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BOOK REVIEWS

Herpetological Review, 2006, 37(3), 368–373.

Giant Tortoises of the Indian Ocean. The Genus *Dipsochelys* Inhabiting the Seychelles Islands and the Extinct Giants of Madagascar and the Mascarenes, by Justin Gerlach. 2004. Edition Chimaira, Frankfurt am Main (www.chimaira.de), distributed in the USA by Zoo Book Sales, Lanesboro, Minnesota (www.zoobooksales.com). 207 pp. US $49.95. ISBN 3–930612–63–1.

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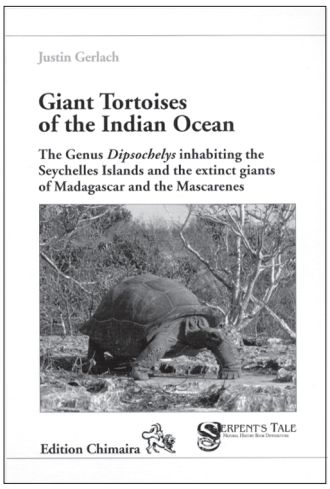

There is a rich, centuries-old tradition of natural history books by gentleman naturalists; and tomes on turtles and tortoises are particularly noteworthy in this genre. The volume under review, an extension of this custom, is attractively presented, with glossy paper, tight binding, and 188 figures, most of which are in color. Its eight chapters are: Introduction; Identification of the Indian Ocean giant tortoises and theories of their evolution; The morphology of giant tortoises; Taxonomy; Ecology; The discovery of Indian Ocean giant tortoises and their history; Conservation; and Bibliography. An enormous amount of historic, factual, theoretical, hypothetical, and speculative information is summarized in the book, presented together with a wealth of old, difficult-to-find text and photos. There is a table of contents, but no list of tables or figures, or even a general index—usual components for any scholarly tome as large and complex as this. And this raises a fundamental question: what is the objective of this publication? Will serious students—seeking much-needed scholarly treatment of Indian Ocean giant tortoises, with organized, up-to-date summaries and syntheses—find that it meets their needs and expectations? Or, is its cache of color photos and attractive presentation designed for an active hobbyist market, less concerned about seemingly pedantic details of the scientific debates, hypothesis testing, and the International Code of Zoological Nomenclature?

The book has an uneasy mix of styles, ranging from general, simplified stories of natural history to curt accounts of highly specialized analytical processes and terms—often with no explanation, background, or context for understanding the information presented or the issue under discussion. Numerous comments, claims, and arguments throughout the book raise basic concerns and distract from an easy read. Surely many of these contentious points of substance (not to mention the miscellaneous details of form including punctuation, grammar, redundancies, inconsisten-

cies, self-contradictions, incomplete citations and so on) could have been polished or mitigated had usual peer and editorial review processes been employed.[i] Only a sample of notable points is discussed herein.

The introduction sets the style for the volume; its three-and-a-half pages of text are accompanied by copious figures: in this case, ten, eight of which are in color. We are told that despite several in-depth works on the Galápagos tortoises, "their taxonomy remains highly confused" (p. 10). Yet, in treating the subject of the book, the Indian Ocean tortoises, the author simply states that there are two genera: "*Dipsochelys*" from the Madagascar to Seychelles, and *Cylindraspis* on the volcanic Mascarene islands. There is no mention in the introduction that the first name is promoted steadfastly by the author, despite its rejection in numerous peer-reviewed, scholarly studies by specialists knowledgeable of the taxonomic and nomenclatural issues (e.g., Crumly 1986; Pritchard 1986:532; Meylan and Auffenberg 1987:74; King and Burke 1989:70; Iverson 1992:249; Austin and Arnold 2001; Austin et al. 2002, 2003). These, and other, authors have argued, for decades, that the generic term *Aldabrachelys* is available and senior to "*Dipsochelys*," coined in 1982 by Roger Bour. Not only is "*Dipsochelys*" not widely used, especially in the scientific literature, but recently Bour has been co-author of peer-reviewed papers that employed the more usual *Aldabrachelys* (see Austin et al. 2002, 2003).

Near the end of the Introduction, the author states (p. 14) that "there are no external features which distinguish the three groups" [Galápagos, Mascarene, and Seychelles]—a claim with tremendous implications that is soon contradicted. Figures in the Introduction provide excellent images of heads of Aldabra, Mascarene, and Galápagos giant tortoises, clearly illustrating differences in head shape that many tortoise enthusiasts use to differentiate these three clades, and a distinguishing feature that has been well known for over a century (e.g., Gray 1872:3–4). In addition to several prominent personalities recognized by the author, other illustrations include a "phylogeny of recent tortoises" and a "world map of living and extinct giant tortoise distribution." It is remarkable that although several recent scientific studies directly applicable to questions of phylogeny are relatively easy to obtain (see below), the scheme proposed in this book is based on an unpublished thesis and one of three (which one is not identified) 2001 publications by the author that appeared in *Phelsuma*.[ii] The world map will disappoint tortoise aficionados who marvel at the gigantic size of living continental forms such as *Geochelone* [*Chelonoidis*] *denticulata* from northern South America (Pritchard 1986), *Geochelone* [*Centrochelys*] *sulcata* from northern Africa, and *Manouria emys* from Southeast Asia, not to mention scores of extinct gigantic forms (e.g., Auffenberg 1974) whose representation would have populated much of the apparently blank areas on the map. The closing of the Introduction states that "[i]n all cases the original literature has been tracked down to determine the real facts and separate them from the all too frequent myths that these animals seem to inspire." It is no mean feat to separate "real facts" from myths, especially when a writer is passionate about his topic.

Chapter Two, on identification and theories of evolution, begins with a candid appraisal of the problems: 18th and 19th century specimens without accurate localities; dubious original descriptions; confused type specimens, many described after having been transported from native lands; early diagnoses based on highly variable features and small sample sizes (commonly, just one specimen); and the less than careful use of taxonomic names. The summary of the intriguing early history of naming Indian Ocean tortoises is useful, and here the author explains some of the confusion and chaos in which the names of these chelonians are enmeshed. Curiously, he presents Schweigger's 1812 description for *T. gigantea* in French as if this were the original, and then gives an English translation. Schweigger (1812), as was common at that period, wrote in Latin (see also Duméril and Bibron 1834:416; Crumly 1986:238; Pritchard, 1986:522), but apparently Gerlach used Bour's (1984a:163) French translation, without explaining his source.

More importantly, a debatable logic is used in deciding which taxonomic names to reject and which to employ. The confusion regarding the generic name was mentioned above; the contention regarding the correct species appellation is more acute. A name that has been in regular usage for more than a century in hundreds of scientific publications about Aldabra tortoises—Schweiger's 1812 *Testudo gigantea* (Frazier 2006)—is rejected and replaced with Gray's 1831 *T. dussumieri*. But, this last name was clearly used by Gray (1831a:3, 1831b:9) only as a synonym to *T. indica*; and, hence, it is unavailable if one follows the International Code of Zoological Nomenclature (Art. 11.6; Frazier, *in prep*.). Moreover, another name, applied to a specimen of unknown origin, and with a transport history and final fate that reads like an adventure book, a name essentially forgotten for more than a century—*Testudo hololissa*—is recognized as a separate species. This is applied to specimens for which all available genetic information indicates that they are indistinguishable from the Aldabra tortoise (Palkovacs et al. 2002, 2003; Austin et al. 2003; Karanth et al. 2005; Noble, *in litt*. 10 August 2005).

Statements about ***results*** from studies of molecular genetics are generally consistent with the publications cited, but numerous matter-of-fact ***interpretations*** are subject to debate. The root of the dilemma lies with the author's conviction that since 1995 he has rediscovered at least two, near-extinct species of giant tortoises in the Seychelles, claims that have been made primarily in hobbyist and proprietary magazines (Gerlach and Canning 1995a,1995b, 1996:33, 1998a, 1998b:134; Gerlach 1997a:28, 1997b:71 ff., 1998a:31 ff., 1998b:4, 1999a:58, 1999b:9, 1999c:34, 1999d:496, 2001a:12, 2001b:127, 2002, 2003a:57, 2003b:8, 2005:938). These assertions have been substantiated by authoritative statements about proof of genetic differences between these so-called distinct species (Gerlach 1997a:28, 1997b:71 ff., 1998b:6, 2003a:59; Gerlach and Canning 1998b:134), allegations that were based on Les Noble's unpublished results of RAPDs research. However, these claims are inconsistent with what was found by the geneticist who did the work (Noble, *in litt*. 10 Aug. 2005, 24 Aug. 2005). Hence, it is refreshing that in his book Gerlach at last admits (p. 37) that "[r]ecent molecular analyses (Austin & Arnold 200 [sic.]; Austin et al. 2003; Palkovacs et al. 2002, 2003) have failed to locate any genetic differences between the living taxa or any genetic structuring of wild populations on Aldabra."

However, he goes on to contend (p. 37) that despite these recent, peer-reviewed publications that ***expressly*** investigated the question of specific differentiation "species differences are found in other molecular data." This bold claim is based on Cunningham's (2002) unpublished thesis which studied the cytochrome *b* gene (Cyt *b*) and the little-investigated nicotinamide adenine dinucle-

otide dehydrogenase subunit 4 gene (ND4). Her principal aim and methods were to "elucidate the inter-generic relationships among extant tortoises using two mitochondrial gene fragments"—***not*** to investigate species differences. She found no differences between individual Aldabra/Seychelles tortoises at the Cyt *b* site; and at the ND4 site the difference was "a maximum of 8bp [base pairs] in total and usually zero;" and it was unclear how to interpret this low level of differentiation, or indeed if it was due to artifacts (*in litt*. 3 August 2005). Hence, the author herself is not convinced that the molecular data alone support species differences in the six Aldabra/Seychelles tortoises that were sampled (*in litt*. 3 Aug. 2005, 7 Feb. 2006).

To explain the lack of genetic differences Gerlach (p. 30) argues that "*Dipsochelys* taxa are morphologically distinctive but appear to have diverged too recently to be fully reflected in the available molecular data." In his book he speculates that the granitic Seychelles were "colonized from Aldabra 15,000 years ago" (p. 39; in other publications he set the date at 18,000 years ago [Gerlach 2003a:58; Gerlach and Bour 2003:15]). He speculates even further that "[s]mall genetic changes within the last 3–7,000 years" may have given rise to the distinct species that he claims to have rediscovered. This possibility cannot be entirely ruled out, but given the available information on giant tortoises as well as other organisms, it is exceedingly unlikely.

Rather than employ the genetic research to test his hypotheses about morphological differences, the author decides that morphological differences are determinant, and he discounts widely held concerns about the remarkable intra-specific variability and plasticity of shell form, shape, and size. The earlier assertion in the book's introduction, that external features cannot be used to distinguish the three geographically separated clades of giant tortoises (Galápagos, Mascarenes, and Madagascar/Seychelles), taxa that are widely agreed upon, becomes even more noteworthy; for now we are told that external features can be used to distinguish species that are not generally accepted! Information derived from less-than obvious processes (like plots of eigenvectors) is presented with the scantiest of explanations (not to mention sample sizes that are inconsistent between text and legends; e.g., tables 1–2, figs. 13–14). Yet, these procedures (often based on debatable assumptions) form the basis for the author's selection of the species and names to be recognized. As has been pointed out elsewhere (Bour 2004), there are significant inconsistencies in the various hypothetical phylogenetic schemes presented (figs. 9, 36, 38).

The many details on morphology presented in the third chapter, particularly the comparative illustrations of various bony elements (figs. 44, 46–50), would have been considerably more valuable had they been accompanied by explanations not only of how the measurements were taken, but also the provenance, sex, size, etc. of the specimens measured and illustrated. Most hobbyists know that the size, shape, and relative proportions of a tortoise can be distorted—sometimes greatly—when it lives under certain conditions. Despite statements about allometric and isometric growth (pp. 41–45), much more information and analysis than is provided in the book is required to evaluate and understand these phenomena in the tortoises. Shapes and patterns of neural bones are notoriously variable in many chelonians (Pritchard 1988), so generalities about these features (p. 45) must be taken with great care, particularly when only small samples (e.g., two specimens per taxon) are available. Likewise, generalities about cranial morphology (p. 46), and suggestions about some tortoises having a "grinding action" during mastication—particularly when specimens are incomplete (and the samples on which the study is based are not explained)—need to be evaluated with caution. How much Crumly's (1982) seminal study of tortoise crania contributed to the book's description of giant tortoise skulls is not explained. Generalities about bony elements, and processes involved in their ontogeny, that are based on unspecified specimens, and evidently small numbers of specimens for species whose existence is not widely accepted in scholarly circles, must be considered with caution. In contrast to the lengthy details on bony elements to which the majority of the chapter on morphology is dedicated, the sections on skin, digestive system, penis, and heart are remarkably short and abbreviated. The intriguing question of gigantism is left to a couple of paragraphs.

The chapter on taxonomy occupies a quarter of the book. It begins with a reproduction of the fascinating cover from *The Illustrated London News* (ILN) of 5 July 1875, which shows two giant tortoises from the Seychelles. In his legend to this figure, the author determines that one of these tortoises was a female of one species and the other, a male of another species—a feat few people would attempt on the basis of just this old wood engraving.[iii] He lists six species in the genus "*Dipsochelys*," two of which are extinct species known from Madagascar. In addition to the Aldabra tortoise, called "*Dipsochelys dussumieri*" by the author, three other "species" are listed for the granitic Seychelles islands, of which he suggests one may be extinct. Additionally, five species of *Cylindraspis* are listed, this group being native to the Mascarene Islands. It is incredible that the binomial used most commonly in the hobbyist, and also scientific, publications for nearly fifty years to refer to the Aldabra giant tortoise—*Geochelone gigantea*—appears only a few times in the book, and is totally absent from the synonymy that is proposed (p. 67). This, and synonymies for other supposed species, is likely to greatly confuse the understanding of tortoise nomenclature and taxonomy.

The photographs of rarely seen type specimens are valuable, and a wealth of information is provided in the species synopses. However, it is bewildering that the nomenclature and taxonomy used in the book contradicts what has been used after careful research published recently in mainstream scientific journals (e.g., Austin and Arnold 2001; Palkovacs et al. 2002, 2003; Austin et al. 2002, 2003; Karanth et al. 2005)—even more so in that the author of the book is also a co-author on three of these peer-reviewed papers. Moreover, Roger Bour, an earlier proponent of resurrecting various names in disuse, and also author of the new name "*Dipsochelys arnoldi*" (Bour 1982) is a co-author of a recent study that concludes that only one species, *gigantea*, exists and has existed on Aldabra and the Seychelles (see Austin et al. 2003). Since the writings on giant tortoises by the early herpetological giants of the 18th, 19th and early 20th century, there has been a general realization that although species may be typified by certain external characteristics, there is still considerable intra-specific variability in skeletal, soft tissue, ecological, and behavioral characteristics (e.g., Rothschild 1915:428). In numerous parts of Gerlach's book, this general biological notion of the importance of intra-specific variability does not seem to be accepted. Indeed, as colleagues familiar with his work have observed, the author's rejec-

tion of recent findings from mainstream scientific research, even those with which he has collaborated as a co-author (e.g., Palkovacs et al. 2002, 2003; Karanth et al. 2005), suggests he has little faith in the scientific method, at least when the results contradict his conviction that he has rediscovered and saved the last remnants of two species of Seychelles tortoise (Gerlach 1998b).[iv]

While the tortoises of the Mascarenes are not the main subject matter of the book,[v] it is important to point out several anomalies. The claim that each of the three major Mascarene islands (Mauritius, Réunion, and Rodrigues) had two sympatric species of giant tortoises (p. 36, fig. 38) is a *faux pas* (that is corrected later on in the book). It contradicts recent scholarly research (Austin and Arnold 2001; Austin et al. 2002), which confirms two pairs of sympatric species, one on Mauritius and one on Rodrigues with but a single species on Réunion. The nomenclature and "phylogenetic scheme" presented for these animals (pp. 38, 99 ff.) are also at variance with recent studies published by various scholars in widely available professional journals (e.g., Austin and Arnold 2001; Austin et al. 2002). In the last named study, Roger Bour, author of *Cylindraspis borbonica* (1978), has accepted that his name is a junior synonym for *C. indica* Schneider, 1783, the extinct tortoise from Réunion. Yet, Gerlach's book lists only *C. borbonica* for the Réunion tortoise (p. 99), with no explanation of the other (older and available) names that have been applied (see Austin et al. 2002:284).

In summarizing the nomenclatural complexities involving giant tortoises, Bour (1984b:282–283) concluded that "[t]he peak of entanglement appeared with the publication of Lord Rothschild's (1915) work. But we willingly admit that this enthusiast did good both as a protectionist and popularizer." Perhaps he misjudged recent events. In the end, an enormous amount of time and effort has gone into debating what names to use for the giant tortoises of the Indian Ocean, a dubious situation this book will help sustain. "If all the time we all spend worrying about tortoise names were spent investigating their biology, they would be a very well studied group!" (Arnold *in litt*. 24 August 2005).

The chapter on ecology brings together much of the unique field work done on Aldabra Atoll over several decades, and the author rightly emphasizes the main limiting factors for tortoises on the Atoll: water, food, and shade. Yet, this chapter could be stronger. The narrative about shallow pools influenced by tidal ebb and flow (p. 119) confuses different types of phenomena affecting very different types of water bodies. Activity patterns of tortoises, at least on Aldabra and Curieuse, vary with size and sex of the animal, as well as with environmental conditions (Frazier 1972; Hambler 1994), so it is not clear how to interpret the book's generalized activity graphs—with no explanation of the individuals and conditions sampled (figs. 125–126; republished in Gerlach 2005). Thus, reported "differences in thermoregulatory behaviour between the three species of *Dipsochelys* giant tortoise" could be easily explained by differences in tortoise sizes and/or environmental conditions (e.g., Frazier 1972; Hambler 1994), but since these details are not provided one can only guess. The claim that "[r]egular basking behaviour has been observed in *D. arnoldi* only" contradicts extensive observations of giant tortoises on Aldabra (where the occurrence of "*Dipsochelys arnoldi*" has yet to be affirmed), and elsewhere, over periods of differing climatic conditions, where "basking" does occur, although not commonly. The descriptions of feeding are useful, although not without deficiencies. If the extensive work on wild tortoises on Aldabra is considered, it is clear that generalities about diet vary from place to place, from season to season, and between individuals, especially between different size classes (e.g., Frazier 1972; Gibson and Hamilton 1983). Hence, Gerlach's claims about species-specific differences in feeding behaviors (p. 139) need to be viewed within the context of the tremendous variation that occurs on just Aldabra. His interpretation that males mounted on other males are exhibiting conflict behavior (p. 135) is novel, and may be a gentlemanly way to avoid revealing that the extremely high libido in some male tortoises can result in them mounting just about anything, with just about any orientation (Frazier 1972). The concepts of "asocial" and "antisocial" behaviors (p. 135) are, despite the author's implications, very different.

Observations that age at maturity and reproductive effort vary with population density (pp. 138–139, 143) are critical, for they show yet again how plastic the biological features of these animals can be, with remarkable variation in physiology, growth, behavior, and morphology—all within individuals from the same population. Photos presented in support of species-specific differences in hatchling giant tortoises (figs. 145–147) are misleading, for the individuals shown are of different ages and sizes; the photo labeled as "*Dipsochelys arnoldi*" is comparable to some recently emerged hatchlings on Aldabra. Generalities about tortoises spending the first four years of their lives living in rock crevices (p. 147), while fascinating, do not tally with observations on Aldabra, nor with the fact that some of the areas on the Atoll with the highest density of tortoises are characterized by a pavement type of limestone, with a paucity of crevices (Grubb 1971). Speculation about rates of gene flow on Aldabra (p. 150, fig. 149) must be tempered with adequate studies; moreover, the displacement of animals in a dense population where successful reproduction is low is not the same as gene flow. Besides a number of points that are debatable, the order of ideas in this chapter is not always easy to follow.

As Bour (2004) explained, the chapter on history of giant tortoise discovery would seem more appropriate at the beginning of the book. In addition to the publications that Bour (2004) listed as missing from the historic treatment, a number of others could be added, including North-Coombes' (1991) intriguing account of early records from Rodrigues. Much of the historic information presented on the Seychelles seems to have come from Fauvel's (1909) impressive compilation of unpublished historic documents, although this detail is not mentioned in the book. The speculations about two sympatric tortoise species on the island of Mahé at the time of European discovery (pp. 162–163) are apparently supported primarily by the authors' intense conviction that he has rediscovered at least two species thought to have been extinct. The map depicting giant tortoise localities on Madagascar (fig. 157) is apparently, like several other parts of the book, based on the extensive research by Roger Bour. Unfortunately, it omits the northwestern localities (see Bour 1985: map 2, 1994:173, fig. 3), those that may be critical for explaining colonizations by these highly specialized tortoises onto the islands to the north (Austin et al. 2003).

The penultimate chapter on conservation is short, as Bour (2004) has pointed out. That captive rearing dominates its nine-and-a-

half pages, with enormous detail paid to tortoises in captive conditions, clearly shows the author's priorities. Yet, Gerlach himself admits that the long history of captive breeding has "played little part in conservation of Indian Ocean giants" (p. 179).

The final section, bibliography, brings together a useful compilation of sources of information on Indian Ocean giant tortoises from hobbyist magazines, unpublished theses and reports, old and hard-to-find writings, and also from the mainstream academic literature. The fact that several valuable publications were not included (Bour 2004) is not surprising given the vastness of the subject. Nonetheless, if the extensive scientific work done on Aldabra is to be considered, a number of scholarly publications would need to be included in a bibliography of Indian Ocean giant tortoises.

The bountiful color photos in the penultimate chapter, and throughout the book, are very effective in showing the beauty of the Seychelles and its wildlife, as well as providing an alluring travelogue style. Speculations on the origin and evolution of tortoises in the western Indian Ocean as well as other topics provide plenteous themes for years of careful research to test and tease apart the various assumptions and scenarios. Yet, assertions throughout the book, ranging from the stories of certain tectonic movements to variability in chromosomal base pairs, need to be evaluated on the basis of the best available information, not the author's passionate views regarding the creation of these captivating reptiles.

News that new species have been discovered, or "rediscovered," is routinely met with great interest. When combined with the need to save the animals from extinction, the topic takes on great public appeal, garnering support from diverse sectors, particularly the very dynamic community of tortoise breeders and hobbyists (e.g., Bruckers 1998; Devaux 1999), and often involving international celebrities, such as, in this case, Sir David Attenborough (Gerlach 2002). At one level there is an undeniable charm in being able to rediscover lost species and save them from extinction. However, the unrelenting insistence throughout the book to promote the existence of various living species of giant tortoise in the Seychelles flies in the face of diverse sources of scientific evidence and distracts from those contributions that the volume could make. Some conservationists in these incredible islands have pleaded for leaving the tortoises alone and getting on with other, more pressing priorities (Shah 2003).

As a continuation in the long line of popular literature on chelonians, this book is sure to be well-liked among the large, active community of herpetological enthusiasts,[vi] particularly tortoise aficionados. It may not fare so well in the scholarly community, where there is, early or late, a requirement for rigorous defense of claims and theoretical constructs, the clear separation of factual information from speculation, and theoretical discussion based on sources that have survived some form of academic review and critique. The book does make contributions, but tortoise students struggling to apply the scientific method may yet have to wait for that much-needed synopsis of Indian Ocean tortoises.

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NOTES

[i] Several researchers have expressed similar concerns about other publications by the same author on subjects including birds, tortoises, terrapins, land snails, and plants of the Seychelles (e.g., Hambler 1997; Beaver, *in litt*. 8 August 2005; Mortimer, *in litt*. 31 July 2005; 26 Jan 2006).

[ii] *Phelsuma* is "the scientific journal of The Nature Protection Trust of Seychelles [NPTS]," an active NGO in the Seychelles established by Ron Gerlach, the author's artist father, and passionate conservationist who lives on the island of Silhouette, Seychelles (Devaux 1999:20). This serial has published 12 volumes and 147 articles since its inception in 1992, where J. Gerlach has a prodigious publishing record, with 34% of all articles authored either solely or jointly by him; his work load also includes the editorship of the journal (<http://members.aol.com/jstgerlach/phelsuma.htm>), as well as running the Indian Ocean Biodiversity Assessment (Gerlach 2004; <http://members.aol.com/jstgerlach/jg.htm>).

[iii] For information on 19th century illustrations in the ILN see http://www.ilnpictures.co.uk/showpage.asp?showdocumentid=192

[iv] The tortoises identified as "the last remaining individuals of two nearly extinct species" are popular attractions for tourists, some of whom take helicopter rides from the main island of Mahé to Silhouette to see the NPTS tortoise project and facilities (Devaux 1999:20). The NPTS also organizes tours to view the tortoises and terrapins of Seychelles and solicits funds for adopting various tortoises kept by the Trust (Gerlach 2002).

[v] Indeed, the book's title "*Giant Tortoises of the Indian Ocean. The Genus* Dipsochelys *inhabiting the Seychelles Islands and the extinct giants of Madagascar and the Mascarenes*" could be misunderstood to mean that the Mascarene tortoises are part of the genus "*Dipsochelys.*"

[vi] Indeed, this attractively produced book is the product of the very active hobbyist community in Germany.