NATIVE ORTHOPTEROIDS IN SOMERSET: RISK OF LOSS

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Abstract

This paper presents an estimate of the risk of Orthopteroid species being lost from Somerset as a result of low population viability. Using population viability analyses, it is suggested that Bog and Grey Bush-crickets, as well as Large Marsh Grasshopper, could be lost within five years and should have Species Action Plans.

INTRODUCTION

Any population exists in a state of flux. Whether or not there is a massive impact on it (ie it is endangered), a population can be lost if recruitment falls below mortality for long enough. This can happen as a result of change in environment. But it can also happen more subtly, entirely as a consequence of knock-on effects of past population age structure. Furthermore, it can happen because of wild swings in population size resulting from overcompensation in density-dependence combining with at least a fairly high natural growth rate (‘chaos’). The first of these is extrinsic, resulting from an external impact, say of disease or building works. If serious, it results in the population being *endangered.* The second and third are intrinsic, ie they result in loss of *viability.* Risk of loss from endangerment must be estimated from a knowledge of the impact of the factor responsible. That factor and its action must be known. Risk of loss through low viability, however, can be estimated from population parameters. Population Viability Analyses (PVA) are used for this.

In conservation, empirical science has proved far more useful in practice than either pure theory or modelling. This is because few models are sufficiently robust, and because theory rarely includes perfect variables or functions. Empirical methods (‘look and see; trial and error’), however, usually take too long to provide the forecast needed. For example, adequate monitoring (following the time curve) of the loss of populations of ‘Common’ Green grasshopper would generally take too long to provide a basis for a new SAP. But some combinations of empirical science and either theoretical or modelling approaches (usually the latter) have proved powerful and practical. The key is *iteration*, ie successive approximation alternating between the two approaches and so tying the work to reality. This is the sort of approach used successfully to determine viability of Black rhino in East Africa. It resulted in a lot of rhinos being ferried to Australia. Not such a brilliant idea as it turned out, but that was not the fault of PVA, the beasts just died on the boat.

In Somerset we have a number of orthopteroid species with small populations and uncertain breeding. These are predominantly in coastal strips where there is a risk of endangerment from building works. Rarely, however, does a development affect more than one local population, or metapopulation, whereas the functions that determine viability go on all the time in all populations. Any population can become extinct if replacement is inadequate.

AIMS AND OBJECTIVES

The work reported here aims to forecast the loss of orthopteroid species from Somerset as a result of viability failure. The objective was to achieve reliable forecasts for those species that have few, isolated, or very small populations. These are the species whose names were rushed to The Biodiversity Steering Group's meeting in December 2005, for inclusion in the initial 'Long List' of candidates for the Species Priority List (and thence some for Species Action Plans (SAPs)), as discussed above in the Ecology in Somerset editorial.

METHODS

Fortuitously, orthopteroids have been major subjects of population science. One result is that general features of the dynamics have been worked out. Indeed, examples are frequently quoted in standard textbooks (eg Richards and Waloff 1954, much used in Begon and Mortimer 1981) and the estimates in them have been available for decades in a few cases. But it is not these estimates themselves that are most valuable – it is the generalizations that have been developed from them. For example, it is now understood that in general the essential danger in orthoperoid population survival is that the peak of mortality is before that of fecundity. There is a pretty good idea of how close the peaks can come before the population is at a high risk of disappearing. We can work PVAs using the known *form* of population structure and timing. We do not have to rely totally on precise field estimation of mortality and fecundity. Fortuitously also, the rarer Somerset orthopteroids generally exist in small populations too widely separated to form communicating (meta-) populations. With one exception (Long-winged Conehead) they just do not fly far enough. This means that their dynamics can be approximated individually.

This article uses the known and inferred forms of mortality and fecundity curves for each species, plus a range of likely population sizes, to forecast survival of populations over five years. PVA programmes were worked through their originators (e.g. Imperial College's Unit of Population Biology) using data supplied from Somerset. Several such programmes, or versions of them, were used, the choice for any species depending on the form of its life-cycle. PVAs for annual species, for example, are not much use for biennial ones such as the Bush-crickets. In each case three runs were carried out, using population census estimates 0.5, 1.0 and 5.0 times the sizes considered most likely in any year. It is the *range* of risks-of-loss from these three runs that form the main results. The empirical side of iteration was the observed gross rise or fall in population size over the five years or so for which I have records.

RESULTS

The Table shows the results of the three PVA runs for each species. Iterations between the known conditions of the populations and the forecast population sizes continued until the successive population changes were continuously in the same direction. The right hand column is the punch-line, ie the expected probability of loss (five-year multiples) for each species overall in the county. It is important to recognise that a forecast of this sort has the nature of a mean or average. That is to say, it does not take much account of huge differences in year-to-year mortality and recruitment that might result from either intrinsic (population) or extrinsic (eg weather or disease) causes. In general, we would expect 50% of the species to actually fare better, and 50% worse.

TABLE: VIABILITY OF RARE ORTHOPTEROID POPULATIONS IN SOMERSET 2005

Species	No of local populations	Risk of loss in any five years
Large Marsh grasshopper	1?	0.6–0.9
Grey Bush-cricket	1	0.3–0.5
Bog Bush-cricket	3–5	0.2–0.6
Roesel's Bush-cricket	1	0.1–0.2
Rufous grasshopper	1–2?	0.05–0.3
Woodland grasshopper	4–10	0.1– 0.15
Any of 3 Cockroaches	2– 4	0.2 –0.25
Long-winged conehead	5– 0	0.05– 0.1
Stripe-winged grasshopper	1?	0.05– 0.3
Great Green Bush-cricket	10–15	0.05– 0.1
Lesne's Earwig	10–20	0.05– 0.05
All others (including groundhoppers)	10–?	<0.01

It is clear from the Table that there are four classes of species:

- Large Marsh Grasshopper, more than 50% likely to be lost (or to have been lost already).
- Grey Bush-cricket and Bog Bush-cricket, very close to 50% likely to be lost in five years.
- Other named species, likely to last decades under present conditions.
- Other unnamed species, likely to last indefinitely.

Note that Rufous Grasshopper, though only doubtfully present in the county, will probably last for many decades at least, if it is there. This is because its particular pattern of mortality and fecundity predispose it to high nett reproductivity.

DISCUSSION

Geography and science

Rarity is not a sound indicator of risk-of-loss. Rarity, like distribution, is geography (location). Viability is science (understanding). Geography, as rarity, is flawed because population size and functioning can go against it. That is to say, there are some species such as Roesel's Bush-cricket, with only a single population, which might, because of generally good breeding success, last longer than others with poorer population maintenance. An extreme case is Rufous Grasshopper – we may not have it, but if we do have it on even one site we may not need to do a SAP for it. Conversely, we need to think about some protection for Long-winged Cone-head because although it breeds rapidly it tends to die off a bit early in the season. It is a lucky cone-head that gets as far as laying a good sound egg that will survive and in turn breed on. So, where populations are small, few, and independent, we must put science first. This will inform us which species are really at risk, and which can cope.

Populations of rare orthopteroids in Somerset function entirely individually. This is because we think they are not going in much for metapopulation behaviour (flitting from site to site). This has an important consequence: we need to base our decisions about support, for these species at least, on population science. But we do not for the less rare species, because there will either be spares to replace deaths, or one population will do a meta-job of topping up others. A simple Somerset principle follows from this: we can make up a candidate list from geography, ie regional or national rarity and distribution, but then we must refine it using science, not more geography.

The list of named species in the Table was compiled from geography. That is to say, it is a list of species known to be rare nationally, or to be here in less than about 20 individual populations. But now this list has been refined by the PVA analyses, and doing so has proved fruitful. It has resulted in four classes, the most significant being the top two of greatest risk – those with a 50%, or greater, risk of dying out in five years. By definition this group is at extreme risk of being lost and is therefore of species logically needing full protection and SAPS. The third group is of species that are identifiably at risk (could be lost in a few decades) but this risk is low. These are species logically in need of protection, but not so urgently. They are therefore the remaining species to go on the Species Priority List but without SAPS.

Some would argue that not all of these should go on the list, because those right at the bottom of the table could survive for many decades unaided. Quite right, they might. But the nature of PVA analyses for these species is such that the loss of even one population is generally sufficient to push their rankings markedly up towards that unarguable 50% risk level. Indeed, this is probably a very conservative list; there may be one or two species not considered geographically but for which PVA analyses might conceivably result in a forecast list of loss as great as those at the bottom of the table. Nonetheless, the cut-offs of 0.5 (ie 50% risk) and 0.05 (ie 5% risk) are good and clear, the higher of the two hardly even being arbitrary.

Other intrinsic population-dynamics risks

The PVA analyses have not addressed risk of loss from chaotic population dynamics. That needs information on density dependence to be put in. However, it should be borne in mind that a species showing attributes of potential chaos is not just one at a risk of loss because of it. It is also a species that might suddenly increase; another example being the wild boar, reported on the spread in several counties recently.

The extrinsic risks – disease and other environmental impacts

Inherent disease, such as the pretty little fungal infestations that usually trouble most of our grasshoppers, are automatically taken into account by the PVAs. They are just part of the usual mortality and fecundity pattern. But new epidemics, habitat change, building and other developments are not. Is this bad? It is, of course, if we are trying to estimate the overall risk of loss of a species in Somerset. However this article is simply addressing the general background risk of loss from a species' death and breeding patterns. These are always there. They include the effects of the general background of environment in the existing habitats, of course, but not sudden new ones that might result from, say, *Ivermectin* getting on to the Berrow golf course, or from Somerset Wildlife Trust building a new HQ on some Poldens grassland! These are special, site specific, risks that apply site by site. Logically they apply to the risk of loss of individual populations, rather than of each species as a whole in the county. So they ought not to influence the Priority listing of species.

But there are two exceptions: firstly where a specific risk can be identified on a site that holds the one and only (or perhaps one of just two) populations of a species in the county; and secondly where a new environmental impact is likely to be common to all populations. These would apply if the National Trust were to consider building a visitor centre on the south side of Brean Down, for instance, or if new agricultural grant aid were to reduce scrubby tall grassland to shorter, supposedly species-rich turf on old undisturbed swards.

Putting the risks together

I have argued that the risk Table will not be altered by considerations of chaos. And I am not aware of any widespread or site-specific environmental impacts that would affect the Table either. But I could be wrong and new environmental nasties could appear tomorrow. However the list could then be modified according to these extra risks – they multiply. So, in the unlikely event that some significant new factor is identified, or rather the risk of it knocking out a species is identified, the order of the Table is readily changed and species added to the Priority List. This list will, inevitably, be under constant or periodic review.

EXTENSION TO OTHER TAXA?

Can we do the same sort of geography-plus science for, say, beetles or flowering plants? No. Perhaps I ought to be more cautious, and say probably not. The reason for my being inclined to black and white, though, is that there are special reasons why orthopteroids can be tackled: known forms of population dynamics. With the exception of some mammals and fruit flies I doubt that similar data exist for other taxa. Fruit flies are many and various, making PVA a daunting task, and their dynamics are essentially known more for colonies living in bottles than in our countryside. As for mammals, for some there is extremely good population dynamics knowledge, but they are either crops like boar and deer or species whose presence on the SAP and Priority Lists is not going to be questioned anyway.

Plants are a different kettle of fish. Their population dynamics are based on population density, not size. Density interacts with pattern in perennials in ways that influence mortality and competition inestimably in the field. This makes it extremely difficult to use conventional PVA methods to forecast risk of loss quickly. Also many plants have long-dormant seeds, and the dynamics of the sub-populations of these are usually intractable. Finally most plants exist in metapopulations that are not in the least independent.

CONCLUSIONS

- Large Marsh Grasshopper (if not extinct), Grey Bush-cricket, and Bog Bush-cricket should have SAPS.
- The other species named in Table 1 should be on the Species Priority List for protection in Planning etc.
- When Reviews are due, or if new information becomes available, other species should be assessed and included in the Priority List if forecast risk of loss exceeds 0.05 in a five-year period.
- Similarly if the risk of loss of any Priority List species is found, on review, to reach or exceed 0.5 in any period, it should receive a SAP.
- It is unlikely, but possible, that other taxa can be treated in this way yet. Plants can be eliminated altogether.

References

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