27.0 Techniques for Live Capture and Radio-telemetry of Galliformes

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Introduction

Live captures of animals are required for a wide range of purposes in wildlife research and conservation. Most commonly, individuals are captured for application of telemetry to quantify habitat use, survival, migration and behaviour (White and Garrott 1990; Aebischer *et al.* 1993; Powell *et al.* 2000; Javed *et al*. 2003; Cooke *et al*. 2004; Kalsi and Rana 2004; Rana and Kalsi 2004; Kalsi 2005), and for population estimation using capture-recapture framework and other methods (Otis *et a*l. 1978; Nichols 1992; Buckland *et al*. 2006). Capture is also necessary for conservation breeding projects, transporting animals between captive breeding centers, zoos and for release or reintroduction into the wild habitats. Typically, live capture is an arduous undertaking and more so in the wild, especially of rare animals and that are elusive and shy. It is critical that the capture induces only negligible risk to physical and psychological states of the animals. Besides ethical and legal consequences, any mortality or negative impact on the animal would only make the capture redundant or weaken the utility for which it was captured (Calvo and Furness 1992). Therefore, successful capture essentially relates to meticulous design, effective trap and professional execution which include appropriate handling protocol. Simultaneously, a basic understanding on the distribution, movement and physiology of target individuals would likely enhance the trapping opportunities and success. Through innovations and experimentations, there are now several trapping techniques available for different groups of birds and for specific conditions (Bub 1991). Indigenous methods used by forest dwelling people have also contributed to the design and development of some of these techniques.

Use of telemetry doubtless scripted a revolutionary step in wildlife research, for its ability to gather finer details of almost every aspect of a species, overcoming methodological constraints faced earlier. Human-wildlife conflict could be better understood and suggestions towards scientific management received greater credibility and acceptance. Disease related investigations involve telemetry, as there is a need for comparative knowledge of movement and activity of infested and healthy animals (Houseknecht 1970). Telemetry is often the only way of collecting quality data on evasive species and those are difficult to be monitored by visual encounter or through conspicuous tags or visible markers (Kenward 2001). It is also remarkable in saving human life particularly of dementia patients, helping memory impaired people to track their way through (McShane *et al*. 1998) and in preventing vehicular accidents and unlawful activities. However, application of telemetry in wildlife studies is not without limitations and most often, the decision to use this tool is driven by (a) the real necessity after considering other options, (b) affordability of finance, people and time, (c) ability to capture required number of target individuals, and (d) more importantly, the efficiency of tagging and subsequent monitoring (Kenward 2001). Since inception in late 1950s, ecological investigations using telemetry are numerous, but several are limited by low sample size (*i.e.* inadequate tagged individuals), equipment failures and negative effect on the tagged individuals.

Like many species, understanding the life history and management of Galliformes demand specific information related to population distribution, demography, behaviour and genetics. Aside from opportunistic records, knowledge of successful hunters and captive breeders, much of the details on this group of birds are obtained from systematic visual observations and indirect signs such as vocalization, feathers, foraging signs, feces etc. Noninvasive tools such as DNA extraction from feces and feathers (Kohn and Wayne 1997; Taberlet and Luikart 1999) and automated remote cameras (King *et al*. 2001; Rollins and Carroll 2001; O'Brien *et al*. 2003; Winarni *et al.* 2005) have provided additional opportunities to study these birds. However, because of their ground dwelling habits with preference for dense undergrowth and secretiveness, obtaining reliable data on Galliformes proved challenging and significantly large number of studies lack adequate observations or details. Collecting some crucial data on social interactions, movement and demography is almost impossible without monitoring marked individuals. The obvious use of telemetry in

Galliformes studies have been underscored in earlier literatures (Hill and Robertson 1987; Conroy and Carroll 2001). In this paper, we aim to provide only an overview of the capture and telemetry methods relevant for Galliformes and for details; we recommend White and Garrott (1990), Bub (1991), Boitani and Fuller (2000), and Kenward (2001). We also present case studies of Galliformes involving trapping and radio-telemetry in India, and discuss certain general and specific issues envisioning useful insight for future projects.

Trapping Methods

Trapping animal was arguably one of the earliest human activity using specific tools. Of the several techniques adapted over generations of game hunters and Galliformes biologists, successful ones are continued to be exploited, along with increasing sophistications in materials and methods. The number of trap methods that were found efficient for some or other species is exhaustive, but most of these are broadly of (1) Cage or Box traps, (2) Funnel traps, (3) Nets, (4) Nooses, and (5) Spot lighting (see, Bub 1991). Birds are caught in these traps either by automated function that works upon the physical contact of the birds, or by manually driving the birds into the traps and also by way of physical capture. Decoy birds and bait of food items (e.g. grains) are often used to attract the target birds into traps. Though decoy is readily effective especially for Partridges and Francolins, trapping success using bait largely depends on the response of birds. Therefore, in several cases, baiting for some period prior to setting traps proved to lure the birds to baited locations, thereby, increasing the chances of trap success. It is not always possible to allocate time for pre-baiting or to locate right locations, but there are ecologically relevant sites that offer opportunities for trapping. Galliformes tend to use fixed waterholes and roost sites, follow specific routes for foraging and regularly choose certain areas for nesting. These places could be easily identified by the frequency of their sightings and by their characteristic territorial, courtship and pre-roosting calls. Play-back of recorded calls (e.g. breeding and territorial calls) would also attract the birds to traps. It is apparent that live trapping is a specialized and skillful activity, and that thorough field knowledge about the species and their space use are prerequisites for achieving desired success.

Cage or box traps are efficient for small sized birds (e.g. Quails and Partridges), but return only fewer catches per trap effort. Such traps are generally with automated trigger system that closes the door after the bird entered the trap, and are used with or without decoy or appropriate baits. In funnel types, the traps are designed to have much wider entrance and both sides (walls) become narrower towards the other end in a funnel shape. Width of the dead-end depends on the size class of target species and desired number, and the birds are trapped at the end by snares or nets designed for specific conditions. The trap is placed such that birds walk into the trap on its own, or driven to the trap or lured by baits and decoy birds. Funnel trap is among the most efficient methods of trapping a variety of species regardless of body size, and is particularly useful for most of the Galliformes species. Among the net types, mist netting is commonly used to capture passerine birds, but fall or drop nets are better suited for larger birds such as Galliformes. Camouflaged nets are placed in a strategic location with ground support (e.g. pole) which is connected by a long rope held by the trapper and once the birds reach below the net, the trapper pulls the string forcing the net to fall on the birds. There are also automated drop nets, wherein the poles are pulled down automatically when the birds make physical contact with the nets. In this case, the surface can have a hidden pressure pad connected to a trip wire or poles. Alternately, a portion of the net is spread on the ground, leaving the rest half to be positioned in an angle supported by poles. When the bird steps on the ground net, the poles are triggered, making the rest of the net to fall down on the birds. Capturing birds by snares made up of series of nooses are among the oldest trapping practices. This type of noose traps are known to yield remarkable trapping success, but potentially cause mild to fatal injuries to the trapped birds. However, a modified version of the snare allowing for trapped bird to reduce the associated risk is found to be efficient for trapping Galliformes species. Also termed

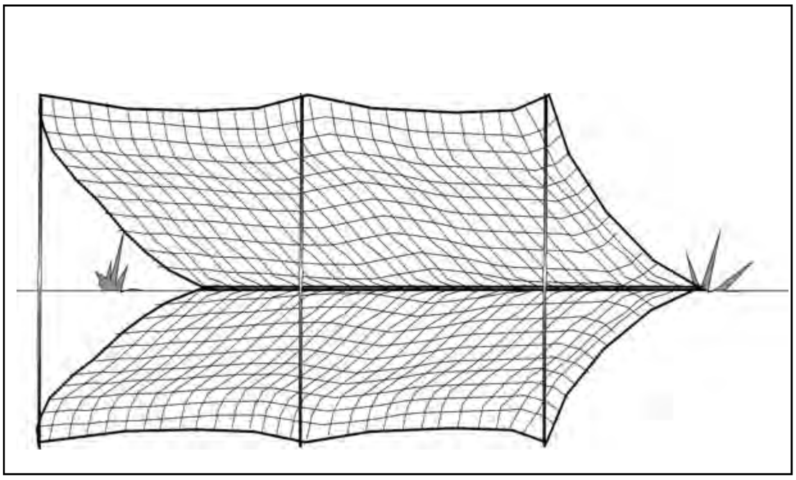

Figure 1 : Fall Net

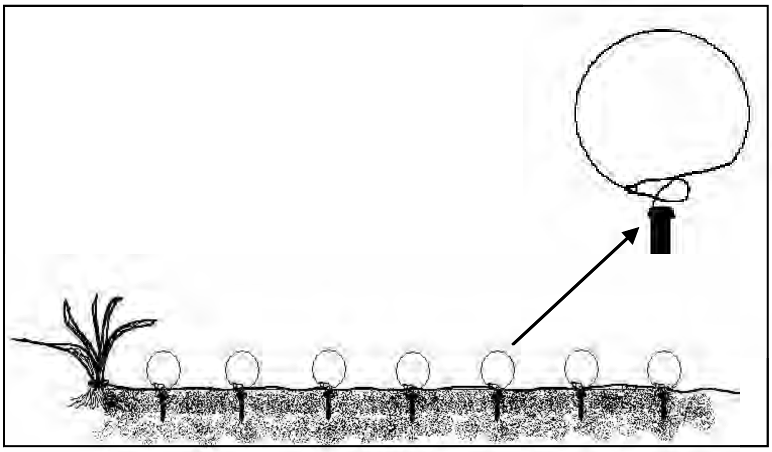

Figure 2. Leg-hold Snare

as leg-hold snare, a series of nooses tied to a long sting at 90° angle is placed at strategic locations along the ground, and the birds moving through this noose trap get caught by their legs. There are also methods where capture is done directly by hand or by spot lighting (or night lighting). Spot lighting is one of the ancient methods and has been found to be productive for many birds. In this method, high power spot lights are directed at the birds sitting on the nest or roost temporarily blind the birds, which are then caught effortlessly by hand or by a net.

Handling Protocol

Once the capture is made, the birds have to be handled for attaching bands or radio tags, recording morphometric data, extracting genetic sample (e.g. blood), veterinary care, transportation, etc. These require keeping the birds in hand for a specific period of time depending on the nature of purpose and equipments involved. Inappropriate handling can cause physical and mental injury, and even lead to shock related mortality. The immediate response of most trapped birds is often the frantic struggle to escape. Unless the bird is held properly, it is likely to experience injury and shock. Experienced trappers immediately cover the birds with dark cloth; so that it can not see the handler and people around, making it to struggle less. While handling, it is important to hold the bird firmly around the upper legs close to the body, where the bones and muscles are stronger to absorb sudden movement. In addition, the bird could be held around the folded wings in case of large sized bird such as pheasants. Conversely, holding the bird by one leg, lower legs, head and neck must be avoided, as this would increase the chances of injury (www.gct.org.uk/psg/policy/livetrappingpheasants). Entire trapping exercise should maintain a first-aid kit for treating any injuries to the birds. If the trapped bird is gasping, it is likely that breathing is restricted by excessive pressure on the body (e.g. wind pipe or air sac). So, care must be taken. It is also important to avoid pressure on abdomen of breeding female so that the eggs in the oviduct are not affected. While undertaking trapping and handling the birds, it is always advisable to involve more than one person to be able to follow the protocol efficiently. Such help would be particularly important while dealing with large birds and also recording body measurements. The trapped bird must always be released back on the same spot where it was trapped, unless the requirements demanded otherwise.

Radio-Telemetry

The terms radio-telemetry and radio-tracking are interchangeably used to refer to remote collection of data through radio equipments (derived from Greek 'tele' for remote and 'metron' for measure). The equipments comprise of a transmitter (fitted as radio tag or radio collar) that emits radio signal and receiver equipment along with an antenna to collect signal from the transmitter. Currently, Very High Frequency (VHF: 30-300 MHz)) and Ultra High Frequency (UHF: above 300 MHz) transmitters are designed for specific needs (Kenward 2001). However, the VHF tags are commonly used on account of cost, frequency variation suited for studying different species and battery life. After radio collaring of target individuals, tracking could be done on foot by hand-held antenna, vehicle mounted antenna and through satellites. Radio tags are also mounted with GPS (Global Positioning System) and Data Loggers which have automated function to record various data such as geographic coordinates of animal location, activity and body temperature. Several types of radio tags exist for galliformes species, which include Harness/Backpack, Dwyer Backpack, Necklace, Tail Mount, Neck Band and Leg Band. There are several standard companies. Satellite tracking is increasingly utilized in several wildlife studies, specifically for wide ranging large mammals and migratory waterfowls. Among the Galliformes, satellite tracking is perhaps suited for some Quail species that are known to migrate for very long distances across several countries.

Radio-tracking makes the job easier for biologists to collect data that are hard to get from conventional sampling methods. The methods of monitoring radio tagged individuals vary depending on the study questions and radio tracking equipments. Data from radio tagged individuals are collected in three major ways; (1) Continuous Monitoring, (2) Triangulation, and (3) Home-in. In continuous monitoring method, tagged individuals are followed continuously, even for 24 hours, and this would allow understanding of habitat use and behaviour at large and local scales. This method is, however, difficult to execute for Galliformes since these birds are sensitive to human and tend to evade the observer. Alternately, if the radio tag is fitted with a GPS or Data Loggers, and monitored by an automated tracking protocol including satellite tracking, continuous data collection is possible. Triangulation method uses trigonometry as its foundation and the radio signals obtained from three locations enable locating the tagged individuals adequately. It is an efficient method of data collection suited for wide range of animals since the tagged animals could be located from far distance, and observer effect does not occur. In home-in method, the observer locates the animal directly following the radio signal. Although this method is superior in terms of obtaining information on micro habitat use and behaviour, the likelihood of animal being disturbed by the observer is greater, unless the observer stays within the zone of 'no influence'. All of these methods return location data (*i.e.* animal use), activity and body temperature, and there are several analytical tools available to discern these data for appropriate interpretation (White and Garrott 1990; Aebischer *et al.* 1993; Powell 2000).

Case Studies

In India, Galliformes studies involving telemetry are very few. Iqubal *et al*. (2003) quantified home range, habitat use and nesting of Swamp Francolin (*Francolinus gularis*) on an agricultural landscape in northern India. Grey and Black Francolins were studied in the Yamuna plains of Haryana (Kalsi and Rana 2004; Rana and Kalsi 2004; Kalsi 2005). Among the pheasants, Western Tragopan (*Tragopan melanocephalus*) and Satyr Tragopan were studied using telemetry, though with limited success (Khaling 1999; Ramesh *et al*. 2001). The following provide the details of studies involving trapping and telemetry of Galliformes in India.

Swamp Francolin

Iqubal *et al* (1995, 2003) studied home range size, habitat use and nesting success of Swamp Francolin (*Francolinus gularis)* on agricultural land in northern India. A total of 13 Francolins in adult plumage were trapped by driving them into mist nets, erected at one end of sugarcane field. Driving was done slowly along most of the length of the field and rapidly towards the end so that the chances of flushed birds getting trapped is high. Trapped birds were attached with necklace transmitter, but one female bird was soon predated upon, leaving the tagged birds to 12 (five males and seven females). The periods of radio-collar attachment and data collection varied from 2-4 months. The radio-locations were determined by triangulation, with bearings from at least three tracking locations. Given that transmitter range were typically within 250m, the birds were routinely approached very closely such that triangulation error was small and that each location could be reliably assigned to a patch of habitat. Minimum Convex Polygon method and compositional analysis (Aebischer *et al.* 1993) were respectively used to study the home range and habitat use of the species. Breeding behaviour was monitored by following tagged birds, and found that eight of the 12 radio-tagged birds took part in breeding in six pairs. Home range of Swamp Francolin was very small (male = 1,050 m^2, and female = 822 m^2), and interestingly, the home range was positively related to duration of radio tracking, possibly as a consequence of birds moving further once nesting was completed. It is remarkable that there are not many studies in India that had so many radio tagged individuals of a single species for a study. This study has not only provided insights on technical issues related to capturing and radio tracking of Francolins, but has also raised some interesting questions as a result of inexplicable observations on the species.

Grey and Black Francolins

In the years 2002-03, Grey (*Francolinus pondicerianus*) and Black francolins (*Francolinus francolinus*) were trapped and radio-collared for studying their home ranges and habitat use (Kalsi and Rana 2004; Rana and Kalsi 2004; Kalsi 2005). Francolins were trapped with leg-hold snares (Figure 2). Snares were set in previously identified locations at foraging grounds where francolins were frequently sighted. Observers closely monitored the snares from a distance and trapped Francolins were removed immediately from the snares to prevent injury. The Francolins were fitted with backpack radio-transmitters weighing 5 gm each and were released back in the same habitat where they were trapped. Indigenously built radio-transmitters (Kalsi 2004) were used. No bird was injured during trapping. However, on one occasion, a mongoose got trapped in the snare and chocked itself to death. A total of 12 Francolins were snared, of which five Grey and six Black francolins were radio-collared. One juvenile Grey francolin was not collared and was released immediately.

The radio-tracking continued till the power supply of the radio-transmitter was exhausted. Out of the 11 radio-collars used, eight lasted for five months; two lasted seven months while one was lost after eleven days of activation. It could not be ascertained whether the radio-collar had failed or the bird was removed afar from the study area by a predator. For home-range estimation, point locations from radio-tracking data were used. Home ranges were estimated using, ArcView 3.1 extension package Animal Movement

Analysis. Models were run using the Universal Transverse Mercator (UTM) co-ordinate system and Minimum Convex Polygon (MCP) method was used to estimate home-range sizes. The home range polygons were overlaid on classified habitat maps of the study area to study habitat use.

Western Tragopan

In 1999, radio tracking of Western Tragopan was attempted in the Great Himalayan National Park, Himachal Pradesh, to better understand movement pattern and habitat use of the species. Six fall nets and nine leg-hold snares were used to trap the birds. The fall net used in this study was a combination of 'automatic fall net' and 'walk-in trap' described by Bub (1991). Nets were considerably long ranging from 15 to 18m, 6m width and the mesh size was 40 x 40mm. All the nets were coloured with black and dark-green stain to give a camouflage effect. The nets were placed in such way that 3m of the net was spread on the ground and the remaining 3m at 50° angle supported by triggers which, in this case, were bamboo sticks (Fig. 1). The net would fall down upon release of trigger when disturbed by the bird walking into the trap. Leg-hold snare had a series of 40 – 50 nooses fixed at 15cm interval in a thin and strong rope (Fig. 2). The noose was made up of nylon, measuring about 30 cm diametre, fixed with a bamboo or any other stick at the base of the noose. The stick measuring 10 cm long and 2 cm girth was pressed into the soft soil, leaving only the noose part on the ground sticking out at 90°angle. One end of the trap was tied with a nearby pole or shrub that holds back the trap when trapped bird tried to pull away from the trap; where as the other end was left loose. This set up prevented the bird from breaking away from the trap, while enabling the bird to move around without inflicting any sort of damage to the leg.

One female Western Tragopan was trapped in the leg-hold snare and was fitted with a necklace type radio transmitter weighing about 50g, which had the potential life span of minimum 12 months. Interestingly, the trapped bird did show any agitation and could be handled without any problem whatsoever. After attaching transmitter, it was released on the same spot of capture. Home-in method to locate the bird was discarded after three consecutive sampling days, as the movement of the bird was found to be influenced by the observer. Rest of the data collection was based on triangulation method systematically recorded at three times sampling (6 – 11 hrs, 10 – 15 hrs and 15 – 18 hrs) every third day. The bird was radio-tracked for six months (from May to November 1999) covering both summer and autumn seasons, after which no signal was received possibly due to transmitter failure or the radio tagged bird was taken away by a predator. Locations were plotted on 1:50,000 scale topographic map and using these points, home range was estimated based on Minimum Convex Polygon (MCP) method in Animal Movement Extension (beta version) of Arcview GIS software. Habitat use was studied by overlaying radiolocations and home range polygons on the spatial layer on vegetation, elevation, aspect and slope, and also by quantifying habitat variables in concentric circular plots at bird locations. Although trapping was attempted for three months (April - June) with total trap efforts of 256 man-days and 6694 trap hours, trap success of target species (Western Tragopan) was very low with just one bird, possibly attributed to low population density and secretiveness. However, accidental capture of significant number of other ground dwelling birds such as Koklass (n =1), Woodcock (n = 4) and Hill Partridge (n = 4) indicates that the traps are effective for Galliformes.

Discussion

Trapping of Galliformes is a very old practice, but largely for game hunting, wild meat extraction and cultural requirements. Although these activities are responsible for extinction risk to several Galliformes (Keane *et al*. 2005), the knowledge and skills required and gained over these have also contributed to modern trapping techniques and to the science and management of Galliformes. As the purpose shifted from consumption to management, the real development and efficacy of trapping methods revolved around the ability to capture the birds alive, without inflicting any sort of damage. Unless the methods are efficient and executed properly, live trapping can be a futile and risky enterprise as experienced by several research and conservation projects all over the world. In other situations, even after successful trapping, the birds could be killed by predators if left unattended for prolonged period. Among the several methods evolved and adapted for birds, leg hold snares and nets have been commonly used for live trapping Galliformes. Besides the case studies presented in this paper, leg hold snares have been successfully used for Great Argus (*Argusianus argus*) in Sumatra (Winarni 2002), Silver Pheasant (*Lophura nycthemera*) in Cambodia (Samnang *et al*. 2005) and reportedly of Peafowl (*Pavo cristatus*) in India. Modified form of mist nets have also been used to capture Galliformes. In a study of the mound nesting Megapodes (*Megapodius nicobariensis*) in the Nicobar Islands of India, the birds were caught by chasing into mist nets (Sivakumar 2000). Grey Francolins (*Francolinus pondicerianus*) are illegally caught by a variety of traps that use combination of nets and snares along with baits and decoy birds (Priscilla and Jasmine 2002). Although the available options for traps and trapping techniques are many, it is always desirable to clearly understand the nature of the birds (e.g. size, habitat and behavior), risk involved, and appropriate trapping protocol before embarking on actual field exercise to capture the birds. Such preplanning would not only be cost effective, but would also increase the trap success. Similarly, use of telemetry in research and conservation projects should be treaded with care as the telemetry is not always efficient due to inherent factors such as battery life, signal range and technical failures. Further, for species such as galliformes that live under the canopy in dense bushes and in mountainous terrain, radio signals are deflected or poorly received. These confounding factors would directly lead to unsystematic or discontinuous data collection, limiting the strength of analysis and interpretation. However, with the deployment of advanced tools and local adjustments in data collection procedure, quality data could be obtained for specified targets.

Depending upon the objectives, the trapped birds are handled for marking or attaching tags, and taking blood and feather samples. Since birds are very sensitive to any extraneous factors, inappropriate handling can cause death or defect normal behaviour. Studies involving marking or tagging generally assume that marking or tags do not affect the animal or that negative effects are irrelevant, but rarely such assumptions have been adequately tested and remain a contentious issue in wildlife studies. A critical review on the effect of marking on animals by Murray and Fuller (2000) highlights these issues and suggests measures for future studies. On ethical considerations, in response to awareness and concern for animals, captures are increasingly governed by national legislations and international treaties, and there are clear guidelines needed to be followed even for publishing research papers (Anon 2001; 2002). It is, therefore, necessary to adhere to these prescriptions in order to prevent the risk of permission being denied or discontinuation of further activity, which would potentially jeopardize the objectives, efforts, investments and publications. More than these regulatory protocols, field research and conservation management are responsible and service-oriented undertakings, and it is expected that the personnel involved accomplish their objectives with sensitivity to data quality and species population in both scientific and ethical terms.

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