phylogenetic analysis of a six-locus data set of Marsileaceae were presented to the XVII International Botanical Congress in Vienna, Austria (Nagalingum *et al.* 2005; Lupia *et al.* 2005), as well as at the “Botany 2006” meetings in Chico, California (Nagalingum *et al.* 2006b). By integrating critical spore microfossils as age constraints, she was able to estimate divergence times for the intergeneric splits in Marsileaceae and species-level divergences within extant *Marsilea*. When these data were published (Nagalingum *et al.* 2007, 2008), Nathalie’s expertise in molecular phylogenetic analyses was firmly established as a well-earned addition to her research toolkit.

As skilled as she was in the lab and behind a microscope, Nathalie was also always eager to get into the field and she participated in several excursions while a postdoc at Duke. We were together in the field on three memorable occasions: Austria (2005), Arizona (2006), and Malaysia (2006). In late July 2005, following the XVII International Botanical Congress in Vienna, we joined a delightful long weekend excursion to the Austrian Alps near Graz, organized by Johannes Vogel and Harald Schneider, where we saw a diversity of *Asplenium* on dolomite, and ate some insanely delicious Viennese desserts (Fig. 1A). In April 2006, we took a lab field trip organized by Michael Windham to collect desert ferns in the American Southwest. Although Nathalie loved experiencing the desert, she was ever cautious about encountering a rattlesnake, routinely and forcefully tapping her *Agave* stem walking stick ahead of her to broadcast her approach (Fig. 1B). Four months later, for three weeks in August and September 2006, we traveled to peninsular Malaysia to study paleotropical ferns. This epic adventure was organized by Eric Schuettpelz, coordinated by Gary Theseira from the Forest Research Institute Malaysia (FRIM), and funded by a grant from the National Geographic Society. Our journey took us to the lowland dipterocarp, karst, and montane forests of Selangor State (Forest Research Institute Malaysia, Templer Park, Batu Caves, Taman Negara, Genting Highlands), to the montane forests of the Cameron Highlands in the state of Pahang, and to the dipterocarp forests of the Gunung Jerai Forest Reserve in the state of Kedah (Fig. 1C). We made 322 collections (generally in triplicate), including 80 genera and 250 species, approximately 90% of the genera and 70% of the species recognized in the peninsular Malaysian fern flora. We were



FIG. 1. **Panel A.** July 2005 field excursion to Austrian Alps: a) left to right, Eric Schuettpelz, Amanda Grusz, Nathalie Nagalingum, Jordan Metzgar, Johannes Vogel, Mary Gibby, and Harald Schneider; b) Styrian Alps near Emerald Lake; c) left to right, Kathleen Pryer, Nathalie, and Amanda; d) *Asplenium trichomanes*; e) Eric and Nathalie; f) yummy Austrian dessert. **Panel B.** April 2006 field trip to the American Southwest: a) left to right, Nathalie, Michael Windham, Amanda, and Jordan hunting for cheilantheid ferns in Arizona; b) Nathalie, ever wary of rattlesnakes, with *Agave* stem walking stick in hand; c–e) Nathalie and Amanda reviewing the miniscule characters necessary

awed by the exceptional diversity of the flora and fauna, our frequent and bloody encounters with land leeches, and food and accommodations that ranged from absolutely delightful to a bit “dodgy” (a favorite adjective of Nat’s). When things were at their “dodgiest”, Nathalie would purse her lips and cheer me on by insisting that the experience would make me “a better person”.

Because of Nathalie’s innate friendliness, vitality, and generosity in helping others, she integrated herself quickly within the Duke Biology community and was well-liked and sought-after by both faculty and students. Her home was a regular destination for knitters’ “Stitch N’ Bitch” sessions and yummy potluck dinners. Being a naturally curious person, Nathalie was a fearless traveler, an intrepid expert at maneuvering long trips, and quick to make new friends and broaden her research links wherever she went. Nathalie had a rare quality that drew people to her for so many different reasons. At professional meetings that I attended with her it was impossible to sneak away for a chat. We were always bumping into someone who knew her, was delighted to see her, who wanted a hug, who wanted to catch up, who needed her warmth.

In August 2007, Nathalie left our lab at Duke to begin a new postdoc at Harvard where she switched her research focus to gymnosperms. In early 2010, Nathalie took up a third postdoc at UC-Berkeley, examining paleo-biological patterns in plant evolution, and by 2011, she had landed a position as a research scientist back in Australia at the Royal Botanic Gardens in Sydney where she was awarded a prestigious Winston Churchill Fellowship to investigate the genomics and biodiversity of the endangered cycads of Australia and Asia. Nathalie’s work on cycads resulted in a highly influential paper published in the journal *Science* (Nagalingum *et al.* 2011). By combining data and approaches from both paleontology and molecular phylogenetics it was shown that cycads survived an evolutionary bottleneck about 12 million years ago to diversify into today’s ~300 species (Renner 2011; Dasgupta 2017). In March 2017, Nathalie returned to the U.S., having been appointed Associate Curator and McAllister Chair of Botany at the California Academy of Sciences, San Francisco. She loved her position at Cal Academy where she continued to study the evolution and diversification of plants—particularly cycads and ferns.

During her lifetime, Nathalie made a remarkable number of friends—she had the Midas touch at everything she did, and everyone enjoyed her company. She could switch from talking about science to swooning over shoes and earrings or a new shade of red lipstick in a minute. Nat was a fearless adventurer with a lot of daring and verve and smarts. She cherished life and she lived it well. During her career, Nathalie made exceptional contributions to botany spanning fossil and living taxa (Appendices 1–3). Not only was she an accomplished paleobotanist but

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to identify *Myriopteris* (*Cheilanthes*) *lindheimeri*, a group that later became the topic of Amanda’s PhD. **Panel C.** August–September 2006 field excursion to peninsular Malaysia: a) left to right, Jordan, Amanda, our boatmaster, Eric, Nathalie, Kathleen, Harald, Nor Ezzawanis Abdullah Thani, Michael, and Petra Korall. b–h) assorted photos of our 2006 Malaysian adventure featuring the always smiling Nathalie.

she was also skilled in dealing with “big data” and comparative genomics. Nathalie was a gifted science communicator (Appendix 4) and cared deeply about increasing diversity in science. For as long as I knew her, she was committed to fostering a safe and inclusive environment around her for everyone. Promoting equal opportunities and treatment for all and working against harassment and discrimination were among her most paramount goals. Sadly, Nathalie, like many other scientists of color, had experienced intimidation and discrimination throughout her academic career. Despite this, or perhaps because of this, she was outspoken in denouncing unacceptable behavior by others related to gender, sexual orientation, race, or other personal characteristics, and worked hard to bring an end to it. She was a fierce advocate for those who found themselves in less privileged positions.

Tragically, on 22 August 2022, Nathalie was lost to ovarian cancer at the prime of her life and career (McLoughlin 2022). Nathalie had been an active and beloved member of the American Fern Society (AFS) and the larger botanical community for over 20 years. Upon learning of her passing, three Past-Presidents of the AFS (Kathleen Pryer, Eric Schuettpelz, and Emily Sessa) organized a fundraiser using the GoFundMe platform to seek contributions for the establishment of an annual award to support student research in Nathalie’s name, the “**Nathalie S. Nagalingum Graduate Student Research Award**”. In this way, Nathalie’s name will continue to resonate with botanists well into the future and it is a way for us to celebrate Nathalie’s life and contributions to fern biology. More than 135 individuals from around the world contributed generously to honor Nathalie’s memory, a clear testament to how dearly loved Nathalie was by her friends, family, and the botanical community at large. The first AFS Nagalingum award was made in May 2023 to Ms. Susana Vega Betancur, a Master’s student at Universidad de Antioquia in Medellín-Colombia for her research on “Overcoming long-standing taxonomic challenges to advance knowledge of species limits in Colombian spikemosses (*Selaginella*)”. We wish her every success. Should you wish to contribute to the Nagalingum award fund, please contact the AFS Treasurer.

It has been very difficult to comprehend the tragic loss of so dear a friend and colleague at such an early age. Nathalie’s presence and voice will always be dearly missed by so many. . .her family, her friends, and the global and rich community of “Nat fans” who loved her very much. Her smile, her laugh, her heart, her kindness, her wit, her style, her charm, and her brilliance will never leave us. We are so grateful to have had our time with her.

#### ACKNOWLEDGEMENTS

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## APPENDIX 2. EXTANT FERN TAXA CO-AUTHORED BY N. S. NAGALINGUM

### DRYOPTERIDACEAE

*Parapolystichum calanthum* (Endl.) J. S. S. Gardner & Nagalingum  
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*Parapolystichum pacificum* (Tindale) J. S. S. Gardner & Nagalingum  
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## APPENDIX 3. MACROFOSSIL FERN TAXA AUTHORED AND CO-AUTHORED BY N. S. NAGALINGUM

*Bellarinea* Florin 1952 emend. Nagalingum, Drinnan & McLaughlin  
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- Marsileaceaphyllum lobatum* Nagalingum  
Plant Systematics and Evolution 264:45. 2007
- Medwellia* Nagalingum & McLoughlin  
Memoirs of the Association of Australasian Palaeontologists 26:35. 2002
- Medwellia lacerata* (J.G. Douglas) Nagalingum & McLoughlin  
Memoirs of the Association of Australasian Palaeontologists 26:35. 2002
- Pachydermophyllum austropapillosum* (J.G. Douglas) McLoughlin & Nagalingum  
Memoirs of the Association of Australasian Palaeontologists 26:61. 2002
- Rintoulia* McLoughlin & Nagalingum  
Memoirs of the Association of Australasian Palaeontologists 26:56. 2002
- Rintoulia pectinata* (Hector) McLoughlin, Tosol., Nagalingum & Drinnan  
Memoirs of the Association of Australasian Palaeontologists 26:60. 2002
- Rintoulia pinnata* (Walkom) McLoughlin, Tosol., Nagalingum, & Drinnan  
Memoirs of the Association of Australasian Palaeontologists 26:60. 2002
- Rintoulia variabilis* (J.G. Douglas) McLoughlin & Nagalingum  
Memoirs of the Association of Australasian Palaeontologists 26:57. 2002

**APPENDIX 4. EDUCATIONAL VIDEOS FEATURING N. S. NAGALINGUM PRODUCED  
BY THE CALIFORNIA ACADEMY OF SCIENCES, AND TWO “OLOGIES”  
PODCAST LINKS**

**Breakfast Club, Ep. 1: Dr. Nathalie Nagalingum on Ferns**

<https://www.youtube.com/watch?v=w32eO-y53QM>

**Breakfast Club, Ep. 18: Dr. Nathalie Nagalingum on Flowers**

<https://www.facebook.com/calacademy/videos/breakfast-club-dr-nathalie-nagalingum-on-flowers/2839450699615594/>

**Breakfast Club, Ep. 27: Dr. Nathalie Nagalingum on Cycads**

<https://www.youtube.com/watch?v=4Qshbk7WVKk>

**Breakfast Club, Ep. 47: Dr. Nathalie Nagalingum on Holiday Plants**

[https://www.youtube.com/watch?v=S5mzUoyf4xU&list=PLS14biAqBAth9EQk78-pIBjR\\_LY6ozgr7&index=15](https://www.youtube.com/watch?v=S5mzUoyf4xU&list=PLS14biAqBAth9EQk78-pIBjR_LY6ozgr7&index=15)

**Saving Cycads with Science**

<https://www.youtube.com/watch?app=desktop&v=oDtSx1qCB-M>

**Cycads: An Ancient Plant**

[https://www.youtube.com/watch?v=8wSqC\\_avxtI](https://www.youtube.com/watch?v=8wSqC_avxtI)

**The Price of Plant Poaching**

<https://www.youtube.com/watch?v=OFp8yBHgkPE>

**How Did Past Climate Change Influence Today's Plants?**

<https://www.calacademy.org/educators/how-did-past-climate-change-influence-todays-plants>

**How Did Plants Change Our Planet?**

<https://www.calacademy.org/educators/how-did-plants-change-our-planet>

**How Do Scientists Work Together?**

<https://www.calacademy.org/educators/how-do-scientists-work-together>

**Science Hero: Nathalie Nagalingum (1975–2022)**

<https://www.calacademy.org/learn-explore/science-heroes/nathalie-nagalingum>

**Women in Science at NightLife, Hosted by Alie Ward (“Ologies”)**

<https://www.youtube.com/watch?v=I14ZTLU6k0M>

**Cycadology (RARE PLANT DRAMA) with Dr. Nathalie Nagalingum**

<https://www.alieaward.com/ologies/cycadology>