

Life in the Wild

VETERINARY
ASSOCIATION
for
WILDLIFE
MANAGEMENT



JULY 2011

“ It requires very little knowledge to care passionately about animals.
It requires a great deal of understanding to care properly for them. ”

Animal Welfare – Limping towards Eden by John Webster
Emeritus Professor of Animal Husbandry at Bristol University

INTRODUCTION

This paper highlights the differences between the *life of wild mammals* and the *life of domestic animals*, whether they are companion or farmed animals. People who either care for, or care about, animals need to understand why life in the wild bears little resemblance to that of domestic life. So the aim of the paper is to create an understanding of what these differences mean in terms of how wild animals live and survive in the wild, the pressures they are under and how they should be considered in ways that do not apply to domestic animals.

SUMMARY

- There are behavioural, physiological and anatomical differences between wild and domesticated animals, which render the latter ill-adapted for life in the wild. (1.1.1)
- The difference between wild and domestic animals may be illustrated by their response to capture and restraint. (1.1.3)
- Numerous misconceptions surround the state in which wild animals live. Wild animals are, in general, in harmony with themselves and with their environment. (1.2.1)
- Alertness or fear in wild animals, the ability to anticipate, understand and learn to avoid danger once experienced (associative learning) are crucial to their survival. (1.2.2)
- Wild animals are by evolution adapted to hunting and being hunted. (1.2.3)
- Wild animals face degrees of stress, including within their own species, but to imagine this pressure in human terms or that of a domestic animal would be wrong. (1.2.5)
- Wild animals almost certainly lack the complex brain and mental abilities necessary to experience fear and the concept of death as a human would. (1.2.6)
- Death in the wild, in the absence of predators and without man's intervention is variously protracted pain, sepsis, gangrene, starvation, hypothermia, inability to feed, inability to hold territory, for days probably weeks before death finally supervenes. (1.3.1)
- There is no ownership of, or legal duty of care for, wild animals, unlike domestic animals. However, mankind has a responsibility to manage the countryside that it has created, including its wildlife populations. (2.1.1)
- There is an evident difference between wild and domestic animals when considering biodiversity and conservation. Sustainable and healthy wild life populations will not result from a "hands-off" approach. (2.2.2)
- There is a need to manage and/or control the populations of certain species by various means to address over-population, to ensure healthy populations, to control disease, to protect habitat and to limit damage to crops and livestock. (2.2.2)
- The legal culling methods include shooting, trapping and gassing and poisoning for certain species. (2.2.3)

- Sustainable and healthy populations will best be achieved by control methods that selectively remove the old, weak, injured and diseased individuals. The evolutionary or natural way to reveal the weakness, injury or simply old age of the individual, is by way of pursuit – a natural process that has been undertaken by wolves and other predators for millennia. (2.2.6)
- Diseased wild animals can have an adverse effect on their own species as well as threatening other wild and domestic species, including humans. Disease in domestic animals is likely to be noticed and its effect on other animals will be limited or non-existent. (2.2.6)
- Government has the ultimate responsibility to ensure that disease in wildlife is controlled, though farmers, gamekeepers and huntsmen are, in effect, unpaid “eyes and ears” in the countryside. (2.2.7)
- Potential man made threats to biodiversity also need to be recognised. For example the current vogue for the reintroduction of species formerly present in Britain needs to be carefully assessed before being permitted. (2.2.8)
- A second potential man made threat to biodiversity is preferential legislation. (2.2.9)
- The threat to wildlife habitat from industrial farming is being addressed by financial incentives via stewardship schemes. However, there is no logic in providing habitat for vulnerable species unless populations of predators can be managed. (2.2.10)

Section 1 UNDERSTANDING LIFE IN THE WILD

1.1 *PHYSICAL AND BEHAVIOURAL DIFFERENCES*

- 1.1.1 Apart from the obvious behavioural differences between wild and domestic animals, there is also evidence of fundamental biological differences between the two. Thus there is in domestic animals, relative to their wild cousins, reduced adrenal gland size plus other endocrine changes, altered brain size and sense organ structure (Hemmer 1990, Belyaev and Trut 1975) and probably brain layout and function (Addison and Thomas 2009).
- 1.1.2 Comparison of similar species in contemporary Britain such as the dog and fox reveals the basis of these differences. The dog has undergone selection by humans over thousands of years to fit it for domestic life, in the absence of predators; the fox has undergone natural selection for infinitely longer to fit it for life in the wild, in the presence of predators (Thomas and Allen 2002).
- 1.1.3 The clear behavioural difference between wild and domestic animals may be illustrated by their response to capture and restraint. Thus, whereas domestic animals accept the confinement of a cage, for a wild animal it can be a cause of acute distress even physiological shock, particularly when approached by man (Wise 1999). For example domesticated rat breeds will tolerate being held in the hand while wild subjects will kill themselves by struggling (Hemmer 1990). Cage trapping therefore risks protracted and distressing incarceration for a wild animal with serious risk of self-mutilation in trying to escape. This fundamental behavioural difference seems not to be appreciated by persons who advocate cage trapping as a humane method of controlling wild animals.

1.2 *STRESS, FEAR AND SURVIVAL*

- 1.2.1 Numerous misconceptions surround the state in which wild animals live. On one hand there is an imagined woodland utopia, in which everything in nature lives in harmony. An opposite scenario is one in which animals are living in a state of constant anxiety, fleeing in dread from predators, including man. Neither description accurately portrays the reality of life in the wild. (note: 1)

- 1.2.2 Alertness or fear in wild animals, the ability to anticipate, understand and learn to avoid danger once experienced (associative learning) are crucial to their survival. Anti-predator behaviour in prey species such as elk (Laundré et al. 2001) and impala (Hunter and Skinner 1998) was found to be significantly greater in areas where carnivores had been reintroduced than in areas where they were absent. For example, the vigilance of elk increased steadily over five years as wolves re-colonised Yellowstone National Park (Laundré et al. 2001)
- 1.2.3 Wild animals are by evolution adapted to hunting and being hunted. What might be a devastating experience for a domestic animal or man is part of the pattern of normal life for the wild animal. Furthermore wild animals that evade pursuit rapidly return to normal activity. Indeed, one line of scientific thought is that because wild animals have no perception of their own death (see 1.2.6) and because selective predation is shaping in a demographic and/or evolutionary sense, escape from hunting or a predator can be biologically rewarding in itself (note: 2).
- 1.2.4 Alertness brings about a temporary physiological reaction to threat (known as the fight or flight response) in order that the animal can react quickly and strongly. However, it would be energy costly to be in this state all the time and it is a well accepted principle that evolution shapes behaviour to minimise energy use.
- 1.2.5 Wild animals face degrees of stress at various times, including within their own species, but to imagine this pressure in human terms or that of a domestic animal would be wrong (notes: 3, 4& 5). Unlike domestic animals, they have to find food, protection from elements and deal with predators. It is almost axiomatic that evolution has designed them to cope with all this without experiencing deleterious or chronic (persistent) stress.
- 1.2.6 Comparative neuroscience and comparative psychology combine in supporting the view that both wild and domestic animals lack the complex brain and mental abilities necessary to experience fear as a human would and the human concept of death. These require at least some elements considered unique to man. (A large body of peer-reviewed material supporting these conclusions, much very recent, is available at www.vet-wildlifemanagement.org.uk).
- 1.2.7 Though animals may investigate dying and dead members of their species, it is as something that is 'different', and thought to be a process in which conditions associated with sickness or death are learned (note: 6). This is very different to recognising death as a concept (note: 7). Thus during the tracking phase of a hunt a fox does not behave as if it perceives the possibility of ensuing death. Indeed, since it has never been caught before, it will 'expect' to escape (lack of associative learning) (note: 8).

1.3 **DEATH IN THE WILD**

- 1.3.1 Death in the wild, in the absence of predators and without man's intervention is not a beautiful mist that gently descends; it is variously protracted pain, sepsis, gangrene, starvation, hypothermia, inability to feed, inability to hold territory, for days probably weeks before death finally supervenes. Clearly, this is not a situation that is either desirable or one that is faced by domestic animals.
- 1.3.2 Natural biological control, in the absence of predators, for over successful species that is "leaving it to nature" will not occur until lack of nutrition, due to overpopulation, and disease are so extreme as to suppress reproductive activity. This clearly does not represent a healthy and vigorous wild life species. Furthermore population levels at which this so called control might occur would see levels of predation and damage totally unacceptable to farmers and the overall balance of other wildlife.

Section 2 LIFE IN THE WILD – MAN’S INVOLVEMENT AND RESPONSIBILITIES

2.1. **DUTY OF CARE**

- 2.1.1 A person who owns or keeps a domestic animal has a legal duty of care to ensure its welfare (note: 9). There is no such ownership of, or legal duty for, wild animals. However, mankind has a responsibility to manage the countryside that it has created, including its wildlife populations.
- 2.1.2 Currently most animal welfare legislation concerned with cruelty to animals excludes animals living in the wild because they are not under human ownership. Laws that specifically refer to cruelty to wild animals generally only come into play when the animal is rendered or being rendered into the control of humans, for example live cage trapping. Certain species are protected under the Wildlife and Countryside Act 1981 and other laws, mainly for conservation reasons.
- 2.1.3 Whereas one might feel the need to relieve the suffering of an individual wild animal, there is no legal duty to do so. Moreover it would place a burden on many people, in particular farmers and landowners that would be unworkable and absurd, not least because wild animals cannot recognise land ownership boundaries.
- 2.1.4 Individuals or organisations that take wild animals into care for treatment and rehabilitation should seriously question their motives for doing so. The welfare of the wild animal is paramount, not the sentiments and feelings of the human intervener. When taking a wild animal into care consideration should be given to the impact on the wild population, the individual animal and the information that may be gained from such an action. (Meredith, 2010).

2.2 **BIODIVERSITY AND CONSERVATION**

- 2.2.1 Biodiversity may be defined as *“The richness and diversity of species of animals, plants and organisms co-existing together within the natural order”*.
- 2.2.2 There is an evident difference between wild and domestic animals when considering biodiversity and conservation. In an environment such as the UK that is almost entirely managed by man (note: 10), sustainable and healthy wild life populations will not result from a “hands-off” approach. There is a need to manage and/or control the populations of certain species, usually by culling, but sometimes by other means such as dispersal or fencing, to:
- reduce numbers of over-successful species that have no natural predators other than man;
 - ensure the overall health of populations;
 - control disease of both wild and domesticated animals;
 - promote and protect habitat;
 - limit damage to property, crops and farm livestock.
- 2.2.3 The legal methods for culling of wild animals include shooting, trapping (including live cage trapping) and gassing and poisoning for certain species. Artificial control of fertility is currently not a realistic or arguably desirable method of population control for wild mammals.
- 2.2.4 None of these methods is singly adequate or suitable for all circumstances, nor are they selective or without adverse welfare consequences. In the man-made countryside, control of an over-successful species is best achieved by a combination of legal methods undertaken by farmers, gamekeepers, landowners, naturalists and huntsmen, with their divergent interests using the appropriate methods of control for their particular circumstances. Furthermore

restricting any of these methods puts pressure on the other methods that might have detrimental consequences to biodiversity.

- 2.2.5 Sustainable and healthy populations will best be achieved by control methods that selectively remove the old, weak, injured or diseased individuals, (as would have been done by wild predators), thereby promoting the health and vigour of the species (Mech and Peterson 2003, Packer et al. and notes: 11&12). However, shooting, trapping and poisoning although intrinsically uncertain and non-selective will nevertheless always be necessary to control over-successful species. Application of all methods as appropriate will be needed on a semi-continuous basis.
- 2.2.6 Diseased wild animals can have an adverse effect on their own species as well as threatening other species, including humans. "Predators have been shown to selectively remove prey with high parasite burdens (Packer et al. 2003, Mech et al. 2003) .The health of a domestic animal is likely to be noticed and its effect on other animals will be limited or non-existent. Whereas such care is a legal responsibility of its owner or keeper, wild animals do not benefit from similar care or attention. Observation can sometimes detect animals that need to be removed if the injury or disease is obvious, but the evolutionary or natural way to reveal the weakness, injury or simply old age of the individual is by way of pursuit – a natural process that has been undertaken by wolves and other predators for millennia. (Colvile, K., 2007).
- 2.2.7 Government has the ultimate responsibility to ensure that disease in wildlife is controlled. (DEFRA, Wildlife Health Strategy, England 2009) However, farmers, gamekeepers and huntsmen are, in effect, unpaid "eyes and ears" in the countryside. Biodiversity changes in animal and plant abundance are often noticed first by such people by virtue of their numbers, their widespread distribution and their commitment to wildlife management.
- 2.2.8 Potential man-made threats to biodiversity also need to be recognised. For example the current vogue for the reintroduction of species formerly present in Britain needs to be carefully assessed before being permitted. It is not sufficient justification to say they were in this country some hundreds of years ago. The danger from introducing or reintroducing a species which might become over-successful may be clearly recognised with the widespread success of the grey squirrel, the American mink and more recently the reintroduced or escaped wild boar represents a potential habitat and disease threat.
- 2.2.9 A second potential man made threat to biodiversity is preferential legislation. Examples are the Hunting Act 2004 and sections of badger protection legislation since 1973. The Hunting Act has rendered illegal the unique wildlife management tool that selectively removes sick, wounded and aged members of several wild species. The badger is a classic example of a population out of control through lack of management. It is not and never was an endangered species and is now having, because of well intentioned but misguided legislation, an ever increasing detrimental effect on vulnerable wildlife, farming and indeed the health and vigour of it own population.
- 2.2.10 The threat to wildlife habitat from industrial farming has now been recognised and is being addressed by financial incentives in the form of stewardship schemes to provide pockets or strips of uncultivated land. However, there is no logic in providing habitat for vulnerable species unless populations of predators can be managed.

REFERENCES

1. Addison and Thomas, 2009 UFAW conference, Bristol 2009
2. Belyaev, D. and Trut, L, 1975, Some genetic and endocrine effects of selection for domestication in silver foxes in the wild. *Canids* ed M.W. Fox 416-26, Van Nostrand Reinhold.

3. A review by K. Colville, *The Natural Chase, 2007*, commissioned by the All Party Parliamentary Middle Way Group and the Veterinary Association for Wildlife Management (2007).
4. Hemmer, H., 1990 *Domestication: The Decline of Environmental Appreciation*, Cambridge University Press.
5. Hunter, L., Skinner, J. (1998). Vigilance behaviour in African ungulates: the role of predation pressure. *Behaviour* 135 (2) 195-211.
6. Landré, J., Hernández, L., Altendorf, K. (2001). Wolves, elk, and bison: reestablishing the "landscape of fear" in Yellowstone National Park, U.S.A. *Canadian Journal of Zoology* 79 (8) 1401-1409.
7. Mech, L., Peterson, R. (2003). Wolf-prey relations. In *Wolves: Behaviour, Ecology and Conservation*. Mech, D., Boitani, L. (eds). Chicago and London: University of Chicago Press. 105-160.
8. Meredith, A, 2010 VAWM wildlife symposium, London 2010
9. Packer, C., Holt, R., Hudson, P., Lafferty, K., Dobson, A. (2003). Keeping the herds healthy and alert: implications of predator control for infectious disease. *Ecology Letters* 6 (9) 797-802.
10. Thomas and Allen, *A Veterinary Opinion on Hunting with Hounds* 2002
11. Wise, D., 1999, *The Bateson Report: Use or Abuse of Science?* Countryside Alliance, London.

NOTES

1. "A wild animal's affective system has evolutionarily adapted in a way that 'matches' the states likely to occur in its ecological niche. So its affective system is likely to function optimally (or at least satisfactorily) in that environment".
J. Yeates, School of Veterinary Sciences, Bristol University.
2. "Fear is one of the most useful properties of the conscious mind because it is conducive to survival. Sentient animals are born curious because they need education to survive and acquire this education usually while under the protection of a parent or parents. They learn to discriminate between real and apparent dangers and, as they mature, become progressively cautious. Having lost the protection of a parent, they rely on their own sense of fear to direct their actions towards survival. When the gazelle learns that the charge of the leopard is truly frightening but once again, manages to escape, it may come to recognize fear as a constructive force that produces its own reward, not as a source of suffering."
Professor John Webster, *Animal Welfare – A Cool Eye towards Eden*, Wiley-Blackwell 1995
3. "Anxiety is a state of mind that is initiated and perpetuated with very little external assistance. Anxiety, one might think, is far closer to fear than is pleasure, but in brain terms, it could be the exact opposite. After all, pure fear, as pleasure, is very much in the here and now. Anxiety, on the other hand...depends on the ability to forsake the present moment and anticipate an uncomfortable future. It is hard to imagine that the rabbit in his burrow dwells on past times when it manages to escape a fox and is now worrying about whether a fox is going to pass that way once more."
Susan A. Greenfield, *The Private Life of the Brain*, Penguin Books 2000

4. *"It seems likely that the states of the brain that embody the intensity and duration of unpleasant feelings such as fear and pain, are closely regulated through evolutionary scrutiny because, for example, being either too fearful or not fearful enough would be detrimental to evolutionary fitness."*

Dr J.K. Kirkwood, Darwinian selection, selective breeding and the welfare of animals, Universities Federation for Animal Welfare International Symposium 2009

5. *"Being afraid is a short-term life-saver, but there is a long-term health cost, so the best evolutionary strategy is a compromise."*

Dr Jonathan Reynolds, Game and Wildlife Conservation Trust (personal communication 12th April 2011)

6. *"Finally, tracking also enables us to find an animal quickly, be it to collect samples or to observe behaviour at close range. Tracking a number of herds allowed a remarkable observation. Eleanor, the matriarch of a herd, was dying, perhaps as the result of a snake bite in her trunk. Other - unrelated - elephant cows not only tried to help her back up onto her feet, but came from considerable distances with their own herds for days after her death to visit the carcass. At first sight, it seemed as if they were paying their respects. In reality, they were probably visiting to assess mortal risks in the environment and to collect information about the changes in a familiar herd. After all, the death of a matriarch has crucial implications for the knowledge residing in a herd and thus on its collective behaviour. It will be fascinating to see how Eleanor's absence will affect the pattern of the tracks left behind by her old herd on the maps of the STE computers."*

Professor Fritz Vollrath, *Trunks, tracks and spiders' webs*, Oxford Today, Vol. 19 Number 2, Hilary 2007.

7. *"I do not question the observations of animals responding to dead group members what I question is their interpretation. Given the lack of evidence for self awareness as well as the opportunity to attribute mental states to others, my own hunch is that no animal will be found to have a system of beliefs about death."*

Professor Marc Hauser, *Wild Minds : What animals really think* Penguin Books 2001

8. *"They do not necessarily have an image of the hunt in advance but have the capacity to learn from experience and modify their behaviour accordingly. In the case of many prey animals in the presence of a predator, the immediate chasing predator, they take immediate action which is appropriate in response to the stress and constructive fear and then, having achieved their immediate gain - they may subsequently be hunted and harried but that is a separate issue - their behaviour appears to return to, shall we say, normal maintenance behaviour. From the interpretation of their behaviour, I believe they are learning by experience as they deal with the initial challenge. Threats come again and again and again and ultimately they may fail to cope, but the evidence of their behaviour is that they learn from experience and we do know that animals learn from experience..."*

They only experience death once. They do not learn from it. Their experience is that they will not get killed. From the time they are killed, they learn nothing."

Professor John Webster, DEFRA Hearing on Hunting with Dogs, Portcullis House, London, 2002

9. Under the Animal Welfare Act 2006, E+W an animal is a protected animal for the purposes of the Act if (a) it is of a kind which is commonly domesticated in the British Islands, (b) it is under the control of man whether on a permanent or temporary basis, or (c) **it is not living in a wild state.**
10. *"The increasing size of the human population has driven us to claim so much of the natural world that there is no longer any corner of our landscape that is not affected by our presence."*
Sir David Attenborough, *Silent Summer*, Cambridge University Press 2010
11. Following the re-introduction of wolves into Yellowstone Park, USA in 1995, elk numbers, which had previously grown to a disproportionate size, were reduced. Examination of elk bones at the site of wolf kills showed that the old, weak and injured animals were being taken. The remaining herd was smaller, but fitter and healthier.
BBC "Horizon" *Predators in your Backyard*, 8th March 2011.
12. *"If you can imagine the Serengeti without lions, what would happen? Well, the antelopes would take over... We're moving from healthy eco-systems where we have predators and prey, where the predators would eat the sick animals and keep the population healthy."*
Professor Villy Christensen, Program Director of the Nureus Program, University of British Columbia Fisheries Centre, Vancouver, British Columbia. (BBC Radio 4 "Today", 19th February 2011).

THE VETERINARY ASSOCIATION FOR WILDLIFE MANAGEMENT

The Veterinary Association for Wildlife Management (VAWM) was formed in May 2004 with the remit to provide a balanced veterinary opinion on a variety of subjects concerning the management and welfare of British wild animals.

Most of the 570 supporters of VAWM are general practitioners spread across England, Wales, Scotland and Ireland. Many have had years of clinical experience with all common species of domestic and wild animals. Some are academics with a wealth of research experience, five are veterinary professors and six are fellows of the Royal College of Pathologists, a collective authority that must be second to none in the current debates on the management and welfare of wildlife.

INTRODUCTION

This is supporting material for the section on *Fear and Stress*, where much had to be conveyed in a very limited space, in particular, the contention that wild animals do not have the mental tackle to worry about the past and the future as we do, and especially, to conceive of, and therefore to fear, death. Inevitably this involves consideration of a wider range of mental abilities. It carries forward the 2006 survey (updated 2007) of animal-to-human differences in brain and cognition, available on the VAWM web-site (click on "Animal cognition and awareness", then "*Even less like a human in 2006 than in 2002*". It presents evidence from largely recent brain studies demonstrating structural and functional differences between the human brain and those of even our closest evolutionary neighbours (in addition to the long-recognised difference in size) implying a gulf between the mental abilities of humans and other animals. That there is indeed such a difference is made clear by studies, again many recent, in comparative psychology showing the absence of human behaviour, or alternative explanations for, 'humanoid' behaviours (i.e. resembling human behaviours) being found in a wide variety of animals and discussion of the underlying mental abilities. To give this collection some structure, the references have been grouped in to five categories. Quotations are given in italics and clarifying comments in plain text and enclosed in square brackets.

The first category is usefully introduced by a quote from a senior figure in comparative studies, Sara Shettleworth, Professor Emerita of Psychology, Ecology and Evolutionary Biology at the University of Toronto (reference 13):

"..... *the recent explosion of data on all aspects of animal cognition underpins several recent reexaminations of [the] claim that humans differ mentally in degree but not in kind from other species*".

1. These references explain the 'humanoid' behaviours as separately-evolved, species-specific skills, therefore not implying a general mental ability which humans might employ to solve the similar problem: the mental life of animals differs from humans in kind, not just degree.

2. These references are from the 'other' school, which views these same behaviours as prototypes (though 'rudimentary' or 'embryonic' or 'glimmerings') of humanoid behaviours, so that the mental life of animals was taken to differ in degree but not kind, from that of humans. (It should be noted how this assertion has been misunderstood by public, media, and politics ignorant of - or ignoring - a clear statement of an 'astronomical' difference between an animal 'mind' and the human mind, made, by the founder of this school, the late Donald Griffin in his seminal book "*Animal Minds*"). Now however, as will be obvious from the dates of the references in group 1, the pendulum is swinging, mainly because of more extended and careful experimental analysis of humanoid behaviours and because of the implications of the innovative studies of brain structure and function presented in groups 3 and 4.

To introduce the next two categories here is quote from ref 38 (p 182):

"...two hypotheses: humans acquire their powers primarily because their brains are big, or primarily because our brains are different from other brains.. That is, as our brains grew huge did they stay much the same, operating like an enormous, but otherwise typical, primate brain? Or did our brains grow wholly new areas, new structures new types of circuits that might generate our unique powers? [N.B.] We note that these hypotheses are not mutually exclusive: "

As the authors and the following sections show, there is ample evidence for both mechanisms having operated in concert to give rise to the human brain.

3. Studies of brain anatomy, structure and function (many only enabled by very recent technical advances) demonstrating clear differences between the human brain and that of even our nearest evolutionary neighbours, found at almost every level from the molecular to the holistic. These began in part as a reaction to the view that the human brain is no more than a larger animal brain, that there is no real difference in mental lives. (However as will be clear from the next group of references, the latter view is wrong on a second count – even increase in size alone can lead to differences in kind.)

4. Further evidence that human to animal mental lives will differ in kind, is coming from studies of the nature of complex systems and brain structure: the increased size, and connectivity ('wiring'), i.e. complexity, of the massively developed human brain, would, promote the emergence of new and unique mental capacities...

5. This group considers the different effects of stress in humans and animals, largely consequent upon their different mental handling of it

Index Given the volume of material presented, it seems worthwhile to attempt flag references to some particular subjects, especially as they are often distributed through several references and in varying groupings. Obviously each of the two comprehensive text books, 8 and 12, cover everything below so will not be indexed..

1. Human psychology and sensibilities; defining features and their existence or not, in animals. Unfortunately, these are variously named, and differently grouped, by different authors.

Awareness of own thoughts/thinking about thinking/metacognition 6, 7, 9, 11, 13, 20, 21 23
(a sub-group on handling uncertainty 6, 7, 20)

Self-awareness/ awareness of a self with a past and an (imagined) future/autobiographical sense/ ditto extending into future/reflective consciousness (as opposed to phenomenological consciousness).. 8, 9, 10, 11, 13, 14.15, 16, 17, 19, 21

Understanding that others are not just bags of behaviour but have the same experiences and mental life as oneself/ empathy/theory of mind/ metacognition (again!) 1 9, 11, 13, 18 21 23

True (grammatical and open-ended) language. 2, 8, 9, 21,

2. Behaviour

Clever behaviour outside mammals 4.
 Anthropomorphic v. simple explanations of behaviour. 3, 5, 9, 11, 13

3. Human specific brain features.

General ... 21, 28, 30
 Structural: Anterior Insula 25, 26., 29, 3
 Association cortex 38
 Functional: Connectivity/complexity 32, 33, 35, 37.
 'Emergent' properties 34, 38.

REFERENCES

Group 1 Behaviour

1. Simon Baron-Cohen, *Zero Degrees of Empathy*, Allen Lane, 2011. p99

The author is internationally recognized as an authority on autism and its psychology. which is characterized by a defective understanding of other people's thinking and feelings ('empathy').

"Clearly whatever glimmering of empathy we discern (or imagine we discern) in other species, the level of empathy that humans show is qualitatively different to that seen in any other species."

2.. Robert Berwick et al 2011 *Songs to syntax: the linguistics of birdsong* Trends in Cognitive sciences 15(3) 113-121

Concerning the popular belief that animals have something of human language

"Unlike our primate cousins many species of birds share with humans a capacity for vocal learning.... "However a consideration of what is required for language contradicts the popular idea that birds, [let alone the rare and exhaustively human-trained apes, limited to banal two-word requests for food or attention!] are well on the way to it.

3. Johan Bolhuis and Clive Wynne 2009 *Can evolution explain how minds work?* Nature 458 832-83

"As long as researchers focus on identifying human-like behaviour in other animals [this] will not advance our understanding of cognition"

"..... we must study animal and human minds empirically without naive evolutionary suppositions." The latter includes anthropomorphism justified by the mistaken idea that existing species are joined via an evolutionary continuity of the sort that allows one to 'read backwards' from humans to understand animal behaviour.

"A closer look at these studies [identifying human-like behaviour in apes and monkeys] reveals however that appropriate control conditions have often been lacking, and simpler explanations overlooked in a flurry of anthropomorphism". See ref 11.

4. Ann Butler 2008 *Evolution of brains, cognition, and consciousness* Brain Res Bull 75 442-449

"Recent studies have revealed a host of highly cognitive abilities in birds ...". At the same time brain research has revealed an analogue of the mammalian cortex - a structure thought to set mammals mentally apart from all other animals: mammals may not be so special after all! This presents a problem to those who maintain that other mammals are so similar to humans (especially because they share a cortex) that extensive legislation and interference with human activities is required to protect them - they will have to extend the latter to birds (and indeed to fishes who can also show unsuspected 'cognitive abilities' and also have been found to possess a cortex analogue).

5.. Charlotte Hemelrijk and Johan Bolhuis. 2011 *A minimalist approach to comparative psychology* Trends in Cognitive Sciences 15 185-186.

" simple behavioural rules can lead to complex behaviour."

"Models of self-organisation show that cognitively simple explanations can be generated for several phenomena including cultural phenomena and the caching [of different foods] and recovery behaviour of corvids." The latter is a favourite example for those arguing for foresight in animals.

6.. Cyril Herry et al 2007 *Processing Temporal Unpredictability in Human and Animal Amygdala* J., Neuroscience 27 5958-59

Behaviour implying uncertainty is enthusiastically taken as evidence that animals are conscious of their own thoughts. (metacognition) However it seems to be a "widespread evolutionary conserved mechanism for adapting behaviour in anticipation of temporally unpredictable events."

Moreover, In humans but not in animals (mice), the brain response is transferred to an area implicated in anxiety states - a recipe for specifically human stress!

7.. Metcalfe, J. (2008). *Evolution of metacognition*. In J. Dunlosky & R. Bjork (Eds.), *Handbook of Metamemory and Memory* (pp. 29-46). New York: Psychology Press.

"To date no studies with any animals other than primates have provided convincing evidence for this particular capability [highly elaborated self-reflection],"

Moreover the primate evidence is confined to three monkeys: *"Even in these primates, however, the capabilities are limited. Despite claims that rats have metacognition, the data can be explained in terms of mere conditioning contingencies. No other species have been shown to have metacognition."* (see ref 38 re rats.)

8.. John Pearce 2008 *Animal learning and cognition* 3rd edition. Psychology press

As ref 21, a considerably enlarged update of a University textbook central to the field, necessitated by recent work. Similarly to ref 22 (from the other side of the Atlantic!), markedly sceptical about claims of abilities beyond those explicable by basic and widespread animal cognitive skills. For instance p 325

"We saw in chapter 7 that there is very little evidence to suggest that animals possess an abstract code, and if they do, it may be relatively simple and depend on special methods of training [intense and over many years] for it to develop. If this is correct then animals will not be equipped with the necessary thought processes to engage in the reasoning that would allow a theory of mind [consciousness of one's own thoughts and imagining conscious thoughts in others] to be effective.

9...David Premack 2007 *Human and animal cognition: Continuity and discontinuity* Proceedings of the National Academy of Sciences USA 104 13861-13867

On the one hand, *"Microscopic study of the human brain has revealed neural structures, enhanced wiring, and forms of connectivity amongst nerve cells not found in any animal, challenging the view that the human brain is simply an enlarged chimpanzee brain."*

On the other,, *"..... virtually every month another cognitive ability thought to be unique to humans is reported in an animal."*

Taken together, this would imply a *"disparity between brain and mind."*

However, *" We consider several examples in which animals have shown human like abilities..."* They find: *" in all cases, the similarities are small and the dissimilarities large. There is no disparity between brain and mind."*

N.B Further (re-) examination of these 'human-like abilities' is the subject of many of the later studies referenced here while *"Microscopic study of the human brain"* has continued apace (see ref 28)

10.. William Roberts et al 2010 *Temporal sequencing is essential to future planning.* Trends in Cognitive sciences 14 52-53

Full awareness of the future is far more than knowing there is a future, full stop, it requires *Temporal sequencing* , i.e. being able to place and plan future event/needs in a sequence - e.g. getting out the meat from the deep freeze next Saturday so that it can be cooked the following dinner on Sunday. This has not been shown in non-humans.

11. Sarah Shettleworth 2010 *Clever animals and killjoy explanations in comparative psychology* Trends in Cognitive Sciences vol 903, p

An important reference for explaining and countering growing popular and political anthropomorphism, the assumption that "they" are being found to be more like "us" than we thought. Claims of human abilities such as 'insight', 'mind-reading', 'foresight', in animals are examined (*"deconstructed"* !) to show how they can be explained in terms of simpler and evolutionary-widespread mechanisms. One might put it that when an ape is being clever it is probably being more like a crow or honey bee than like us.

"Nevertheless although the extent of human-animal cognitive similarity is undoubtedly a key issue for comparative psychology, it sometimes seems the agenda to support anthropomorphic interpretations rather than to pit them experimentally against well-defined alternatives. The enthusiasm for the popular and even scientific press for clever animal stories nourishes this tendency: killjoy explanations [ones which are mechanistically simpler, comprehensively covered the next ref] are less likely to make headlines than stories about how octupi or birds are unexpectedly human-like." [See ref 16]

12.. Sarah Shettleworth 2010 *Cognition, evolution, and behaviour* 2nd ed. Oxford University Press

Another, and considerable, update of a 'gold-standard' and encyclopaedic text by a long-time authority in the field - again necessitated by the volume of recent studies - see the introductory quotation... Contains the full data base for refs 11 and 131

13.. Sara Shettleworth. In Press [as of 2010]. Darwin, Tinbergen, and the Evolution of Comparative Cognition A chapter for The Oxford Handbook of Evolutionary Comparative Psychology

A series of quotations is the best way to point to the message of this most recent authoritative statement.

" when another animal does something that looks human-like, is that behavior evidence for the same cognitive processes underlying analogous behavior in people?"

"Indeed, the recent explosion of data on all aspects of animal cognition underpins several recent reexaminations of Darwin's claim that humans differ mentally in degree but not in kind from other species."

"... the fact that simple forms of memory and associative learning have been found in all species tested, including even simple invertebrates (Papini, 2008) justifies claims that these processes evolved very early, perhaps reflecting universal causal processes and/or properties of nervous systems, and therefore are present throughout the animal kingdom. Thus no special evidence should be required to invoke them for explaining behavior of a previously unstudied species such as New Caledonian crows or bonobos."

"The examples sketched here indicate that progress in understanding how animals solve novel problems is more likely from examining the contributions of simple learning mechanisms and species-typical behavioral predispositions than from attempting to prove the existence of reasoning or insight. Discovering how animals successfully interact with their social and physical worlds through such simple mechanisms should be as much as cause for joy as any validation anthropomorphism."

14.. Thomas Suddendorf et al 2009 *How great is ape foresight ?* Anim Cogn 12 751-754

There have been recent claims concerning foresight in apes, however, *"It is not clear to what extent apes really engage in any foresight in these studies"*

15.. Thomas Suddendorf et al 2009 *Behavioural evidence for mental time travel in nonhuman animals* Behavioural Brain Research 215 292-298

"..... here we review recent data on foresight in animals and conclude that the evidence to support episodic memory [necessary for foresight, see ref 26] is equivocal."

16.. Thomas Suddendorf 2010 *Episodic memory versus episodic foresight: similarities and differences* WIREs Cognitive science 1

99-107

Memory of personal events gives the knowledge required for foresight so are part of the same system and the 'moldability' by subsequent experience, of memory is necessary to allow planning in an uncertainly predictable environment.

17. Thomas Suddendorf et al 2009 *Mental time travel and the shaping of the human mind*. Phil Trans R Soc B 364 1317-1324

"The notion that there might be something distinctly human about mental time travel has provoked ingenious attempts to demonstrate episodic memory or future simulation in non-human animals, but we argue that they have not yet established a capacity comparable to the human faculty."

"There can be little doubt that flexible foresight became a key human survival strategy and that humans have taken the quest for securing future survival to a new level."

18.. Raymond Tallis 2010 *Michelangelo's Finger* Atlantic books

Philosopher and psychologist (formerly University of Manchester) on the profound significance of apes failure to point ('things out to each other') for any attempt to give them even proto-human human mental abilities

19. Wade and Laney, 2008, *Time to rewrite your autobiography?* The Psychologist 21 588-592)

On the need for autobiographical memory to be flexible in order to allow a mechanism for foresight in an uncertain environment.. Relates to the subject of ref 26 .and best summarized by a quote from the New Scientist May 14th, 20011 "It seems that having a head full of half truths is the price we pay for being able to see the future."

20.. Paul Whaley 2007 *The uncertainty of it all* Trends in Cognitive sciences 11

Activation of particular brain area - the amygdala - is often taken to signal and prove fear in animals. However "A new study (ref 10 above) using both human and mouse subjects seemingly throws a wrench in the spokes by demonstrating that the amygdala is sensitive to non-biologically relevant stimuli (i.e. tones) when they occur in an unpredictable fashion.". i.e.. activation can signal harmless uncertainty as well as fear.

21. Clive Wynne 2004 *Do animals think ?* Princeton University Press

Neuroscientist (co-author of ref 4) already in 2004 comprehensively challenging the claims for human-like mental activities in animals , which have indeed come under much criticism. since then..

Group 2 Behaviour again

22 Donald Griffin et al 2004 *New evidence of animal consciousness* Animal Cog 7 5-18

Though an older reference than the rest this is the last compilation of evidence for a proto-human 'mind' driving animal behaviour, by the late originator of the then unfashionable, view that animals are more than automata. It is worth noting that from the very beginning in his book "Animal Minds" he made it clear that his concept was "astronomically" separated from the human mind and their consciousness was awareness of the what was around them ('phenomenological' consciousness) and not of their mind itself (reflective 'consciousness). Many who use him to support anthropomorphism, are ignorant of, or miss (or ignore) these distinctions.

23.. J David Smith 2009 *The study of animal metacognition* Trends in Cognitive sciences 13(9) 389-396

Believes that animals do show some evidence of metacognitive behaviours, not just special skills, but they are "the antecedents of human consciousness". This is not anthropomorphism, but an alternative to the argument that animal clevernesses have evolved separately in evolution so are not related to how human experience and do things.

24.. DeWaal et al. 2010 *Towards a bottom-up perspective on animal and human cognition*. Trends in Cognitive Sciences Published on line

doi:10.1016/j.tics.2010.03.00

Along with the last two references, maintaining that there there is in some sense continuity between our minds and animals, because "complex capacities can often be broken down into components that humans share not just with apes, but also with a host of other species". However. this does not seem incompatible with there being in practice, a gulf. due to the human brain's capacity to combine these components to new heights of cognition (see refs 32,33).

Group 3 Brain structure

25..A d Craig 2009. *How do you feel now - The anterior insula and human awareness* Nature Reviews Neuroscience 10 59-70

"New findings suggest a fundamental role for the anterior insula cortex in awareness and thus it needs to be considered as a potential neural correlate of consciousness." See comment on next ref.

26. Craig AD 2011 *Significance of the insula for the evolution of human awareness of feelings from the body*.

Ann N Y Acad Sci. 2011 Apr;1225:72-82. doi: 10.1111/j.1749-6632.2011.05990.x.

"Activation in the anterior insula correlates directly with subjective feelings from the body and, strikingly, with all emotional feelings."

Also presents detailed evidence that this area is not present in monkeys (?apes) and outside primates. (see VAWM 2007),

27. Stephen Fleming et al 2010 *Relating introspective accuracy to individual differences in brain structure* Science vol 329 p 1541

" We show that introspective ability is correlated with gray matter (i.e. nerve cell) volume in the anterior prefrontal cortex, a region that shows marked evolutionary development in humans. Moreover, individual variation in introspective ability is also correlated with white-matter microstructure (i.e. 'wiring') connected with this area of the prefrontal cortex.

N.B If individuals with less of 'something' have less of an ability then that 'something' must determine that ability . Grey and white

matter in this area are hugely increased in human

28... Preuss T *The human brain: rewired and running hot* Ann N Y Acad Sci. 2011 May;1225 Suppl 1:E182-91.

It is worth giving quoting the complete abstract, as many have not yet caught up with (or are ignoring) the work only begun in 1999 demonstrating that the human brain is indeed different from any other, and not just in size, but in content and organisation.

"The past two decades have witnessed tremendous advances in noninvasive and postmortem neuroscientific techniques, advances that have made it possible, for the first time, to compare in detail the organization of the human brain to that of other primates. Studies comparing humans to chimpanzees and other great apes reveal that human brain evolution was not merely a matter of enlargement, but involved changes at all levels of organization that have been examined. These include the cellular and laminar organization of cortical areas; the higher order organization of the cortex, as reflected in the expansion of association cortex (in absolute terms, as well as relative to primary areas); the distribution of long-distance cortical connections; and hemispheric asymmetry. Additionally, genetic differences between humans and other primates have proven to be more extensive than previously thought, raising the possibility that human brain evolution involved significant modifications of neurophysiology and cerebral energy metabolism"

29. Clau Lamm and Tania Singer. 2010 *The role of the anterior insular cortex in social emotions* Struct Func 214 579-591

"Functional neuroimaging investigations indicates that the anterior insula (AI) plays an important role is consistently involved in empathy, compassion and interpersonal phenomena such as fairness and cooperation." This brain area is recorded as being unique to humans (? apes) and much evidence for its necessary status in subjective consciousness is available at the VAWM web-site in *"Even less like a human in 2006 than in 2002"* (see introduction.).

30.. Jeremy Taylor 2009 *Not a chimp: the hunt to find the genes that make us human*. Oxford University Press

Though by a science-documentary producer, this is entirely composed from peer-reviewed material (as well as discussions with the scientists themselves) resulting from the recent emphasis on differences and not just similarities, and covers a whole range of human to chimp differences in the brain, from genes through molecules, cells, cell-associations, area expansions, intra-area wiring, to inter-area wiring (i.e. global re-organisation)

31... Kalina Christoff et al 2011 *Specifying the self for cognitive neuroscience*. Trends in Cognitive Sciences. 15 104 - 112

An in-depth analysis of self-consciousness and brain areas involved, many of which are human near-specialities. Of particular interest here is:

"... the comparison between efferent and reafferent signals [e.g. feeling you are reaching for a glass and then receiving the feeling of glass] can be remapped at higher levels by specific neural structures. For example the anterior insula can serve to remap the second-order comparison between efferent and reafferent signals"

This helps to create the concept "I have picked up the glass" - hence you know not only that there is a glass out there but there is such a thing as an "I".

Group 4 Brain function..

32. Marc Hauser 2009 *The possibility of impossible cultures* Nature 460 190-196.

He gives evidence for *"humans evolv(ing) unique neural capacities and these capacities [result in] a fundamental and unprecedented gap in the evolution of animal mind. It created what I call our 'humaniqueness'."* Significantly, amongst the elements picked out as contributing to the latter, is *"Abstract thought"*.

33. Marc Hauser and Justin Wood 2010 *Evolving the capacity to understand actions, intentions, and goals* Annu Rev Psychol 61 303-324

Examines the limitations of these capacities in apes and monkeys relative to humans and concludes that the vast capacity of the human brain to cross-correlate and combine its separate mental contents and then to elaborate using further, higher order, systems, results in uniquely human capacities.

"This integration of different systems is one of the distinguishing features of human cognition"

"..... the human brain with its massive capacity to link cognitive representations across domains and recruit a number of domain-general generative mechanisms to support a highly variable range of potential representations." N.B This could well be a description of 'imagination'.

34.. Michael Gazzaniga 2010 *Neuroscience and the correct level for understanding mind*. Trends in Cognitive sciences 14 291-292

"The leading neuroscientists are beginning to accept emergence."

N.B Emergent properties are totally new features that appear suddenly at some critical level as systems become more complex. Much recent research has shown massive increase in the human brain's 'wiring' and its local and 'global' interconnection, i.e. its complexity. Hence there is every reason to allow that the human brain has unique properties on this argument alone. Such complexity will allow the emergence of a 'top down' ability of the brain to control own components - i.e. allow the escape from stimulus-determined behaviour.....

35. William Newsome 2009 *Human Freedom and "Emergence"*

In: *Downward Causation and the Neurobiology of Free Will* (Nancy Murphy, George F. R. Ellis, Timothy O'Connor)
"How are we to reconcile the 'autonomy' of a reasoning intellect with our scientific conviction that all behaviour is mediated by mechanistic interactions between cells of the central nervous system? It seems that the answer will ultimately lie in a deeper understanding of emergent phenomena in complex systems."

37.. Giulio Tononi and Christof Koch. 2008

The Neural Correlates of Consciousness: An Update Ann N Y Acad Sci 112439-261.

(Koch has long worked with the late Francis Crick on this).

To drastically over-simplify (but one hopes not distort) , consciousness depends on the extent to which brain systems integrate so as to specify at the whole brain level, what is perceived (selecting from a myriad of alternative interpretations), and, importantly, on the repertoire of systems available within that whole brain. Levels of consciousness therefore must be in some proportion to brain size, complexity of wiring and number and complexity of component-types, the very features which distinguish human brain from that of even its nearest evolutionary neighbours,

38. Gary Lynch and Richard Granger. 2008 *Big Brain: The origins and future of human intelligence* Palgrave, Macmillan.

(See extended quotation in Introduction)

This study by experts in psychology, computation and brain sciences, notes some of the human specialities covered in section 3 but at its core is the disproportional increase in the size and wiring of human association cortex (cortex over and above - literally! - that processing primary external and internal data) and what will result from such an increase in its size and complexity.. It is only here that a mass of neural extensions arranged to give 'random access', provides the substrate for higher-order thought, one that can combine of data from all over the brain, traveling from percepts to concepts., from simile to metaphor to transcendence.. Put simply, the more you have, the deeper your thoughts (and, as is made clear in the next section, the greater your capacity to be stressed !, as life becomes more - or one might say unnaturally - complex)..

Whereas " *In the rat much of the brain is taken up by vision, hearing, olfaction [etc] precious little is occupied by association zones*" (p 91): in contrast " *In the human the sensory zones occupy only a small fraction of the greatly enlarged neocortex. `all the rest is association cortex* (p 91).

On the same theme: " [the human] cortex seems to grow new functions (referring to language): just by growing more cortex" (p 194)

Group 5 Stress

38.. Robert Sapolsky 2004 *Why zebras don't get ulcers* 3rd ed. Henry Holt N.Y.

Despite its catchy title (and style - see below!), perhaps the, classic text book on the biology of stress, by a Professor of Biology and Neurology at Stanford University.

p5. " *Essentially, we humans live well enough and long enough, and are smart enough to generate all sorts of stressful events purely in our heads. How many hippos worry about whether Social Security is going to last as long as they will, or what they are going to say on a first date ? Viewed from the perspective of evolution, sustained psychological stress is a recent invention, mostly limited to humans and other social primates. We can experience wildly strong emotions (provoking our bodies into an accompanying uproar) linked to mere thoughts.*"

(N.B. he notes it is not that zebras can't get ulcers, they can, but it is as a result of stress outside their evolutionary experience, such as prolonged restraint, transport, periods in a restricted environment, as they have no natural coping mechanisms for such unnatural stress.)

39. Gill Aitken 2008 *Animal Suffering: An Evolutionary Approach* Environ. Values **17** 165-180

An animal's well-being depends on the extent to which its environment matches its evolved "survival skills" and in particular, because of animals' lower cognitive abilities, anthropomorphic assumptions can cause suffering.

" *Animals may be both more and less open to suffering than humans.*" *Less likely "because many of these [i.e. human worries] lie outside the animals ability to comprehend."* *More likely " ... because they lack [the human] ability to see beyond immediate situations.."*. Because of this lack, " *pain, confinement and disorientation can trigger this descent [i.e into "misery"] very rapidly, where they would not do so in humans.*" All in all " *Situations that may not lead to suffering for us may well do so for some animals and vice versa.*"

Coda To show the ungoing nature of these debates, some relevant comments very from recent " *New Scientist*" on what is now regarded as one mental module, for Mental Time Travel/Autobiographical Memory/awareness the future/foresight..

April 30th 2011 " *Our forgotten years*" Kirsten Weir

p45 " according to *Catriona Morrison (University of Leeds) animal memories are thought to be conditioned responses to stimuli rather than conscious reflection. Without language and a more sophisticated sense of self, it's unlikely that our non-human cousins have autobiographical memories, Morrison says. Harlene Hayne (University of Otago) agrees : "Most experts believe that autobiographical memory is unique to humans"*."

And then, on the relation of autobiographical memory to foresight and planning.

14th May 2011 *The Grand Delusion* Graham Lawton p 39

" according to *Wade, [of 'Wade and Laney', ref 30 above] Memory is no longer conceived as being exclusively about the past, but as part of a generalised "mental time travel" module that allows us to construct and test future [imagined] scenarios based on past experience. If memory were inflexible that would not be possible. It seems that having a head full of half truths is the price we pay for being able to see the future.*"

That is - no autobiographical memory, no foresight.