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Sustainable hunting and the conservation of the threatened houbara bustards

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Highlights

- Asian and African Houbara are both threatened by uncontrolled hunting
- The main conservation measure has been large-scale releases of captive-bred birds
- Repeated reinforcement threatens the integrity and viability of wild populations
- Implementing principles of sustainable hunting offers hope for both species
- To be meaningful, sustainable hunting needs clear and transparent criteria

Abstract

African houbara (*Chlamydotis undulata*) and Asian houbara (*C. macqueenii*), classified as Vulnerable on the IUCN Red List, have been over-exploited across their global ranges. The highest-profile conservation response has been large-scale releases of captive-bred birds, potentially threatening wild populations through introgression. Options for increasing numbers of the species are habitat management to counter overgrazing (in North Africa and the Middle East), mitigation of powerline collisions, predator control (ethically questionable and impractical), reduction of poaching and trapping, limited captive breeding, and hunting controls. Assuming hunting continues, the best model for conserving both species is a system of sustainable hunting that incorporates stakeholder observance, involvement of stakeholders and local communities in decisions and monitoring, protection of no-hunting areas, scientifically-determined quotas, small-scale use of captive-bred birds, and—if numbers still fail to respond, as a last resort—moratoria. These measures provide the only realistic guarantee for the long-term survival of Arab falconry, a part of humanity's intangible cultural heritage.

Keywords: captive-breeding, translocation, population reinforcement, supplementation, game management, sustainable hunting

Introduction

The two closely related species of houbara bustard occupy huge areas of semi-desert from Morocco to Egypt west of the Nile (African houbara *Chlamydotis undulata*) and from the Sinai Peninsula across Arabia and the Middle East to Central Asia as far as western China (Asian houbara *C. macqueenii*) (del Hoyo & Collar, 2014). The two species have for many centuries been the favoured avian quarry of Arab falconers (Bailey, Samour, & Bailey, 1998; Upton, 2010), contributing to the living human heritage of falconry in multiple Gulf states (UNESCO, 2016; see Fig. 1). For the past fifty years, however, falconers, assisted by many technological innovations, have been able to travel to hunt across almost every part of the range of the two species; Asian houbara is also hunted by indigenous communities across much of its wintering range and is also trapped in large numbers, mainly for the international live-trade for falcon training and put-and-take hunting in the Arabian Peninsula (Allinson, 2014; Combreau, Launay, & Lawrence, 2005; Goriup, 1997; Hasnain, 2017). The resulting decline in African houbara has not been documented quantitatively, although credible testimony to its over-exploitation has been collated (Azafzaf, Sande, Evans, Smart, & Collar, 2005; Goriup, 1997). In contrast, significant continuing declines in populations of the Asian houbara have been robustly established (Dolman, Collar, & Burnside, 2018; Riou, Judas, Lawrence, Pole, & Combreau, 2011; Tourenq, et al., 2005), with 60% of winter mortality of the central Uzbekistan breeding population attributable to hunting or trapping (Burnside, Collar, & Dolman, 2018). Both species are now listed as Vulnerable on the IUCN Red List (BirdLife International, 2020a, 2020b).

To date, the highest-profile conservation response has been the attempted reinforcement of exploited populations of both species through the release of captive-bred individuals on an ever-larger scale (Hardouin, Hingrat, Nevoux, Lacroix, & Robert, 2015; IFHC, 2017; Islam, Basheer, Shah, Subai, & Boug, 2012). However, captive breeding alters multiple traits in species and, when numbers of released captive-bred animals are disproportionately large, introgression can compromise wild biogeography, population structure and viability (Dolman, et al., 2018; Laikre, Schwartz, Waples, & Ryman, 2010; Willoughby & Christie, 2019). Wild populations of African houbara are now apparently heavily introgressed from captive-bred reinforcements across much of the remaining core range (Bacon, 2017; L. Bacon, Robert, & Hingrat, 2018). Disturbingly, demographic modelling from survival and reproductive data now suggests populations would decline even without hunting (Bacon, 2017), indicating the need for a complete moratorium and recovery period. Released captive-bred non-migratory and migratory Asian houbara have had low breeding success and low survival success, so

that the local reinforcement simply to stabilise regional migratory populations subject to current levels of offtake needs *annually* to be ≈1.5 times total wild numbers in the area defining the population (Azar, Chalah, Rautureau, Lawrence, & Hingrat, 2018; Azar, Rautureau, Lawrence, Calabuig, & Hingrat, 2016; Dolman, et al., 2018). Even so, there is no published evidence that strategies for the release of captive-bred birds have been determined by reference to the genetic, ecological, geographic and demographic characteristics of wild populations.

Large-scale releases of captive-bred houbaras therefore potentially represent a significant risk in two ways, first by endangering wild populations through introgression with less fit stock, and second—as breeding centres proliferate (with at least 16 currently active) and despite the evidence of potential or actual declines—by creating the impression that large-scale supplementation can protect wild populations from continuing unregulated exploitation, with little need for other interventions (IFHC, 2013, 2017). In red-legged partridge *Alectoris rufa*, for example, releases of farmed birds can increase rather than reduce pressure on wild populations, particularly if levels of offtake are based on released numbers or hunters' perceptions of overall abundance, rather than the impact on wild birds (Casas, Arroyo, Viñuela, Guzmán, & Mougeot, 2016; Díaz-Fernández, Viñuela, & Arroyo, 2012). In reality, any intervention that reduces the capacity of a species to survive is not a conservation measure but its opposite, and a major dependence on that intervention represents a serious management error. For Asian houbara, evidence from Uzbekistan shows that the only way to confine releases of captive-bred birds to a precautionarily acceptable level is to reduce flyway-scale winter mortality before there can be any harvestable surplus (Dolman, et al., 2018). Analysis of satellite telemetry data reveals a suite of dangers along the flyway, including in Iran, Afghanistan and Pakistan (Burnside, et al., 2018). For these reasons a new model for the management of houbara stocks, allowing for the interests of the houbaras, the communities on whose territories the species depend and the falconers who hunt them, is urgently needed.

Here we evaluate the various alternatives and initiatives that could form part of an effective long-term management strategy for maintaining houbara populations, and outline the elements necessary for the implementation of truly sustainable hunting.

Houbara management options

Management options available for the conservation of the houbara include: (1) preserving, and in some areas restoring, habitat integrity; (2) mitigating powerline effects; (3) improving productivity by predator control; (4) reducing and preferably eliminating poaching and trapping; (5) deploying captive-bred birds; and (6) controlling hunting by setting geographical and numerical limits.

Habitat management

The contribution of livestock to houbara habitat degradation has been indicated (Osborne, Launay, & Gliddon, 1997) but requires nuanced evaluation. Perceptions and reality of overgrazing are contentious and often distorted through historical colonialism, political control and initiatives focused on desertification (Gilbert, 2013; Squires, 2012), while pastoralist communities are often marginalised, with their social and ecological resilience disrupted by sedentarisation (Farvar, 2003; Gilbert, 2013; Oufkir, 2019). Livestock density may be high and increasing in parts of North Africa and the Middle East (Gamoun, Tarhouni, Belgacem, Hanchp, & Neffati, 2010; Louhaichi & Tastad, 2010). In post-Soviet Central Asia, while sedentarisation degrades habitat around wells or villages, the extent of livestock pastoralism has reduced substantially across southern Kazakhstan and Uzbekistan, but remains undiminished in Turkmenistan (Behnke, 2006; Koshkin, Collar, & Dolman, 2014). Unsurprisingly, therefore, evidence for houbara responses to livestock also varies regionally. In Morocco, African houbara may avoid the vicinity of sheep flocks (Le Cuziat, Lacroix, et al., 2005; Le Cuziat, Vidal, Roche, & Lacroix, 2005). In the north-western Negev, Israel, sedentary high-density livestock maintained through supplementary feeding and water are thought to decrease habitat suitability for Asian houbara and to disturb incubating females, reducing their nesting success (Lavee, 1988). However, for incubating female migratory Asian houbara exposed to spring sheep- and goat-grazing in Uzbekistan, extensive nest-camera footage shows that disturbance is ephemeral; and current levels of sheep density do not affect shrub vegetation structure, houbara nest success, or territorial male houbara distribution (Koshkin, Burnside, Collar, et al., 2016; Koshkin, Burnside, Packman, Collar, & Dolman, 2016; Koshkin, et al., 2014). While detailed study is needed of the effects of pastoralism on houbara habitat suitability and nest success across North Africa and the Middle East, a community-based payment for ecosystem service (PES) agreement (Ferraro, 2011) represents an important option in the quest to improve habitat quality, protect livelihoods and render ecosystems (and houbara populations) more resilient to climate change. A solution is all the more urgent, as climate change threatens to shift semi-deserts, which are houbara habitat, into deserts, which are not (Martin, Müller, Linstädter, & Frank, 2014; Schilling, Freier, Hertig, & Scheffran, 2012).

Powerline mitigation

Significant houbara mortality on powerlines has been recorded in the Canary Islands, Central Asia and Mongolia (Collar, et al., 2017). The problem is increasing everywhere, and failure to address it—mitigation measures for all bustard species are under review by J. P. Silva (*in litt.*)—risks compromising other investments in houbara management. All parties with a stake in the survival (or

revival) of healthy houbara populations should remain vigilant against the multiplication of powerlines across semi-desert areas and do everything possible to minimise the risks this infrastructure poses.

Predator control

Houbara reproductive rates are reduced by nest predators, chiefly foxes *Vulpes vulpes* and *V. corsac*, hedgehogs Erinaceidae and desert monitor *Varanus griseus* (Combreau, et al., 2002; Guilherme, Burnside, Collar, & Dolman, 2018; Koshkin, Burnside, Packman, et al., 2016), while chicks and juveniles also suffer predation by owls and raptors (Combreau, et al., 2002; Combreau & Smith, 1998). For ground-nesting bird species, appropriately targeted predator control can increase both breeding productivity and population size (Smith, Pullin, Stewart, & Sutherland, 2010), and some predator control is reportedly practised in hunting concessions in Morocco (Oufkir, 2019). Nevertheless, the sustained removal of predators at a spatial scale relevant to the two widely distributed, low-density houbaras poses significant ethical and practical problems (Van Heezik, Seddon, & Maloney, 1999) and may have unintended consequences, including increased abundance of rodents and thus of other generalist predators. In any case, predation is a key factor in the natural selection processes that are necessary to the health of houbara populations. For these and other reasons (see Dolman, et al., 2018) we reject predator control as a houbara management intervention, except possibly in rare circumstances where anthropogenic factors (e.g. garbage dumps: Lavee, 1988) produce unnaturally elevated local predator abundance.

Poaching and trapping reduction

Following the legal status of both species in most countries, the taking of birds by hunters inside their own national borders, most commonly using firearms and vehicles, possibly for subsistence but largely for sport, is classified as poaching (see Fig. 2). A further threat is the live-trapping of Asian houbaras for training falcons. Goriup (1997) repeated an authoritative eye-witness estimate that 4,000–7,000 birds were being traded annually from Pakistan for this purpose, while T. Bailey, et al. (2000) even suggested that 'this trade may have more impact on the status of the houbara bustard than direct hunting with falcons'. In Balochistan, trapping now also provides houbara released for visiting falconry parties from Gulf states (Baloch, 2021). Satellite telemetry data allow discrimination between natural mortality and anthropogenic causes, but rarely distinguish death due to falconry, hunting with firearms, or trapping (Burnside, et al., 2018; Combreau, Launay, & Lawrence, 2001); such data show that human-caused mortality remains widespread across all passage and wintering countries of Asian houbara (Burnside, et al., 2018). Currently, although Arab falconry parties have

only minimal activity in Afghanistan and Iran and may have reduced activity in Pakistan owing to security concerns, combined rates of anthropogenic mortality are undiminished (Burnside, et al., 2018) and similar across these three countries (RJB unpublished data), emphasising the contribution of local hunting and trapping to overall offtake (see Figs. 2 and 3). Such hunting is widespread, facilitated by the availability of firearms, including in Iran and Pakistan (Bailey, et al., 1998; Combreau, et al., 2001), and Uzbekistan where illegal hunting accounts for 23% of summer adult mortality (Burnside, et al., 2018). Photographs of hunting trophies posted online show that numbers shot can sometimes be considerable, but the magnitude and impact of this problem, and the relative role of local communities or city-based elites, are all unknown. Although smuggling to the Arabian Peninsula may previously have largely originated from Pakistan (Lampen, Bailey, & Combreau, 2005), recent reports from Iran indicate 7,000 or 11,000 traps seized in single enforcement events (Hamshahri Online, 2020; IRNA, 2016b), suggesting a substantial level of trapping there, potentially exacerbated by high unemployment and drought that have driven local people to explore alternative incomes (IRNA, 2016a).

The education of falconers, enforcement of CITES law (under which the international movement of birds without permits is prohibited) and use of captive-bred houbara as alternative training animals have long been identified as measures to curb the trade (Combreau, et al., 2005). Strong publicity and educational campaigns are still needed to counter and suppress the demand for live-trapped houbara, possibly through an agreed strategy such as the unadopted international action plan for the Asian houbara prepared under the auspices of the Convention on the Conservation of Migratory Species of Animals (CMS, 2005).

Resolving the threat of hunting will require engagement with national and local communities, who in some territories are excluded or otherwise disadvantaged by hunting concessions and enforcement strategies (Ata, Shahbaz, Watto, & Siddiqui, 2019; Hasnain, 2017; Khan, 2016; Oufkir, 2019; Paracha, 2016). Although falconry interests from Gulf states can provide local employment and income (Oufkir, 2019) and have invested in local welfare and major infrastructure projects, benefits to local communities can be mixed, for example with elite infrastructure remote from local settlements or hospitals lacking trained staff or key equipment (e.g. Baloch, 2021; Hasnain, 2017). More generally, the ecological success of conservation initiatives is strengthened by local participation, co-design, and shared benefits (Oldekop, Holmes, Harris, & Evans, 2016), while hunting revenues potentially offer a successful model for conservation through natural resource utilisation (Dickson, Hutton, & Adams, 2009). Within Central Asia, some examples of co-management of ibex (*Capra sibirica*) trophy hunting have increased populations, reduced over-exploitation and improved attitudes to wild ungulates (Ahmad, et al., 2020). Such community-based

initiatives within and around falconry concessions may offer a mechanism to reduce poaching and trapping, but would require careful planning and implementation and a scientific basis for quotas.

Captive breeding

Large-scale captive breeding and release of houbaras as a conservation measure is ultimately unsustainable and probably counterproductive. Despite decades of investment in houbara research, the genetic, immune, behavioural and physiological equivalence of captive-bred houbara to ancestral wild populations remains uninvestigated, despite the inevitable selection for genotypes in captivity that will be less fit in the wild following release (Dolman, et al., 2018; Frankham, 2008). Certainly a single concession or breeding centre cannot safely compensate for iterative mortality along the migratory route. Moreover, there is no evidence that captive-bred birds can substitute for hunted wild birds of breeding age. This is not, however, to deny a role for captive breeding in the management of houbara populations; but, to avoid flooding wild populations with unfit genetic material, that role needs robust circumscription.

Such circumscription involves a precautionary approach. For African houbara, further releases into the introgressed eastern Morocco population should be suspended, allowing for genetic recovery of the free-living population in the hope that this can restore its viability, and populations in other range states should not be supplemented by releases of captive-bred birds until it has been demonstrated that captive stock is genetically and phenotypically equivalent to wild birds, with similar fitness. For Asian houbara, no further releases of long-term captive stock from the Arabian Peninsula should proceed until the provenance and genetic management of this stock is demonstrated as appropriate and the genetic composition and fitness of captive populations shown to be equivalent to that of wild birds. Releases of captive-bred stock derived from local breeding populations must be limited in proportion to the size of recipient wild populations. Under CMS (2005), captive-bred releases were to be permitted to increase or supplement houbara numbers, so long as they (a) followed IUCN re-introduction guidelines, (b) were subject to CMS approval and (c) publicly reported their captive inventories and the numbers involved in the reinforcements.

Hunting controls

CMS (2005) called for a prohibition of hunting and trapping of Asian houbaras, but separately recognised the need for limited offtake, involving traditional local use and lawful sustainable falconry, informed by the best available knowledge of population dynamics. Hunting of the species is restricted by tradition and practicality to the period from October to March, when migratory birds

once occupied the Arabian Peninsula. Moreover, hunters acknowledge the imprudence of hunting quarry in the breeding season, and in any case the heat of summer is unconducive to falconry.

Laws prohibit the hunting of the two houbaras in many countries across their ranges, but economic and political leverage appears often to exempt visiting hunters from effective enforcement. In any case, visiting houbara falconry parties, some of which are led by national heads of state, their relatives and other high-ranking dignitaries, may not technically be in breach of the law, since host states appear frequently to issue them with dispensations (Hasnain, 2017; Oufkir, 2019).

Nevertheless, there are restrictions which most hunters from the Gulf observe, especially when these involve their compatriots. Hunting territories are generally acquired as long-term concessions in which accommodation and facilities are built to serve as bases for the hunt. The concessions may be very large—the map in Shah (2014) indicates that the Gulf states have exclusive houbara hunting rights over 61% of Pakistan's national territory—but their boundaries seem to be respected by other hunters. Such observance may not, however, be so stringent in relation to the quotas set by the authorities when the permits or dispensations are issued, as illustrated by an incident in Pakistan in which 2,100 birds were hunted over 21 days when the permit was for 100 over 10 days (Bhagwandas, 2014). Even so, the system of concessions provides the basis for a management model that could address the long-term needs of wild houbara populations, and honouring scientifically informed quotas is vital if hunters are to have an opportunity to continue their tradition into the future.

Declining species for which hunting is a major threat need refugia so that a proportion of the population is unaffected (and if necessary can recover), providing a source of animals to offset the losses incurred elsewhere (Bennett, et al., 2007; Duriez, Eraud, Barbraud, & Ferrand, 2005). No-hunting areas in eastern Morocco reduce mortality rates (Hardouin, et al., 2015), but do not provide genetic refugia fully insulated from releases; and in Asia hunting concessions appear to lack zonation (Hasnain, 2017). In North Africa, a system of effective refugia is needed to safeguard wild populations. For migratory Asian houbara the situation is complicated by the fact that concessions in many western and central parts of the Central Asian flyway host both breeding and migratory populations at the time of the autumn hunt (October–November). Nevertheless, the establishment of no-hunting areas for the Asian houbara was a central feature of the draft action plan (CMS, 2005), and was reportedly a declared ambition of the United Arab Emirates over ten years ago (Stone, 2008). With current unsustainable rates of hunting and trapping mortality, the demographic model developed for a migratory population of Asian houbara (Dolman, et al., 2018) shows that it would be necessary to reduce overall anthropogenic mortality (through falconry, other hunting, and trapping)

by at least 60% to have a 50% probability of stabilising the population, or to reduce it by 80% to have a high (95%) confidence of stabilising the population. This cannot be fully achieved solely by action taken within single falconry concessions; coordinated transnational action at flyway scale is required to reduce winter mortality to a level at which hunting, mitigated by precautionarily low levels of captive-bred reinforcements, becomes sustainable (Dolman, et al., 2018). Such refugia must comprise a fully researched network of staging and wintering areas so that survival increases sufficiently for migratory populations to be self-sustaining. The satellite-tracking of large numbers of houbara from this flyway (e.g. IFHC, 2017) represents a remarkable accumulation of data reflecting decades of fieldwork and multi-million dollar investment, and the use of this information to fully inform sustainable management is long overdue.

Sustainable hunting: the evidence-based solution

Given the risk to houbara populations posed by both large-scale captive breeding and large-scale offtake, the only practical solution is to adopt an adaptive harvest mechanism to achieve sustainable hunting. As a middle way between the extremes of unenforceable prohibition and unfettered exploitation, sustainable hunting offers a mechanism for preserving the deep tradition of Arab falconry while safeguarding the populations of the species on which that tradition depends. To be meaningful, sustainable hunting needs clear and transparent criteria. The conditions under which sustainable hunting can be achieved are:

(1) agreement and commitment by all stakeholders—hunters, host countries, managers of breeding centres and scientific collaborators—to honour the system adopted;
(2) allocation of concessions with due involvement of and clear benefit to local communities;
(3) designation of strictly observed and enforced no-hunting reserves covering no less than 50% of each hunting concession (as an initial precaution, but proportion then variable depending on outcome);
(4) for migratory Asian houbara, additional strictly protected reserves to extend protection to a substantial part of the flyway, including enforcement and control of hunting, poaching and trapping (for territories outside the direct influence of falconry stakeholders, international PES agreements, remotely monitored through satellite telemetry of migratory birds, may offer a mechanism);
(5) verifiable quotas in all hunting concessions, informed by independent long-term population monitoring;

(6) reinforcement of wild populations through captive breeding limited to *small* numbers of fully fit birds (predator-aware, disease-free, of verified wild genetic and phenotypic characteristics) at agreed times in circumscribed areas of the concession, chiefly as a 'put-and-take' strategy aimed at reducing and compensating for losses of wild birds without loss of genetic integrity;
(7) comprehensive research and monitoring programmes at the species population scale to build the evidence base for decision-making relating to hunting quotas and releases of captive-bred birds; and
(8) national and international moratoria on hunting, as a measure of last resort, if the science indicates that the measures above are failing to maintain numbers.

Conclusions

This concept of sustainable hunting represents a coherent, inclusive and fair response to a seemingly intractable situation. It substitutes science, collaboration and transparency for the current opaque regime of undocumented, unregulated hunting, which allows no means of measuring changes in populations or levels of offtake and is presiding over the numerical deterioration, and likely also the genetic erosion, of both species. If such an approach is not embraced, there is a risk that wild populations may be increasingly replaced by captive-bred analogues, similar to the situation for many farmed gamebird species in Europe and North America. For both species, levels of sustainable offtake may be lower than numbers hunted under current arrangements (which, however, yield too little information on either input or offtake to be of use in making dependable estimations). Inevitably, therefore, the concept represents a challenge to falconers who are accustomed to a high degree of freedom in their activity. This proposal obviously curtails such freedom, but only in order to safeguard the far greater freedom of having birds to hunt into the far future; and the falconers have already been pressed by calls for change in their hunting culture (e.g. Combreau, et al., 2005). The concept also represents a challenge to the breeding centres to concentrate their endeavours on producing much smaller numbers of much fitter birds. The substitution of quality for quantity of captive-bred birds would increase the equality of the contest between falcon and quarry, a cherished component of the houbara hunting experience (Upton, 2010). The adoption of sustainable hunting can unite falconers and conservationists in a way that will make it far easier than it is at present to address these other issues in sound ecological and equitable ways.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

Keith Scotland is employed by a houbara captive breeding organization; his first-hand experience has informed his critical views on captive breeding and large-scale supplementation of wild populations through release of captive bred birds. The views expressed in this paper are critical of scaling up such interventions and thus contrary to his own financial self interest.

No other authors have any known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Fig. 1 (reproduce in color in print). Both African and Asian houbara (pictured) are hunted by falconers using specially trained falcons, traditionally saker falcons (*Falco cherrug*), but more recently using captive-bred gyr (*F. rusticolus*), peregrine (*F. peregrinus*) and saker hybrids.

Fig. 2 (reproduce in color in print). Images widely circulated on social media illustrate hunting bags of Asian houbara shot on their wintering grounds. Photographs anonymous, believed to have been taken in Balochistan.

Fig. 3 (reproduce in color in print). Image widely circulated on social media showing live trapped Asian houbara, believed to have been taken in Pakistan.