Convention sur la conservation des espèces migratrices appartenant à la faune sauvage

Secrétariat assuré par le Programme des Nations Unies pour l'Environnement

Douzième réunion du Conseil scientifique de la CMS

31 mars-3 avril 2004, Glasgow, Ecosse, Royaume-Uni

CMS/ScC.12/Doc.13
Agenda item 6.1

REPORT ON A FEASIBILITY STUDY ON ADDITIONAL BATS AGREEMENTS UNDER CMS

(*Prepared by the Secretariat*)

1. Les chauves-souris sont des composantes clés de la biodiversité à travers le monde, en particulier dans les zones tropicales et arides, où elles contribuent à la structure et la fonction des écosystèmes. Les espèces de chauves-souris représentent approximativement 25% de toutes les espèces de mammifères. A ce jour, seule une espèce, *Tadarida brasiliensis*, figure à l'annexe I de la CMS. Pourtant, sur un effectif approximatif de 1 100 espèces de chauves-souris, environ 22% sont considérées comme menacées, et 25% de plus sont quasiment menacées selon les informations reçues par le Secrétariat.

2. L'objectif opérationnel 1.5 (Chauves-souris) du Plan stratégique de la CMS (2000-2005) est "d'encourager des actions concertées en faveur de toutes les espèces de chauves-souris menacées figurant à l'annexe I et identifiées comme priorité d'action concertée et d'étudier les besoins et les possibilités d'élaboration d'accords pour la protection des chauves-souris hors d'Europe."

3. En conséquence, au début de 2002, le Secrétariat a commandé une étude à M. Tony Huston, co-président du Groupe de spécialistes sur les chiroptères de l'UICN , sur la faisabilité de l'élaboration d'accords supplémentaires de la CMS sur les chauves souris. Les objectifs de cette étude étaient les suivants : a) identifier au moins une zone biogéographique pour un accord futur de la CMS sur les chauves-souris (migratrices et non migratrices); b) identifier les espèces de chauves-souris migratrices qui pourraient être inscrites aux annexes de la CMS; c) identifier des experts et des organisations intéressées qui pourraient appuyer le travail ultérieur de la CMS sur d'éventuels accords sur les chauves-souris.

4. The study was presented to the Scientific Council at its 11th Meeting and the Council heard a presentation from Mr Hutson. The Council took note of the report and encouraged the Secretariat to continue its activities in that field, including the development of further agreements on bats. The Chair expressed the interest in pursuing a substantive discussion on bats at the Council's 12th Meeting.

5. The Conference of the Parties (COP) at its Seventh Meeting was provided the study. The COP: (a) took note of the study; (b) encouraged the Secretariat to continue its activities in this field, including exploring the potential to develop further CMS Agreements on bats; (c) invited the Scientific Council to have a substantial discussion on bats at its next meeting; and (d) invited the Parties to consider developing and submitting proposals to list additional bat species in the CMS Appendices.

6. To support the Council's further consideration of bats, Mr Hutson graciously offered to update the study at no cost to the Convention. The study was re-circulated for additional comments in late 2003. The comments received are presented as an addendum to the original study. Both documents are attached to this note and are presented to the Council for its further consideration. The Secretariat regrets that because of the length of the study, neither it, nor the addendum, were translated due to budgetary considerations. However, the Study's executive summary has been translated into Spanish and French.

7. It should be noted that the study and addendum should be read in conjunction with ScC12/Doc.12 (Draft proposals for the inclusion of bat species on CMS Appendices). The draft listing proposals were developed by Mr Hutson on behalf of the CMS Secretariat in order to pre-identify species that, based on the scientific knowledge available, would appear to be eligible for listing on the CMS Appendices. They have been submitted to the Scientific Council and will be considered under agenda item 5. Based on a positive evaluation from the Scientific Council, the Secretariat will address appropriate Parties and invite them to consider and subsequently submit the proposals to the Eighth Meeting of the Conference of the Parties.

8. The Council is requested to review both the study as well as the addendum, and suggest what further action should be undertaken. The Council may wish to take into consideration the draft CMS Strategic Plan (2006-2011) (ScC12/Doc.4), and the Scientific Council draft Implementation Plan to the revised CMS Strategic Plan (ScC12/Doc.3) under agenda items 3.2 and 3.0, respectively.

ATTACHMENT 1
to CMS/ScC12/Doc.13

A feasibility study on additional bats Agreements under CMS

Submitted to the 11th Meeting of the CMS Scientific Council (UNEP/ScC11/Doc.7)

August 2002

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A feasibility study on additional bats Agreements under CMS

Contents

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Executive summary

1. There are about 1100 bat species in the world. Almost half of the species are considered threatened or near threatened according to the IUCN Red List. Many species are known to migrate or believed to migrate. Migrant bats use a wide range of migration strategies and undertake migration for a variety of reasons.

2. There are currently two international programmes relating to migratory bats. CMS established the Agreement on the Conservation of Populations of European Bats (EUROBATS), which covers all species within a definition of Europe. EUROBATS has 26 Parties and the participation of a number of non-party Range States. The other is the Program for the Conservation of Migratory Bats of Mexico and the United States (Programa para la Conservacion de Murcielagos Migratorios de Mexico y Estados Unidos de Norteamerica - PCMM). PCMM was originally established as a partnership of NGOs for three migrant bat species of Mexico and USA. The geographical and species scope of this partnership has expanded and includes strong government support and participation.

3. Apart from the species included in EUROBATS, only one bat species is included in CMS Appendices. This is *Tadarida brasiliensis* (family Molossidae), a widespread New World species included in Appendix I.

4. The objectives of the current project were:

   - to identify at least one biogeographical area for a future CMS Agreement on bats (both migratory and non-migratory). For each region investigated, efforts were made to assess the relevant knowledge relating to bats; the region's ability to establish and implement a bats Agreement and action plan; the expertise available to support, develop and implement a bats Agreement and action plan; and the technical or other support available;

   - to identify migratory bat species that could qualify for listing in CMS Appendices; and

   - to provide a list of experts and interested organisations that could support further work by CMS on possible bats Agreements.

5. Four regions were selected for investigation as being possible regions within which a CMS-initiated bat Agreement could contribute significantly to biodiversity conservation in general and bat conservation in particular. These are South America, southern Africa, South Asia and South-East Asia. They are areas where there is existing knowledge of bat migration or at least significant indication of such migration.

6. Individuals and organisations in each region were sent information about CMS and EUROBATS. They were asked for relevant information and expressions as to whether they thought a regional bats Agreement would be beneficial for their area. The individuals were mainly bats specialists or named contacts in relevant

NGOs, plus named contacts in some government departments. A few international specialists from outside the regions were also circulated. In total about 120 people were circulated and their contact details are lodged with the CMS Secretariat. In view of the very short response time expected, relatively few responses had been received by the time of submission of this report. Literature searches were made and direct contact with individuals over particular species or areas. Discussion continues and additional data and opinion can be submitted to CMS as required.

7. A brief overview of bat conservation issues and migration is presented.

8. For each of the four regions, information is given on range states included in the region (including identification of current CMS Parties), accounts of current knowledge base, individual species information with reference to movements and migration, a general statement of the resources available for support in the development and implementation of a CMS Agreement and action plan, references to sources of information on bat migration. Elements of an action plan appropriate for all regions are offered and some sources of external assistance identified.

9. Species information includes distribution, IUCN status, relevant aspects of biology, population and threats, and details of recorded migratory behaviour.

10. At this stage, the available support identified is organisations (mainly NGO networks) and current measures that might be available to assist in the establishment and development of a regional Agreement and associated action plan.

11. Summary remarks stress that the knowledge of bat migration is patchy and largely based on relatively abundant species. Increased interest and the availability of modern techniques and technology offer new opportunities to improve the knowledge base. Meanwhile there is very good reason for the precautionary principle to be applied in the case of species where the evidence of migration is still unclear. Migration is a phenomenon that is apparently widespread in bats but in need of much more research.

12. All regions include species that are appropriate for an Agreement and where such an Agreement would bring benefit to bat species other than the target species and to other biodiversity elements. All regions appear to have the organisational capacity to carry forward an Agreement.

13. It is considered premature at this stage to identify priorities between the regions investigated. While there might be identifiable priorities with regard to species, it is too early to assess the priority individuals and organisations within the regions would give to a CMS-style Agreement. Hence, it is as yet uncertain whether the appropriate scientific, technical and other support is available for the development and implementation of an Agreement and associate action plan. A number of

needs and resources are identified and tabulated for all four regions to assist in identifying future directions of CMS involvement.

14. Eight species are selected as potential candidates for listing in CMS Appendices. These are *Eidolon helvum* (Appendix II), *Pteropus vampyrus* (I), *Choeronycteris mexicana* (II), *Leptonycteris curasoae* (I), *Leptonycteris nivalis* (I), *Miniopterus schreibersii* (II), *Otomops martiensseni* (II), *Tadarida brasiliensis* (I). *Tadarida brasiliensis* is already listed in Appendix I. For each of these species a summary rationale following the format of a full CMS proposal is given. It is considered that this is a short list and that many other species are likely to be appropriate for CMS listing in due course.

15. A list of all the individuals and organisations consulted in this study, many of whom might be approached towards involvement in future development in any particular region, is lodged with the CMS Secretariat.

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Résumé exécutif

1. Il y a environ 1100 espèces de chauves-souris dans le monde. Presque la moitié de ces espèces sont considérées comme menacées ou presque menacées d'après la Liste Rouge de l'IUCN . On sait ou on suppose que beaucoup de ces espèces sont migratrices. Les chauves-souris migrantes utilisent une large gamme de stratégies migratoires et entreprennent leur migration pour toutes sortes de raisons.

2. Il existe actuellement deux programmes internationaux concernant les chauves-souris migratrices. La CMS a établi un Accord sur la conservation des populations des chauves-souris d'Europe (EUROBATS), qui couvre toutes les espèces au sein d'une certaine définition de l'Europe. EUROBATS compte 26 Parties et un certain nombre d'Etats de l'aire de répartition non-Parties y participent. L'autre est le Programme pour la conservation des chauves-souris migratrices du Mexique et des Etats-Unis (Programa para la Conservacion de Murcielagos Migratorios de Mexico y Estados Unidos de Norteamerica - PCMM). Le PCMM a été établi à l'origine comme partenaire d'une ONG pour trois espèces de chauves-souris migratrices au Mexique et aux USA. Le champ d'application géographique et des espèces de ce partenariat s'est étendu et bénéficie d'un vigoureux soutien et de la participation des gouvernements.

3. Mises à part les espèces incluses dans EUROBAT, une espèce de chauves-souris seulement figure aux Annexes de la CMS, à savoir *Tadarida brasiliensis* (famille des Molossidés), une espèce du nouveau monde largement répandue inscrite à l'Annexe I..

4. Les objectifs du projet en cours étaient :

   - d'identifier au moins une zone biogéographique pour un futur Accord de la CMS sur les chauves-souris (migratrices et non-migratrices). Pour chaque région investiguée, des efforts ont été faits pour évaluer les connaissances pertinentes ayant trait aux chauves-souris, les possiblités de la région pour établir et appliquer un Accord et un plan d'action sur les chauves-souris, le savoir-faire disponible pour appuyer, développer et appliquer un Accord et un plan d'action sur les chauves-souris et le soutien technique ou autre disponible,

   - d'identifier les espèces de chauves-souris migratrices qui pourraient justifier une inscription sur les listes des Annexes de la CMS et

   - de fournir une liste d'experts et d'organisations intéressées qui pourraient appuyer les travaux à venir de la CMS sur des Accords éventuels de la CMS concernant les chauves-souris.

5. Quatre régions ont été choisies pour investigation comme étant des régions dans lesquelles un Accord sur les chauves-souris mis en place par la CMS pourrait contribuer d'une manière significative à la conservation de la biodiversité en général et des chauves-souris en particulier. Ces régions sont l'Amérique du Sud,

l'Afrique australe, l'Asie du Sud et le sud-est asiatique. Ce sont des régions où des connaissances existent sur la migration des chauves-souris, ou tout au moins une indication significative sur cette migration.

6. Dans chaque région des renseignements ont été adressés à des personnes et à des organisations au sujet de la CMS et d'EUROBATS. On leur a demandé de donner des renseignements pertinents et de dire si elles pensaient qu'un Accord régional sur les chauves-souris serait bénéfique pour leur région. Les personnes étaient surtout des spécialistes des chauves-souris ou des contacts connus dans des ONG pertinentes et dans des administrations gouvernementales. Les noms de quelques spécialistes internationaux étrangers à ces régions ont également été communiqués. Au total, les noms de 120 personnes environ ont été diffusés et les renseignements sur la façon de les contacter sont déposés au Secrétariat de la CMS. Etant donné la brièveté du délai pour obtenir une réponse, relativement peu de réponses ont été reçues au moment de la soumission du présent rapport. Des recherches bibliographiques ont été effectuées et un contact direct a été pris avec des personnes sur des espèces ou des zones particulières. Le débat se poursuit et des données supplémentaires ainsi que des avis peuvent être soumis à la CMS, le cas échéant.

7. Il a été donné un bref aperçu des questions sur la conservation des chauves-souris et sur leur migration.

8. Pour chacune des quatre régions, des renseignements sont fournis sur les Etats de l'aire de répartition qui se trouvent dans la région (y compris l'identification des Parties actuelles à la CMS), un bilan des connaissances fondamentales connues, des renseignements sur chaque espèce avec des indications sur leurs déplacements et leur migration, un état général des ressources disponibles pour le soutien d'un Accord et d'un plan d'action de la CMS en vue de leur développement et leur application, des références sur les sources de renseignement concernant la migration des chauves-souris. Des éléments d'un plan d'action adapté à toutes les régions sont proposés et des sources d'aide extérieures identifiées.

9. Les renseignements sur une espèce comprennent la répartition, le statut à l'UICN, des aspects pertinents sur la biologie, la population et les menaces ainsi que des précisions sur le comportement migratoire observé.

10. A ce stade, le soutien disponible identifié est constitué par des organisations (surtout des réseaux d'ONG) ainsi que par les mesures actuelles susceptibles d'être disponibles pour aider à l'établissement et au développement d'un Accord régional et d'un plan d'action associé.

11. Un condensé de remarques souligne que les connaissances sur la migration des chauves-souris sont fragmentaires et largement basées sur des espèces relativement abondantes. Un intérêt accru et la possibilité d'utiliser des techniques et une technologie modernes offrent de nouvelles possibilité pour améliorer les connaissances de base. En outre, il y a de bonnes raisons d'appliquer le principe

de précaution dans le cas d'espèces dont la migration n'est pas clairement prouvée. La migration est un phénomène qui est, semble-il, largement répandu chez les chauves-souris mais qui exige des recherches plus approfondies.

12. Dans toutes les régions il y a des espèces qui justifient un Accord et où un tel Accord bénéficierait aux espèces de chauves-souris autres que celles qui sont ciblées et à d'autres éléments de la biodiversité. Toutes les régions semblent avoir la capacité organisationnelle de faire progresser un Accord.

13. On estime qu'il est prématuré à ce stade d'établir des priorités entre les régions étudiées. Alors qu'il pourrait y avoir des priorités identifiables en ce qui concerne les espèces, il trop tôt pour évaluer les prioriés que les personnes et les organisations de ces régions donneraient à un Accord du style de ceux de la CMS. Par conséquent, il n'est pas encore sûr que le soutien scientifique, technique et autre approprié soit disponible pour l'élaboration et l'application d'un Accord et d'un plan d'action qui y est associé. Un certain nombre de besoins et de ressources sont identifiés et classifiés pour les quatre régions afin de pouvoir déterminer les futures orientations de la participation de la CMS.

14. Huit espèces sont choisies comme candidats possibles pour inscription sur les listes des Annexes de la CMS. Ce sont *Eidolon helvum* (Annexe II), *Pteropus vampyrus* (I), *Choeronycteris mexicana* (II), *Leptonycteris curasoae* (I), *Leptonycteris nivalis* (I), *Miniopterus schreibersii* (II), *Otomops martiensseni* (II), *Tadarida brasiliensis* (I). *Tadarida brasiliensis* est déjà inscrite à l'Annexe I. Pour chacune de ces espèces il est donné un condensé de raisons à la suite du format d'une proposition pleine et entière de la CMS. On estime que la liste n'est pas exhaustive et qu'il y a bien d'autres espèces susceptibles d'être inscrites sur les listes de la CMS en temps utile.

15. Une liste de toutes les personnes et organisations consultées dans cette étude, dont beaucoup pourraient être approchées pour participer à la future évolution dans n'importe quelle région, est déposée au Secrétariat de la CMS.

1. Introduction

There are approximately 1100 bat species in the world. About 22% are considered threatened and a further 25% considered near threatened. Bats are key components of biological diversity, especially in tropical areas; in some circumstances they are keystone species, being the major faunal element responsible for pollination and seed dispersal. Other species may be important for the control of insect pests.

Many bat species are known or suspected to migrate, although details of their migrations are poorly known, apart from for a few mainly temperate species.

An Agreement on the Conservation of Populations of European Bats ('EUROBATS), developed under CMS, was opened for signature in 1991 and came into force in 1994. It now has 26 Parties and many other range states demonstrate support and collaboration. EUROBATS covers the European populations of all species occurring in Europe (about 40 species). The Agreement is currently collating all information on migration in Europe, but has also been instrumental in bringing governments and others together to discuss common conservation issues and to attempt to resolve these through its Conservation and Management Plan and other initiatives (Racey 1998; Hutson, 1999; Racey & Entwistle, in press).

For the purposes of this Agreement, 'Europe' is currently considered to be the Western Palaearctic region, excluding North Africa and Iceland, with the eastern boundary to include the whole of Turkey and the Caucasus countries, and the southern boundary being the south coast of the continent of Europe, with the addition of the Mediterranean states (Cyprus and Malta), and the islands belonging to the mainland European states, with the exception of the Canary Islands, Madeira and the Azores. This includes the Russian Federation to 50^{o}E. The Agreement is open to countries outside this area which share migratory populations of bats with Europe.

The last session of the Meeting of Parties (MoP 3, Bristol, 2000) adopted a list of species for the Agreement area as an Appendix to the Agreement. None of the species included in this list is endemic to Europe, with most extending further eastwards in the Palaearctic Region and a few species ranging into the Afrotropical Region or the Indomalayan Region. However, recent research has proposed additional species for Europe, some of which (if accepted as valid species) would be endemic to Europe. Changes to the Appendix list will be considered at future MoPs.

The only other similar initiative is the Program for the Conservation of Migratory Bats of Mexico and the United States (Programa para la Conservacion de Murcielagos Migratorios de Mexico y Estados Unidos de Norteamerica - PCMM). It was launched in 1994 as a partnership between the Institute of Ecology of Mexico's Universidad Nacional Autonoma de Mexico and Bat Conservation International, based in Texas, USA. Although not an intergovernmental programme it has the support and participation of its host governments and is producing valuable results for conservation (Walker, 1995). Originally established for three threatened migratory species (*Tadarida brasiliensis*, *Leptonycteris curasoae* and *Leptonycteris nivalis*), the program has been extended to

include Canada and some currently less threatened long-range migrants (such as *Lasiurus* spp and *Lasionycteris noctivagans*) and now includes all Mexican bat species. The importance of this programme has been highlighted in discussing the needs for integrated programmes of research, education and conservation of a wide range of pollinators (birds, bats, butterflies) in Mexico and USA (Withgott, 1999). Currently the programme is working to identify and conserve habitats along migratory corridors and to identify and protect key roosts along migratory routes.

Recognising the benefits that the European bats Agreement has brought to Europe and that bats are poorly represented in CMS appendices, CMS proposed in its Strategic Plan for the Convention on Migratory Species (UNEP/CMS/CoP6.Resolution 6.4, 1999), under Operational Objective 1 (To promote the conservation of migratory species included in major animal groups listed in the CMS Appendices) at 1.5, to stimulate concerted actions in favour of any endangered bat species listed in Appendix I and identified as a priority for concerted action, and explore needs and opportunities to develop Agreements for the conservation of bats outside Europe. Under Operational Objective 2 (To focus and prioritise conservation actions for migratory species) the strategy identifies the need 1) to ensure that Appendix I reflects accurately those endangered migratory species most in need of action, and 2) to ensure that Appendix II reflects accurately those migratory species with an unfavourable conservation status or which would benefit from the conclusion of Agreements for their conservation.

At present, only one non-European species, *Tadarida brasiliensis*, is listed by CMS.

Four regions have been selected for investigation as being possible regions within which a CMS-initiated bat Agreement could contribute significantly to biodiversity conservation in general and bat conservation in particular. These are South America, southern Africa, South Asia and South-East Asia. They are areas where there is existing knowledge of bat migration or at least significant indication of such migration. They are mostly areas of higher latitude, high variation in altitude and/or areas of major seasonal change. In presenting examples of migration that would be applicable to these areas, examples from outside these regions have been discussed.

The initial results of a feasibility study of these areas are presented below.

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2. Objectives

The objectives of the current project were

- to identify at least one biogeographical area for a future CMS Agreement on bats (both migratory and non-migratory). For each region, efforts were made to assess the relevant knowledge relating to bats; the region's ability to establish and implement a bats Agreement and action plan; the expertise available to support, develop and implement a bats Agreement and action plan; and the technical or other support available
- to identify migratory bat species that could qualify for listing in CMS Appendices
- to provide a list of experts and interested organisations that could support further work by CMS on possible bats Agreements.

3. Methodology

Between 20 and 30 individuals and organisations in each of four geographical regions were sent information about CMS and the EUROBATS. They were asked for relevant information and expressions as to whether they thought a regional bats Agreement would be beneficial for their area. The individuals were mainly bat specialists or named contacts in relevant NGOs, plus named contacts in some government departments. A few international specialists from outside the regions were also circulated. They were asked to copy the information to or to consult with any other people or organisations they thought appropriate. In view of the aim to present a report in time for the Seventh Meeting of the Conference of the Parties, the requested response time was extremely short.

A list of those people and organisations circulated is lodged with the CMS Secretariat.

A literature search was also carried out and other specialists were contacted.

At the International Bat Research Conference in Brasilia in 1998, attendees of an open meeting of the IUCN/SSC Chiroptera Specialist Group (CSG) were asked to write down a list of species that they knew to be migratory or seasonally absent from their area. A list of about 70 species was compiled, although the attendees were not, by any means, representative of the whole world, and a number of well-known migrant species are missing from the list. The species listed have also been considered in the present context.

In view of the time scale for the project, response so far from those consulted has been limited. Most of the information on bats presented here is from published literature and more time is needed to assess what expertise (scientific, technical and other) might be available to support the development and implementation of any such bats Agreement.

Any further information, expressions of interest or other matters of relevance to this report will be maintained by the author and will be available to CMS to update this report or in the furtherance of efforts to develop an Agreement in any of the regions discussed.

4. General account of bats and migration

There are approximately 1100 bat species in the world (Simmons, in press); of which about 22% are considered threatened and a further 25% considered near threatened (Mickleburgh *et al*., 1992; Hutson *et al.,* 2001; Hilton-Taylor, 2000).

About 75% of bat species feed on insects, with most of the rest feeding mainly on fruit and flowers. A small number feed on small vertebrates, from fish to other bats, and three species from Central and South America feed on blood.

Particular features of bats that place them at risk are their slow breeding rate (most bats only have one young per year) and the propensity of many species to concentrate into large colonies, particularly for the birth and nurture of the young. Communal roosting, especially in caves, places bats at particular risk of the loss of the whole population from a wide area. Cave (or other underground roost sites) have a range of threats, including mineral exploitation, sealing of caves and mines, various kinds of incidental disturbances (including caving and tourism) and deliberate disturbance or exploitation of the bats themselves. Loss of mature trees with suitable roost cavities is a threat to many species, and where bats have adapted to roosting in buildings their future may be affected by renovation or maintenance work or because they are unwelcome. Throughout the world bats are strongly associated with forests and water, and populations are affected by the loss of these and other habitats or of key structural elements of the habitats. Agricultural development, industrial development and other pressures from increased human populations generally are common threats throughout the world. Other threats, such as over-exploitation for food and damaging practices for the control of vampire bats, are more regional threats.

The benefits from bats have been poorly appreciated. Many species play a key role in the pollination and seed dispersal of plants grown or utilised by man. In many examples the vast number of insects consumed by bats are often insects regarded as pests of agriculture or other products. The accumulations of guano under the larger roosts has long provided an important source of fertilizer. Increasingly bats are being incorporated into eco- and other tourism.

While it is probable that many species of bats undertake regular seasonal movements (migration), the scale and extent of such movements is largely unknown. For the purposes of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) 'migratory species' is defined as (Article 1a) "… the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries".

For the purposes of this project migration is defined as any more or less regular, usually two-way, seasonal movement from one location or habitat to another. The movements may be to avoid unfavourable climatic conditions and/or to take advantage of seasonably favourable energetic conditions. Normal, usually one-way, dispersal, e.g. from a natal area, is excluded. Also excluded are daily foraging movements which may take some

species many kilometres and into quite different habitats from that of the daytime roost. Most research has been carried out in temperate areas (where migration is likely to be more marked), but there have been some important studies in tropical areas.

Traditionally, most data has come from the results of ringing (banding), although this has never been undertaken on the scale of bird-banding. Some recent studies have used more newly-developed approaches, such as analysis of DNA, and it is likely that further technological advances will provide other opportunities to study bat movements in the future.

The most recent review of bat migration is that of Fleming & Eby (in press), which discusses in detail the ecological, behavioural, social and physiological effects on migrant bats.

Various attempts to classify migratory bat species, e.g. as short-range (or sedentary), medium-range (or regional) and long range (Strelkov, 1969, 1997a, 1997b; Fleming & Eby, in press) are based on the maximum distance that a species is known to move. Such classifications are complicated by several factors:

- migration may be more pronounced in one sex (usually female) than the other;
- only certain populations of a species may migrate; and
- the migration route and distance covered may vary depending on the differing flowering and fruiting pattern between years.

The reasons for migration also vary.

In temperate areas, where all bats are insectivorous, migration is usually between warm sites suitable for pregnancy and lactation and with adequate food supplies in summer, and cool sites for hibernation in winter (and this migration may not be north/south). Such regular movements may take bats from the roof of a building in summer to its cellar in winter, or to a location up to 2000 km from the summer roost. Winter aggregations may include individuals of a single species involved in short-, medium- or long-range movements. In Europe, populations of some species in north-east Europe are more likely to undertake longer migrations than populations of the same species in the north west. Some species more or less consistently move only short distances and others regularly move long distances, giving some use to the application of a classification of migration. However, it is clear that in Europe (where many range states are quite small in area) all species regularly make transboundary movements and hence fit migration in the sense of the Bonn Convention. Elsewhere in the world, even relatively long-range migration may not always take bats across national borders.

Available evidence suggests that most bats do not undertake long continuous movements; rather that the journey is interrupted at frequent intervals (perhaps daily) at ‘stopover’ points, with the bats resting and feeding to replenish energy requirements. Thus, the maintenance of suitable migration corridors, which include adequate stopover points, may be a more important conservation requirement for migrating bats than it is for many bird species.

In some temperate zone bat species migration may be undertaken to allow wintering in areas that will allow feeding throughout the temperate winter period when insects are scarce, but this behaviour is rarely recorded and intercontinental migration is recorded in only one species, *Lasiurus cinereus* of North America. On the other hand, some tropical/subtropical species move into more temperate areas for parturition (e.g. some populations of *Tadarida brasiliensis*), or to take advantage of seasonally available food supplies (e.g. *Leptonycteris* spp, *Choeronycteris mexicana*).

Within the tropical or subtropical latitudes, migrations are still directed by changes in food supply and to allow the formation of large communal maternity colonies. In some cases, movements may be associated with retreating from seasonally arid areas to concentrate in moister areas where food supply may be more persistent. Similarly, although little studied as yet, altitudinal movements for the same reason are also recorded in a few species and suspected to occur in many more. In contrast, some African fruit bat species seasonally move into savannah habitat from wet forests; the wet forests may consistently provide a higher density of fruit, but in the wet season foraging in the savannah is still profitable. In some cases these movements are following a resource gradient (a flowering/fruiting corridor) and in years of particular abundance of food resources along the route, the bats may not complete the maximum route. In some cases, food resources may not follow a strict gradient, and resultant movements may be more erratic.

Some species are highly colonial during the period of parturition and rearing of young. These concentrations of bats may accumulate from a very wide area and give a special vulnerability to catastrophic loss of bat populations. Similarly, ideal hibernation sites may aggregate large numbers of bats of a wide range of species from a wide catchment area. Where large aggregations are for breeding purposes, there is the potential for the influx to produce competition for local resources; where it is for hibernation purposes, there is little impact on local resources.

Where there is sex bias in migratory bat species it is generally more pronounced in females (e.g. *Nyctalus noctula*, *Pipistrellus nathusii* in Europe, *Miniopterus schreibersii* generally, *Tadarida brasiliensis* and *Leptonycteris* spp in Central and North America). However, in the African fruit bat, *Myonycteris torquatus*, migration is more pronounced in (immature) males. In *Lasiurus cinereus* both sexes winter in Mexico (and possibly further south) but as they migrate to the northern summer the sexes become geographically segregated.

Summary

A wide range of migration strategies are used by bats and it is likely that the phenomenon is much more widespread than currently recognized. The migration of bats needs a lot more study. Much of the research on bat migration has been carried out on relatively abundant species. Nevertheless, threatened species that are migratory can be identified, and there are very clear threats to some migratory species that are still widespread and relatively abundant.

A high percentage of the 1100 bat species are considered threatened and there are obvious instances where an intergovernmental collaborative approach to their conservation, such as through a CMS bats Agreement, would benefit greatly the conservation of the threatened migratory species as well as a range of other bat species and wider biodiversity.

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5. Regional accounts

5.1. General remarks

Relatively little is known about details of migration in these regions and much of what has been published relates to relatively abundant and widespread species. Most of the accounts given here should be viewed as examples of what might be movements or migrations that actually occur on a much wider scale. There is a clear need for more research in all regions and a co-ordinated approach to that would help in many cases.

Some general priorities for research are:

- further collation of available data on seasonal movements;
- further effort to establish the threats posed by migration;
- further investigation of bat communities and seasonal variation in relation to migration; and
- further investigation of migration and the associated requirements of particular key bat species.

The species discussed are given their IUCN Red List status as defined in Table 1. The Red List categories are assigned through an assessment process using criteria identified in IUCN (2001).

Table 1. Red List categories

CR	Critically Endangered	a taxon considered to be facing an extremely high risk of extinction in the wild by meeting, on the best available evidence, any of a set of criteria designated for Critically Endangered.
EN	Endangered	a taxon considered to be facing a very high risk of extinction in the wild by meeting, on the best available evidence, any of a set of criteria designated for Endangered.
VU	Vulnerable	a taxon considered to be facing a high risk of extinction in the wild by meeting, on the best available evidence, any of a set of criteria designated for Vulnerable.
NT	Near Threatened	a taxon evaluated against the above criteria, but which does not qualify for CR, EN or VU now, but is close to qualifying or is likely to qualify for a threatened category in the near future.
LC	Least Concern	a taxon evaluated against the above criteria, but which does not qualify for CR, EN, VU or NT. Widespread and abundant taxa are included in this category.

In three of the four regions discussed there is already a regional international network of bat specialists and organisations concerned for bat research and conservation. On a global scale the Chiroptera Specialist Group (CSG) of IUCN's Species Survival Commission provides a network of about 150 specialists concerned for bat conservation. Two of the regional networks act as regional groups of CSG. Bat Conservation International (Texas, USA) also has a global remit. Interest in the conservation of migratory (and other) bats was expressed to the author of this report by national delegates to CoP5 of CMS (Geneva, 1997).

These organisations would be capable of assisting in the development and implementation of any Agreement with an action plan. Action plans to implement any Agreement should take account of the global IUCN action plans, other conventions (such as CBD) and other relevant regional or national initiatives or treaties and should consider aspects of:

- legislation and policy (including those relating to the conservation of bat habitat as well as species protection),
- species, site and habitat protection and safeguard, including the role of the protection of roost sites and the role of wider protected area systems
- advisory matters relating to above,
- education for general public (including schools) and industries whose activities might affect bat conservation,
- survey, monitoring and research requirements, including international collaboration on projects related to obtaining better information on migratory behaviour and requirements,
- international collaboration and support from both governments and NGOs.

In preparing such action plans for migratory species, consideration should be given to ensuring that the action plan gives maximum benefit to other bat species and to biodiversity in general.

The existing knowledge base, species information and available support are discussed for each region.

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5.2. South America

5.2.1. Countries considered (Parties to CMS are given in capitals):

ARGENTINA, Bolivia, Brazil, CHILE, Colombia, Ecuador, French Guiana, Guyana, PARAGUAY, PERU, Surinam, URUGUAY, Venezuela.

5.2.2. Knowledge base

There is good knowledge for some species at the northern end of their range, where they are the subject of the Program for the Conservation of Migratory Bats of Mexico and the United States (PCMM) (Walker, 1995; Withgott, 1999). Most of the species covered by this programme also occur in South America.

In considering the South American bat fauna, evidence of migration has also been drawn from studies in Central America (as well as PCMM). There are large knowledge gaps and hence major research requirements – studies of migration patterns of South American bat species is a recommendation in Hutson *et al.* (2001). Migration is probably more marked in the southern cone, but there is evidence of migration in Venezuela and associated with the Andes further south.

Threats include deforestation (including of drier forests and other habitats) and persecution (often in attempts at vampire bat control). Development for agriculture, oil extraction and mineral exploitation are other widespread threats. Desert areas with low species diversity but high endemism are also threatened. These and other more local threats are discussed in Hutson *et al.* (2001). In general, the southern cone, which does not have the high diversity of the more tropical rainforest areas, but does have a number of endemics, is somewhat neglected by major conservation initiatives.

Bats are protected in many of the countries considered, but usually only by inclusion in general wildlife legislation which is poorly enforced.

It has to be admitted that the knowledge base on migration is limited in the region, and with many countries being very large, transboundary movements are difficult to identify. Nevertheless, threatened and migratory species can be identified and could benefit from an integrated initiative such as an Agreement under CMS. Other examples of seasonal movements are given and these are likely to be replicated in other species.

The majority of the data at present relates to fruit- and flower-feeding bats, including reports such as that of Myers & Wetzel (1983), which showed that most frugivorous bats are largely absent from the Chaco Boreal of adjacent parts of Argentina, Paraguay and Bolivia, except from mesic areas or at times (late winter, August) when many trees are in flower.

Similar seasonal changes in species composition were observed in Monteverde, Costa Rica (Timm & LaVal, 2000). These authors found strong seasonal patterns of abundance in four frugivores (*Artibeus lituratus*, *Artibeus toltecus*, *Carollia brevicauda*, *Sturnira*

lilium) and one nectarivore (*Hylonycteris underwoodi*). *A. lituratus* and *S. lilium* are absent most of the year and common from September to November. They are considered as lowland species that migrate up to the highlands during part of the year to take advantage of seasonally available fruits. *H. underwoodi* is common only from May to October. The other two species are present all year, but with strong seasonal peaks in abundance. Here, a comparatively short flight could allow a bat a considerable change in altitude and bats could fly up or down hill to vary food sources without moving roosts – similar to the 'para-montane' distribution discussed by Koopman (1984). Timm & LaVal (2000) considered whether this might explain the seasonal differences, but felt that there was overwhelming indication that the bats were relocating. Evidence in McCarthy *et al*. (in prep.) also suggested that *Sturnira mordax* might be an altitudinal migrant.

5.2.3. Species data

The following species are known or believed to migrate and it is likely that related bat species behave in a similar fashion.

Leptonycteris curasoae (Family Phyllostomidae, Glossophaginae)

Distributed from southern states of USA (central Arizona and south-west New Mexico) to northern Central America and in Colombia, Venezuela and the Netherlands Antilles.

IUCN status: Vulnerable.

Nectarivore, roosting in caves, mines, etc. These bats are regarded as keystone species in maintaining the pollination of the principal components of the arid zone flora. The reliance on a number of caves, migration along nectar corridors of critically important plants (including columnar cacti and paniculate agaves), and the importance in other threatened tropical dry forests, makes this an important species. For a species account see Hutson *et al*. (2001).

Large declines are recorded in Mexico/USA and Curacao.

Migrates from Mexico to maternity colonies in southern USA following flowering of arid-zone plants. Migrations cover distances of up to more than 1500 km. Colonies in northern Mexico may reach 5000 in spring (March) or 75,000-100,000 in autumn (November), with females more or less absent from March to September (when they migrate further north to maternity colonies), but with an influx in July – August and a decrease in December (Ceballos *et al*., 1997). There may be two reproductive populations in Mexico, one with a spring birth period, one with a winter birth period. Fleming *et al*. (1993) found the species followed a predictable spatio-temporal corridor of CAM plants (plants using crassulacean acid metabolism, such as Cactaceae, Agave), although in southern Mexico they fed on more mixed sources (including other non-CAM, i.e. C3, plants) where *Glossophaga soricina* used C3 plants continually. Later Wilkinson & Fleming (1996) demonstrated two routes for separate populations (clades), one along the coast (with columnar cacti) and one along foothills of the Sierra Madre Occidental (with paniculate Agave). The inland bats move later than the coastal bats in line with flowering

times. The authors noted with interest that such a long-range migrant should maintain separate clades. Rojas-Martinez *et al*. (1999) suggest that the species is resident below 21^{o}N.

In the north-west part of the range maternity colonies of 12-15,000 gather in Organ Pipe Cactus National Monument in mid-May and disappear by September. These may accumulate from a wide area (judging from the wide range in the progress of pregnancy on arrival, and DNA studies) (Ceballos *et al*., 1997).

Seasonal fluctuations in numbers in colonies makes population monitoring difficult.

Major passage of bats, including this species, have been observed in Rancho Grande region of Venezuela. Recent studies of DNA in Venezuela (where movements of up to 60 km are recorded) shows the likelihood of this being a long-range migrant here (more so than in the related *Glossophaga longirostris*) and this is supported by observations of its temporal absence from some areas and with large seasonal concentrations in certain caves (Newton *et al*. 2001; S.Walker, pers. comm.). Studies of movement in this species in Colombia have been made by Sanchez & Cadena (1999).

In Mexico/USA similar migrations are undertaken by one other species of *Leptonycteris* (*L. nivalis* – see Hensley & Wilkins, 1988) and the monotypic *Choeronycteris mexicana* (see Arroyo-Cabrales *et al.*, 1987) – both similarly nectarivorous. While the migration in Mexico/USA is certainly transboundary, it is unclear as yet whether migration in northern South America includes transboundary movements.

Ceballos *et al*. (1997) also discuss the appearance of large numbers of *Pteronotus davyi* in their study caves in October, plus this and *P. parnellii* in March to May and *Mormoops megalophylla* in April (all members of the family Mormoopidae).

Platalina genovensium (Family Phyllostomidae, Lonchophyllinae)

Restricted to Peru.

IUCN status: Vulnerable.

Desert nectarivore (and frugivore), roosting in caves and mines. In arid habitats from near sea level to 2500 m.

Sold for ‘medicinal’ value. Habitat threatened by development and clearing of riverine vegetation.

Although only known from western Peru, there is evidence of seasonal movements from desert areas along riverine woodland to areas of continued flowering (distance unknown). Resident in some areas where its favoured cactus flowers all year, but even here, movements away from the desert are suspected in response to periods of El Nino. Nevertheless, the species is not recorded outside Peru and so cannot be regarded as an

example of transboundary movements, but is a threatened species that relies (in part) on seasonal movement to avoid food shortages in a severe tropical environment.

Sahley &Baraybar (1996) review the natural history of this species.

Similarly, its relative *Lonchophylla robusta* is recorded (Winter 2001) as being present in lowland forest in Costa Rica only in winter, due to nectar shortages in summer.

Carollia perspicillata (Family Phyllostomidae, Carolliinae)

Widespread and common species from Mexico to Peru, Bolivia, Paraguay and south-east Brazil, also some Caribbean islands.

IUCN status: Least Concern.

Frugivore, plus some insects, roosting in caves, tree holes, buildings, etc.

Not threatened and not a long-range migrant, but a species demonstrating a form of movement (migration) that may be more widespread. In Costa Rica, during the dry season females migrate from dry forests to moist forests where food remains more abundant. The bat gives birth twice yearly, once at either end of the migration route. Males in both habitats maintain year-round territories which are occupied by the females at the appropriate time of year. But the females arrive at the roosts already pregnant from matings at the other season's roosts. The males guard the females while they give birth and rear the young. The bats then mate before the females return to the other habitat. Thus, at both ends of the migration, the males guard females which give birth and rear young that are quite unrelated to the harem or territorial male (Fleming 1988).

In this study, the distances of migration are likely to be less than 200 km, but in other areas it might be more.

Desmodus rotundus (Family Phyllostomidae, Desmodontinae)

Widspread and common from Mexico to northern Argentina and Chile.

IUCN status: Least Concern.

The common vampire bat, feeding on blood of larger mammals and roosting in caves, trees, buildings, etc.

Again, not a threatened species and one that is generally regarded as sedentary. However, data from one study in Sao Paulo State, S. E. Brazil, (Trajano, 1996) suggested that at this latitude (c.25^{o}S), the winter cold may not suit the physiology of the bat and may create difficulties in feeding since the host (domestic) animals tended to cluster together on cold nights. With some evidence of seasonal population changes, it is suggested that the bats might migrate down to the coast to continue feeding normally. Estimating from a map, that might involve movements of up to 100 km.

A detailed account of the vampire bat can be found in Greenhall & Schmidt (1988). Since vampire bat control has had heavy impact on the conservation of beneficial or innocuous bat species a code of practice was developed and is available in Hutson *et al*.(2001).

Myotis chiloensis (Family Vespertilionidae)

Chile and parts of adjacent Argentina from 30°S to Tierra del Fuego.

IUCN status: Near Threatened.

Insectivorous, roosting in buildings, caves and other structures.

The species is reported to be present in southern Chile (at 51°S) only in summer (Johnson *et al*., 1992). Fleming & Eby (in press) argue that this is likely to be due to quite local movements to suitable hibernation sites, in line with the behaviour of many *Myotis* species in the northern hemisphere. However, a number of northern hemisphere *Myotis* species are medium-range migrants with recorded movements of over 300 km and up to 800 km in Europe (Rodrigues, 2002), and up to more than 500 km in North America (Fleming & Eby, in press). Such movements from southern Chile would not take them north of Chile, but there may well be regular movements between Chile and Argentina.

Lasiurus species (Family Vespertilionidae)

L. borealis occurs from Chile and Argentina north to Canada and on Galapagos Islands (as *L. brachyotis*) and several islands of the Caribbean. *L. cinereus* is not recorded in parts of Central America or so widely in the Caribbean, but otherwise has a similar distribution and is additionally found on Hawaii and Bermuda (and is recorded as a vagrant in Iceland and Orkney Islands, UK).

IUCN status for both: Least Concern.

Insectivorous, normally roosting more or less solitarily in trees.

The genus includes a number of other species in the Americas, although the systematics of the genus is still subject to discussion.

L. cinereus is regarded by Fleming & Eby (in press) as possibly the only recorded truly intercontinental migrant, moving from much of North America into the subtropics and possibly the tropics. Females migrate northwards before the males with the main arrival being in April (Findley & Jones, 1964). The sexes are generally segregated in summer quarters, males being more common in western USA, while most females rearing young are found in eastern and central USA and into the prairie provinces of Canada. The southward migration is mainly in August to September. In Manitoba, Canada, Barclay (1984) recorded arrival of *L. cinereus* and *Lasionycteris noctivagans* in mid-May and departure by mid- to late September; *L. borealis* was only recorded during migration periods. Some mating is believed to occur on migration, but perhaps most in the winter quarters. While generally solitary, they are reported to migrate often in groups, which can

comprise groups of several hundred individuals (e.g. LaVal & LaVal, 1979). Findley & Jones (op.cit.) suggested there might be a major undiscovered wintering ground south of USA and even that bats in northern South America might include North American migrants.

The behaviour of *L. borealis* is very similar. At least some of the population in the southern states of USA and parts of warmer coastal areas do not migrate and the species is able to tolerate very cold conditions (to –15°C).

There are no bats resident on Bermuda (especially following the loss of the cedar forests as a result of scale insects in 1946-51), but four species regularly occur there, 900-1300 km from the US mainland. The species are *L. cinereus*, *L. borealis*, *L. seminolus* and *Lasionycteris noctivagans* (Van Gelder & Wingate, 1961). *L. noctivagans* is another North American migrant that has been recorded also on Turks & Caicos (Buden, 1985) and in northern Mexico (Arita & Ortega, 1995), although these occurrences outside North America may be just vagrants rather than regular migrants.

There are a number of references to these species migrating in South America with movements into more southern latitudes in warmer months (e.g. Myers & Wetzel 1983), and Johnson *et al*. (1992) regard *L. borealis* as a migrant at 51°S in Chilean Patagonia and Fleming & Eby (in press) suggested this was likely to be a long-range migrant at this latitude. Villa-R & Villa Cornejo (1969) discussed the potential of migration of *L. cinereus* in northern Argentina and Sanborn & Crespo (1957) suggested that the species is rare in central Argentina in October to April and that there was probably north/south migration.

Sanborn & Crespo (1957) also suggested altitudinal migration in these species was more likely in Chile, and possibly in Colombia and Venzuela. On the Galapagos Islands, McCracken *et al*. (1997) found more activity of *L. cinereus* and *L. brachyotis* (a close relative of *L. borealis*) in lowland habitats in the cool garua season and less activity in these areas in the hot season, when the 'upland mesic habitats may be critical to the maintenance of viable populations of both species'.

Tadarida brasiliensis (Family Molossidae)

Distributed from about 40°S in Chile and Argentina to the southern states of USA (to about 40°N) and on many Caribbean islands. It is scarce or absent in much of Amazonia.

IUCN status: Near Threatened.

Bonn Convention: Appendix I (listed in 1985).

Insectivorous, forming large colonies in caves, also in buildings and other structures. Colonies of up to 20 million recorded now, some larger colonies recorded formerly. Possible declines of over 99% reported in some areas. For a species account see Williams (1989); see also Hutson *et al*. (2001).

Threats have been through damage to, destruction of or disturbance to cave roosting sites at both ends of the migration route (and possibly at stop-over points in between). Pesticides have also been regarded as a threat, less so now at the northern end of the distribution. Most of the USA population is concentrated in about 12 sites, some forming the largest aggregations of warm-blooded animals.

Migrations of up to 1840 km are recorded from natal sites in USA (Glass, 1982; Williams, 1989). Populations in central Mexico are very low from February to September, build up during October and are decreasing again by late January (Villa & Cockrum, 1962). Not all populations in North America are migratory; those on the Pacific side (Oregon, Nevada, south-western Utah, western Arizona and California) and those east of eastern Texas do not undertake long migrations, but may undertake local movements of up to 150 km (LaVal, 1973). The populations in between undertake longer migrations, some stopping in USA, but many moving into north and central Mexico and possibly further south. It is mainly females that migrate north in spring to summer maternity colony sites, although males are first to arrive at these roosts. While there was attempt to separate the migratory and non-migratory populations into separate subspecies, more recent DNA studies suggest that such separation is unjustified (e.g. McCracken *et al*, 1994; McCracken & Gassell, 1997). Russell & McCracken (2001) were, however, able to show differences between the populations of North and South America.

Stopping-off points are important on this migration. Davis et al. (1962) estimated that these bats might travel nearly 500 km per night, but Villa-R. & Cockrum (1962) suggested maximum documented daily travel at about 35 km, and data in Glass (1982) suggest up to 50 km/day (but compare that with estimated daily travel from maternity colony sites of up to 60 km). Cockrum (1969) suggest nearly 70 km between stopping-off points, which may only be used for a few days or even one day. From Oklahoma bats moved to the Mexican coast east to Sierra Madre Oriental and into the eastern half of the Mexican plateau (Glass, 1982). Migration is often in large flocks.

Nothing is recorded of migration at the southern end of the range, although there seems every reason to assume that similar migrations occur here and the potential has been discussed (e.g. Villa-R & Villa Cornejo, 1969). A newspaper report describes a colony of 12 million bats in Argentina that was believed to ‘originate’ from Brazil (Wullich, 1994). Apart from one record of a mummified bat found on the Falkland Islands (Hill, 1988), there is one recent record of a live individual found on a small northern island in the Falkland Islands group where there is no evidence for assisted passage (A. M. Hutson, pers.obs.), but the location is c.1300 km from the nearest locality in Argentina and if these were natural occurrences, they would be an extreme example of ‘reverse migration’, regularly reported in birds, but not so far for bats.

5.2.4. Expertise, technical and other support for development and implementation of an Agreement and action plan

There is a co-ordinated network of bat specialists through the region and many of the major international conservation bodies have projects in the region. Bat Conservation International (USA) assisted in the establishment of a Programa para la Conservacion de

Murcielagos Bolivien in 1998. This programme now has several negotiated agreements to protect bats, including in protected areas. Similar networks to promote bat conservation efforts also exist in Chile and Venezuela. Other national and ex-situ organisations might be available to help in the development of an integrated strategy for migratory bats. Increased integrated research and conservation with relation to vampire bat control was the subject of a Resolution at the 11th International Bat Research Conference (Brasilia, 1998), but has relevance to wider bat conservation; details of the Resolution can be found in Hutson *et al*. (2001).

This study has concentrated on issues relating to an Agreement for South America. It may be worth considering extending this region to a Pan-American Agreement that incorporates the well-established PCMM of North America and Mexico (see Introduction to this report) and brings in newly established bat conservation programmes (Programa para la Conservacion de Murcielagos - PCMs) established in Costa Rica in 2001 and Guatemala in 2002. USA has recently adopted a migratory bird act and a similar act for bats would be appropriate. *Tadarida brasiliensis* would provide a good flagship species for such a Pan-American Agreement.

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5.3. Southern Africa

5.3.1. Countries considered (Parties to CMS are given in capitals):

Angola, Botswana, DEMOCRATIC REPUBLIC OF CONGO, Lesotho, Malawi, Mozambique, Namibia, SOUTH AFRICA, Swaziland, UNITED REPUBLIC OF TANZANIA, Zambia, Zimbabwe

5.3.2. Knowledge base

There have been few studies relating to migration in Africa, although the recognition of long-range movements by the straw-coloured fruit bat (*Eidolon helvum*) is well known. The most significant studies have been those of Van der Merwe (1975) on *Miniopterus* in South Africa, O'Shea & Vaughan (1980) on general bat communities in Kenya, and Thomas (1983) on fruit bats in West Africa. As elsewhere, traditionally much of the research has been carried out on the more common (available) species, but there is increasing accent on bat communities and studies of more threatened species.

For the most part, literature has been scattered and sometimes difficult to access, but current work to complete the multivolume *Mammals of Africa* should help consolidate available knowledge. About 180 species are included in Africa as a whole.

Regional threats (mostly arising from the rapidly increasing human population) include deforestation, conversion of grassland and woodland savannah to agriculture and in some areas to silviculture of exotic tree species. Permanent or seasonal swamps also suffer from agricultural conversion and the removal of riparian vegetation is a serious threat in some areas. Caves are important, here as elsewhere, and are threatened by tourist development, cave tourism, mineral exploitation and, in some cases, guano exploitation. Further details of the general threats to bats in the region can be found in Hutson *et al*. (2001). Current lack of resources for bat conservation and research are a major problem.

While there appears to be good liaison between the bat researchers and conservationists of the region, there is probably little liaison between governments with common conservation issues. A bats Agreement could develop better liaison between all interested or involved parties and using the right target species, could improve public perception and involvement with bats and their conservation.

5.3.3. Species data

As stated above there have only been three principal studies related to bat migration, plus a number of other works referring to the movements of *Eidolon*.

The work of O'Shea & Vaughan (1980) was on bat communities and was carried out in the Machakos district of Kenya at about 700 m above sea level. Over the course of a year, 25 species in seven families were trapped, but most species were either absent or present in very low numbers during the main dry season (May to September). The species were

mostly insectivorous, but included one fruit feeder and one more or less carnivore. The insectivorous bats covered a wide range of roost types and foraging strategies. The authors also noted build-up of subcutaneous fat in some likely migrants (such as the hipposiderid *Hipposideros commersoni*, the vespertilionids *Miniopterus natalensis* (= *schreibersii*), *Scotophilus nigrita* and *Scotoecus hindei*, and in the very small samples of molossids caught). The authors 'suspect that through migration many species of bats follow these shifting patterns of rainfall and subsequent community productivity during their life cycles'. This could apply much more widely in Africa and is also supported by the results of Thomas (1983).

Eidolon helvum (Family Pteropodidae)

Present all year in coastal areas of West African counties along the gulf of Guinea and across to southern Kenya in the north and from northern Angola across to northern Mozambique in the south. Seasonally it extends north to southern Mauritania, across through southern Niger to most of Sudan and south through much of southern Africa. The population on Madagascar is now generally regarded as a separate species, *E. dupreanum*, (Bergmans, 1990).

IUCN status: Least Concern.

Feeds on fruit and flowers and forms large colonies in trees, often in major cities (such as Accra, Lagos, Kampala, Dar Es Salaam); sometimes roosts in rock crevices or caves. One of the largest bats of the region.

While not in danger of extinction, it is widely taken for food (and sometimes medicine), and persecuted in towns and by fruit growers. Forest destruction may also be a threat. Electrocution on power lines is an obvious, and probably increasing, cause of death, but is unlikely to be a major threat to the population. The colony in Kampala (in what was known as 'Bat Valley') was believed to number about one million in the 1970s, but is now estimated at 200,000. Other such declines have been recorded. An account of the species can be found in DeFrees & Wilson (1988) and Mickleburgh *et al*. (1992).

Thomas (1983) estimated a colony in Abidjan (Cote d'Ivoire) at 300,000 to 500,000 in January/February, when the young were born. The main dispersal was in March, but colonies could be found in open savannah in February, where colonies of up to 100,000 could appear 'overnight'. There was little evidence of colonies in August to November when dispersal may be at its peak. Dispersal was estimated to take many bats more than 1000 km. In Kampala the young are born in late February and early March, with the colony dispersed between June and August (Kingdon, 1974). A colony of up to five million accumulates in Kasanka National Park, Zambia, in November/December and that number of bats must be widely dispersed during the rest of the year. There is some evidence of movement of these bats to Democratic Republic of the Congo and to Tanzania, but it is also likely that many move south. In the extremes of southern Africa it occurs sporadically and seasonally throughout the region with most records from the wetter eastern parts during the summer months (Taylor, 2000). Movements may be somewhat erratic depending on available food resources and ambient weather conditions.

Within the colonies they form tight clusters of up to 100 animals; evening dispersal for foraging may take bats to 30 km from the roost.

Nanonycteris veldkampi (Family Pteropodidae)

Distributed in West Africa east to Central African Republic.

IUCN status: Least Concern.

One of the smallest African fruit bats, feeding on a range of flowers and some fruit; it roosts solitarily or in small groups in trees. The only species in its genus.

Little known of threats to the species; its roosting behaviour makes it less vulnerable than species like *Eidolon*, but its migratory behaviour may pose some threat. The forest zone is essential for the maintenance of the species. A rather poorly known species, with accounts available in Rosevear (1964), Bergmans (1989), Mickleburgh *et al*. (1992).

Although not occurring in the region under discussion, Thomas (1983) showed the species in the Cote d'Ivoire to be locally common in the forest in the dry season and to move into the savannah in the wet season. Seasonal shifts in area of occupancy could be more than 400 km.

Myonycteris torquatus (Family Pteropodidae)

West Africa and Bioko (Fernando Poo) east to Uganda and south to northern Angola and Zambia.

IUCN status: Least Concern.

Feeds on fruit, roosts solitarily or in small groups in low dense vegetation, although the related species, *M. relicta*, is reported to roost in small groups in caves.

Threats not known, but probably similar to *Nanonycteris*. Another relatively poorly known species with accounts available from Bergmans (1989), and Mickleburgh *et al*. (1992).

Thomas (1983) found this species occurring in the forest zone of Cote d'Ivoire, but moving into the savannah with the April rains. Pregnant females returned to the forest zone to give birth during the wet season, but males, and principally immature males, continued north involving movements of over 400 km.

In Thomas' study (1983) all the above three species moved into the savannah in the wet season at the time of maximum fruit productivity in the forest zone. The savannah fruit level is also increased but not to the level found in forests. Nevertheless, the increased fruit availability in the savannah zone is probably more 'available' to these migrants where there is less competition.

Miniopterus schreibersii (Family Vespertilionidae)

Southern Europe to Japan through the Old World tropics to South Africa, Sri Lanka and southern Australia.

IUCN status: Near Threatened

Insectivorous, roosting in caves.

Although effects on foraging habitats are likely to be a serious problem for the species, most conservation concern has been expressed about problems of conservation of cave roosts, as a result of damage, disturbance, change of use, mineral exploitation, etc. Although the species is widespread – it is the most widely distributed species in the world – in areas where studies have been carried out (principally Europe, South Africa and Australia) marked declines have been recorded. At least in the more temperate regions, it needs a range of cave sites at different times of its annual cycle.

The extraordinarily wide range of this species has led to many attempts to separate it into a number of geographically separated species. So far such attempts have failed. Recent attempts to identify DNA characteristics of the South African population offers another opportunity (Miller-Butterworth *et al*., 2002).

In Africa the species appears to favour the cooler moister areas. Van der Merwe (1975) examined migration in South Africa. He studied a number of sites with up to 4000 bats and found bats move from hibernation sites in the southern Transvaal highveld to maternity sites in northern Transvaal bushveld. Such movements recorded were up to 260 km (Taylor, 2000). Some animals remain in the highveld, moving less than 60 km to maternity roosts. In Europe the maximum recorded movement is 833 km (Rodrigues, 2002) and in Australia it is 1300 km (Dwyer, 1969) and it is considered likely that similar range movements occur in Africa. In Australia, Dwyer (1966) identified sites for transient colonies (mostly of juveniles) that are reused each year and are otherwise empty of the species; and transient colonies have been identified as an important feature of migration of the species in Europe. It is also considered that although migration may occur in any direction, particular routes are followed by the bats, with stop-over sites used temporarily and that key maternity sites draw bats from a very wide area. While Dwyer (1966) originally suggested that winter dispersal was possibly not along set routes, he later (Dwyer, 1969) suggested that most movements were within specific (or related) drainage areas; the same is thought to be true in Europe. Colonies of up to 200,000 are recorded in South Africa (Taylor, 2000).

A number of other species of the genus occur in Africa.

Otomops martiensseni (Family Molossidae)

Eastern Africa south to South Africa. The Madagascan population is now regarded as a separate species, *O. madagascariensis*. It is possible that the southern African populations may also be separated (as *O. icarus*).

IUCN status: Vulnerable.

Insectivorous, generally roosting in caves, but in South Africa it generally uses houses and elsewhere has also been found roosting in trees. This large bat is often regarded as the species with the longest and narrowest wings, and is likely to travel great distances even during nightly foraging. Accounts of the species can be found in Long (1995) and Hutson *et al*. (2001).

While no particular threats are known, the species is thinly distributed with few colony sites known. The only large colonies, in East Africa, have all but disappeared, possibly from disturbance (guano collecting and tourism). It feeds (mainly on small moths) in open areas and often at high altitude. As a fast flying aerial insectivore capable of ranging widely and using a variety of habitats, it is likely that problems at roost sites are the main concern.

There is no direct evidence of migration in this species, but marked seasonal absence from some areas has prompted the suggestion of migration (Mutere, 1973), and the species should certainly be capable of extended migration.

Other potential migrant bat species include *Myotis tricolor*.

5.3.4. Expertise, technical and other support for development and implementation of an Agreement and action plan

There is a good informal e-mail network, which possibly only covers part of the region at present. Expertise is currently lacking in some countries. South Africa has about three well-developed local volunteer bat interest groups, with good contact with researchers and other conservation bodies. Namibia's Department of the Environment would be interested in further discussion on this matter.

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5.4. South Asia

5.4.1. Countries considered (Parties to CMS are given in capitals):

Afghanistan, Bangladesh, Bhutan, INDIA, Myanmar, Nepal, PAKISTAN, SRI LANKA

5.4.2. Knowledge base

Very little published on migration of bats in the region, although it is widely said that many species migrate down the Himalayas and adjacent hills. Some migration is recorded within India. No movements are recorded between India and Sri Lanka, although the crossing would be no obstacle for many bat species.

There appears to be no movement of bats between India (or Sri Lanka) and the Maldives, where only an endemic subspecies of *Pteropus giganteus* is currently recorded and an endemic subspecies of *Pteropus hypomelanus* was described from a single specimen (Holmes *et al*., 1995). The Andaman & Nicobar Islands (India) are discussed under South-East Asia (Section 5.5.).

The bat fauna of the region is reviewed by Bates & Harrison (1997).

General threats are forest loss (especially lowland forest), cave disturbance and destruction and intolerance of bats in buildings (especially temples, etc). See Hutson *et al*. (2001).

5.4.3. Species data

Pteropus giganteus (Family Pteropodidae)

The species is more or less endemic to the region and has a wide distribution within the region, with one record from China. Note that some authorities regard this species and *P.vampyrus* as probably conspecific.

IUCN status: Least Concern.

Included in Appendix II of CITES.

Feeds on a range of fruits and flowers and roosts in trees, often forming large colonies. By far the largest bat in the region considered here.

While not seriously threatened at present, declines are recorded in various parts. The bats are hunted for food and medicine and persecuted when visiting orchards. Although included in the ‘vermin’ list under India’s Wildlife Protection Act, it is likely that this may change in the near future; in some areas the bats are considered sacred and thereby not persecuted. It is similarly exempted from protection in Pakistan. General accounts can be found in Bates & Harrison (1997) and Mickleburgh *et al*. (1992).

Various seasonal absences and changes in populations recorded, but no hard evidence of migration. It is generally regarded as non-resident at higher altitudes and so its presence in Kathmandu might be expected to be seasonal and associated with significant movements. There is evidence of seasonal migration to and from Myanmar (K.Swee, pers. comm.).

Rousettus leschenaulti (Family Pteropodidae)

Ranges from Pakistan south to Sri Lanka and east through Nepal, Tibet and Myanmar to south China, Vietnam and Thailand, and from Sumatra and Java to Lombok. The population on Sri Lanka is regarded as a separate subspecies, *R. l. seminudus*, and that in Indonesia as *R. l. shortridgei*.

IUCN status: Least Concern

Fruit and flower feeder. Roosts in caves, tunnels and large disused buildings, rarely in vegetation (Bates & Harrison, 1997).

Colonies vary in size from as little as two or three individuals to several thousand, with one colony of 10,000 recorded. It is found at altitudes from sea level to 1400 m. The species feeds on a range of fruits and flowers, many of which are grown by man or have economic or social value to man. Fish and molluscs are also recorded in the diet, but are regarded as exceptional. An account of the species can be found in Mickleburgh *et al*. (1992) and in Bates & Harrison (1997).

Populations poorly known and still regarded as widespread and common with no identified threats of extinction. In common with other fruit bats, it may be persecuted at times as a pest of fruit trees. It presumably also suffers the same threats that other cave bats face.

Roberts (1977) considered this species seasonally migratory, colonizing fruit growing districts in Himalayan valleys in summer to an altitude of 1200 m. Indeed, apart from one colony at Lahore, he considered most of the populations found in Pakistan (where it is mainly restricted to the north-eastern borders with India) to be ‘mainly a summer visitor to Pakistan’. It is also recorded as a seasonal migrant in India in Rajasthan (Advani, 1982) and around Bombay by Brosset (1962).

Rhinopoma microphyllum (Family Rhinopomatidae)

Ranges from Mauritania around the edges of the Sahara Desert to Arabia, Iran, Afghanistan, Pakistan, India and Sumatra.

IUCN status: Least Concern.

Insectivorous, generally roosting in caves and tunnels or substantial old buildings (Bates & Harrison, 1997).

At a fort at Burhanpur (Madhya Pradesh), Badwaik (1991) records the presence of a mixed colony of 7500-8000 of this species and *Taphozous melanopogon* being present in April and May, the main breeding season. *Rhinopoma* are absent from December to February. Gopalakrishna (1986) marked a number of bats of this species in the same area and recorded movements up to 900 km from a cave at Osmanabad in Maharashtra. Roberts (1977) also reported seasonal migrations, vacating roosts in Punjab from mid-October to mid-May.

Taphozous melanopogon (Family Emballonuridae)

Widespread through India and Sri Lanka to southern China, Borneo, Java, Philippines.

IUCN status: Least Concern.

Insectivorous, roosting in caves, ruins and temples (Bates & Harrison, 1997).

In the fort discussed above for *R. microphyllum*, a site used by 7500-8000 *R. microphyllum* and this species, only 2000-2500 *T. melanopogon* are present in the winter and these are largely young or immature (Badwaik, 1991). Gopalakrishna (1986) recorded movements of 200 km from a breeding roost, which was more or less vacated by adults between September and June.

Hipposideros lankadiva (Family Hipposideridae)

Confined to India and Sri Lanka. Widespread, but relatively sparse in India with few colonies known.

IUCN status: Least Concern.

Insectivorous, roosting in caves and tunnels, and temples (Bates & Harrison, 1997).

Gopalakrishna (1986) recorded movements of 475 km between sites, although some adults remained at each site all year.

'Pipistrellus' (Family Vespertilionidae)

A curious anecdote is related by Prakash (1960) [and reprinted in CCINSA newsletter *Bat Net* 3(1), 2002]. The author reports on the behaviour of pygmy pipistrelle bats, *Pipistrellus mimus*, retreating to cover before impending storms were apparent to the human observer. As an afternote the author reports that captains of ocean-going ships had reported that they also used the same behaviour in 'pipistrelle' bats flying along with the ship to warn of approaching storms. It is not clear from this how frequently bats might appear on such ships and in what circumstances, but it might imply that bats here frequently fly over the sea, which would most likely be during migrations; bats frequently cross seas in Europe and are recorded well off the coasts of North America and occasionally off Africa, but regular migrations across seas off India would not seem likely.

5.4.4. Expertise, technical and other support for development and implementation of an Agreement and action plan

A Chiroptera Conservation Information Network of South Asia (CCINSA) has been established and includes representation from most countries of the region. CCINSA has recently reviewed the conservation status of all the region's species and has held initial discussions on a regional conservation action plan. These discussions included consideration of policy and legislation issues (including the potential of a CMS bats Agreement), as well as discussion on threats to species and habitats (especially bats in temples), educational requirements, and survey and research priorities.

India is currently revising its wildlife legislation and it is hoped that this will move fruit bats from the 'vermin' list to a schedule of protected species.

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5.5. South-East Asia

5.5.1. Countries considered (Parties to CMS are given in capitals):

Cambodia, Brunei, INDIA (Andaman and Nicobar Islands), Indonesia, Laos, Malaysia, Myanmar, Singapore, Thailand, Viet Nam.

5.5.2. Knowledge base.

Very little is known about bat migration in the region.

However, at the 12th International Bat Research Conference in Kuala Lumpur, Malaysia, in August 2001, the question of transboundary movements of the large flying fox, *Pteropus vampyrus*, was mentioned several times. In both an opening address to the conference from the Department of Wildlife and National Parks, and in an account of conservation activity in Malaysia by the Malaysian Nature Society, the development of a CMS Agreement was proposed in view of the severely declining status of the species and its observed movements between Malaysia and Thailand and from Malaysia southwards across the Straits of Malacca (towards Singapore and Indonesia).

The proposal for such an Agreement is also made in a recent review of the distribution, abundance and status of the species in Peninsular Malaysia published after the conference (Mohd-Azlan *et al*., 2001).

At present no other bat species have been identified as migratory in the region. Whether other species could be included in such an Agreement therefore needs to be further assessed. An Agreement for *P. vampyrus* would have impact on the conservation of other larger fruit bats (including a number of threatened island species where they are sympatric with *P. vampyrus*), would have benefits for other fruit bats and probably for other bats and may influence the conservation of important forest and mangrove areas. While the species is protected and hunting regulations apply in Malaysia, there are clear needs for better enforcement and education; the conservation status and needs in other countries of the region are currently unknown.

5.4.3. Species data

Pteropus vampyrus (Family Pteropodidae)

This one of the few widespread mainland *Pteropus* species, occurring from Myanmar and the Andaman and Nicobar Islands in the west, through Thailand, Cambodia to Vietnam (with a single record from northern Laos) and through Malaysia and Indonesia to the Philippines, Borneo and Timor. Up to seven subspecies (mainly restricted to island groups) have been recognised, but the status of some subspecies needs reassessment; some authorities have even argued that the species might be synonymised with *P. giganteus* from South Asia (e.g. Corbet & Hill 1992).

IUCN status: Least Concern.

Included in Appendix II of CITES (although no international trade is recorded).

The Javan form of this species, locally known as 'Kalong', is regarded as the largest bat in the world with a wing span of up to 1.7 m. The species roosts colonially in trees and feeds on a range of fruits and flowers, many of which are grown by man or have economic or social value to man. Colonies can be large, up to 15,000 recorded in Borneo, but are often mixed with other species. An account of the species can be found in Mickleburgh *et al*. (1992) and in Kunz & Jones (2000).

In Peninsular Malaysia declines have been particularly evident over the last 10–20 years. Threats to the species include deforestation (including of mangrove swamps principally used for roosting) and hunting (for medicines, food and by orchard owners) (Mohd-Azlan *et al*. 2001). Declines are also reported for Borneo and massive declines (up to 99%) since the 1920s in parts of the Philippines (see Mickleburgh *et al*. 1992). In Brunei there are current threats to coastal forests used as foraging habitat, but also the hope that some mangrove roosts will be incorporated into a proposed Ramsar site (D.J.W. Lane, *in litt*.)

Apart from the above discussions about movements involving Malaysia, in subsequent discussion at the Malaysia conference, it was further suggested that this species probably also moved seasonally between Cambodia and Vietnam (J. Walston, pers.comm.) and between Sarawak (Malaysia) and adjacent Indonesia (M. Gumal, pers. comm.). It has also been suggested that populations on the Andaman and Nicobar Islands (India) are seasonally migratory (Mason, 1908; Hill, 1967). Mason says the species is possibly a regular migrant to the Nicobar Islands during monsoons, arriving April and leaving in September; although he noted one record of them being seen in Car Nicobar in February/March of one year. It is believed to migrate between these islands and Myanmar (K. Swee, pers.comm.), but Mason's comments may also imply movement between the islands and adjacent parts of Indonesia (Sumatra). Large colonies are recorded from inner Brunei Bay and these undoubtedly range into Sarawak and probably Sabah.

5.4.4. Expertise, technical and other support for development and implementation of an Agreement and action plan

There would appear to be interest and expertise in Malaysia (both in government and non-government organisations) to support, develop and implement an Agreement and action plan for *Pteropus vampyrus*. The basis for an action plan is included in Mohd-Azlan *et al*. (2001). This includes control of hunting, increased co-operation between relevant government departments, biological studies (including demographic studies to determine sustainable hunting strategies), survey and roost monitoring, and educational activities. The Malaysian Nature Society has the capacity to be involved in awareness and education programmes and is currently developing a programme on bats for schools.

Interest from other countries is yet to be determined.

This is a species for which there is potential for involving the public in the survey and roost monitoring, through contributing observations on the seasonal presence/absence, numbers and possibly food items used by the bats. At the other end of the scale, the species might be ideal for satellite/radio-tracking to clarify migration behaviour.

The only current CMS Party in the region under discussion is India, which has jurisdiction over Andaman and Nicobar Islands within the migratory distribution of *P. vampyrus*.

5.4.5. References

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Hill, J.E. 1967. The bats of the Andaman and Nicobar Islands. *Journal Bombay Natural History Society* 64(1): 1-9.

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Mason, G.E. 1908. On the fruit bats of the genus Pteropus inhabiting the Andaman and Nicobar Archipelagos, with the descrption of a new species. *Records Indian Museum* 2: 159-166.

Mickleburgh, S.P., Hutson, A.M. & Racey, P.A. 1992. *Old World Fruit Bats – An Action Plan for their Conservation*. IUCN, Gland. 252pp.

Mohd-Azlan, J., Zubaid, A. & Kunz, T.H. 2001. Distribution, relative abundance, and conservation status of the large flying fox, *Pteropus vampyrus*, in peninsular Malaysia: a preliminary assessment. *Acta Chiropterologica* 3(2): 149-162.

6. Summary remarks

At present the knowledge of bat migration is patchy and is largely based on relatively abundant species, but the available information suggests that it is probably a much more widespread and important phenomenon than is currently recognised and not just at the more temperate ends of their distributions. A wide range of migration strategies are used by bats. There is scope for a lot more basic research and probably collation of existing data collected for other purposes.

The traditional means of identifying migrants and their behaviour has been through ringing (banding) and associated observation, including systematic trapping. Banding has not been undertaken on the scale that it has with birds and in many countries is discouraged except for particular identified projects. In Europe (and elsewhere), casual field observation, e.g. by bird watchers, has also highlighted otherwise unrecorded movements and mass arrivals. More recently, the use of DNA techniques has been used to identify migration potential and actual routes and sources for some species (e.g. Wilkinson & Fleming, 1996; Petit & Mayer, 2000). Promising preliminary studies have been carried out using stable isotope analysis, fine detail radar and the availability of satellite tags that can be applied to the larger fruit bats; and doubtless other improved technologies or new mechanisms will offer further opportunities.

The fresh opportunities that new technologies can bring to more traditional study techniques offers exciting challenges for future years.

Fleming & Eby (in press) argue strongly that the conservation of such migratory species relies on broad-scale, co-operative approaches that engage all relevant parties. It is clear from existing programmes that they can bring great benefit to other sympatric species and to other biodiversity components and general environmental concerns.

While much of the research on bat migration has been carried out on relatively abundant species, threatened species that are migratory can be identified, there are very clear threats to some migratory species that are still widespread and relatively abundant, and there is very good reason for the precautionary principle to be applied in the case of species where the evidence of migration is still unclear.

The threats particularly associated with migration are clear in only very few cases, but they will be common to a wide range of species.

A high percentage of the 1100 bat species are considered threatened and there are obvious instances where an intergovernmental collaborative approach to their conservation, such as through a CMS bats Agreement, would benefit greatly the conservation of the threatened migratory species as well as a range of other bat species and wider biodiversity.

References

Fleming, T.H. & Eby, P. in press. *Ecology of Bat Migration*. (*in* Kunz, T.H. & Fenton, M.B., *Bat Ecology*, Plenum Press, New York).

Petit, E. & Mayer, F. 2000. A population genetic analysis of migration: the case of the noctule bat (Nyctalus noctula). *Molecular Ecology* 9: 683-690.

Wilkinson, G.S. & Fleming, T.H. 1996. Migration and evolution of lesser long-nosed bats *Leptonycteris curasoae*, inferred from mitochondrial DNA. *Molecular Ecology* 5: 329-339.

7. Prioritising of regions

In all the regions considered there is sufficient evidence of bat migration to warrant international collaboration on the conservation of those bat species that move between range states.

In the timescale available for this project there has been expression of interest in such regional Agreements from a number of individuals, but it has not been possible for organisations to comment in the time available. Neither has it been possible to identify more than a few government bodies or individuals who could commit to pursuing the recognised benefits of developing and implementing a CMS or CMS-style of Agreement.

Expressions of interest have been received from all the regions approached, including recognition of the benefits that a CMS-style bats Agreement would bring to these regions. In view of the limited response in the time frame offered, no firm lists are given in this report of specialists and interested organisations that have volunteered such opinions. However, the circulation lists developed for this project and provided to CMS will provide a foundation for further development of any Agreement.

All the regions investigated could benefit from a CMS or CMS-style Agreement. A CMS Agreement could provide an international legal framework for government and NGO activity. Range states could also consider the benefits to bat conservation that an essentially NGO initiative is developing through the collaboration of Mexico and USA in their Programme for the Conservation of Migratory Bats.

Offering priorities to CMS for regions that it should or could concentrate on are difficult at this stage and may be premature. For a successful Agreement to be established, there is the need, *inter alia*, to identify appropriate species and the need for appropriate specialist, technical and other support for the development and implementation of the Agreement through an action plan. While all the regions under discussion have appropriate species and the capability to carry that through, it is not yet possible to gauge the level of recognition of the full benefits of such an Agreement and hence the level of commitment that might be available.

Nevertheless, the needs and resources identified through this report varies between regions and as a first step towards establishing priorities, Table 2 offers a range of factors relating to the development of an Agreement and the regions to which they apply on the basis of current knowledge

Table 2. Distribution of factors relating to development of a regional bats Agreement

	South America	Southern Africa	South Asia	South-East Asia
Existing CMS App I species	+			
Existing CMS App II species				
App I species proposed here	+			+
App II species proposed here	(+)	+		
Formal network of bat specialists	+		+	
Informal network of bat specialists		+		
Availability of appropriate NGOs	+	+	+	+
CMS Party available for lead	+	+	+	(+)
Appropriate action plan in preparation			+	+
National government interest				

8. Migratory species that could qualify for CMS appendices

Appendix I lists migratory species that are endangered.

Appendix II lists migratory species that have an unfavourable conservation status and which require international agreements for their conservation and management, as well as those which have a conservation status which would significantly benefit from the international co-operation that could be achieved by an international agreement.

N.B. if the circumstances so warrant, a migratory species may be listed both in Appendix I and Appendix II.

From the species discussed above, eight species have been selected as potential candidates for listing in CMS Appendices. This is probably a rather conservative selection of species where there is sufficient understanding of their migration and where clear benefits for their conservation and for the conservation of sympatric bat species and other biodiversity elements could accrue from listing.

For those eight species, summary data is given in support of proposed listing in either Appendix I or Appendix II. The summary data is arranged to conform with the structure of full detailed proposals required by CMS for listing species. Thus the accounts include Biological data (including distribution, populations, habitat, migrations), Threat data (direct threats to populations, habitat destruction, indirect threats, threats connected especially with migrations, national and international utilisation), Protected status and needs (national protection status, international protection status, additional protection needs), Range states (list of recorded range states), and Recommended CMS status (Appendix I or II). Further detail of most of these species can be found in earlier text of this report.

8.1. *Eidolon helvum* (Kerr 1792). Family Pteropodidae

8.1.1. Biological data

Fruit and flower feeder. Widespread Africa, including Gulf of Guinea islands and Zanzibar, Pemba and Mafia off Tanzania. Forms large colonies of 10s to 100s of thousands, occasional colonies estimated at about one million, with one in Zambia estimated at up to five million. Recorded at sea 250 km from nearest land, and at altitudes to 2000m. Occupies wide range of forest, savannah and urban habitats. Resident in much of central Africa with long-range migrations south and north as far south as South Africa (to 32^{o}S) and north to northern Senegal across to the southern half of Sudan and Ethiopia. To 18^{o}N in Niger. Distribution at northern and southern extremes of range patchy and erratic. Also sparse or absent in large areas of the Horn of Africa, central East Africa and elsewhere. The wide distribution and seasonal and erratic occurrence may mask a more complex distribution and smaller population than is apparent from distribution maps (particularly outside the rain forest areas of West and Central Africa), and from records of colony size.

Also present South-West Arabia as subspecies *E.h.sabaeum*. The only other species of the genus is *E. dupreanum* of Madagascar.

8.1.2. Threat data

Frequently forms large colonies in towns and cities where unwelcome through fruit feeding, defoliation of roost trees, defecation on (commercial) buildings. Taken as food (including commercially) in towns and elsewhere – and occasionally for medicinal use. As food it may be the source of fruit bat meat that appears in European food retailers. Persecuted as pest by fruit growers, but damage is likely to be far outweighed by benefits from pollination and seed dispersal. Encroachment on natural habitats through increased agriculture and developments. Vulnerable, and perhaps misleadingly abundant, in large and temporary colonies.

8.1.3. Protected status and needs

Not protected under any international measures and probably not protected in any range state legislation (unless included in very general wildlife protection). May require management of hunting and other persecution.

IUCN status: Least Concern.

8.1.4. Range states

Nominate subspecies recorded from Angola, BENIN, Bioko, BURKINA FASO, Burundi, CAMEROON, Central African Republic, CHAD, CONGO, Equatorial Guinea, Ethiopia, Gabon, GAMBIA, GHANA, GUINEA, GUINEA-BISSAU, Ivory Coast, KENYA, Liberia, Malawi, MALI, Mozambique, Namibia, NIGER, NIGERIA, PRINCIPE, Rwanda, SAO THOME, SENEGAL, Sierra Leone, SOMALIA, SOUTH AFRICA, Sudan, Tanzania (including Mafia, Pemba, Zanzibar), TOGO, UGANDA, Democratic Republic of Congo, Zambia, Zimbabwe. (not Botswana, Lesotho, Swaziland?).

E.h.sabaeum from North Yemen, Saudi Arabia, South Yemen.

8.1.5. Recommended CMS status

Appendix II.

8.2. *Pteropus vampyrus* (Linnaeus 1758). Family Pteropodidae

8.2.1. Biological data

Fruit and flower feeder. Distributed from South Myanmar east to Viet Nam and south through Andaman and Nicobar Islands (India) to Sumatra and east to Philippines, Borneo and Timor. On many smaller islands, including recent colonisation of Krakatau group. About seven subspecies recognised, but likely that few of these are valid. Populations

poorly known, but widespread reports of declines in colony sizes of up to 90% and there has been recent sightings at only 40% of 115 recorded colony sites in Peninsular Malaysia. Current colonies generally to about 1500 in tall forest trees or mangrove areas. Feeds on a wide range of wild and cultivated trees. From sea level to at least 1300m, most frequent in lower (coastal) areas. Migrations poorly known, but believed to migrate between southern Myanmar to Andaman and Nicobar Islands, between Andaman and Nicobar islands and Sumatra, Cambodia and Viet Nam, Thailand and Malaysia, Malaysia and Singapore and Indonesia.

The genus *Pteropus* includes about 70 species, most species restricted to individual islands or island groups. Note that some authorities regard this species and *P. giganteus* of South Asia as probably conspecific.

8.2.2. Threat data

Hunting (for food, medicine or sport) is a widespread threat. Where licensed, hunting is often poorly controlled and monitored. Persecuted as a pest of fruit in some areas, although damage likely to be outweighed by benefits from pollination and seed dispersal. Habitat loss is particularly a threat in lowland forests and mangrove areas. Development, for various purposes, is a principal threat here (including rapid and increasing removal of mangrove). More generally agriculture, including widespread monoculture of crops unsuitable as food sources, such as oil palm, is also a threat. Both aspects of habitat loss may also affect continuity of feeding habitat on migration routes.

8.2.3. Protected status and needs

Included in CITES Appendix II. Fruit bats (Pteropodidae) currently classed as ‘Vermin’ in India. Probably not protected in any other range state, although hunting is only allowed under licence in Malaysia.

IUCN status: Least Concern (needs reassessment).

8.2.4. Range states

Brunei, Cambodia, INDIA (Andaman & Nicobar Islands only), Indonesia (east to Makassar Straits and Timor), Laos (one record only), Malaysia, Myanmar, PHILIPPINES, Singapore, Thailand, Viet Nam.

8.2.5. Recommended CMS status

Appendix I

8.3. *Choeronycteris mexicana* Tschadi 1844. Family Phyllostomidae

8.3.1. Biological data

Feeds on nectar, pollen, fruit and probably some insects. Distributed from extreme south Texas (Hidalgo County), south-east Arizona, extreme south-west New Mexico, south to El Salvador and Honduras. Roosts in caves and mines (occasionally buildings), in small insular mountain ranges in the north. Tend to roost spaced apart (not in dense clusters). Forage in arid thorn scrub to tropical deciduous forest and mixed oak-conifer forest. Primarily above 500 m (to 2400 m). Migrates north from Mexico during pregnancy to Arizona/New Mexico (USA) to give birth June/July. Some populations in New Mexico may be permanent summer residents (and some may overwinter).

The genus includes only this species.

8.3.2. Threat data

Concentration in caves where subject to disturbance, blocking of entrances, direct killing (mainly in misplaced attempts at vampire bat control), recreational caving and tourism, mineral extraction. These bats have an extreme mutualism with key arid zone plants (such as Agave and certain cacti): the bats are the primary pollinators of the plants and the plants are the primary food source of the bats. The bats are threatened by loss of food sources, interruption of flowering of key food plants, and disruption of flowering corridors.

8.3.3. Protected status and needs

Protected USA and Mexico, elsewhere (?). Mexico's Federal Law of Wildlife encompasses all caves and crevices *de facto* as protected areas.

IUCN status: Near Threatened.

Included in the Program for the Conservation of Migratory Bats of Mexico and the United States (PCMM) – see Section 1 of this report.

8.3.4. Range states

El Salvador, Guatemala, Honduras (?), Mexico, USA, Venezuela (?)

8.3.5. Recommended CMS status

Appendix II

8.4. *Leptonycteris curasoae* Miller 1900. Family Phyllostomidae

8.4.1. Biological data

Specialist feeder on nectar and pollen, plus some insects and soft fruit. Occurs in Netherlands Antilles to Columbia and Venezuela, and from USA (Central Arizona and south-west New Mexico) to El Salvador. Forms large colonies, to 20,000, in caves and mines with major declines recorded in Netherlands Antilles, USA and Mexico. Forages in arid scrub zones with agaves and columnar cacti. Migrates between Mexico and USA. Evidence of long-range movements Venezuela, assumed sedentary in Netherlands Antilles.

The northern populations have been regarded as separate species or subspecies. *L. nivalis* is the only other species in the genus.

8.4.2. Threat data

Concentration in caves where subject to disturbance, blocking of entrances, direct killing (mainly in misplaced attempts at vampire bat control), recreational caving and tourism, mineral extraction. These bats have an extreme mutualism with key arid zone plants (such as Agave and certain cacti): the bats are the primary pollinators of the plants and the plants are the primary food source of the bats. The bats are threatened by loss of food sources, interruption of flowering of key food plants, and disruption of flowering corridors.

8.4.3. Protected status and needs

Protected USA and Mexico, status elsewhere unknown. Mexico's Federal Law of Wildlife encompasses all caves and crevices *de facto* as protected areas.

IUCN status: Vulnerable.

Key species in the Program for the Conservation of Migratory Bats of Mexico and the United States (PCMM) – see Section 1 of this report.

8.4.4. Range states

Colombia, El Salvador, Guatemala, Honduras, Mexico, NETHERLANDS ANTILLES (Aruba, Curasoa, Bonnaire) (NETHERLANDS), USA, Venezuela (including Il de Margarita).

8.4.5. Recommended CMS status

Appendix I

8.5. *Leptonycteris nivalis* (Saussure 1860). Family Phyllostomidae

8.5.1. Biological data

Specialist feeder on nectar and pollen, plus some insects and soft fruit. Occurs in USA (south-west Texas: Presidio and Brewster Counties), through Mexico to Guatemala. Colonial roosts in caves, mines and tunnels, sometimes rock crevices, buildings or trees. Colonies to 10,000 in underground habitats. Forages in arid areas of Mexico and mountainous pine-oak habitats in north (Texas). Occurs to 3500 m. Does not hibernate. Major declines recorded in Mexico. Females migrate northwards to occupy northern parts of range from June to August, extent of migration varying from year to year (Texas populations vary between none and 14,000) probably depending on variation in flowering succession in individual years. Young are born in Mexico (April to June) and travel north with mothers. Most males remain in south of range. More southern populations non-migratory.

L. curasoae is the only other species in the genus.

8.5.2. Threat data

Concentration in caves where subject to disturbance, blocking of entrances, direct killing (mainly in misplaced attempts at vampire bat control), recreational caving and tourism, mineral extraction. These bats have an extreme mutualism with key arid zone plants (such as agaves and certain cacti): the bats are the primary pollinators of the plants and the plants are the primary food source of the bats. The bats are threatened by loss of food sources, interruption of flowering of key food plants, and disruption of flowering corridors.

One key cave roost in Mexico was destroyed by a road development.

8.5.3. Protected status and needs

Protected USA and Mexico. Guatemala (?). Texas roost site protected within National Park. Mexico's Federal Law of Wildlife encompasses all caves and crevices *de facto* as protected areas.

IUCN status: Endangered.

Key species in the Program for the Conservation of Migratory Bats of Mexico and the United States (PCMM) – see Section 1 of this report.

8.5.4. Range states

Guatemala, Mexico, USA.

8.5.5. Recommended CMS status

Appendix I.

8.6. *Miniopterus schreibersii* (Kuhl 1817). Family Vespertilionidae

8.6.1. Biological data

Insectivorous species. The most widely distributed bat species, occurring from southern Europe east to Japan, south to South Africa and through to Australia. Distribution uneven (e.g in Afrotropical region only recorded across central, eastern and moister parts of southern Africa). Cave bat forming colonies of up to 300,000. Caves used for maternity colonies, for hibernation at higher latitudes and as stop-off points during migration. Major population declines recorded in Europe, Australia and South Africa (those places at higher latitudes where the species has been most studied). Migrations to 1300 km (Australia), over 800 km (Europe), 250 km (South Africa). Movements to hibernation sites may be in almost any direction. Males often less migratory, but movements and summer behaviour poorly understood.

There have been many attempts to separate this species into a number of species – none has been widely accepted so far. The genus includes about 14 species, some with restricted distribution.

8.6.2. Threat data

Reliant on caves where subject to disturbance, blocking of entrances, direct killing, recreational caving and tourism, mineral extraction, changes to microclimate within cave. Particularly sensitive during maternity and hibernation periods, but conservation of other used sites, including caves used as migratory stop-off points, also important. Foraging habitat threatened by intensive agriculture, development, forestry (including logging).

Recent major mortality in summer maternity colonies of western Europe from, as yet, unknown causes.

8.6.3. Protected status and needs

Protected in most European and former Soviet Union range states, and Australia. Protected status elsewhere uncertain. In Europe included in CMS Appendix II and the Agreement on the Conservation of Bats in Europe, Annex II of EU Habitats and Species Directive, Bern Convention on the Conservation of European Wildlife and Natural Habitats (Appendix II). Some international collaborative programmes in Europe.

IUCN status: Near Threatened.

8.6.4. Range states

Afghanistan, ALBANIA, Algeria, Angola, AUSTRALIA, Austria, Azerbaijan, Bosnia & Herzegovina, Botswana, BULGARIA, CAMEROON, Central African Republic, China, CROATIA, Ethiopia, FRANCE, GAMBIA (?), GERMANY, GHANA, GIBRALTAR (UK), GREECE, GUINEA, Hong Kong, HUNGARY, INDIA, Indonesia, Iran, Iraq, ISRAEL, ITALY, Japan, JORDAN, KENYA, Lebanon, MACEDONIA, Madagascar, Malawi, Malaysia, MALTA, MOROCCO, Mozambique, Myanmar, Namibia, Nepal, Papua New Guinea, PHILIPPINES, PORTUGAL, ROMANIA, Rwanda (?), SAUDI ARABIA, Sierra Leone, SLOVAKIA, SLOVENIA, Solomon Islands, SOMALIA (?), SOUTH AFRICA, SPAIN, SRI LANKA, Sudan, SWITZERLAND, Syria, Taiwan, TAJIKISTAN, Tanzania, Thailand, TUNISIA, Turkey, Turkmenistan, UGANDA, UKRAINE, UZBEKISTAN, Viet Nam, Yemen, Yugoslavia, Democratic Republic of Congo, Zambia, Zimbabwe.

8.6.5. Recommended CMS status

Appendix II for southern African populations (European populations already included in CMS Agreement on the Conservation of Bats in Europe).

8.7. *Otomops martiensseni* (Matschie 1897). Family Molossidae

8.7.1. Biological data

Aerial insectivore, feeding mainly on small moths. Large species with the narrowest wings of any bat for fast direct flight in open areas. Widely distributed in eastern Africa from Yemen to South Africa, one record Ghana. Widespread western Madagascar. Sparsely recorded with few breeding sites known. Generally colonial with larger colonies in underground sites. In South Africa forms small colonies in houses, one small colony recorded from a tree in Tanzania, other records from caves and lava tubes. Colonies to several hundred, two caves (Kenya) recorded with more than 1000 (one with several thousand). These major Kenya colony sites now with few or no bats. Forages over semi-arid areas to montane forest up to 2000 m. Probably a long-range forager over a wide diversity of habitats. Migration unknown, but reported to be absent during dry season from some major colony sites.

The genus includes six species, the other species all known from three or less localities. The Madagascan population of *O. martiensseni* is regarded by some authorities as a separate species (*O. madagascariensis*) and it has been suggested that the southern African populations should be regarded as a separate species, *O. icarus*, or subspecies.

8.7.2. Threat data

Threats poorly known, but major colonies in caves and lava tubes may have been lost through disturbance, including by guano digging and associated changes to microclimate. Other general conservation problems associated with caves may apply (other forms of

disturbance, blocking of entrances, direct killing, recreational caving and tourism, mineral extraction). Ability for long-range foraging may mean that only gross landscape changes would affect foraging habitat and food availability.

8.7.3. Protected status and needs

Listed for protection South Africa, protected status elsewhere unknown. Not listed in any international conservation statute or treaty. Roost sites need protection in some areas.

IUCN status: Vulnerable.

8.7.4. Range states

Angola, Botswana, CONGO, Djibouti, Ethiopia, KENYA, Madagascar, Mozambique, Rwanda, SOUTH AFRICA, Sudan, Tanzania, UGANDA, Yemen, Democratic Republic of Congo, Zambia, Zimbabwe.

8.7.5. Recommended CMS status

Appendix II

8.8. *Tadarida brasiliensis* (Geoffroy 1824). Family Molossidae

8.8.1. Biological data

Aerial hawking insectivorous species. Distributed from c. 40^{o}N in North America (USA), through Central America to c. 30^{o}S in South America, plus many islands in the Caribbean Sea; scarce or absent in much of Amazonia. Forms largest aggregations of any terrestrial vertebrate (to 20 million, rising to close to 40 million with young). Largest colonies in caves in northern part of range, but records to 12 million also recorded in Argentina. Large colonies (up to one million) also found under bridges, smaller colonies in buildings. Population declines of over 90% recorded at some North American roost sites. Generally forages in open air over a wide range of habitats and may range to 60 km during nightly foraging flights. Migratory at least in north and south of range (to 1840 km between USA and Mexico). Migration mainly of females moving to higher latitudes to form nursery colonies. Not all populations of North America migrate and migration in central (tropical) parts of range not known.

The genus has a world wide distribution with about eight species.

8.8.2. Threat data

The major colonies rely on underground habitats where subject to disturbance, blocking of entrances, direct killing, recreational caving and tourism, mineral extraction, guano extraction, changes to microclimate within cave. Intentional exclusion from bridges has also been a threat in North America, but is being addressed by negotiated conservation

policy. Exclusion from buildings is only likely to be a serious threat to the populations on islands. Association with rabies in Latin America and USA also a threat. Not very habitat specific for foraging, so threats to foraging habitat difficult to define and probably not a major influence. However, large-scale conversion to agriculture with associated use of pesticides has been identified as a major conservation concern. Uses a range of stop-over points on migration. Such temporarily used sites may be difficult to identify and not receive the conservation effort that major nursery colony sites receive, but their loss could be critical to successful migration.

8.8.3. Protected status and needs

Protected USA and Mexico, protected status elsewhere not established, though some range states have all-embracing legislation that nominally protects all wildlife. Mexico's Federal Law of Wildlife encompasses all caves and crevices *de facto* as protected areas.

IUCN status: Near Threatened.

Key species in the Program for the Conservation of Migratory Bats of Mexico and the United States (PCMM) – see Section 1 of this report.

8.8.4. Range states

Antigua and Barbuda, ARGENTINA, BAHAMAS (UK), Belize, Bolivia, Brazil, CAYMAN ISLANDS (UK), CHILE, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, GUADELOUPE (FRANCE), Guatemala, Haiti, Honduras, Jamaica, MARTINIQUE (FRANCE), Mexico, MONTSERRAT (UK), NETHERLANDS ANTILLES (NETHERLANDS), Nicaragua, PANAMA, PARAGUAY, PERU, Puerto Rico, St Kitts & Nevis, St Lucia, Trinidad and Tobago, TURKS & CAICOS ISLANDS (UK), USA, URUGUAY, Venezuela.

8.8.5. Recommended CMS status

Already included in Appendix I. The species was included in the original Appendix listing in 1985. The status could be reviewed during consideration of other bat species for listing.

ATTACHMENT 1I
to CMS/ScC12/Doc.13

Update to:

A feasibility study on additional bats Agreements under CMS

Update of UNEP/ScC11/Doc.7

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1. Introduction

CMS Resolution 7.7 requested the CMS Secretariat to continue its activities in the field of bats, including exploring the potential to develop further CMS Agreements on bats.

The following notes report on further information received from correspondents responding to the circulation of the earlier study undertaken for the Scientific Council (UNEP/ScC11/Doc. 7).

Preliminary drafts of proposals for listing by CMS have been prepared for the following species (UNEP/ScC12/Doc.12). Further work on these is intended with the aim of providing completed drafts by June 2004.

Species for which draft proposals for inclusion in CMS appendices are in preparation are:

Choeronycteris mexicana	(family Phyllostomidae)
Eidolon helvum	(family Pteropodidae)
Leptonycteris curasoae	(family Phyllostomidae)
Leptonycteris nivalis	(family Phyllostomidae)
Miniopterus 'schreibersii' (Africa)	(family Vespertilionidae)
Otomops martiensseni	(family Molossidae)
Pteropus vampyrus	(family Pteropodidae)
Tadarida brasiliensis	(family Molossidae)

For the most part, where a correspondent's response was with respect to species proposed for listing by CMS, the information has been incorporated into the draft proposal for the individual species (see ScC12/Doc.12). In the case of Venezuela, some more general points were raised while dealing with *Leptonycteris curasoae*, so the response is included here, with details incorporated into the species proposal.

The other species discussed in this update (and in the earlier report) can be considered as providing further evidence or likelihood of a wide range of bat species undertaking migrations. Most of the species discussed here are fruit and flower feeders. It is likely that many insectivorous bats also migrate but, the evidence is harder to acquire. In the development of any further bats Agreement(s), the proposed species for listing may be the key species to concentrate on, but the other species for which migratory data is less secure should also be considered.

2. Africa

East Africa

Coleura africana (family Emballonuridae). Kingdon (1974) suggests that this East African species migrates. Seasonal fluctuations in numbers have been recorded at Lake Baringo, Kenya, and at Suakin on the Red Sea Coast. In some other areas, it is thought that the populations in caves remain relatively stable. It is possible that some populations retreat from drier parts of their range due to a seasonal shortage of insects.

Reference:
Kingdon, J. 1974. *East African Mammals – an atlas of evolution in Africa. Vol IIA (Insectivores and Bats)*. Academic Press, London/New York. 341pp.

Congo

A list of fruit bat species (Pteropodidae) that is believed to include species that are migratory in the Congo was presented to CMS ScC11 and CoP7 (UNEP/CMS/Inf. 7.14.2, National Report for Congo Brazzaville). It is suggested that further research is needed, as well as public education, since a number of species are exploited. The species listed are *Eidolon helvum*, *Epomophorus grandis*, *Epomophorus labiatus, Epomophorus wahlbergi*, *Epomops franqueti*, *Hypsignathus monstrosus*, *Megaloglossus woermanni*, *Micropteropus pusillus*, *Myonycteris torquata*, *Rousettus angolensis*, *Rousettus aegyptiacus*, *Scotonycteris ophiodon* and *Scotonycteris zenkeri*. *Epomophorus grandis* is regarded as threatened.

Kenya

Hipposideros 'commersoni' (*marungensis* and *gigas*) (Family Hipposideridae). Two forms occur in caves on the Kenya coast and it is believed that at least one of these is migratory. (Reference: Andrew McWilliams, Unpublished PhD.

Ivory Coast

N.M.Ebigbo, University of Ulm (Linnean Society Conference, London, November 2003).
Some (mainly fruit bat, Pteropodidae) species leave Comoe National Park, Ivory Coast, in the dry season.

Uganda

Robert Kityo, Makerere University (February 2004)
The response includes information that Dr Kityo also is "of the impression that *Myonycteris torquata* also has migratory tendencies, there is not very much data on it available to me, but my own field observation suggest it. It appears as a not so abundant species as other fruit bats in areas where encountered." This species is further discussed in UNEP/ScC11/Doc.7.

South Africa

Ric Bernard, Rhodes University (December 2003)
From observations made during PhD studies, *M. tricolor* (Vespertilionidae) was present in mines and caves in the Natal Midlands of South Africa during summer (September to April) and absent for the winter months. Females were pregnant when they arrived in August/September and gave birth in the area (no adult males were found in the area). Mating occurred just prior to the species leaving and it is likely that sperm storage occurred through winter. Where they go in winter is unknown.

N. thebaica (Nycteridae) did the opposite and spent winter in the study area. Although Dr. Bernard caught them at the coast throughout the year, banding showed that it was not coastal bats that moved inland in winter.

Swaziland

Ara Monajdem University of Swaziland (August, 2002)
The following species have regular/seasonal population fluctuations (numbers drop from hundreds or thousands, depending on the species, down to a handful of individuals on a seasonal basis): 1) *Rhinolophus clivosus*, 2) *Miniopterus schreibersii*, 3) *Miniopterus frateculus* (See Monadjem, A. 1998. *Mammals of Swaziland*. The Conservation Trust of Swaziland & Big Game Parks, Mbabane).

A fourth species (*Myotis tricolor*) has recently been discovered in Swaziland, and it is almost certainly a migrant as well. There may well be other migratory species that are not known about.

Dr Monajdem considered that an international agreement would stimulate collaborative research into our bats, which would go a long way towards their conservation. Furthermore, international agreements tend to be used as a basis for the development of proposals. And governments often give more weight to issues (e.g. conservation activities) arising from international agreements.

3. Americas

Ecuador

L. Albuja, Escuela Politecnica Nacional (February 2004)
Considers the work of CMS and the possibility of a bats Agreement most important and registers interest. He suggests the viability of such an initiative could be realised through environmental campaigns and correspondence with various bat specialists in Ecuador and ornithologists to communicate the proposition to study migratory bat species and the necessity to accumulate data on these animals. Also important would be marking examples of migratory species and distributing information to other countries to determine the range of these movements.

Supplementary report (February 2004): Dr. Albuja confirms that there is not much knowledge in Ecuador on migratory bat species. With Dr Roger Rageot, Dr Albuja has for the last 10 years been studying bats in the area of Mera, an area of high equatorial Amazonia (Ragoet & Albuja, 1994). Here it is believed that 12 bat species (of 92 mammal species) are migratory, undertaking altitudinal movements to coincide with the availability of food resources, principally fruit. For the most part, these migrants are moving from the low-lying areas of the Rio Pastaza, although as yet we have not proved the distance of these migratory movements. The species concerned are *Micronycteris megalotis, Mimon crenulatum, Phyllostomus hastatus, Lonchopylla robusta, Sturnira lilium, Uroderma bilobatum, Platyrrhinus helleri, Platyrrhinus brachycephalus, Vampyrodes caraccioli, Vampyressa melissa, Artibeus concolor* and *Artibeus obscurus.*

With regard to the general state of conservation of bats in Ecuador, including as identified in the Mamiferos del Ecuador (Albuja, 2002), eight bat species are considered threatened. These are *Amorphochilus schnablii, Artibeus fraterculus, Balantiopteryx infusca, Choeroniscus periosus, Eptesicus innoxius, Lonchophylla hesperia, Molossops aequatorianus,*and *Vampyrum spectrum*. Considered most critical for *Molossops aequatorianus, Amorphochilus schnablii and Lonchophylla hesperia,* is the rapid loss of forest habitat of western Ecuador.

References:

Albuja, L. 2002.Mamíferos del Ecuador,Pp. 271-327, en: Diversidad y Conservación de los Mamíferos Neotropicales (G. Ceballos y J.A. Simonetti, eds). CONABIO-UNAM, México, D.F.

Rageot,R. & Albuja, L. 1994. Mamíferos de un sector de la alta amazonía ecuatoriana: Mera, Provincia de Pastaza. Revista Politécnica, Serie Biología, 19: 165-208.

Trujillo, F. & Albuja, L. (in press). Nuevos registros de Phylloderma stenops (Chiroptera: Phylostomidae) y Lasiurus boreales (Chiroptera: Vespertilionidae) para el Ecuador.

Panama

Dr. Rafael Samudio, Smithsonian Tropical Research Institute(January, 2004)

Dr. Samudio is enthusiastic about possible CMS Agreements and suggests a number of organisations that might be able to assist in development and implementation.

The following information on bat species is based in Dr Samudio's long-term comparative field study between a lowland and cloud forest bat community (2002 unpublished dissertation University of Florida, Gainesville, Florida) and previous studies (Bonaccorso, F.J. and S.R. Humphrey. 1984. Pages 169-183 in Tropical Rain Forest: The Leeds Symposium, A.C. Chadwick and S.L. Sutton, eds; Kalko et al. 1996. Journal of Biogeography 23:565-576). Bats in Panama that show some evidence of seasonal movement or local migration in the lowlands or highlands are the following species: *Phyllostomus discolor*, *Carollia perspicillata*, *Artibeus phaeotis*, *Artibeus jamaicensis*, *Artibeus lituratus*, *Enchisthenes hartii*, *Vampyressa thyone* (formerly *V. pusilla*), *Platyrrhinus helleri*, *Vampyrodes caraccioli, Chiroderma villosum* and *Uroderma bilobatum*.

Puerto Rico (for Caribbean)

Dr. Armando Rodriguez-Duran, Interamerican University (November 2002)

Dr. Rodriguez indicated his interest, but noted little evidence of migration although it undoubtedly occurs and the Caribbean should be considered in such discussions. The Caribbean has a high bat diversity including a high proportion of endemic species and many conservation problems associated with islands undergoing rapid development.

Uruguay

Dr. Enrique M. Gonzalez, Museo Nacional de Historia Natural(December, 2003)

Dr. Gonzalez indicated that there was no data on migration in bats in Uruguay, but only information based on the author's field work for last 12 years.

Found colonies of *M.levis* and *M.albescens*, between 10s and 100s of individuals, which can be found in some years and not others. He has not recorded a seasonal pattern in the presence/absence of these colonies, although methodical observations have not been carried out and the possibility cannot be excluded. One cave housing a colony of several 100s of *M.levis* was developed for ecotourism, which included lighting the interior of the cave; the colony decreased to a few 10s of individuals.

Desmodus rotundus can be considered very common in Uruguay and probably the population has even increased in recent decades. In the middle of the 20th Century only two localities were know for this species in the north of Uruguay. Currently the species is found all over the country. Probably the abundance of cattle and the presence of numerous natural refuges in mountainous zones have allowed the broad dispersion of the vampire bat in Uruguay. Uruguay represented the limit of its distribution. Physiological factors probably limit or prevent the occurrence further south.

Lasiurus cinereus and *L.blossevilli* (= *borealis*). These species have been little collected in Uruguay. For *cinereus* some groups were recorded from forested areas around the city of Montevideo, but in less than 10 years these refuges were no longer used, with no known cause. For *blossevilli*, some populations are resident during the summer, with decreased prevalence in winter (with no quantitative data).

Tadarida brasiliensis is the species most common in the cities of Uruguay. In these cities they generally occupy buildings, abandoned or in use. Frequently their presence results in people calling in pest control companies, who usually completely exterminate the colony. There is no confirmation that numbers are decreasing, but no studies have been carried out and it is most likely that numbers decrease due to the attitudes of these people.

In addition, although no proper migratory species can be identified, Dr Gonzales reports serious conservation problems for two bat species in Uruguay: *Platyrrhinus lineatus* and *Sturnira lilium*. Both of these were found in riverine forest and woodlands of the Rio Uruguay, in the extreme north of the country, before the construction of a large dam. Since the dam construction the species have not been found for almost 30 years. In summer 1999, he collected bats for two months in that area and among more than 180 bats captured, only one was *P.lineatus*.

For frugivorous bat species, the presence of fruits within the indigenous flora of Uruguay is markedly seasonal being present only in warm periods, hence it is probable that such species are only found in Uruguay in summer, moving in the cold season a little further north (into the forest of the Argentinian province of Misiones, where there is fruit all year).

USA

Merlin Tuttle, Bat Conservation International (December 2003)
Mention of *Tadarida brasiliensis*, *Lasiurus cinereus*, *Lasiurus borealis, Lasionycteris noctivagans* migrating from Canada, northern states to southern parts of US and across borders with Mexico. Proportion that cross border not known, probably less than 25%. Also ‘long-nosed’ bats (*Leptonycteris*, *Choeronycteris*).

Venezuela

Angela Martino, Centro de Investigaciones en Ecologia y Zonas Aridas (CIEZA), Calle Maparari (December 2003)

I am interested that you have included *Leptonycteris curasoae*, a species I have been working with for many years in Venezuela. Although certainly the local populations differ from those in Curasoa, in that there do not seem to be such populations declines, this species can be considered vulnerable for two fundamental reasons:

1. from the data collected, it seems that this species is at the southern limit of its distribution for reproduction mainly in caves located in the north-western zone of Venezuela,
2. from its feeding habits, it is the principal pollinator of the cacti that occur in the dry zones of Venezuela.

In this region in recent years, there has been tourist development, which can be dangerous because it can result in disturbance to the colonies especially in their reproductive period. Due to the facility to move freely, it is possible that they could easily disappear, disrupting the dynamics of the semi-arid ecosystem in question.

Also, from the research work you mention as indication of migration, we, who have studied this species for at least 10 years, have observed periods during which the number of individuals present in the zone is very low or nil, reappearing later during the months of parturition and lactation. Coincidentally, in the arid zones of the Venezuelan Andes (at a distance of about 700km) they disappear in the reproductive period and reappear in the months when they are absent from the north-western zone. The same behaviour has been noticed by local people in the dry zones showing periods in which these people see many bats concentrated in some sites.

In this way, one local NGO, INFALCOSTA, together with CIEZA (of the Universidad Nacional Experimental Francisco de Miranda) is trying to protect the caves which serve as a maternity refuge for this species in the Peninsula de Paraguana, reaching a partnership with the local communities. Also, the regional government is trying to introduce legislation that allows for the protection of the roost sites, but there are considerable difficulties in developing such legislation. Nevertheless, resources are very limited to sustain this initiative, and I believe that with listing of this species on CMS, it would be much easier to obtain resources and local support for its protection. Although some contacts were made with Bat Conservation International, this has not yet achieved the more forceful campaign needed to be initiated for the necessary protection and environmental education of the community and public in general that are involved with this species.

Finally, through a project funded by the Fondo Nacional de Ciencia y Tecnologia (FONICIT) some studies using molecular techniques will be initiated related to the possible migrations that this species may undertake and with respect to other species associated with *L. curasoae* (mainly Mormoopidae).

Further details can be found in the following papers:

Martino, A. , Aranguren, J. & Arends, A. 1997. Los quirópteros asociados a la cueva de Piedra Honda (Península de Paraguaná, Venezuela: su importancia como reserva biológica. *Acta Científica Venezolana*, 48: 182-187.
Martino, A , Arends, A. & Aranguren, J. 1998. Reproductive pattern of *Leptonycteris curasoae* Miller (Chiroptera: Phyllostomidae) in northern Venezuela. *Mammalia*, 62: 69-76.
Sosa, M & Soriano, P.J. 1993. Solapamiento de la dieta entre *Leptonycteris curasoae y Glossophaga longirostris* (Mammalia: Chiroptera). *Revista de Biología Tropical*, 41: 529-532.

Yucatan Peninsula

M.B.Fenton, University of York Canada (November 2002)
Centurio only trapped at certain times of year in Yucatan Peninsula.

4. South Asia

Bangladesh

Ainun Nishat, IUCN office (January 2004)
Bangladesh has 29 bat species in eight families, but there are no detailed surveys. IUCN Bangladesh collaborates on bats with CCINSA. Migration of some species takes place between Myanmar (Arakan State and Chittagong), Meghalaya, Assam, Tripura states of India, and Chittagong, Sylhet and Mymensingh districts of Bangladesh. Other contacts suggested.

5. Elsewhere

Israel

M.B.Fenton, University of York Canada (November 2002)
Dr. Fenton noted that there was evidence from Benny Shalmon that *Rhinopoma* (and possibly *Taphozous*) migratory based on seasonal roost use.