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Fieldwork results, anonymity, rare observations and cognition-questions of method, biases and interpretations

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QUESTION

When are data acceptable in field research?

ABSTRACT

The study of birds in the natural environment largely falls to two disciplines: ecology and ethology. At this time of substantial decline of bird species and numbers, it is argued that ecology cannot do without ethology, especially cognitive ethology, if real progress of saving species is to be made. The paper is concerned with problems of methodology, partly to do with lack of familiarity with behaviour and characteristics of the species (the anonymity problem) on one hand and partly to do with an underestimation of the effects of 'an ecology of fear'. It will raise the question of sampling bias, express concern about the use of technological gadgets that may produce large data sets but often too little of value. It is not just an argument of quantitative versus qualitative data but of distortions, oversights, and insights that are not used. Studying cognition and emotional intelligence are as important hallmarks of animals ability to cope in the current wildlife crisis as are knowing about migration routes. Moreover, there is little doubt that systematic discussions in ethology rarely prepare one on how to respond to unexpected or incidental behaviour and to discuss the future of ethological fieldwork and cognitive studies. Examples of rare behaviour will also be provided to show how they can be pivotal in good science when momentary surprises in witnessing unusual behaviour can lead to new insight, and then to experiments and data. The paper will suggest, however, that new insights may only be

possible when a robust methodology used in field research reflects a positive, non-invasive approach. The paper proposes that social interactions between conspecifics can become one of the drivers of cognition and social bonding that provides critical support for avian survival.

Keywords: field methods, technology, bias, rare observations, cognitive research, birds, Australian magpies, ethology, ecology.

INTRODUCTION

The Anthropocene has created conditions in which most living organisms – apart from humans, some rodents and a smattering of other species and plants – are in decline [1,2]. One of the most pronounced interests in bird behaviour in recent decades is cognition, with special interest in the avian brain, social behaviour and exploration, and the other is in conservation, due to the ongoing and substantial decline of birds worldwide. The former is of interest specifically to ethology, the latter to ecology. Migrations, reproduction, and adaptations are the province of ecology. Ethology, a separate discipline, is often practised in conjunction with other relevant disciplines such as neuroethology, endocrinology and comparative psychology as a form of behavioural biology including also cognitive studies. Many topics may overlap but less so the methodology.

Fieldwork has perhaps never been so important, but some conservationists have doubted that cognition in birds is a subject of any interest at this time, and that all efforts should be poured solely into endeavours to save species. Herein lies a near tragic misunderstanding. For birds, we need not only to know where they move from and to and how they adapt to and can reproduce in changing environments, but also how cognitively and emotionally capable and adaptable birds may be, both as species and as individuals [3]. The latter is important given the far shorter timeframes in which climate changes are now happening, falling well short of timespans required for evolutionary adaptations.

This paper deals particularly with fieldwork and the data it produces. In a recent paper I discussed a highly problematic area of ecological fieldwork from the point of view of animal welfare [4]. Here I look at the data produced as a result of remote and nearly anonymous collections of data – an area of scientific endeavour that has had far too little critical and impactful reflection and, instead, has created its own partly undeserved nimbus of authority via an ever-growing citation network [5].

Further, the paper addresses so-called anecdotal findings in ethological field research that, by contrast, have been and regularly come under scrutiny. In either field practice or data collection, some careful rethinking might be needed. The question is under what circumstances data are scientifically acceptable and robust, especially if the results are to be used in conjunction with certain conservational goals. Perhaps it is also necessary to ask, how one can best explore complex cognition within the context of a bird's life history and in the natural environment and whether we employ the best techniques, have reliable methods, and do not introduce sampling biases. Of particular concern are rare observations in the field that may appear puzzling, surprising, or even extraordinary. Such rare observations usually fall into the category of behaviours that are either celebrated as discoveries of complex cognition or dismissed as useless anecdotes.

Finally, the paper will argue that cognitive research in birds, while progressing at a remarkable pace particularly via establishing biologically verifiable attributes in avian brain function, is as important to undertake in the field as it is in the laboratory. Of course, such comparative work is well established in biology and in soil, water and toxicology studies [6, 7]. The question is, thus, how and whether one can do effective cognitive research in the field and whether laboratory work, with its excellent controls, actually provides results that are reflections of specific cognitive abilities and skills of avian species that apply and have explanatory power for species in their natural environment.

Fieldwork whether done in ecology or ethology, in the sense of controlled experiments, is a relatively 'messy' business with many unexpected (or unwanted) possible variables. Norris wrote in his book on spinner dolphins:

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"Science is tinkery business. One must conceptualize, design, test, repair and modify, discard, and above all try to perceive without bias what nature has to say as a result of the test. And it all takes a lot a time" [8]

As late as 2007, it was argued with some justification, that there has been very little research on the practice of fieldwork [9] and this is something that is still awaiting review and broad coverage. In the absence of such a framework, some known issues relating to data collection in ecology will be examined, especially problems in data distortions and its probable causes. In cognitive research in ethology, how can one best explore complex cognition within the context of a bird's life history and in the natural environment and how comparable are the results obtained in laboratory and in field studies? What status is to be assigned to rare observations in the field that may appear puzzling, surprising, or even extraordinary? Rare observations usually fall into the category of behaviours that are either celebrated as complex cognition or dismissed as useless anecdotes.

TESTING COGNITION AND WHAT IS IT?

The concept that birds have cognitive abilities now requires little elaboration. While the idea was still somewhat controversial at the turn of the century, i.e. from 20th to 21st [10], the evidence is now overwhelming that some bird species can do a range of cognitively complex tasks, engage in behaviour that is recognisably complex and have forebrains that biologically underpin such abilities [11-14]. Some cognitive processes are domain-specific, and these are usually referred to as modules [15,16]. All studies on animal cognition in general have tended to be modular to some extent, i.e., observed skills in one domain followed by testing such specific abilities [17,18]. Inevitably, research had to concentrate on very targeted questions and slowly assemble a picture of the birds' cognitive world [17]. Some investigations started with natural behaviour associated with food acquisition and reproduction, two of the most basic abilities for survival in an individual and the species.

To take cognitive studies beyond basic skill sets required new theoretical considerations. The social brain hypothesis largely filled this need. Dunbar had argued

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that large brains first and foremost had to do with social bonds and bonded relationships [19]. The concept of the 'social' brain arose out of the view that more complex cognition was needed when animals lived in groups because of their need for communication and possibly even negotiation, arguing that the major functional role of the vertebrate telencephalon is the regulation of social interaction leading to social complexity, an argument that has been debated for the past twenty or so years and often confirmed [20,21]. Most affirmative results of complex cognition have arisen from laboratory experiments but, of course, the evolution of such traits occurred in the natural environment and proving that can be problematic if there are no field work data to support such claims.

Also, the claims for acquiring greater brain power rested on the assumption of social complexity [19], its evolution should hold for entire species and across species and this may not be so. Insights and innovations may remain specific to a group and even be instigated by just one individual and copied by other members of the group. In Japanese macaques, for instance, potato washing spread from one group to others and then expanded from potato to food washing [22]. However, the hunting techniques of some killer whale pods may not spread. One such strategy, risky for the orcas, is called "stranding" to capture seals, a technique that seems to have remained an innovation confined to a small population but not across all killer whale populations [23].

Can the theory of cognitive complexity be upheld when the same conclusions are applied to avian species that might not be considered as the brightest and best in the cognitive domain but live in complex groups and show group specific behaviour? In several interesting studies of superb fairy-wrens, Langmore and colleagues investigated why some nest sites were heavily parasitised while others were rarely parasitised by cuckoos even though, geographically, the sites were not far apart [24-26]. The researchers found that the ability of one group and not the other, to successfully avoid being parasitised, was achieved by learning and, more broadly, by social transmission [27]. As in the orca example, the specific behaviour (anti-parasitising in case of the wrens) did not spread to other groups.

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Some neuroscientists and developmental biologists have raised doubt recently about calling too many behavioural expressions 'cognition'. Levin et al. [28] wrote recently that one cannot be certain when biological information of essential features of the brain turns into a justification for seeing such behavioural evidence as a "canonical 'instantiator' of cognition". They asked what was needed in an organism to become familiar with all relevant features of an environment to keep itself alive, growing and (with luck) reproducing? And they cite "a-neural" systems showing that

"the cognitive operations we usually ascribe to brains — sensing, information processing, memory, valence, decision making, learning, anticipation, problem solving, generalization and goal directedness — are all observed in living forms that don't have brains or even neurons." [28]

Indeed, looking at phylogenetic data it can be shown that neurotransmitters, synaptic proteins, networks and circuits exist across a wide spectrum of organisms [28]. Even some invertebrates, that may not have a brain as we identify it, can also have cognitive capacities once solely ascribed to humans and primates and, very occasionally, to birds. The octopus is a prime example in this [29].

Similar traits can develop in orders in which there is no relatedness, such as the ability of vocal learning in songbirds (over 5000 extant species), parrots and some hummingbirds, cetaceans, and humans as well as some seals, elephants, and the horseshoe bat [30]. The point here is that convergent evolution [31] may also result in similar traits (including cognitive traits) in very dissimilar species. Equally, we know that some biological traits in animals are marginal or superficial (even though extremely complex biologically) in the sense that they can be dropped and reinstated in one species when needed, such as colour vision [32-34].

Whether or not Levin and colleagues [28] are right in suggesting that the great variety of such systems suggests not a binary dichotomy of cognitive versus mechanical but, rather, a continuum of cognition from modest to complex, is yet another question. I fear, that adopting such a viewpoint might lead us back to the Aristotelian scala naturae, a way of relegating some life to 'low' and others to 'high' in

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value according to the criterion of cognition and/or other abilities, or as Joan Silk called it 'Taxonomies of cognition' in a review of Frans de Waal's book on the evolution of animal intelligence [35,36]. Or whether one embraces the conceptually/philosophically opposite position as Naess [37] had argued decades ago, that we are animals among others and not quite as unique as we would like to be. Rarely does it get pointed out that calling one species 'unique' (as the human species) is tautological: every species is "unique" by definition.

However, against the critique by Levin et al. 2021 [28], cognitive behaviour in birds, cetaceans, and primates, also has a social and emotional dimension that may even be more important than had been realised when Dunbar formulated the social brain hypothesis [19]. The social brain requires not just memory, learning ability but the capacity to think of and respond to others, be this in terms of cooperation, affection, consolidated behaviour, partner commitment, or even altruism and empathy. Richard Lazarus has argued from the 1960s onwards [38] that cognitive processes precede emotional ones, establishing a clear link between cognition and emotions well before neuroscience could confirm the brain processes involved. He argued that cognitive processes generate, influence, and shape the emotional response in every species that reacts with emotion, a theoretical position supported by Salovey and Mayer 1990 [39].

Emotions, after all, may be suppressed or expressed, i.e., are regulated, and can be utilised in various ways, be this for planning or influencing motivations. Indeed, as has now been confirmed in countless papers in human and animal studies, emotions are under cognitive control [40]. However, there is little ever said about this variable when scoring behaviour of parrots or other avian species in laboratory tests designed specifically for cognitive abilities. What is the role of the experimenter? What is the personal relationship of the experimenter with the birds being tested? Our pet cockatoos responded very differently to different people, expressing strong likes and dislikes, affiliative behaviour or aggression and their performance in given tasks could be quite different (expressed, for instance, in latency to approach, completion of tasks etc.) depending on the social context. One suspects that most laboratories are aware of this and make some adjustments as needed but, as far as I am aware, such awareness and possible adjustments in response to anticipated behaviour of the

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subjects are never mentioned. After all, the birds tested for specific skills have to be willing participants in the entire experiment.

Investigations into the possibilities that birds may be capable of showing altruism and empathy are still rare and very recent but show that even such subtleties of emotions are possible to test. This recognition opened the door for the study of the entire range of emotional and cognitive abilities in birds [41]. One of the most explicit papers on the topic of empathy in birds shows that a distressed member of a group of ravens gets consoled by another member [42]. Consolation of a vanquished member may also be an integral part of keeping a group functioning .

Ideally, we should observe, record, and test as much as possible cognitive behaviour in the field in contexts in which birds/animals are likely to display context appropriate and natural behaviour. Empathy assumes a close link or insight into the other's physical existence: I move as you do and therefore I 'know' you better. In one theory, called the theory of social-cognitive transference, it is proposed that mental representations of attachment figures strongly influence how we judge others [43]. This may also be true in birds, even if individual participants are not aware of the influence other attachment figures might have had [44].

One set of testable behaviour conducted that combines emotions and cognition well is self-control and this has been tested in many studies [45]. Broadly speaking, self-control relates to one aspect of executive function that supports flexible adaptation to the environment [46, 47] and a number of ingeniously simple tests have been devised for testing, such as qualities of motor-self regulation and delayed gratification [48] and other attributes of executive function in laboratories. Tests concerned with inhibitory control, such as motor self-regulation in a detour tasks (tested in standard cylinder tests) raised doubts as to the usefulness of some of these experiments. A standard detour task uses the cylinder task. Typically, an opaque cylinder was first used and subjects could find a piece of food inside if they went to the open end of the cylinder to retrieve it. In the second round, a transparent cylinder was used showing the food in the same position as before but now the subjects could see it. Parrots did rather poorly at it, raising doubts what exactly the test measured [49,

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50]. My own preliminary field test with the cylinder was even more simplified (i.e. presenting only the clear tube and inserting food that could be reached from either side by even large birds). I watched every interaction — king parrots, *Alisterus scapularis*, kept trying to get the food by scratching the plastic material with their beaks at the site of the food in the middle of the tube. Even after a day, they did not use the detour. The same happened with bar-shouldered doves, *Geopelia humeralis*, pecking consistently at the food on the side. A male bowerbird, *Ptilonorhynchus violaceus*, appeared and made the detour at once and without hesitation and retrieved the food, so did an Australian magpie and a Lewin's honeyeater, *Meliphaga lewinii*, but not the blue-faced honeyeater, *Entomyzon cyanotis*, and a pair of scaly-breasted lorikeets, *Trichoglossus chlorolepidotus*. However, since the food was displayed in the natural environment, it was potentially open to any wildlife. On day 2, the wildlife visiting the tube were also two lizards, a skink and a water dragon, as well as a brown rat. The amphibians and the rat detoured immediately and without hesitation and one wonders indeed how many other vertebrates and even invertebrates could have solved such a problem and what this means to our assessment of 'complex cognition' in birds and in animals generally? The idea of an experiment in the natural environment had to be abandoned largely because of the appearance of the rat that could quite easily have killed one or the other visitors, no matter how well the site was protected. Even in this brief preliminary test, it seemed more than evident that this kind of detouring ability was not specific to a) particularly large-brained animals or b) to a single class of animal.

Likewise, eye-gaze following was once considered special to humans and primates. However, chickens [51], African grey parrots, *Psittacus erithacus* [52], bobwhite quails, *Colinus virginianus* [53], bee-eaters [54], Northern bald ibises, [55], jackdaws, *Coloeus monedula* [56], starlings, *Sturnus vulgaris* [57], and American crows, *Corvus brachyrhynchos* [58] have been shown to engage in eye-gaze following. Common ravens (*Corvus corax*), when caching a food item, use the ability to recognise direction of gaze to decide when they are being observed as they cache it [59]. Gaze following has also been studied in many primates and in wolves [60] as well as in domestic mammals, such as dogs, cats, horses and even goats [61] the latter largely with respect to cueing by humans. Social attentional cues as we now know are

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important across a wide range of species, be this as part of an imprinting process or as an ability to learn from observing behaviour of a conspecific (here: body or gaze orientation). Archerfish, *Toxotes chatareus*, soon assemble when one archerfish is lining up body and eyes for targeting a prey item above the water [62]. Fish cognition is now also an established field [63- 65] suggesting that cognitive abilities of various complexities may be found across a wide range of vertebrates and even invertebrates [66-69].

We believed that eye-gaze following provided a window into social cognition (with emphasis on 'social' [70]. Perhaps this was a little premature. In some instances, it would seem more correct to refer to this as visual cueing, i.e. a very important adaptive behaviour since eye gaze following has so far both been observed and studied in an asocial reptile [71] and in a red-footed tortoise [72].

Finally, we now know that at least precocial birds hatch already equipped with a basic 'tool kit' of sensory perceptions, discriminatory abilities, and a set of basic cognitive skills. As an important review in 2010 described it, after testing nearly newly hatched chickens [73]. Certain cognitive abilities appear to be part of a basic tool kit, including degrees of numeracy, geometry (spatial ability), physics (understanding gravity), and even psychology. 'Psychology' here refers to the ability to correctly interpret the behaviour of others and understand that objects and living things remain complete when half their body may be hidden, an ability referred to as object permanence [74]. Amodal completion, the ability to imagine a visible segment of a shape or body being part of a whole even when hidden, was once thought to be unique to humans but that soon proved not to be true - rodents, primates and birds can also do it [75]. For precocial species, such as geese, ducks, chickens, this makes a great deal of sense since it explains how they find their mother when she is half hidden behind some natural object [76]. For altricial species, the same should largely hold since altriciality (ie. hatching at an earlier stage of development) potentially permits slower but more extensive development and growth of the brain. But results are by no means even. Amodal completion, for instance, has been shown in Bengalese finches [77], but when tested in pigeons, it was not mastered. Pigeons seemed unable to complete the disappearing object [78].

https://doi.org/10.52732/ETPR9295

Knowing all this from laboratory research, in field work, it may be more difficult to test cognitive skills, at least in some special tasks (as will be shown later), because the environment can simply not be as well manipulated as it can be in a laboratory.

However, regardless of the overwhelming success of laboratory studies, the question Calisi and Bentley (2009) asked some years ago was whether animals tested in laboratory and field experiments are really the same animals. In their review they concluded they are not [79], because captivity alters animals profoundly, be this in hormonal responses or even in brain morphology and function. For instance, Nuttall's white-crowned sparrows (*Zonotrichia leucophrys nuttali*) were shown to have seasonal changes in the volumes of the forebrain nuclei in the song system (HVC and robust nucleus of the archistriatum--both central for the avian song system). These nuclei were larger in spring than autumn in free-ranging birds than in captive ones; dark-eyed juncos (*Junco hyemalis*) had a larger hippocampal volume than captive birds; superb fairy-wrens (*Malurus cyaneus*) showed a decreased immune response in males in captivity compared to free-ranging birds [79]. In more than 20 songbird species it could be shown that testosterone levels are higher in response to social instability in free-living breeding birds than in captive birds [79].

All these, at times substantial, differences in some biological factors between laboratory and free-living birds, may result in important changes in behaviour, making the extrapolation of data collected in the laboratory and field discordant and sometimes perhaps even questionable. Quite often, the circumstances and housing details are not described in detail in submitted papers. It is often also not stated for how long birds had been in captivity at the time of testing, noting here that birds, apart from those for domestic use, are generally not listed as companion animals because many have shared human company for very few generations, or they may have been bred in laboratories or are still taken directly from the wild. The latter has its own substantial risks: physical deterioration because of stress or capture myopathy. Climatic changes and stress during longer transports (from country to country or across climate zones) can cause significant mortality even when birds are imported legally and those that stay alive are dealing with significant trauma. Stress alone from handling raises corticosterone level [80].

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These details ought to be carefully examined and stated in laboratory behavioural tests, especially for something as sensitive to change as behaviour. Some observational data presented can thus place doubt on the exclusivity of cognitive behaviour linked to the tested species, the circumstances of which might have been biased to begin with. At least such a bias should be known and considered although only very few research papers have done so [81].

FIELDWORK - METHODS AND ATTITUDES

One school of fieldwork in ethology seeks to understand natural behaviour and frame questions that can be answered within the limitations of field work observations and naturalistic settings. Fieldwork here means going out to established avian communities, slowly habituating a specific group of animals, here birds, to one's presence and trying to do so without provisioning them. Some individual experiences in the field will be recounted here in as far as they raise questions.

Bearing witness to animal behaviour are not 'results' but they are experiences and such experiences, if a scientist is honest, may very well change the way he or she views the objects of his or her study and may also alter the way a particular fieldwork project is conceived. This is certainly how Konrad Lorenz approached his subjects and many of his insights arose first out of such close encounters and the time he spent allowing these relationships between birds and human observer/participant to develop [82]. His intimacy with the birds of interest was not limited to ducks and geese [83] that imprinted on him [84] but involved other species such as jackdaws [85], a member of the European corvids. Intimacy here means not treating the subject as a pet but allowing free-roaming and wild-living birds the freedom to go about their lives or even interact with the observer while continuing to display the entire, context appropriate range of natural behaviour.

In his method of fieldwork, a researcher presents in the field, usually alone, to make as small a footprint as possible and stays with the subjects over a designated number of hours and days, as the experimental or observational schedule requires, and does so without indirect or direct intervention. This form of ethological fieldwork is

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usually very time-consuming but has the distinct advantage that the researcher gains some insights into individual and group behaviour, may bear witness to unexpected behaviour or may be able to observe encounters with predators of the species under study and can record changes in behaviour [86, 87].

There are also some issues arising that are rarely debated in research but are of some consequence in fieldwork; namely, how the researcher behaves and thinks while in the field. For instance: will he/she believe his/her eyes, note/record actions and behaviour seen or not record some that, to the observer, have little or no meaning. Might a researcher respond to observed behaviour by changing his/her own behaviour? Is it clear and certain that researchers do not assume universality of behaviour at a species level (e.g., all zebra finches or even all songbirds are this, do this, behave in this or that way) and bring to it a negative human bias or not?

One of the advantages and disadvantages of fieldwork, in almost equal measure, is the rare opportunity of researchers to observe and document behaviour in its natural environment and identify contexts in which they occur. Certain instances may capture the interest of the observer and may actually be suitable to be followed up by well-designed experiments. Other observations may appear fascinating but cannot be replicated.

2.1 Publishable projects (examples)

For field researchers, there are a few preferred characteristics when choosing a study subject: accessibility, stability, abundance. For over two decades my own field research centred on one species: the Australian magpie (*Gymnorhina tibicen*) [88], a species that belongs to the broader Corvoidea, but not related to the Eurasian (*Pica pica*) or the American black-billed magpie (*Pica hudsonia*). The advantages of studying magpies were obvious: in the areas of New South Wales, and close to the university, they are an abundant species, live in stable territories (open woodland) that can remain unchanged for as many as two decades. The parents usually form a strong bond and stay together even for life, usually getting offspring to leave when the next breeding season is about to begin. They sometimes use helpers, offspring from a previous year,

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when breeding [89,90]. They are furthermore ground-feeders, are easily distinguishable individually by their wing-markings and have a methodical way of foraging. As songbirds, they are unusual in several ways, apart from being accomplished and versatile songbirds (over 900 syllables), they are excellent mimics [91], life-long learners, and they also have the distinction that male and female sing alike and do so throughout the year [92].

For vocal studies, collecting song and using playback is easily set up in the field. Their song carries a long distance and is readily recorded and this was initially the topic of my main interest. The analysis of vocal behaviour eventually also led to the discovery of referential signalling in this species [93], but this took an inordinate amount of time: thousands of hours of recording, analysing, and preparing playbacks to test the hypothesis that some of their vocalisations were, in fact, 'referential', i.e., had a fixed semantic meaning that other magpies understood immediately [94].

A similarly familiar type of project for field work is to simulate natural encounters with predators. Magpies are a very good subject for such a project because of their known fearlessness and skill to drive even large aerial predators out of their territory [95]. On the basis of a few casual field observations, noticing that the birds seemed to use slightly different tactics in response to different aerial predators of different height, weight, talon strength and bodily manoeuvrability, our laboratory had taxidermic models made of the most abundant aerial predators in the region that were known to present real predatory threats to magpies, such as the little eagle, *Hieraetus morphnoides* [96], brown goshawk, *Accipter fasciatus*, [97] and the wedge-tailed eagle, *Aquila audax* [98]. By presenting these various predators in the field, one could produce a profile of the methods of attack of each predator which proved to be surprisingly sophisticated [99].

On another occasion, working on a different project I noticed purely perchance that one magpie raised an eagle alarm call (with the referential signal identified earlier) while looking intently at some shrubs. There was indeed, an eagle, half hidden by foliage on the ground and the magpie seemed to lean its body so hard in the direction of this wedge-tailed eagle that it nearly fell off the branch. That brief observation turned

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into a well-controlled field experiment, made possible by using a taxidermic model of a wedge-tailed eagle that was indeed very life-like. A set of 3 experiments were set up to evaluate the behaviour of the magpie in detail and assess the sequence of events once the taxidermic model was in position. The response was overwhelming, even dramatic: the entire family became involved, and a cacophony of eagle alarm calls rang through the air. Most importantly, it could be shown that they used their whole body to point towards the eagle [100]. The results were published and this paper was the very first report of pointing behaviour in a bird taken in the natural environment and showing a well-rehearsed performance of a set of cognitively complex behaviour [100] followed that same year by a similar study of pointing in ravens [101]. These two reports have remained the only ones so far on this rather abstract body movement as a referential signal to others.

Behaviour in encounters with humans and equipment

Over many generations, research has shown that most birds generally seem to have learned that most humans are dangerous, even more dangerous than apex predators and this elicits responses of hiding, fleeing or quiet (freezing) behaviour [102]. If anything, one could speculate that such fear might have increased over the last decade since the report by Cuiti and colleagues came out in 2012. Some reports have indeed suggested that this is so [103]. The sources of fear of human inhabited areas are manifold and culture and area specific. Poaching in one area, shooting birds for food or fun in another, simply removing roosting and nesting trees but also unleashing millions of cats on birds' trails, flooding the landscape with noise and light and many other things. In some areas, when we went 'outback' into relatively uninhabited inland semi-desert areas of Australia, birds fled when they saw a human shape on the horizon, several kilometres away. We then learned that the red-tailed black cockatoos (*Calyptorhynchus banksia*) were regularly shot in that area. Their flight was the only defence.

Hence, fieldwork can be made much more difficult by the potential dangers that humans have come to represent. It can take a year or more to habituate birds to one's presence. Jane Goodall needed 2 years before the chimpanzees were able to relax in

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her presence [104]. While the geographical areas in which I conducted most of my research was low in human populations, the key feature was that most landholders entertained friendly relationships with their magpie families and that certainly has helped. However, it did take at least half a year before I felt that the birds were beginning to relax. Nevertheless, I continued being watched for every move I made. To make things easier, I wore only khaki-coloured clothes, which had no patterns and turned up day after day in the same outfit, just equipped with a camera, a notebook and later also with a video camera.

The video camera caused almost immediate problems and, when running, it almost caused a direct attack by the male during the breeding season. I did not know what was wrong at first but then had the idea of running the camcorder while facing it to see what the magpies saw. Indeed, there was a problem: when the camcorder was on, there was a red light flashing next to the lens, via a small vertical slit. This looked like an image of a dangerous flashing eye. I placed a non-transparent sticker over that flashing slit and then tried to film again the next day. The problem stopped at once and the male never tried to attack again. My camera traps I had set up also showed the same problem: a small round red flashing light once activated facing the objects to be captured.

It is well-known that bears, elephants and sometimes lions will destroy camera traps. Possibly the flashing light is the problem and only the most fearless species would attempt to remedy the situation by permanently disabling the flashing which, generally, in animals is responded to as if the flashing signified a threat or a warning of danger.

In one study, 40% of all camera traps were destroyed by elephants, *Loxodonta africana* [105]. In another study, it was mentioned that flashing lights deterred pumas from attacking livestock [106]. There are guides for field researchers about types and features of camera traps [107] and perhaps they mention the flashing light issue but, generally, it seems that the interest in technology is not necessarily matched by probing for behavioural reasons of the animals for the destruction and that is where technology interest and interests in animal behaviour can quickly part company.

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There is also the question between anonymity in field work and being known or becoming known to the study subjects. Camera traps are a wonderful tool when one cannot be certain where animals are and which species are in an area but they keep the researcher out of contact.

It is different when one goes directly to the animals and is in visual distance. One of the inevitable consequences of watching group/family living of one's chosen species is the total loss of anonymity as a researcher. Researchers moving amidst their study subjects, or are at least visible to the birds and can be in relatively close proximity, become a known factor in the lives of the animals being studied.

Of interest was, of course, whether the researched magpie groups saw me as an individual with specific characteristics or merely as a human in a particularly colour outfit and wearing the same hat. In interactions with humans, it has thus become important for all animals in remaining wild spaces to guard against humans or at least learn to distinguish between dangerous and friendly human faces as has been shown in New Zealand's North Island robins, *Petroica longipes* [108] and magpies, *Pica pica* [109]. American crows, *Corvus brachyrhynchos*, have been shown to remember particularly those faces that they perceive as threatening and dangerous [110, 111].

Based on these research results, the family groups included in my study were therefore also subjected to assessments as to whether the magpies recognised me as an individual or merely as any human in specific clothes. To test this, human females of similar height and hair style were selected to wear my clothes and walk towards the study groups and then sit down in my observation chair. After 5 minutes the seated person simply got up and walked away. As a second part of the same experiment, I then appeared and walked towards the chair as per usual. There were immediate differences and changes in the birds' behaviour. In the first segment, the birds stopped foraging and flew to vantage points nearby when the look-alikes walked towards the chair, and then came down from their watching post and started foraging again once I moved towards the chair. Although the samples were repeated, there was not enough material to publish these observations and results, but they were certainly convincing

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enough in the field to accept that the birds had made a clear distinction between the stand-in observers and the researcher.

Testing means-ends test

The means-ends test is one of the standard tests used in studies of cognition in birds [112] but to replicate this in fieldwork was made more difficult because Australian magpies are ground-feeders. Sometimes it also does not help to try alternative ways but the attempt was made. A black steel cage (1.0 x 2.0 x 0.8 m) was placed on the ground and the food visibly displayed in the cross- stringed fashion. Not one bird expressed any startle responses or took a detour or showed any hesitation when passing the cage. It was clear from the way passing magpies turned their heads that they had seen the meat, one of their favourite foods. This was repeated in three different territories, the steel cage was placed in a prominent position within the area of their normal foraging paths, and not a single magpie showed the slightest interest in the cage or the food. They proceeded with their normal foraging activities, often walking straight past the cage.

However, after weeks of observation, a juvenile in one territory showed great interest in the food but seemed unable to pull it within reach. The adult female parent walked by, approached the cage and, in the briefest moment, without actually stopping, in one fast and goal directed movement, pulled the correct string, getting the food within reach of the juvenile. She then walked on without any further interest in the matter. Over several weeks, there were no repeats of this performance. Although this standard experiment has been used successfully in laboratories across the world [112-114], after three weeks of attempting to test the string-pulling task in this manner without success, the attempt to conduct the means-end test as a field experiment was discontinued. This is an example of incidental observations leading to discontinuing the experiment.

However, this one interaction between juvenile and adult was puzzling and a question of interpretation. It had already been shown that magpies can carefully distinguish between the nutritional value of different food items [115,116]. The brief

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incident also showed that, for the adult, the string-pulling task posed no difficulty at all to establish which string to pull to obtain the food. It was a non-event. Juveniles walk with a parent at the time of foraging and by watching, begin to able to identify what is edible or not and how to obtain the food, including extractive foraging [117]. Yet the interaction was unusual in the speed with which the action was carried out and the distinct lack of interest in following it. The experiment was never reported, and the event is indeed 'anecdotal'.

Social breaches: Behaviour suggesting rationality, (im)moral acts and considered decisions

It was said before, that engaging in this form of field work, being in the environment and amidst one's bird families, one inevitably also encounters incidental behaviours that tend not to be reported because they either do not have any repeats (or are rare or rarely observed) or they cannot be replicated easily or not at all. And of, course, the question is, in some cases, whether the observations seen should not also be made public because a single observation can have seminal character and perhaps should not be dismissed entirely.

Example 1

For instance, a singular observation suggested far more important qualities that were nevertheless difficult to explain: a group of Australian magpies, engaged in what perhaps could best be described as 'holding court' (court not as a regal but as a legal environment): magpies would be seen forming a semi-circle, standing on the ground. In front of the group, a single magpie stood facing the group arranged in a semi-circle. Then one individual would step in front, face the single magpie and deliver a sharp jab on its head. The so punished magpie did not move away but continued to stand in its position until each magpie in the group had delivered the jab. This was a highly controlled sequence of behaviour - there was no obvious indication of aggression, apart from the pecking behaviour. Every bird stood completely still, performed its one and only pecking role and then stepped back into its former position. There are two reports of this behaviour that I know of, and both were privately communicated. This

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behaviour does raise perplexing questions. If this bird has broken rules of social conduct and is being punished, why does the entire group participate in this and why in such a controlled manner?

Example 2

Example 2 mentioned here describes behavioural evidence of an extra-pair copulation across two magpie territories. Genetic tests had already revealed that Australian magpies, while they may pair-bond for years and sometimes even for life, are by no means faithful to their partners [118]. Since magpies are strictly territorial, a question arises how such infidelities might occur. In a field study on vocal behaviour in magpies, it became my habit to be out at sunrise (about 5 or 6 am with recording equipment and sound enhancing dishes) to record any early morning vocal behaviour. On several of such occasions over several breeding seasons starting in the cold winter month, a single young male magpie was observed to walk stealthily towards his family's territorial boundary, frequently looking back. If another magpie was spotted far away, the bird turned to pretend foraging while walking towards and eventually crossing the boundary meeting a female. The bird eventually returned some 20 minutes later, feign-foraging its way back from the edge to more central parts of the territory. This was not a singular observation.

The fact that magpies have extra-pair copulations, although at different rates in different regions, has already been shown [119] but this behaviour is rarely seen and, to my knowledge, has been described here for the first time. Having watched the behaviour of the 'offending male' one wonders whether there is more to this behaviour. The first stages of moral development, described in dogs, is called "resistance to temptation", and it is thought that the degree to which an animal "violates a taboo" after punishment may be related to the same variables that control shame and guilt in children [120]. Rats, as Hank Davis (1989) argued, are at a 'preconventional' level of morality, i.e., they show obedience for its own sake and avoid breaking rules backed by punishment [121]. Obviously, magpies go a little further and some break the rules. Rule-breaking juvenile magpies get disciplined regularly by parents or aunts or at least warned. As long as the juvenile immediately changes into a submissive posture (lying

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on its back), the youngster would get away with a warning and not get pecked. Parents tightly control their offspring. In order to carry out extra-pair mating, this male had to break two social rules: one to engage in copulation with an unpaired female from another group, another to avoid parenting, a sneaker male, that will not raise his offspring. When in pairs, this task is always shared. There have been attempts In the past to argue for the presence of causal reasoning in rats but in my reading of these arguments raised by Dwyer and Burgess (2011) [122] and Blaisdell et al. (2006) [123] this went nowhere not even when invoking Morgan's dictum, formulated in 1894 [124], and still a yard stick today: 'a complex cognitive account was only accepted once simpler accounts were considered and rejected'. And yet, in the debate on rats' ability to reason there has been no answer.

RESEARCH GEARED TO PROTECTION, TRANSLOCATION OR REINTRODUCTIONS OF ENDANGERED SPECIES

As said in the introduction, conservation is largely the field of ecology and largely based on fieldwork and, as a field, has made major contributions to bird studies. It is also well recognised that ecology grapples with its own demons and mismatches, at times referred to as 'wicked problems' which possess specific challenges to reconcile a mismatch between failures or ambivalent success and a tension between "best practice" and creativity [125]. But even 'best practice' may not always be informed by the latest scientific insights, may not always be ethical if it involves pain and suffering for the animal and does not always deal effectively with unexpected findings (surprises) if they do not fall into the canon of the expected outcomes [126]. 'Surprises' here suggest something very different from 'discovery'. Surprises are not the kind of findings that may fit into the conceptual framework of the researcher — 'discoveries', on the other hand, do. The difference between the two terms may simply lie in the bias that the researcher brings to the tasks and, that, of course, is a problem not specific to one discipline but pervasive across many disciplines.

Some of the failures of reintroductions/translocations that ethologists were able to predict happened because key behaviour was ignored. Lessons have been

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learned, of course, but sensible integrations of knowledge of species and even individual behaviour may often be considered superfluous.

There is an additional issue. Failures of some conservation efforts, at least of some current conservation field work, may lead to what psychologist Leon Festinger in the 1950s coined as an important concept of 'cognitive dissonance' [127] — the inability to reconcile two seemingly opposing views and sticking with the framework one has learned but uncomfortably so when ignoring other findings that do not fit into the framework. In 2016, the North American Society for Conservation Biology held a symposium with the title "Realizing Failure's Opportunity". It would have been valuable to establish whether any ethologists attended that symposium and how ecologists responded to ideas obviously counter to their current practice. In personal interactions, there have been ecologists who became extremely aggressive and angry and dismissed cognition and emotions as 'rubbish' and on the topic of conservation they asserted that academics dealing with cognitive ethology or compassionate conservation "didn't know what they were talking about", while others, in personal contact, felt bad about causing pain to animals but accepted it as long as they it was for 'the greater good". Ultimately, cognition and emotions in birds are of great importance and should be part of the lessons learned in many of the failures of conservation attempts [128]. The historical roots of ecology [129] and tensions between the two disciplines of ethology and ecology notwithstanding [130], its historical sources and differences are largely irrelevant in this paper but the data and what can be believed is not.

Hence, the treatment of birds in fieldwork and in captive breeding programs is of considerable interest in terms of research ethics. The latter has been reported in detail elsewhere [4]. However, here it is more a matter of whether the data, however large the data set might be, can be believed and advances our knowledge of a species.

There is a growing technology-driven type of fieldwork for conservational purposes, conducted by ecology field researchers. Because of methods used, research (ironically often in the name of conservation) is sometimes at risk of turning the very subjects to be protected (i.e., endangered species) into victims. Some of these gadget-

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driven field practices provide for large scale data sets and researchers can be assured to obtain them while waiting for downloads from satellite-provided data, sitting at the computer in an office, often without any further direct contact with the birds.

Such field practices, as will be explained further below, might urgently need updating and brought into line with our current understanding of animal welfare in cases when obvious, even if unintended, cruelty against birds (due to methods employed) can be shown [131]. This is so because some ecological field work consists of trapping and often fitting individual birds with GPS devices or similar technology attached to wings, the back or a leg, or even with invasive subcutaneous instruments [4].

The trend has been particularly evident over the last decades and is growing. The use of electronic devices, backpacks and general telemetry attached directly to the birds' bodies has increased dramatically and has become so standard that these methods are often not even mentioned or fully defended in papers, and there is often no follow-up on survival of the individuals wearing these devices [132]. The ease of use of such remote devices and the similarity of these to the latest mobile phones, have made this technology very attractive. Researchers must be made aware that such devices are the most questionable or at least the most harmful way of collecting data [131].

In a recent review of this practice, more than 34,000 recent papers were identified using such technology, with an increase of its use on birds by 4.4% annually [132]. Hence this is not a marginal issue and in particular, not marginal in terms of the data that arise from such practice.

Secondly, as another consequence of installing remote electronic devices directly on birds, research of birds in the natural world has become more and more anonymous. Researchers using devices then do not watch birds, they do not necessarily see them interact, they do not get to know the dynamics of the groups, cannot discover surprising new foraging techniques, acts of empathy or problem-solving and, importantly, they do not see the consequences of having attached the

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electronic trackers. After the technical jobs of tagging and whatever else is done, the bird is usually released, and no further information is obtained from that individual other than that transmitted by the attached instruments and gleaned on computers indoors and far away from the species and the individuals captured and tagged.

Of course, by using such a method (data being beamed back to the researcher's computer at regular interval), large data sets can be generated, and this is often highly encouraged because a large data set suggests validity or representativeness of results. A critique of this technology is often geared towards the problems with the equipment itself, not with the living organisms. Whether these concern GPS radiotelemetry error and bias in mountainous terrain [133], underestimating the frequency, strength and cost of antipredator responses with data from GPS collars [134], or simply the problems of inferring animal densities from such trackers [135]. Such debates are generally enjoyed and reveal the gadget-tinkering side of fieldwork.

But these practices hide heart-breaking stories. For instance, Dougill and colleagues (2000) reported on the consequences of antenna design in telemetry studies used on endangered Hawaiian honeycreepers, Palila (*Loxioides bailleui*) [136]. They had been radio-tagged with transmitters equipped with a long, limp, solder-tipped antennas that keep moving over the back and close to the top of the head with every movement of the bird.

The birds were found suspended in trees by their transmitter antenna on eight occasions and at least one bird died. This may not sound too dramatic but, bearing in mind that reintroductions into the wild of endangered species always happen in relatively small numbers and that the birds take a long time to raise in captivity and prepare for release, such methods and treatments of birds are lamentable. The authors recommended avoiding transmitters equipped with an antenna that can lead to entanglement and the birds literally hanging themselves. Yet, the Puerto Rican parrot (*Amazona vittata*), one of the most critically endangered birds worldwide, and named so in 1992 [137] was subjected to the very same equipment with a floppy antenna. The valuable individual birds had been hand-raised in suitable large cages, largely by local volunteers in the environment into which they would be released and when they had

https://doi.org/10.52732/ETPR9295

gone through all the proper pre-release stages (i.e., also identifying edible food etc.) the volunteers were then given this equipment by experts. More than likely this last act before release would see the birds off, not into freedom but into misery, pain and fear.

An even more anonymous form of research was conducted in the Bolivian Andes using endangered red-fronted macaws, *Ara rubrogenys* [138], a project ironically conducted by a Centre for Nature Conservation. The birds were caught in nylon traps, then immediately fitted with satellite transmitters and let go. The weight of transmitters of 22.5g conformed with ethics regulations of a maximum weight of 5% of body weight (these were between 3.4% and 4.5% of the body mass and thus legal. Translated: for an average 80kg human male this percentage presents a weight between 2.72.kg and 3.6kg — affixed to the body — permanently can also be difficult in humans. And this is not even considering flight, turbulence, drag and all the restrictive elements to flight that such a backpack may bring [4]. Very clearly the welfare rules should change and be changed urgently.

As was shown so clearly in the endangered New Zealand rail, called a tahake, *Porphyrio mantelli*, daily energy expenditure increased by 8.5% simply by carrying the radio tag. Because they tested the effects, they were able to make appropriate changes to their program [131].

In another study, also an endangered species, the blue-throated macaw (Ara glaucogularis) in Barba Azul Nature Reserve (Beni, Bolivia), three individuals were released, fitted with Geotrak collars (also satellite telemetry). The researchers received dispersal data for two birds, until battery depletion in November and December 2019. It does not say whether the collars were ever removed or automatically fell off. One bird with a collar was spotted 2 years later, a torturous burden to bear for the bird - yet the paper celebrated the project as a victory because it helped them uncover a distant nest site. The other two collar bearing birds were never found and one can, as in so many other cases, surmise, unless otherwise stated, that they died as a consequence of the fitted apparatus.

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A very useful study of golden eagles, *Aquila chrysaetos*, was conducted by McIntyre [140]. It concerned the dispersal patterns of these birds from inner Alaska to wintering ranges southwards. The important part of his methodology was that he used two different identification techniques for the same release project of over 300 golden eagles in a ten-year period and then compared the results of the two different identifications methods. One was the traditional leg banding, the other (48 eagles from the same group and origin) were given radio tags. The ones recovered with traditional banding, as far as recovered, lived long lives or, if they met their death, it was due to being shot by hunters or to electrocution. By contrast, the ones fitted with radio tags suffered a 30% death rate and those deaths, after autopsies had been conducted, were identified as having been due to starvation. There are further hints that telemetry was the cause of their deaths: firstly, the flight distance to their wintering quarters south fell substantially short (by hundreds of kilometres) of the group that had been traditionally banded. Getting to the right wintering quarters is of course important for food supplies. The question is why did so many eagles die on the way?

Aerial predators like golden eagles depend entirely on their aerial manoeuvrability and speed. The golden eagle is the fastest and most nimble raptor in North America, with top speeds reaching over 200km/h. There is plenty of evidence that telemetry affixed to the back creates turbulence and resistance and thus slows down flight. Catching prey or not is often a matter of seconds, even milli-seconds, thus precise timing is essential. And, of course, the more often hunting attempts are unsuccessful, the weaker they become and the lower the chances of a successful kill will be. We know that eagles deal well with atmospheric turbulence during soaring flight by folding in their wings [141] but in the turbulences created by backpacks, no wing folding is going to remove or counteract the source. Another clue in their study was that traditionally banded golden eagles stayed close to the road, the radio-tagged birds stayed away for at least 5 km. Roads with their occasional road-kills can become an important source of food but the proximity to humans would have been avoided if the birds were not confident of being able to take flight.

The serious concerns that have been raised throughout this section concern the data produced. As McIntyre demonstrated so well, methodology affects results, i.e.

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different marking and tracking tools produced very different outcomes [140] and the distortions happened right across all measures-flight distance, proximity to roads and death rates. If one had been presented only with data from the radio-tracked individuals, the data would have been thoroughly misleading.

Some scientists have now asked whether the data sets derived from telemetry may not lead to a) poor outcomes for the birds being studied and b) partly or entirely falsify the data, rendering them possibly useless or substantially flawed and distorted. Also, in most cases, we do not know under what individual negative circumstances (i.e., stress, pain, fear) the tagged birds had lived. Even those that stayed alive may have been forced to choose very different courses of action than had they been healthy.

When in pain or fearful, very different decisions are sometimes made than might have been, had the bird been relaxed and pain-free [142]. Stress caused by invasive techniques may be fuelled by fear or pain and alter behaviour as researchers well know [143].

The review by Geen and colleagues, mentioned before [132], drew attention to these confounding problems for two main reasons: to support more rigorous science and to improve or even just introduce rules for avian welfare in field work [132].

Establishing overall patterns of competencies, flexibilities, and cognitive ability is, of course, not always easy in field work but ethology has a long list of results that are discoveries of complex cognitive behaviour or problem-solving abilities. Some well-designed and controlled experiments can be carried out in the field as has been shown in vocal behaviour and anti-predator techniques. Some standard laboratory tests, as has also been shown, do not necessarily do well when attempting to apply them in the natural environment. However, some crucial discoveries, and they may be single events being observed, may show the innovativeness and problem-solving abilities of a particular group or species, or even other cognitive feats that may only be seen once. Sometimes, of course, they can be followed up by more examples of the same behaviour or even experiments. Surely, one can trust those results. Thinking of

https://doi.org/10.52732/ETPR9295

the discovery of mussel-eating white- winged choughs that was recorded in great detail in New South Wales [Hobbes, 10]. The 19 choughs he observed were not only all very successful in opening the mussels, which had to be dug from the mud at the banks of the river. They were not visible to the foraging birds (i.e., extractive foraging, a rare skill). The choughs thus needed to know where to find them, how to extract them and then how to access the food. They even cleaned off the mud and then hammered the shells with their beaks until they broke [10, 144]; or the discovery of New Caledonian crows manufacturing their own tools [145]. Feeding innovations have been the result of fieldwork, or the sophisticated ways of using vocal signals, be this to deceive [147], to warn [93, 100], or to invite others for a feast [147] , referential gestures [100] , are all discoveries of fieldwork. Later, such behaviours have been found to be associated with larger forebrain size [148].

In such significant cases, even though at times these might have been singular events, they are certainly not well-described as ‘anecdotal’ because they are significant observations.

CONCLUDING REMARKS

The days of relatively non-invasive ethological field research methods are dangerously close to going extinct and, at this time of species decline, this development is going in a direction opposite to that needed. We need intimate knowledge of bird behaviour as much as their macro-movements in their natural environment without prejudice and distorting factors. Stress is a problem that can have health and behaviour altering consequences and hence distort results, introduce biases in such a way that they mislead. The survival of species does not hang just on habitat and other macro-problems but ultimately depends also on individual behaviour, on choices and alternatives sought and taken, and on conspecifics and their communities, as well as external influences that we may not have considered. Some zoos now offer night parties, roads and streets are brightly lit at night and in every corner and part of the world, thereby we have invaded and damaged the environment of animals and created an ecology of fear. As part of conservation, we now seek out remnant populations in less disturbed areas and may ruin the last havens a species has, especially when we

https://doi.org/10.52732/ETPR9295

walk in with the assured sense of dominance to bend animals to our will. For research and science, we need to think how we can adequately record and test the degree of malleability and adaptability. To do this and confirm the existence and functionality of behaviour in the wild, and specific cognitive behaviours, that have been revealed and measured under rigorous laboratory conditions need to be confirmed to exist in the wild.

The choices birds make depend ultimately on the sum-total of experiences, the management of emotions and cognition [149]. Moreover, those who still believe that a bit of telemetry or other invasive procedures carried out in the field constitute brief encounters that do no harm, be this to the individual bird or to the data set, are incorrect. Humans are recognisably the apex predators and invaders and they have created fear with 'landscape-scale impacts from lions to mice' [150]. Worse still: human-induced fear can lead to natural top predators increasing their kill rate [151]. Invasive and aggressive interventions by humans can also lead to the collapse of entire niche structures and species co-existence [152]. The point is that the instigators of field research that may have brought about any such harm, even if only just going to nest sites and taking some eggs, then walk away [153]. The researchers do not see what behaviour follows. The data then collected reflect the post-manipulation phase of behaviour and it may not be at all what an individual, pair or group might have done without such intervention.

In summary, there is plenty of scientific evidence now that we have had a detrimental effect on birds and on wild animals in general and that the mega-data we get from technologically advanced equipment may not deliver what a healthy, fearless and free bird could tell us. Indeed, the problem of the 'ecology of fear' [143], a well-known concept, has been magnified by the exponential growth, even explosion, of human populations in just 100 years (a more than seven-fold increase). Recent papers have clearly shown that animals' fear of humans now far exceeds the fear they have of large carnivores [154,155], perhaps a shocking finding but one that should not surprise, given how much damage we have done to the environment and to wildlife. Ignoring this dimension in field research, especially in one's methods and approach to wildlife, is a luxury we can ill afforded in the Anthropocene. One barely needs to be

https://doi.org/10.52732/ETPR9295

reminded that the living world is a dynamic interaction between organisms and that humans have played and play a very significant, and an increasingly overwhelming role, in this mass extinction of life forms.

Researchers have pleaded for years to look more closely at methods in field research, arguing that sound science requires animal subjects to be physically, physiologically, and behaviourally unharmed [156] and that more compassionate wildlife research [157] should move from invasive to non-invasive methods [158].

The welfare aspects aside, covered in detail elsewhere [4], the emphasis in this paper has been on the quality and trustworthiness of data generated often under unknown and presumed stressful conditions of the subjects. Bernstein had formulated a powerful dictum for good research, condemned rare behaviour as anecdotes and said that “the plural of anecdote is not data” [159]. For fieldwork this can be a requirement that cannot be met because, ironically, going by this rule could wipe out any observations in the natural environment not part of an experiment. And that is a ridiculous restriction for fieldwork. Most of Jane Goodall’s observations and insights into chimpanzee behaviour would have had to be eliminated. In cognitive behaviour observed in the wild, there are many occasions when one observation of one particular behaviour or suite of behaviour, is all one will ever see in one’s research life and possibly in the bird’s/species’ life.

Some special observations can and should make one data point and each new one may eventually create an ethogram of an individual, a group or even of a species. While this can be a laborious process, rare behaviour does not necessarily equate to ‘anecdotal’, and use of gadgets as shortcuts, however technologically attractive, are not always the best way to do and produce good science. Equally, one might say that the mismatches between behavioural findings in the laboratory and in the field suggest that laboratory results may, at times, be contrived and invalid. For example, Alex, the African grey parrot was shown to be very adept at communicating with humans. Yet, in the wild researchers looked for years to find a single example of mimicry by that species [160, 161] recently observed Goffin cockatoos in the wild and found that they use no tools whatsoever, while in the laboratory tests they had conducted with captive

https://doi.org/10.52732/ETPR9295

Goffin cockatoos, the birds were particularly skilled in tool using [162]. Many bird species in the wild are neophobic while the same species are generally neophilic in laboratories [163], showing that captivity fosters behaviours that are either entirely new, may not always be necessary or useful, and can be dangerous, in the natural environment. Being burdened with backpacks may do the very opposite of what we need: we need good data, meaning trustworthy data not behaviour produced under duress and extreme stress. Rare behaviour observed and noted in fieldwork ought to be seen as a discovery and remain so if no follow up experiments can be logically devised for confirming the event.

Recently, an interesting article argued that perhaps we are not as rational as we wish we were and not all decisions and behaviours when we study other species are always rational. Yong et al. doubted that we were incorruptibly 'rational' but argued that we are the most 'rationalising' species [164]. However, even if one cannot solve the problem of what motivated an animal/a bird in some of its actions and behaviours, it seems that by quiet and non-assertive respectful human behaviour vis à vis the subjects of study and believing, even without irrefutable evidence, that they might be explicable reasons for their behaviour, good behavioural data can be secured that might otherwise not be discovered.

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