LAKE SUPERIOR
STATE UNIVERSITY

January 13, 2015

Dr. Jason Garvon
School of Biological Science

Dear Dr. Garvon,

Congratulations! I am pleased to inform you that the Sabbatical Committee has recommended approval of your request for a Fall 2015/Spring 2016 sabbatical to the Provost and Board of Trustees. The committee, which met on January 13, found your proposal entitled *"Keeping pace with the field: Learning DNA extraction, PCR and sequence analysis"* well thought out and meeting the full intent of sabbatical release for both professional growth and enhancement of future student outcomes. We look forward to reading the final report detailing your research and accomplishments from this sabbatical.

Sincerely,

Ron Hutchins, for the Sabbatical Committee
(Allan, Crandall, Childs, Kabke, Finley, McDonald, Swedene)

cc Morrie Walworth, Provost ✓
Barb Keller, Dean

650 W. Easterday Ave., Sault Ste. Marie, MI 49783
Telephone: 906-632-6841 · Fax: 906-635-2111
www.lssu.edu

Keeping Pace with the Field: Learning DNA extraction, PCR and Sequence Analysis

Application for Sabbatical Leave for the 2015-2016 Academic Year

Jason M. Garvon, Ph.D.
School of Biological Sciences
Lake Superior State University

LAKE SUPERIOR STATE UNIVERSITY
OFFICE OF THE PROVOST

APPLICATION FOR SABBATICAL LEAVE
(Refer to Section 15.4 of the Faculty Association Agreement)

I. Name Jason Garvon Date 10 November 2014

Department Biological Sciences Ext. No. 2471

Home Address [redacted] Home Phone [redacted]

II. Application for leave during the following (*indicate semester and/or year*):

☐ Fall ☐ Spring ☒ Full Year

III. Number of years of faculty service (*minimum of 5 years required*) 9

IV. Year your tenure at LSSU was earned (*tenure required*) 2009

V. Semester or year of last sabbatical (*if applicable*) NA
(*minimum of 5 years since last sabbatical required*)

VI. I agree to return to the University and to provide a complete written report (electronic) to the Provost upon the completion of my sabbatical semester(s) as denoted in section 15.4 of the Faculty Associate Contract.

14 November 2014

Signature of Faculty Applicant Date

VII. Signature of your Dean indicating his/her awareness of the application:

11-14-14

Signature of Dean Date

VIII. Attachments:
a. Title and Description of Sabbatical Project (Required and described on the next page)
b. Support Documents (Optional but strongly suggested)
c. Curriculum Vitae (Required)

Provost Office

NOV 14 2014

Lake Superior State University

12:40 pm

Revised 12/16/2011

Keeping Pace with the Field: Learning DNA extraction, PCR and Sequence Analysis

Application for Sabbatical Leave for the 2015-2016 Academic Year

Jason M. Garvon, Ph.D.
School of Biological Sciences
Lake Superior State University

Project Abstract/Executive Summary:

As the field of Parasitology, and Biology in general, becomes more reliant on DNA analysis those classically trained in organismal Biology must either learn new DNA based techniques or risk becoming obsolete. I propose a sabbatical leave to work in the laboratory of Dr. Pedro Antunes of Algoma University to learn and become proficient in PCR analysis, which is the basic tool necessary to conduct all modern DNA analysis. This activity will make me relevant in my own field of Parasitology again as well as allow me bring first hand experience of using modern techniques and analysis into the classes I teach.

Introduction:

In our modern society the term DNA analysis is commonplace. Whether it is identifying strains of Ebola, reporting of Asian Carp DNA in the Kalamazoo river, extracting Neanderthal DNA from fossils and comparing it to our own to determine that they hybridized with early *Homo sapiens*, or watching the latest crime drama where the suspect is caught through DNA matching, we are inundated with information derived from DNA analysis. These analyses have become so common because they relatively cheap for the amount of information that can be obtained, take less time to extract data than traditional methods, and basic techniques can be applied to almost any field so one can learn techniques and transcend multiple disciplines.

As a classically trained parasitologist with degrees in Ecology (BS), Biology (MS) and Wildlife Science (PhD) my research focuses on applying ecological principles to parasite communities infecting wildlife. Traditional techniques are very time consuming as in my dissertation research where host (blue-winged teal) collections took 2 months (186 teal) and lab work took 2 years (4-8 hours processing per host, 1-2 days staining and mounting parasite specimens per host, 1 month for mounted specimens to dry, 1 day to identify specimens from each host using microscopy). Because of this high time commitment, continuation of research in this manner is not conducive at a teaching institution. Additionally, the labor intensive nature of these projects makes them expensive and potential funding sources realize that there are cheaper and more modern techniques available.

The field of parasitology, like most other areas of Biology, has evolved to the point where molecular techniques (DNA analysis) are a mainstay. A common procedure in DNA analysis is the use of Polymerase Chain Reaction (PCR). The process involving PCR is much like photocopying DNA, a single copy (or few copies) of DNA are obtained, isolated, and replicated to end up with millions of copies. This is necessary because often only small amounts of DNA can be originally obtained. Once the product has been amplified, analysis, such as determining the presence of specific species, or subspecies, within samples, identification of discrete populations, and establishing species relationships in the construction of phylogenetic (species) trees, can be completed. In the field of parasitology, this procedure has become so common that it is now being used for diagnosis of infections that would have traditionally been done through microscopy. For example, the 1996 edition (5th) of Roberts and Janovy "Foundations of Parasitology" lists the preferred technique of diagnosing *Plasmodium falciparum* (which causes malaria) microscopically by examination of a blood smear slide. The 2009 edition (8th edition) lists microscopy as a technique requiring great training and then lists DNA analysis as the preferred method of determining the exact species of *Plasmodium*, as there are four species capable of infecting humans.

Within the past 9 years since I began at LSSU, my field has quickly evolved to primarily use PCR based techniques to identify species infecting hosts. In reviewing 14 grant proposals for the National Center for Veterinary Parasitology in October of 2014, 14 of 14 proposals contained a PCR component. Recently, my dissertation advisor took over an abandoned manuscript from extra samples I collected during my dissertation research. The thesis work was performed with microscopy in 2004 by another student and at the time was perfectly acceptable. In acquiring friendly reviews prior to submission my advisor received many comments of the work being outdated and not publication worthy. We have chosen to submit the manuscript anyway as a few potential reviewers saw some value in having microscopy based research (see documentation attached; Fedynich). While one does still see manuscripts published based on classical parasitological studies they are few and far between. In addition these studies require high quality specimens that may be difficult to obtain in a cost efficient manner. For example, I have been part of a collaborative effort to examine parasites from

wolverines in the arctic. While we did publish a few articles rapidly, we have struggled to get the last few out due to samples in poor condition and the fact that I processed the samples here using classical techniques that rendered specimens un-usable for PCR analysis. At this time our primary taxonomist is waiting for a better sample before he is comfortable with making appositive identification of a tapeworm (see documentation attached; Blend) using microscopy; this would have been simple with PCR analysis. On the other hand, where we were able to use PCR we not only identified *Trichinella*, but discover that we actually had two unique species, *Trichinella native* and *Trichinella T6* (see Reichard et al. 2008 in CV). This would not have been possible with microscopy alone, and illustrates how the field of Parasitology and Biology in general has modernized.

While there are colleagues in my school that know PCR, they are also busy teaching and learned these techniques during graduate research, where large blocks of time are dedicated to mastery of techniques. In addition, due to teaching overload all but one semester since arriving at LSSU, mentoring an average of 5 senior thesis students per year (each requires 2 semesters prior to the actual thesis semester) and maintaining grant funded piping plover monitoring in the summers, which employs 5 LSSU students, I have not had the opportunity to learn the newest techniques of my field. Therefore, I am requesting sabbatical leave for the 2015-2016 academic year to learn PCR techniques through collaboration in the lab of Dr. Pedro Antunes at Algoma University. In addition, I plan to prepare 2 manuscripts from work I have performed with senior thesis students (Dusty Arsnoe/Travis McCleod, and Amanda Martin) for publication so that no old research is left and I can move forward in research with my newly gained skill set.

Background:

While I have a strong background in classical parasitology my experience with PCR is limited to co-authors performing the analysis and being primary author on any published work coming from it. I do have a minor in Chemistry from my undergraduate education, where I had the chance to learn PCR but chose to learn HPLC (high pressure liquid chromatography) and gel electrophoresis and ELISA (enzyme-linked immunosorbent assay) instead. In retrospect, this was like the thought of the 1980's that computers were

just a fad that would be outdated in a decade. I possess the necessary bench skills to conduct PCR analyses through my undergraduate education and working as a Chemistry TA during graduate school. I do anticipate some re-learning of basics through reviewing literature prior to entering the lab of Dr. Antunes.

Dr. Antunes studies plant pathogens and symbiotic fungi and has a prolific and active research lab focused on invasive species. Techniques of PCR and DNA sequence analysis are consistent across fields. We have discussed future collaborations after my time in his lab as well as a project for me to complete next year once I gain proficiency in the techniques. This will be finalized in the fall if awarded sabbatical but currently, as a place holder, will be a continuation of a small part of my dissertation. I have, provided we can get them here safely, 184 blood samples from blue-winged teal from Florida, Louisiana and Texas collected during my dissertation research. These were sent to the lab of Gene Rhodes of Purdue University to be analyzed by a graduate student as a side project, but never made the short list. He has agreed to send them to me here at LSSU. Once obtained we will extract DNA, amplify with PCR and conduct micro-satellite analysis to determine if blue-winged teal using the Atlantic coast are truly a unique population from those using the Central flyway. I have conclusions drawn from parasite community data and several reviewers asked about genetic data, which we did not have at the time of publication. While this is not directly related to parasitology it does directly relate to wildlife science, which is the field of my PhD and general area where most of my undergrad senior thesis research is focused due to student interest.

Outcomes:

Through learning and becoming proficient in DNA extraction, PCR and sequence analysis I will be of higher value to my field and have a broader impact as a researcher and peer reviewer, and have access to grant funding not available to me at this time. In addition by I plan to address issues identified as weaknesses in previously published manuscripts. One area of focus will be on the populations of blue-winged teal migrating through the southern US. Data from parasite communities suggests that there is a sub-population of blue-winged teal that stay along the Atlantic coast and use primarily

brackish environments. This was hypothesized in the 1950's but never truly tested. Reviewers of the published manuscript of helminth community dynamics in migratory populations of Blue-winged teal asked about genetic analysis to support evidence from parasite community analysis and there was none at the time.

Second, as an instructor of BIOL 132 General Biology II-organisms I teach students about phylogenetic analysis and ways in which we decide when two organisms are the same species or different species. I know in theory, but not practice, how these decisions are made using DNA analysis. Students learn the cellular side of Biology in BIOL 131, having a better grip on this topic will help me blend the information from BIOL 131 with what we talk about in BIOL 132. In BIOL 420 – Evolutionary Analysis we discuss how Biologists go about documenting evolution, which currently is heavily dependent upon PCR and DNA analysis. The pre-requisite for this class in BIOL 220 – Genetics. Again, while I have a grasp of the theories behind DNA analysis, I can become a better teacher if I can practice the very things that I talk about. In my BIOL 422 – Parasitology class, I will design a laboratory exercise to identify an infection using DNA extraction, PCR and sequence analysis, as my students will have to do in practice once they leave LSSU. Finally, with proficiency inDNA extraction, PCR and sequence analysis I can further help senior thesis students with projects in wildlife (what most of my students study) as they seek to examine differences in populations of presence of hybrids in populations. Currently we have one faculty member who regularly assists in such matters and has indicated a desire for retirement in the next 5 years.

Finally, by submitting manuscripts from research conducted with undergraduates at LSSU I will be further promoting the quality of our senior thesis program.

Timeline:

August 2015 – Begin meeting with Dr. Antunes weekly to get caught up on pertinent literature necessary to start lab work. Begin manuscript prep on ectoparasite removal manuscript

September 2015 – Begin visiting Dr. Antunes' lab for orientation and basics

October 2015 – Begin regular lab work with Dr. Antunes. Submit manuscript on Ectoparasite removal

November 2015 – Continue regular lab work. Begin Wolverine helminth manuscript.

December 2015 – Design research for spring 2016, order supplies necessary (I have saved PD funds to cover expected cost of $1,500) continue lab skills and wolverine manuscript

January 2016 – Begin lab work on blue-winged teal populations*, submit wolverine helminth manuscript

February 2016 – Continue blue-winged teal population analysis, begin developing parasitology PCR lab

March 2016 – Wrap up blue-winged teal population analysis, manuscript revisions, begin blue-winged teal manuscript

April 2016 – Complete blue-winged teal population manuscript and submit

May 2016 – Write sabbatical report

*If blue-winged teal samples are damaged Dr. Antunes and I will come up with another project for me to lead, likely population characterization of lice infecting different species of waterfowl as I already have many preserved specimens from prior senior thesis research.

ALGOMA university

12 November 2014

Sabbatical Committee
Lake Superior State University
650 W. Easterday Ave
Sault Ste. Marie, MI 49783

Dear Sabbatical Committee,

I am happy to provide this letter of support for Dr. Jason Garvon as he applies for sabbatical leave. I have known Dr. Garvon for 5 years and over that time I have seen him present a seminar on his research on parasite communities in addition to having casual conversations about our research. Through these interactions it is clear that Dr. Garvon's work would be enhanced by the use of PCR-based techniques.

My lab has been funded through a research Chair in Invasive Species Biology and research support to work in this field will continue until 2020. I have an active research lab focusing on plant-microbe interactions where we routinely conduct DNA extraction, PCR, gel electrophoresis and sequence analysis. I welcome Dr. Garvon to work with researchers in my lab so that he will become proficient in these molecular techniques. This will create the conditions for Dr. Garvon to obtain important data for advancing his research on parasite communities, that we can then publish in the peer reviewed literature.

In summary, Dr. Garvon's future research prospects would be greatly improved with the use of PCR-based techniques and I welcome him into my lab to learn these techniques. However, this process itself, as well as learning it, requires large blocks of time. Therefore, I strongly support his application for sabbatical leave for the 2015-16 academic year and look forward to welcoming him into my lab and collaborating in the future.

Sincerely,

Pedro M. Antunes, Ph.D.
Tel: (705) 949-2301 ext. 4379
E.mail: antunes@algomau.ca
Website: http://people.auc.ca/antunes

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Jason Garvon <jgarvon@lssu.edu>

possible journals for the BWT blood parasite manuscript

4 messages

Alan M. Fedynich <Alan.Fedynich@tamuk.edu> Fri, May 31, 2013 at 11:09 AM
To: jgarvon@lssu.edu

Jason
Hope all is going well and you are enjoying the summer break, if you have one. I am about done with the BWT blood parasite manuscript and Joanna Mott has reviewed an earlier version. Do you know Sandy's current email address? Since she is listed as a co-author, she would need to review it as well.

One of my concerns has been that this study was done just as PCR methods were gaining steam for blood protozoan prevalence detection. Consequently, many of the top tier journals (Journal of Parasitology and Journal of Wildlife Diseases) have published mostly those articles that included a PCR component unless the manuscript was from a 3rd world country. I sent an email to the editors of the above journals to get their input and they have provided their response to me (see below). It may be a better option for JWD, but I would hate to have it rejected since I am one of the AE's for that journal. The manuscript is loosely formatted as a Short Communication for Journal of Wildlife Diseases.

Before I start serious formatting to a specific journal, I wanted your input as to what you thought and whether a lesser journal would be a better option. I would hate to send it to either of the above, wait 6 months to find out that it is unacceptable, have to revise for another journal and wait another 6 months. Do you know of any 2nd tier journals that would be more receptive to the manuscript? I published a vulture blood parasite article in Northeastern Naturalist in 2005.

Comments from editor of Journal of Wildlife Diseases:
Hi Alan,
I reached out to three really knowledgeable people and this is the feedback I got:

1. I would hope we would not discard automatically on this point. There could other overwhelming value in the data that could warrant publication ... Or at least a good look at such a ms
2. Well it depends on results. If they found positives, then I'd be perfectly happy with smears alone because those give you far more info on morphology of parasite and effect on host cells than does PCR. However, if negative, then question will always be whether it was missed because parasitemia too low (and would have been detected by PCR).
3. If the parasites are identified to species and representative smears are deposited in a suitable museum collection, then I think the minimum requirements are met...

So, unless there is something in these points that scares you off, it sounds to me like you should send it in!

I look forward to seeing it.

Jim

-Original Message-----
From: fedynich alan [mailto:alan.fedynich@tamuk.edu]
Sent: Wednesday, May 15, 2013 6:07 PM
To: Jim Mills

Subject: question on a manuscript I am working on

Jim
I have been seeing more and more blood parasite articles published using PCR techniques or both PCR and blood smears, rather than blood smears alone. I have a former student that never finished her thesis on blue-winged teal blood parasite survey, but since it was in 2007 she used exclusively blood smear examination. I am hesitatent to submit to JWD if it has no chance of being acceptable because she used the older examination methods. Based on what you are seeing coming back from the JWD AE's and reviewers, do you have a feeling on whether or not I should consider JWD or look to a lesser journal? Thanks for your input.

Comments from editor of Journal of Parasitology:

Dear Alan,
I apologize for my tardy response. It was also a pleasure for me to meet you all at the recent SWAP meeting, I was very impressed by the science and the collegiality.
Regarding your question, there is no clear cut answer, but the field has definitely moved towards a more molecular approach. Because of the easy and cheap access to molecular tools nowadays, blood smears alone seem to be less acceptable than they used to be.
Best, Mike
Michael Sukhdeo, Professor
Editor-in-Chief, Journal of Parasitology
Center for Research on Animal Parasites
Dept. Ecology, Evolution and Natural Resources
Rutgers University, New Brunswick, NJ
3) 932-9406

From: Journal of Parasitology <jparasitology@gmail.com>
Date: Wednesday, May 15, 2013 8:04 PM
To: Michael Sukhdeo <sukhdeo@aesop.rutgers.edu>
Subject: Fwd: input on a manuscript I am working on

From: fedynich alan <alan.fedynich@tamuk.edu>
Date: Wed, May 15, 2013 at 7:04 PM
Subject: input on a manuscript I am working on
To: jparasitology@gmail.com

Vickie
Can you forward this email to the new editor Dr. Sukhdeo? Thanks

Dr. Sukhedo
It was a pleasure to meet you at the recent Southwestern Association of Parasitologists meeting and hope you are adjusting to the editor's position for JP. I would like your input on a manuscript that I am preparing. I have been seeing more and more blood parasite articles published using PCR techniques or both PCR and blood smears, rather than blood smears alone. I have a former student that never finished her thesis on a blue-winged teal blood parasite survey, but since it was in 2007 she used exclusively blood smear examination. I am hesitatent to submit to JP if it has no chance of being acceptable because she used the older examination methods. Based on what you are seeing coming back from the AE's and reviewers, do you have a feeling on whether or not I should consider JP or look for a lesser journal? Thanks for your input.

Alan Fedynich, Ph.D.

LAKE SUPERIOR STATE UNIVERSITY
MyLSSU

Jason Garvon <jgarvon@lssu.edu>

Gu.o gulo-Taenia update

3 messages

Chuck Blend <ilovethesea@att.net> Mon, Aug 5, 2013 at 6:41 PM
To: Mason Reichard <mason.reichard@okstate.edu>, Jason Garvon <jgarvon@lssu.edu>
Cc: Chaimeleh <ilovethesea@att.net>

Hello, Mason & Jason. Many hopes you and yours are well this first Monday of August. Hard to believe that classes begin in only a few weeks and the students are coming back so soon. I hope your summer has been productive and I wish each of you ease in preparing for another academic year.

I wanted to email you both to let you know that I returned yesterday (4 Aug 2013) from spending at week at College Station with Norm Dronen and his family. Always enjoy spending time with "my second dad" and this week was no different. One of the things to get done there at his lab was to stain and mount another vial of the tapeworms from *Gulo gulo* you had sent me a few years ago while I was up in Boston. I can report that I was able to stain, clear and mount fresh material of another 10 tapeworms (entire worms) so as to have fresh material to work with. The sad news is that the majority of the first batch I mounted years ago was not salvageable (didn't survive the move down and the ravages of time) except for about 8 or so slides of tapeworm proglottids and a few scoleces I could remount on new slides. Several of the "new" scoleces from the "new" vial I squash-mounted (as per recommendation by Scott Gardner for working with taeniids) so I could better see the hooks and rostellum; everything stained up and cleared well. ☺

In honesty, team, I fear after preliminary glancing at the wet slides that the material is poorly fixed, as I saw in the first batch of worms I mounted years ago while at Gordon College. I am now waiting for the slides to dry for a few weeks before I take a really good look at them, but I can tell from their general appearance (edges curled up, etc.) that the quality isn't the best. This will be my last attempt at staining/mounting this material my friends, as it is likely that all the tapeworms in the 2 remaining vials are probably not in the best condition either, I'm sorry to say. Still, museums will accept materials in vials (preserved in 70% EtOH), so once the MS is completed and with your permission, I would like to deposit the 40 or so new slides of tapeworms I mounted last week and the 2 vials still full of worms. In summary, this will then be all the material you sent me (2 complete vials still full of tapes; ~40 slides from a 3rd vial mounted this past week [vial is now empty]; and ~8 slides of tapes from a 4th vial mounted years ago [this vial is also empty]).

I am now working on illustrations for quite a large MS, upwards of ~35 or so figures, but once that paper is completed and submitted for review (the text of the MS is finished), I plan to begin revising our wolverine-tape paper. On that note, can either of you fill me on the molecular portion of this MS? Looking back thru our first shot at the MS from years ago, I noticed that there was a section for molecular data. Is that still in the game plan, team? If so, can I have details?

I hope this update is helpful, Mason & Jason. I figure with ~40 slides of "fresh" tapeworm material, and if the material is not too contracted, we can at least work on getting an ID confirmation on *Taenia* and submit to *Veterinary Parasitology*, which I believe is the journal we had decided on.

Looking forward to hearing back from you both.

Parasitol Res
DOI 10.1007/s00436-008-1028-y

ORIGINAL PAPER

Trichinella T6 and *Trichinella nativa* in Wolverines (*Gulo gulo*) from Nunavut, Canada

Mason V. Reichard · Luigi Torretti · Timothy A. Snider · Jason M. Garvon · Gianluca Marucci · Edoardo Pozio

Received: 7 February 2008 / Accepted: 1 May 2008

Abstract Infection of *Trichinella* spp. is common among animals in the Canadian Arctic. We determined the prevalence of *Trichinella* spp. infection in wolverines (*Gulo gulo*) from Nunavut, Canada. Diaphragms from 41 wolverines were examined by artificial digestion. *Trichinella* spp. larvae were detected in 36 (87.8%) examined animals. *Trichinella* T6 was detected in 33 (91.7%), *Trichinella nativa* in only one (2.8%), and a mixed *Trichinella* T6 and *T. nativa* infections were detected in two (5.6%) wolverines. This is the first report of *Trichinella* spp. infection in wolverines from Nunavut and the first report of sympatric *Trichinella* T6 and *T. nativa* in any host. The high prevalence of *Trichinella* spp. infection in combination with the natural history of wolverines suggests that the mustelid may be a key species in the natural cycle of these parasites in Arctic and Subarctic areas.

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Introduction

Infection with *Trichinella* spp. is common in carnivores throughout the world (Pozio and Murrell 2006). The biology of *Trichinella* spp. is unusual in that the same individual animal serves as both definitive and intermediate host, with juvenile and adult worms located in different tissues. Hosts become infected when they ingest muscle tissues containing infective larvae. The infective muscle larvae reach the duodenum and within 2 days develop to adults which parasitize the intestinal epithelium. Adult worms sexually reproduce in the host intestinal tract and females give birth to larvae that are distributed throughout the host body by the blood and may reach every kind of tissue and space. When the new born larvae reach striated muscles, they penetrate into the muscle cells which then modify to nurse cells. New born larvae develop to the infective stage (without any molt) inducing the development of a protective collagen capsule (Pozio 2007).

Infection of *Trichinella* spp. in wild carnivores and scavengers is common in the Canadian Arctic and Subarctic areas (Dick and Pozio 2001). The wolverine (*Gulo gulo*) is the largest member of the weasel family and is found in circumpolar areas throughout Holarctic regions. The scavenging lifestyle, large home range, and extensive seasonal movements (Pasitschniak-Arts and Lariviere 1995) of wolverines predisposes them for exposure to

Trichinella spp. The objective of the present paper was to determine the prevalence of *Trichinella* spp. infection in wolverines in the Kitikmeot (westernmost) region of Nunavut. We report that 87.8% (36 of 41) wolverines from Nunavut were infected with *Trichinella* spp., most of which belonged to the genotype *Trichinella* T6.

Materials and methods

Sample collection

Wolverine carcasses were collected from hunters and trappers from Kugluktuk, Nunavut, Canada from November 2006 until April 2007. Samples originated from an area ranging from 66–67° North and 110–117° West. Sex, approximate age (juvenile [<2 years old] or adult), and actual or proximate harvest location waypoint coordinates were recorded for each wolverine. All carcasses were frozen until May 2007 when partial necropsies were performed. At necropsy, nearly the entire diaphragm from each wolverine was collected and re-frozen at −20°C or with dry ice until they were shipped to the Center for Veterinary Health Sciences at Oklahoma State University (OSU) in August for analysis of *Trichinella* spp. infection.

Trichinella sp. detection

Wolverine diaphragms were tested for infection with *Trichinella* spp. by artificial digestion (Webster et al. 2006). Approximately 5.0 g of tissue were weighed (to the nearest 0.1 gram) and homogenized in a Polytron (Kinematica GmbH, Kriens-Luzern, Switzerland). Homogenized samples were mixed with 10 mL of artificial digestive fluid (1% pepsin 1:10,000 IU and 1% hydrochloric acid) per 1.0 g of tissue (Korinkova et al. 2006). Digests were mixed vigorously on magnetic stir plates at 37°C for 3 h. Digests were poured through a double-layer of coarse (20 threads by 12 threads per 6.45 cm^2) cheesecloth to remove any connective tissue that was undigested and allowed to settle for 20 min. Sediment containing *Trichinella* spp. larvae was washed with tap water three to five times, depending on the amount of cellular debris, and enumerated at 40× magnification. Results were recorded as the number of *Trichinella* sp. larvae per gram (LPG) of tissue digested.

Molecular characterization of *Trichinella* sp. isolates

Trichinella spp. larvae recovered by artificial tissue digestion from positive wolverines were washed in saline, preserved in absolute ethyl alcohol, and submitted to the International *Trichinella* Reference Center (ITRC, www.iss.it/site/Trichinella/) in Rome, Italy for genotyping. Individual *Trichinella* sp. larvae were identified by multiplex PCR analysis following the protocol described by Zarlenga et al. (1999) and modified by Pozio and La Rosa (2003). Briefly, DNA was extracted from ten individual worms of each isolate; PCR was performed using ExTaq DNA polymerase (Takara) in 50 ml containing 1.5 mM $MgCl_2$, 200 mM dNTPs, 50 pmol of each primer and 0.5 unit of ExTaq DNA polymerase. The PCR-amplified fragments from purified DNA were visualised by agarose gel electrophoresis (2.0% standard agarose). Single *Trichinella* sp. larvae from one reference strain (ITRC code) for each taxa circulating in North America, were used for comparison: *Trichinella spiralis* (ISS003), *T. nativa* (ISS010), *Trichinella pseudospiralis* (ISS470), *Trichinella murrelli* (ISS035), and *Trichinella* T6 (ISS040).

Statistics

The prevalence of *Trichinella* spp. infection between sex and age class of wolverines was compared using Fisher Exact tests since over 20% of the expected values were less than five (Sokal and Rohlf 1997). Mann–Whitney Rank Sum tests (Sokal and Rohlf 1997) were used to compare *Trichinella* spp. LPG between sex and age of wolverines. Statistical analyses were performed with SigmaStat 3.1 statistical software package (Systat Software, Point Richmond, California).

Results

Trichinella detection

Forty-one wolverine carcasses were collected and tested. The place of animal origin is shown in Fig. 1. Of 41 examined diaphragms, 36 (87.8%) were infected with *Trichinella* sp. larvae without any statistical difference between males and females or between juveniles and adults (Table 1). Mean intensity (SE; range) of LPG was 8.6 (2.0; 0.2–51.8). Table 1 also shows the average LPG of *Trichinella* spp. observed in diaphragms according to sex and age classes of wolverines. Statistically significant differences were not detected in the average numbers of LPG between sex and age classes of wolverines.

Molecular identification

Banding patterns from multiplex PCR amplifications of the *Trichinella* isolates showed that 33 (91.7) of the 36 positive wolverines were infected with *Trichinella* T6 (ITRC, codes ISS1872 through ISS1901 and ISS1903 to ISS1905). Two (5.6%) of the wolverines (KU-02 and KU-35) were

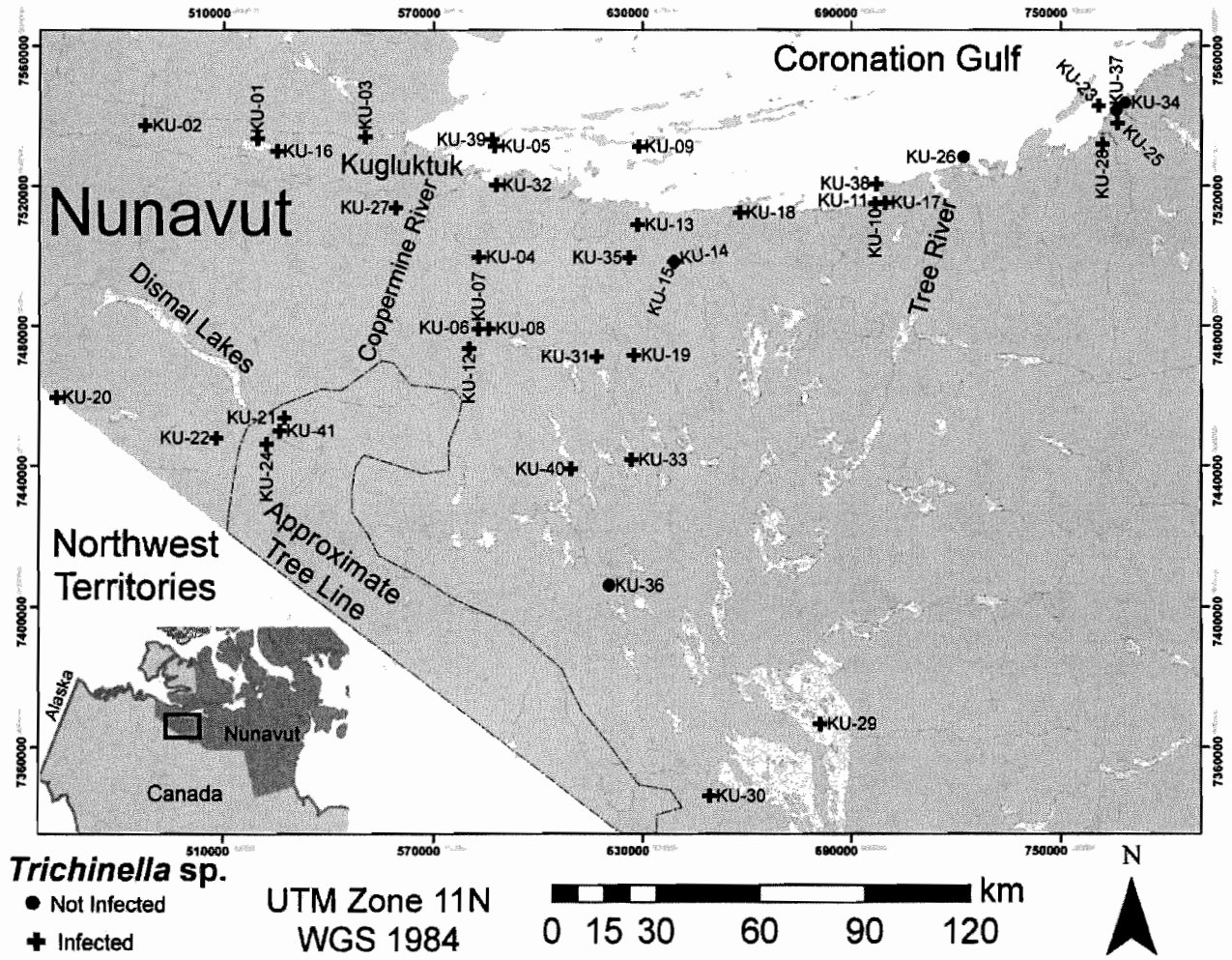

Fig. 1 Locations in Nunavut, Canada where wolverines (*Gulo gulo*) were harvested from November 2006 until April 2007

co-infected with both *Trichinella* T6 and *T. nativa* (ITRC, codes ISS1822 and ISS1902, respectively). One (2.8%) wolverine KU-40 was infected with just *T. nativa* (ITRC, code ISS1823).

Discussion

We report, for the first time, the occurrence and prevalence of *Trichinella* T6 and *T. nativa* infections in wolverines from Nunavut. In Canada, larvae belonging to the *T. nativa* group have been previously isolated from a wolverine in Manitoba (Chadee and Dick 1982) and two of four (50.0%) wolverines from British Columbia (Schmitt et al. 1976), whereas no larvae of *Trichinella* spp. was detected in the diaphragms of 38 wolverines collected in the Northwest Territories that were tested by tissue compression (Addison and Boles 1978). In Alaska, USA, 19 of 38 (50.0%) were infected with *Trichinella* spp. (Rausch et al. 1956).

Table 1 Prevalence of infection and average number of *Trichinella* larvae per gram (LPG) in diaphragms of wolverines collected from Nunavut, Canada

Sex	Age	Total number of samples	No. positive by digestion (%)	Average LPG by digestion (SE; min–max)
Male	Juvenile	4	4 (9.8)	20.6 (11.4; 0.2–51.8)
	Adult	23	20 (48.8)	7.5 (2.1; 0.6–31.6)
Female	Juvenile	7	6 (14.6)	1.9 (1.2; 0.2–7.8)
	Adult	7	6 (14.6)	10.8 (5.3; 0.4–29.4)
Total		41	36 (87.8)	8.6 (2.0; 0.2–51.8)

Comparing the prevalence from Alaska (Rausch et al. 1956) to those that were determined by a similar method in the present study (87.8%), a significantly higher proportion ($DF=1$, $X^2=11.599$, $p=0.0007$) of wolverines in Nunavut were infected with *Trichinella* spp. It is difficult to explain the significant difference in the prevalence of *Trichinella* spp. infection in wolverines between Alaska and Nunavut. It is possible that food sources in the two geographically distinct areas are different or have changed over time which makes wolverines in Nunavut more likely to be infected with *Trichinella* spp.

In addition to the Arctic and Subarctic areas in North America, wolverines infected with *Trichinella* T6 have been reported from Montana, USA (ITRC, code ISS39 and ISS339); and one wolverine infected with *Trichinella* spp. in Iowa, USA. (Zimmerman et al. 1962). In Asia, Britov (1997) reported 29.7% of wolverines examined from Kamchatka (Eastern Russia) were infected with *Trichinella* spp. In Sweden, *Trichinella* spp. larvae were not detected in 27 wolverines that were examined (Mörner et al. 2005).

The intensity of *Trichinella* spp. infection in wild animals is generally very low, ranging from 0.1 to 10 LPG, in preferential muscles, and intensities >50.0 to 100.0 LPG are exceptional (Dick and Pozio 2001). Rausch et al. (1956) reported the average *Trichinella* spp. LPG was 3.5 and ranged from 0.2 and 18.0 in infected wolverines from Alaska. In the present study, the average number of *Trichinella* spp. from infected individuals was 8.6 and ranged from 0.2–51.8 LPG based on artificial digestion of diaphragms from infected wolverines. Additionally, in the present study, digested wolverine diaphragms were sieved through coarse cheesecloth that easily permitted the passage of digested larvae but is not a standard technique and may have prevented recovery of all *Trichinella* larvae in the samples.

A variety of mammals in Canada have been found infected with *Trichinella* spp. (reviewed by Appleyard and Gajadhar 2000). Among those animals most commonly reported with a high (>30%) prevalence of *Trichinella* spp. infection are carnivores and scavengers including polar bears (*Ursus maritimus*), grizzly bears (*Ursus arctos*), and arctic foxes (*Alopex lagopus*; Smith and Snowden 1988; Appleyard and Gajadhar 2000; Forbes 2000; Dick and Pozio 2001). The high prevalence of *Trichinella* spp. infection among polar bears and arctic foxes suggests they are key mammalian species in the transmission of the parasite in the Arctic (Dick and Pozio 2001). This hypothesis may also extend to wolverines due to similar scavenging strategies combined with a high prevalence of *Trichinella* spp. infection.

The genotyping of *Trichinella* spp. larvae from two wolverines showed that they were infected with both *T. nativa* and *Trichinella* T6. This is the first time that both these taxa have been detected in a single host (mixed infections in KU-02 and KU-35). The three wolverines which harbored *T. nativa* alone or with *Trichinella* T6 larvae, originated from three different localities of Nunavut far more than 60–120 km from each other, suggesting different origins of infection. *Trichinella* T6 is the most common etiological agent of *Trichinella* sp. infection in the Kitikmeot, at least among wolverines.

Previously, individual hosts had been found infected with *T. nativa*, *Trichinella* T6 or hybrids between the two taxa but multiple infection of *T. nativa* and *Trichinella* T6 within individual hosts had not been detected before the present study (La Rosa et al. 2003). *Trichinella nativa* and *Trichinella* T6 are closely related and can only be distinguished using molecular and biochemical methods (Pozio and Murrell 2006). The presence of both *Trichinella* spp. taxa in two wolverines and the lack of hybrid larvae, suggests that these two parasites were transmitted through distinct contaminated food sources. If both *Trichinella* spp. taxa were present in only one food source, there would be a high probability to observe hybrid *Trichinella* larvae as observed in wolves of Alaska (La Rosa et al. 2003).

T. nativa is widespread among wildlife throughout Arctic and Subarctic areas in Holarctic regions whereas *Trichinella* T6 has been found in fewer wild mammals and only in Arctic, Subarctic and Temperate areas of North America (Dick and Pozio 2001). The results of the present study suggest that *T. nativa* and *Trichinella* T6 can be sympatric in wolverines from Nunavut.

Acknowledgments The present study was funded in part by the Oklahoma State University Center for Veterinary Health Sciences, the Nunavut Wildlife Management Board, and the Department of Environment, Government of Nunavut. We thank the Kugluktuk Hunters' and Trappers' Organization for their support and participation with the wolverine carcass collection program, Angie Bruner and Jennifer Jane Garrett for laboratory assistance, two anonymous reviewers, and Mathieu Dumond for helpful comments. The present study complied with the laws of Canada, Italy, and the United States of America in which the experiments were conducted.

References

Addison EM, Boles B (1978) Helminth parasites of wolverine, *Gulo gulo*, from the District of Mackenzie, Northwest Territories. Can J Zool 56:2241–2242

Appleyard GD, Gajadhar AA (2000) A review of trichinellosis in people and wildlife in Canada. Can J Public Health 91:293–297

Britov A (1997) Trichinellosis in Kamchatka. Wiad Parazytol 43:287–288

Chadee KC, Dick TA (1982) Biological characteristics and host influence on a geographical isolate of *Trichinella* (Wolverine: 55° 00'N, 100°00'W, 1979). J Parasitol 68:451–456

Dick TA, Pozio E (2001) *Trichinella* spp. and trichinosis. In: Samuel WM, Pybus MJ, Kocan AA (eds) Parasitic diseases of wild mammals, 2nd edn. Iowa State University Press, Ames, Iowa

Forbes LB (2000) The occurrence and ecology of *Trichinella* in marine mammals. Vet Parasit 93:321–334

Korinkova K, Pavlickova Z, Kovarcki K, Koudela B (2006) Distribution of muscle larvae and antibody dynamics in goats experimentally infected with *Trichinella spiralis*. Parasitol Res 99:643–647

La Rosa G, Marucci G, Zarlenga DS, Casulli A, Zarnke RL, Pozio E (2003) Molecular identification of natural hybrids between *Trichinella nativa* and *Trichinella* T6 provides evidence of gene flow and ongoing genetic divergence. Int J Parasitol 33:209–216

Mörner T, Eriksson H, Bröjer C, Nilsson K, Uhlhorn H, Ågren E, Hård af Segerstad C, Jansson DS, Gavier-Widén D (2005) Diseases and mortality in free-ranging brown bear (*Ursus arctos*), gray wolf (*Canis lupus*), and wolverine (*Gulo gulo*) in Sweden. J Wildl Dis 41:298–303

Pasitschniak-Arts M, Lariviere S (1995) *Gulo gulo*. Mammalian Species 499:1–10

Pozio E (2007) Taxonomy, biology and epidemiology of *Trichinella* parasites. In: Dupouy-Camet J, Murrell KD (eds) FAO/WHO/OIE guidelines for the surveillance, management, prevention and control of trichinellosis. World Organization for Animal Health, Paris, France

Pozio E, La Rosa G (2003) PCR-derived methods for the identification of *Trichinella* parasites from animal and human samples. Methods Mol Biol 216:299–309

Pozio E, Murrell KD (2006) Systematics and epidemiology of *Trichinella*. Adv Parasitol 63:368–439

Rausch R, Babero BB, Rausch RV, Schiller EL (1956) Studies on the helminth fauna of Alaska. XXVII. The occurrence of larvae of *Trichinella spiralis* in Alaskan mammals. J Parasitol 42:259–271

Schmitt N, Saville JM, Friis L, Stovell PL (1976) Trichinosis in British Columbia wildlife. Can J Public Health 76:21–24

Smith HJ, Snowden KE (1988) Sylvatic trichinosis in Canada. Can J Vet Res 52:488–489

Sokal RR, Rohlf FJ (1997) Biometry, 3rd edn. Freeman, New York, New York

Webster P, Maddox-Hyttel C, Nockler K, Malajauskas A, van der Giessen J, Pozio E, Boireau P, Kapel CMO (2006) Meat inspection for *Trichinella* in pork, horsemeat and game within the EU: available technology and its present implementation. Euro Surveill 11:50–55

Zarlenga DS, Chute MB, Martin A, Kapel CM (1999) A multiplex PCR for unequivocal differentiation of all encapsulated and nonencapsulated genotypes of *Trichinella*. Int J Parasitol 29:1859–1867

Zimmerman WJ, Hubbard ED, Schwarte LH, Biester HE (1962) *Trichinella spiralis* in Iowa wildlife during the years of 1953 to 1961. J Parasitol 48:429–432

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EDUCATION

Doctor of Philosophy (2005), Wildlife Science, Texas A&M University-Kingsville, Kingsville, Texas and Texas A&M University, College Station, Texas - Joint Program.
Dissertation: Biogeographic diversity in helminth communities of migrating blue-winged teal.

Master of Science (2001), Biology, Northern Michigan University, Marquette, Michigan
Thesis: Nematode parasitism in the land snail *Anguispira alternata*: aspects of infection with *Cosmocercoides dukae* and evaluation of a mechanism of infection with *Parelaphostrongylus tenuis*.

Bachelor of Science (1998), Ecology (Wildlife Management Emphasis), Northern Michigan University, Marquette, Michigan Minor 1: Chemistry, Minor 2: Conservation.

ACADEMIC POSITIONS HELD

Assistant Professor
Lake Superior State University: August 2005 – Present (Granted Tenure November 2009)
Department of Biological Sciences

Lecturer
The University of Texas at Brownsville and Texas Southmost College: January – May 2005
Biological Sciences Department

Texas A&M University-Kingsville: January – May 2003
Department of Animal and Wildlife Science

Research Assistant
Texas A&M University-Kingsville: July 2001 – August 2005
Caesar Kleberg Wildlife Research Institute and Department of Animal and Wildlife Science

Graduate Teaching Assistant
Northern Michigan University: August 1999 – April 2001
Department of Chemistry

EXECUTIVE SUMMARY OF ACTIVITIES

COURSES DEVELOPED

Level	Description	Credits	Lab	Semesters Taught
100	General Biology II, Organisms	4	Y	19
100	Freshman Seminar	1	N	6
100	Human Anatomy and Physiology I	4	Y	5
100	Human Anatomy and Physiology II	4	Y	4
100	Introduction to Fish and Wildlife Management*	1	N	2
200	Principles of Wildlife Management	3	N	1
300	General Ecology	4	Y	3
300	Invertebrate Zoology as Wildlife Parasitology*	3	N	1
300	Invertebrate Zoology	3	N	2
300	General Entomology	4	Y	1
400	Evolutionary Analysis	3	N	5
400	Animal Behavior	3	N	1
400	Parasitology	3	Y	4
400	Senior Seminar – Senior Symposia	1	N	1
400	Texas Coastal Ecology & Outdoor Writing*	2	Y	1

* Courses co-taught

Grants Received and Peer Reviewed Publications by Year

Year	Granting Agency	Total Grant	Journal
2013	NFWF	$341,430.00	
2011	NFWF	$313, 459.00	Journal of Parasitology Research
2010	NFWF	$388,000.00	Journal of Parasitology
2008	MI DNR	$30,000	Journal of Parasitology Parasitological Research
2007			Archives of Environmental Contaminants and Toxicology
2005			Comparative Parasitology Canadian Journal of Zoology
Totals		**$1,072,889.00**	**8**

UNIVERSITY SERVICE

LEADERSHIP ROLES

LSSU Faculty Association Executive Council: May 2010 – Present

Member of negotiating team to bargain faculty contract, handle grievances from faculty from filing to meeting with administration, serve as LSSU representative on MEA section 16A Coordinating Council to direct leadership of the MEA within the eastern UP, evaluated past proposed contract for presentation to faculty, address other issues of faculty. President (2012-present), Vice president (2011/2012), member at large 2010/2011)

NEA – Emerging Leaders Academy : June 2011 – March 2012
ELA provides hands-on training to new and future leaders of higher education local unions to strengthen the long-term viability and effectiveness of these locals and their state associations. ELA also provides emerging leaders an opportunity to become part of a national network of ELA participants and graduates.

Co-chair LSSU Retention Committee: August 2010 – May 2011
Work with Director of Retention and retention committee to identify student retention issues at LSSU, evaluate tools to promote retention, analyze retention reports, work to disseminate information to faculty.

Faculty Development Presenter: August 2009
Presented two sessions on simple and effective use of the I-Clicker student response system to interested faculty during the LSSU Faculty Development Day.

Assessment Chair (School of Biological Sciences): January 2009 - Present
Lead efforts to write comprehensive assessment plan for the School of Biological Sciences, report on current assessment activities to Provost, and participate in overall evaluation of assessment to meet university accreditation requirements.

Seminar Series Leader (School of Biological Sciences): August 2008 – May 2009
Recruited and made arrangements for seminar speakers, organized seminar students into groups based on research interest, coordinated classroom use for groups.

Laboratory Coordinator (School of Biological Sciences): 2005 – present
Responsible for placing orders, setup, and coordinating lectures and grading of lab assignments among multiple lab instructors.

COMMITTEES

LSSU Honors Program Council: September 2008 – Present
Review both proposals and final theses of honors program students and proposed honors courses submitted by faculty.

LSSU General Education Committee: August 2008 – August 2010
Led development of Natural Sciences section of general education program assessment. Worked with small committee to create objective statements for the major sections of general education program in preparation for HLC accreditation.

LSSU Retention Committee: March 2008 – July 2010
Actively participate in meetings and discussions of retention issues.
Assist in evaluation of LSSU retention strategic plan.

LSSU Faculty Search Committee Member: June 2006 - Present (as needed)
Review applications and conduct interviews of potential candidates for positions in the School of Biological Sciences (n = 3) and School of Nursing (n = 4).

ADVISORY

LSSU Student Chapter of Ducks Unlimited: August 2007 – Present
Co-advise the only student chapter of D.U. in Michigan. Help organize annual fundraising banquet, manage finances, and plan activities.

LSSU Fisheries and Wildlife Club: March 2006 – April 2011
Served as advisor (2006-2007), and co-advisor (200 8– 2011) which includes meeting with executive committee to discuss club functions, plan events, establish contacts between the club and natural resource professionals. Re-established club as an official student chapter of The Wildlife Society. Club has won most active student chapter of the North Central Division of The American Fisheries Society for 2007, 2008, 2009, 2010, as well as 2 national most active student chapter awards 2008 and 2009.

PUBLIC SERVICE AND OUTREACH

LEADERSHIP

MI DNR Eastern Upper Peninsula Citizens Advisory Council – 2012 to Present
A group of 21 citizens from the EUP who are elected to represent citizen concerns and provide input on important issues to the DNR at bi-monthly meetings. Issues discussed such as the Graymont proposal, wolf hunting season, and increase to license fees.

LTC - Vermilion Nature Preserve Advisory Group: 2007- present
Work with staff of Little Travers Conservancy and members of LSSU and the Wildshores Foundation to foster research at Vermilion, upkeep of grounds, and LSSU use of the property. Developed Vermilion use protocol and application form.

Route 5M Leader - Audubon Christmas Bird Count: 2005-Present
Annually organize volunteers, conduct Christmas Bird count with LSSU students and submit data to national representative.

EDUCATION

The Clergy Letter Project: November 2010 – Present
Serve as resource for local clergy who may have questions regarding evolution.

Science Fair Judge (Brimley Middle School): November 2009
Provided feedback to middle schools regarding science fair projects, worked with ISD members to rank projects based on scientific merit.

Michigan Math and Science Teacher Leader Collaborative: 2009
Developed inquiry based lesson on heredity and natural selection. Presented lesson at Blesch Middle School, Menominee, MI, followed by discussion with teachers of how to incorporate inquiry into the science classroom.

LSSU Summer Exchange Program: 2007
Led students and a faculty member from Shiga University, Japan, on ecological tours of the local area.

LSSU Summer Camp Instructor: 2006 and 2007
Led groups of summer camp participants (high school and middle school) in field and laboratory exercises.

VOLUNTEER WORK

Great Lakes Piping Plover Monitoring Program: 2007-2009
Donated all of my time as a grant match ($2,000 to $3,000 annually) for monitoring activities, consulting and other duties as needed.

Great Lakes Decadal Colonial Waterbird Census: 2007 and 2008
Involved an LSSU student in conducting censuses of several colonial waterbird colonies along the St. Mary's River and in Lake Superior, and submitted data to regional representative.

Double Crested Cormorant Banding: July 2007
Aided Environment Canada biologist, biologists from USDA and Mississippi State University with banding juvenile Cormorants on various islands of Lake Huron.

Habitat for Humanity Nail Sale: August 2006
Solicited donations for Chippewa County Habitat for Humanity.

Friends of the Porkies Artist in Residence Volunteer: Summer and Fall 2006
Assisted in construction and onsite assembly of timber frame cabin used for the artist in residence program at the Porcupine Mountains State Park.

Sustainable Sault Coalition Volunteer: February 2006
Led ecological tours of the Ashmun Creek Natural Area for local residents.

GRANT SUPPORT

GRANTS RECEIVED

National Fish and Wildlife Foundation – Sustain our Great Lakes Grant: July 2013
PI and Administrator for **$341,430.00** ($150,000 cash) grant "An integrated approach to conserving the Great Lakes Piping Plover" to monitor Great Lakes Piping Plovers in the UP, and identify invasive species in nesting areas during 2014 and 2015. Collaborators from: Algoma University, Central UP and Eastern UP Cooperative Weed Management Areas, Detroit Zoo, US Fish & Wildlife Service, US Forest Service, and the Michigan Department of Natural Resources.

National Fish and Wildlife Foundation – Sustain our Great Lakes Grant: July 2011
PI and Administrator for **$313,459** ($150,000 cash) grant "A multifaceted approach to conserving the Great Lakes Piping Plover" to monitor Great Lakes Piping Plovers in the UP, and identify invasive species in nesting areas during 2012 and 2012. Collaborators from: Algoma University, Central UP and Eastern UP Cooperative Weed Management Areas, Detroit Zoo, Upper Peninsula Land Conservancy, US Fish & Wildlife Service, US Forest Service, and the Michigan Department of Natural Resources.

National Fish and Wildlife Foundation – Sustain our Great Lakes Grant: April 2010
PI and Administrator for **$388,000** ($150,000 cash) grant "A multifaceted approach to conserving the Great Lakes Piping Plover population" to monitor Great Lakes Piping Plovers in the UP, and identify invasive species in nesting areas during 2010 and 2011. Collaborators from: Algoma University, The Nature Conservancy, Detroit Zoo, Upper Peninsula Land Conservancy, US Fish & Wildlife Service, US Forest Service, and the Michigan Department of Natural Resources.

Michigan DNR Coastal Zone Management Grant: November 2008
Co-PI for **$30,000** ($13,000 cash) grant "Biological assessment of the Vermilion Point Preserve" to conduct Biological inventory of Vermilion. Collaborator: Doug Fuller of Little Traverse Nature Conservancy. Work began March 2009, final report submitted October 2010.

UNFUNDED GRANTS

National Science Foundation MRI Instrumentation grant: August 2009
Co-PI for **$118,120** grant "Acquisition of Instrumentation for the Determination of Trace Level Mercury Speciation for Use in Multidisciplinary Research and Undergraduate Research Training at Lake Superior State University." Co-PI's: Derek Wright, David Szlag, Barbara Keller (Chemistry); Kristen Arend (Biology).

CONTRACTS

Hiawatha Sportsman's Club: February 2010 – Present
Analyze white-tailed deer harvest data, compile annual report, and make recommendations for management. Participate in game commission meetings and offer suggestions regarding wildlife management on the 35,000 acre club.

Mitigated Wetland Monitor: April 2009 – Present
Conduct mammal, bird, reptile, amphibian, and invertebrate surveys to monitor success of wetland mitigation project. Submit quarterly reports of progress.

Herring Gull Contaminants Study: April 2006 – Present
Conduct annual nest censuses and collect Herring gull eggs for contaminant analysis through Clemson University.

PUBLICATION AND RESEARCH

IN PREPARATION

Blend, C.K., **Garvon, J.M.,** Reichard, M.V., West, M.D., and L. Torretti. Detection of *Taenia martis americana* Wahl, 1967 in Wolverines (*Gulo gulo*) from Nunavut, Canada. Journal for Parasitology Research.

Garvon, J.M., Fedynich, A.M., Jacobs, S.S., and J. Mott. Blood parasites from Blue-winged teal using two flyways. Journal of Parasitology – Submission projection December 2014

Martin, A.M.·, **Garvon, J.M.,** Reichard, M.V., and L. Torretti. Helminth community dynamics in intestines of Wolverines (*Gulo gulo*) from Nunavut, Canada. Canadian Journal of Zoology.

Reichard, M. V., L. Torretti, and **J. M. Garvon**. Tissue tropism of *Trichinella* genotype T6 and *Trichinella nativa* in wolverines (*Gulo gulo*). Journal of Parasitology.

Arsnoe, D. and **J. M. Garvon**. Assessment of a new method for removing and quantifying infestations of ectoparasites from birds.

PUBLISHED MANUSCRIPTS

Garvon, J.M., Fedynich, A.M., Peterson, M.J., and D.B. Pence. 2011. Helminth community dynamics in populations of blue-winged teal (*Anas discors*) using two distinct migratory corridors. Journal for Parasitology Research. Volume 2011, Article ID 306257, 9 pages. doi:10.1155/2011/306257

Dubey, J.P., M.V. Reichard, L. Torretti, **J. M. Garvon**, N. Sundar, and M.E. Grigg. Two new species of *Sarcocystis*, *S. kalvikus* and *S. kitikmeotensis* infecting the wolvering (*Gulo gulo*) from Nunavut, Canada. Journal of Parasitology. 96(5): 972-976.

Reichard, M.V., L. Torretti, **J.M. Garvon**, and J.P. Dubey. 2008. Prevalence of antibodies to *Toxoplasma gondii* in wolverines from Nunavut, Canada. Journal of Parasitology. 94(3): 764-765.

Reichard, M.V., L. Torretti, T. Snider, **J. Garvon**, G. Marucci, and E. Pozio. 2008. *Trichinella T6* and *Trichinella nativa* in Wolverines (*Gulo gulo*) from Nunavut, Canada. Parasitological Research. DOI 10.1007/s00436-008-1028-y

Fedynich, A.M., B.M. Ballard, T.J. McBride, J.A. Estrella, **J.M. Garvon**, and M.J. Hooper. 2007. Arsenic, Cadmium, Copper, Lead, and Selenium in Migrating Blue-Winged Teal (*Anas discors* L.). Archives of Environmental Contaminants and Toxicology. 53(4): 662-666.

Fedynich, A.M., R.S. Finger, B.M. Ballard, **J.M. Garvon**, and M.J. Mayfield. 2005. Helminths of Ross' and greater white-fronted geese wintering in South Texas, U.S.A. Comparative Parasitology. 72(1): 33-38.

Garvon, J.M. and J. Bird. 2005. Attraction of the land snail *Anguispira alternata* to fresh faeces of white-tailed deer: implications in the transmission of *Parelaphostrongylus tenuis*. Canadian Journal of Zoology. 83(2): 358-362.

Popular Article

Garvon, J.M. and A.M. Fedynich. 2003. Blue-winged teal: vagabonds of the Americas. South Texas Wildlife 7(3): 1-2.

· LSSU Undergraduate Student Researcher

IN PROGRESS RESEARCH

Ongoing Undergraduate Research

Crawford, J. Effectiveness of spinning wing decoys on hunter success

Flanagan, T. Invertebrate prey abundance near nest sites of piping plovers

Kane, M. Parental investment of male piping plovers during incubation

Meyers, J. Habituation of white-tailed deer to artificial bait

Completed Undergraduate Senior Theses Supervised

Lipps, C. Fall 2014. Assessment of piping plover nest sites and fledging success at Ludington State Park, MI.

Sonnevil, Z. Fall 2014. Factors influencing Waterbird nesting on islands of the St. Mary's River

Addington, R. Spring 2014. Local Support of a citizen science program for aging Whitetail-deer

Dittrich, H. Spring 2014. Early Recovery of Biodiversity Post-Wildfire: A Comparison of Three Ecosystems

Esslin, K. Spring 2014. Equine parasite infestation in horses residing in the Eastern Upper Peninsula

Griffioen, J. Spring 2014. A comparative survey of endoparasite prevalence in owned and shelter dogs in SW Michigan

Harm, J. Spring 2014. Helminths of Gray Wolves, *Canis lupus*, in Michigan's Eastern Upper Peninsula

Oberski, J. Spring 2014. Effects of Protein on Growth Rates for Ring-neck Pheasants (*Phasianus colchicus*)

Schafer, A. Spring 2014. Effects of Season Length on Harvest Rates of Canada Geese in Michigan

Schlak, R. Spring 2014. Protecting Piping Plovers: Conservation Through Education

Besteman, C. Fall 2013. Assessment of three methods of estimating white-tailed deer population on the Hiawatha Sportsman's Club.

Ferris, D. Fall 2013. Prevalence and Intensity of *Baylisascaris procyonis* in Raccoons from Southwestern Michigan

Palmer, S. Fall 2013. The Comparison of Bird Species Composition in Areas with and without Beech Blight Control

Van Buren, M. Fall 2013. Factors Affecting the Effort to Trap American Martens (*Martesamericana*) in the Upper Peninsula of Michigan

Escherich, T. Spring 2013. Assessment of Piping Plover nesting proximity to human disturbance.

Gallagher, S. Spring 2013. Survey of *Tricholbilharzia* in waterfowl livers from Northern Michigan

Pekel, S. Spring 2013. 2012 Cedar Creek ecological damage restoration project

Beyett, C. Fall 2012. Feeding behavior of piping plovers at the Apostle Islands

Connor, H. Fall 2012. Prevalence of *Toxoplasma gondii* in cats from the eastern upper peninsula

Kilponen, J. Fall 2012 Wildlife use of striped maple stands on the Hiawatha Sportsman's Club before and after large scale removal.

Haver, J. Fall 2011. Assessment of Anthropogenic factors involved with crippling loss in waterfowl.

Krajnak, K. Fall 2011. Parasites of Lake Trout (*Salvelinus namaycush*) stomachs taken from Northern Lake Huron

Majerink-Pearce, S. Fall 2011. Interactions of Breeding Coots and Soras on Canadian Wetlands

O'Mara, S. Fall 2011. Fungal distribution on Bog Islands at Vermilion Point Preserve.

Evey, K. Spring 2011 – Survey for *Trichinella* sp. in black bears from the eastern Upper Peninsula.

Morgan, R. Spring 2011. Raptor foraging in relation to game farms during migration.

Novak, T. Spring 2011. Deer preference of food plots near Cedar, Michigan.

Penfold, L., 2010. Assessment of the frog and toad survey from Emmet County, MI.

Sommers, K., 2010. Nesting Painted turtle movement at Trout Brook Pond, MI.

Strzacowski, M. 2011. Evaluation of snow shoe hare habitat suitability models in the eastern Upper Peninsula.

Woodthorp, B. 2011. Basking behavior in painted turtles.

Martin, A., Fall 2010. Community dynamics of intestinal helminths in wolverines (*Gulo gulo*) from Ninavut, Canada.

Penfold, L., Fall 2010. Assessment of the frog and toad survey from Emmet County, MI.

Sommers, K., Fall 2010. Nesting Painted turtle movement at Trout Brook Pond, MI.

Edwards, J., Fall 2009. Assessment of antler characteristics of deer harvested from the Hiawatha Sportsman's ten years after the implementation of quality deer management.

Meader, J., Fall 2009. Evaluation of the Gogomain swamp for white-tailed deer wintering habitat.

[1]Schwab, K., Fall 2009. Comparison of waterfowl nesting in natural and artificial habitat.

Vitale, N., Fall 2009. Human disturbance effects on nest success of Piping Plovers (*Charadrius melodus*) on Cape Cod.

Bumbstead, D., Spring 2009. Insulin therapy in dogs with diabetes mellitus: Comparison of animal recombinant and human recombinant insulin.

[2]Judnich, J., Spring 2009. Accumulation of heavy metals in predatory fish and their intestinal parasites.

Kamps, J., Spring 2009. Species, sex, and age composition of ducks harvested in the eastern Upper Peninsula.

Kent, A., Spring 2009. Relationships between Emerald Ash Borer, *Agrilus planipennis*, invasion and population size of indigenous Buprestidae species.

Dunham, C., Spring 2008. Effects of Ivermectin in cattle feces on terrestrial and aquatic gastropods.

Arsnoe, D., Fall 2007. Survey of endohelminths in three species of waterfowl migrating through Michigan.

Buelow, M., Spring 2007. Survey of entomopathogenic fungi and nematodes near Brimley, MI.

McCloud, T., Spring 2007. Survey of ectoparasitic lice on migrating waterfowl in Michigan's eastern Upper Peninsula.

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[1] Student Presentation accepted for presentation at 70th annual Midwest Fish & Wildlife Conference
[2] Student in the School of Physical Science (Department of Chemisty)

SCIENTIFIC PRESENTATIONS

National and International Meetings

Torretti, L., Reichard, M.V., **Garvon, J.M.**, Pozio, E., and M. Dumond. 2009 *Trichinella* spp. in terrestrial arctic carnivores from Nunavut, Canada. The 54th Annual Meeting of the American Association of Veterinary Parasitologists, Calgury, Alberta.

Reichard, Mason V., Luigi Torretti, **Jason M. Garvon**, Edoardo Pozio, and J. P. Dubey. 2008. *Toxoplasma gondii* and *Trichinella* spp. in wolverines (*Gulo gulo*) from Nunavut, Canada. The 53rd Annual Meeting of the American Association of Veterinary Parasitologists, New Orleans, LA.

Garvon, J.M. and A.M. Fedynich. 2005. Influence of host migratory behavior and habitat specificity on helminth community composition in blue-winged teal. The 80th Annual Meeting of The American Society of Parasitologists, Mobile, AL.

Garvon, J.M. and A.M. Fedynich. 2004. Impacts of host habitat on the helminth communities of blue-winged teal. The 53rd Annual Meeting of the Wildlife Disease Association held jointly with The American Association of Zoo Veterinarians and The American Association of Wildlife Veterinarians, San Diego, CA, USA.

Garvon, J.M., A.M. Fedynich, R.S. Finger, and B.M. Ballard. 2004. Ecological significance of gizzard nematodes. The 53rd Annual Meeting of the Wildlife Disease Association held jointly with The American Association of Zoo Veterinarians and The American Association of Wildlife Veterinarians, San Diego, CA, USA.

Fedynich, A.M., R.S. Finger, B.M. Ballard, **J.M. Garvon**, and M.J. Mayfield. 2004. Helminths of Ross' and white-fronted geese wintering in South Texas. The 53rd Annual Meeting of the Wildlife Disease Association held jointly with The American Association of Zoo Veterinarians, and The American Association of Wildlife Veterinarians, San Diego, CA, USA.

Garvon, J.M. and J. Bird. 2002. Effects of *Cosmocercoides dukae* infection on feeding behavior of *Anguispira alternata*. The 10th International Congress of Parasitology, Vancouver, British Columbia, Canada.

State and Regional Meetings

Schwab, K.· and **J.M. Garvon**. 2009. Comparison of Waterfowl Nesting in Natural and Artificial Habitats in Michigan's eastern Upper Peninsula. Accepted to Midwest Fish and Wildlife Conference, Springfield, IL.

Garvon, J.M. and A.M. Fedynich. 2004. Impacts of host habitat on the helminth communities of blue-winged teal. Southwestern Association of Parasitologists 37th Annual Meeting, The University of Oklahoma Biological Station, Lake Texoma, OK.

Jacobs, S.S., J. Mott, A.M. Fedynich, and **J.M. Garvon**. 2004. Blood parasites in blue-

· LSSU undergraduate student

winged teal from two migratory corridors. Southwestern Association of Parasitologists 37th Annual Meeting, The University of Oklahoma Biological Station, Lake Texoma, OK.

Fedynich, A.M., R.S. Finger, B.M. Ballard, and **J.M. Garvon**. 2004. Helminth community structure and pattern in white-fronted geese wintering in South Texas. Southwestern Association of Parasitologists 37th Annual Meeting, The University of Oklahoma Biological Station, Lake Texoma, OK.

Fedynich, A.M., R.S. Finger, B.M. Ballard, **J.M. Garvon**, and M.E. Mayfield. 2003. Helminth community structure and pattern in Ross' geese wintering in South Texas. Southwestern Association of Parasitologists 36th Annual Meeting, The University of Oklahoma Biological Station, Lake Texoma, OK.

Garvon, J.M., A.M. Fedynich, R.S. Finger, and B.M. Ballard. 2003. Sex ratios of gizzard nematodes from white-fronted and Ross' geese. Southwestern Association of Parasitologists 36th Annual Meeting, The University of Oklahoma Biological Station, Lake Texoma, OK.

Garvon, J.M. and J. Bird. 2002. Effects of *Parelaphostrongylus tenuis* larvae on *Anguispira alternata* feeding preference of white-tailed deer (*Odocoileus virginianus*) feces. Southwestern Association of Parasitologists 35th Annual Meeting, The University of Oklahoma Biological Station, Lake Texoma, OK.

MEETINGS AND WORKSHOPS ATTENDED

Lily Conference on Teaching and Learning (September 2010). Traverse City, MI.

6th North American Duck Symposium – NADS (August, 2009). Toronto, Ontario. NADS meets once every three years and is sponsored by the US Fish & Wildlife Service, Canadian Wildlife Service, Ducks Unlimited, and Delta Waterfowl.

Improving Biology Education: Theory and Practice (March, 2007). Chicago, IL. One day teaching workshop focused only on freshman level introductory biology.

67th Annual Midwest Fish & Wildlife (December, 2006). Omaha, NE. Attended meeting along with two LSSU faculty and 12 undergraduate students.

Annual Midwest Wolf Stewards Meeting (April, 2006). Watersmeet, MI. Attended meeting along with 3 students.

National Wildlife Society 12th Annual Meeting (September, 2005). Madison, WI. Attended meeting along with 6 students.

PROFESSIONAL ACTIVITIES

MEMBERSHIPS

The Wildlife Society
American Association of Parasitologists

REVIEW OF MANUSCRIPTS/GRANTS

National Center of Veterinary Parasitology, 2014 – 14 grants applications reviewed
Journal of Wildlife Diseases, 2013
Journal of Parasitology. 2012
Comparative Parasitology. 2010
ZooTaxa. 2007
Comparative Parasitology. 2006
Wildlife Society Bulletin. 2001

AWARDS RECEIVED

Outstanding Volunteer Award (Ducks Unlimited): 2010
Awarded to one person from the northern region (eastern UP and northern lower peninsula) each year.

Golden Anchor Award: 2006 and 2009, 2012
Award given by Student Alumni Involved for Lake State (SAILS) for making a difference in a student's life at Lake Superior State University.