A re-appraisal of the taxonomy and conservation significance of a population of Grey-bellied Dunnart on Boullanger Island, Western Australia.

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Recently, confusion has occurred over the taxonomic identity of a dunnart on Boullanger Island (30°18'S, 115°02'E), Western Australia, following claims that it should be recognised as a distinct species. The following report summarises the background to this work, and reviews the issue of taxonomy and conservation significance of this taxon in light of recent evidence on its genetics and morphology.

Introduction

The *Sminthopsis 'murina* complex' of dunnarts have been recognised as five species following morphological and allozyme comparisons: *S. murina, S. griseoventer, S. dolichura, S. gilberti, and S. aitkeni* (Kitchener *et al.* 1984, Baverstock *et al.* 1982, 1984). A population of dunnarts on Boullanger Island, 2 km off the coast of Jurien, was considered to be different from *S. griseoventer*, and at risk of decline due to an invasion of house mice on the island.

An allozyme study by Lynam (1987) of 18 loci found there were diagnostic differences at three blood allozyme loci (LdH, Fum, Dia[1]) of sufficient magnitude (14%) used to recognise species status in other dasyurids (Baverstock *et al.* 1984, Dickman *et al.* 1988). Subsequent genetic work by Labrinidis *et al.* (1998) used genetic analyses on liver tissue to assess the systematic affinities and genetic diversity of *S. griseoventer* from mainland Australia with those on Boullanger Island. Using allozymes and mitochondrial DNA, they could not find any allozyme differences between island and mainland populations. In addition, mitochondrial DNA control region differences between island and mainland populations of *S. griseoventer*, often used to detect more recent genetic changes than allozyme data, also found no

[1] LdH: Lactate dehydrogenase, Fum: Fumarate hydratase, Dia: Diaphorase

differences between island and mainland populations. Subsequent work by Crowther *et al.* (in prep.) investigated morphological differences between island and mainland populations of *S. griseoventer*. They found differences based upon skull and body characteristics. Differences were recorded for pelage texture, head-vent versus tail-vent, and the presence or absence of entoconids on the lower second and third molars. Crowther *et al.* (in prep.) argued that the population of *S. griseoventer* on Boullanger Island should be recognised as a new and previously undescribed sub-species, and differences in allozyme results between their study and that of Labrinidis *et al.* (1998) may have been due to the use of different tissues and the inactivation of proteins in these tissues over time.

From a conservation and management perspective, the issue therefore arose as to the uniqueness and subsequent conservation significance of the Boullanger Island Dunnart (BID). The genetic work based upon allozymes was not consistent between the studies of Lynam (1987) and Labrinidis *et al.* (1998). However, if the BID is a unique taxon, then it is only found in one locality and could be listed as 'Critically Endangered' using IUCN criteria. It was therefore important to repeat the allozyme work for a third time, and using the same tissues (blood) as the initial study by Lynam (1987), to reassess the degree of similarity or difference between island and mainland populations of *S. griseoventer*.

Methods and Results

Samples of blood tissue from *S. griseoventer* were collected from Boullanger Island (n=6) and from Manjimup in south-west Western Australia (lat/long, n=6). Pit-trapping was conducted in Mt Lesueur National Park (30°18'S, 115°13'E), opposite Boullanger Island: of 808 trap-nights, no dunnarts were captured. Those from Manjimup were confirmed as *S. griseoventer* by tooth morphology characteristics (upper deciduous premolar 4). Blood was spun to separate the plasma and red blood cells, stored at -70°C, and later shipped on dry ice to the Evolutionary Biology Unit (South Australia) for allozyme work. Each allozyme was run under five different buffer systems, because some allozyme differences can be cryptic under one set of electrical conditions but be apparent under another. In addition, head-vent (HV) and tail-vent

(TV) measures of live dunnarts from Boullanger Island and Manjimup were collected, as these were one distinguishing character used to separate the BID (HV<TV) from mainland species of *S. griseoventer* (HV>TV).

The allozyme results were consistent with those repeated earlier using liver tissue, and could not identify differences between BID and mainland *S. griseoventer*. A total of 10 loci were scored, and seven were identical between island and mainland samples of dunnart. Of the three key loci, LdH and Fum only showed one allozyme under all sets of conditions applied (ie. no differences between island and mainland dunnarts). The other key locus, Dia, was not previously re-run because it is red cell specific. However, using red blood cells and under the present allozyme conditions, this locus was polymorphic and exhibited three alleles (a, b, c). Specimens sampled from Boullanger Island only had one genotype (cc), whereas those from Manjimup had three genotypes (ab, bc, cc). Although differences exist at the Dia locus, these were not unique to the island population.

Reproduced below are measurements of HV and TV taken from live specimens of adult dunnarts from Boullanger Island, and from sub-adults from Manjimup. The females at Boullanger Island all had pouch young. Recognise that HV measures would be underestimated due to difficulties in stretching out a live animal. Although TV measures for island animals sampled seem greater than the HV measures, there are no significant differences between them (t_{12}= -1.28, *P*(one-tailed)=0.11). Similarly, there are no significant differences (t_{10}=0.61, *P*(one-tailed)=0.27) between HV and TV measures for sub-adult *S. griseoventer* collected from Manjimup (although measures are restricted to sub-adult individuals and their body allometry may change with age).

	Boullanger Island				Manjimup		
Sex	Body mass (g)	HV (mm)	TV (mm)	Sex	Body mass (g)	HV (mm)	TV (mm)
f	17.5	88	88.9	m	11	56.3	45.1
f	16.5	84.3	85.1	m	12	59.1	57.8
f	21	85.8	86.5	f	14	82.9	80.3
m	18	85	85.2	m	12.5	64.6	58.8
f	22	91	88.6	m	11.5	55.3	53.1
f	21	86	91.9	f	12	57	56.4
f	23	84	89.8				
Mean	19.8	86.3	88	Mean		62.5	58.6
(±SD)	2.5	2.5	2.5	(±SD)		10.5	11.7

The mtDNA data show no significant separation between island and mainland *S. griseoventer*, and therefore, give no support for differences between BIDs and *S. griseoventer*. Furthermore, the allozyme data show that there are no fixed differences between island populations of *Sminthopsis griseoventer* and those sampled from Manjimup in south-west Western Australia. These results are consistent with the previous allozymes obtained from liver tissue. The dunnarts on Boullanger Island have become fixed at the Dia locus for what may have been a common allele in that region prior to the isolation of the island. Taken together, there is no evidence to suggest differences between island and mainland (sampled) populations of *S. griseoventer* based upon genetic criteria.

There is ample evidence in the literature indicating morphological differences between island and mainland populations of the same species. Island mammals, particularly rodents, tend to undergo gigantism effects in island environments compared to mainland species. For example, the Thevenard Island form of short-tailed mouse, *Leggadina lakedownensis*, is larger than those on the mainland. Skull measurements show a clinal variation, with large to small animals ranging from the Pilbara to the Kimberley (N. Cooper, Western Australian Museum, pers. comm.). The Boullanger Island dunnart is likely to be an island variant of *S. griseoventer* that has simply lost some meristic features (eg. entoconids) which may be selected against, or have been lost due to bottleneck and founder events from animals that originally colonised the island. Two species in the *S. murina* group have lost entoconids (*S. dolichura, S. gilberti*), so it seems to be a fairly 'soft' character. Perhaps the Boullanger Island dunnart exhibits clinal variation in skull or even tail morphology?

The head-vent and tail-vent differences do not seem to be reliable for use in the field, since there were no significant differences between them for either island or mainland specimens. There are, however, some cranial meristic characters that differ between island and mainland *S. griseoventer*, in particular, the absence of entoconids on the lower M_2 and M_3 in island forms.

Should the island population of *S. griseoventer* be recognised as a sub-species? It is important to understand the patterns of variation within *S. griseoventer* before simply applying a taxonomic label to one of its populations, and the recognition of a taxonomic entity should not become an end to itself. It is also important to be aware of the consequences of applying a name to a taxon. First and foremost, there should be a need for doing so. The recognition a distinct and possibly endemic sub-species of *S. griseoventer* on Boullanger Island places the population either under the IUCN 'Critically Endangered' category if it is considered to be declining, or under the 'Vulnerable' category if it is not declining. From a management perspective, doing so may funnel already tight funding away from those taxa which are genetically and morphologically much more distinct, and in need of immediate management for their conservation. During pre-molecular science days, 'sub-species' was a term used to separate populations based upon morphological differences and geographic isolation. Now, the issue is to understand whether morphological differences between populations correspond to underlying genetic structure. With the advantages offered by genetic techniques, we are afforded the ability to compare between populations using both morphological and genetic characters. I prefer to use the terms Evolutionary Significant Unit and Management Unit when comparing genetic variation between populations (as defined by Ryder 1986 and Moritz 1994), because these identify historic patterns and relationships between groups and identify groups that may be demographically different yet genetically similar. Using genetic information to date, I can identify only one Management Unit within *S. griseoventer* (identity of an Evolutionary Significant Unit requires information from a nuclear locus, which allozymes do not provide), and this incorporates populations from mainland Western Australia and those from Boullanger Island.

In conclusion, there is limited evidence to date that lends support to the hypothesis that the BID is sufficiently different from mainland populations of *S. griseoventer* as to be considered a new taxon. The evidence available so far suggests the BID is simply an island variant of *S. griseoventer*. Consequently, it should not be recognised as a new taxon.

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References

Baverstock, P. R., Archer, M., Adams, M. and Richardson, B. J. (1982). Genetic relationships among 32 species of Australian Dasyurid marsupials. in Carnivorous Marsupials. M. Archer (ed). Pp 641-650. Royal Zoological Society of New South Wales, Sydney.

Baverstock, P. R., Adams, M. and Archer, M. (1984). Electrophoretic resolution of species boundaries in the *Sminthopsis murina* complex (Dasyuridae). Aust. J. Zool. 32: 823-832.

Crowther, M. S., Dickman, C. R. and Lynam, A. J. *Sminthopsis griseoventer boullangerensis* (Marsupialia: Dasyuridae), a new subspecies in the *S. murina* complex from Boullanger Island, Western Australia. (in prep.).

Dickman, C. R., King, D. H., Adams, M. and Baverstock, P. R. (1988). Electrophoretic identification of a new species of *Antechinus* (Marsupialia: Dasyuridae) in south-eastern Australia. Aust. J. Zool. 36: 455-463.

Labrinidis, A., Cooper, S.J.B., Adams, M. and Baczocha, N. (1998). Systematic affinities of island and mainland populations of the Dunnart *Sminthopsis griseoventer* in Western Australia: data from allozymes and mitochondrial DNA. Pac. Conserv. Biol. 4: 289-295.

Lynam, A. J. (1987). Inbreeding and juvenile dispersal in insular populations of two dasyurid marsupials, the dibbler, *Parantechinus apicalis*, and the grey-bellied dunnart, *Sminthopsis griseoventer*. BSc Honours Thesis, University of Western Australia.

Moritz, C. (1994). Defining "Evolutionary Significant Units" for conservation. TREE 9: 373-375.

Ryder, O. A. (1986). Species conservation and systematics: the dilemma of subspecies. TREE 1: 9-10.