

David S. Woodruff, 1943–2015

Not many academic scientists dedicate virtually all their research and free time to helping save our planet's biodiversity. Prof. David Woodruff, who sadly passed away on 16 December 2015, was one of them. We particularly miss him because he spent a large part of his career working to help solve conservation problems in Thailand, and enriching his colleagues here with his extensive knowledge of genetics, parasitology, ecology and biogeography. He cultivated a wide network of colleagues here and conferred with them on every trip to Thailand, which he visited at least once a year. We miss him as a friend, discussing conservation problems over dinner, a beer, or a desk while working on a paper. Nearly all of his Ph.D. students became conservation biologists and many worked on problems in Thailand. He has served on the editorial board (1994–2005) then advisory board (2006–2015) and helped to review papers for the Natural History Bulletin of the Siam Society, and has contributed papers to it and to many other Thai journals.

David Woodruff hailed from Australia, and received his Ph.D. from the University of Melbourne in 1968. He received a postdoctoral position from Harvard where he spent several years, as Frank Knox Fellow and as Alexander Agassiz Lecturer on Biogeography under the famous ecologist and evolutionary biologist Edward O. Wilson. He then moved to Purdue University in 1974, and later to the University of California, San Diego in 1979, where he helped develop the Section on Behavior, Ecology and Evolution, and also served as its chair. He became active in the San Diego Zoo, and served as a trustee of the Zoological Society of San Diego, which oversees the zoo's research and international conservation programs. Despite his many administrative duties and teaching commitments, Dr. Woodruff was extremely generous of his time and seemed to have a warm spot in his heart and Thailand and his colleagues there. We could depend on him to offer his knowledge and advice on virtually any kind of conservation problem or issue, be it dams, protected areas, species conservation, global warming, sea level change, or zoo management.

Dr. Woodruff's research interests ranged widely over many topics. He has published on the genetics and biogeography of snail hosts of human schistosomiasis parasites, and on frogs (on which he did his doctoral thesis in Australia), gibbons, hornbills, chimpanzees, and elephants. He is perhaps best known for developing non-invasive methods for obtaining DNA from living organisms for genetic analysis. More recently, he turned his interests toward biogeography, and coauthored (with student Jennifer Hughes and Philip Round in 2003, and with Leslie Turner in 2009) several important papers on the biogeography of the Thai peninsula, trying to settle the problem of where the transition between Sundaic and the continental Indochinese fauna and flora is located, and why. A paper published in this journal with his daughter Kathryn, a student in the School of Environment at Yale, predicts future sea level changes on Thai coastlines. But one of his most recent papers, also published in this journal, highlights one of his most significant contributions to Thai conservation biology: his article "Wildlife conservation in protected areas in Thailand: lessons from Chiew Larn, Khao Sok and Khlong Saeng" (NHBSS Vol. 59 [2]: 91–107, 2013). Woodruff describes an important research project, carried out by several of his students (Tony Lynam, Sukamol Srikan and Luke Gibson), in impassioned terms and applies it to Thailand's most important conservation issue, the viability of its protected area system. The research involved studying the genetics and survival of small mammal species naturally remaining on a series of islands created in

the Chiew Larn reservoir behind the Rajaprapha Dam in Surat Thani, completed in 1987. It was a study of the effects of habitat fragmentation and island size on biodiversity, one of the central themes of modern conservation biology. The results of the study were dramatic—the small mammal populations crashed to extinction in rapid fashion, in fact faster than expected from the theory. The results made a global bang in the scientific community and beyond. Anyone wishing to read Prof. Woodruff's most eloquent pleas for conservation science and conservation action should read this paper. It is his crowning gift to us.

Dr. Woodruff is survived by his charming wife Amy and two talented daughters.

Warren Y. Brockelman
Prachya Musikasinthorn

Selected publications of David S. Woodruff:

- EGGERT, L. S., C. A. RASNER, AND D. S. WOODRUFF. 2002. The evolution and phylogeography of the African elephant (*Loxodonta africana*) inferred from mitochondrial DNA sequence and nuclear microsatellite markers. *Proc. Roy. Soc. London B* 269: 1993–2006.
- GIBSON, L., A. J. LYNAM, C. J. A. BRADSHAW, F. L. HE, D. P. BICKFORD, D. S. WOODRUFF, S. BUMRUNGSRI, AND W. F. LAWRENCE. 2013. Near-complete extinction of native small mammal fauna 25 years after forest fragmentation. *Science* 341: 15081510.
- HUGHES, J. B., P. D. ROUND, AND D. S. WOODRUFF. 2003. The Indochinese–Sundaic faunal transition at the Isthmus of Kra: an analysis of resident bird species distributions. *J. Biogeogr.* 30: 569–580.
- MONDA, K., R. E. SIMMONS, P. KRESSIRER, B. SU, AND D. S. WOODRUFF. 2007. Mitochondrial DNA sequence variation and phylogeny of concolor gibbons, *Nomascus*. *Am. J. Primatol.* 69: 1285–1306.
- MORIN, P. A., AND D. S. WOODRUFF. 1996. Noninvasive genotyping for vertebrate conservation. Pages 289–303 in T. B. Smith and R. K. Wayne (eds.), *Molecular Genetic Approaches in Conservation*. Oxford Univ. Press, Oxford.
- MORIN, P. A., J. MESSIER, AND D. S. WOODRUFF. 1994. DNA extraction, amplification and direct sequencing from hornbill feathers. *J. Science Soc. Thailand* 20: 31–41.
- SRIKWAN, S., AND D. S. WOODRUFF. 1998. DNA sequence variation and hornbill conservation. Pages 69–82 in P. Poonswad (ed.), *The Asian Hornbills: Ecology and Conservation*. Thai Studies in Biodiversity, No. 2. BIOTEC, Bangkok.
- SRIKWAN, S., AND D. S. WOODRUFF. 2000. Genetic erosion in isolated small mammal populations following rain forest fragmentation. Pages 149–142 in A. Young and G. Clarke (eds.), *Genetics, Demography and Viability of Fragmented Populations*. Cambridge Univ. Press, Cambridge.
- SRIKWAN, S., D. FIELD, AND D. S. WOODRUFF. 1996. Genotyping free-ranging rodents with heterologous PRC primer pairs for hypervariable nuclear microsatellite loci. *J. Science Soc. Thailand* 22: 267–274.
- SRIKWAN, S., K. HUFFORD, L. S. EGGERT, AND D. S. WOODRUFF. 2000. Variable microsatellite markers for genotyping tree shrews, *Tupaia*, and their potential use in genetic studies of fragmented populations. *ScienceAsia* 28: 95–97.
- WOODRUFF, D. S. 1989. The problems of conserving genes and species. Pages 76–88 in D. Western and M. Pearl (eds.), *Conservation for the Twenty-first Century*. Oxford Univ. Press, New York.
- WOODRUFF, D. S. 1990. Genetics and demography in the conservation of biodiversity. *J. Science Soc. Thailand* 16: 117–132.
- WOODRUFF, D. S. 1992. Genetics and the conservation of animals in fragmented habitats. Pages 258–272 in: *In Harmony with Nature*. Proc. Intl. Conf. Tropical Biodiversity. Malay Nature Society, Kuala Lumpur.
- WOODRUFF, D. S. 1993. Non-invasive genotyping of primates. *Primates* 34: 233–246.
- WOODRUFF, D. S. 2001a. Declines of biomes and biotas and the future of evolution. *Proc. Nat. Acad. Sci. USA* 98: 541–5476.
- WOODRUFF, D. S. 2001b. Sustainable agriculture and biodiversity conservation. Pages 55–62 in S. Suthipradit et al. (eds.), *Sustainable Agriculture: Possibility and Direction*. National Science and Technology Development Agency, Bangkok.
- WOODRUFF, D. S. 2010. Biodiversity and conservation in Southeast Asia: How 2.7 million years of repeated environmental fluctuations affect today's patterns and the future of the remaining refugial-phase biodiversity. *Biodiversity and Conservation* 19: 919–941.

- WOODRUFF, D. S. 2013. Wildlife conservation in protected areas in Thailand: lessons from Chiew Larn, Khao Sok and Khlong Saeng. *Nat. Hist. Bull. Siam Soc.* 51(1): 97–108.
- WOODRUFF, D. S., AND S. SRIKWAN. 1998. Molecular genetics and the conservation of hornbills. Pages 257–263 in P. Poonswad (ed.), *The Asian Hornbills: Ecology and Conservation. Thai Studies in Biodiversity, No. 2.* BIOTEC, Bangkok.
- WOODRUFF, D. S., AND L. M. TURNER. 2009. The Indochinese–Sundaic zoogeographic transition: a description and analysis of mammal species distributions. *J. Biogeogr.* 36: 803–821.
- WOODRUFF, D. S., S. SRIKWAN, AND A. J. LYNAM. The Klong Saeng biodiversity project: population viability and biodiversity following rainforest fragmentation. *Bull. Ecol. Soc. America* 77: *Suppl. Pt. 2*: 489.
- WOODRUFF, D. S., AND K. A. WOODRUFF. 2008. Paleogeography, global sea level changes, and the future coastline of Thailand. *Nat. Hist. Bull. Siam Soc.* 56: 1–24.



A, David Woodruff with a cheetah at the San Diego Zoo's Safari Park; B, David in the forest in Thailand, somewhat leech-bitten; C, Prof. Woodruff giving a lecture at the 2005 meeting of the Biodiversity Research and Training Program in Khon Kaen; and D, Prof. Woodruff on Univ. of California San Diego campus in 2006 with visiting Thai students Chalita (left) and Chomcheun (right) from Mahidol University.