Part II
Ecology

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Introduction

When satellite technology became widely available, many animals studied revealed surprising behaviour and showed up in unexpected places. Likewise, modern genome studies on kinship relations show that the spreading of genes cannot easily be explained by visual observation. This raises the question whether erstwhile interpretations of animal movements and social organization stand the test of time. Dispersal (the movement of individuals away from their place of birth) is an influential life-history trait that alters the spatial distribution of species, individuals and, if followed by reproduction, alleles. Knowledge of dispersal behaviour, in terms of frequency, distance and direction, is essential for understanding population dynamics, structure and genetics, but can one-time deductions on social structure still be trusted? Likewise, can satellite-derived observations be trusted? Indeed, satellite-based remote sensing (RS) interpretations of vegetation and vegetation change over time are notorious for their dependency on underlying (often poorly known) algorithms. While RS specialists are mostly aware of the pitfalls, ecologists are not and merrily draw conclusions where RS specialists caution care. Since the beginning of modern ecology in the 1960s, African buffalo have been subject to observational studies, but the technologies that have been developed since the 1990s seem to question older interpretations. In this section, we examine the idea that buffalo may be migratory in some places. Older literature also showed this, but the deployment of GPS collars appears to reveal even more migratory behaviour.

The same GPS-collaring data may also lead to a different interpretation of the social organization of buffalo than previously posited. In that case, genetic data (see Part I) also appear to underpin the notion that buffalo may be less of a herding species, in which females live their lives

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in cohesive societies that undergo fission–fusion processes, than earlier interpretations indicated, but show more fluidity and less natal philopatry. It is of great importance to validate the GPS-based data. From other extensive data analyses on these types of data, we know that data cleaning is essential before one interprets GPS data, and we thus recommend that analyses of these types of data have a clear description of how raw data were transposed into the data used for the analyses. Compared to past literature, much more attention has been given in recent papers to the justification of the statistical methods used. Reliance on modern technology should lead to a similar openness about how data are acquired. Data handling may affect the trustworthiness of conclusions, as was demonstrated so aptly in climatology when the Antarctic ozone hole was erased from the data.

In the same vein, not enough is yet known about the effects on buffalo physiology, brain processes and behavioural (ab-)normality of chasing, darting and immobilizing African buffalo. The chapters presented are unique in the sense that we bring together for the first time ecologists, students of behaviour, animal handlers, veterinarians and physiologists in the hope that they all can learn from one another. We, as editors, thus hope that the disciplinary knowledge from these different specialities percolate into a fuller understanding of the technologies that (field) scientists use, so that they can draw well-informed conclusions on African buffalo.

This is also shown in the chapter on population dynamics. It is not easy to make a good life table of a species if there are no hard and fast rules to establish age estimates of individuals. Nor is it easy to apply mathematical models if one does not fully grasp the underlying assumptions. And if these assumptions do not incorporate the reality of the African savannas, with their recurrent droughts and permanent non-equilibrium states, then completely erroneous estimates of safe harvesting rates, not to mention estimates of 'maximum sustainable offtakes', could easily be made. Indeed, the latter concepts hail from environments where equilibrium dynamics govern systems and populations show a stable population structure; for African buffalo, that would appear to be another universe.

Diving deeper into evolutionary time, this section also provides a podium to discuss how to deal with the considerable morphological variation displayed by African buffalo. Through the simple mechanism of isolation by distance (see Part I), one might expect variation from a species with such an enormous geographical range, but neither the

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editors nor any of the authors advocate for the resurrection of 'micro-species' as were exuberantly discerned in the 1930s and again even more recently. If for conservation reasons (and not for postage stamp collecting) different forms need to be identified, then the smallest number of 'subspecies' that can be discerned on ecological and genetic grounds appears to be three (the northern savanna buffalo, the forest buffalo and the Cape buffalo). Ecologically speaking, they live under quite different natural selection pressures. These can be translated into different conservation challenges. It is too early, however, to translate these into us being able to precisely formulate differences in management challenges for the three different forms. Apart from the economic, financial and game handling challenges (Part IV), the lack of knowledge on African buffalo physiology (including thermal stress and precise food requirements) and its three 'subspecies' continues to prevent management based on science. As demonstrated by the chapters in this section, knowledge on the ecology of this fascinating species continues to widen. We certainly have made progress since M. Taute published his work in 1913 and F. Vaughan-Kirby in 1917, but when one century of research can be summarized in less than 100 pages, we think there is still much to learn.

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