Development of switching state models for bird count series

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This paper fits switching state models to bird count series observed monthly in Tokyo, Japan, for the period from 1964 to 2007, in order to analyse changes in number of birds individual due to disturbance by human activities or climatic factors. The model considered here builds directly on Shimadzu and Shibata (2005) which additively decomposed bird count series into three components, namely *long trend*, *short trend* and *irregular* by applying a nonparametric smoothing technique (loess) and modelled relationships between the number of birds individual and effects of human activities. It extends such nonparametric models by accounting for some climatic factors and setting them in a suitable framework of parametric modelling which incorporates ecological dynamics. For instance, the three components of which the model consists are given in a parametric form and drawn from a simple class of parsimonious, two or three state switching models. The long trends are described as a parametric model like logistic equations concerning with carrying capacity which may be easily influenced by human activities. It is assumed that the condition of such carrying capacity can be characterised by only two states; *disturbed* when some developments are progressed or *undisturbed* when there is no development. As to the short trends, they relatively show strong seasonal variation over the year which may be reflecting the effect of seasonal wandering or migrating of each species. It is therefore assumed that the seasonal variation can be classified into three states; *general*, *warm winter* and *cool summer* which are characterised by a climatic factor (eg. temperature). As a consequence, in the case of Turtle Dove (*Streptopelia orientalis*), it was found that the long trend monotonically increased during the state of *disturbed*. Further, the short trend highly varied when the state was *warm winter*. This implies that these states assumed would be of use to capture the characteristics of each species. The model proposed fits the data well and also provides a good description for the variation of the number of birds individual.

References

[1] Shimadzu H and Shibata R (2005) Analysis of bird count series by local regression to explore environmental changes. Journal of the Japan Statistical Society J 34(2): 187-207.