

Scope of using surveillance cameras for studying nesting ecology of colonial waterbirds: Painted Storks in National Zoo, Delhi

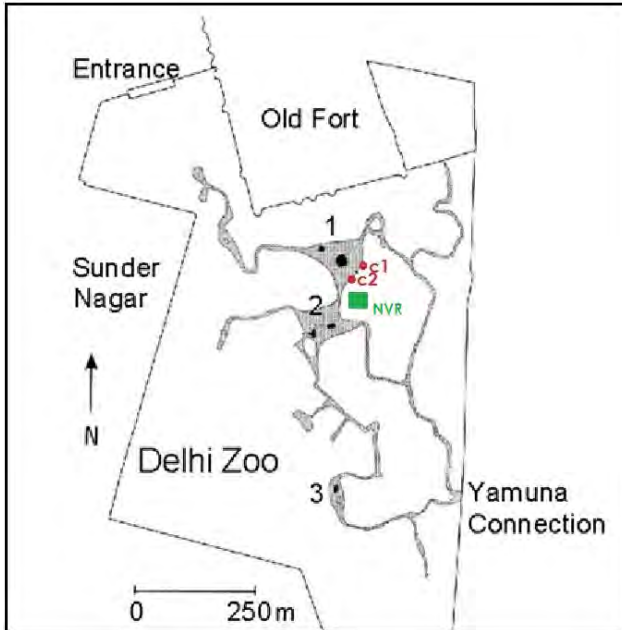


One of the two surveillance cameras installed in the Delhi Zoo in Pond 1 of the zoo. © A J Urfi.

The usage of camera methods for population census, studying behaviour by surveillance or camera traps is becoming common place in wildlife biology studies. Worldwide camera techniques have been used by several investigators in bird studies, some examples of which, through a casual literature search on the internet, are provided in Table 1. A number of different species have been studied and the objectives of the studies undertaken have been to determine the nest fate, nest predators and predation events,

parental behavior, diet and feeding pattern of nesting birds, etc. In addition, some papers have provided a general discussion of camera methods. In India, while camera methods have been used for studying many species of wildlife, particularly big cats and some other mammal species, no proper study seems to have been undertaken yet on birds.

We explored the possibility of using surveillance cameras for studying the nesting ecology of colonial waterbirds. For this purpose, a study was initiated



Map of the Delhi Zoo showing the location of cameras and NVR near pond 1.

in September 2019 on the free-ranging Painted Stork *Mycteria leucocephala* which regularly nests in the premises of the National Zoological Park, Delhi. A report of the camera setup and related equipment is presented here.

Studying nesting success of colonial waterbirds: general considerations

The modern method to estimate one important parameter of nesting birds, i.e., nest success is usually modeled by using the program Mark (Rotella 2005; Tiwary & Urfi 2016). This information is vital for conservation and monitoring purposes. The method involves repeated visits to marked nests to record nest fate: active (0) or failed (1). Along with a series of covariates, by using Mark it is possible to model nest success in the context of all

the relevant parameters which may have a bearing on nest survival. The time interval between successive visits to the nest is an important consideration. For instance, if the interval between two visits is very long, the confidence of the final nest success estimate is likely to be gross because a lot may have happened in the intervening days about which the investigator has no clue. Therefore, if there is a system in place, say constant surveillance through camera recording, then the time interval can be altered at will.

Secondly and importantly, the factors leading to nest loss between two successive intervals when the investigator is not present are impossible to know in most cases. They could be a natural predator, a human disturbance related



A close up of the recording device. © A J Urfi.

Table 1. A summary of some recent examples of studies on birds in which camera methods have been employed.

Objectives	Place	Species	Reference
Monitoring predation events at nests	UK	Lapwing <i>Vanellus vanellus</i> Spotted Flycatchers <i>Muscica pastrata</i>	Bolton et al. 2007
Monitoring of nesting success	Hawaii USA	Hawaiian Honeycreeper <i>Magumma parva</i> Monarch Flycatcher <i>Chasiempis sclateri</i> Japanese White-eye <i>Zosterops japonicus</i>	Hammond et.al. 2016
To assess the timings of nest predation by video surveillance method	USA	Acadian Flycatchers <i>Empidonax virescens</i> Indigo Buntings <i>Passerina cyanea</i>	Gill et al. 2016
General article regarding the use of small video camera device	USA	Several species	Ouchley et al. 1994
The application of a robotic camera system (Gigapan) which takes a tiled sequence of photographs which are automatically stitched together to form high-resolution panoramas	Australia	Shy albatross <i>Thalassarche cauta</i>	Lynch et al. 2015
To determine the effect of parental behavior on nesting success using video surveillance	USA	Painted Buntings <i>Passerina ciris</i>	Vasseur & Leberg 2016
Evaluation of trail-cameras for analyzing the diet of nesting raptors	Spain	Northern Goshawk <i>Accipiter gentilis</i>	Salgado et al. 2016
To evaluate nest success and nest predator dynamics	USA	Sharp-tailed Grouse <i>Tympanuchus phasianellus</i>	Burr et al. 2017
To evaluate the effect of off road vehicles on nesting behaviour as well as the reproductive success using video cameras	USA	American Oystercatchers <i>Haematopus palliatus</i>	Borneman et al. 2016
Effects of created forest edges on nest predators and interaction of these predators with forest birds	Thailand	Multiple species of forest birds	Khamcha et al. 2018
To determine nest fates and causes of nest failure	USA	Least Terns <i>Sternula antillarum</i> Piping Plovers <i>Charadrius melodus</i>	Andes et al. 2019

Objectives	Place	Species	Reference
A protocol that utilizes a minimally invasive surveillance system to continuously monitor breeding colonies of Common terns	USA	Common Terns <i>Sterna hirundo</i> Short-tailed Shearwaters <i>Puffinus tenuirostris</i> Common Eiders <i>Somateria mollissima</i> Black Skimmers <i>Rynchops niger</i> Fiordland Crested Penguins <i>Eudyptes pachyrhynchus</i>	Wall et al. 2018
A simple, inexpensive video camera setup for the study of avian nest activity	USA	American Oystercatchers <i>Haematopus palliatus</i>	Sabine et al. 2005
To document and quantify the breeding season, record behavior associated with feeding at nests	USA	Northern Goshawk <i>Accipiter gentilis</i>	Lewis et al. 2004
The aim of this study was to quantify the efficiency of camera traps in a wildlife crossing evaluation.	France	Wild animals	Jonathan et al. 2017

event or something else. This problem can also be solved by camera recording methods.

In an earlier study on the Painted Stork population at the Delhi Zoo (Tiwary & Urfi 2016), we studied nesting success using observational methods which involved visitation to the nesting colonies at regular intervals of 2–3 days. While this method gives reasonable results, it has one major drawback, i.e., it is impossible to know the causes of nest loss and interactions between the individuals of Painted Stork in a colony unless they are recorded accidentally viz. during the course of a field visit if there is a chance of observation of predation on the nest. Here, camera recording methods can be extremely useful.

Study area

The Delhi Zoo heronries have been described in detail by Urfi (2011) and Tiwary & Urfi (2016). How the Delhi Zoo accidentally became a nesting ground for free-ranging colonial waterbirds, especially the Painted Stork since 1960 has also been well documented (see the box in Urfi 2019).

The site has two interconnected ponds (1 & 2) with each having two islands (0.8ha each) planted with *Prosopis juliflora* trees. The merged canopies of these trees are utilized for nesting by eight species of colonial waterbirds at different times of the year besides the Painted Stork.

Each year after the monsoon rains, the Painted Storks start congregating in the

two ponds where they contest territories and commence nesting by September. On an average, approximately 400 birds arrive each year (the number of immigrant potential nesters varying in relation to the monsoonal rainfall that year). The nesting continues from January up to March of the succeeding year after which all the storks leave the zoo premises and do not return till August/September. In the intervening period, where exactly the birds remain is not clearly known but most likely they remain widely scattered in the surrounding countryside looking for food at wetlands. The Delhi Zoo population offers an excellent opportunity for experimenting with various study techniques like using cameras in the present study because of the ease with which the free-ranging Painted Stork can be studied.



The NVR unit installed in the water cooler room from where cables approximately 20-26 feet in length connect to the two cameras outside. © A J Urfi.

Camera setup and related equipment in the present study

In September 2019, two cameras were set up in pond 1. The placement of the cameras and the CPU. The specifications

Table 2. Specification and placement of cameras to record the nesting of Painted Storks in the National Zoological Park (Delhi Zoo) in 2019.

Units	Specifications	Comments
Cameras HIKVISION FIXER IR BULLET Network Camera, Model no. DS-2CD122P-I3 4mm	HD video (High-Definition) EXIR (Extended InfraRed) IP67 (International Protection) PoE Optional (Power over Ethernet)	Mounted on iron pillars at a height of approximately 10-12ft. Camera 1, Recording distance 25-27ft. approx No. of nests under observation 11 (8.3%) Camera 2, Recording distance 48-50ft. approx no. of nests under observation 22(16.5%)
NVR (Network Video Recorder) HIKVISION DS 7600 series Embedded NVR CPU Model no. DS-7P04NI-Q1	HD video stream input Third-party network camera supported HDMI/VGA HD output(High-definition multimedia interface/ Video Graphics Array) EZVIZ Cloud P2P function Gigabit NIC (Network Interface Controller)	Kept inside the room which houses the water coolers. The room has a continuous power supply.



Photo of the monitor displaying the view from the cameras. © Paritosh Ahmed.

of the Network Video Recorder (NVR) and cameras are given in Table 2. The visual output from which relevant data can be obtained. Together, the two cameras recording from a distance of 7.5–15 m mounted on top of iron columns approximately 3m high, had in view 33 nests. Out of 133 active nests in pond 1 colonies in the month of September, this accounted for 24% of the nests.

General Discussion

By September 2019, nesting activity had commenced in both the ponds and 133 nests were counted in pond 1. The nests under surveillance were a small fraction of all the nests built (Table 2). It is hoped to carry the study until November 2019 and analyse the data with respect to intra and interspecific interactions, colony attendance during day and night hours, and causes of nest failure.

The advantages and disadvantages of using camera methods are obvious. The surveillance cameras make a continuous recording and all important events are recorded. The investigator has all the relevant data on his laptop for detailed analysis at leisure (Demers & Robinson-Nilsen 2012; Brandis et al. 2014; Jumeau et al. 2017). At the same time, the disadvantages of these technologies are primarily the high costs involved in purchase and estimation. Therefore, only a limited number of functional units can be installed in the field. Storage of the data is also an issue and if the study has to be carried out for the entire duration of nesting period, which may be several months, then it has to factored in at the planning stage itself.

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