Agreement on the Conservation of Albatrosses and Petrels

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Report of the Taxonomy Working Group (TWG) to AC5

Members of the Taxonomy Working Group

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1. BACKGROUND

Article IX 6 (b) of the Agreement on the Conservation of Albatrosses and Petrels (ACAP) requires the Advisory Committee to "endorse a standard reference text listing the taxonomy and maintain a listing of taxonomic synonyms for all species covered by the Agreement".

Resolution 1.5 of the First Session of the Meeting of the Parties (MoP1) to ACAP provides for the establishment by the Advisory Committee of a Working Group on the taxonomy of albatross and petrel species covered by the Agreement.

The objective of the Working Group was to establish a transparent, defensible and highly consultative taxonomic listing process. The Scientific Meeting that preceded the first meeting of Parties (MoP1; ScM1; Section 4.3) stated that "…given the importance that species lists have upon conservation policy and scientific communication, taxonomic decisions must be based on robust and defensible criteria. It is important to resolve differences in a scientific and transparent manner with appropriate use of peer-reviewed publications."

The Terms of Reference for the Taxonomy Working groups are presented in AC4 Doc 12 Attachment 3.

The first action for this WG was to agree on a set of guidelines for taxonomic decision-making (AC2 Doc 11). These guidelines are based on those described by Helbig *et al.* (2002) of the taxonomic sub-committee of the British Ornithologists' Union and justify the adoption of a particular species concept and make the decision-making process transparent. They facilitate the assessment and assimilation of potentially influential studies while guarding against poor science. The guidelines also consider the inevitable limitations of species lists and the benefits of taxonomic stability.

2. TWG WORK PROGRAMME 2008/10

The 2008/10 TWG Work Programme included:

a. Review of the taxonomic status of the Tristan and Wandering Albatross species;
b. Review of recent publications pertinent to albatross and petrel taxonomy;
c. Continue the establishment of a morphometric and plumage database to facilitate the taxonomic process, the identification of bycatch specimens, and the long-term storage of valuable data;
d. Continue to update the Taxonomy Working Group's web-based bibliographic database.

3. REVIEW OF TAXONOMIC DATA AND JUSTIFICATION OF TAXONOMIC DECISIONS

Tristan and Wandering Albatross

For convenience, Wandering Albatross and Tristan Albatross are sometimes referred to as *exulans* and *dabbenena* respectively.

Recent taxonomic history

First described as a separate taxa by Dabbene in 1926, *Diomedea chionoptera alexanderi* was later recognised by Mathews (1929) as a separate species (and renamed *dabbenena)* that is sister to the larger *chionoptera (*now named *D. exulans)*. Debate over the taxonomic status of these taxa has continued since, with the taxa recognised as separate species or subspecies (Bourne 1989; Warham 1990).

Subsequent molecular studies (Nunn & Stanley 1998) established *dabbenena* as the sister taxon to *exulans*. Based on morphology and genetic data, Robertson & Nunn (1998) argued that *dabbenena* should be recognised as a separate species. Further genetic studies by Burg & Croxall (2004) supported the findings of Nunn & Stanley (1998). Burg & Croxall (2004) also argued their data supported recognising *dabbenena* at the species level. In contrast, Penhallurick & Wink (2004) and subsequently Christidis & Boles (2008) questioned the validity of splitting the Wandering complex into separate species because of the low genetic distances between the taxa. This genetic-distance approach to taxonomy was severely criticised by Rheindt & Austin (2005).

Primary publications or reviews of data relevant to the great albatross taxonomy

1. **Nunn & Stanley (1998)** provided the first molecular evidence that *dabbenena* and *exulans* were very closely related but distinct.
2. **Cuthbert *et al.* (2003)** provided the first detailed morphometric analysis of *dabbenena* and *exulans*. *D. exulans* was significantly larger across all measurements although the smallest female *exulans* overlapped with the largest male *dabbenena*. If sex is known then bill length alone can be used to identify *dabbenena* from *exulans.*
3. **Burg & Croxall (2004)** supported earlier findings that *dabbenena* was the most distant of the Wandering albatross taxa to *exulans* and that *dabbenena* did not group more closely with the other smaller Wandering Albatross such as *D. amsterdamensis* or *D. antipodensis.*
4. **Penhallurick & Wink (2004),** noting the slight molecular differences, suggested that *dabbenena* be considered as a subspecies of *exulans.* Christidis & Boles (2008) follow this approach.
5. **Rheindt & Austin (2005)** were highly critical of Penhallurick & Wink's tendency to 'lump' taxa based on genetic distance and an arbitrary 'benchmark' but these authors did not comment specifically on the issue of *dabbenena/exulans*.
6. **Chambers *et al.* (2009)** further support the findings of Nunn & Stanley (1998)**.**

Assessment of diagnosability

A. Same age/sex individuals of *dabbenena* and *exulans (sensu stricto)* **cannot** be distinguished by one or more qualitative differences.

B. Same age/sex individuals of *dabbenena* and *exulans (sensu stricto)* **can** be distinguished by a complete discontinuity in one or more continuously varying characters (morphology).
C. Same age/sex individuals of *dabbenena* and *exulans (sensu stricto)* **can** be distinguished by a combination of two or three functionally independent characters (morphology, mtDNA).

Decision
The genetic and morphometric data argue strongly in favour of diagnosability. It should be noted however that *dabbenena* is more difficult to distinguish from the other smaller taxa within the Wandering Albatross complex, *antipodensis* and *amsterdamensis.* However, molecular data (Nunn & Stanley 1998; Burg & Croxall 2004; Chambers *et al.* 2009) suggest that *dabbenena* is a sister taxon to *exulans* and that *amsterdamensis* and *antipodensis* are less closely related to *dabbenena* despite their similarity in size.

Tristan and Wandering Albatrosses are clearly diagnosable and should be retained as two full species:
Tristan Albatross *Diomedea dabbenena*
Wandering Albatross *Diomedea exulans*

This is the position adopted by most of the recent synoptic works on the Procellariiformes (e.g. Brooke 2004; Onley & Scofield 2007) but see Penhallurick & Wink (2004) and Christidis & Boles (2008).

Also noteworthy is that as yet unpublished data (Ryan, Cuthbert & Phillips) show little overlap between the Gibson plumage scores of *dabbenena* and *exulans* from the South Atlantic after controlling for age and sex. However, there is variation in plumage maturation rates among colonies of *exulans* birds from the South Atlantic whitening more rapidly than birds from Ile Possession, Crozet Islands.

The TWG has now completed its first full review of the taxonomic issues associated with the species currently listed under Annex 1 of the Agreement.

Amendments to Annex 1

The TWG notes that MoP3 (2009) passed a resolution that added three albatross species to Annex 1 of the Agreement (MOP3 Final Report, Paragraph 7.3.3). The three species were the Short-tailed Albatross (*Phoebastria albatrus*), the Laysan Albatross (*Phoebastria immutabilis*) and the Black-footed Albatross (*Phoebastria nigripes*). The TWG acknowledges that there is little or no taxonomic debate relating to these three long-recognised species (Brooke 2004).

The TWG also notes that MoP3 (2009) recommended the scientific name of the Black-browed Albatross be amended from *Thalassarche melanophrys* to *Thalassarche melanophris* supposedly based on a decision by the International Commission on Zoological Nomenclature. At the time of writing, this case (Case 3449) is still being voted upon by the ICZN.

4. OTHER ITEMS ON THE 2008/10 WORK PROGRAMME

Review of recent publications pertinent to albatross and petrel taxonomy

The taxonomy adopted by ACAP has been the subject of review and modification since 2006. Although papers published since 2006 have been considered in the reviews of sister taxa, the TWG has provided little commentary on recent synthetic publications on albatross taxonomy. Here we comment on five such books or papers published since 2006.

1. Chambers *et al.* (2009) present an extended analysis of mtDNA cytochrome-b sequences for all ACAP listed taxa. Their contributions are 1) to set the phylogenetic data analysis on a sound footing (cf. Rheindt & Austin 2005) and 2) to add DNA sequence data for *Thalassarche bulleri platei* and *T. steadi*. Their phylogenetic tree places these two taxa adjacent to their sister taxa, *T. b. bulleri* and *T. cauta*, with minimal separation, 0.09% and 0.18%, respectively based on uncorrected *p* distances. The report examines the role of molecular data and species concepts in albatross taxonomy and follows ACAP in naming taxa, including the controversial *T. cauta/steadi* split on the balance of other biological and genetic evidence.

The authors also point out that there is probably good reason to split two other pairs, *T. bulleri/platei* and *Diomedea antipodensis/gibsoni*, but that reliable, published, peer-reviewed evidence is presently lacking (but see van Bekkum 2004).

The primary author of this paper is a member of the TWG.

2. OSNZ Checklist Committee, B. J. Gill convenor (in press) is a fully annotated checklist of the birds of the New Zealand biogeographical region and limited to albatross taxa that occur there (i.e. 20 of the 24 albatross taxa on the expanded ACAP list). Their taxonomic analysis is exhaustive, fully referenced and follows explicitly stated policy on classification and species concepts (pp. 3-4). The work acknowledges the taxonomic decisions made by Christidis & Boles (2008) book (p.1) but frequently notes differences of opinion and differences in the treatment of available data. Overall, the OSNZ taxonomy is concordant with the taxonomy currently used by ACAP with the single exception of recognising *T. cauta* and *T. steadi* as subspecies of *T. cauta*. This is done on the basis that Abbott & Double (2003b; 2003a) show that the Tasmanian population (i.e. *T. c. cauta* according to OSNZ, 2010) is originally derived from a small number of New Zealand *T. c. steadi* colonists.

Chambers and Scofield (see below) are members of the OSNZ Checklist Committee.

3. Christidis & Boles (2008) is a fully referenced annotated checklist of Australian birds published as a book by CSIRO (Commonwealth Science and Industrial Research Organisation). It does not include all ACAP listed taxa, since not all of them occur in Australian waters. The authors summarise the past taxonomic treatment of the Family Diomedeidae and recent genetic research. The outcome of their review is not clear because no explicit statements are made regarding their conclusions. Their species list would suggest they favour the views and approach of Penhallurick & Wink (2004) who argue that taxonomists should not accept at the species level ‘forms that differ markedly in their level of genetic differentiation.’(p.86). This stands in marked contrast to the opening statements by Christidis & Boles on species concepts (p.9) which call for

a total evidence approach. In their review of the Family Diomedeidae, Christidis & Boles only consider genetic data in any detail (pp.84-87).

Their recommendations are presented in tabular form on p. 87 and in their species list on pp. 17-18. Based on their treatment they recognise only a single shy, royal, wandering, yellow-nosed and black-browed albatross species. They note the apparent requirement for new name for the taxon presently known as *platei* but do not offer suggestions. They do, however, maintain that it should be retained as a subspecies of *T. bulleri*.

4. Onley & Scofield (2007) is a field guide to the world's Procellariiformes but it also provides some commentary on taxonomy, morphology, biology however there are relatively few references to published work. Their species list is also concordant with the taxonomy currently used by ACAP but again with the single exception of recognising *T. cauta* and *T. steadi* as subspecies of *T. cauta*. They refer to the molecular data of Abbott & Double (2003b; 2003a) and acknowledge that these data may be indicative of individual species status for *T. cauta* and *T. steadi* but note that the authors did not make any specific taxonomic recommendation in their paper.

5. Lindsey (2008) is serious text for the popular audience published by CSIRO in their Australian Natural History Series. The author examines the molecular and biological evidence for albatross classification (pp. 11-19) but ultimately follows a 13-species taxonomy after Penhallurick and Wink (2004). Their subdivisions are confusingly called 'populations' (pp. 114-115) and then re-titled more conventionally as subspecies (pp. 116-117), but are then not distinguished from species.

Discussion
Three out of the five above works summarised above are generally in agreement with the current ACAP taxonomy but we recognise that the authors of these works are not independent of the TWG. The most scholarly and influential of the remaining two publications is that of Christidis & Boles (2008). The TWG acknowledges the impressive scope of the work published by these well-respected avian taxonomists but it is our opinion that they sometimes apply a contradictory and uncritical genetic-distance based approach to taxonomy. The albatross species recognised by Christidis & Boles (2008) would suggest they are swayed by the views and approach of Penhallurick & Wink (2004) who recognise taxa at the species level entirely based on genetic distances at a single gene and without any consideration of other informative data. Penhallurick & Wink (2004) do not recognise taxa at the species level unless the genetic distance is 'sufficient' but their determination of sufficient is based on the genetic distance between arbitrarily selected 'good species'. That two taxa must reach a threshold of genetic divergence at a single gene before being recognised as separate species, irrespective of other informative data, is an taxonomic approach that has been severely criticised in the literature (Rheindt & Austin 2005).

Importantly, Christidis & Boles (2008) do diverge from Penhallurick & Wink (2004) in recognising Northern and Southern Giant Petrels as separate species despite their low genetic divergence (0.6% at cytochrome b gene). These Giant Petrels represent one of the few cases among the albatrosses and petrels where contentious sister taxa breed sympatrically and so

perhaps where non-genetic data are more difficult to ignore. The behavioural, ecological and genetic data show these taxa are distinct (González-Solís *et al.* 2000; González-Solís *et al.* 2002a; González-Solís *et al.* 2002b; Techow *et al.* 2010) which is perhaps why, in this case, Christidis & Boles do not apply the rules of uniform genetic divergence between species as espoused by Penhallurick & Wink.

Although the Giant Petrels belong to a different family to the albatross it is our view that this case highlights that using genetic distances alone to delineate albatross species will not necessarily produce a sensible and defendable taxonomy. Even if some taxa are less divergent than so-called 'good species' they should not be precluded from species status if other evidence suggests they are morphologically, ecologically, behaviourally and genetically distinct.

These five publications highlight the lack of consensus on albatross taxonomy. Essentially two schools of thought remain, those who place a strong emphasis on the taxonomic information provided by the level of sequence divergence at a single mitochondrial gene (e.g. Penhallurick & Wink 2004; Christidis & Boles 2008) and those that also assess information provided by morphology, plumage, breeding phenology, breeding behaviour, distribution, feeding behaviour and phylogeography (e.g. Robertson & Nunn 1998; Brooke 2004; Burg & Croxall 2004; Rheindt & Austin 2005). The TWG prefers the latter approach as explained in AC2 Doc 11 because through assessing all available evidence the taxonomy is more likely to reflect the observed biodiversity and differentiation.

As acknowledged by the TWG previously, the specific status of *T. cauta* and *T. steadi* requires close attention given their close genetic relationship coupled with the arguments in OSNZ (2010). In contrast Chambers *et al.* (2009) point out that the key diagnostic is the lack of overlap in mtDNA haplotypes between the two taxa which implies the existence of an effective barrier to mating between them as recognised by ACAP (2006) and the original authors (Abbott & Double 2003b; Abbott & Double 2003a). Consequently, at present there would seem to be no compelling reason for ACAP to revise its position on these taxa, but it would be prudent for the TWG to keep them under review together with the subspecies of *D. antipodensis* and *T. bulleri*.

The present phylogenetic tree based on cytochrome-b sequence data probably represents a robust and stable arrangement of taxa but must still be regarded as provisional in relation to taxonomy. Full resolution of the tree will probably require multiple nuclear gene sequences from several individuals from each breeding population sampled at source. While such data are not likely to be immediately forthcoming, it is to be hoped that ACAP will support such research.

Continue the establishment of a morphometric and plumage database to facilitate the taxonomic process, the identification of bycatch specimens, and the long-term storage of valuable data;

A proposal for the architecture and management of an ACAP morphometric and plumage database was presented to AC4 in AC4 Doc12. This database is now under construction in the 'Prototype' section of ACAP's web-based Data Portal (http://data.acap.aq/). To assist the further development of the database 640 morphometric records were very generously provided by R. Gales (DPIPWE, Tasmanian Government). The TWG will continue to liaise with the database

developer and the ACAP Secretariat to finish the development phase. It will then approach all potential data holders and encourage submission of their data to ACAP.

Maintain the WG's bibliographic database of published scientific papers relevant to the taxonomic status of ACAP listed taxa

The bibliographic database has been updated to include all the new references identified in the latest taxonomic assessments. This database and associated pdf files of the references is available to the ACAP Secretariat and the TWG.

5. OTHER BUSINESS

ACAP is a 'daughter agreement' of the Convention on Migratory Species (CMS). The CMS has not reviewed its albatross and petrel taxonomy for many years and so the taxonomy of the CMS and ACAP are not concordant. At the CMS COP9 meeting Parties requested the Scientific Council, through Recommendation 9.4, to consider the implications of adopting the taxonomic list in Annex 1 of ACAP as the Convention's standard nomenclatural reference for albatrosses and large petrels.

The CMS Secretariat has drafted a document to facilitate the discussions during the 16th Scientific Council Meeting, scheduled to be held on June 2010. The CMS has approached the TWG to review this document. In addition to this document, the TWG suggests that it may be helpful if the AC or the ACAP Secretariat, with the assistance of the TWG, provide its own document to assist the discussions of the Scientific Council.

6. RECOMMENDATIONS

The Taxonomy Working Group will continue to work on the relevant items in the AC's work programme provided by the Meeting of Parties. In addition, it will respond to CMS Scientific Committee (see Item 5 above) and will consider ways of influencing other regional/global taxonomy decision committees/groups.

7. REFERENCES

Abbott, C. L. & Double, M. C. (2003a). Genetic structure, conservation genetics, and evidence of speciation by range expansion in shy and white-capped albatrosses. *Molecular Ecology* **12**:2953-2962.

Abbott, C. L. & Double, M. C. (2003b). Phylogeography of shy and white-capped albatrosses inferred from mitochondrial DNA sequences: implications for population history and taxonomy. *Molecular Ecology* **12**:2747-2758.

Bourne, W. R. P. (1989). The evolution, classification and nomenclature of the great albatrosses. *Gerfaut* **79**:105-116.

Brooke, M. (2004). 'Albatrosses and petrels across the world.' (Oxford University Press: Oxford).

Burg, T. M. & Croxall, J. P. (2004). Global population structure and taxonomy of the wandering albatross species complex. *Molecular Ecology* **13**:2345-2355.

Chambers, G. K., Moeke, C., Steel, R. & Trueman, J. W. H. (2009). Phylogenetic analysis of the 24 named albatross taxa based on full mitochondrial cytochrome b DNA sequences. *Notornis* **56**:82-94.

Christidis, L. & Boles, W. E. (2008). 'Systematics and Taxonomy of Australian Birds.' (CSIRO Publishing: Melbourne).

Cuthbert, R. J., Phillips, R. A. & Ryan, P. G. (2003). Separating the Tristan albatross and the wandering albatross using morphometric measurements. *Waterbirds* **26**:338-344.

González-Solís, J., Croxall, J. P. & Briggs, D. R. (2002a). Activity patterns of giant petrels, *Macronectes* spp., using different foraging strategies. *Marine Biology* **140**:197-204.

González-Solís, J., Croxall, J. P. & Wood, A. G. (2000). Foraging partitioning between giant petrels Macronectes spp. and its relationship with breeding population changes at Bird Island, South Georgia. *Marine Ecology-Progress Series* **204**:279-288.

González-Solís, J., Sanpera, C. & Ruiz, X. (2002b). Metals and selenium as bioindicators of geographic and trophic segregation in giant petrels Macronectes spp. *Marine Ecology-Progress Series* **244**:257-264.

Helbig, A. J., Knox, A. K., Parkin, D. T., Sangster, G. & Collinson, M. (2002). Guidelines for assigning species rank. *Ibis* **144**:518-525.

Lindsey, T. (2008). 'Albatrosses.' (CSIRO Publishing: Melbourne).

Mathews, L. H. (1929). Birds of South Georgia. *Discovery Rep* **1**:561-592.

Nunn, G. B. & Stanley, S. E. (1998). Body size effects and rates of cytochrome b evolution in tube-nosed seabirds. *Molecular Biology & Evolution* **15**:1360-1371.

Onley, D. & Scofield, P. (2007). 'Albatrosses, Petrels and Shearwaters of the World.' (Christopher Helm: London).

OSNZ Checklist Committee – B. J. Gill Convener (in press). 'Checklist of the Birds of New Zealand, Norfolk and Macquarie Islands, and the Ross Dependency, Antarctica '. (Te Papa Press and OSNZ: Wellington).

Penhallurick, J. & Wink, M. (2004). Analysis of the taxonomy and nomenclature of the Procellariiformes based on complete nucleotide sequences of the mitochondrial cytochrome *b* gene. *Emu* **104**:125-147.

Rheindt, F. E. & Austin, J. J. (2005). Major analytical and conceptual shortcomings in a recent taxonomic revision of the Procellariiformes - a reply to Penhallurick and Wink (2004). *Emu* **105**:181-186.

Robertson, C. J. & Nunn, G. B. (1998). Towards a new taxonomy for albatrosses. In: 'Albatross biology and conservation' (Ed. G. Robertson and R. Gales.) pp. 13-19. Surrey Beatty & Sons: Chipping Norton.

Techow, N. M. S. M., O'Ryan, C., Phillips, R. A., Gales, R., Marin, M., Patterson-Fraser, D., Quintana, F., Ritz, M. S., Thompson, D. R., Wanless, R. M., Weimerskirch, H. & Ryan, P.G. (2010). Speciation and phylogeography of giant petrels Macronectes. *Molecular Phylogenetics and Evolution* **54**:472-487.

van Bekkum, M. 2004. Microsatellite DNA analysis of breeding behaviour in Bullers's albatross, *Thalassarche bulleri* Thesis. Victoria University of Wellington, Wellington, New Zealand.

Warham, J. (1990). 'The petrels - their ecology and breeding systems.' (Academic Press: London).

Attachment 1

Species currently listed under Annex 1 of the Agreement on the Conservation of Albatrosses and petrels (ACAP)

Family Diomedeidae Albatrosses		
1	*Diomedea exulans*	Wandering Albatross
2	*Diomedea dabbenena*	Tristan Albatross
3	*Diomedea antipodensis*	Antipodean Albatross
4	*Diomedea amsterdamensis*	Amsterdam Albatross
5	*Diomedea epomophora*	Southern Royal Albatross
6	*Diomedea sanfordi*	Northern Royal Albatross
7	*Phoebastria irrorata*	Waved Albatross
8	*Phoebastria albatrus*	Short-tailed Albatross
9	*Phoebastria immutabilis*	Laysan Albatross
10	*Phoebastria nigripes*	Black-footed Albatross
11	*Thalassarche cauta*	Shy Albatross
12	*Thalassarche steadi*	White-capped Albatross
13	*Thalassarche salvini*	Salvin's Albatross
14	*Thalassarche eremita*	Chatham Albatross
15	*Thalassarche bulleri*	Buller's Albatross
16	*Thalassarche chrysostoma*	Grey-headed Albatross
17	*Thalassarche melanophris*	Black-browed Albatross
18	*Thalassarche impavida*	Campbell Albatross
19	*Thalassarche carteri*	Indian Yellow-nosed Albatross
20	*Thalassarche chlororhynchos*	Atlantic Yellow-nosed Albatross
21	*Phoebetria fusca*	Sooty Albatross
22	*Phoebetria palpebrata*	Light-mantled Albatross

Family Procellariidae - Petrels		
23	*Macronectes giganteus*	Southern Giant-petrel
24	*Macronectes halli*	Northern Giant-petrel
25	*Procellaria aequinoctialis*	White-chinned Petrel
26	*Procellaria conspicillata*	Spectacled Petrel
27	*Procellaria parkinsoni*	Black Petrel
28	*Procellaria westlandica*	Westland Petrel
29	*Procellaria cinerea*	Grey Petrel