Bats and climate change

In 2005, the UK's Defra commissioned a review *Climate Change and Migratory Species*[1]. This was presented to CMS CoP8 (Nairobi, November 2005) at a workshop on climate change. The review covers marine mammals, terrestrial mammals, bats, birds, turtles, fish (with cephalopods and plankton) and insects, and deals in particular with the UK and its overseas territories. The report can be viewed at www.defra.gov.uk[2] or as CoP.Inf8.19 at www.cms.int[3]. For the bats, the report concentrates on Europe and the Caribbean, but with case studies covering other areas.

There has been relatively little investigation of the affects of climate change on bats, and no direct studies in Europe. The recent and very rapid northward spread of *Pipistrellus kuhlii* (and perhaps *Hypsugo savii*) has been attributed by a number of authors to a response to climate change, but the issue has not been investigated at a European level.

It might be that for the most part, bats will not be very badly affected by climate change under the current predictions, but there could be marked effect on the bat fauna of Europe and it might have severe impact on some species, including migratory species.

Further information on the migratory requirements of bats is needed. More specifically related to climate change the following areas may usefully be investigated:

1. use of available data to assess any existing evidence of impact of climate change. The question of the recent range change of *P. kuhlii* is mentioned above. Other species or communities of species may show reaction to climate change.

2. use of available data to model likely impacts of climate change. Such modelling has been carried out for at least two studies of bats in North America, one looking specifically at *Myotis lucifugus* and its hibernation, and a more general investigation of potential changes in the bat fauna of a southern state (Texas). In neither case was any great threat identified.

3. further assessment of likely impacts on

i. reproduction and other aspects of annual cycle. Fertilization and parturition dates could change or be disrupted, hibernation periods may change, favoured hibernation sites may become less suitable.

ii. separation of winter and summer sites and availability of suitable territory in between (including migration stopover sites as appropriate). The distance between suitable winter and summer sites could increase or decrease. If they increase, it could affect more sedentary species and for longer range migrants the need for suitable stop-over sites may be an issue.

iii. changes in community structure. Changes in the species composition in some areas may impose pressure on sensitive, specialist species.

iv. phenologies and any important synchronies involved with interactions with prey, roost availability, breeding and migration. Examples might be a breakdown in the synchrony of births, or with the prey at key times, or with the availability of suitable trees if older trees die off before replacement following rapid range shifts of the tree species into newly colonised areas are available.

4. the increased establishment and co-ordination of long-term population and distribution monitoring that considers potential effects of climate change and can be related to that of other biota. These issues are already being discussed by Eurobats and can readily be adopted to cater for data relevant to climate change. Apart from the use of monitoring data to record changes in distribution and populations, it should be noted that changes in, for example, hibernation behaviour might result in apparent rather than real changes in populations or distribution.

5. identification of suitable adaptation strategies, using flexible, multibenefit, integrated and potentially large-scale approaches. All departments of governments will be investigating systems to cope with climate change and there are likely to be opportunities to ensure that such adaptations can assist in maintaining appropriate habitat (and continuities of habitat) for bats.

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[1] Robinson, R.A., Learmouth, J.A., Hutson, A.M., MacLeod, C.D., Sparks, T.H., Leech, D.I., Pierce, G.J., Rehfisch, M.M. & Crick H.Q.P. 2005. *Climate Change and Migratory Species*. *British Trust for Ornithology Research Report 414*. Defra, London. 304pp.

[2] http://www.defra.gov.uk/wildlife-countryside/resprog/findings/climatechange-migratory/index.htm

[3] http://www.cms.int/bodies/COP/cop8/documents/meeting_docs/en/Inf_19_Climate_Change_Migratory_Species.pdf