BLACK-TAILED DEER POPULATION SIZE AND MANAGEMENT IN ESQUIMALT, BRITISH COLUMBIA

A DRAFT PROPOSAL to the TOWNSHIP OF ESQUIMALT

PROPONENT INFORMATION

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PREFACE

This is a *Draft Proposal* presented to the Township of Esquimalt for their information only. It is not yet a final formal proposal from the University of Victoria and its contents are not legally binding in any way.

PROJECT ABSTRACT

Columbia black-tailed deer (*Odocoileus hemionus columbianus)* are increasing in British Columbia's urban and suburban centres, creating management challenges across the province. Human-deer interactions can be expensive, carry perceived risk to property and human safety, and lead to the perception of wildlife as a "pest". Management actions include a cull (direct population reduction) and contraception (indirect population reduction). Evaluating the efficacy of management options requires (1) accurately and precisely estimating deer populations before and after management treatment; (2) understanding what aspects of the suburban landscape facilitate (or preclude) deer occurrence; (3) examining how deer populations and distributions respond to population control. We propose a three-year study in Esquimalt, BC, using a novel combination of camera-trapping and immunocontraception to answer these questions.

Table of Contents

EXECUTIVE SUMMARY

Black-tailed deer populations are on the rise in urban and suburban centres across British Columbia (BC). These small deer, native to Vancouver Island, are an important game species and dominant herbivores in the ecosystem, and have been markedly increasing in density in suburban centres. An abundance of food and an absence of predators have allowed populations to increase dramatically. With common public perception that deer destroy personal property and represent a safety risk, some BC municipalities have undertaken management decisions to reduce suburban black-tailed deer populations. Reduction includes both direct mortality (cull) and indirect population reduction through immunocontraception (IC). Wildlife management requires supporting science of sufficient precision and accuracy to support effective decision-making.

In 2018 the District of Oak Bay launched the Oak Bay Deer Study to answer questions about deer management. We used a combination of infra-red remote cameras, GPS telemetry, and cutting-edge statistical techniques to estimate deer density, distribution, habitat selection, and response to population control via immunocontraception. Here we propose to build on that work.

Capitalizing on the expensive telemetry work already conducted in Oak Bay, we propose to extend the array of camera-traps in Oak Bay to cover Esquimalt, to estimate deer density in this region

before, during, and after immunocontraception treatment. In Year 1 we will monitor the existing deer population and estimate (1) deer density, (2) deer fawning rates, and (3) deer habitat selection. In Year 2 we will treat 60 does with immunocontraception aimed at markedly reducing fawning rates. In Years 2 and 3 we will monitor the population response, and the response of fawning rates and habitat selection, to this treatment. This information will form the basis for a recommended action plan for Esquimalt to humanely and effectively manage black-tailed deer populations.

INTRODUCTION

Black-tailed deer (BTD) are native to BC, an important prey species [1], a key herbivore maintaining ecosystem function, and a game species for many British Columbians. However, the changing landscape of BC's suburban areas has been very good to deer. Predators such as bear, wolves, and cougars are kept at low density from most urban areas and its environs, effectively excluding them from their ecological roles in deer-population control. BTD populations are very sensitive to factors affecting recruitment [2,3]. BTD select high-energy and high-nutrient plants to eat [4]; in BC urban and suburban areas abundant backyard gardens and agricultural crops provides ample deer food, potentially allowing BTD to breed more often and more successfully than in natural landscapes. The trade-off between security from predation and food resources is not well understood [5]. We do know that in BC suburban areas, densities have increased markedly, leading some municipalities to vote to cull black-tailed deer. Thus far management culls have been based on very little data, and have had highly variable results, resulting in acrimonious legal battles. Further, without a common basis for setting culling decisions based on rigorous scientific data, the effect of culling on this important BC resource remains completely unknown.

Managing black-tailed deer populations around suburban centers to achieve long-term stability requires information on habitat selection and population densities. However, prior to research in Oak Bay, there was very limited data on black-tailed deer in suburban centers. Preliminary results from the Oak Bay Deer Study showed that deer are using areas with large residential lots with plenty of gardens (as opposed to smaller, higher-density residential lots), with a lesser contribution of public parks and green space. In other words, people's yards provide substantial food subsidies for black-tailed deer, and managing yard accessibility to deer will be an important piece of deer management.

The Oak Bay study also provided much more precise estimates of deer density. Traditional surveys are based on herd counts - which provide useful distribution information and generally provide low-precision results with wide confidence limits [6] – or aerial surveys which are nearly impossible in suburban areas. Citizen-based herd count surveys engage the public, but do not produce reliable estimates; they lack the statistical rigor to scientifically or legally defend management actions. Estimating black-tailed deer densities in BC's suburban areas requires the application of new surveying approaches using a combination of infrared remote cameras (IRCs) and new statistical techniques.

IRC's are rapidly becoming a greatly popular wildlife research tool because they produce large volumes of data at low cost [7,8] . Their reliability in surveying wildlife species can be quantified [9] and IRCs have been shown to have very high accuracy at detecting species [10]. Remote camera surveys are an increasingly common approach for surveying ungulate occurrence [11-13]. IRCs have previously been used for deer in urban areas but without the statistical ability to estimate density from the data [14].

With this emerging technology comes an emerging challenge: translating photos of deer into accurate and precise estimates of deer density. How does one distinguish between several photos of a single deer, and multiple photos of different deer? With new statistical density models [15-17], the movement pattern and encounter rate of known, tagged deer observed on cameras can be extrapolated to the whole (unmarked, generic) camera-sampled population, and used to estimate density. This is the research we propose for Esquimalt.

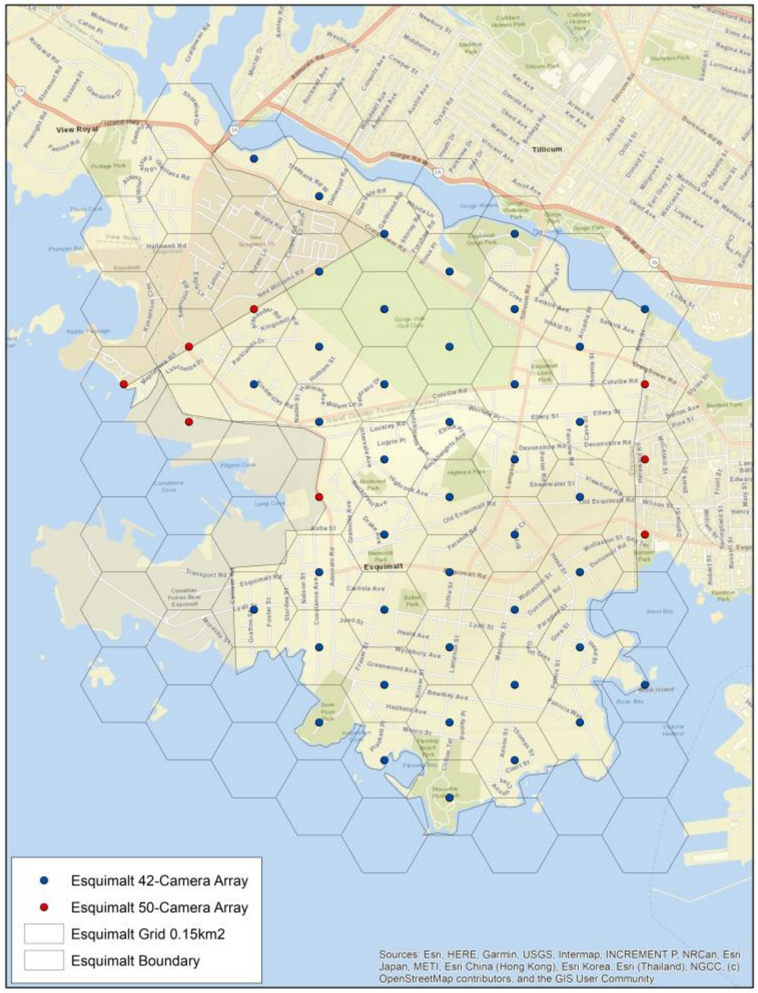
METHODS AND OBJECTIVES

Study Area

We will deploy 40 camera traps across the Township of Esquimalt in a grid pattern, such that 40 cameras will span the region. The spacing between cameras is designed to allow for a single deer to be detected on multiple cameras, a requirement for the density estimation models. We over-design for 50 cameras and drop sites that prove too logistically challenging.

Experimental Design

Camera trapping. – We will survey sites in a systematic design across the study area. We will monitor cameras monthly. For each BTD detection, we record date, time, location, and when possible, demographic information including sex and age group (e.g. adult, fawn). For collared BTD, we also note the unique colour tag combination for individual-level identification. Data on marked and unmarked BTD provide the basis of our population density estimation models.



Marking deer. – Building on the road-based surveys previously conducted in Esquimalt, we will stratify Esquimalt into areas of high and low deer density and apportion our search efforts to these areas to achieve marked deer throughout the entire study area. We search the area for deer in multiple vehicles, once a deer is located that is in a suitable (safe) position for capture, we convene the teams and make the capture. Chemical immobilization is delivered *via* darting by experienced wildlife veterinarian Dr. Adam Hering (supported by capture teams) using current regulatory approvals and field protocols. Upon capture, we fit each doe with a unique colour tag or collar and collect biological samples (DNA, fecal, blood) for the Province.

Data Analysis

We will examine how black-tailed deer are distributed relative to features in the urban landscape (such as forage patches and low-risk predation refuges) by analyzing serial presence-absence camera data using patch occupancy models [18]. These models account for imperfect detectability, and estimate the probability of occupancy at a site in relation to habitat features [19,20]. This analysis has been used multiple times by the proponents [10,21,22]. It reveals those ecological factors – geographical location, habitat type, and anthropogenic footprint – that best predict black-tailed deer occupancy. In addition, we will model rates of local extinction and colonization using multi-season models [23,24] to examine rates of change in black-tailed deer occupancy through time. Seasonal mortality rates and fawning rates of known deer, will be analysed in population models to understand BTD population dynamics [3,25].

We will test the efficacy of IC by estimating BTD density before and after treatment. We will use a new extension of spatial capture-recapture models developed to estimate density from repeated detections of individuals from a partially-marked population: Spatial Mark Resight Models (SMR) [15-17].

SMR models are an extension of capture-recapture models, which estimate population density through a series of capturing and marking occasions. In traditional mark-recapture models, researchers capture animals on an initial survey occasion, mark the animals and then release them back into the population. On the second and subsequent survey occasions, a new set of animals are captured and the number of previously captured animals (possessing a mark, or collar) are counted, along with the total number of animals captured. All new animals are likewise marked and then released back into the population. This continues for as many survey occasions as necessary to reliably estimate the density. Assuming all animals can be captured with equal probability, the higher number of marked animals re-captured within each survey occasion, the smaller the overall population.

SMR models are slightly different in that we consider animals as "marked" if they were collared (or tagged), and "captured" if detected on a camera. Thus, we start and end with a pool of collared animals that are observed repeatedly (hence mark-resight survey, rather than a mark-recapture survey). SMR models use the detections, or "resights", of both unmarked and marked individuals to estimate the density of a population [26,27]. The frequency at which collared animals are observed at neighbouring cameras is important: animals that are seen at many cameras range widely, and suggest a smaller number of deer than animals that are seen on only a few cameras close together. SMR statistical models are very recently developed—yet scientifically accepted—and enable movement pattern and encounter rate of collared ("marked") BTD to be extrapolated to the whole un-collared ("unmarked") camera-sampled BTD population to estimate density. They are revolutionizing how scientists estimate animal abundance [28,29].

COMMUNICATION/OUTREACH

We will rely on Esquimalt staff to assist us with outreach to citizens, informing them of this research and asking for their assistance in allowing us to place cameras on their properties. This assistance will be vital in allowing us to deploy our grid of camera traps. We will coordinate with Esquimalt police to inform them when we are capturing deer.

The results and conclusions from this project will be made widely available in the form of:

1. Final report to all project partners and members of the public.
2. Journal publications in *Journal of Applied Ecology* and *Journal of Wildlife Management* or similar, for dissemination to the scientific community.
3. Presentations at scientific conferences.

Timeline

Objective #	Objective Name	Activity Name	Timeline*
1	Measure pre-treatment deer occurrence across Esquimalt	Deploy 40 cameras across Esquimalt	Fall 2020
1		Capture and tag 20 black-tailed deer does	Late Fall 2020
1		Monitor deer cameras	Fall 2020 – Late spring 2021
2	Data analysis	Estimate deer density, fawning rates, and habitat selection	Early summer 2021
3	Apply treatment	Treat 60 does with immunocontraception	Fall 2021
4	Measure post-treatment deer occurrence across Esquimalt	Monitor deer cameras	Fall 2021 – Fall 2022
5	Data analysis	Estimate post-treatment deer density, fawning rates, and habitat selection	Winter 2022/2023
6	Reporting	Final data analysis and reporting	Winter 2023

*Timeline depends on the timing of funding acquisition and here assumes a summer 2020 approval. The timeline can be shifted as required but treatments must be applied to deer *in the late summer and early fall, before the rutting (mating) season*.

Proposed Budget

Total

General Research Task Breakdown	Materials & Supply	Labour	Proposal Total
Camera trapping	$ 37,938.68	$ 86,465.60	$ 124,404.28
Capture and tag 20 deer (Y1) Capture, IC, tag 60 deer (Y2) Monitoring captures (Y3)	$ 45,843.20	$ 27,703.20	$ 73,546.40
Data Analysis	$ 3,500.00	$ 65,553.60	$ 69,053.60
Scientific oversight	$ -	$ 31,216.00	$ 31,216.00
SUBTOTAL	**$ 87,281.88**	**$ 210,938.40**	**$ 298,220.28**
TOTAL with UVIC overhead 25%			**$ 372,775.35**

Annual

Year	Materials & Supply	Labour	Totals
Year 1	$ 35,340.00	$ 66,350.00	$ 101,690.00
Year 2	$ 47,022.00	$ 79,383.20	$ 126,405.20
Year 3	$ 5,919.88	$ 65,205.20	$ 71,125.08
Totals	**$ 88,281.88**	**$ 210,938.40**	**$ 299,220.28**
TOTAL with UVIC overhead 25%			**$ 372,775.35**

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