
Preface

"Though she be but little, she is fierce!"
(Midsummer Night's Dream, Act 3, Scene 2)

As the third of a trilogy, this book, the *Biology and Conservation of Musteloids*, brings for us, the editors, the contrasting delights of generalization and detail. The aphorism wags a cautionary finger at the risks of failing to see the wood through the mesmerizing profusion of the trees, but while the wood is the emergent generality of all that arboreal detail, so too the trees are what make the wood. Let us see, and learn from, both. In the case of the musteloids, a sub-order of the Carnivora comprising around 90 species (or 92, or even 93, depending on your taxonomic tastes as to precisely how many *Mustela* species are there, and whether there are, for example, three or four species of *Meles*, or two or three South American hog-nosed skunks), whose natural histories glitter with more differentiating detail than exists amongst canids or felids, most share an inherent weaseliness that nonetheless makes them more similar to each other than to the more homogeneous families presented in, successively, the *Biology and Conservation of Wild Canids* (2004) and the *Biology and Conservation of Wild Felids* (2010). To corrupt Oscar Wilde's reflections on losing parents, if opting to edit one enormous book might be regarded as a misfortune, editing two looks like carelessness, while to attempt a third has a strong whiff of lunacy. That, however, is what we have done and for us, and we hope for you, the outcome is a delight packed with insight.

Like its antecedents, the *Biology and Conservation of Musteloids* aspires to durability and topicality, via a weave of deep running themes and waft of the intricacies of case studies. To achieve this, and following an introductory chapter that introduces the dramatis personae, half the book is devoted to chapters reviewing compendiously major themes of musteloid biology. Of course, this being the third of the trilogy, there is now an opportunity to compare these review chapters with their analogues for canids and felids. The second

half of the book is devoted to case study chapters, concerning a particular species or set of species, written by the world's experts in each case. Together, these review chapters and case study chapters provide both the wood and the trees. It also turns out that they reveal that biologists study rather different things about different families (or sub-orders) of Carnivora: the case studies of canids are redolent with the detail of social behaviour, conspicuously absent from studies of musteloids; studies of felids dwell heavily on conflict with humans and associated predatory behaviour, while in this book the case studies that bobbed to the surface often take population level and community structure perspectives, often with a keen eye to both energetics and biological introductions.

Like the two earlier books, the *Biology and Conservation of Musteloids* ends with a chapter on conservation. In the cases of both the canids and felids, these concluding chapters were long, and crammed with detail eager to squeeze into rich tapestries that spanned conflict and coexistence viewed from every angle, drawing on numerous studies embracing not just muddy-booted ecology, but explorations of social science and, especially, economics. Fewer such studies exist for the musteloids. Therefore, the concluding chapter of this book looks out across a different vista, on which a few very notable conservation cases (such as the struggle to conserve black-footed ferrets, or to control bovine tuberculosis in badgers), all covered in depth in case study chapters, are prominent in a much less heavily ploughed landscape. Rather, in the case of the musteloids we focus on the extent to which some might be ambassadors for conservation, but the general impression is that their conservation rests on being fellow-travellers, sheltering under the umbrellas of more charismatic cousins. In a similar vein, we explore, at a geopolitical scale, how their conservation might be prioritized and marketed globally.

Mention of the actors on the stage raises a point too obvious to miss. By the standards of dogs and cats,

musteloids are small, and even the biggest of them (the giant otter and the sea otter in water and the wolverine on land) punches below the weight of wolves and are lightweights beside the big cats. The chapters on canid and felid sociology in their, respective, books propose that a cursorial wolf the size of a lion would morbidly overheat if it did as wolves do, whereas a pack of wolf-sized wolves can fission and fuse to fill all the prey-size niches between those occupied by lions and coyotes (Macdonald and Sillero-Zubiri 2004, p. 126). But does musteloid smallness explain the fact that there may be over 90 species of them, and only around 40 each of canids and felids? Of course, one factor is that we are not comparing like with like: the dogs and cats each represent one extant family, whereas the musteloids comprise over 60 Mustelidae (of which 13 are Lutrinae), 14 Procyonidae, 11 Mephitidae, and one Ailuridae (the red panda). Nonetheless, the question arises of whether the niches of larger carnivores are harder to partition and therefore broader. This question is complicated by the presence of other taxa – hyaenids and even colossal bears rub shoulders with the bigger cats and dogs, whereas viverrids and herpestids live Lilliputian lives alongside musteloids (all these, too, rub shoulders in the uneasy community of carnivore guilds as illustrated, for example, in Chapter 14).

The origins of each of these evolutionary trades, and the natural histories of their craftsmen, are detailed in *The Velvet Claw* (1992, p. 9) where in the Introduction to that book the jostling for evolutionary success in a changing landscape is compared to the parable of two brother potters, with different skills, striving for market share in an ever-changing commercial landscape. One inherited from their father a specialized mould, perfect for making the pots sometimes most in demand; the other brother had inherited a wheel which, while he lost out in the specialized pot trade, enabled him to diversify into ceramics of all sorts, and better to withstand, in time, the arrival of plastic pots that put his brother out of business. This parable seemed to speak powerfully to the rise and fall of numerous Carnivore lineages (remember, the contemporary canid job was formerly also done by hyaenids, while, in the Miocene, canid borophagids played at being hyaenas), and it drew attention to the phylogenetic baggage that dictates much of the evolutionary trajectory of these families. Cats are, with the not very dramatic exception of the cheetah, all pretty much cat-like, and dogs, again with the not very exceptional exception of the hibernating raccoon dog, all dog-like.

There are no extant big musteloids, and none with pretensions to dogginess or cattiness. Instead, musteloid trades show diversity, and we write in Chapter 6 of the fossorial skinnymorphs, musclimorphs, and the aquamorphs, in addition to which come the many tree climbers. Furthermore, we link the burrow-running tubular morphology that characterizes many musteloids to the evolution of rodents, itself a consequence of the evolution of grasses – hence the grass roots of musteloid sociality. This raises the thought of a glass ceiling: musteloids gradually became excluded from lifestyles befitting heftier proportions, because dogs and cats proved better at it. However, is a glass ceiling any less immovable than a glass floor? Likely there are no musteloid-sized canids and felids because they were excluded from those niches by the musteloids (this thought combines again with inflexible directions of evolutionary travel: as Andersson and Werdelin pointed out in 2003, the extant canid lineage traces its ancestry back to runners since the start, and a niche for a 500g runner may be a non-starter). This chicken-and-egg line of thought does, however, recall the weight of phylogenetic baggage. Just as dogs, having evolved sturdy running nails, or cats having evolved sparse and murderous dentition, cannot easily abandon and reverse these trajectories, so too entering these niches from a long and thin starting point may be an evolutionary challenge too many. That said, whilst no modern musteloids are heavyweights, it was not always thus: during the Miocene ‘cat-gap’ in North America, the ancestral bear-like mustelid *Megalictis* was in excess of 60 kg, along with other (rather catty) leopard-sized mustelids (Oligobuninae) – such as *Aelurocyon*, while in the Pliocene an otter ancestor, *Enhydriodon dikikae*, reached the size of a lion (reference to Chapter 22 will cause you to wonder what they ate, how it was dispersed, and what was their society). Those looking sideways today, through comparative analyses, should not forget to look backwards through the lens of palaeontology.

Mention of challenges is the moment to reflect on those that have beset us in editing this book, and to thank wholeheartedly those who have, willingly or through co-option, faced them with us. Of course, our authors and publishers spring to mind; our level of interventionist pernicketiness as editors is an author’s nightmare; that some have graciously said it was worth it has hopefully dulled the pain, and we thank you all for your tolerance.

Of the things that this book is not, is the proceedings of a conference. However, as an embryo it was fertilized by a conference of the same name, The Biology and Conservation of Musteloids, that our unit, the WildCRU, organized in March 2013. So as we add the last full stops in March 2017 a gestation of 48 months will have passed. Thinking of the allometries that exist between the durations of gestation and body size we remember that between the similar conferences, canids in (September) 2001 and felids in (September) 2007, that led to the births of the canid and felid volumes, respectively 35 and 34 months later, we might anticipate that this book is even fuller of fact and wisdom. That is for you, the readers, to judge, but appreciating that gestation length allometry arises due to constraints imposed by the bore of the umbilical cord through which nutrients must pass (namely us editors), we hope that as we cut the cord on this much larger set of species that readers will surely realize the depth of our thanks, and indeed of our apologies, to our partners, Dawn, Christina, and Harry who have endured the birth pangs with us.

This preface, like some of the evolutionary and ecological chapters that follow, indulges occasionally in speculation. For those who prefer firmer ground, this book, with its assembly of all the greatest living biologists working on musteloids, provides fact and substance at every level. In our research unit, the WildCRU, we like to observe that modern conservation spans approaches from groundedness to geopolitics (Macdonald 2016). That spectrum, from the earthy detail of badger scent marking and giant otter fishing to the erudite musing on how geopolitical factors might affect conservation policy, is amply covered herein. However, the target is moving, and in the mill of policy to which the evidence in this book is grist, there's always something new. We mention this to show that the finishing line can never be reached – the masochist might say, finish one book and start another! We won't

do that, but we will close with a quick example of a plot that has unfolded even as we go to press.

For conservation biologists, invasive species introductions are not only revealing experiments in the structure of ecological communities, they are also generally a bad thing. In the case of the UK and continental Europe (not to mention Patagonia and Iceland), the American mink is a prime example, and is the topic of Chapters 16 and 17 in this book. Yet, you will be taken aback to learn that when the EU Regulation (114/2014) obliging Member States to implement 'effective management measures' to minimize the impact of invasive alien (non-native) species on biodiversity came into force on 1 January 2015, the first list of 37 species (Commission Implementing Regulation 2016/1141) that came into force in August 2016 omitted the American mink! Is this startling omission of surely the most publicized invasive mammal in Europe an oversight, or recognition of the unbearable cost of tackling it, or a nod to the multi-billion dollar fur industry that keeps at least 50 million American mink in Europe? Meanwhile, Portugal has submitted a risk assessment (prepared by Spain) to the EC, proposing to add the American mink, on which there may be a vote by the end of 2017. Insofar as the native European mink will otherwise soon be extinct (see Chapter 17), there is some urgency in sorting this out.

We mention this example simply to illustrate that even with 592 pages of Musteloidea ahead of you, new issues continue to arise at the interface of biology and conservation. We hope this book will be a useful part of the foundation for tackling them.

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