Evaluation of helicopter net-gunning to capture wild fallow deer (*Dama dama*)

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Abstract

Context. Safe and effective capture methods are crucial for improving our understanding and management of many wildlife species. The adaptation of established capture methods to novel situations requires critical evaluation because differences in environmental conditions and species' susceptibility to trauma and capture myopathy can produce unexpected outcomes. Helicopter net-gunning has been a valuable tool for capturing wild deer in New Zealand and the Americas, but there are no practical records of its use in Australia and only one report of it being used to capture three fallow deer (*Dama dama*) elsewhere.

Aims. The present study aimed to evaluate the feasibility of a helicopter-based net-gun capture technique for wild fallow deer by quantifying the efficacy of the technique and the frequency of injuries and deaths.

Methods. We captured fallow deer over two 3-day operations at a 135 km² site in eastern Australia. We collected data on operational efficiency and variables expected to affect animal health and welfare, such as injuries and the duration of stressful procedures. We used GPS tracking collars with an accelerometer and a mortality-sensing function to monitor post-release survival and activity of fallow deer.

Key results. In total, 127 deer were targeted for capture, with nets fired at 64 deer (50%) and 27 deer captured (21%). Mortality within 30 days of capture was zero. Mean chase time was 2 min 46 s and mean total time from start of chase until release was 11 min 19 s. No animals were severely injured or euthanased, but hyperthermia was observed in 33% of captured animals.

Conclusions. Helicopter net-gunning was an effective and safe method for capturing wild fallow deer when compared with alternative methods.

Implications. We recommend that researchers consider using helicopter net-gunning to capture fallow deer in Australia and elsewhere, and other deer species in Australia.

Keywords: animal welfare, invasive species, mortality, satellite telemetry, wildlife capture.

Introduction

The physical capture and handling of wild-living animals has been crucial for advancing our collective understanding of wildlife ecology and our ability to effectively manage wildlife populations for conservation, sustainable exploitation, or damage mitigation (Hebblewhite and Haydon 2010; McGowan *et al.* 2017). Studies relying on wildlife capture have provided essential information about animal movements, habitat requirements, population dynamics, evolutionary processes, epidemiology, and responses to anthropogenic disturbance and environmental change (e.g. Edmunds *et al.* 2016; Festa-Bianchet *et al.* 2017; Mysterud *et al.* 2017). However, wildlife capture and handling can pose major health risks to animals and handlers, including physical trauma, thermal stress and capture myopathy (Jessup *et al.* 1988; Jacques *et al.* 2009; Breed *et al.* 2019). Capture operations also usually require substantial investment of time, money and expertise (Hampton *et al.* 2019). Despite recent advances in reducing the invasiveness of some research methods (Zemanova 2020), the need for wildlife researchers and managers to capture and handle wildlife is likely to persist for the

foreseeable future. There is, therefore, a need for continual evaluation and refinement of existing wildlife capture and handling methods and for transparent evaluation of new methods or existing methods applied in novel situations (Hampton *et al.* 2019; Ortega *et al.* 2020).

Six deer (Cervidae) species have been introduced into Australia and are now recognised as influential components of environmental, economic and socio-cultural systems in many parts of the country (Hall and Gill 2005; Davis *et al.* 2016). However, research into fundamental aspects of deer ecology such as movement patterns, habitat use, mortality, fecundity, health status, social behaviour and interspecific interactions has been hindered by a lack of demonstrably safe and effective methods for capturing deer in Australian conditions (Hampton *et al.* 2019). This information is important for effective management of deer impacts and values (Davis *et al.* 2016), and differences in biotic, climatic, edaphic and social conditions mean that information from these species' native ranges cannot be assumed to hold in Australian conditions (Dolman and Wäber 2008; Amos *et al.* 2014).

Recent studies seeking to address these knowledge gaps have relied on chemical immobilisation from ground- or helicopter-based shooters to capture and restrain free-ranging red deer (*Cervus elaphus*; Amos *et al.* 2014) and chital deer (*Axis axis*; Hampton *et al.* 2021), or trapping followed by chemical immobilisation to capture and restrain rusa deer (*Cervus timorensis*; Moriarty 2004). These methods can be time- and labour-intensive and can have a high risk of harming deer (e.g. Moriarty 2004; Hampton *et al.* 2019, 2021). Chemical immobilisation can increase the risk of thermal stress, hypoxaemia, regurgitation, post-release lethargy and other dangerous conditions (DelGiudice *et al.* 2005; Arnemo *et al.* 2006; Ortega *et al.* 2020), and deer can suffer physical injury and death from ballistic trauma or trap-related injuries (DelGiudice *et al.* 2005; Hampton *et al.* 2021). Recent studies have required substantial changes to study design or methods because of difficulties capturing deer and high mortality rates ($\geq 8\%$) at time of capture or shortly thereafter (Moriarty 2004; Hampton *et al.* 2021). Evaluation and demonstration of alternative capture methods should make it easier and safer for researchers to obtain the sample sizes necessary for reliable inference about fundamental aspects of deer ecology and management in Australia.

Helicopter net-gunning was developed in New Zealand in the 1970s to capture wild deer for the game meat industry (Yerex 2001). Animals are captured using a weighted net fired by a shooter in a helicopter and are usually physically restrained and handled without chemical immobilisation. Helicopter net-gunning is now established as standard practice for capturing several ungulate species in North America (Ortega *et al.* 2020; Van de Kerk *et al.* 2020), and it has also been used to capture deer for research in New Zealand (Nugent and Yockney 2004; Latham *et al.* 2020) and South America (Flueck *et al.* 2005). It can provide an efficient and selective method for capturing many animals in a short time over a large geographic area (Webb *et al.* 2008). As for any large-herbivore capture method, net-gunning can pose considerable animal welfare risks, including mortality, morbidity and traumatic injuries. Large-scale studies of helicopter net-gunning for ungulate capture have shown that capture-related mortality and serious injury rates are commonly $\leq 2\%$ (Webb *et al.* 2008; Jacques *et al.* 2009; Van de Kerk *et al.* 2020). However, mortality rates $\geq 8\%$ have been reported in some species and landscapes that have subsequently been associated with inherently high risk of injury (e.g. Firchow *et al.* 1986; Jacques *et al.* 2009; Latham *et al.* 2020). Helicopter net-gunning has scarcely been used in Australia and its use in Australian conditions, which are generally much warmer than those in which net-gunning is common practice for capturing deer (e.g. Jacques *et al.* 2009; Ortega *et al.* 2020), has not been evaluated or described (Hampton *et al.* 2019).

Here, we describe two helicopter net-gunning operations in which we sought to evaluate the feasibility of net-gunning for the capture of wild fallow deer (*Dama dama*) in Australia. Feasibility was assessed in terms of the ability of the method to provide more than three captured deer per day without incurring a mortality rate >2% in captured deer. We are aware of only one other study that has used helicopter net-gunning to capture fallow deer (Nugent and Yockney 2004) and the small sample size ($n = 3$) and scarce detail about methods and outcomes provide little useful information about the capture technique. Following appeals for researchers to evaluate and publish adaptations and novel applications of wildlife capture protocols (Hampton *et al.* 2019; Ortega *et al.* 2020), we report pursuit and animal handling time, types of injuries incurred, post-release activity and survival. This is the first such description of helicopter net-gunning in Australia and of net-gun capture of fallow deer worldwide.

Materials and methods

Study area

Deer were captured at a 135 km^2 site near Glen Innes (151.73°E, 29.74°S) in north-eastern New South Wales, Australia, during two 2.5-day operations in winter (June/July) and spring (September) 2020. Vegetation was dominated by pasture for beef cattle production (e.g. *Phalaris aquatica*, *Festuca arundinacea*), with scattered trees on flat or undulating parts of the site and native eucalypt woodlands (e.g. *Eucalyptus viminalis*, *E. melliodora*), with canopy heights up to 20 m on steeper slopes and gullies. Elevation ranged from 974 to 1429 m above sea level. Daytime temperatures measured at 0900 hours and 1500 hours at the Glen Innes Airport (20 km distant) ranged from 6.2°C to 13.7°C during winter operations and from 14.5°C to 20.3°C during spring operations. The winter operation coincided with the coldest month of the year and followed three of the four driest months (Bureau of Meteorology 2021). Both operations occurred between the rut (late March to early May) and birthing (December) seasons (Bentley 1995). Fallow deer population density was estimated at 8.1 deer km^{-2} (95% CI = 5.2, 12.6) using aerial mark–recapture distance sampling immediately before the second capture operation in September (A. J. Bengsen, and D. M. Forsyth, unpubl. data).

Equipment and procedure

An AS350 B2 Squirrel helicopter (Airbus Helicopters, Marignane, France) was used to search the area for adult or yearling deer with no obvious signs of injury or illness and then manoeuvre them into sparsely treed areas where they could be captured using the net gun. To reduce the risk of head and neck

injuries, we did not target deer with prominent antlers. Initial search and manoeuvring were undertaken at low to moderate speeds (<60 kn) at altitudes ~50 m above ground level. An observer seated next to the pilot started a stopwatch at the beginning of each manoeuvre to time the duration of key parts of the operation, including time at which a net was fired, time until a deer was successfully netted, time until a captured deer was secured by handlers, and time to release. Timings were also sometimes inferred by reviewing digital video of capture and handling events from cameras (GoPro, San Mateo, CA, USA) mounted behind the shooter and on the chest of the observer/animal handler. The observer also ended a pursuit once a pre-determined time limit was reached (10 min during winter and either 7 or 5 min, depending on forecasted daily maximum temperature, during spring). Once a deer was in open terrain suitable for capture, a final low approach was made at a higher speed to close with the deer and match its pace. This typically required a 450–500 m stretch of open terrain with few clusters of trees (Fig. 1). An experienced aerial shooter positioned immediately behind the pilot then used a 0.308 breakaway net gun (ACE Capture, Invercargill, New Zealand) to launch a 5 × 5 m weighted net (Fig. 2). Spare pre-loaded net cannisters were carried in the helicopter so that they could be rapidly loaded onto the gun for a subsequent shot if needed.

When a deer was netted, the helicopter landed at sufficient distance from the animal to minimise disturbance (usually 50–200 m) and shut down. Three people (including the observer and shooter) handled the deer. The first person to arrive secured the animal and covered the eyes with a blindfold, leaving the mouth and nostrils free. After an initial assessment for signs of injury or any other indications that would preclude collaring, one handler attached a GPS tracking collar fitted with a mortality sensor that was set to send an alert via satellite after 12 h of inactivity (G5-2D Iridium, Advanced Telemetry Systems, Isanti, MN, USA). Tracking collars were programmed to record a location fix every hour. Body temperature was measured rectally with a digital thermometer (Vicks V916C-AUS, Procter & Gamble, Cincinnati, OH, USA) after the collar had been applied. Any deer with a rectal temperature >40.6°C (Wolfe *et al.* 2004) was classed as hyperthermic. Body length was measured, a tissue sample was taken from the outer ear with an Allflex tissue sampling unit (Allflex Australia, Capalaba, Qld, Australia), a numbered ear tag was applied, and the deer was assigned to one of six age classes on the basis of incisor wear (following Cattet 2018). We ranked the severity of injuries on a scale from 0 to 4 (Webb *et al.* 2008). Body condition was ranked between 1 and 5 on the basis of fat and muscle composition of the rump and sacral areas assessed by palpation (Audigé *et al.* 1998). Body measurements and incisor photos were sometimes abandoned to minimise handling time for deer with rectal temperatures >41.0°C. A final check for injuries was made before releasing the deer and observing its movement and behaviour as it moved away.

Analysis

We used Kaplan–Meier cumulative hazard estimates to describe the time required to capture, secure and handle deer. Estimates and confidence intervals were calculated using the survival package (v3.2-7, Therneau 2020) in the R statistical environment (v3.6.2, R Core Team 2020).
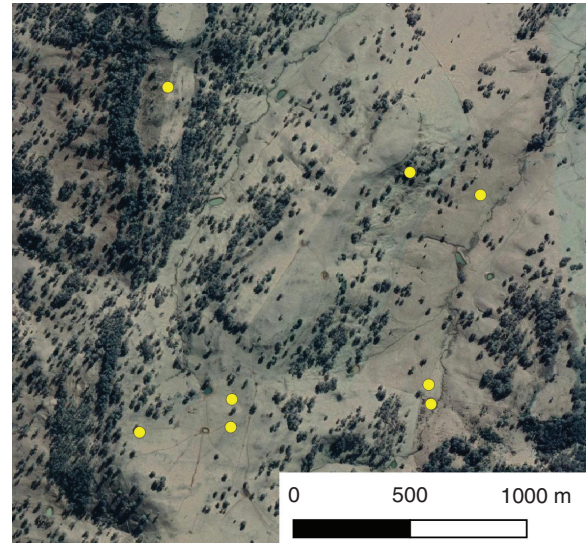
Fig. 1. Locations of eight fallow deer capture sites (yellow circles), showing the density and distribution of trees (map image © 2020 CNES/Airbus, Google).

Fig. 2. Crew locations and position of helicopter relative to deer during capture (image: Andrew Bengsen).

We used GPS collar data to check for activity and movement patterns consistent with physical impairment owing to acute or subacute capture stress. Common signs of capture stress or myopathy include shock, tremors, loss of coordination and weakness, stiffness or paralysis (Spraker 1993). We expected that these conditions would result in reduced activity and distance travelled for a period of up to 14 days after capture (Dechen Quinn *et al.* 2012, 2014). Thus, deer suffering sublethal capture stress or exertion should show low activity or distance travelled between successive location fixes before increasing to a stable average.

We tested for increasing activity with time since capture by using the tri-axial accelerometer mounted in each deer's tracking collar, which estimated the proportion of seconds that the collar was moving between hourly location fixes. Movement was recorded for any given second in which at least one axis differed from its reading during the preceding second by at least

54.6 mg. Manipulation of a sample of four collars suggested that movements of ~10 degrees s^{-1} in the vertical or horizontal plane were sufficient to record movement. We used logistic regression to estimate the rate at which average daily activity increased from 1 to 30 days since capture. Third-order polynomial functions, which allowed for separate sigmoidal curves for females and males, were used to describe the rate at which the average daily proportion of seconds active increased from 1 to 30 days after capture. We excluded the day of capture because the data necessary for a daily average were incomplete, and because the data were likely to be influenced by efforts to rejoin social groups after capture (Jung *et al.* 2019). Activity was averaged daily for each deer to reduce within-day variability owing to circadian rhythms. We used the same polynomial model structure to estimate the rate of change in average daily distance moved from 1 to 30 days after capture, using a linear model with average daily distance between successive location fixes specified as the response variable. Models were implemented in JAGS (Plummer 2003) called via the runjags package (v2.04-2, Denwood 2016) in R, using 50 000 Markov-chain Monte Carlo draws from each of three chains after discarding 5000 burn-in draws. Regression parameter estimates are reported as posterior means and 95% credible intervals.

The study was approved by NSW Department of Primary Industries (NSW DPI) Orange Animal Ethics Committee (Animal Research Authority ORA 20-23-003).

Results

We made 127 attempts to capture deer with the net gun over 6 days. Nets were fired at 64 deer (50%) and two chases were abandoned because of excessive chase times (5 and 7 min). Additionally, four pursuits were abandoned after deer showed signs of excessive exertion within 5 min. The remaining pursuits were abandoned because of deer escaping to unsuitable terrain or because of target-switching when easier capture opportunities became available. Of the 64 deer at which nets were fired, 26 (41%) were captured (18 females, 8 males). An additional female deer was captured without a net being fired when it became entangled in a fence and was safely physically restrained (Table 1). Three captured deer required a second net after the first attempt missed. Three deer remained mobile and ran for up to 100 m while entangled in nets, before becoming recumbent. All others (89%) became entangled and recumbent within ~20 m of being netted. Mean chase time, from the time that an animal was observed to respond to the helicopter until it was captured, was 2 min 46 s (95% CI = 2 min 10 s, 3 min 25 s). Mean time between net capture and handlers securing deer was 1 min 47 s (95% CI = 1 min 9 s, 2 min 17 s). Mean processing time, from handlers securing deer until release, was 6 min 44 s (95% CI = 6 min 17 s, 7 min 52 s) and mean total time (chase + secure + processing) was 11 min 19 s (95% CI = 10 min 11 s, 12 min 53 s; Fig. 3). All deer were netted on undulating grassy terrain (e.g. Figs 1, 2). Hyperthermia was observed in 33% of captured deer and the mean body temperature recorded across both operations was 40.2°C (s.d. = 0.9°C). One deer sustained an injury score of 1 (minor cuts and scrapes, Webb *et al.* 2008); all remaining deer were scored at 0. All deer were assessed as being in good or very good condition, with

Table 1. Summary of outcomes from 127 attempts at net-gunning to capture fallow deer over two 3-day operations in eastern Australia

Category	Frequency	Probability (95% credible interval)
Abandoned, missed shot	38	0.30 (0.22, 0.38)
Abandoned, exertion[A]	4	0.03 (0.01, 0.07)
Abandoned, time[B]	2	0.01 (0.00, 0.04)
Abandoned, other[C]	56	0.44 (0.36, 0.53)
Captured, one shot	23	0.18 (0.012, 0.25)
Captured, two shots	3	0.02 (0.01, 0.06)
Captured, zero shots	1	0.01 (0.00, 0.03)
Total abandoned	100	0.79 (0.71, 0.85)
Total captured	27	0.21 (0.15, 0.29)

[A]Deer was showing signs of excessive exertion.
[B]Chase time reached pre-determined limit of 7 min.
[C]Deer escaped to refuge or crew switched to a more accessible target.
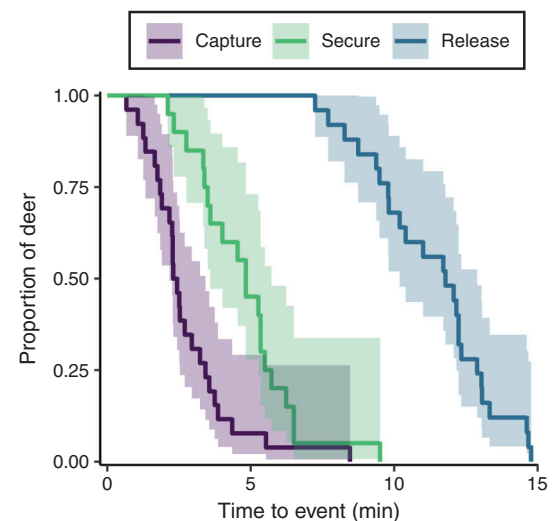
Fig. 3. Time required to capture, secure and process fallow deer using helicopter net-gunning. Left to right: time from identifying a suitable target to capture with a net (Curve 1, purple); time from identifying a target to the captured animal being secured by handlers (Curve 2, green); total time from identifying a target to release after collaring and processing (Curve 3, blue).

body condition scores (Audigé *et al.* 1998) of 4 or 5. Most deer (50%) were classified as young, and the remainder were either medium-young (39%) or medium (11%). Mortality of captured deer up to 30 days after capture was zero. We had no way of knowing whether any deer that were not captured died as a result of pursuit or disturbance.

Accelerometer data showed that the average daily proportion of seconds that a deer was classed as active increased over the first 10 days since capture, at a similar rate for female ($n = 19$, $\beta_1 = 0.05$, 95% CrI = 0.02, 0.07) and male ($n = 8$, $\beta_1 = 0.07$, 95% CrI = 0.04, 0.10) deer before stabilising (Table S1, available as Supplementary material to this paper). However, the predicted proportion of seconds that female deer were active 1 day after capture (0.32, 95% CrI = 0.30, 0.33) was 18% lower than that for male deer (0.39, 95% CrI = 0.37, 0.41). Consequently, female activity was consistently lower than that of males over 30 days post-capture (Fig. 4a). Mean hourly distance

(a)

(b)
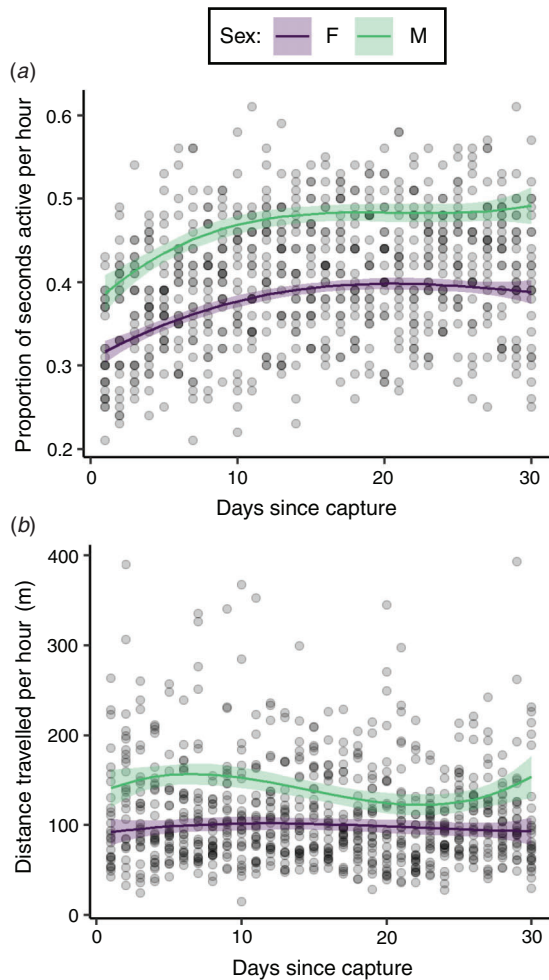
Fig. 4. Activity and distance travelled for 27 deer over 30 days since capture. (*a*) Mean daily proportion of seconds active per hour for male and female deer; (*b*) mean daily distance between successive location fixes for male and female deer. Lines show predicted values and 95% credible intervals for each sex.

travelled showed no consistent change for female or male deer over 30 days post-capture (Table S2). However, female deer travelled 36% shorter distances between hourly location fixes, on average, on the day after capture (93 m, 95% CrI = 78, 107) than did male deer (141 m, 95% CrI = 120, 162). Daily distance travelled was, therefore, consistently lower for female deer than for male deer (Fig. 4*b*).

The total hire cost for the helicopter, pilot, ground crew and an experienced aerial shooter for 20.04 h of flying time over 6 days of operations was A$57 690 or A$2136 per deer captured. The one-off cost for purchase of the net gun and four net cannisters was A$17 910.

Discussion

Helicopter net-gunning was an effective method for capturing multiple wild fallow deer per day with no mortality of captured deer. Despite the low probability (0.21) of a targeted deer ultimately being captured, the capture of one deer per 44 min of

flying time and the short handling time required to process deer provided an average of 5.4 deer captured per day. This was slightly more efficient than the four chital deer captured per day using aerial chemical immobilisation darting in northern Queensland (Hampton *et al.* 2021). The low capture probability in the present study exaggerated the difficulty of capturing fallow deer because a large, but unquantified, proportion of pursuits were abandoned because of opportunistic target-switching, rather than deer becoming unavailable for capture.

Captured deer did not sustain any serious injuries during capture and none died within 30 days of capture during winter and spring. The frequency and severity of injuries were particularly low when compared with alternative capture methods used recently in Australia. Helicopter darting, for example, has produced mortality rates >10% in the initial stages of chital deer capture operations (Hampton *et al.* 2021) and >8% of rusa deer captured in corral traps were euthanased because of capture injuries or morbidity caused by chemical immobilisation (Moriarty 2004). Another important advantage of helicopter net-gunning over these capture methods was that it avoided the animal health risks, expenses and logistical constraints associated with chemical immobilisation, such as long handling times and the requirement for veterinary assistance (e.g. DelGiudice *et al.* 2005; Hampton *et al.* 2021), although chemical capture and immobilisation may be safer in some situations (Latham *et al.* 2020). The short average handling times in our study (<7 min, cf. Jacques *et al.* 2009; Latham *et al.* 2020; Ortega *et al.* 2020) may also have contributed to the favourable outcomes, despite the high ambient temperatures (cf. Webb *et al.* 2008; Jacques *et al.* 2009; Latham *et al.* 2020; Van de Kerk *et al.* 2020). Our chase times were comparable to those in other helicopter net-gunning or chemical immobilisation operations (Latham *et al.* 2020; Hampton *et al.* 2021). Compared with trapping, it was easy to switch locations and cover large areas and to select animals of different age, sex and health classes.

Limitations of helicopter net-gunning included that it was not well suited to expansive areas of tall or dense vegetation where helicopter access is difficult, or to steep and rocky terrain where falls can cause injuries and deaths (e.g. Latham *et al.* 2020). The deployment of nets from within the helicopter, and low-level flying at speeds matching or exceeding those of target animals moving at speeds >45 km h^{-1} (Curry *et al.* 2012), also carried inherent safety risks for the capture team (e.g. Jessup *et al.* 1988; NTSB 2017, 2018). In the present study, these risks were managed using stringent protocols for the operation, inspection and maintenance of equipment. Further, the pilot and shooter each had >30 years' aerial shooting experience and all crew had helicopter experience and safety training. The high immediate cost of helicopter hire and initial equipment purchase could also be a limitation in some applications. We were unable to directly compare the costs of our operations with those of other capture methods, but our costs were similar to a helicopter net-gunning operation for red deer in New Zealand, which found that the cost of net-gunning (A$2068 deer^{-1}) was 17% less expensive than that of chemical immobilisation (Latham *et al.* 2020). Previous work has shown that high initial costs of helicopter net-gunning for capturing bighorn sheep (*Ovis canadensis nelsoni*) were offset by labour savings when distributed over ≥20 animals (Jessup *et al.* 1988).

Animal mortalities in helicopter net-gun capture programs typically occur because of trauma during pursuit and capture, and capture myopathy up to 30 days after release (Webb *et al.* 2008; Jacques *et al.* 2009; Van de Kerk *et al.* 2020). Two deer in our study could have suffered major trauma or death during pursuit and capture; one deer became entangled in a fence and another fell into a creek after being netted. Both deer were collared and released without visible injury or impairment. No deer died during the 30 days following capture in the present study, despite the high proportion of deer being classified as hyperthermic during handling. However, both male and female deer showed a tendency towards reduced activity immediately after capture, before settling at a stable average activity level after ~10 days. This was consistent with our expectation that deer experiencing sublethal symptoms of acute stress or exertion would spend greater time at rest while recovering after capture. Our data did not allow us to isolate the causal factors underlying the reduced activity, but the consistency of the pattern between sexes suggests that both sexes were susceptible. We could not rule out the possibility of mortalities in some deer that were pursued but not captured because of pursuit or disturbance. Future studies aiming to understand relationships between capture-related stress and post-release behaviour should consider collecting additional data during captures, such as respiration rates, behavioural observations, and serum and faecal glucocorticoid concentrations (e.g. Ortega *et al.* 2020).

The low activity levels in the days after capture were not reflected in the daily distances between successive location fixes, which showed no consistent increase or decrease over time. A study of post-capture movement in white-tailed deer (*Odocoileus virginianus*) that were trapped and then chemically immobilised found that deer that died within 30 days of capture had consistently shorter distances between successive location fixes than did survivors (Dechen Quinn *et al.* 2014). Deer in our study probably experienced less-intense physiological challenges as they were subjected to much shorter periods of acute stress, less-invasive procedures during handling, and were not chemically immobilised. Direct measures of animal motion, such as the accelerometer data used in the present study, may be more sensitive indicators of mildly impaired activity than are coarse indirect measures such as distance between location fixes, particularly in social animals that move in herds.

Mortality rates in wildlife capture programs are typically greater in the early stages of operations, when capture protocols have not yet been adapted to the subject species or local conditions (Arnemo *et al.* 2006; Hampton *et al.* 2021). We therefore expect that future net-gunning operations conducted under similar conditions as the present study will have similarly low mortality. However, the results of our study are not necessarily indicative of the efficacy of net-gunning for all Australian deer species under all conditions. Our evaluation was limited to a single species at one site during cool to mild weather (maximum temperature ≤21.0°C), and both operations occurred more than 2 months after the peak of the rut and more than 2 months before the peak birthing period. Operations that require protracted animal handling or that are conducted during other seasons when deer face greater energetic demands or greater ambient temperatures may have less-favourable outcomes. The method may be worth investigating for capture of chital deer in sparsely treed areas of northern Queensland (Hampton *et al.* 2021). Helicopter net-gunning may also be suitable for similar-sized (30–100 kg) ungulate species such as feral pigs (*Sus scrofa*; e.g. Koen *et al.* 2018) and feral goats (*Capra hircus*). It may prove to be less suitable for the much larger sambar deer (*Cervus unicolor*), a species that is notoriously difficult to capture (Hampton *et al.* 2019), with an average adult mass >140 kg, and typically inhabits dense forest (Forsyth *et al.* 2009).

Our results suggest that helicopter net-gunning can be an effective technique for capturing fallow deer during cool to mild weather (8–20°C) in environments where deer can be manoeuvred into open areas for capture. Wider adoption of this methodology would enable previously unknown aspects of the ecology of wild deer to be investigated in Australia. Reporting post-capture activity and characteristics of capture operations relating to animal health will facilitate the identification of 'best practice' techniques for capturing wild deer and other species (Ortega *et al.* 2020; Hampton *et al.* 2021).

Conflicts of interest

The authors declare no conflicts of interest.

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