

METHODS FOR LIVE TRAPPING HOUBARA BUSTARDS

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Abstract.—The ability to trap and mark individuals is important for the ecological study of wild populations of the Houbara Bustard (*Chlamydotis* spp.). Techniques for the live-capture of Houbara Bustards used on breeding birds or at high population densities may not be suitable for non-breeding birds at low density. We review eight trapping methods, six of which have been used with varying success on wild Houbara Bustards in northern and central Saudi Arabia, in the United Arab Emirates, and in Kazakhstan. Baited cages and nets were ineffective at low bustard densities. Lines of snares are worth using in areas where the movements of Houbara Bustards are predictable. Snares carry a low risk of causing injury or death and may be most effective at higher Houbara Bustard densities, for use on breeding bustards faithful to nest or display sites and which can be attracted to decoys, or for the recapture of radio-tagged birds. Cannon nets, clap nets, and net guns also require that Houbara Bustard location can be predicted or influenced, but carry greater risk of injury to the bird and therefore little advantage over the use of snares. The use of trained falcon may carry a high risk of injury to Houbara Bustards, but this is markedly reduced when the falcon is fitted with claw and beak covers, and where the terrain allows the falconer to move rapidly to the site of capture. Unrestrained falcons should not be used for the live capture of Houbara Bustards. The use of disarmed falcons is justified only where other capture methods are forbidden, or when recreational falconers can be persuaded to co-operate with researchers. Unfledged Houbara Bustard chicks are most easily caught by hand.

MÉTODOS PARA ATRAPAR VIVOS INDIVIDUOS DEL GÉNERO *CHLAMYDOTIS*

Sinopsis.—La habilidad de atrapar y marcar individuos es importante para el estudio ecológico de las poblaciones silvestres de *Chlamydotis* sp. Técnicas para la captura en vivo de estas aves usadas en aves reproduciéndose o en grandes densidades poblacionales pueden no ser apropiadas para aves no reproductivas en densidades bajas. Revisamos ocho métodos de atrapar, seis de los cuales se han utilizados con éxito variable en *Chlamydotis* sp. en el norte y centro de Arabia Saudita, en los Emiratos Arabes Unidos, y en Kazakhstan. Trampas con señuelo y nidos fueron inefectivas en densidades bajas de las aves. Se pueden utilizar líneas de lazos en áreas donde los movimientos de las aves es predecible. Los lazos tienen un riesgo

menor de causar daños o la muerte y pueden ser muy efectivos en lugares donde *Chlamydotis* sp. se encuentre en densidades altas, donde las aves reproductivas atiendan sus nidos o en lugares de alta visibilidad y donde pueden ser atraídos con señuelos, o para la recaptura con radio-sellos. Redes de cañón, redes de cierre mecánico y armas de redes también requieren que la localización de estas aves se puedan predecir o influenciar, pero presentan un mayor riesgo al ave y por lo tanto tienen pocas ventajas sobre el uso de lazos. El uso de halcones (*Falco* sp.) entrenados pueden tener un mayor riesgo de herir individuos de *Chlamydotis* sp., pero está marcadamente reducido cuando el ave (*Falco*) tiene cubiertas las garras y el pico, y donde el terreno permite que el cetrero se mueva al lugar de captura. Cetreros sin entrenar no debieran utilizarse para la captura en vivo de *Chlamydotis* sp. El uso de individuos de halcones (*Falco*) se justifica solo cuando los métodos de captura estén prohibidos, o cuando cetreros recreacionales se pueden persuadir a colaborar con los investigadores. Pichones no-volantes de *Chlamydotis* sp. son capturados más fácilmente a mano.

The Asiatic Houbara Bustard (*Chlamydotis [undulata] macqueenii*) is a strong-flying, but largely cursorial bird inhabiting flat and undulating plains in desert and semi-desert areas of the Middle East and Central Asia (Johnsguard 1981, Cramp and Simmons 1983). In some parts of the range resident and migrant Houbara Bustards will mix seasonally (e.g., Pakistan, northern Saudi Arabia, Syria, Jordan, Iraq and Oman); other areas hold only breeding (Commonwealth of Independent States) or migratory (United Arab Emirates, southern Saudi Arabia) populations. The number and range of Houbara Bustards has decreased in the last 30 years as a result of over-hunting, habitat loss, and human disturbance (Collar 1980). Despite regional restrictions on the use of falcons, hunting continues to be widespread in the Middle East and Pakistan, with falconers beginning to harvest the large Houbara Bustard populations in Central Asia.

The first meeting of the IUCN Species Survival Commission's Houbara Bustard Working Group, held in Muscat, Oman in January 1996, brought together representatives of conservation organizations from thirteen of the range states of the Asiatic Houbara Bustard (IUCN 1996). The creation of the working group was prompted by recognition of the threats facing Houbara Bustard populations throughout their range. Principal amongst these threats are habitat loss through agriculture, human disturbance, and unsustainable levels of hunting. The Muscat meeting identified a need for more information on the status of Houbara Bustard populations, the interrelationships between migratory and resident populations, and the relative impacts and causes of mortality (IUCN 1996). This information is required if any form of sustainable hunting program is to be established and regulated.

The key to the study of Houbara Bustard populations lies in the ability of researchers to devise effective means to trap and tag wild birds. This would allow field workers to mark individual animals and to fit them with radio or satellite tracking devices for monitoring behavior, migration, and population ecology. Trapping methods used at high population densities or on breeding Houbara Bustards may not be effective on non-breeding birds at low densities. Some of the more intrusive trapping methods may cause nest desertion, departure from trapping areas, or even injury.

With the expectation that the study of wild Houbara Bustards will become a focus of attention within many parts of the bird's range, we present here a critical review of methods for trapping Houbara Bustards. Methods are assessed on the basis of field trials conducted in Saudi Arabia, the United Arab Emirates, and in the Republic of Kazakhstan.

STUDY SITES

Saudi Arabia.—Harrat al-Harrah was declared a Special Natural Reserve in 1987. This resulted in the protection of over 12,000 km² of basalt lava fields and extinct volcanic cones in the far north of Saudi Arabia, centered on 31°00'N, 39°00'E. Harrat al-Harrah is home to possibly the last resident population of Houbara Bustards in Saudi Arabia, present all year round at very low densities (<0.04 birds/km²; Seddon and van Heezik 1996). Despite extensive searches, only 1–4 breeding attempts are confirmed in the reserve each year, usually at the late chick stage. The reserve is also an important refuge for wintering migrant Houbara Bustards. Vegetation is primarily concentrated in wadis and small drainage lines, and on the margins of silty depressions. The area is sparsely vegetated with *Haloxylon salicornicum*, *Astragalus* spp., *Artemisia* spp., *Achillea* spp., *Zilla spinosa*, *Capparis spinosa*, and a number of annual herbs and grasses. Trees are absent from much of the reserve.

Mahazat as-Sayd is a 2200-km² fenced reserve in western central Saudi Arabia (22°15'N, 41°50'E). The reserve was established in 1989 as the first reintroduction site for Houbara Bustards captively bred at the National Wildlife Research Center, Taif (Combreau et al. 1995, Seddon et al. 1995). All Houbara Bustards released into the reserve have been fitted with radio-transmitters and their location is monitored regularly. The reserve encompasses a portion of the Nadj Pediplain, with its characteristic plant associations of *Acacia* spp., *Stipagrostis* spp., *Panicum turgidum*, *Ochtholoba compressa*, *Lasiurus scindicus*, and a variety of perennial and ephemeral herbs. There are currently 30–50 Houbara Bustards permanently resident in the reserve (R. Maloney and J. Judas, pers. comm.). Breeding by reintroduced Houbara Bustard was confirmed in 1995 (Gélinaud et al. 1997).

United Arab Emirates.—The Baynunah area in the western part of the Abu Dhabi Emirate is an area of approximately 2000 km², consisting of gently undulating sand and gravel plain interspersed with flat salt pans (sabkhas) in the north and occasional mesas. The vegetation is sparse, comprising plant associations dominated by the perennial shrubs *Haloxylon salicornicum* and *Zygophyllum* spp. Other common perennial species include shrubs of the genus *Fagonia*, *Cornulaca monocantha*, the sedge *Cyperus conglomeratus*, and the grasses *Stipagrostis plumosa* and *Panicum turgidum*. In general, vegetation is distributed in patches, interspersed with open, flat plains. Baynunah holds only wintering populations of migrant Houbara Bustard.

Tau Kum Desert, Kazakhstan.—The Tau Kum desert lies in eastern Kazakhstan, south of lake Balkhasch (44°32'N, 74°51'E). The area is a flat

plain bordered by vegetated sand dunes up to 25-m high. Dominant plant species include shrubs of *Artemisia* and *Salsola*, and grass/herb associations of *Poa*, *Allium*, *Allissum*, *Vicia*, *Leotice*, *Ranunculus*, *Astragalus*, *Carex*, *Ceratocephalus*, and *Suaeda*. The Tau Kum desert contains what is believed to be one of the largest breeding populations of Houbara Bustard in the world. The bustards in this area are migratory, moving south and southwest in autumn to wintering grounds in Pakistan, Iraq, and the Arabian Peninsula, where they mix with resident populations. Trapping trials were conducted exclusively on breeding birds.

METHODS

Trapping techniques were divided into two categories. Passive methods (cage traps and snares) involved awaiting the arrival and capture of the birds with no effort beyond trap placement and baiting. Active methods (various nets, falconry, chasing) involved pursuit and or driving of birds into the trap.

Cage traps.—In Harrat al-Harrah between January and March 1993 five cage traps were deployed and were checked twice daily for 18 days. Cages were constructed of wire-mesh or plastic-coated wire mesh (0.6-m high \times 0.4-m wide \times 1.1-m long) with an open swing door at one end. Cages were placed in an extensive area of small wadis within which flocks of Houbara Bustard had been regularly observed feeding, or in vegetation along trails bearing the footprints of Houbara Bustards. The cages were baited with a combination of plants and beetles known to be Houbara Bustard food items. Houbara Bustards entering a cage would trigger the shutting of the cage door by depressing a central foot-plate; alternatively, cage closure may be triggered remotely.

Snares.—Snares consisted of 0.35–0.4-mm diameter, transparent or green-opaque nylon tied in 5–10-cm diameter loops with a slip knot. The nylon nooses were arranged singly, or attached every 8–10 cm along a 50–100-m long cord that was dug into the ground, and fastened securely at the ends to stakes or rocks. The nylon loops should sit upright. Single nooses were placed across Houbara Bustard tracks or display sites, in gaps within low artificial stone walls or vegetation barriers 15–20-cm high, placed around favored Houbara Bustard feeding sites, or around nest sites. Single nooses were also attached to decoys designed to attract Houbara Bustards, and in dense mats placed on the ground.

Intermittently between January 1994 and August 1995 the equivalent of a total of nearly 1000 m of snare lines, comprising over 10,000 individual nylon nooses, was set for a total of 17 days in the Harrat al-Harrah reserve. Trapping took place in six sessions, one during winter, two during mid-summer, and three in autumn. Between 50–200 m of snare lines were laid in fourteen sites and checked twice daily for 8–34 days. Trap sites included narrow wadis where successive lines of snares were placed across the entire wadi at 200–500-m intervals, on the vegetated margins of silty depressions, and around conspicuous patches of flowering annual vege-

tation. In all cases snare lines were located in areas where Houbara Bustard had been seen or flushed at the time of trapping.

In January and February 1994, trapping sites of 30 nooses were set for two nights on two occasions in the Mahazat as-Sayd reserve in an area of cultivated alfalfa known to be visited regularly by radio-tagged birds.

During April and May 1995, snares were used in Kazakhstan to catch breeding birds at display sites or with a chick. Single snare lines 0.5–10-m long were placed across recent tracks indicating male display sites on three occasions, and snare lines were set at male display sites on six occasions around a stuffed Houbara Bustard decoy, and on seven occasions when the snares were attached directly to the decoy.

Clap nets.—Clap nets consisted of nylon mesh within two semicircular or rectangular metal frames. The frames were set flat on the ground and were designed to “clap” and be held together by a spring when their release mechanism was triggered, usually by remote control.

In Kazakhstan a remote-controlled clap net (1.5-m wide and 2.5-m long on each side) was used to catch male bustards at display sites. Once a male was selected, a hide was erected within 200 m of the display site. The hide was left unmanned for one day. On the second day the clap net was placed on the display ground and left until the following day. If the male returned and displayed close to the clap net a capture attempt was scheduled for the following day. If the male did not return, the capture attempt was postponed or cancelled. For actual capture, a decoy Houbara Bustard was placed close to the clap net to attract the displaying male. The trap was sprung when the male was on top of the net.

Static nets.—Nets of fine green-dyed cotton or nylon mesh 1–1.5-m high and 50–100-m long were set up across wadis or perpendicular to bustard tracks, with the leading edge raised by fine cane poles and one edge trailing. In some cases nets were combined into barriers several kilometers long and arranged in a broad v-shape with capture net or box at its center. In theory, Houbara Bustards are herded slowly towards the nets by the trappers. When the Houbara Bustards are close to the nets, they are pushed harder, and in trying to evade the trappers, will become entangled in the net or caught within the box.

A total of 300 m of nets was erected in Harrat al-Harrah for a total of 7 days during January 1994.

Trained falcon.—For hundreds of years falcons have been trained in the Middle East to catch Houbara Bustards (Remple and Gross 1993). Traditionally, Peregrine Falcons (*Falco peregrinus*) and Sakers (*Falco cherrug*) are caught during migration and trained to fly to a lure in preparation for the hunting season. A well-trained falcon is an efficient killer of Houbara Bustards, and although a significant proportion of bustards manage to escape, those that are brought down by a falcon are almost always killed before the falcon is collected by its handler. By rendering the talons and beak of the falcon relatively harmless it is still possible for the birds to pursue and bring down live Houbara Bustards, and to restrain the bustard until the handler arrives.

In February 1992 attempts were made to catch Houbara Bustards in Harrat al-Harrah using a Saker with bound talons. The falcon was flown at lone bustards on five occasions during two days of hunting.

Between October 1994 and April 1997 attempts were made in the United Arab Emirates to catch Houbara Bustards with Saker or Peregrine Falcons. In all cases plastic beads were placed on the points of each of the falcons' claws. On two occasions in April 1996 and during all attempts in 1997 the falcon (a Saker) was wearing a modified hood when flying. The hood allowed the bird to see, but prevented the use of its beak.

Hand capture.—Birds were pursued by car or on foot and restrained by hand or hand-held nets. In 1997 attempts were made to capture by hand unfledged or recently fledged Houbara Bustard chicks within the Mahazat as-Sayd protected area.

RESULTS AND DISCUSSION

Cage traps.—No Houbara Bustards were caught and no bustards were observed near the cage trap site in Harrat al-Harrah. Attempts during a previous study using seven cage traps in Harrat al-Harrah over a 3-wk period in November 1990 were similarly unsuccessful (Goriup et al. 1992).

Modified fox cages measuring $37.5 \times 37.5 \times 105$ cm have been used with limited success to catch Houbara Bustards aggregating at cultivated plots in summer in Israel (Lavee 1985). Some experimentation with cage size and construction was undertaken during trapping trials in Sind. However, the use of bare wire mesh resulted in injury to the single Houbara Bustard captured when the bird repeatedly thrust its head between the mesh, abrading neck, back and crown (Taylor 1985). Plastic coating of the mesh was suggested as a means to eliminate this problem. The success of cage traps will depend on the willingness of a Houbara Bustard to enter the trap in search of bait. Effective baiting will be a problem in most Houbara Bustard areas where natural foods are relatively abundant. Although cheap and simple, the likelihood of success outside areas with very high densities is limited by the small area covered by the traps.

Snares.—A single young male Houbara Bustard was caught in Harrat al-Harrah in July 1994 at a trapping site on a margin of a silty depression. Observations of seasonal changes in Houbara Bustard numbers and distribution in Harrat al-Harrah indicated a mid-summer peak in numbers (Seddon and van Heezik 1996), when the bustards appeared to concentrate around the margins of the dry lakes, where they fed on fruits and seeds of the summer-flowering *Capparis spinosa*. The overall success rate of snares in Harrat al-Harrah was very low: 1 capture/170,000 noose-days.

The placement of snares in Mahazat as-Sayd resulted in the capture of a single Houbara Bustard, enabling researchers to check its radio-transmitter and harness attachment. Success rate in Mahazat as-Sayd, where knowledge of the location and movements of radio-tagged birds greatly facilitated effective snare placement, was 1 capture/120 noose-days.

Snare line placement across male display tracks on three occasions in

Kazakhstan resulted in the capture of a male each time, whereas the use of snares in association with a decoy on 13 occasions resulted in the capture of four displaying males. All birds were radio-tagged and remained in the vicinity of their display sites. Four males were seen displaying in the days following capture. A single attempt to catch a female was successful when a ring of snares was placed around her unfledged chick, which had been caught by hand and gently tied by one leg to a nearby bush. The female was also radio-tagged and observed for two consecutive days with her chick. In no cases were Houbara Bustards damaged by the snares, and captures were made 1.2–7.5 h after trap placement. The overall success rate of snares in trapping breeding bustards in Kazakhstan was approximately 1 capture/100 nooses set.

Lines of snares appear to be the undocumented method of choice for the live capture of Houbara Bustards for falconry in Pakistan. Little Bustards (*Tetrax tetrax*) in Russia, and Arabian (*Ardeotis arabs*) and Denham's (*Neotis denhami*) bustards in Sudan are also caught using a modified snare technique (Schulz 1990). Snares are inexpensive to produce, and can be made or modified in the field as necessary. There appears to be little risk of damage to the Houbara Bustard providing the trap sites are checked regularly, at least once or twice a day, or monitored more frequently if the behavior of the bustards is predictable, to ensure trapped Houbara Bustards do not fall prey to raptors or foxes. Stakes securing snare lines should not protrude above the surface of the ground to avoid the risk of trapped birds becoming entangled around the stake and damaging limbs. Houbara Bustards caught by the leg in a noose seem not always to attempt to escape, but will often sit quietly, at least until approached. The principal limitation of snares is the amount of area able to be covered. Given the large distances over which Houbara Bustards may range, success with snares requires that the bustards targeted move predictably through the trapping area. At low densities and with a very mobile population the technique may be labor intensive and yield limited success. Snares are probably of greatest efficiency when trapping breeding Houbara Bustards whose movements may be localized precisely to a nest, display site or to young, or where the bustards are using localized feeding areas such as cultivated fields.

Clap nets.—Three sites were established in Kazakhstan; at two of these the male did not return to the display site but moved between 50–200 m away. At a third site a displaying male was caught without injury. The captured male was subsequently observed displaying at the same location within one day of capture. Clap net success rate was therefore 1 capture/3 net placements.

The method is only of use when the precise location of a Houbara Bustard can be predicted or influenced, and is therefore most applicable with breeding birds. There is a danger that the bird will be injured by the closing of the net (Taylor 1985), clap nets for Houbara Bustard should therefore be large enough to minimize the risk of injury to the bird when

the two halves spring shut. This method is fairly labor intensive, requiring constant monitoring to operate remotely, and covers only a small area.

Static nets.—No Houbara Bustards were seen in the vicinity of the nets in Harrat al-Harrah. Windy conditions and the presence of camels walking through the trapping areas forced the termination of this trial. No Houbara Bustards were caught and it was felt that this method was inappropriate for the low bustard densities in the reserve. Nets were not deployed in any of the other study sites.

The use of nets is a cheap but labor-intensive trapping method, the success of which depends on having relatively high densities of bustards within a limited area. Windy conditions, dense vegetation, and uneven ground may hamper net placement. In addition, the trapping site needs to be free of livestock and humans. Nets need to be monitored and bustards actively driven into the trap site. In Sind, the use of nets was unsuccessful when the Houbara Bustards reacted to a conspicuous net and flew instead of walked when attempts were made to drive them into the trap site (Taylor 1985). Capture of non-target species may be a problem. Because of either unsuitability of conditions, or the suitability of other trapping methods, the use of nets was not tested extensively in this study and they may be worth trying in undisturbed areas with relatively high Houbara Bustard densities.

Trained falcon.—Two Houbara Bustards were caught by falcon in Harrat al-Harrah, but both birds were killed within the approximately 3 min it took the handler to get to the capture site in rocky terrain. The trial was terminated after the second death, and further trials using falcons were prohibited within the reserve. An earlier attempt using a falcon with bound talons was made in Harrat al-Harrah in November 1989 (Goriup *et al.* 1992), during which two adult male bustards were caught alive. However, one of these birds was apparently injured by the falcon and was killed by a fox soon after release. Three Houbara Bustards were killed by the falcon during these attempts (A. al Murri, pers. comm.). The overall Houbara Bustard mortality rate was therefore 86% when using a falcon with an uncovered beak.

Ten Houbara Bustards were caught in UAE in 1996: eight when only the falcon's claws were disarmed, and two when the falcon was fitted with a hood. Three Houbara Bustards were killed during capture by the unhooded bird (38% mortality). Three birds were held in captivity 1–21 d after capture before being released. Of seven Houbara Bustard released, one was found dead two days after release, and two migrated out of the United Arab Emirates. One of these birds was tracked to Turkmenistan (Osborne *et al.* 1997). Eight Houbara Bustards were caught in 1997; one bird was killed but the others were apparently unharmed (13% mortality). Satellite tags were fitted to five of the unharmed birds and all undertook annual migration, moving up to 7000 km within two months of capture (F. Launay, unpubl. data).

An experienced falconer using a well-trained falcon with adequately covered talons and beak has a good chance of successfully capturing Hou-

bara Bustards. Without use of beak and claw covers however, this method carried an unacceptably high risk of causing fatal injury to the Houbara Bustard (38–86%) and should not be used as a capture method under any circumstances. With the falcon's talons and beak covered the Houbara Bustard mortality rate can be reduced to 13%, with death related to the impact of the falcon strike or the fall to the ground, restraint on the ground, and the stress of pursuit and capture. It is essential that the handler is able to move quickly to the capture site to recover the falcon. Local regulations may forbid the use of falcons to catch bustards within reserves or no-hunting areas, or outside legally prescribed hunting seasons. In contrast, in some countries, (e.g., Abu Dhabi), capture of Houbara Bustards for any purpose is permitted *only* by falcon. There, and in other areas live birds may be obtained if legally operating falconers can be persuaded to use disarmed falcons. In such cases mortality rates can be lowered from 100% to approx. 13%, reducing the impact of legal falconry, and providing Houbara Bustards for radio-telemetry studies.

Capture by hand.—In early summer 1995 in Mahazat as-Sayd a total of three unfledged chicks less than approximately 3 wk old were tracked on the ground and located when they sought cover beneath low vegetation and remained prone and still when approached. Chicks were not restrained on these occasions, but could have been easily caught by hand. In 1997 attempts to catch free-ranging chicks in Mahazat as-Sayd were successful and four chicks were fitted with radio-transmitters (R. Maloney, unpubl. data.)

In Kazakhstan an adult female Houbara Bustard was caught by a snare after its chick had been caught by hand and tethered to a bush.

Powerful flight and long flush distances make the running down of adult Houbara Bustards impractical under usual conditions. Strong winds or very wet or cold weather may allow close approach. The use of spotlights at night could warrant further trials; there is a record from Pakistan of a single adult Houbara Bustard being caught by hand after being dazzled by car lights (Surahio in Taylor 1985). However, running down is generally practical only for the capture of unfledged or recently fledged Houbara Bustard chicks, where it is the simplest method and the least likely to cause injury to the bird. Fledging of Houbara Bustards takes place at around four weeks of age, though chicks 3–4 wk old may be capable of short flights and are more likely to run than freeze when approached.

Other methods.—Cannon nets use gun-powder or compressed air to fire 100–900 m² of net over birds entering a trap site. Sites are either regularly used feeding areas or areas into which birds may be attracted by bait or decoy. The firing of the net is triggered by an operator within several hundred meters of the trap site. Cannon nets were not used during this study, although previous attempts have been made in Harrat al-Harrah during November 1990 to attract Houbara Bustards to automatically irrigated plots of alfalfa over which a net could be fired by pneumatic cannon (Goriup et al. 1992). There were some difficulties maintaining

the alfalfa plot in the harsh desert conditions and bustards did not enter the trap site at times when the net was manned by a hidden observer.

Cannon nets are one of the more expensive and intensive methods of Houbara Bustard capture, particularly when a great deal of effort is required to establish a baited plot. A cannon net was used to catch 43 Little Bustards (*Otis tarda*) in a single firing over a baited plot in La Mancha, Spain (Muerza 1985), though similar congregations of Houbara Bustard seldom, if ever, occur. As with the other limited-area methods, cannon nets require the target birds to be within a fairly confined area. There is a danger of injury to birds caused by the firing of the 2–3-kg net-weights, or by the cannon itself. Misfiring and premature firing may easily negate efforts. This method may be most appropriate with high densities of birds, or where the movements and location of Houbara Bustards can be predicted or influenced, though under such circumstances there may be little advantage in using cannon nets over snares or clap nets.

A hand-held or tripod mounted net gun can also be fired over birds from a blind, or during approach or pursuit from a driven vehicle. This technique was not tried in this study. Hand-held net guns were used successfully for trapping Australian Bustards *Ardeotis australis* (Schulz 1990). Active pursuit requires even terrain and carries the risk of injury to the bird. The long flush distances of Houbara Bustards in many parts of their range would preclude any approach close enough to make hand-held net guns worthwhile. The tendency for female Houbara Bustards to remain prone on an active nest when approached closely by vehicle makes the use of a net gun a potential and rapid method for female capture. There is however, risk of damage to eggs in the nest, and of nest desertion. Net guns could be used in conjunction with spotlighting at night, though available evidence suggests that Asiatic Houbara Bustards do not invariably freeze when caught in a spotlight beam (O. Combreau, unpubl. data).

SUMMARY AND RECOMMENDATIONS

Six techniques were used to try to capture wild Houbara Bustards in northern and central Saudi Arabia, in the United Arab Emirates, and in Kazakhstan. The ease of use and the recommended applications of each are presented in Table 1.

Lines of snares, or snares used in conjunction with decoys in the form of a stuffed Houbara Bustard may be used with good results at male display sites, for females on nests, or for non-breeding birds frequenting localised feeding areas. Acceptable yields and low risk of injury or death make snares the method of choice.

The use of noose lines in reintroduction sites such as Mahazat as-Sayd may be an effective means of recapturing released Houbara Bustards unharmed, for health checks or to replace failing transmitters. The ability to radio-track the Mahazat as-Sayd bustards greatly increased the likelihood of capture.

The use of baited cages, clap nets, cannon nets, static nets, and noose

TABLE 1. Summary of methods for live-trapping *Houbara Bustards*.

Technique	Risk/cost ^a				Applications ^b					
	Risk of injury to bird	Risk of changing behaviour	Effort	Expense	Low density	Non-breeding	Displaying males	Nesting females	Female with chick	Unfledged chick
Passive										
Cage traps	2	1	1	1						
Snare lines with a decoy	1	1	1	1	*	*	*	*	x	x
Active										
Clap nets	2	1	2	2	x	x	x	x		
Cannon nets	2	2	3	3	x	x				
Static nets	1	1	2	1	x	x				
Hand-held net/gun	2	1	2	2				x		x
Trained falcon ^c	3	2	3	3	x	x				
Capture by hand	1	1	2	1						*

^a Risk/Cost: 1 = low; 2 = moderate; 3 = high. Risks include desertion of feeding areas or nest sites, and cessation of display.

^b Applications: blank = not suitable; x = suitable; * = recommended.

^c The use of trained falcon is only acceptable if the falcon is disarmed with beak and claw covers, and should only be used where other methods are forbidden, or where legal falconers can be persuaded to reduce houbara deaths through use of a suitably disarmed falcon.

lines may be labor-intensive and unproductive where there are low Houbara Bustard densities and an inability of trappers to predict or influence where bustards will choose to feed. Widespread availability of suitable Houbara Bustard feeding habitat may hinder efforts to attract birds to baited trap sites. At low densities the best approach may be to concentrate efforts on resident birds and attempt to locate display and nest sites where the location of birds can be predicted in advance of trap placement. In use at baited or decoy sites hand held net-guns have no clear advantage over the use of remotely fired cannon, clap nets or snares.

The use of a trained falcon with appropriately covered or padded talons and beak may be effective in the capture of Houbara Bustards from mobile populations at varying density, particularly in areas where local regulations forbid the use of other methods. Capture by disarmed falcon however, carries a significant risk (13%) of causing fatal injury to the Houbara Bustard. This risk may be minimized by choosing areas where the terrain allows falcon handlers to move quickly to the site of a downed Houbara Bustard. Additional indirect risks may include desertion of feeding areas or nest sites, or cessation of display by Houbara Bustard which have been pursued but not necessarily caught by the falcon. Reduction of these risks is possible through use of falcon only on wintering populations, and is only justified if recreational falconers can be persuaded to use disarmed falcons, thereby reducing the impact of falconry on local populations. Unrestrained falcons or falcons with only talons bound are efficient killers of Houbara Bustards and should never be used to try and capture live birds.

Capture of unfledged chicks is most safely and easily accomplished by hand.

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