Tufts UNIVERSITY

CUMMINGS SCHOOL OF
VETERINARY MEDICINE

Center for Animals and Public Policy

June 30, 2017

The Honorable Mayor Douglas A. Dahlgard
Village of Head-of-the-Harbor
Municipal Building
500 N. Country Road
St. James, NY, 11780

Re: Proposal – White Tailed Deer Immunocontraception Study

Dear Mayor Dahlgard and Council:

Based on the feedback we received at our deer immunocontraception presentation in June 2016, and on our observations during the site evaluation we conducted in October 2016, the Cummings School of Veterinary Medicine at Tufts University and The Humane Society of the United States (HSUS) jointly propose a cooperative deer immunocontraception project with Avalon Park and Preserve and the Village of Head of the Harbor (HotH).

While our primary objectives include further exploring the feasibility and efficacy of remote delivery of long-acting PZP vaccines and investigating non-invasive technologies for identifying deer, the overriding goal of this research project is to test and refine tools that will help better enable the wider humane management of suburban white-tailed deer populations with immunocontraception.

Please find attached for your review a copy of our study proposal to conduct field work in partnership with the Village. During the review process, please do not hesitate to contact us with any additional questions or concerns regarding the proposal or processes entailed.

We'd like to thank you once more for the opportunity to share our work to date with the Village, and look forward to discussing the project with you again soon.

Respectfully,

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A Proposal to the Village of Head-of-Harbor, New York

Allen Rutberg, Center for Animals and Public Policy, Cummings School of Veterinary Medicine, Tufts University

Kali Pereira, The Humane Society of the United States

30 June 2017

Summary

In more than 20 years of field testing, the PZP vaccine has been shown to be an effective contraceptive in female white-tailed deer. Side effects have been minimal; and in some environments, PZP application has successfully stabilized and reduced deer populations. As PZP use begins to transition from research to management, several technical and practical challenges still need to be addressed. One is the need to minimize the number of times a deer must be treated to provide long-term contraception. A second challenge is to reduce the need to capture deer for individual identification and treatment. Meeting both challenges will enable broad application of PZP for controlling suburban deer populations and reducing conflicts with deer.

Accordingly, Cummings School of Veterinary Medicine at Tufts University and The Humane Society of the United States (HSUS) jointly propose a cooperative project with Avalon Park and Preserve and the Village of Head of the Harbor (HotH) to refine, test, and apply a set of tools that will help enable the humane management of suburban white-tailed deer populations with the PZP (porcine zona pellucida) immunocontraceptive vaccine.

The immediate objectives of the study are to test the effectiveness and longevity of initial treatments of controlled-release PZP vaccine delivered by dart, and to refine and test detection stations for implantable microchips (PIT tags) for identification of individual deer. Both remote delivery of long-acting PZP vaccines and non-invasive technologies for identifying individual deer will be essential tools for wider management use of contraception for suburban deer management.

To pursue these objectives, we will capture ~80 female deer over a three to four year period (winter 2018-2020 or 2021) using tranquilizers delivered by dart. All captured deer will be fitted with ear-tags to allow individual identification.

The project will be carried out primarily by personnel from The HSUS and Cummings School, with field assistance and logistic support provided by Avalon Park and Preserve. It is expected that necessary funding for the project will be drawn from multiple sources, including the Village of Head of the Harbor, foundations, and private donors.

HSUS and Cummings School will also work with Avalon Park & Preserve and the Village of HotH to develop and disseminate information regarding the humane resolution of wildlife conflicts, with a focus on deer, and carry out programs as needed to encourage tolerance and appreciation of local wildlife in the community.

Introduction

Conflicts between people and thriving populations of white-tailed deer are common in towns and suburbs throughout the northeast and mid-Atlantic regions and in clusters scattered throughout the U.S. While many actions can be taken by communities and property owners to mitigate these conflicts, the effectiveness of mitigation may be limited unless some action is taken to stabilize or reduce deer populations.

In many areas where deer are abundant, however, deer population management tactics are severely constrained by the environments in which they live. Deer inhabit suburban backyards, school properties, heavily used public recreation spaces and industrial parks within which traditional deer management techniques such as hunting simply cannot be safely applied. In other portions of the community, hunting is feasible but so constrained by firearms bans, no-discharge zones and other limitations that hunters cannot take sufficient numbers of deer to measurably affect population growth. Hunting and other lethal approaches to deer management may also be incompatible with the cultures and values of some communities.

Two major approaches to non-lethal management of suburban deer populations have emerged: irreversible surgical sterilization and reversible immunocontraceptive vaccines. Each approach has advantages and disadvantages; we prefer pursuing immunocontraceptive vaccines because (1) they are less invasive; (2) further research may significantly improve cost-effectiveness; and (3) their application requires less technical training and in our view has greater potential to be scaled up, especially as techniques are improved.

Previous work on the PZP (porcine zona pellucida) vaccine indicates that "native PZP," the simple emulsion form of the vaccine (registered for use in wild horses and burros as ZonaStat-H), is effective when delivered by dart in a wide range of species, including white-tailed deer, wild horses and burros, African elephants, bison, elk, and many species captive in zoos (Kirkpatrick et al. 2011). For management applications to free-roaming wildlife that are not easily accessed for darting, including deer, the annual application of native PZP that is required to maintain contraceptive effectiveness is impractical. Consequently, research conducted on deer and wild horses for the last 15 years has focused on testing a controlled-release PZP vaccine ("PZP-22") designed to last several years with a single treatment (Turner et al. 2007, 2008; Rutberg et al. 2013a). In white-tailed deer, data from Fripp Island, SC, and Hastings-on-Hudson, NY, indicate that a single hand-injection of PZP-22 produces two to three years of effectiveness in deer (Rutberg et al. 2013a; Pereira and Rutberg, unpubl. data). Ongoing

research at Hastings-on-Hudson is investigating the effectiveness and longevity of remotely delivered native PZP and PZP-22 boosters to deer primed with PZP-22. This study follows up on work in wild horses demonstrating that a single booster delivered to a PZP-22-primed mare yields three or more additional years of contraception (Rutberg et al. 2017).

The capacity of native PZP and PZP-22 to stabilize and reduce white-tailed deer populations in some suburban environments has been clearly established (Rutberg and Naugle 2008; Rutberg et al. 2013b). While the success of any technique will be affected by the environment and, most importantly, the behavior of the deer, the biggest remaining technical obstacle to wider application is the need to capture deer prior to treatment. Relative to simple remote darting with vaccine, capturing deer for tagging and treatment is far more time-consuming, more expensive, and more constrained by safety and environmental concerns (Naugle and Grams 2013).

The main purpose of this study is to explore techniques that will reduce the need to capture deer for PZP treatment.

Site Description

Head of the Harbor, NY, comprises approximately 3 square miles on Long Island's North Shore. Population as of 2013 was just under 1500 people. Significant areas of open space are occupied by Harmony Vineyards, Avalon Park and Preserve, and BB & GG Farms and Nursery, in addition to residential and private properties of 2 acres and above.

Neighboring communities include Stony Brook, St James, and Nissequogue. Nissequogue utilizes hunting as a means of deer management.

Preliminary Observations

From 26 Oct through 28 Oct 2016 Kali Pereira of The HSUS and Dr. Allen Rutberg of the Cummings School of Veterinary Medicine at Tufts University met with local land owners, business owners, the mayor, and Avalon Park & Preserve staff to discuss observations of deer and perceived trends in deer movements and numbers. Deer were scouted with spotlights in the early morning for 2 consecutive days, and from 1700-2200 for 3 consecutive evenings. Midday meetings took place with private property owners who voiced an interest in assisting a potential project, and allowing access to their property.

Terrain. Most homes are sited on lots of 2 to several acres. Although there are rises and depressions along the roadsides and a handful of steeper hillsides, much of the land is flat with gradual elevation changes, with few drastic inclines and drop-offs. Much of the terrain is wooded, interspersed with large lawns, farm fields, and meadows on

private, commercial, and preserve land. With the exception of some "hot spots" and trees (such as yews and eastern red cedars) that are deer browsing favorites, deer impacts on the landscape are subtle, and seedling regeneration and understory plant growth are still robust in most places. Thus, deer impacts may be considered moderate.

Behavior & Accessibility of Deer. During our deer observations, many animals appeared a bit jumpy and more alert when we stopped the vehicle to watch them. Windy and rainy weather during much of our observation period could also have contributed to deer wariness. With this in mind there were still instances along the roadside where we could get into appropriate darting ranges (under 25 yards).

Except on certain main highways during morning and evening traffic peaks, human disturbance is relatively low onsite, and public interference with darting activity would be minimal, especially on medium-to-large tracts of private land. Residents who see deer frequently have noted that the deer often are not disturbed by the residents' activities in their yards and around their homes. Darting where deer are accustomed to seeing human activity may be an effective way to access deer.

Bait stations placed securely on private property would likely attract and focus the attention of otherwise wary deer away from field staff. With community support and accessibility of private lands, access to animals will be much easier than relying on opportunistic darting only.

Community Partnership. During our visit, strong community support was expressed for implementing and sustaining a deer contraception project. Physical facilities and other infrastructure is also in place. The project would rely heavily on logistical and potentially personnel support from Avalon Park & Preserve and its staff, which could also form a core for sustaining a program after the initial research phase is completed. Subsequent to our visit, the Village Board of Trustees formally voted to support the project.

Project Goals

This project is intended to test technologies that will improve cost-effectiveness and practicality of PZP contraceptives for management of suburban deer. Specifically, we propose to:

1. Test remote delivery of priming doses of controlled-release PZP vaccines ("PZP-22"). Although there is evidence for effectiveness of remotely delivered PZP-22 primers in wild horses, for deer PZP-22 primers have only been administered by hand.

2. Test individual identification systems that could ultimately reduce the need to capture all deer prior to treatment. Capturing deer for ear-tagging is more time-consuming, costlier, and riskier to animals and field personnel than direct administration of vaccine by dart. Capture also requires higher levels of

personnel training, expertise, permitting, and personal commitment. In addition, capturing deer with immobilizing drugs poses higher risks to secondary consumers (including predators, scavengers, and hunters) than direct PZP administration.

3. Contingent on successful outcomes in accomplishing goals 1 and 2, develop and test tools to deliver PZP-22 and PIT tags remotely in a single package.

4. Working with community resources, to develop and apply a comprehensive sustainable community-based model for managing wildlife-human conflicts focusing on but not limited to deer.

Study Design

All study subjects will be captured via chemical immobilization and marked with ear tags. In general, each deer will be darted once for capture, and then up to two more times total for direct dart administration of the PIT tag and/or PZP.

Remote delivery of priming doses of PZP-22

A total of 40-50 adult female deer will be captured in March using chemical immobilization following protocols refined at Hastings-on-Hudson, NY (see Appendix B). All captured deer will be ear-tagged, assessed for health and reproductive status and blood-sampled for pregnancy testing. Standard body measurements will also be taken. Half of the captured females will be treated by hand with a priming dose of PZP-22 (Appendix C). Half will be released and remotely darted with PZP-22 in April (or September if they cannot be located in April). Fawning rates in subsequent years will be monitored to assess the relative effectiveness of the two treatments and compare both rates to pre-treatment pregnancy rates.

All surviving PZP-22-treated deer will be boosted 2.5 years after initial treatment with the same booster preparation, either PZP-22 or native PZP. PZP-22 will be used as the booster if it is shown to be markedly more effective or long-lasting than native PZP in trials currently being conducted in Hastings. If the two booster preparations show comparable effectiveness and longevity, native PZP boosters will be used to reduce program costs.

Remote Identification: PIT Tags

Phase I. All females captured, handled, and ear-tagged as above will also be hand-injected with 13 mm HDX PIT tags (Passive Integrated Transponder; Oregon RFID) at one of two locations on their bodies (high hip/low hip) (see Appendix D). Activity of

tags will be confirmed with a hand detector before release. Antenna arrays will be set up around feeders and other predictable and confined travel routes. Feeders will be placed in the field in February, prior to capture, while antenna arrays will be set up after capture, in late March or April. Trail cameras will be directed at antenna arrays to evaluate effectiveness of antennas in detecting visits. The concept will be further evaluated by estimating the proportion of known PIT-tagged does that are detected.

Phase II. If satisfactory properly placed antenna arrays can be constructed that will reliably detect PIT-tagged deer in Phase I, we will subsequently (in March of year two and/or year three) capture, ear-tag, treat with PZP-22 and release up to 20 additional deer without injecting PIT tags. A month later, we will remotely dart these deer in the hip with darts which contain PIT tags in the needle barrel following methods described in Walter et al. (2012). Detection of these deer will be monitored as in Phase I. For ease of observation, deer released without PIT tags will receive different-colored ear tags than deer hand-injected with PIT tags before release.

Phase III. Assuming (a) remote delivery of PZP-22 primers is effective ($\leq$ 20% fawning) for at least one year and (b) PIT tags can be remotely delivered and reliably detected by properly placed antenna arrays, we will work with Pneu-dart® to develop and test a dart that can simultaneously inject PZP-22 (emulsion plus pellets) and 13 mm PIT tags. If preliminary (non-live animal) testing is encouraging, we will capture and ear-tag 20 additional deer in March (year four) and remotely dart these deer in the hip with the new dart incorporating PZP-22 plus pellets. Success will be evaluated in detectability and reduction in fawning.

Community-Based Model for Managing Deer-Human Conflicts

The HSUS will also assist the Village on a more comprehensive scale by working with village officials and Avalon Park and Preserve to adapt elements of The HSUS's comprehensive deer management plan, which includes tools and techniques for addressing the root causes of specific deer conflicts, such as garden damage, deer-vehicle collisions, and the transmission of Lyme disease. We will also assist the Village in a public educational and awareness campaign to involve the public in addressing these root causes of conflict.

In addition to helping to resolve human-deer conflicts within the Village, The HSUS will also work with Avalon Park and Preserve to conduct opportunistic trainings for key HOTH Village agencies or organizations that need assistance addressing public concerns with wildlife, and develop and distribute *Wild Neighbors* wildlife conflict resolution resources to village departments and organizations within the community. We can also provide or help staff public events featuring natural history discussions of "problem" wildlife to educate residents and reinforce positive framings that encourage positive attitudes toward local wildlife.

Literature Cited

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APPENDIX A.

Project Time Line

Year	PZP-22 Delivery	PIT Tag Testing	# Deer (cumulative)
2018	- Set up feeders (February) - Capture, tag, and pregnancy test (March) - Treat half with PZP-22 at capture, dart half with PZP-22 after release - Monitor fawning (August)	- Inject all captured deer with PIT tags (March) - Establish camera-monitored tag-reading stations (March-April) -Evaluate station PIT tag detection capacity (April) - Modify and/or relocate tag-reading stations as needed (April-September)	40-50
2019	- Set up feeders (February) - Capture, tag, and pregnancy test (March) - If needed to reach target sample size, treat half of captured deer with PZP-22 after release - Monitor fawning (August)	- Set up feeders (February) - Establish camera-monitored tag-reading stations (March-April) - Dart newly captured deer with PIT tags (April) - Evaluate station PIT tag detection capacity	60-70
2020	- Set up feeders (February) - Capture, tag, and pregnancy test (March) - Dart with combined PZP-22/PIT tag dart (April) - Monitor fawning (August) -Boost 2018-treated does (September)	- Establish camera-monitored tag-reading stations (March-April) - Dart with combined PZP-22/PIT tag dart (April) - Evaluate station PIT tag detection capacity	80-90
2021	-Monitor fawning (August) -Boost 2019-treated does (September)	Evaluate use of tag-reading stations for booster delivery	80-90
2022	- Monitor fawning (August) - Boost 2020-treated does (September)	Evaluate use of tag-reading stations for booster delivery	80-90
2023	-Monitor fawning (August)	Evaluate use of tag-reading stations for booster delivery	80-90

APPENDIX B.

Capture & Animal Handling Methods: All animal handling procedures will be carried out with primary concern for the safety and well-being of animals, researchers, and bystanders. A local project veterinarian will be identified who will secure and oversee the use of drugs for chemical immobilization, provide veterinary medical advice, and be available to intervene in the event of a veterinary emergency involving a study subject.

Chemical Immobilization:

Deer will be captured by chemical immobilization with a pre-mixed formulation of BAM (Butorphanol, Azaperone, Medetomidine; Wildlife Pharmaceuticals, Windsor, CO; http://wildpharm.com/bam-kit/item/2-wildlife/61-bamiikit.html). Each 1 mL of BAM contains 27.3mg Butorphanol, 9.1 mg Azaperone, and 10.9 mg Medetomidine, and will be protected from prolonged cold to ensure stabilization of solution components. Use of chemical immobilizing drugs will be carried out under the supervision and authority of a licensed veterinarian in the area (who has yet to be identified).

Deer will be captured via darting during March and April 2018. Animals will receive 1-2 cc of BAM (approx. 0.6 – 1.2 mg/kg Butorphanol + 0.2-0.4mg/kg Azaperone + 0.2-0.5mg/kg Medetomidine) (Wildlife Pharmaceuticals 2015 BAM Administrative Guidelines for white-tailed deer, http://wildpharm.com/media/djcatalog/BAM_2015DEER_AdministrationGuidelines_2-25-FINAL.pdf).

Exact dosages are determined on site after deer weights are estimated and it is seen how they respond to the standard drug dosages under field conditions. BAM is delivered intramuscularly in the hip via a 1 to 2 cc self-injecting PneuDart® transmitter dart with a 1 to 1.25" barbed needle tip, using a Dan-Inject® Model CO2 PI pistol, or Model JM Standard CO2 rifle or equivalent. After darting, all animals will be tracked visually and with radiotelemetry.

Additional Doses & Supplemental Injections:

If animals receiving an initial injection of BAM are not recumbent or sedate within 15 to 20 minutes, the initial dose can be re-administered i.m., as the sedative medications are fully reversible. Depending upon patient response, depth of anesthesia, and with primary concern for both human and animal safety, supplemental injections may be given via dart projector or hand injection via 3cc syringe with an 18-20g needle.

Animal Handling:

Once the target animal is sedate, it will be approached quietly and placed in sternal recumbency in a safe area for the work-up to take place. A hood or towel will be placed over the animal's eyes to reduce visual stimuli. Ophthalmic ointment will be administered topically in each eye to prevent corneal desiccation during sedation. Oxygen will be administered via nasal cannula or mask to help reduce the risks of

hypoxemia associated with Medetomidine (Mich et al., J. Zoo Wildl. Med. 39(3):480-487 (2014)). Uniquely numbered cattle tags will be placed in each ear, followed by administration of PZP vaccinations and PIT Tags as outlined in the protocol. Further identification and body measurements including body condition scoring, hind limb length, body length and girth, and any distinguishing markings or scars will be recorded. Weight will be obtained via spring scale whenever possible, or will be estimated based on linear measurements and visual assessment.

Approximately 8 to 10 mL of blood will be collected via jugular, cephalic, or saphenous veins to test for pregnancy at time of capture. Samples will be labelled with date and corresponding ear tag numbers and centrifuged. Serum will be submitted to BioTracking, Inc. (Moscow, ID) for pregnancy testing using pregnancy-specific protein B.

Darts will be carefully removed and any wounds associated with dart impact will have the hair around it clipped and the site cleansed with antimicrobial solution and packed with antibiotic ointment. In addition, all animals captured will receive a subcutaneous injection of Oxytetracycline, a broad spectrum antibiotic, to further reduce risk of infection related to darting. Any existing wounds or injuries will be assessed and treated appropriately, with veterinary oversight for significant findings.

In addition to physical assessment and assessing response to stimuli and presence of reflexes (palpebral, corneal, gag/swallow, and jaw and rectal tone) throughout the sedation procedure, vital signs (heart rate, respiratory rate, SpO2, rectal temperature) will be monitored using auscultation with a stethoscope, visual monitoring, a pulse oximeter, and a digital rectal thermometer, and recorded every 5 to 10 minutes until anesthetic reversal and recovery.

Responses to Emergencies

Deer showing signs of respiratory distress (O2 Saturation <85-90%, decreased respiratory rate, cyanotic mucous membranes) will be given Doxipram intravenously or intramuscularly along with supplemental Oxygen via nasal cannula or mask. Animals showing signs of persistent or severe respiratory distress will receive drug antagonists specific to induction medications used (in dosages specified below) and be released and monitored. In the event of prolonged apnea, an endotracheal tube will be placed in the airway, the patient will be manually ventilated via ambu-bag and the field crew will seek immediate assistance and direction from the Project Veterinarian.

Animals with persistent bradycardia and poor perfusion will receive drug antagonists specific to induction medications (as described below) and will be released and monitored.

To combat hypothermia associated with cold environmental temperatures and/or exposure to moisture, patients will be placed on emergency foil blankets and wool blankets, with direct contact to snow and damp ground being minimized. Deer with persistent hypothermia or extremely low body temperature (less than 37C) upon initial

handling will immediately receive drug antagonists specific to induction medications (as described below) and stimulated until they are able to walk or run.

Reversal of Anesthesia:

Upon completion of the capture and treatment, the BAM formulation is effectively and quickly reversed by administering reversal agents by intramuscular injections in the hip or shoulder. This includes the Butorphanol antagonist Naltrexone (0.5 ml at 25mg/ml) intramuscularly plus the Medetomidine antagonist Atipamezole at twice the total volume of BAM delivery (2.0-4.0 cc, equivalent to 50 to 100mg I.M.) as per formulation specified in Wildlife Pharmaceuticals' 2015 BAM Administrative Guidelines for white-tailed deer (http://wildpharm.com/media/djcatalog/BAM_2015DEER_AdministrationGuidelines_2-25-FINAL.pdf) .

All recovering deer will be monitored and observed at least until they stand and walk out of sight or to another location.

Efforts will be made to relocate all captured deer during the day following anesthesia and subsequently throughout the duration of field work to ensure animals have fully recovered from capture.

APPENDIX C: PZP Delivery Methods

Animals receiving PZP- 22 by hand will be injected in the hip musculature while sedated via 3mL syringe with an 18-20 gauge x 1" sterile needle containing 1 cc of liquid vaccine comprised of 0.5mL (100ug) porcine zona pellucida emulsified in 0.5mL modified Freund's Complete Adjuvant (Science and Conservation Center, Billings, MT).

Pellet doses comprised of 550µg PZP and 500µg QA-21 prepared in three heat-extruded lactide-glycolide pellets engineered to release at 1 month, 3 months, and 12 months (Dr. J.W. Turner, Jr., University of Toledo, Ohio) will be administered by a second IM injection close to the PZP emulsion injection site. These three pellets will be loaded into 14 gauge needles and a trocar syringe.

Animals receiving priming doses PZP-22 via remote delivery will receive PZP emulsified in mFCA placed in the body of a 1 cc self-injecting implant dart with a 14g x 1" needle, with the pellets being placed inside the needle of the implant dart (Pneudart®, Williamsport, PA). This will allow both vaccine components be given in a single dart and reduces the need for multiple injections. Darts will be delivered with a Dan-Inject® Model CO2 PI pistol, or Model JM Standard CO2 rifle or equivalent.

Booster doses of PZP will consist of 100 µg PZP emulsified with Freund's Incomplete Adjuvant (FIA) (Science and Conservation Center, Billings, MT) and may be administered with or without controlled-release pellets pending results from the Hastings-On Hudson, NY study.

APPENDIX D.

PIT Tag & Reader Methods

Administering PIT Tags

13 mm HDX PIT Tags will be injected intramuscularly via hand injection with a trocar syringe during the capture process, or remotely by 1 cc self-injecting implant dart (PneuDart®, Williamsport, PA).

- Phase 1: All deer that are chemically immobilized in Year 1 will have *yellow* ear tags applied to each ear, and receive their PIT tag via hand injection. Successful placement will be confirmed with a handheld reader prior to release from capture.
- Phase 2: Deer captured in Year 2 will have *white* ear tags applied to both ears and will receive their PIT tag via dart, after they have been released and relocated.
- Phase 3: Deer captured in Year 3 will have *pink* ear tags applied to both ears, and will receive their PIT tag, along with PZP-22 vaccine in a single implant dart, after they have been released and relocated. For these applications, the 1 cc implant dart will first be loaded with PZP emulsion inside the dart body, then pellets placed in the needle, followed by the PIT Tag. Therefore the injection order into the muscle tissue will be PIT Tag, then pellets, then emulsion.

This color coding will assist field staff in quickly identifying which tagged animals need to be darted with a PIT tag, as well as determine whether the delivery method of the tag plays a role in reliability of signal capture by a reader.

PIT tags will be injected in either hind end of each deer, with at least half placed higher in the hip muscular, and the other approximate half placed in the lower half of hip musculature, but above the stifle joint. PIT tag placement must be compatible with appropriate PZP administration sites, which as per label is defined as "hip musculature". By placing the tags in different positions, we hope to better assess ability of reader antenna to pick up signals in regards to the tag's position in the body. Additionally, we hope this information may better guide us in finding the most reliable combination between tag placement and reader configuration.

PIT Tag Reading Methods

A total of 2 to 4 PIT Tag readers will be utilized during the study, each in a fixed and secure location. Reader stations will likely be set up on a natural deer pathway, placed near a bait station, or baited regularly to entice deer to come within range to have their indwelling PIT tag read. Reader components and assembly will be supplied and supported by OregonRFID (https://www.oregonrfid.com/; Portland, Oregon). Each

fixed station will contain a multiple antenna reader that will support up to 4 antenna arrays at one time, along with an auto tuner for each configuration. Twinax cable will be used between the direct reader location and the antenna. Cables and antenna arrays will be adjusted periodically to determine which types of set-up work best in reading PIT tags placed in the hind quarters of deer. Each complete station will be powered by 12 volts DC power, which will be generated from a pair of deep cycle marine batteries. Batteries will be swapped and charged weekly to insure appropriate charge levels in reading tags of deer that pass by or through the reader station.

Data collected from reader stations will be downloaded manually or via Bluetooth to a compatible device. Data will be downloaded periodically during active field sessions, as well as during the spring and summer months, to verify the presence of study deer and the reliability of tag location and reader configuration.

APPENDIX E.

Budget

Total of Estimated Costs

Year 1	$82,626.20
Year 2	$50,870.80
Year 3	$67,899.50
Year 4	$23,101.00
Year 5	$13,418.00
Year 6	$4,300.00
PROJECT 6-YEAR TOTAL	**$242,215.50**

Cost Analysis per Project Year

Year 1: 2018

Session Events:

1. Pre-baiting & field set-up
2. Winter population census
3. Winter capture March
4. Winter capture and re-darting April
5. Summer fawning observations

Activity	Type of Expense	General Costs	Estimated Total	Total for 2018:
Fieldwork	Baiting	1348	45,011.20	82,626.20
	Capture & Treatment	21228.2		
	PIT Readers & Monitoring	19915		
	Population Estimate	1500		
	Lab Fees	1020		
Administrative	Permitting	15	37,615.00	
	Staff Travel	5900		
	Staff Lodging	12900		
	Staff Meals	7050		
	Field Vehicles & Fuel	8250		
	Community Education	3500		

Year 2: 2019

Session Events:

1. Pre-baiting & field set-up
2. Winter Population Census
3. Winter capture March
4. Winter capture and re-darting April
5. Summer fawning observations

Activity	Type of Expense	General Costs	Estimated Total	Total for 2019:
Fieldwork	Baiting	492	16,370.80	50,870.80
	Capture & Treatment	13758.8		
	PIT Readers & Monitoring	0		
	Population Estimate	1500		
	Lab Fees	620		
Administrative	Permitting	0	34,500.00	
	Staff Travel	5900		
	Staff Lodging	12900		
	Staff Meals	5600		
	Field Vehicles & Fuel	6600		
	Community Education	3500		

Year 3: 2020

Session Events:

1. Pre-baiting & field set-up
2. Winter population census
3. Winter capture March
4. Winter capture and re-darting April
5. Summer fawning observations
6. Fall PZP retreatment

Activity	Type of Expense	General Costs	Estimated Total	Total for 2020:
Fieldwork	Baiting	492	26,949.50	67,899.50
	Capture & Treatment	24,537.50		
	PIT Readers & Monitoring	0		
	Population Estimate	1500		
	Lab Fees	420		
Administrative	Permitting	0	40,950.00	
	Staff Travel	7700		
	Staff Lodging	16900		
	Staff Meals	7550		
	Field Vehicles & Fuel	8800		

Year 4: 2021

Session Events:

1. Winter population census
2. Summer fawning observations
3. Fall PZP retreatment

Activity	Type of Expense	General Costs	Estimated Total	Total for 2021:
Fieldwork	Baiting	0	10,351.00	23,101.00
	Capture & Treatment	8,851.00		
	PIT Readers & Monitoring	0		
	Population Estimate	1500		
	Lab Fees	0		
Administrative	Permitting	0	12,750.00	
	Staff Travel	2500		
	Staff Lodging	5200		
	Staff Meals	2300		
	Field Vehicles & Fuel	2750		

Year 5: 2022

Session Events:

1. Winter population census
2. Summer fawning observations
3. Fall PZP retreatment

Activity	Type of Expense	General Costs	Estimated Total	Total for 2022:
Fieldwork	Baiting	0	7,418.00	13,418.00
	Capture & Treatment	5,918.00		
	PIT Readers & Monitoring	0		
	Population Estimate	1500		
	Lab Fees	0		
Administrative	Permitting	0	6,000.00	
	Staff Travel	1600		
	Staff Lodging	2400		
	Staff Meals	850		
	Field Vehicles & Fuel	1150		

Year 6: 2023

Session Events:

1. Winter population census
2. Summer fawning observations

Activity	Type of Expense	General Costs	Estimated Total	Total for 2023:
Fieldwork	Baiting	0	1,500.00	4,300.00
	Capture & Treatment	0.00		
	PIT Readers & Monitoring	0		
	Population Estimate	1500		
	Lab Fees	0		
Administrative	Permitting	0	2,800.00	
	Staff Travel	700		
	Staff Lodging	1200		
	Staff Meals	350		
	Field Vehicles & Fuel	550		

Cost Contingencies and Potential Reductions:

1. Housing and field vehicle rental costs could be reduced if the municipality is able to procure discounts or donations for these items
2. PIT Tag Reader Stations cost approximately $4200.00 each. The current budget reflects 3 units, which is the ideal scenario. However, reducing down to 2 units would not significantly impact the project and could be a potential avenue for cost savings.
3. A third alternative for potential cost reductions is the price of booster doses of PZP-22. This is contingent upon outcomes that are yet to be observed at the Hastings on Hudson, NY study site. Should that study show that pellets are not necessary in follow up vaccinations, then there is a potential cost reduction of approximately $20,000.00