Michigan Department of Natural Resources – Procurement Services
P.O. Box 30028, Lansing, MI 48909
OR
525 W. Allegan, Lansing, MI 48933

CHANGE NOTICE NO. 01 TO CONTRACT NO. 751B2200001
Between
STATE OF MICHIGAN
and

Required by authority of 1984 PA 431, as amended.

Name and Address of Contractor	Primary Contact	
Mississippi State University Office of Sponsored Programs Administration PO Box 6156 133 Etheredge Hall Mississippi State, MS 39762	Jennifer Easley	
	Email aor@spa.msstate.edu	
	Telephone (662)325-7404	Contractor #, Mail Code *****5984/283

State Contact	Agency	Name	Telephone	Email
Contract Administrator	DNR	Steve Beyer	(517)243-5179	BeyerS1@michigan.gov
Buyer	DNR	Jana Harding-Bishop	(517)284-5938	HardingJ3@michigan.gov

Initial Contract Summary

Description (Provide a basic but comprehensive description of services)

Project title: Role of predators, winter weather, and habitat on white-tailed deer fawn survival in Michigan – Phase II

Effective Date	Initial Expiration Date	Initial Available Options	Current Expiration Date
10/1/2011	9/30/2017	1 – 5 year option	9/30/2017
Payment Terms	F.O.B.	Shipped	Shipped From
Net 45	N/A	N/A	N/A
Minimum Delivery Requirements		Alternate Payment Options	Available to MiDeal Participants
N/A		☐ P-Card ☐ Direct Voucher (DV)	☐ Yes ☒ No

Description of Change Notice

Option Exercised: ☐ Yes ☒ No If Yes, New Expiration Date: _____

Provide the detail of the Change Notice

Per Change Notice 001 attached:
Change Contract Administrator, update DNR Buyer Phone number, clarify section I-F deliverable due dates and allow for subcontracting two sections of the work statement.

Value/Cost of Change Notice	Estimated Revised Aggregate Contract Value
$0.00	$1,160,000.00

FOR THE CONTRACTOR:	FOR THE STATE:
Michigan State University	Department of Natural Resources
On- file in DNR Procurement	On-file in DNR Procurement – Joe Frick for
Authorized Agent Signature	Authorized Buyer Signature
Jennifer Easley	Sharon Walenga-Maynard, Procurement Supervisor
Authorized Agent (Print or Type)	Authorized Buyer (Print or Type)
4/9/14	4/10/14
Date	Date

PR1181 (Rev. 09/**/2012

CHANGE AUTHORIZATION REQUEST

Contract No. 751B2200001
Change Authorization Request No. 001

I. General

This Change Authorization Request is subject to all terms and conditions of the Contract between Mississippi State and the State of Michigan for the project titled "Role of predators, winter weather, and habitat on white-tailed deer fawn survival in Michigan – Phase II". Except as expressly specified herein, all terms and conditions of the Contract shall remain in full force and effect upon execution of this request. This request is not valid until a Contract Change Notice is issued and signed by all parties and a Purchase Order is issued or revised by the Department of Natural Resources.

II. Reason for Change

This contract is also being changed to allow Mississippi State University to subcontract two portions of the methods section of the Work Statement (Appendix A of the existing contract). In each case, the new subcontractor has improved capabilities to do the work from the original contract using newer techniques not available at the time MSU was awarded the contract. In each case, the new subcontract has the expertise in the new techniques not currently available through MSU. There is no change to the overall contract amount as a result of this subcontracting. Consequently, The Department of Natural Resources will receive a better product at no additional cost.

The two method portions being changed along with the new subcontractor are:

1. Beth Garner, North Carolina State University (NCSU) – Under the *Population Estimates* portion of the methods (Page 18 in original contract), this subcontractor will be providing an enhanced estimate of black bear populations by integrating additional data sets into a hierarchical modelling framework. This method will replace the original estimate using solely DNA-based mark-recapture data.

   Subcontractor Information: Beth Gardner
   NC State University
   Department of Forestry and Environmental Resources
   Turner House, Campus Box 7646
   Raleigh, NC 27695-7646

2. Find It Detection Dogs – Under the *Monitoring and Survival* portion of the methods (the first full paragraph on page 18 in original contract), this subcontractor will be providing an enhanced searching technique to find where fawn predation may have occurred using trained dogs to locate carcasses in areas where there have been clusters of radio-collared predator locations determined by MSU researchers from radio-telemetry. This method will replace the visual searches by MSU researchers that would have been done within these same location clusters.

   Subcontractor Information: Greg Davidson, Owner
   Find it Detection Dogs
   P.O. Box 693
   Walden, CO 80480

III. Description of Changes

Change Mississippi State Authorized Signature and Primary Contact to Jennifer Easley
Change Contract Administrator to Steve Beyer
Update Buyer Jana Harding-Bishop's phone number

Clarify in Section I-F when deliverables are due: Revise the due dates of the reports to the following:

Annual Progress Report	September 15, 2012
Annual Progress Report	September 15, 2013
Annual Progress Report	September 15, 2014
Annual Progress Report	September 15, 2015
Annual Progress Report	September 15, 2016
Final Report and Management Executive Summary	September 30, 2017

For each of the two subcontractor modifications being made to this contract, the original contract language will be modified with the specified language provided below.

1. The original language for *Population Estimates,* Page 18 in the original contract, reads as follows with the language to be replaced highlighted:

   Population estimates.—The deer population will be estimated using mark-resight data based on images collected from trail cameras during September. Cameras will be placed in a grid and operated for 10 days in September. Two estimates of deer abundance will be derived. The first will use antler characteristics for males and correction factors for fawn deer (Demarais et al. 2000). The second will incorporate data from tagged females in models (e.g., Pradel model) in program MARK (White and Burnham 1999). The camera survey will also provide an estimate of the sex and age structure of the deer population, particularly the pre-deer season doe-to-buck ratio. Black bear and bobcat abundance will be estimated using DNA-based mark-recapture data from hair snares (Belant et al. 2005). Coyote abundance will be estimated using howling surveys (Okoniewski and Chambers 1984) and winter track counts. Wolf abundance will be estimated by winter track counts.

Revised and Additional language – this section will now read as follows with new text highlighted:

Population estimates.—The deer population will be estimated using mark-resight data based on images collected from trail cameras during September. Cameras will be placed in a grid and operated for 10 days in September. Two estimates of deer abundance will be derived. The first will use antler characteristics for males and correction factors for fawn deer (Demarais et al. 2000). The second will incorporate data from tagged females in models (e.g., Pradel model) in program MARK (White and Burnham 1999). The camera survey will also provide an estimate of the sex and age structure of the deer population, particularly the pre-deer season doe-to-buck ratio. Bobcat abundance will be estimated using DNA-based mark-recapture data from hair snares (Belant et al. 2005). Coyote abundance will be estimated using howling surveys (Okoniewski and Chambers 1984) and winter track counts. Wolf abundance will be estimated by winter track counts.

Black bear abundance will be estimated similar to bobcats, using a DNA-based mark-recapture data from hair snares. Additionally, GPS location data already collected by the MSU researchers will be integrated from collared black bears to better estimate sigma (movement parameter) used in mark-recapture models through multiple sources of point process data. This technique is an example of

hierarchical modelling that will be done through a subcontract with NCSU by researchers expert in this technique.

Hierarchical models allow for better estimates when additional datasets are available because they allow for the description of the true underlying ecological process with a conditional model describing the observation process. Aspects of imperfect and varying detection probability are accounted for within the model for the observation process. In addition to accounting for imperfect detection, hierarchical models allow the combination of datasets from different techniques or replicated surveys. This also enables researchers to combine low cost/low-resolution and high-cost/high resolution data into more comprehensive analyses, allowing for more cost effective and logistically feasible long term population monitoring programs.

2. The original language for *Monitoring and Survival,* the first full paragraph on page 18 in original contract, reads as follows with the language to be replaced highlighted:

   Aerial telemetry of collared predators will occur 2-3 times each week from mid-May to mid-August. Animal locations will be integrated within a GIS environment to ascertain location clusters that could represent predation events. These locations will be searched to determine whether a fawn predation occurred. We have used this technique successfully on all carnivore species during Phase I of this overall study. The minimum number of fawns killed by each radio-collared predator will be determined which can then be extrapolated to respective predator population estimates.

Revised and Additional language – this section will now read as follows with new text highlighted:

Aerial telemetry of collared predators will occur 2-3 times each week from mid-May to mid-August. Animal locations will be integrated within a GIS environment to ascertain location clusters that could represent predation events. These locations will be searched using dogs trained specifically to detect prey remains of mammals and birds and has been demonstrated as more effective than searches for prey remains by humans only. These searches will be conducted under a subcontract with Find It Detection Dogs. This company is the recognized leader in the use of dogs for such surveys. Both the dog handlers and dogs have considerable experience in conducting this type of surveys. The minimum number of fawns killed by each radio-collared predator will be determined which can then be extrapolated to respective predator population estimates.

IV. Time Period of Change

The above described changes will occur over the remainder of the original contract period. The subcontract for NCSU will occur during FY 2014 only. After this initial year, the original contract researchers will be able to calculate the hierarchical model for the remaining contract period. The subcontract for Find It Detection Dogs will occur during the field data collection years of FY 2014 through FY 2016. These changes do not require any adjustment to the original contract period.

V. Budget Change

There is no change in value in the overall approved budget or the annual allocation of funds from the budget. MSU will be paying the subcontractors from a portion of the contract they are receiving.

Original: $1,160,800 over six years Revised: $1,160,800 over six years

The table below depicts the original cost details and the modified cost details with subcontracting costs beginning with FY 2014, the first year these modifications are being incorporated into this study. As FY 2012 and 2013 are completed, the cost details for those years is not included as there were no previous changes. The totals for those previous years were $118,000 and $251,600 respectively.

	Fiscal Year			
Cost Item	**2014**	**2015**	**2016**	**2017**
Original Costs:				
Salaries and Fringes	$165,600	$171,600	$135,000	$100,000
Travel	$32,000	$36,000	$7,000	$10,000
Supplies	$45,000	$45,000	$27,000	$17,000
Equipment	$0	$0	$0	$0
Subtotal	$242,600	$252,600	$169,000	$127,000
Overhead (44.5%)	$107,957	$112,407	$75,205	$56,515
Total Project Costs	$350,557	$365,007	$244,205	$183,515
Waived Overhead	$107,957	$112,407	$75,205	$56,515
Original Contract Cost	**$242,600**	**$252,600**	**$169,000**	**$127,000**
CAR Cost Modifications:				
Salaries and Fringes	$103,829	$142,728	$101,050	$100,000
Travel	$26,394	$29,943	$5,240	$10,000
Supplies	$37,117	$37,429	$20,210	$17,000
Equipment	$0	$0	$0	$0
NCSU Subcontract				
Post Doc Salary and Fringe	$32,760	$0	$0	$0
Find It Detection Dog Subcontract				
Contractual Expense	$42,500	$42,500	$42,500	$0
Subtotal	$242,600	$252,600	$169,000	$127,000
Overhead (44.5%)	$107,957	$112,407	$75,205	$56,515
CAR Modification Project Costs	$350,557	$365,007	$244,205	$183,515
CAR Waived Overhead	$107,957	$112,407	$75,205	$56,515
CAR Total with Cost Modifications	**$242,600**	**$252,600**	**$169,000**	**$127,000**
Modification Cost Difference	**$0**	**$0**	**$0**	**$0**

VI. Summary of Impact on Contract

There are no impacts of the contract changes on the overall value of the contract or the cost totals of any given fiscal year covered by the contract. These contract changes, however, will increase the quality of the product received by the Department of Natural Resources. Specifically, these changes will provide a better understanding of the role of predation on white-tailed deer along with a better understanding of the population size of carnivore species with reduced uncertainty in estimates. Consequently, the Department of Natural Resources will gain a greater confidence in estimated population-level effects of predation on white-tailed deer.

November 1, 2011

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES
Office of Financial Services
Procurement Services
PO Box 30028
Lansing, Michigan 48909

NOTICE
OF
CONTRACT NO. 751B2200001
between
THE STATE OF MICHIGAN
And

NAME & ADDRESS OF VENDOR Mississippi State University Office of Sponsored Programs Administration PO Box 6156 133 Etheredge Hall Mississippi State, MS 39762	TELEPHONE **(662) 325-7404** Richard Swann VENDOR NUMBER/MAIL CODE xxxxx0819 (002) BUYER **(517) 373-1190** Jana Harding-Bishop
Contract Administrator: Dr. Pat Lederle, MDNR-Wildlife Division **Project title: Role of predators, winter weather, and habitat on white-tailed deer fawn survival in Michigan – Phase II**	
CONTRACT PERIOD: From: **October 1, 2011** To: **September 30, 2017**	
TERMS **Net 45 days**	SHIPMENT **N/A**
F.O.B. **N/A**	SHIPPED FROM **N/A**
MINIMUM DELIVERY REQUIREMENTS **N/A**	

The attached represents the mutually agreed to description of services to be provided and terms and conditions.

This is not an order. A Purchase Order will be issued and sent to the contractor to request goods or services as authorized under the terms and conditions of this contract.

Est. Contract Value: $1,160,000.00

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES
FINANCIAL SERVICES
P.O. BOX 30028, LANSING, MI 48909
or
530 W. ALLEGAN, LANSING, MI 48933

CONTRACT AGREEMENT NO. 751B2200001
between
THE STATE OF MICHIGAN
And

NAME & ADDRESS OF VENDOR Mississippi State University Office of Sponsored Programs Administration PO Box 6156 133 Etheredge Hall Mississippi State, MS 39762	TELEPHONE **(662) 325-7404** Richard Swann VENDOR NUMBER/MAIL CODE xxxxx0819 (002) BUYER **(517) 373-1190** Jana Harding-Bishop
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F.O.B. **N/A**	SHIPPED FROM **N/A**
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Richard Swanson **Director of Sponsored Programs Administration** **Mississippi State University**	**Date**	**Jana Harding-Bishop** **Buyer** **MDNR, Purchasing Services**	**Date**

STATE OF MICHIGAN TERMS AND CONDITIONS

I-A PURPOSE

This contract consists of the State of Michigan's (State) terms and conditions and the work statement (Appendix A). This contract constitutes the complete and exclusive agreement and understanding of the parties as it relates to this transaction. This contract supersedes all proposals, or other prior agreements, and all other communications between the parties relating to this transaction. If there is a conflict between the State's terms and conditions and the Contractor's Proposal, the State's terms and conditions shall take precedence.

The purpose of this contract is to obtain the services of the Department of Wildlife and Fisheries at Mississippi State University to conduct predator/ prey research in the Upper Peninsula of Michigan in collaboration with the Wildlife Division of the Michigan Department of Natural Resources (DNR). This is Phase II of a similar project (**751B9200072)** that was initiated January 20, 2009 and will be completed September 30, 2012. Project completion date for Phase II is September 30, 2017. Fiscal Year 2012 (October 1, 2011 through September 30, 2012 is a transition year and will be covered by both the old and new contracts.

I-B ISSUING OFFICE

This contract is issued by the State of Michigan, Department of Natural Resources, Financial Services (FS) for the Wildlife Division (WD).

FS is the only office authorized to change, modify, amend, alter, clarify, etc., the prices, specifications, terms, and conditions of this contract. All requests for changes, modifications, amendments, etc. must be addressed to:

Jana Harding-Bishop, Buyer
DNR, FS
6th Floor, Mason Building
P.O. Box 30028
Lansing, MI 48909
(517) 373-1190

I-C CONTRACT ADMINISTRATOR

Upon receipt of the properly executed contract agreement, it is anticipated that the person named below or any other person so designated be authorized to administer the contract on a day-to-day basis during the term of the contract. However, administration of this contract implies no authority to change, modify, clarify, amend, or otherwise alter the prices, terms, conditions, and specifications of this contract.

The DNR contract administrator is:

Dr. Patrick Lederle
Department of Natural Resources
Wildlife Division
P.O. Box 30444
Lansing, MI 48909
Telephone: (517) 373-1263
Fax: (517) 373-6705
Email: lederlep@michigan.gov

DNR project manager for this contract is:

Dr. Dean Beyer
New Science Building
Northern Michigan University
Marquette, MI 49855
(906) 227-1627
Email: beyerd@michigan.gov

University project contact is:

Richard Swann, Director
Sponsored Programs Administration
Mississippi State University
Box 6156
Mississippi State, MI 39762
Telephone: (662) 325-7404
Fax: (662) 325-3803
Email: aor@spa.msstate.edu

I-D PROBLEM STATEMENT

This research project is designed to investigate the role of predators, winter weather, and habitat on white-tailed deer condition and survival across a gradient of ecological conditions (snowfall zones) in the UP. Results from this project will help us understand the interactions among various factors that may limit deer abundance. Specific study components include: 1) estimating pregnancy rates and condition of white-tailed deer; 2) estimating survival and cause-specific mortality of white-tailed deer fawns and does; 3) estimating proportion of fawn mortality attributable to black bear, coyote, bobcat, and wolf predation; and 4) comparing vegetation characteristics at fawn birth sites and kill sites with predator habitat use.

Knowledge of limiting factors is the foundation of wildlife management. This study will provide information on the importance and interactions among several factors that may limit deer abundance. Results from this work are intended to help us formulate appropriate harvest and management recommendations for both deer and predators. Results will also help us address increasing public concerns regarding the impact of predators on deer. Additional details are included in the attached Work Statement (Appendix A).

I-E OBJECTIVES/GOALS

1. Quantify survival and cause-specific mortality of white-tailed deer fawns and does.
   a. Monitor using radio-telemetry up to 60 deer fawns and 50 does during each of 3 years. Conduct field necropsies of mortality events as they occur.

2. Estimate proportion of fawn mortality attributable to black bear, bobcat, coyote, and wolf predation.
   a. Estimate abundance of white-tailed deer, black bears, bobcat, coyote, and wolf using spatial attributes of radio telemetry data, mark-recapture techniques, and field track surveys during each of 3 years.
   b. Quantify mean number of fawns produced by does from up to 50 telemetered individuals during each of three years.
   c. Quantify mean annual number of fawns killed by black bear, bobcat, coyote, and wolf using cluster analyses of GPS collar locations and cause-specific mortality of telemetered fawns during each of 3 years.

3. Estimate number and age of fawns killed by a bear, bobcat, coyote, or wolf during summer.
   a. Quantify age of fawns using morphological data collected during initial capture and forward data to respective mortality events of telemetered individuals.
   b. Quantify number of fawns killed using GPS location data from predators and from specific predation events of telemetered fawns.

4. Estimate white-tailed deer pregnancy and fecundity rates.
   a. Quantify pregnancy and fecundity rates from up to 50 winter-captured does and opportunistically-collected vehicle-killed (May-June) does during each of 3 years.

5. Estimate if estimated probability of use of an area to a black bear, bobcat, coyote, or wolf affects the likelihood of fawn predation.
   a. Quantify distribution of fawns and fawn mortality events relative to estimated distributions of respective carnivore species.

6. Estimate if minimum composite bear, bobcat, coyote, and wolf use of an area influences fawn predation rates.
   a. Quantify distribution of fawns and fawn mortality events relative to cumulative estimated use distributions for all carnivore species.

7. Describe association between fawn birth site habitat characteristics and black bear, bobcat, coyote, or wolf habitat use.
   a. Quantify vegetation characteristics at fawn birth sites relative to vegetation characteristics at sites used by each respective predator and random locations within the study area.

I-F DELIVERABLES

The Principal Investigator is responsible for providing an annual progress report and a final report to the DNR contract administrator in written and electronic format by the specified date. A template for these reports will be provided by the DNR contract administrator and submitted reports must use the template or contain all information requested on the template. The reports shall be mailed and transmitted electronically to the DNR contract administrator listed in I-C.

Annual Progress Report	September 15, 2012
Annual Progress Report	September 15, 2012
Annual Progress Report	September 15, 2012
Annual Progress Report	September 15, 2012
Annual Progress Report	September 15, 2012
Final Report and Management Executive Summary	September 30, 2017

Annual progress reports will contain a quantitative assessment of the accomplishments completed **by research objective** during the reporting period. Any deviations from the planned schedule of accomplishments must be explained along with a discussion of how these deviations will be addressed in subsequent reporting periods. Any adjustments to the research that occurred during the reporting period that affect the completion of research objectives must be explained.

The final report will include a Management Executive Summary written in a style and level of detail to be understood by local land and wildlife managers. The final report will include recommendations on how management techniques should be modified based on the results of the contracted research. The report will contain a conclusion/discussion section that details how the accomplishments by objective addressed the overall goal of the research. Additionally, the conclusion/discussion section will contain a detailed description of how the new information will lead to modifications to existing management.

In addition to annual progress reports and a final report, brief quarterly updates (to be sent electronically to a distribution list) on research progress are required. Specific content of these updates, due dates, and the distribution list will be mutually agreed upon by the DNR project manager and the Contractor's Principle Investigator.

The Principle Investigator, graduate students and collaborators will reach external audiences through inclusion of project information on websites (one project website must be hosted and maintained by the Contractor), development of project-specific brochures and fact sheets, presentations to DNR meetings and conferences, and publication of research findings in popular articles and peer-reviewed scientific journals. The exact nature of these products will be mutually agreed upon by the DNR project manager and the Contractor's Principle Investigator.

I-G PROJECT CONTROL AND REPORTS

The Contractor will carry out this project under the direction and control of the DNR.

The DNR contract administrator will meet as needed with the Contractor for the purpose of reviewing progress and providing necessary guidance to the Contractor in solving problems which arise.

The Contractor will submit deliverables as listed in Section I-F above, and identify any problems, real or anticipated, which should be brought to the attention of the DNR contract administrator to insure that the contract remains on schedule and will be completed as scheduled.

I-H PRICE PROPOSAL

This is a fixed price contract, and Mississippi State University may invoice at the end of each fiscal quarter (December 31, March 31, June 30, and September 30) for 25% of the annual DNR contribution to the study (the contract cost). Mississippi State University's fiscal contribution to this study (31%) is the waiver of normal indirect charges.

	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	Totals
Salary and Benefits	$70,000	$161,600	$165,600	$171,600	$135,000	$100,000	$803,800
Travel	$8,000	$30,000	$32,000	$36,000	$7,000	$10,000	$123,000
Supplies	$40,000	$60,000	$45,000	$45,000	$27,000	$17,000	$234,000
Equipment	$0	$0	$0	$0	$0	$0	$0
Subtotal	$118,000	$251,600	$242,600	$252,600	$169,000	$127,000	$1,160,800
Indirect Costs (44.5%)	$52,510	$111,962	$107,957	$112,407	$75,205	$56,515	$516,556
Total Project Costs	$170,510	$363,562	$350,557	$365,007	$244,205	$183,515	$1,677,356
Matching funds (Waived Indirects)	$52,510	$111,962	$107,957	$112,407	$75,205	$56,515	$516,556
Contract Cost	**$118,000**	**$251,600**	**$242,600**	**$252,600**	**$169,000**	**$127,000**	**$1,160,800**

The Contractor shall establish a separate account for the research project and have available all direct project costs for audit purposes.

I-I MODIFICATIONS OF CONTRACT

This contract may be modified provided that any changes proposed by either party are requested in writing and mutually agreed to by the official representative of the Contractor shown in this contract and the DNR contract administrator. This request is not valid until it is signed by all parties, a Contract Change Notice is issued by the Issuing Office and a Purchase Order is issued by the DNR.

I-J NO WAIVER OF DEFAULT

The failure of a party to insist upon strict adherence to any term of this contract shall not be considered a waiver or deprive the party of the right thereafter to insist upon strict adherence to that term, or any other term, of this contract.

I-K SEVERABILITY

Each provision of this contract shall be deemed to be severable from all other provisions, and if one or more of the provisions shall be declared invalid, the remaining provisions of this contract shall remain in full force and effect.

I-L HEADINGS

Captions and headings used in this contract are for information and organization purposes. Captions and headings, including inaccurate references, do not, in any way, define or limit the requirements or terms and conditions of this contract.

I-M RELATIONSHIP OF THE PARTIES

The relationship between the State and the Contractor is that of client and independent Contractor. No agent, employee, or servant of the Contractor or any of its subcontractors shall be or shall be deemed to be an employee, agent, or servant of the State for any reason.

I-N COST LIABILITY

The State of Michigan assumes no responsibility or liability for costs incurred by the Contractor prior to the signing this contract. Total liability of the State is limited to the terms and conditions of this contract.

I-O CONTRACTOR RESPONSIBILITIES

The Contractor is responsible for the performance of all of its obligations under this contract, whether the obligations are performed by the Contractor or a subcontractor. The State reserves the right to approve any subcontractor hired to perform the Contractor's obligations under this contract, and the right to require the Contractor to replace any subcontractor deemed unacceptable by the State. The Contractor is exclusively responsible for adherence by subcontractors to all provisions of this contract. Further, the State will consider the Contractor to be the sole point of contact with regard to contractual matters, including but not limited to payment of any and all costs resulting from the contract.

I-P NEWS RELEASES

News releases pertaining to this contract or the services, study, data, or project to which it relates will not be made without prior written State approval, and then only in accordance with the explicit written instructions from the State. No results of the program are to be released without prior approval of the State and then only to persons designated.

I-Q DISCLOSURE

All information in this contract is subject to the provisions of the Freedom of Information Act, 1976 Public Act No. 442, as amended, MCL 15.231, et seq.

I-R ACCOUNTING RECORDS

The Contractor will be required to maintain all pertinent financial and accounting records and evidence pertaining to this contract in accordance with generally accepted principles of accounting and other procedures specified by the State of Michigan. Financial and accounting records shall be made available, upon request, to the State of Michigan, its designees, or the Michigan Auditor General at any time within the duration of this contract and any extension thereof, and for three (3) years from the expiration date and final payment on this contract or extension thereof.

I-S AUDIT OF CONTRACT COMPLIANCE

The Contractor agrees that the State may, upon 24-hour notice, perform an audit at Contractor's location(s) to determine if the Contractor is complying with the requirements of this contract. The Contractor agrees to cooperate with the State during the audit and produce all records and documentation that verifies compliance with the requirements of this contract.

I-T SAFETY AND ACCIDENT PREVENTION

In performing work under this contract on State premises, the Contractor shall conform to any specific safety requirements contained in this contract or as required by law or regulation. The Contractor shall take any additional precautions as the State may reasonably require for safety and accident prevention purposes. Any violation of such safety requirements, rules, laws or regulations shall be a material breach of this contract and shall be grounds for cancellation of this contract in accordance with the Cancellation provisions contained herein.

I-U TAXES

Contractors are expected to collect and pay all applicable federal, state, and local employment taxes for all persons involved in the resulting contract. Also, Contractor shall maintain appropriate payroll information on a system that can produce any reports that may be needed by the State.

I-V GENERAL INDEMNIFICATION

Each party to this contract must seek its own legal representative and bear its own costs; including judgments, in any litigation that may arise from performance specific to each party's responsibilities. It is specifically understood and agreed that neither party will indemnify the other party in such litigation.

I-W INSURANCE REQUIREMENTS

The contractor shall purchase and maintain such insurance as will protect him/her from claims set forth below which may arise out of or result from the contractor's operations under the contract (Purchase Order), whether such operations be by himself/herself or by any subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

NOTE: CONTRACTOR MAY SUBMIT EVIDENCE OF SELF-INSURANCE AND/OR AMENDMENT OF EXISTING LIABILITY COVERAGE IN FULFILLMENT OF ABOVE PROVISIONS, IF THE STATE ACCEPTS THE EVIDENCE OR AMENDED LIABILITY COVERAGE AS PROVIDING COMPARABLE PROTECTION OF THE STATE'S INTEREST.

The contractor is required to provide proof of insurance or self-insurance. The purpose of this coverage shall be to protect the State from claims which may arise out of or result from the contractor's performance of services under the terms of this Contract, whether such services are performed by the contractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable.

I-X NOTICE AND RIGHT TO CURE

In the event of a curable breach by the Contractor, the State shall provide the Contractor written notice of the breach and a time period to cure said breach described in the notice. This section requiring notice and an opportunity to cure shall not be applicable in the event of successive or repeated breaches of the same nature or if the State determines in its sole discretion that the breach poses a serious and imminent threat to the health or safety of any person or the imminent loss, damage or destruction of any real or tangible personal property.

I-Y CANCELLATION

The State may cancel this contract without further liability or penalty to the State, its departments, divisions, agencies, offices, commissions, officers, agents, and employees for any of the following reasons:

1. Material Breach by the Contractor. In the event that the Contractor breaches any of its material duties or obligations under this contract, which are either not capable of or subject to being cured, or are not cured within the time period specified in the written notice of breach provided by the State, or pose a serious and imminent threat to the health and safety of any person, or the imminent loss, damage or destruction of any real or tangible personal property, the State may, having provided written notice of cancellation to the Contractor, cancel this contract in whole or in part, for cause, as of the date specified in the notice of cancellation.

In the event the State chooses to partially cancel this contract for cause charges payable under this contract will be equitably adjusted to reflect those services that are cancelled.

In the event this contract is cancelled for cause pursuant to this section, and it is therefore determined, for any reason, that the Contractor was not in breach of contract pursuant to the provisions of this section, that cancellation for cause shall be deemed to have been a cancellation for convenience, effective as of the same date, and the rights and obligations of the parties shall be limited to that otherwise provided in this contract for a cancellation for convenience.

2. Cancellation For Convenience By the State. The State may cancel this contract for its convenience, in whole or part, if the State determines that such a cancellation is in the State's best interest. Reasons for such cancellation shall be left to the sole discretion of the State and may include, but not necessarily be limited to (a) the State no longer needs the services or products specified in this contract, (b) relocation of office, program changes, changes in laws, rules, or regulations make performance of the services under this contract no longer practical or feasible, and

(c) unacceptable prices for additional services requested by the State. The State may cancel this contract for its convenience, in whole or in part, by giving the Contractor written notice 30 days prior to the date of cancellation. If the State chooses to cancel this contract in part, the charges payable under this contract shall be equitably adjusted to reflect those services that are cancelled.

3. Non-Appropriation. The State may cancel this contract in the event that funds to enable the State to effect continued payment under this contract are not appropriated or otherwise made available. The Contractor acknowledges that, if this contract extends for several fiscal years, continuation of this contract is subject to annual appropriation or availability of funds for this contract. If funds are not appropriated or otherwise made available, the State shall have the right to cancel this contract at the end of the last period for which funds have been appropriated or otherwise made available by giving written notice of cancellation to the Contractor. The State shall give the Contractor written notice of such non-appropriation or unavailability within 30 days after it receives notice of such non-appropriation or unavailability.

4. Criminal Conviction. In the event the Contractor, an officer of the Contractor, or an owner of a 25% or greater share of the Contractor, is convicted of a criminal offense incident to the application for or performance of a State, public or private contract or subcontract; or convicted of a criminal offense including but not limited to any of the following: embezzlement, theft, forgery, bribery, falsification or destruction of records, receiving stolen property, attempting to influence a public employee to breach the ethical conduct standards for State of Michigan employees; convicted under State or federal antitrust statutes; or convicted of any other criminal offense which in the sole discretion of the State, reflects upon the contractor's business integrity, the State may cancel this contract.

5. Approvals Rescinded. In the event any final administrative or judicial decision or adjudication disapproves a previously approved request for purchase of personal services pursuant to Article 11, Section 5 of the Michigan Constitution of 1963, and Chapter 7 of the Civil Service Rules, the State may cancel this contract. Notwithstanding any other provision of this contract to the contrary, the State Personnel Director is authorized to disapprove contractual disbursements for personal services if the Director determines that disbursements under this contract violate Article 11, Section 5 of the Michigan Constitution or violate applicable Civil Service rules or regulations. Cancellation may be in whole or in part and may be immediate as of the date of the written notice to the Contractor or may be effective as of the date stated in such written notice.

I-Z ASSIGNMENT

The Contractor shall not have the right to assign this contract or to assign or delegate any of its duties or obligations under this contract to any other party (whether by operation of law or otherwise), without the prior written consent of the State. Any purported assignment in violation of this section shall be null and void. Further, the Contractor may not assign the right to receive money due under this contract without the prior written consent of DNR Financial Services.

I-AA DELEGATION

The Contractor shall not delegate any duties or obligations under this contract to a subcontractor other than a subcontractor named in the bid unless DNR Financial Services has given written consent to the delegation.

I-BB NON-DISCRIMINATION CLAUSE

In the performance of any contract or purchase order resulting herefrom, the Contractor agrees not to discriminate against any employee or applicant for employment, with respect to their hire, tenure, terms, conditions or privileges of employment, or any matter directly or indirectly related to employment, because of race, color, religion, national origin, ancestry, age, sex, height, weight, marital status, physical or mental disability unrelated to the individual's ability to perform the duties of the particular job or position. The Contractor further agrees that every subcontract entered into for the performance of any contract or purchase order resulting herefrom will contain a provision requiring non-discrimination in employment, as herein specified, binding upon each subcontractor. This covenant is required pursuant to the Elliot Larsen Civil Rights Act, 1976 Public Act 453, as amended, MCL 37.2101, et seq, and the Persons with Disabilities Civil Rights Act, 1976 Public Act 220, as amended, MCL 37.1101, et seq, and any breach thereof may be regarded as a material breach of the contract or purchase order.

I-CC UNFAIR LABOR PRACTICES

Pursuant to 1980 Public Act 278, as amended, MCL 423.231, et seq, the State shall not award a contract or subcontract to an employer whose name appears in the current register of employers failing to correct an unfair labor practice compiled pursuant to Section 2 of the Act. This information is compiled by the United States National Labor Relations Board.
A Contractor of the State, in relation to the contract, shall not enter into a contract with a subcontractor, manufacturer, or supplier whose name appears in this register. Pursuant to Section 4 of 1980 Public Act 278, MCL 423.324, the State may void any contract if, subsequent to award of the contract, the name of the Contractor as an employer, or the name of the subcontractor, manufacturer or supplier of the Contractor appears in the register.

I-DD SURVIVOR

Any provisions of this contract that impose continuing obligations on the parties shall survive the expiration or cancellation of this contract for any reason.

I-EE PERFORMANCE REVIEWS

DNR may review with the contractor their performance under the contract. Performance reviews shall be conducted quarterly, semi-annually or annually depending on contractor's past performance with the State. Performance reviews shall include, but are not limited to, quality of service being delivered and provided, timeliness, percentage of completion, accuracy of billings, customer service, completion and submission of required paperwork, and other requirements of the contract.

Upon a finding of poor performance, which has been documented by DNR Financial Services, the Contractor shall be given an opportunity to respond and take corrective action. If corrective action is not taken in a reasonable amount of time as determined by DNR Financial Services, the contract may be canceled for default.

I-FF ELECTRONIC PAYMENT AVAILABILITY

Electronic transfer of funds is available to State contractors. Contractor is required to register with the State electronically at http://www.cpexpress.state.mi.us. Public Act 533 of 2004 requires all payments made by the State of Michigan be transitioned to Electronic Funds Transfers (EFT).

I-GG RENEWALS

This contract may be renewed by a written and mutually executed agreement of the parties, in accordance with Section I-I above, not less than 30 days before its expiration. The contract may be renewed for one (1) five-year period.

I-HH COMPLIANCE WITH LAWS

The Contractor represents to the best of its knowledge and belief that, in performing the services called for by this Contract, it will not violate any applicable law, rule, or regulation, or any intellectual rights of any third party; including but not limited to, any United States patent, trademark, copyright, or trade secret.

Appendix A

Work Statement

Role of predators, winter weather, and habitat on white-tailed deer fawn survival in Michigan—Phase II

Management of wildlife is based on an understanding, and in some cases, manipulation of factors that limit wildlife populations. Wildlife managers sometimes reduce the effect of a limiting factor to allow a wildlife population to increase. Similarly, one or more limiting factors can be intentionally increased to reduce population size. White-tailed deer are an important species in Michigan providing many values, including ecological, social and economic. Most generally, factors that can limit deer numbers include food supply, winter cover, disease, predation, weather, and hunter harvest. Deer numbers change with changes in these limiting factors. Michigan spans about 600 km from north to south. The importance of factors that limit deer populations vary along this latitudinal gradient. For example, winter severity and winter food availability have less impact on deer numbers in southern Michigan than in Upper Michigan.

Quantifying the relative role of factors potentially limiting white-tailed deer recruitment and how the importance of these factors varies across this latitudinal gradient is critical for understanding deer demography and ensuring effective management strategies. Considerable research has been conducted demonstrating the effects of winter severity on white-tailed deer condition and survival (Ozoga and Gysel 1972, Moen 1976, DelGiudice et al. 2002). In addition, the importance of food supply and cover, particularly during winter, has been documented (Moen 1976, Taillon et al. 2006). Finally, the role of predation on white-tailed deer survival has received considerable attention (e.g., Ballard et al. 2001). However, few studies have simultaneously addressed the roles of limiting factors on white-tailed deer.

Previously (1952-1985), MDNR personnel conducted fetus counts from road-killed deer in the Upper Peninsula during spring. These counts demonstrated high mean annual pregnancy rates (94%; range = 85-100%) and fecundity (range = 1.25-1.81 fawns/doe) for does $\geq$2 years old. This potentially high recruitment was not reflected in fawn/doe ratios during the 1996-2006 deer firearms harvest seasons as suggested by camp surveys (mean = 54 fawns/100 does; range = 44-65 fawns/100 does [1996-2007]; C. Albright, MDNR, unpublished data). High fecundity combined with low observed fawn/doe ratios suggest high fawn mortality rates shortly after parturition (Ballard et al. 2001). These large losses of fawns may be indicative of high predation (Ballard et al. 2001). Losses of young fawns have also been related to poor nutritional condition of the dam (e.g., Verme 1979). Severe weather (generally winter conditions) or inadequate diet (poor habitat) can stress pregnant does resulting in fawns with low birth weights and decreased rates of survival.

An alternative explanation for the low fawn-doe ratios documented during fall in recent years is lower pregnancy rates than those documented 20+ years ago. Many deer hunters in the Upper Peninsula believe the adult sex ratio of deer is so badly skewed that does are not always bred, and this has fueled demands for tighter restrictions on the harvest of male deer. Updated pregnancy rates will help managers address this issue. Another possible reason for low fawn-doe ratios is inherent low fecundity due to a high proportion of immature or primiparous females in the deer population. Very few fawn females breed in the U.P., and 1.5-year-old females tend to produce single fawns.

Long-term deer abundance (1957-1990) in the Upper Peninsula has been strongly associated with intensity of pulpwood harvest (MDNR, unpublished data). However, a key index to deer abundance in the Western Upper Peninsula (WUP) has apparently declined overall since 1990 (Fig. 1A) and appears poorly associated with winter severity (Fig. 1B) and pulpwood harvest (Fig. 1C). While the index to deer abundance has declined, indices of abundance for predators of white-tailed deer have increased (Fig. 1D-1F). Mean percent annual changes in abundance for wolves, black bears, and coyotes in the WUP are 5.5%, 18%, and 4%, respectively (Fig. 2). In contrast, WUP deer abundance has declined 7% annually since 1990.

Predation of white-tailed deer fawns by black bears, wolves, coyotes, and other predators has been demonstrated, with overall fawn mortality due to predation reaching 60% (Carroll and Brown 1977, Ballard and Whitlaw 1999, Whittaker and Lindzey 1999, Lingle 2000, Brinnkman et al. 2004, Vreeland et al. 2004, Pusateri Burroughs et al. 2006). Dominant predators varied across studies, likely a result of factors such as predator and prey behavior and abundance (e.g., Nixon et al. 1991, Lingle 2000). Ungulate mortality from predators is generally considered additive if deer populations are below carrying capacity (*K*; Ballard et al. 2001, Zager and Beecham 2006). As deer populations approach or are at *K*, mortality appears to become compensatory (Zager and Beecham 2006).

Based on available indices (Figs. 1-2) and scientific literature, predators may be limiting deer recruitment in the WUP. However, the potential for low pregnancy/fecundity rates and effects of winter weather and habitat conditions cannot be discounted. Thus, the overall goal of this project is to assess baseline reproductive parameters and the magnitude of cause-specific mortality and survival of white-tailed deer fawns, particularly mortality due to predation, in relation to other possible limiting mortality agents along a latitudinal gradient in Michigan. We will simultaneously assess effects of predation and winter severity and indirectly evaluate the influence of habitat conditions on fawn recruitment. Considering results from Lower Michigan (Pusateri Burroughs et al. 2006) as the southern extent of this gradient, we proposed three additional study sites from south to north across Upper Michigan. Work is nearing completion in the low snowfall study area and this proposal outlines work to be completed in the mid snowfall study area. We intend to meet the following objectives.

Primary Objectives

1. Quantify survival and cause-specific mortality of white-tailed deer fawns and does.

a. Monitor using radio-telemetry up to 60 deer fawns and 50 does during each of 3 years. Conduct field necropsies of mortality events as they occur.

2. Estimate proportion of fawn mortality attributable to black bear, bobcat, coyote, and wolf predation.
   a. Estimate abundance of white-tailed deer, black bears, bobcat, coyote, and wolf using spatial attributes of radio telemetry data, mark-recapture techniques, and field track surveys during each of 3 years.
   b. Quantify mean number of fawns produced by does from up to 50 telemetered individuals during each of three years.
   c. Quantify mean annual number of fawns killed by black bear, bobcat, coyote, and wolf using cluster analyses of GPS collar locations and cause-specific mortality of telemetered fawns during each of 3 years.

4. Estimate number and age of fawns killed by a bear, bobcat, coyote, or wolf during summer.
   a. Quantify age of fawns using morphological data collected during initial capture and forward data to respective mortality events of telemetered individuals.
   b. Quantify number of fawns killed using GPS location data from predators and from specific predation events of telemetered fawns.

4. Estimate white-tailed deer pregnancy and fecundity rates.
   a. Quantify pregnancy and fecundity rates from up to 50 winter-captured does and opportunistically-collected vehicle-killed (May-June) does during each of 3 years.

5. Estimate if estimated probability of use of an area to a black bear, bobcat, coyote, or wolf affects the likelihood of fawn predation.
   a. Quantify distribution of fawns and fawn mortality events relative to estimated distributions of respective carnivore species.

6. Estimate if minimum composite bear, bobcat, coyote, and wolf use of an area influences fawn predation rates.
   a. Quantify distribution of fawns and fawn mortality events relative to cumulative estimated use distributions for all carnivore species.

7. Describe association between fawn birth site habitat characteristics and black bear, bobcat, coyote, or wolf habitat use.
   a. Quantify vegetation characteristics at fawn birth sites relative to vegetation characteristics at sites used by each respective predator and random locations within the study area.

Study Area

The second phase of this study will be conducted in the mid-snowfall zone of the Upper Peninsula. After aerial and ground reconnaissance, we have selected an area immediately north of Michigamme Reservoir, about 10 miles northeast of Crystal Falls in Iron County.

Methods

Capture and marking.—We will capture ≥50 pregnant female white-tailed deer annually during January-March 2013-2015 using Clover traps and rocket nets (Clover 1956, Hawkins et al. 1968). Deer will be immobilized with an intramuscular injection of a mixture of xylazine and ketamine (DelGiudice et al. 2001) and blindfolded. Pregnancy will be assessed during capture using ultrasound (DelGiudice et al. 2007). A canine will be extracted from deer >1-year old (Nelson 2001, 2002) to estimate age (Gilbert 1966). Weights of all deer will be obtained using a spring-scale and sling. All pregnant females will receive a collar-mounted VHF radio transmitter, ear tags, and a vaginal-implant transmitter with temperature-sensitive switch designed to expel at parturition (Bowman and Jacobson 1998, Christensen et al. 2003). The radio collar will contain a breakaway link, allowing the collar to release in about 18 months (e.g., Garshelis and McLaughlin 1998). Risk of capture myopathy will be minimized following Beringer et al. (1996). Yohimbine will be administered (15 mg intravenously) to reverse the effects of xylazine and reduce recovery times (DelGuidice et al. 2001).

Newborn deer fawns will be located during spring via daily monitoring of vaginal implant transmitters in does or by searching from roads (Carstensen et al. 2003, Ditchkoff et al. 2005). When a change in pulse rate is detected for implant transmitters, transmitters will be located and areas searched for fawns (Bowman and Jacobson 1998, Carstensen et al. 2003). Each fawn will receive ear tags and an expandable breakaway radiocollar (Diefenbach et al. 2003). In addition, weight, total hoof length, length of new hoof growth, total length, and a blood sample will be collected from each fawn captured (Carstensen Powell and DelGiudice 2005). Although capturing and handling fawns does not appear to influence their survival (Carstensen et al. 2005), handling times will be minimized to reduce stress (Livezey 1990, DelGuidice et al. 1990).

Black bears will be captured initially during late-May to June using barrel traps or Aldrich foot snares (Kohn 1982). Bears will receive ear tags and a downloadable GPS collar (with VHS transmitter) which will attempt relocations at about 15-minute intervals. Coyotes and wolves will be captured in late-April or May using foothold traps and select individuals will similarly receive a downloadable GPS collar. All GPS collars will include breakaway or drop-off mechanisms. Collars placed on coyotes and wolves will be released remotely during September of each year to download data. Data from black bear collars will be retrieved and collars refurbished during annual den checks.

Monitoring and survival.—Deer fawns and adults will be monitored daily for 30 days postcapture and at least twice weekly thereafter using standard hand-held or aerial radio-tracking techniques (Mech 1983). Cause of death will be estimated using site-specific evidence described within Vreeland et al. (2004). When possible, femur fat will be estimated for radio-collared deer found dead. When cause of death can not be determined

from field evidence, carcasses will be transported to the MDNR Diagnostic Center for Population and Animal Health for necropsy. Fawns and does will be monitored for at least 1 year to estimate survival. Survival estimates will be performed using the Known Fate model estimator in program MARK (White and Burnham 1999).

Aerial telemetry of collared predators will occur 2-3 times each week from mid-May to mid-August. Animal locations will be integrated within a GIS environment to ascertain location clusters that could represent predation events. These locations will be searched to determine whether a fawn predation occurred. We have used this technique successfully on all carnivore species during Phase I of this overall study. The minimum number of fawns killed by each radio-collared predator will be determined which can then be extrapolated to respective predator population estimates.

Population estimates.—The deer population will be estimated using mark-resight data based on images collected from trail cameras during September. Cameras will be placed in a grid and operated for 10 days in September. Two estimates of deer abundance will be derived. The first will use antler characteristics for males and correction factors for fawn deer **(**Demarais et al. 2000). The second will incorporate data from tagged females in models (e.g., Pradel model) in program MARK (White and Burnham 1999). The camera survey will also provide an estimate of the sex and age structure of the deer population, particularly the pre-deer season doe-to-buck ratio. Black bear and bobcat abundance will be estimated using DNA-based mark-recapture data from hair snares (Belant et al. 2005). Coyote abundance will be estimated using howling surveys (Okoniewski and Chambers 1984) and winter track counts. Wolf abundance will be estimated by winter track counts

Fecundity.—Blood samples of females captured during winter will be taken to estimate pregnancy rates using pregnancy-specific protein-B at a commercial lab (BioTracking, Moscow, Idaho 83843, USA). Pregnancy assessment from blood will follow guidelines established by DelGuidice et al. (2007). Necropsies of vehicle-killed female white-tailed deer will be performed through June to count number of fetuses present or whether females are lactating. Additionally, observations of females and fawns will be recorded during routine field operations, particularly August-October.

Deer condition.—To provide an index to relative condition and effects of winter severity, rump body fat depth will be measured on all captured deer using ultrasound (Vann et al. 2001) and femur fat will be measured on vehicle-killed deer. Fat measurements, weight, and survival will be compared to winter severity across years. Timing of fawn births in addition to twinning rates, hoof length, body weights, and various blood characteristics will be compared to winter severity and doe age (Carstensen Powell and DelGiudice 2005).

Habitat suitability.—Habitat suitability for deer will be assessed using aerial photography and field assessment of forested and agricultural lands. Included in this assessment will be ground surveys to assess extent of palatable agriculture forage crops (e.g., corn) and active timber harvest operations. Habitat Suitability Index models (e.g., Rothley 2001, Miranda and Porter 2003) will be used to provide a quantitative value of overall habitat quality that can be compared across study sites.

We will also conduct site-specific habitat analyses, including horizontal structure and distance to agriculture or habitat edge, at all fawn birth sites, capture sites, and predation sites. Birth sites will be considered as the point where vaginal implant transmitters are located. Habitat characteristics will be compared to a series of stratified random locations throughout the study area and at a series of randomly selected bear and coyote locations where similar habitat data will be collected.

Winter severity.—A weather station will be deployed in the center of the study area to record snowfall, snowdepth, and temperature to calculate winter severity indices.

Products/Outcomes

This project will have several management implications including:

1. Pregnancy rates of does will be updated for the first time in 25 years. Although we expect to find most adult females are bred, it is important to verify this assumption considering present concerns expressed by sportsmen that bucks are harvested too intensively and doe-to-buck ratios are unacceptably skewed.

2. The deer population in the west half of the U.P. has declined since the 1990s to levels that approximate the 50-year average. Wildlife managers have speculated on the reasons for this decline, but research has not yet been undertaken to fully understand this change. This study will examine several possible causes of the decline by focusing on white tailed deer fawn survival and recruitment as impacted by predation (by species), winter weather, and habitat conditions.

3. Estimates of black bear, coyote, and wolf predation on white-tailed deer fawns in the Upper Peninsula of Michigan will be obtained. This is important because many sportsmen have come to believe that fawn survival and recruitment is being negatively affected by predation. Predator hunts have become popular, as have requests to liberalize hunting seasons for bears, coyotes, and other predators. It is important to understand the impact of various predator species on deer fawns in order to formulate appropriate harvest recommendations for both deer and their predators.

4. The MDNR relies primarily on trend indicators for monitoring the deer population, and these indicators suggest whether the herd is up, down, or stable compared to previous years. Few methods are available for estimating the number of deer in an area. The trail camera technique we describe will provide numerical deer estimates (with confidence intervals) for the study area that will help us understand whether previous assumptions of deer density were correct. In addition, attempts will be made to estimate the doe-to-buck ratio and buck age structure from trail cams.

5. The study may allow us to opportunistically examine other questions of interest regarding deer and predators. For example, the sample of radio-marked does and fawns might allow

us to determine the fate of fawns if the mother perishes at a certain time during the year. For example, if a doe is killed in a deer-vehicle accident in July, does the fawn survive?

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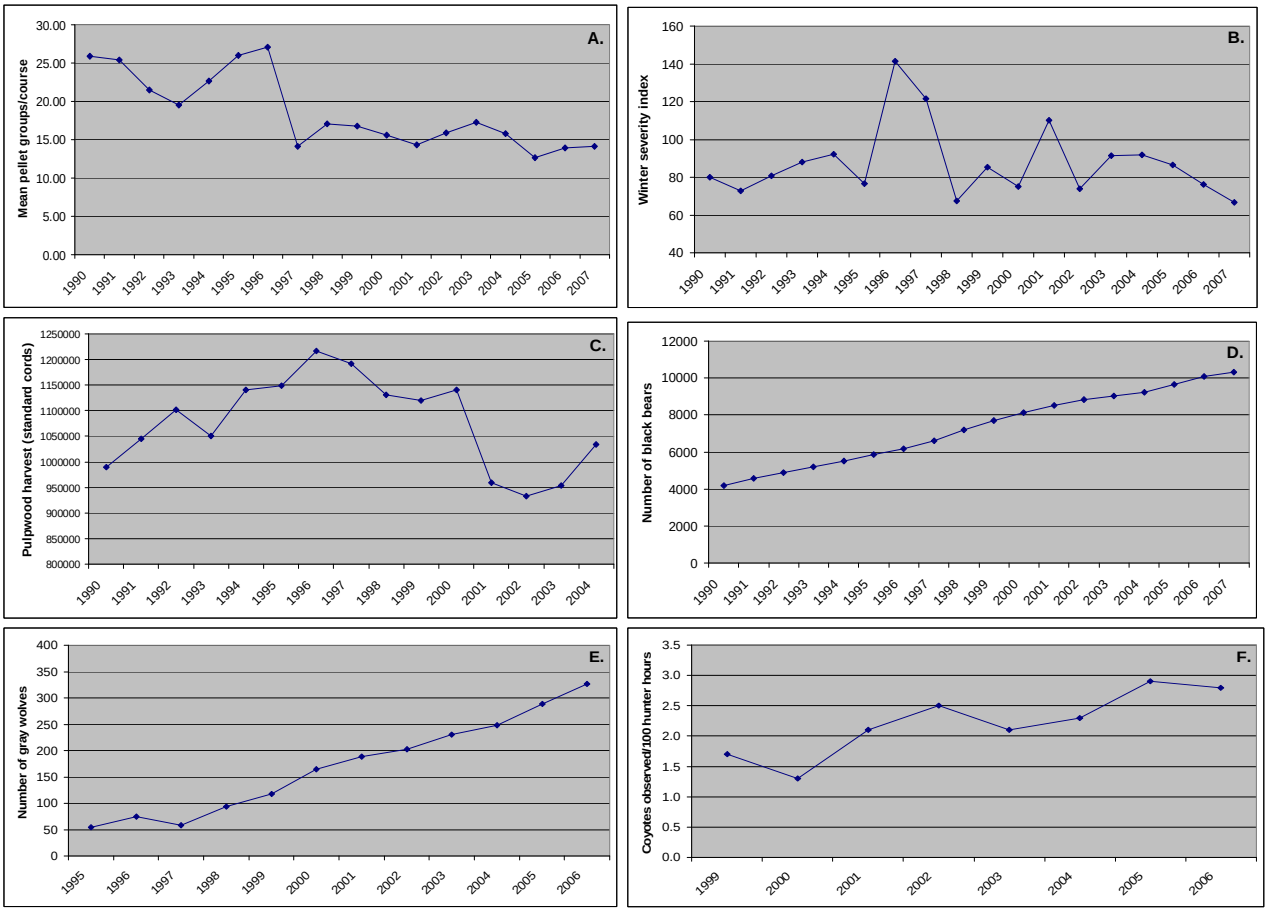

Figure 1. Trend in the Western Upper Peninsula (WUP) deer population as indexed by mean pellet group counts per course (A), and associated factors that may potentially limit deer numbers (B-F). Panel B shows winter severity index values. Panel C shows WUP pulpwood harvest levels; pulpwood harvest can provide deer immediate food in the form of tree tops and subsequent food as forest stands regenerate. Panel D shows the trend in the WUP black bear population estimated from a population model. Panel E shows minimum winter counts of gray wolves in the WUP. Panel F shows an index of coyote population size in the WUP based on hunter observations. Bears typically prey only newborn fawns whereas wolves and coyotes prey on fawns and adults.

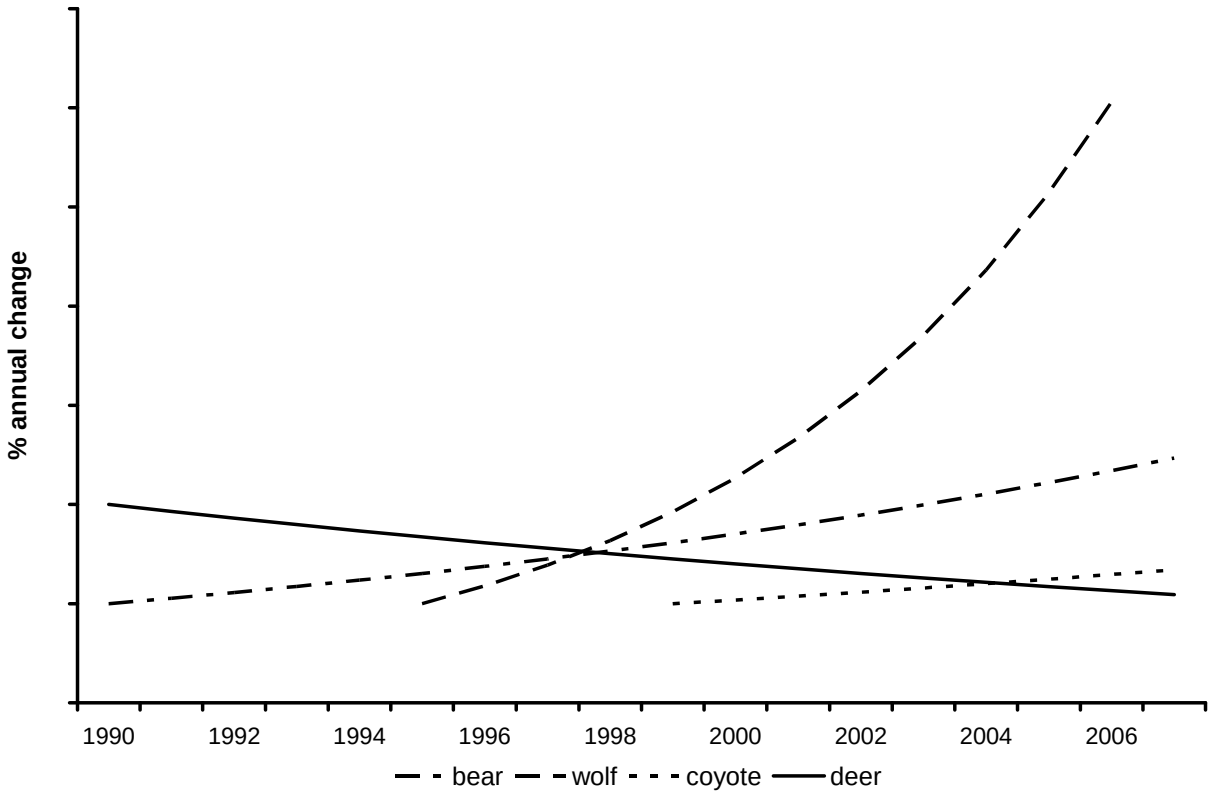

Fig. 2. Mean percent annual change in indices of abundance for black bears, wolves, coyotes, and white-tailed deer, Western Upper Peninsula of Michigan, 1990-2007.