Project Update: September 2012

Group of mountain zebra waiting to drink at Renostervlei water hole in the western part of Etosha National Park. Photo © Morris Gosling.

Summary

A mark-recapture estimate of mountain zebra numbers was carried out in Etosha National Park using data collected between the 29th August and the 4th September 2012, that is, 6.5 days in the field. The estimate used the numbers of individually known animals which were identified using a stripe coding system. 283 individuals were identified, mainly at 6 water holes: Jakkalswater, Renostervlei, Otjovasandu, Rateldraf, Klippan and Dolomietpunt. A few groups were seen in long grass areas away from these water holes. All individuals were photographed and IDs established subsequently; constructing the ID library and coding the stripe patterns took a further 7 days. In an estimate using the first 3.5 days as a 'mark' period and the last 3 as a 'recapture' period, 180 individuals were marked, 132 recaptured and 29 resighted in the second period. This yields an estimate of 802+/-116 mountain zebra. This compares with an estimate of 685+/-158 from an MET air survey carried out earlier in August (6-17 August 2012; Kolberg 2012).

Introduction

I carried out an introductory survey of the mountain zebra in the western area of Etosha National Park as part of the preparation for a study of hybridization that is planned by Pauline Kamath (Kamath, 2011). Following the individual-based approach (de Angelis & Gross, 1992) I have used elsewhere, the main aim was to start a library of individual mountain zebra that could be used in future for the study of hybridization and other aspects of mountain zebra biology. Depending on the availability of the study animals, this approach can yield information about numbers and other demographic data and this report is confined to these aspects. I also looked at mountain zebra and a sample of plains zebra for evidence of hybridization but will not consider this aspect in this report. However, for the purposes of defining the study population in this report, all of the mountain zebra seen appeared typical of the species and there were none that seemed intermediate with plains zebra. Of course this does not preclude the possibility that hybridization has occurred and indeed, in view of the preliminary genetic information that is now available (Kamath, 2011) this seems likely.

By chance, an MET air survey was carried out earlier in August (Kolberg 2012) and so the present study gives a rare opportunity to compare the results of an aerial survey with a mark-recapture estimate of the same population.

Methods

Sampling

Field work was carried out over 6.5 days between the afternoon of the 29th August and the 4th September. The survey was carried out in the dry season and since mountain zebra are water dependent the survey was focussed on water holes. Following information on distribution from the recent air survey by MET staff and advice from the EEI, the water holes considered were Jakkalswater, Renostervlei, Otjovasandu, Rateldraf, Klippan and Dolomietpunt. Okawao was visited on 3 days but no mountain zebra were seen there. The water hole near Otjovasandu does not appear on most maps and I only started sampling it on the 1st September. Sampling consisted of driving to water holes and photographing as many mountain zebra as possible for individual recognition photographs. The time spent at water holes depended on the number of animals available for photography but I aimed to sample all water holes more than once in the first and second halves of the sample period to keep open the possibility of carrying out a mark-recapture estimate of the population. Visits to the 6 water holes were as follows.

	29 Aug	30 Aug	31 Aug	1 Sept	2 Sept	3 Sept	4 Sept
Okawao	✓				✓		✓
Jakkalswater	✓		✓		✓		✓
Renostervlei	✓	✓	✓	✓	✓	✓	✓
Otjovasandu				✓			✓
Rateldraf		✓	✓		✓	✓	
Klippan		✓	✓			✓	
Dolomietpunt			✓			✓	

Individual recognition

The individual recognition technique used is based on a bar-code where individual stripe positions are identified in four locations on the body: on the rump (3 stripes, including the 'gridiron stripe', a stripe descending from the 'gridiron pattern above the base of the tail); on the body anterior to the gridiron stripe (4 'body' stripes); the shoulder stripe (1 stripe); the body stripes posterior to the shoulder stripe (4 'rib' stripes); in addition the presence or absence of 'islands' between particular stripes in the shoulder and rump area is recorded. At each stripe position a number of variants have been identified, for example simple linear shapes, branched, joining the next stripe, short (less than half the normal length) and so on. These variants are coded in columns in an Excel spreadsheet for all known individuals. When a new photograph is taken, stripe types are identified for each stripe position (or for as many as possible in an incomplete photograph). As each variant is identified in the spreadsheet, individual zebra which do not have that variant are excluded (using the filter function of Excel) and the number of candidate individuals is progressively reduced. Sometimes the possibilities are reduced to one individual or a small group. In either case the possibilities are checked against reference images held for that individual using a number of other, non-coded, characteristics, such as face stripes, which are individually distinctive. When necessary, images are checked using more than one type of search (for example using the shoulder and rump stripes separately). When an individual cannot be found, a new individual is added to the reference collection with the next consecutive number.

It is also possible to use pattern recognition software to recognise individual zebra but the bar-code technique is quicker to use and yields additional information about quantitative aspects of stripe patterns.

Mountain zebra stripes, like human fingerprints are complex and variable and can be used for individual recognition. Mountain zebra are unusually tame in Etosha National park and can easily be photographed; these are four of the 283 individuals identified in this study. Photos © Morris Gosling.

Mark-recapture

Mark-recapture techniques are well established for estimating population size and can be used in populations where individuals can be identified in separate, notional 'mark' and 'recapture' periods.

The technique used here is a variant of the Lincoln-Peterson method (Seber 1982)

$$N = \frac{[(M+1)(n+1)-1]}{R+1} \quad \text{.........} \quad (1)$$

Where N = the population estimate; M = the number of individuals identified in the first sample period; n = the total seen in the second sample period; R = the number of those identified in the first period that were also identified in the second period.

Standard errors were calculated from:

$$SE = \sqrt{\frac{(M+1)(N+1)(M-R)(n-R)}{(R+1)^2(R+2)}} \quad \text{.........} \quad (2)$$

In theory, the 'recapture' period should be separated from the 'marking' period by an interval during which the marked animals randomly mix in the general population. We do not know enough about the movements of mountain zebra social groups to know to what extent their relative movements approximate to random mixing. However, while such mixing is unlikely to be strictly random, there is certainly extensive movement and even in the short study period here, many groups moved between water holes. The mating system of mountain zebra in which social groups move in large undefended areas is more amenable to the idea of random mixing than resource defence systems.

The sampling distribution shown above, particularly the need to include the Otjovasandu water hole in both mark and recapture periods, limits the periods that can be used for mark-recapture. An approximately balanced design is to use individuals seen in the first four days as the 'mark' period and in the last three days for 'recapture'. The number of individuals identified on each day of the study, and used in the estimate, were as follows; the total of 332 identifications is greater than the number of individuals (283) because of repeat sightings.

	29 Aug	30 Aug	31 Aug	1 Sept	2 Sept	3 Sept	4 Sept
No. MZ indent.	39	81	33	40	45	37	57

Results

283 individuals were identified from the photographs taken. 332 identifications were possible in the first examination of the photographic record and a few more may be possible if time allows further study of the photographs. The distribution of individuals across water holes is given in the table below. The total of 306 is greater than the total IDs because some animals occurred at more than one water hole; and less than 332 because some individuals were identified at the same water hole more than once. 'Away' refers to animals that were well away from water holes.

	Okaw	Jakk	Reno	Otjo	Rate	Klip	Dolo	Away
No idents	0	30	121	30	56	44	10	15
% of 306	0.0	9.8	39.5	9.8	18.3	14.4	3.3	4.9

180 mountain zebra were identified in the notional 'mark' period of the 29th to the 31st August and 132 in the 'recapture' period of the 1st to the 4th September. 29 animals were identified in both periods. Using the expression given above, this yields an estimate of **802+/-116 mountain zebras** (estimate+/-standard error) in the ENP population.

Further demographic analysis will be carried out on the individually recognised animals but one element that deserves initial mention is the proportion of young animals. Predation in the first year of life may limit zebra populations elsewhere (Grange et al 2004) and in the Otjovasandu population a number of animals were photographed that had large scars, not seen in other study areas without lions. Foals can be aged using criteria described by Penzhorn (1982), together with additional known age animals in Namibian study sites. Ageing shows that of the 283 identified animals, 21 (7.4% of the total) were born in 2011. These values are compared with my other mountain zebra study sites in the table below where, for consistency with the Etosha data, the denominator is the number of animals identified so far in 2012. The values will change as further data are analysed from camera trap images (the main technique in the other areas) but, since sampling is well advanced at this time of year in all the sites mentioned, the relative proportions should remain similar.

Area	No. Ident. In 2012	No. Born in 2011	% of total
Etosha NP	283	21	7.4
Naukluft NP	313	30	9.6
NamibRand NR	364	38	10.4
Gondwana CP	395	36	9.1

Discussion

The estimate of 802+/-116 mountain zebras (estimate+/-standard error) in the ENP population compares with one of 685+/-158 from the recent air survey (Kolberg 2012). The two surveys were so close in time that births and deaths cannot have had any significant effect on the comparison. In addition, the population is 'closed', being enclosed by the park fence to the west and south and not extending far into the main part of the park to the east and north perhaps for reasons linked to habitat specialisation or competitive exclusion by plains zebra. In addition, the animals were mainly quite close to six water holes. Movement should thus have little effect on any difference between the two estimates.

This is thus a rare opportunity to compare estimates which use different statistical approaches and which have comparable rigour. Having said this, there is no objective basis for saying which is closer to the truth. While the standard errors of the two estimates overlap, there is a tendency for the mark-recapture estimate to be higher than that from the air survey. A number of factors could account for such a tendency but the most likely is the difficulty of seeing some animals from the air – for example young foals running close to their mothers or the challenge of separating mountain zebra from the more abundant plains zebra. However, further mark-recapture estimates of the Otjovasandu population are required to put the present estimate on a comparable basis with the long standing series of air surveys.

The spatial distribution of identified mountain zebras give an indication of the relative importance of the six water holes for this species. Renostervlei is the most important in terms of mountain zebra numbers, Rateldraf the next and Klippan, Otjovasandu and Jakkalswater the next most significant; Dolomietpunt has small numbers of mountain zebra.
The proportion of foals born in 2011 was highlighted because it is increasingly recognised that predation may limit zebra populations, in particular through mortality in the first year of life (Grange et al 2004). Values such as the 7.4% value in Etosha are the outcome of the interaction between birth rate in the year in question and mortality up to the time of sampling. Small populations such as that of mountain zebra in ENP may be particularly vulnerable to predation and the occurrence of large scars on the hindquarters of a number of mountain zebras suggest that this factor could be significant. The scars were of a type not seen previously in areas without populations of lions (but some of which have both brown and spotted hyaenas). In practice, the Etosha value for foals born in 2011 was lower than my three other main study areas, but to an extent perhaps less than expected. This may be because higher birth rates in Etosha (linked to higher rainfall than in the southern sites) may compensate to some extent for a higher mortality rate due to predation by lions. But, I need to check one or more comparable northern populations where lions are absent to further explore this idea.

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