

E. IMPORT/EXPORT/RE-EXPORT OF BIOLOGICAL SPECIMENS (CITES/ESA) FOR SCIENTIFIC RESEARCH

General Information

This application covers activities involving CITES and ESA-listed animal specimens used for scientific research, including any readily recognizable parts, products, or derivatives unless otherwise noted in the Appendices.

Review this application carefully and **provide complete answers to all of the questions**. If you are applying for multiple species, be sure to indicate which species you are addressing in each response. **If more space is needed, attach a separate sheet with your responses numbered according to the questions.**

Please allow at least 90 days for the application to be processed.

How do I determine whether the species is protected under CITES and/or the ESA?

CITES	ESA
To determine whether an animal species is protected under CITES, when the species was listed, or whether exemptions apply to your requested activity, see the list of CITES species	To determine whether an animal species is protected under the ESA, please review the list of ESA-listed species in the Code of Federal Regulations. Please be aware that any permit request involving an ESA endangered species must be published in the Federal Register for a required 30-day public comment period.

- If applying as an **individual or institution** please note that you will have to pay the appropriate permit fee.
- If applying as an **institution** that is (or is acting) on behalf of a Federal, Tribal, State, and/or local government agency, no permit fee is required. Provide fee exempt documentation with your application materials.
 - The individual signing the permit must have legal authority to do so if applying on behalf of the institution.

Questions

If you have any questions regarding an action you are requesting authorization for please contact the Division of Management Authority at managementauthority@fws.gov.

Please note: for renewal or amendment of a multi-use permit being requested **within the 5 year** Federal Register public notice period, use application [3-200-52](#)

This form should NOT be used for:

- Captive Bred Wildlife Registration (use application [3-200-41](#))
- ESA Plants (use application [3-200-36](#))

Electronic Information Submission

Electronic submission of inventories, photographs, and receipts: For hard copy applications, if you wish to provide information electronically, please include a flash drive containing this information with your physical application.

All Applicants Must Complete

1. Name and address where you wish the permit to be mailed, **if different from physical address**. If you would like expedited shipping, please enclose a self-addressed, pre-paid, computer-generated, courier service airway bill. If unspecified, all documents will be mailed via regular mail through the U.S. Postal Service.

Smithsonian National Zoological Park
ATTN: Jennifer Donato, Registrars Office
P.O. Box 37012, MRC 5507, Washington DC 20013-7012

2. Point of contact if we have questions about the application (name, phone number, and email).

Jennifer Donato, Registrar; Phone: 202-633-3239; Email: donatoj@si.edu

3. Have you or any of the owners of the business (if applying as a business, corporation, or institution), been assessed a civil penalty or convicted of any criminal provision of any statute or regulation relating to the activity for which the application is filed; been convicted, or entered a plea of guilty or nolo contendere, for a felony violation of the Lacey Act, the Migratory Bird Treaty Act, or the Bald and Golden Eagle Protection Act; forfeited collateral; OR are currently under charges for any violation of the laws mentioned above?

☒ No ☐ Yes

If you answered "Yes" to Question 3, provide: a) the individual's name; b) date of charge; c) charge(s); d) location of incident; e) court, and f) action taken for each violation. Please be aware that a "Yes" response does not automatically disqualify you from getting a permit.

Proposed Activity

- ☐ Import
☐ Export
☐ Re-export (e.g. export of a specimen that was previously imported into the United States)

4. The **current** location of the samples (if different from the physical address provided):

Name: See attached

Address:

City:

State/Province:

Postal Code:

Country:

5. Recipient/Sender:

- If **export or re-export**, provide name and **physical address** of the recipient in the foreign country.
- If **import**, provide name and **physical address** of the exporter/re-exporter in the foreign country.

Name: See attached

Address:

City:

State/Province:

Postal Code:

Country:

6. Information on the type of biological samples involved in the import/export/re-export, provide for each species (you may use the table located below):

- Scientific name (genus, species, and, if applicable, subspecies);
- Common name;
- Number and type of sample(s) (e.g. 10 blood samples, ear clips, etc.)
- Source (wild or captive-born)
- Approximate date of collection (MM/YYYY)
- Description of packaging (vials, slides, envelopes, etc.)
- Total # of all samples in shipment.

a. Scientific name (genus, species, and, if applicable, subspecies)	b. Common Name	c. Number & type of sample/part	d. Wild or Captive born	e. Approximate date of collection (mm/yyyy)	f. Description of packaging (vials, slides, envelopes, etc)
EXAMPLE: <i>Pan troglodytes</i>	Chimpanzee	10 blood samples; 4 hair samples	W	08/2015	Vial Envelope
See attached					
				g. TOTAL # of all samples in the shipment:	

Source of Specimen

7. For **each biological sample taken from a captive-born/captive hatched animal(s)**, provide a signed and dated statement from the breeder or appropriate documentation (e.g. Species 360 report) that includes the following:
- Scientific name (genus, species, and *if applicable*, subspecies),
 - Common name,
 - Name and address of the facility where the animal was bred and born;
 - Birth/hatch date (mm/dd/yyyy),
 - Identification information (studbook #, microchip, leg band, etc.),
 - Name and address of facility where the parental stock is located; and
 - A statement from the breeder that the animal was bred and born at the breeder's facility (including the facility's name and address), and
 - If not the breeder, documentation demonstrating the history of transactions (e.g., chain of custody or ownership of the sample(s), *if applicable*).
8. For **each biological sample taken from an animal in the wild**, provide:
- Scientific name (genus, species, and *if applicable*, subspecies),
 - Common name,
 - Specific location (e.g., county, state, province, country) where the samples were taken from the wild,
 - The name of the individual(s) who collected the animal/samples and their authorization to do so including (but not limited to) copies of foreign and domestic (Federal, State, and/or Tribal) government collecting permits, licenses, contracts, and/or agreements.
 - Method of collection: sampling protocol, approximate length of time held in captivity, any injury and/or mortality experienced during collection, transport, or holding;
 - Information related to any remuneration, either financial or in-kind, provided for acquiring the sample(s);
 - Efforts to use captive specimens (e.g., captive-born, captive-held) in lieu of taking samples from wild animals.
9. For **each biological sample being re-exported** (e.g., exporting a specimen that was previously imported into the United States), provide:
- A copy of the **canceled** CITES export or re-export document issued by the appropriate CITES office in the country from which the wildlife was imported;
 - A copy of your Declaration for Importation or Exportation of Fish or Wildlife (Form 3-177), **cleared** by USFWS Office of Law Enforcement.
 - A copy of the ESA permit that authorized the original import.
 - If you did not make the original import, please provide documentation outlining chain-of-ownership since import, including:
 - A copy of the importer's CITES, ESA, and declaration documents (a, b, & c above) and,
 - Subsequent invoices (or other documentation) showing the history of transactions leading to your ownership of the sample(s) after import (provenance).

Description and Justification For Requested Activity

10. Describe the purpose of the scientific research and include:
- A copy of the research proposal (outlining the purpose, objectives, methods),
 - How long the research has been (or will be) conducted,

- c. Detailed information on sampling methods including:
 - i. who will be taking the samples
 - ii. equipment and methods used
 - iii. measures taken to prevent injuries and mortalities during collection
- d. A copy of the study's Institutional Animal Care and Use Committee (IACUC) form (*if applicable*),
- e. Peer-reviewed scientific papers published from this research (*if applicable*),
- f. An explanation of whether similar research has already been conducted or is currently being conducted.

11. Please provide a detailed description on how the proposed activities will **enhance or benefit the wild population within its native range** (e.g., direct or indirect **conservation efforts**) and provide documentation (e.g., signed memorandums of understanding) demonstrating your commitment to supporting the program and how the program contributes directly to the species identified in your application.

Technical Expertise & Authorizations

12. CV or resume outlining the technical experience of the researchers and field technicians collecting the samples, as it relates to the proposed activities, including experience with other similar species.

Shipment Information

13. Please indicate if this is a one-time shipment or if you anticipate needing to import/export/re-export samples multiple times within one year or over multiple years.
14. How will the samples be imported or exported (e.g., personally carried or shipped)?
15. If personally carried, please specify the individual(s) who will be transporting the samples.

All international shipment(s) must be through a designated port. A [list of designated ports](#) (where an inspector is posted) is available. If you wish to use a port not listed, please contact the Office of Law Enforcement for a Designated Port Exemption Permit (form 3-200-2).

CITES Appendix I & Marine Mammal Species

- For **export** of a **CITES Appendix I-listed species**, provide a copy of the CITES import permit, or evidence one will be issued by the Management Authority of the country to which you plan to export the specimen(s). In accordance with Article III of the CITES treaty, it is required that import permits are issued before the corresponding export permit.
- For **import** of **CITES Appendix-I listed species**, provide information to show the import is not for primarily commercial purposes as outlined in [Resolution Conf. 5.10 \(Rev CoP15\)](#).
- For **import** of **CITES Appendix-I marine mammal samples**, please provide a copy of your FWS or NMFS Marine Mammal Protection Act (MMPA) permit or authorization.

1. Name and address where you wish the permit to be mailed, **if different from physical address**.

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2. Point of contact if we have questions about the application (name, phone number, and email).

Jennifer Donato, Registrar; Phone: 202-633-3239; Email: donatoj@si.edu

3. Have you or any of the owners of the business (if applying as a business, corporation, or institution), been assessed a civil penalty or convicted of any criminal provision of any statute or regulation relating to the activity for which the application is filed; been convicted, or entered a plea of guilty or nolo contendere, for a felony violation of the Lacey Act, the Migratory Bird Treaty Act, or the Bald and Golden Eagle Protection Act; forfeited collateral; OR are currently under charges for any violation of the laws mentioned above?

No.

PROPOSED ACTIVITY

Import
Export
Re-export

4. The **current** location of the samples (if different from the physical address provided):

Biological samples from non-native/foreign endangered species that the Smithsonian's National Zoo and Conservation Biology Institute (NZP-SCBI) proposes to import for research and scientific purposes are located in various institutions and research facilities in Asia (China, Nepal, Myanmar), Africa (Kenya, South Africa), Europe (UK, EU), the Americas (Canada, Mexico, Panama, Ecuador, Brazil, Venezuela), and the Pacific (Australia, New Zealand).

Samples for export are located at the two campuses of NZP-SCBI:

Smithsonian National Zoological Park
3001 Connecticut Ave.
Washington, DC

Smithsonian Conservation Biology Institute
1500 Remount Road
Front Royal VA 2263

5. **Recipient/Sender:**

- If **export or re-export**, provide name and **physical address** of the recipient in the foreign country.
- If **import**, provide name and **physical address** of the exporter/re-exporter in the foreign country.

Various institutions and research facilities in multiple countries, including Canada, Mexico, Panama, Ecuador, Brazil, Venezuela, China, Nepal, Myanmar, Kenya, South Africa, UK, the Netherlands, Australia, and New Zealand

6. Information on the type of **biological samples** involved in the import/export/re-export, provide for **each species**:

The types of samples that NZP-SCBI proposes to import/export include whole blood, serum, tissue, hair, feathers, feces, milk, and extracted DNA/RNA from various wild and captive-born endangered and CITES-listed species such as elephants (*Elephas maximus*, *Loxodonta africana*), rhinos (*Diceros bicornis*), cats (*Acinonyx jubatus*, *Panthera tigris*, *Panthera leo*, *Neofelis nebulosa*), maned wolves (*Chrysocyon brachyurus*), Przewalski's horse (*Equus przewalskii*), giant panda (*Ailuropoda melanoleuca*), tapir (*Tapirus*), various primates, and several migratory bird species such as cranes (*Grus americana*, *Grus monacha*) and shrikes (*Lanius ludovicianus*).

SOURCE OF SPECIMEN

Questions 7 – 9:

Samples are taken from various wild and captive-born endangered and CITES-listed species located in research facilities/institutions in multiple countries, including from animals housed at NZP-SCBI. Some are field-collected but most are banked samples, either collected opportunistically or with appropriate collecting permits issued by the governing agencies, then are transferred or donated to NZP-SCBI solely for approved research purposes and non-commercial use.

DESCRIPTION AND JUSTIFICATION FOR REQUESTED ACTIVITY

10. Describe the purpose of the scientific research:

This application is to request the renewal of ESA Import-Export Permit # MA700309, which authorizes NZP-SCBI to “take, import, export, re-export, and purchase in interstate and foreign commerce as listed in 50 CFR Part 17 blood, hair and tissue (including semen, ova, milk and embryos) samples and salvaged carcasses of endangered and/or threatened species that are exotic to the United States for the purposes of scientific research.” We use this permit to import biomaterials for numerous ongoing research projects in wildlife conservation at the Smithsonian National Zoological Park in Washington, DC, and the Smithsonian Conservation Biology Institute at Front Royal, Virginia. Specifically, our research addresses long-term changes in behavior; response to stress; the origins, spread, diagnosis and treatment of diseases that can be transmitted between species and to humans; and how to prevent the loss of species diversity and to prevent loss of genetic variation within a species. These projects require the periodic importation of biomaterials and specimens from both captive-held and wild populations of various species, including foreign endangered species. Occasionally, we export materials and samples that were taken incidentally or opportunistically from animals in our collection to research partners and other zoological institutions worldwide after a review of the research project and approval by our Animal Care and Use Committee. Due to varying life cycles of research projects, there may be some years that we will need to conduct multiple imports/exports of samples and others with little to no import/export activity.

Over the next five years, NZP-SCBI will initiate or continue the following work:

- NKP-SCBI has a robust Elephant Conservation and Science Program. It is a multidisciplinary program, advancing elephant research and conservation through integrating Smithsonian expertise in elephant veterinary medicine, genetics, reproductive physiology, ecology, behavior, nutrition, and conservation biology. The program strives to create partnerships with other organizations and provide training and capacity building to partners. The program relies on the exchange of elephant samples from and to domestic and international partners, and also benefits from the import of samples from both wild and captive populations.
- The Wildlife Health Science department will continue research on EEHV (Elephant Endotheliotropic Herpesvirus), with colleagues in Myanmar, Thailand and Sri Lanka, and with planned shipments of whole blood and serum from South East Asia to continue determining the extent of EEHV in captive elephants and to correlate captive virus serotypes found in Asia *in situ* populations. Currently, we are also developing a partnership with Chitwan National Park and the National Trust for Nature Conservation in Nepal, which would involve several importations of elephant tissue, serum, blood and DNA for analysis in the United States. This ongoing research project provides answers on how the disease is spread between elephants, the mechanism of the disease, and to provide the tools for early diagnosis and treatment, thereby decreasing the mortality rate of this disease. This project builds on previous studies of EEHV infection in elephants held in North America.
- The Reproductive Science department will continue their studies of reproductive hormones, stress hormones and related behaviors focusing on Giant pandas, Maned wolves, Stony corals, Ostriches, Rhinoceros, elephants (both Asian and African), endangered cats (Cheetahs, Clouded Leopards, and Fishing Cats), endangered canids (Dhole, Golden Jackals), endangered hoof stock (Scimitar-horned oryx, Dama gazelle, Persian onager, and Przewalski's horse) and Baird's tapirs. This research will enable zoo's and conservation centers to increase breeding and rearing success in captive held populations that will act as population reserves for current and future re-introductions of these species to their native habitats. In addition, these studies help us understand why *in situ* animal populations are experiencing reproductive declines across their natural ranges.
- Scientists at the Center for Species Survival will continue their research on the influence of sex, diet, reproductive status, and health on changes in gut microbiome of wild versus captive/zoo populations of various species. Immediate plans for import are samples from black rhino populations in South Africa.
- Researchers at NKP-SCBI also collect samples to store long-term for future genetic analyses and cell line studies. As an example, SCBI researchers were the first to develop a safe and reproducible method to collect semen from the Przewalski's horse. This was accomplished by first developing a safe anesthesia protocol and then adapting a standardized electro-stimulation method validated in diverse species. SCBI has banked sperm from over 22 stallions resulting in over 1,500 plastic straws. All samples are currently stored at the SCBI's biorepository in Front Royal, Virginia. This technology has immense value for animals in the wild – as SCBI scientists can now collect and bank sperm from wild, reintroduced stallions to capture novel genetics from the reintroduced herds. Further, we can transfer frozen sperm from animals managed in captivity to reintroduced populations to increase genetic diversity without the involvement of live animal transport.

11. Please provide a detailed description on how the proposed activities **will enhance or benefit the wild population within its native range** (e.g., direct or indirect **conservation efforts**)

NZP-SCBI participates in several of the Association of Zoos and Aquarium's (AZA) Species Survival Plan (SSP) programs for the ex-situ management and breeding of several endangered species for genetic diversity, population stability, and demographic distribution. To date, NZP-SCBI participates in over 40 SSP programs for species such as the Black-footed ferret and Scimitar-horned oryx – species that were once extinct in the wild. NZP-SCBI also has assisted in the reintroduction efforts for several endangered species, including the Guam rail, Black-footed ferret, and Przewalski's horse.

Furthermore, NZP- SCBI spearheads research programs at Front Royal, Virginia, Washington, D.C., and at field research stations and training sites worldwide. Approximately 250 NZP-SCBI scientists and research associates collaborate with colleagues in more than 25 countries. These collaborations sometimes entail the exchange of biological materials from endangered species populations worldwide, and scientists use data from these materials to tackle some of today's most complex conservation challenges, such as animal health, reproductive physiology, disease sensitivity, and other topics that are difficult to study in the wild. As an example, the import of biological samples from elephants in different parts of the world allowed NZP-SCBI scientists to discover the lethal elephant endotheliotropic herpes virus (EEHV), which affects both wild and captive elephant populations.

TECHNICAL EXPERTISE AND AUTHORIZATIONS

12. CV or resume outlining the technical experience of the researchers and field technicians collecting the samples, as it relates to the proposed activities, including experience with other similar species.

See attached CVs.

SHIPMENT INFORMATION

13. Please indicate if this is a one-time shipment or if you anticipate needing to import/export/re-export samples multiple times within one year or over multiple years.

We anticipate needing to import/export/re-export samples **multiple times** over **multiple years**.

14. How will the samples be imported or exported (e.g., personally carried or shipped)?

Some samples will be personally carried during transport (in compliance with IATA and airline regulations) or shipped via freight forwarding services such FedEx (packaging in compliance with UN3373).

15. If personally carried, please specify the individual(s) who will be transporting the samples.

Various scientific staff at NZP-SCBI. See attached CVs.

Budhan S. Pukazhenth, B.V.Sc., M.S., Ph.D.

CURRICULUM VITAE

PERSONAL

Address: Center for Species Survival
Department of Reproductive Sciences
Smithsonian National Zoological Park
1500 Remount Road, Front Royal, VA 22630
Office phone: (540) 635-6591
Email: pukazhenthb@si.edu

EDUCATION

B.V.Sc., Madras Veterinary College, Madras, India, 1987 (Veterinary Medicine)
M.S., University of Maryland, College Park, Maryland, 1993 (Animal Science)
Ph.D., University of Maryland, College Park, Maryland, 1996 (Animal Science)

PROFESSIONAL EXPERIENCE

2006-present Ungulate Scientist, Smithsonian National Zoological Park
2011-present Adjunct Professor, Department of Clinical Science, Cornell University
2008-2020 Adjunct Professor, Department of Animal and Avian Sciences, University of Maryland
2007-2008 Visiting Scientist, INDICASAT, Panama
2005-2010 Adjunct Professor, Department of Biology, American University
2003-2006 Cryobiologist, Smithsonian National Zoological Park
2002-present Affiliate Professor, Department of Biology, George Mason University
1998-2003 NIH Special Emphasis Research Career Award Fellow, Smithsonian National Zoological Park
1996-1998 Smithsonian Post-doctoral Fellow, Smithsonian National Zoological Park
1992-1993 Smithsonian Pre-doctoral Fellow, Smithsonian National Zoological Park

RECENT COMMITTEE DUTIES AND HONORS

Guest Worker, National Cancer Institute (NCI)
Reproductive Advisor, Lion Species Survival Plan
Chair, IUCN Eld's Deer Interest Group
Member, IUCN Deer Specialist Group
Member, AZA Cervid Taxon Advisory Group (current)
Member, AZA Equid Taxon Advisory Group (current)
Member, AZA Ungulate Taxon Advisory Group (current)
Member, Trainee Affairs Committee, American Society for Andrology (2016-2020)
Member, Editorial Board, Journal of Andrology (2010-2014)
Member, Editorial Board, Tapir Specialist Group Newsletter (2015-present)
Chair, AZA Biomaterial Banking Advisory Group (2016-present)
Member, Wildlife Scientific Advisory Board, Morris Animal Foundation (2016-2019)
Reproductive Advisor, Cervid Taxon Advisory Group (2018-present)
Chair, Wildlife Scientific Advisory Board, Morris Animal Foundation (2019)

Member, Senior Scientific Advisory Group, Morris Animal Foundation (2020-present)
Member, Executive Board, Conservation Centers for Species Survival (2020-present)
Member, Smithsonian Institutional Review Board (2020-present)

PEER-REVIEWED PUBLICATIONS

1. Shailubhai, K., **B.S. Pukazhenth**i, E.S. Saxena, G.M. Varma and I.K. Vijay. 1990. Glucosidase I is an endoplasmic reticular transmembrane glycoprotein with a luminal catalytic domain and a cytoplasmic tail. Glycoconj. J. 7: 496-505.
2. Shailubhai, K., **B.S. Pukazhenth**i, E.S. Saxena, G. Varma and I.K. Vijay. 1991. Glucosidase I, a transmembrane endoplasmic reticular protein with a luminal catalytic domain. J. Biol. Chem. 266: 16587-16593.
3. **Pukazhenth**i, **B.S.**, G.M. Varma and I.K. Vijay. 1993. Conserved structural features in glycoprotein processing specific glucosidase I from several tissues and species. Ind. J. Biochem. Biophys. 30: 333-340.
4. **Pukazhenth**i, **B.S.**, N. Muniappa and I.K. Vijay. 1994. Role of sulfhydryl groups in the function of glucosidase I from mammary gland. J. Biol. Chem. 268: 6445-6452.
5. Wildt, D.E., **B.S. Pukazhenth**i, J.L. Brown, S.L. Monfort, J.G. Howard and T.L. Roth. 1995. Spermatology for understanding, managing and conserving rare species. Reprod. Fertil. Dev. 7: 811-824.
6. **Pukazhenth**i, **B.S.**, D.E. Wildt, M.A. Ottinger and J.G. Howard. 1996. Compromised sperm protein phosphorylation after capacitation, swim-up and zona pellucida exposure in teratospermic domestic cats. J. Androl. 17: 409-419.
7. **Pukazhenth**i, **B.S.**, D.E. Wildt, M.A. Ottinger and J.G. Howard. 1997. Inhibition of domestic cat spermatozoa acrosome reaction and zona pellucida penetration by tyrosine kinase inhibitors. Mol. Reprod. Dev. 49: 48-57.
8. **Pukazhenth**i, **B.S.**, J.A. Long, D.E. Wildt, M.A. Ottinger, D.L. Armstrong and J.G. Howard. 1998. Regulation of sperm function by protein tyrosine phosphorylation in diverse wild felid species. J. Androl. 19: 675-685.
9. **Pukazhenth**i, **B.S.**, K. Pelican, D.E. Wildt and J.G. Howard. 1999. Sensitivity of domestic cat (*Felis catus*) sperm from normospermic versus teratospermic donors to cold-induced acrosomal damage. Biol. Reprod. 61: 135-141.
10. **Pukazhenth**i, **B.S.**, E. Noiles, K. Pelican, A. Donoghue, D.E. Wildt and J.G. Howard. 2000. Osmotic effects on feline spermatozoa from normospermic versus teratospermic donors. Cryobiology 40: 139-150.
11. Spindler, R.E., **B. Pukazhenth**i and D.E. Wildt. 2000. Oocyte metabolism predicts the development of cat embryos to blastocyst *in vitro*. Mol. Reprod. Dev. 56: 163-171.
12. Harnal, V.K., R. Spindler, S.L. Monfort, **B. Pukazhenth**i, D.M. Bird and D.E. Wildt. 2001. Sperm capacitation *in vitro* in the Eld's deer. Theriogenology 56: 399-413.
13. Axner, E., **B.S. Pukazhenth**i, D.E. Wildt, C. Linde-Forsberg and R.E. Spindler. 2002. Creatine phosphokinase in domestic cat epididymal spermatozoa. Mol. Reprod. Dev. 62:265-270.
14. **Pukazhenth**i, **B.**, R. Spindler, D. Wildt, L.M. Bush and J.G. Howard. 2002. Osmotic properties of spermatozoa from felids producing different proportions of pleiomorphisms: Influence of adding and removing cryoprotectant. Cryobiology 44: 288-298.
15. Hagedorn, M., S.L. Lance, D.M. Fonseca, F.W. Kleinhans, D. Artimov, R. Fleischer, A.T. Hoque, M.B. Hamilton and **B.S. Pukazhenth**i. 2002. Altering fish embryos with aquaporin-3: an essential step toward successful cryopreservation. Biol. Reprod. 67: 961-966
16. Comizzoli, P., D.E. Wildt and **B.S. Pukazhenth**i. 2003. Overcoming poor *in vitro* nuclear maturation and developmental competence of domestic cat oocytes during the non-breeding season. Reproduction 126: 809-816.

17. **Pukazhenth, B.S.** and D.E. Wildt. 2004. Which reproductive technologies are most relevant to studying, managing and conserving wildlife? *Reprod Fertil Dev* 16:33-46.
18. Comizzoli, P., D.E. Wildt and **B.S. Pukazhenth**. 2004. Effect of 1,2-propanediol versus 1,2-ethanediol on subsequent oocyte maturation, spindle integrity, fertilization and embryo development in vitro in the domestic cat. *Biol Reprod* 71:598-604.
19. Neubauer K, Jewgenow K, Blottner S, Wildt DE and **B.S. Pukazhenth**. 2004. Quantity rather than quality in teratospermic males: a histomorphometric and flow cytometric evaluation of spermatogenesis in the domestic cat (*Felis catus*). *Biol Reprod* 71:1571-1524.
20. Comizzoli, P., D.E. Wildt and **B.S. Pukazhenth**. 2005. Oocyte quality and *in vitro* culture in the domestic cat. *ART & Science* 2004, 4, 11-13.
21. Comizzoli, P., **B.S. Pukazhenth**, J.G. Howard and D.E. Wildt. 2005. Collaborative science and its impact on management and conservation of felid species. *AZA Communique*, December 23-25.
22. **Pukazhenth B. S.**, P. Comizzoli, A. J. Travis and D. E. Wildt. 2006. Applications of emerging technologies to the study and conservation of threatened and endangered species. *Reprod Fertil Develop* 18:77-90.
23. Collins, C.W., N. Songsasen, S. L. Monfort , M. Bush , B. Wolfe, S. B. James, D. E. Wildt and **B. S. Pukazhenth**. 2006. Seminal traits of the Przewalski's horse (*Equus ferus przewalskii*) following electroejaculation. *Anim Reprod Sci* 94:46-49.
24. Pelican, K.M., D.E. Wildt, **B.S. Pukazhenth** and J.G. Howard. 2006. Ovarian control for assisted reproduction in the domestic cat and wild felids. *Theriogenology* 66:37-48.
25. **Pukazhenth, B.S.**, K. Neubauer, K. Jewgenow, J.G. Howard and D.E. Wildt. 2006. The impact and potential etiology of teratospermia in the domestic cat and its wild relatives. *Theriogenology* 66:112-121.
26. Crosier, A.E., **B.S. Pukazhenth**, J.N. Henghali, J.G. Howard, A.J. Dickman, L. Marker and D.E. Wildt. 2006. Successful cryopreservation of spermatozoa from wild-born Namibian cheetahs (*Acinonyx jubatus*) - Influence of glycerol on cryosurvival. *Cryobiology* 52:169-181.
27. Comizzoli, P., D.E. Wildt and **B.S. Pukazhenth**. 2006. *In vitro* development of domestic cat embryos following intra-cytoplasmic sperm injection with testicular spermatozoa. *Theriogenology* 66:1659-1663.
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PROFESSIONAL SOCIETIES

IUCN, Species Survival Commission
IUCN Conservation Planning Specialist Group
IUCN Deer Specialist Group
IUCN Equid Specialist Group
American Society of Andrology
Society for the Study of Reproduction
Society for Low Temperature Biology
American Association of Zoo and Aquarium

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Research Associate 5, Department of Biological Science, University of New Orleans, New Orleans	2000
Veterinary officer, Artificial Insemination Division, Department of Livestock Development, Thailand	1988-1999
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Relevant Research Support/Grants

Dr. Holly Reed Wildlife Conservation Fund Grant	
Point Defiance Zoo and Aquarium Songsasen/Tipkantha (co-PIs)	10/2019 – 9/2021
<i>Uncovering the Mysteries of the Ghost Cat of Thailand</i>	Amount: \$ [REDACTED]
Goal: The objectives include (1) determine population density and abundance of clouded leopards in the Phu Khieo Wildlife Sanctuary, Thailand and 2) assess behavioral and physiological responses of clouded leopard to a tracking collar.	
Morris Animal Foundation Songsasen/Muletz Wolz (Co-PIs)	9/2019-8/2021
<i>Good bugs gone bad? Gut microbial variations in captive maned wolves and the link between gastrointestinal health and microbiomes</i>	

Goal: The objectives are to (1) compare gut microbiome composition between captive and wild maned wolves and (2) determine the link between gut microbiota and diet and health of ex situ individuals.

Dr. Holly Reed Wildlife Conservation Fund Grant
Point Defiance Zoo and Aquarium Songsasen (PI)

09/2017-08/2019

Understanding the link between gut microbiomes and inflammatory bowel disease in the red wolf.

Amount: [REDACTED]

Goal: The objectives is to utilize metagenomics to characterize gut microbiome composition of the red wolf maintained ex situ, and delineate the relationship(s) among diet, gut microbiome, and health of individuals.

Earthwatch

1/2017-12/2020

Tracking Asiatic wild dog in Thailand

Goal: The objective is to determine movement ecology of dholes living in Thai protected areas.

AZA Conservation Grant Fund

10/2014-9/2015

Understanding the etiologies and establishing biomarkers for inflammatory bowel disease in zoo managed large canids

Goal: The objectives include (1) determining if genetic factors are responsible for the occurrence of IBD in both red wolves and maned wolves, (2) examining the link between IBD and stress in the two canid species and (3) comparing serum and fecal biomarkers between healthy and IBD affected maned wolves.

Selected Publications

Peer-reviewed articles (from 80 publications)

Brown M. E., Keefer, C. L., **Songsasen N.** Factors affecting captive whooping crane egg fertility: A retrospective analysis. *Journal of Wildlife Management* DOI:10.1002/jwmg.21717, 2019.

Ferraz, M.A.M.M, Carothers, A., Dahal, R., Noonan, M.J., **Songsasen, N.** Oviductal extracellular vesicles interact with the spermatozoon's head and mid-piece and improves its motility and fertilizing ability in the domestic cat. *Scientific Reports* 9:9484, 2019.

Nagashima J. B., Travis, A. J., **Songsasen, N.** The domestic dog embryo: In vitro fertilization, culture and transfer. *Methods in Molecular Biology*. 2006:247-267, 2019.

Thuwanut P., Comizzoli P., Pruksananonda K., Chatdarong, K., **Songsasen, N.** Activation of adenosine monophosphate-activated protein kiase (AMPK) enhances energy metabolism, motility, and fertilizing ability of cryopreserved spermatozoa in domestic cat model. *Journal of Assisted Reproduction Genetic* 36:1401-1412, 2019.

Nagashima J. B., Wildt D. E., Travis, A. J., Songsasen, N. Activin promotes growth and antral cavity expansion in the dog ovarian follicle. *Theriogenology* 129:168-177, 2019.

Jones M. K., Reiter, L. E., Gilmore, M. P., Freeman, E. W., **Songsasen, N.** Physiological impacts of housing maned wolves (*Chrysocyon brachyurus*) with female relatives or unrelated males. *General Comparative Endocrinology* 267:109-115, 2018.

Brown M. E., Singh R. P., Pukazhenth, B., Keefer, C. L., **Songsasen, N.** Cryopreservation effects on sperm function and fertility in two threatened crane species, *Cryobiology* 82:148-154, 2018.

Henson, L.H., **Songsasen, N.**, Waddell, W., Wolf, K. N., Emmons, L., Gonzalez, S., Freeman, E., Maldonado, J. Characterization of genetic variation and basis of inflammatory bowel disease in the toll-like receptor 5 gene of the red wolf and maned wolf. *Endangered Species Research* 32:135-144, 2017.

Khonmee J., Rojanasthien, S., Thiraram, C., Sumretprasong, j., Anususin, A., Chaisongkram, C., **Songsasen, N.** Non-invasive endocrine monitoring indicates seasonal variations in gonadal hormone metabolites in dholes (*Cuon alpinus*). *Conservation Physiology*. 5: cox001. doi: 10.1093/conphys/cox001, 2017.

Panyaboriban S, Pukazhenth, B., Brown, M.E., Crowe, C., Lynch, W., Singh, R. P., Techakumphu, M., **Songsasen, N.** Influence of cooling and thawing conditions and cryoprotectant concentration on frozen-thawed survival of white naped crane (*Antigone vipio*) spermatozoa. *Cryobiology* 73:209-215, 2017, 2017.

Brown, M. E., Converse, S.J., Chandler, J. N., Shafer, C., Brown, J. L., Keefer, C. L., **Songsasen, N.** Female gonadal hormones and reproductive behaviors as key determinants of successful reproductive output of breeding whooping cranes (*Grus americana*). *General Comparative Endocrinology* 230-231:158-165, 2016.

Johnson A. E., Freeman, E. W., Wildt, D. E., **Songsasen, N.** Spermatozoa from the maned wolf (*Chrysocyon brachyurus*) display typical canid hyper-sensitivity to osmotic and freezing-induced injury, but respond favorably to dimethyl sulfoxide. *Cryobiology* 68:361-370, 2014.

Book chapters

Songsasen, N., Ferraz, M.A.M.M., and Nagashima, J.B. Chapter: Applications of dynamic microfluidic platforms in reproductive studies and fertility preservation. *Emerging Technologies for Fertility*, World Scientific Publishing Company (in press).

Songsasen N., Comverse, S. J., Brown, M. E. Reproduction and reproductive strategies relevant to management of whooping cranes ex situ. In: French, Jr, J. B., S. Converse, J. E. Austin (eds), *Whooping Cranes Biology and Conservation*, Academic Press, London pp. 373-388, 2019.

Songsasen N, Comizzoli, P. Protecting and extending fertility of females of wild and endangered mammals. In: Woodruff T.K., D. K. Shah, W. S. Vitek. (eds.), *Textbook of Oncofertility Research and Practice*, Springer Nature Switzerland. pp. 401-414, 2019.

Jewgenow, K., **Songsasen, N.** Reproduction and advance in reproductive studies in carnivores. In: Holt, W. V., Brown, J. L., Comizzoli, P. (eds.) *Reproductive Sciences in Animal Conservation.: Progress and Prospects*. Springer, New York. pp. 205-240, 2014.

Songsasen N., Johnson, A. E., Reiter, L. E., Rodden, M. Reproduction and factors impacting reproductive success in the maned wolf. In: Corsorte-McCrea A., E. Ferraz (eds.), *Ecology and Conservation of the Maned Wolf*, Tay & Francis Group, Boca Raton, FL pp.99-108, 2013.

Red Wolf Experience

2014 – present

- Coordinate and oversee red wolf research to help maintain genetically diverse and healthy red wolf population *ex situ*.
- Secure funding to support red wolf research
- Supervise two graduate students on red wolf health studies

2018 – Organized Red Wolf Science and Conservation Workshop at the Smithsonian Conservation Biology Institute. The goals of the workshop are for the attending experts: 1) share all new information on the biology and management of the species, and 2) identify knowledge gaps and management/research priorities that can be implemented short-term to improve conservation both in situ and ex situ.

Experience with similar species

- 2006-present Serve as a Reproductive advisor for the AZA's Canid Taxon Advisory Group
- 2011-present Serve as the Coordinator of the IUCN/Canid Specialist Group's Dhole Working Group
- 2015-present Serve the Coordinator of the AZA's Maned Wolf Species Survival Plan
- 2002-present Conduct research in maned wolves to advance the understanding of species reproductive biology, and threats to ex situ and in situ populations.

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EDUCATION:

Ph.D.	1984	Washington State University	Animal Science
M.S.	1980	Washington State University	Animal Science
B.S.	1977	North Dakota State University	Animal Science
A.A.	1975	Los Angeles Pierce College, CA	Animal Science

PROFESSIONAL EXPERIENCE:

1991-present	Research Physiologist, Smithsonian Institution, National Zoological Park, Smithsonian Conservation Biology Institute, Front Royal, VA
1987-1991	Associate Professor, Department of Obstetrics and Gynecology, Uniformed Services University of the Health Sciences, Bethesda, MD
1985-1987	Research Associate, Department of Obstetrics and Gynecology, Uniformed Services University of the Health Sciences, Bethesda, MD

ADJUNCT APPOINTMENTS:

2019-present	International Advisor, Elephant Research Centre, Chennai, India
2012-2020	Adjunct Associate Professor, Department of Population Medicine and Diagnostic Services, College of Veterinary Medicine, Cornell University, Ithaca, New York
2009-2012	Adjunct Faculty, Department of Animal & Poultry Science, University of Guelph, Canada
2008-2013	Adjunct Faculty, Department of Zoology, University of Michigan, Lansing, MI
2004-2019	Adjunct Graduate Faculty, Department of Clinical Sciences, Kansas State University, Manhattan, KS
2002-2009	Adjunct Research Professor, Biology Department, American University, Washington, DC
1998-2009	Adjunct Graduate Faculty, University of Maryland, College Park, MD
1996-2002	Adjunct Associate Professor, Department of Obstetrics and Gynecology, Uniformed Services University of the Health Sciences, Bethesda, MD
1988-present	Affiliate Professor, Department of Biology, George Mason University, Fairfax, VA

HONORS and AWARDS:

2019	Honorary Doctorate in Veterinary Medicine, Chiang Mai University, Thailand
2019	Most cited paper award - Primates
2012	Morris Animal Foundation Innovative Scientist of the Year
2010	Zoo Biology Best Published Paper in 2010
2009	Outstanding Graduate Award: Science, Education Technology, Washington State University
2005	Distinguished Service Award, Elephant Manager's Association
2004	Zoo Biology Best Published Paper in 2002
2003	Zoo Biology Best Published Paper in 2001
2003	Discovery Film, <u>Kandula: An Elephant Story</u> , focused on the science behind the production of NZP elephant by AI
2002	Alumni Recognition Award, Washington State University
2000	PBS/BBC Film, <u>Urban Elephant</u> , highlighted elephant AI at NZP
1995	AAZV Presidential Service Award
1983	American Society of Animal Science Graduate Student Competition (1st place)
1977	Graduation with honors (B.S.)

EDITORIAL ACTIVITIES:

2017-present	<u>Editorial Board</u> : Frontiers in Veterinary Science
2017-present	<u>Editorial Board</u> : Chiang Mai Veterinary Journal
2011-present	<u>Associate Editor</u> : Zoo Biology

2010-present	<u>Editorial Board:</u> Domestic Animal Endocrinology
2009	<u>Guest Editor:</u> Zoo Biology – Special Issue on <i>Care and Welfare of Elephants in AZA Institutions</i>
2008-present	<u>Advisory Board:</u> Brazilian Journal of Veterinary Research
2004	<u>Guest Editor:</u> Science India – Special Issue on <i>Elephants</i>
2000	<u>Guest Editor:</u> Zoo Biology – Special Issue on <i>Elephant Biology</i>
1998	<u>Guest Editor:</u> Animal Reproduction Science - Special Issue on <i>Reproductive Research in Wildlife Species</i>
1996-2005	<u>Editorial Board:</u> Animal Reproduction Science
1995-2004	<u>Editorial Board:</u> Biology of Reproduction
1995-2010	<u>Editorial Board:</u> Zoo Biology
1992-1995	<u>Associate Editor:</u> Journal of Zoo and Wildlife Medicine
1988-present	<u>Ad hoc reviewer</u> for over 20 scientific journals

OTHER PROFESSIONAL ACTIVITIES:

2019-present	International Advisor, Elephant Research Centre, Chennai, India
2016-present	<u>Advisory Board:</u> NAKA Elephant Foundation
2015-present	<u>Founding member and Co-Chair:</u> Asian Captive Elephant Working Group
2012-present	<u>Emeritus:</u> International Society of Wildlife Endocrinologists
2009-2012	<u>Chair:</u> International Society of Wildlife Endocrinologists
2009	<u>Co-Founder:</u> International Society of Wildlife Endocrinologists
2008-2017	<u>Chair:</u> AZA Endocrinology Scientific Advisory Group
2007-2010	<u>Wildlife Advisory Board:</u> Morris Animal Foundation
2007-present	<u>Research Advisory Board:</u> Audubon Center for Research on Endangered Species
2003-present	<u>Elected Member:</u> Asian Elephant Specialist Group
2003-present	<u>Elected Member:</u> IUCN World Conservation Union
2002-2006	IACUC Committee, SCBI
2002-present	AZA Reproduction Scientific Advisory Group
2001-2006	<u>Endocrinology Advisor:</u> Felid Taxon Advisory Group
2001-2005	<u>Endocrinology Advisor:</u> Cheetah SSP; Clouded Leopard SSP
2000-2009	<u>Scientific Advisor:</u> International Elephant Foundation
1996-present	<u>Reproductive Advisor:</u> Elephant Taxon Advisory Group/SSP

TRAINING:

Graduate Students (M.S) - 30
Graduate Students (Ph.D.) - 17
Postdoctoral Fellows - 11
Visiting Scientists - 50
International Training Workshops - 14

PUBLICATIONS:

M.S. Thesis

Influence of selenium and glutathione peroxidase on bovine seminal production and quality. 1980. P.L. Senger, advisor (Washington State University, Pullman).

Ph.D. Dissertation

Studies of pituitary LHRH and ovarian LH and FSH receptors in cystic-ovarian-diseased dairy cows. 1984. J.J. Reeves, advisor (Washington State University, Pullman).

Book Chapters

1. Brown, J.L. 2019. Update on comparative biology of elephants: Factors affecting reproduction, health and welfare. In: Reproductive Sciences in Animal Conservation - Progress and Prospects. Advances in Experimental Medicine and Biology, 2nd edition. W.V. Holt, J.L. Brown, P. Comizzoli, eds., Springer Science and Business Media, New York, NY. Pp. 243-274.
2. Edwards, K.L., Edes, A., Brown, J.L. 2019. Stress, well-being and reproductive success. In: Reproductive Sciences in Animal Conservation - Progress and Prospects. Advances in Experimental Medicine and

- Biology, 2nd edition. W.V. Holt, J.L. Brown, P. Comizzoli, eds., Springer Science and Business Media, New York, NY. Pp. 91-162.
3. Comizzoli P., Brown, J.L., Holt, W.V. 2019. Reproductive science as an essential component of conservation biology – New edition. In: Reproductive Sciences in Animal Conservation - Progress and Prospects. Advances in Experimental Medicine and Biology, 2nd edition. W.V. Holt, J.L. Brown, P. Comizzoli, eds., Springer Science and Business Media, New York, NY. Pp. 1-12.
4. Comizzoli P., Brown, J.L., Holt, W.V. 2019. From the ivory tower to reality! – Conclusions of the new edition. In: Reproductive Sciences in Animal Conservation - Progress and Prospects. Advances in Experimental Medicine and Biology, 2nd edition. W.V. Holt, J.L. Brown, P. Comizzoli, eds., Springer Science and Business Media, New York, NY. Pp. 545-550.
5. Pushpakumara, P.G.A., Thitaram, C., Brown, J.L. 2018. Reproduction in elephants. In: Veterinary Reproduction and Obstetrics, 10th edition. D. Noakes, T.J. Parkinson and G. England, eds., W.B. Saunders Ltd. Pp. 724-744.
6. Brown, J.L., Comizzoli, P. 2018. Reproduction in cats. In: Encyclopedia of Reproduction, 2nd Edition, Vol. 2. M.K. Skinner, ed., Academic Press, New York. Pp. 692–701.
7. Brown, J.L. 2018. Elephants. In: Encyclopedia of Reproduction, 2nd Edition, Vol. 6. M.K. Skinner, ed., Academic Press, New York. Pp. 654-665.
8. Brown, J.L. 2014. Comparative reproductive biology of elephants. In: Reproductive Sciences in Animal Conservation - Progress and Prospects. Advances in Experimental Medicine and Biology. W.V. Holt, J.L. Brown, P. Comizzoli, eds., Springer Science and Business Media, New York, NY. Pp. 135-169.
9. Holt, W.V., Brown, J.L., Comizzoli, P. 2014. Reproductive science as an essential component of conservation biology. In: Reproductive Sciences in Animal Conservation - Progress and Prospects. Advances in Experimental Medicine and Biology. W.V. Holt, J.L. Brown, P. Comizzoli, eds., Springer Science and Business Media, New York, NY. Pp. 3-14.
10. Holt, W.V., Brown, J.L., Comizzoli, P. 2014. Conclusions: Environmental change, wildlife conservation and reproduction. In: Reproductive Sciences in Animal Conservation - Progress and Prospects. Advances in Experimental Medicine and Biology. W.V. Holt, J.L. Brown, P. Comizzoli, eds., Springer Science and Business Media, New York, NY. Pp. 503-514.
11. Micheletti, T., Walker, S., Brown, J.L. 2014. Non-invasive hormonal monitoring. In: Tratado de Animais Selvagens, 2nd Edition. Z.S. Cubas, J.C.R. Silva, J.L. Catao-Dias, eds., ROCA Publishing, Brazil.
12. Hodges, K., Brown, J.L., Heistermann, M. 2010. Endocrine monitoring of reproductive status and stress. In: Wild Mammals in Captivity, Principles and Techniques for Zoo Management, 2nd Edition. D.G. Kleiman, K.V. Thompson, C.K. Baer, eds., University of Chicago Press, Chicago, IL. Pp. 447-468.
13. Wildt, D., Swanson, W., Brown, J., Sliwa, A., Vargas, A. 2010. Felids *ex situ* for managed programmes, research and species recovery. In: Biology and Conservation of Wild Felids. D. McDonald, ed., Oxford University Press, Oxford, UK. Pp. 292-303.
14. Wildt, D.E., Howard, J.G., Pelican, K., Brown, J., Pukazhenth, B. 2009. Contributions of reproductive science to wild felid conservation. In: Iberian Lynx Ex-situ Conservation: An Interdisciplinary Approach. A. Vargas, C. Breitenmoser, U. Breitenmoser, eds., Fundación Biodiversidad, Madrid, Spain. Pp. 293-304.
15. Pelican, K.M., Abaigar, T., Vargas, A., Rodríguez, J.M., Bergara, J., Rivas, A., López, J., Brown, J., Wildt, D.E. 2009. Unusual gonadal hormone profiles in the Iberian as determined by fecal monitoring. In: Iberian Lynx Ex-situ Conservation: An Interdisciplinary Approach. Fundación Biodiversidad. A. Vargas, C. Breitenmoser, U. Breitenmoser, eds., Fundación Biodiversidad, Madrid, Spain. Pp. 341-352.
16. Brown, J.L. 2009. Comparative endocrinology of domestic and nondomestic felids. In: Iberian Lynx Ex-situ Conservation: An Interdisciplinary Approach. A. Vargas, C. Breitenmoser, U. Breitenmoser, eds., Fundación Biodiversidad, Madrid, Spain. Pp. 329-340.
17. Brown, J.L., Wielebnowski, N., Cheeran, J. 2008. Challenges with identifying and evaluating pain, distress and suffering in elephants. In: Elephants and Ethics. C. Wemmer, C. Christen, eds., John Hopkins University Press, Baltimore, MD. Pp. 121-148.
18. Hildebrandt, T.B., Brown, J.L., Jewgenow, K., Goeritz, F. 2006. Use of ultrasound to study and augment reproduction in the giant panda. In: Biology of the Giant Panda. D.E. Wildt, D. Lindburg, eds., Cambridge University Press, Cambridge, UK. Pp. 410-439.
19. Brown, J.L. 2006. Reproductive endocrinology. In: The Biology, Medicine and Surgery of Elephants. S. Mikota, M. Fowler, eds., Blackwell Publishing, Ames, IA. Pp. 377-388.

20. Hildebrandt, T.B., Brown, J.L., Hermes, R., Goeritz, F. 2003. Ultrasound for the analysis of reproductive function in wildlife. In: Reproduction and Integrated Conservation Science. D.E. Wildt, W.V. Holt, A.R. Pickard, J.C. Roger, eds., Zoological Society of London. Pp. 166-182.
21. Wildt, D.E., Howard, J.G., Brown, J.L. 2001. Role of reproductive sciences in carnivore conservation. In: Carnivore Conservation. J.L. Gittleman, S.M. Funk, D.W. Macdonald, R.K. Wayne, eds., Cambridge University Press, Cambridge, UK. Pp 359-371.
22. Brown, J.L., Graham, L.H., Wielebnowski, N., Swanson, W.F., Wildt, D.E., Howard, J.G. 2001. Understanding the basic reproductive biology of wild felids by monitoring faecal steroids. In: Advances in Reproduction in Dogs, Cats and Exotic Carnivores. P.W. Concannon, G.C.W. England, W. Farstad, C. Linde-Forsberg, J.P. Verstegen, C. Doberska, eds., J. Reprod. Fertil. Suppl. 57, Portland Press, Colchester, UK. Pp. 71-82.
23. Wildt, D.E., Brown, J.L., Swanson, W.F. 1998. Reproduction in cats. In: Encyclopedia of Reproduction, Vol. 1. E. Knobil, J. Neill, eds., Academic Press, New York. Pp. 497-510.
24. Niemuller, C., Brown, J.L., Hodges, J.K. 1998. Reproduction in elephants. In: Encyclopedia of Reproduction, Vol. 1. E. Knobil, J. Neill, eds., Academic Press, New York. Pp. 1018-1029.
25. Wildt, D.E., Phillips, L.G., Simmons, L.G., Goodrowe, K.L., Howard, J.G., Brown, J.L., Bush, M. 1987. Seminal-endocrine characteristics of the tiger and the potential for artificial breeding. In: Tigers of the World: The Biology, Biopolitics, Management and Conservation of an Endangered Species. R.L. Tilson, U.S. Seal, eds., Noyes Publications, Park Ridge. Pp. 255-279.
26. Brown, J.L., Schoenemann, H.M., Chakraborty, P.K. 1994. Pituitary and gonadal responses to hemicastration: A model for investigating the regulation of testicular function. In: Current Trends in Experimental Endocrinology, Vol. 2. J. Menon, ed., Research Trends Publications, Council of Scientific Research Integration, Trivandrum. Pp. 41-56.

Edited Volumes

1. Comizzoli, P., Brown, J.L., Holt, W.V. 2019. Reproductive Sciences in Animal Conservation - Progress and Prospects. Advances in Experimental Medicine and Biology, 2nd Edition. Springer Science and Business Media, New York, NY.
2. Holt, W.V., Brown, J.L., Comizzoli, P.C. 2014. Reproductive Sciences in Animal Conservation - Progress and Prospects. Advances in Experimental Medicine and Biology. Springer Science and Business Media, New York, NY.
3. Soltis, J., Brown, J.L. 2010. Special Issue on The Care and Welfare of Elephants in AZA Institutions, Vol. 29 (3-4). 450 pages.
4. Iyer, S., Brown, J.L. 2004. Special Issue on Elephants. Science India. 120 pages.
5. Brown, J.L. 2000. Special Issue on Elephant Biology. Zoo Biology, Vol. 19 (5). 480 pages.
6. Wildt, D.E., Mellen, J.D., Brown, J.L. 1999. Felid Taxon Advisory Group Action Plan. Disney's Animal Kingdom, Publ., Florida. 128 pages.
7. Brown, J.L., Wildt, D.E. 1998. Reproductive Research in Wildlife Species. Animal Reproduction Science, Vol. 53 (1-4). Elsevier Science, United Kingdom. 320 pages.

Peer-reviewed Publications

1. Fernando, C., Brown, J.L., Corea, R. Field Observations of a wild female Asian elephant (*Elephas maximus maximus*) with a partial vaginal/vestibular prolapse in Wasgamuwa, Sri Lanka. Gajah (provisional accepted)
2. Khammesri S., Ampasavate, C., Hongwiset, D., Boonprasert, K., Brown, J.L., Thitaram, C. Case report: Use of acyclovir for treatment of elephant endotheliotropic herpesvirus infection in an Asian elephant (*Elephas maximus*) calf. J Vet. Med. Sci. (provisional accepted)
3. Glaeser, S.S., Edwards, K.L., Wielebnowski, N., Brown, J.L. Effects of physiological changes and life events on adrenal glucocorticoid activity in female Asian elephants (*Elephas maximus*). PLOS One (accepted)
4. Edes, A.N., Brown, J.L., Edwards, K.L. 2020. Testing lipid markers as predictors of all-cause morbidity, cardiac disease, and mortality risk in captive western lowland gorillas (*Gorilla gorilla gorilla*). Primate Biol. (accepted)
5. Cherdasukjai, P., Buddhachat, K., Brown, J.L., Kaewkool, M., Poommouang, A., Kaewmong, P., Kittiwatananawong, K., Nganvongpanit, K. 2020. Age relationships with telomere length, body weight, and body length in wild dugong (*Dugong dugon*). PeerJ (accepted)

6. Fazio, J.M., Barthel, T., Freeman, E.W., Garlick-Ott, K., Scholle, A., Brown, J.L. Utilizing camera traps and behavioral observations to monitor activity budgets, habitat use, and social interactions in zoo Asian elephants. *Animals* (accepted)
7. Kosaruk, W., Brown, J.L., Plangsangmas, T., Towiboon, P., Punyapornwithaya, V., Silva-Fletcher, A., Thitaram, C., Khonmee, J., Somgird, C. 2020. Effect of tourist activities on cortisol and secretory immunoglobulin A in female captive Asian elephants in Thailand. *Animals* 10(10):1928 doi.org/10.3390/ani10101928.
8. Prado, N.A., Brown, J.L., Zoller, J.A., Haghani, A., Yao, M., Bagryanova, L.R., Campana, M.G., Maldonado, J.E., Raj, K., Schmitt, D., Robeck, T.R., Horvath, S. Epigenetic clock and methylation studies in elephants. *bioRxiv* doi.org/10.1101/2020.09.22.308882
9. Toin, P., Brown, J.L., Punyapornwithaya, V., Bansiddhi, P., Somgird, C., Thitaram, C. 2020. Reproductive performance of captive Asian elephants (*Elephas maximus*) in large tourist camps in Thailand. *Anim. Reprod. Sci.* 222:106606 <https://doi.org/10.1016/j.anireprosci.2020.106606>.
10. Edwards, K.L., Miller, M.A., Siegal-Willott, J., Brown, J.L. 2020. Serum health biomarkers in African and Asian elephants: Value ranges and clinical values indicative of the immune response. *Animals* 10(10), 1756; <https://doi.org/10.3390/ani10101756>.
11. Odour, S., Brown, J.L., Macharia, G., Boisseau, N., Obade, P. 2020. Differing physiological and behavioral responses to environmental and anthropogenic factors between resident and migrant African elephants at Mpala Ranch, Laikipia County, Kenya. *PeerJ* 10.7717/peerj.10010.
12. Brown, J.L., Corea, R., Dangolla, A., Easwaran, E.K., Mikota, S., Oo, Z.M., Sarma, K., Thitaram, C. 2020. Management and care of captive Asian elephant bulls in musth. *Gajah* 52:38-41.
13. Bastian, M.L., Glendinning, D.R., Brown, J.L., Boisseau, N.P., Edwards, K.L. 2020. Effects of a recurring late night event on the behavior and welfare of a population of zoo-housed gorillas. *Zoo Biol.* 39:217-229.
14. Augustine, L., Miller, K., Peters, A., Franklin, A.D., Steinbeiser, C.M., Brown, J.L., Prado, N.A. 2020. Impacts of social grouping on excreted gonadal and adrenal steroids in zoo-housed Cuban crocodiles (*Crocodylus rhombifer*). *Zoo Biol.* doi.org/10.1002/zoo.21559
15. Chowdhury, S., Brown, J.L., Swedell, L. Anthropogenic effects on the physiology and behavior of chacma baboons in the cape peninsula of South Africa. *Conserv. Physiol.* 8(1):coaa066; doi:10.1093/conphys/coaa066.
16. Prado, N.A., Malloy, E., Carlstead, K., Wielebnowski, N., Brown, J.L. 2020. The role of life history and temperament in hyperprolactinemia of African elephants (*Loxodonta africana*). *Horm. Behav.* 125:104804. doi:10.1016/j.yhbeh.2020.104804
17. Pukazhenth, B., Songsasen, N., Brown, J., Comizzoli, P., Crosier, A., Hagedorn, M., Gratwicke, B., Pitt, W., Monfort, S. 2020. David E. Wildt—An inspiring leader in the conservation of wild species. *J. Heredity* 112:1–3. doi:10.1093/jhered/esaa013.
18. Bansiddhi, P., Brown, J.L., Thitaram, C. 2020. Welfare assessment and activities of captive elephants in Thailand: the epicenter of elephant tourism. *Animals* 10:919-937.
19. Brown, J.L., Bansiddhi, P., Khonmee, J., Thitaram, C. 2020. Commonalities in management and husbandry factors important for welfare of captive elephants in North America and Thailand. *Animals* 10:737-760.
20. Khonmee, J., Sumretprasong, J., Brown, J.L., Lokham, K., Phakoetsuk, W., Punyapornwithaya, V. 2020. Evidence that increased adrenal glucocorticoid release during superovulation does not impair gonadal responses in crossbred Thai dairy cows. *CMU J. Nat. Sci.* 19 (4):738-751.
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Manuscripts in Preparation/Review

1. Edwards, K.L., Latimer, E.M., Siegal-Willott, J., Brown, J.L. Using serum biomarkers to investigate the immune response to elephant endotheliotropic herpesvirus. (in prep)
2. Metrione, L.C., Flora, P., Foster, W., Prado, N., Brown, J.L., Penfold, L.M. Behavioral and hormonal monitoring of the first bachelor group of African elephants in a North American zoo. *Zoo Biol.* (under review)
3. Chusyd, D.E., Nagy, T.R., Golzarri-Arroyo, L., Dickinson, S.L., Speakman, J.R., Hambly, C., Johnson, M.S., Allison, D.B., Brown, J.L. Adiposity, reproductive and metabolic health, and activity levels in zoo Asian elephant (*Elephas maximus*). *Exp. Biol.* (under review)
4. Kamau, MW., Brown, J.L., Hassell, J., Gaymer, J., Mutinda, M., Kariuki, L., Gakuya, F., Martins, D.J., Murray, S. Endocrine monitoring as a tool for eastern black rhinoceros (*Diceros bicornis michaeli*) population management in Kenya. *Af. J. Wildl. Res.* (in prep)
5. Prado, N.A., Brown, J.L., Zoller, J.A., Haghani, A., Li, C., Bagryanova, L.R., Campana, M.G., Maldonado, J.E., Schmitt, D., Robeck, T.R., Horvath, S. DNA methylation aging studies in elephants. (in prep)
6. Yu, J.H., Brown, J.L., Boisseau, N., Barthel, T., Murry, S. Effects of Lupron and surgical castration on fecal androgen metabolite concentrations and intermale aggression in capybaras (*Hydrochoerus hydrochaeris*). *Zoo Biol.* (under review)
7. Freel, T., Koutsos, E., Minter, L.J., Tollefson, R., Ridgley, F., Brown, J.L., Smith, D., Scott, H., Ange-van Heugten, K. Cane toad (*Rhinella marina*) urinary corticosterone concentration responses from free-ranging to human care. *J. Zoo Wildl. Med.* (in prep)
8. Yao Yao.....Epidemiology and clinical characteristics of elephant endotheliotropic herpesvirus (EEHV) Type 1 and 4 cases in Thailand between 2006-2019. (in prep)
9. Glaeser, S.S., Shepherdson, D., Lewis, K., Prado, N., Brown, J.L., Wielebnowski, N. Supporting Asian elephant (*Elephas maximus*) welfare and herd dynamics with a more complex and expanded habitat at the Oregon Zoo. *J. Zoo Aquar. Res.* (in prep)
10. Lertwichaikul, T., Pornnimatra, P., Sathanawongs, A., Thitaram, C., Brown, J.L., Khonmee, J. Effect of electroejaculation on testosterone, cortisol, malondialdehyde levels and semen quantity in captive tigers (*Panthera tigris*). (in prep)
11. Angkawanish, T., Vernoy, H., Sirimalaisuwan, A., Charernpan, P., Brown, J.L., Rutten, V. Risk factors for Mycobacterium tuberculosis infection in domestic Asian elephants (*Elephas maximus*). (in prep)

12. Steiniche, T., Foerster, S., Monfort, S., Brown, J.L., Swedell, L. Energetic and hormonal tradeoffs during the ovarian cycle influence reproductive function in female chacma baboons. *Horm. Behav.* (in prep)

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UNIVERSITY AFFILIATIONS

Affiliated Professor, Dept. of Environmental Sciences and Policy, George Mason University, 2005-present

Affiliated Faculty, Smithsonian Mason School of Conservation, George Mason University, 2016-present

Affiliate Faculty, Department of Fish, Wildlife, and Conservation Biology, Colorado State University, 2018-present

Adjunct Professor, Behavior, Ecology, Evolution & Systematics, University of Maryland, 2008-present

Adjunct Full Professor, Department of Biological Sciences, Clemson University, 2012-2018

Adjunct Professor, Department of Geography, University of New Orleans, 2002-2003

PUBLICATIONS

Peer-reviewed Articles and Chapters:

Total: 114. Elephant Focused: 28, these include

1. Chan, A.N., G. Wittemyer, J. McEvoy, A. C. Williams, N. Cox, P. Soe, M. Grindley, N. M. Shwe, A. M. Chit, Z. M. Oo, Z.M. and **P. Leimgruber**. (In Review). Landscape characteristics influence ranging behavior of Asian elephants at the human-wildlands interface in Myanmar. *Landscape Ecology*
2. McEvoy J. F., J. Pastorini, P. Fernando, A. N. Chan, C. Sampson, A. M. Chit, M. Songer, J. Stabach, Z. M. Oo, K. Reisinger, C. A. Williams, **P. Leimgruber**. (In Review). Feel Like Going Home: Habitat Selection Alone Doesn't Explain Movement Paths in Translocated Asian Elephants. *Biological Conservation*.
3. de Silva, S, T. Wu, A. Thieme, J. Johnson, P. Nyhus, J. Wadey, T. Vu, A. Mossbrucker, T. Neang, B. Shu Chen, M. Songer, and **P. Leimgruber**. (In Review). The Past, Present and Future of Elephant Landscapes in Asia. *Global Change Biology*.
4. Sampson, C., J. A. Glikman, S. L. Rodriguez, D. Tonkyn, Paing Soe, D. O'Connor, Aung Myo Chit, and **P. Leimgruber**. (In Review). Rural and urban views on elephants, conservation, and poaching. *Biological Conservation*.
5. Da Costa Dias, T., J. A. Stabach, Q. Huang, M. B. Labruna, **P. Leimgruber**, K. M. P. M. B. Ferraz, B. Lopes, H. R. Luz, F. B. Costa, H. R. Benatti, L. R. Correa, A. M. Nievas, P. F. Monticelli. U. Piovezan. M. P. J. Szabó, D. M. Aguir, J. Brites-Neto, M. Port-Carvalho, and V. J. Rocha. L. Ribeiro Correa, J. Brites-Neto, V. Rocha, M. Port-Carvalho, K. M. P. M. B. Ferraz, J. Stabach, Q. Huang, H. Benatti, M. Labruna, F. Costa, P. F. Monticelli, A. M. Nievas, and U. Piovezan. (2020). Habitat selection in natural and human-modified landscapes by capybaras (*Hydrochoerus hydrochaeris*), an important host for *Amblyomma sculptum* ticks. *PLOS ONE* 15(8): e0229277. <https://doi.org/10.1371/journal.pone.0229277>
6. McEvoy, J., G. Connette, Q. Huang, Khin Htet Htet Pyone, M. Valitutto, Paing Soe, Yan Lin Tun, Aung Naing Lin, Wai Yan Htun, Kaung Htet Paing, Aung Lwin Thant, Khine Khine Swe, Myint Aung, Sapai Min, M. Songer, **P. Leimgruber** (2019). Two sides of the same coin—Wildmeat consumption and illegal wildlife trade at the crossroads of Asia. *Biological Conservation* 238: 108197. <https://doi.org/10.1016/j.biocon.2019.108197>
7. De Silva, S., and **P. Leimgruber**. (2019). Demographic tipping points as early indicators of vulnerability for slow-breeding megafaunal populations. *Frontiers in Ecology and Evolution* <https://doi.org/10.3389/fevo.2019.00171>
8. Goldenberg, S.Z., M. A. Owen, J. L. Brown, G. Wittemyer, Z. M. Oo, and **P. Leimgruber**. 2019. Increasing conservation translocation success by building social functionality in released populations. *Global Ecology and Conservation*. <https://doi.org/10.1016/j.gecco.2019.e00604>.
9. Sampson, C., **P. Leimgruber**, S. Rodriguez, J. McEvoy, E. Sotherden, and D. Tonkyn. (2019). Perception of human-elephant conflict and conservation attitudes of affected communities in Myanmar. *Tropical Conservation Biology* 12: 1–17. <https://doi.org/10.1177/1940082919831242>

10. Sampson, C., J. McEvoy, Zaw Min Oo, Aung Myo Chit, Aung Nyein Chan, D. Tonkyn, Paing Soe, M. Songer, A. C. Williams, K. Reisinger, G. Wittemyer, and **P. Leimgruber**. (2018). New Elephant Crisis in Asia—Early Warning Signs from Myanmar. *PLoS ONE* 13(3): e0194113. <https://doi.org/10.1371/journal.pone.0194113>
11. Sampson, C, **P. Leimgruber**, D. Tonkyn, J. Pastorini, H. K. Janaka, and P. Fernando. (2018). Effects of illegal grazing and invasive *Lantana camara* on Asian elephant habitat use. *Biological Conservation* 220: 50-59.
12. Wadey, J., H. L. Beyer, S. Saaban, N. Othman, **P. Leimgruber**, and A. Campos-Arceiz. (2018). Why did the elephant cross the road? The complex response of wild elephants to a major road in Peninsular Malaysia. *Biological Conservation* 218:91-98.
13. Calabrese, A., J. Calabrese, M. Songer, M. Wegmann, S. Hedges, R. Rose, and **P. Leimgruber**. (2017). Conservation status of Asian elephants – The influence of habitat and governance. *Biodiversity and Conservation*. DOI:10.1007/s10531-017-1345-5.
14. Songer, M., Myint Aung, T. D. Allendorf, J. Calabrese, and **P. Leimgruber**. (2016). Drivers of change in Myanmar’s wild elephant distribution. *Tropical Conservation Science*, 9(4), 1940082916673749. <https://doi.org/10.1177/1940082916673749>.
15. Pastorini, J., T. Prasad, **P. Leimgruber**, K. Isler, and P. Fernando. (2015). Elephant GPS tracking collars: Is there a best? *Gajah* 43:15-25.
16. Allendorf, T., Khine Khine Swe, Myint Aung, **P. Leimgruber**, and M. Songer. (2015). Mitigating human-elephant conflict near Shwe-U-Daung Wildlife Sanctuary, Myanmar. *Gajah* 42:22-29.
17. Fernando, P., **P. Leimgruber**, T. Prasad, and J. Pastorini. (2012). Problem-elephant translocation: Translocating the problem and the elephant? *PLOS ONE* 7: e50917. doi:10.1371/ journal.pone.0050917.
18. **Leimgruber, P.**, Zaw Min Oo, Myint Aung, D. S. Kelly, C. Wemmer, B. Senior and M. Songer. (2011). Current status of elephants in Myanmar. *Gajah* 35: 76-86.
19. Gopala, A., O. Hadian, Sunarto, A. Sitompul, A. Williams, **P. Leimgruber**, S.E. Chambliss and D. Gunaryadi. (2011). *Elephas maximus ssp. sumatranus*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2.
20. **Leimgruber, P.**, W. Azmi, H. Baishya, A. Campos-Arceiz, P. Fernando, W. Jitvijak, M. Maltby, J. Pastorini, N. M. B. Pradhan, J. Ritthirat, B. Stewart-Cox9 and C. Williams. (2011). Developing adaptive management for mitigating human-elephant conflict across Asia. *Gajah* 34: 63-66.
21. Fernando, P. and **P. Leimgruber**. (2011). Asian elephants and dry forests. Pages 151-163 in *The Ecology and Conservation of Seasonally Dry Forests in Asia*. Edited by W. J. McShea, S. J. Davies, N. Phumpakphan, and A. Pattanavibool. Smithsonian Institution Scholarly Press.
22. Annasiwaththa, B. I., R. Munasinghe, P. Fernando and **P. Leimgruber**. (2010). Design and development of power optimized satellite elephant collar with remote programmability. *Proc. ICIAfS2010*, pp. 370-375, Colombo, Sri Lanka, Dec.15-16, 2010.
23. Doyle, S., M. Groo, C. Sampson, M. Songer, M. Jones, and **P. Leimgruber**. (2010). Human-elephant conflict—What can we learn from the news? *Gajah* 32: 22-25.
24. Campos-Arceiz, A., A. R. Larrinaga, U. R. Weerasinghe, S. Takatsuki, J. Pastorini, **P. Leimgruber**, P. Fernando, and L. Santamaría. (2008). Behavior rather than diet mediates seasonal differences in seed dispersal by Asian elephants. *Ecology* 89:2684-2691.

25. Campos-Arceiz, A., Thin Z Lin, Wan Htun, S. Takatsuki, and **P. Leimgruber**. (2008). Working with mahouts to explore diets of working elephants in Myanmar (Burma). *Ecological Research*: 23:1057-1064.
26. **Leimgruber, P.**, B. Senior, Uga, Myint Aung, M. A. Songer, T. Mueller, C. Wemmer, and J. Ballou. (2008). Modeling population viability of captive elephants in Myanmar (Burma)—implications for wild populations. *Animal Conservation* 11:198-205.
27. Wikramanayake, E., P. Fernando, and **P. Leimgruber**. (2006). Behavioral response of satellite-collared elephants to the tsunami in southern Sri Lanka. *Biotropica* 38:775-777.
28. **Leimgruber, P.**, J. B. Gagnon, C. Wemmer, D. S. Kelly, M. A. Songer, and E. R. Selig. (2003). Fragmentation of Asia's remaining wildlands: implications for Asian elephant conservation. *Animal Conservation* 6:347-359.

Proceedings, Reports & Other

Total: 21; Elephant Focused: 8, these include:

1. McEvoy, J., Aung Nyein Chan, M. Songer, **P. Leimgruber**. (2019). GPS Collaring Elephants in Dak Lak, Vietnam. Technical Feasibility Study commissioned by WWF Vietnam.
2. Hedges, S., **P. Leimgruber**, A. Lynam, Khyne U Mar, H. Riddle, Win Naing Thaw, and M. Tyson. (2018). The Myanmar Conservation Action Plan (MECAP) 2018-2027. Nay Pyi Daw, Myanmar.
3. **Leimgruber, P.**, C. Sampson, M. Songer, and Aung Myo Chit. (2018). Human-elephant conflict in Myanmar: Current status, causes and management. Chapter 3 in Myanmar Elephant Conservation Action Plan (MECAP), Nay Pyi Daw, Myanmar.
4. **Leimgruber, P.**, and M. Jones. (2010). The Role of Zoos in the Conservation of Wild Asian Elephants—Executive Summary and Action Plan. Report from a Stakeholder Workshop on Elephant Conservation at the Smithsonian Conservation Biology Institute, Front Royal, VA, USA.
5. Songer, M., C. Sampson, J. Forrest, C. Williams, **P. Leimgruber**, et al. (2010). Mapping Habitat Loss and Human-Elephant-Conflict (HEC) in WWF AREAS and Tiger Priority Landscapes Prototyping Habitat and Population Monitoring for Asia's Charismatic Megafauna. Smithsonian and WWF.
6. Deem, S. L., J. L. Brown, L. Eggert, C. Wemmer, Wan Htun, Thouny Nyunt, S. Murray, and **P. Leimgruber**. 2005. Health and management of working elephants in Myanmar (Burma). *Proceedings of AAZV/AAWV*.
7. Wemmer, C., **P. Leimgruber**, D. S. Kelly, Ye Htut, and Myint Aung. (2005). Managing wild elephants in Alaungdaw Kathapa National Park and Htamanthi Wildlife Sanctuary. Report submitted to the Myanmar Forest Department and the U.S. Fish & Wildlife Service.
8. **Leimgruber, P.** and C. Wemmer. (2004). Pixels, peoples, and elephants—predicting people-elephant conflict from satellite imagery in Southeast Asia. Pp. 123-127 in J. Jayewardne (Ed.) *Endangered elephants. Past, present and future. Proceedings of the Symposium for Human-Elephant Relationships and Conflicts*. Colombo, August 2003.

9. **Leimgruber, P.** and C. Wemmer. (2004). National elephant conservation symposium and workshop. Report submitted to the Myanmar Forest Department and the U.S. Fish & Wildlife Service.

Meeting Abstracts

Total: 97 (2005-present); Elephant Focused: 22, including

1. Venkatesh, S., J. Plotnick, **P. Leimgruber**, and S. Goldenberg. Linking personality traits to crop raiding behavior in semi-captive Myanmar Elephants. Annual meeting of the Animal Behavior Society, Virtual-Online, 28-30 July 2020.
2. Sampson, C., **P. Leimgruber**, and D. Tonkyn. Living with Giants: Mitigating human-elephant conflict in Myanmar. International Congress for Conservation Biology, Cartagena, Colombia July 25, 2017.
3. Sampson, C., D. Tonkyn, M. Songer, and **P. Leimgruber**. Human-elephant Conflict in Myanmar. US-IALE 2016 Annual Meeting. Asheville, NC, April 3-7, 2016.
4. Wadey, J., H. Beyer, S. Saaban, **P. Leimgruber**, A. Campos-Arceiz. The impacts of a major road on elephant movement in northern Peninsular Malaysia." SCB Asia Meeting, Singapore, 28 June-2 July 2016.
5. **Leimgruber, P.** A Fitbit to Save the Elephants. Invited presentation and panel discussion with George Wittemyer (Colorado State University & Save the Elephant), Lucas Joppa (Microsoft Research Scientist), Kathleen Gobush (Vulcan Philanthropy), Tedd Schmitt (Vulcan Inc). SXSW Eco Conference, Austin, TX, Oct 6-8, 2014.
6. **Leimgruber, P.**, A. Campos-Arceiz, P. Fernando, W. Jitvijak, T. Neang, J. Pastorini, V. Ponnusamy, N. M. B. Pradhan, S. Chen, and B. Stewart-Cox. Factors Influencing People's Perception of Human Elephant Conflict Across Asia. Meeting of the Asia Section of the Society for Conservation Biology, Melaka, Malaysia, 19-22 August 2014.
7. Lynam, A., S. Hedges, **P. Leimgruber**. Reducing extractive harvest and implications for the conservation of Asian elephants in Myanmar. Meeting of the Asia Section of the Society for Conservation Biology, Melaka, Malaysia, 19-22 August 2014.
8. Samy, J., K. Thompson, G. Wilkinson, P. Fernando, and **P. Leimgruber**. Social Networks of Wild Asian Elephants. Animal Behavioral Society Annual Conference 2014. Princeton, NJ, USA.
9. Sampson, C., **P. Leimgruber**, J. Pastorini, D. Tonkyn, and P. Fernando, Conserving Asian elephant habitats impacted by fire and Lantana camara, US-IALE Annual Conference, April 2013.
10. Songer, M., M. Aung, and **P. Leimgruber**. Drivers of change in Myanmar's wild elephant distribution. Annual Conference of the Society for Conservation Biology, Baltimore, July 2013.

11. Pastorini, J., **P. Leimgruber**, T. Prasad, and P. Fernando. Conserving Asian elephants requires the coordination and integration of multiple agencies and stakeholders. Annual Conference of the Society for Conservation Biology, Baltimore, July 2013.
12. **Leimgruber, P.**, P. Fernando, and A. C. Christy. Developing adaptive management for mitigating human-elephant conflict across Asia. Symposium at the Society for Conservation Biology, Asia Meeting, Banaglore, India, August 2012.
13. Songer, M. and **P. Leimgruber**. Using online data and software to analyze and monitor human-elephant conflict in Asia. Annual Meeting of the Association of American Geographers, New York, NY, February 2012.
14. Sampson, C., **P. Leimgruber**, D. Tonkyn, J. Pastorini, P. Fernando. The role of fire in maintaining Asian elephant habitat in Sri Lanka The Wildlife Society 18th Annual Conference, Waikoloa HI, November 2011.
15. **Leimgruber, P.** The Conservation Status of Asian Elephants. Symposium on the “Role of Zoos for Conservation of Wild Elephants” Annual meeting of the Association of Zoos and Aquariums, Houston, September 2010.
16. Songer, M., C. Sampson J. Forrest, C. Williams, **P. Leimgruber**. Mapping Habitat Loss and Human-Elephant-Conflict in Priority Landscapes. Annual Meeting of the Society for Conservation Biology, Edmonton, Canada, July 2010.
17. Fernando, P. and **P. Leimgruber**. Are Asian Elephants a Dry Forest “Keystone Species”? Symposium IV-Dry Forest Ecology and Conservation at the FORTROP II International Conference: Tropical Forest Change in a Changing World, Bangkok, Thailand, November 2008.
18. Campos-Arceiz, A.R. Larrinaga, U.R. Weerasinghe, S. Takatsuki, J. Pastorini, **P. Leimgruber**, P. Fernando, and L. Santamaria. Behavior Rather than Digestive Physiology Mediates in Seasonal Differences in Seed Shadows by Asian elephants. The Evolutionary Ecology of Plant-Animal Interactions - From Genes to Communities. Symposium of the Spanish Society of Terrestrial Ecology. Palma (Spain), April 2008.
19. **Leimgruber, P.**, and M. Songer. Linking Captive and Wild Elephant Populations. Annual Meeting of The Wildlife Society in Tucson, AZ, September 2007.
20. **Leimgruber, P.**, M. Songer, D. Shanahan, E. Wikramanayake, J. Pastorini, and P. Fernando. Differences in Movement and Area Use in Asian Elephants—A Comparison between Dry and Deciduous Forest Elephants in Asia. Annual Meeting of the Society for Conservation Biology, Port Elizabeth, South Africa, July 2007.
21. **Leimgruber, P.**, C. Wemmer, D. S. Kelly, and T. Muller. Thousands Missing? The Status of Myanmar’s Elephants, Annual Meeting of the Society for Conservation Biology, Brasilia, Brazil, July 2005.
22. Kelly, D. S., **P. Leimgruber**, and C. Wemmer. Seasonal Habitat Use of Asian Elephants in Two Protected Areas in Myanmar. Smithsonian Institution, GIS Conference, February 2005

Training

Name and Tenure of Students Advised:

Ph.D. students (10):

Aung [REDACTED] (2016-present, Colorado State University)
 David [REDACTED] (2017-present, Frankfurt University, Germany)
 Cao [REDACTED] (2009-present, Princeton University)
 Christie [REDACTED] (2014-2018, Clemson University)
 Dejid [REDACTED] (2015-2019, Frankfurt University, Germany)
 Julie [REDACTED] (2008-2015, Univ. of Maryland, SI Fellowship)
 Kate [REDACTED] (2006-2012, Univ. of Massachusetts)
 Christine [REDACTED] (2007-2009, Virginia Tech)
 Thomas [REDACTED] (2003-2008, Univ. of Maryland, SI Fellowship)
 Melissa [REDACTED] (2002-2006, Univ. of Maryland)

M.Sc. students (9):

Bruna [REDACTED] (2019-present, Federal University of Parana, Brazil)
 Felipe [REDACTED] (2018-2019, Federal University of Parana, Brazil)
 Andrea [REDACTED] (2015-2013, Bayreuth University, Germany)
 Dejid [REDACTED] (2013-2015, Frankfurt University, Germany)
 Christie [REDACTED] (2010-2013, Clemson University)
 Christian [REDACTED] (2012-2013, Bayreuth University, Germany)
 Jan [REDACTED] (2011-2013, Bayreuth University, Germany)
 Anne [REDACTED] (2010-2012, Bayreuth University, Germany)
 Daniel [REDACTED] (2002-2004, George Mason University)
 Jennifer [REDACTED] (2002-2004, University of New Orleans)

Name and Tenure of Postdoctoral Fellows (15):

Rafael [REDACTED] (2020-present, Work Land and Seascapes Project, Pantanal, Brazil)
 Ramiro [REDACTED] (2018-present, Mpala Research Center)
 Qing [REDACTED] (2018-present; Cedar Hill Foundation Fellowship)
 Sumalika [REDACTED] (2017-present, NASA Fellowship)
 John [REDACTED] (2017-2020, Aramco Fellowship)
 Katherine [REDACTED] (2016-2020, SCF Postdoctoral Fellowship)
 Grant [REDACTED] (2015-2019, Helmsley Charitable Trust Fellowship)
 Nandintsetseg [REDACTED] (2018-2019, Movement of Life Fellowship)
 Qiongyu [REDACTED] (2015-2016, UMD-SI Seed Grant Fellowship)
 Jared [REDACTED] (2015-2016, SI Move Fellowship)
 Shermin da [REDACTED] (2014-present, James Smithson Fellowship)
 Chris [REDACTED] (2013-2015, NSF & SI Fellowship)
 Thomas [REDACTED] (2009-2010, SI Fellowship)
 Ilya [REDACTED] (2007-2008, SI Fellowship)
 Swen [REDACTED] (2005-2007)
 Becky [REDACTED] (2004-2007, SI Fellowship)

Visiting Scientists Sponsored (25):

Barnerd [REDACTED] Save the Elephant, Kenya, 2017
 Frederico Gemesio [REDACTED] Brazil, 2015, 2016
 Fernanda Cavalcanti de [REDACTED] Federal University of Viçosa, 2015, 2016
 Dr. George [REDACTED] Colorado State University & Save the Elephant, 2015, 2016
 Dr. Ronaldo [REDACTED] Chico Mendes Institute for Biodiversity, Brazil, 2015, 2016
 Jamie [REDACTED] Management of Malaysian Elephants, Malaysia, 2015
 Dr. Rogerio Cunha de [REDACTED] Chico Mendes Institute for Biodiversity, Brazil, 2014, 2015
 Belinda Stewart-[REDACTED] Zoological Society London, 2014
 Albert [REDACTED] Ustyurt Landscape Project, Kazakhstan, 2013, 2014
 Ned [REDACTED] American Museum of Natural History, 2013
 Anne [REDACTED] Bayreuth University, Germany, 2013
 Hariyo [REDACTED] University of Delaware & Indonesia, 2013
 Buuveibaatar [REDACTED] University of Massachusetts & WCS Mongolia, 2012
 Nandintsegtsseg [REDACTED] Takhi Project, Mongolia, 2012, 2013
 Dr. Martin [REDACTED] Deutsche Luft- und Raumfahrt, Bayreuth University, Germany, 2012
 Dr. Petra [REDACTED] Veterinary University Vienna, Austria, 2012
 Dr. Kirk [REDACTED] University of Massachusetts, USA, 2008, 2009, 2010, 2011, 2012
 Dr. Ahimsa Campos [REDACTED] National University of Singapore, Singapore, 2009
 Dr. Prithiviraj [REDACTED] Centre for Conservation Research, Sri Lanka, 2008
 Dr. Jennifer [REDACTED] Centre for Conservation Research, Sri Lanka, 2008, 2014, 2017
 Dr. Manuel [REDACTED] INTA: Instituto Nacional de Tecnologia Agropecuaria, Argentina, 2006
 Shanon [REDACTED] TNC, Papua New Guinea, 2004
 Enkhbold [REDACTED] GEF Biodiversity of Mongolia's Eastern Steppe Project, Mongolia, 2004
 Alongkot [REDACTED] Wild Aid Thailand, Thailand, 2003
 U [REDACTED] Retired Director Department of Wildlife Conservation, Myanmar, 2002

EXTERNAL RECOGNITION*Invited Expert:*

Smithsonian Representative to the Jaguar 2030 High Level Forum hosted by the United Nations Development Program (UNDP) at the United Nations in New York City, March 1, 2018.
 Member of U.S. Government Delegation for negotiating 2013/2014 and 2014/2015 Action plan for the Science & Technology Agreement between the U.S. and Malaysia; November 2012; March 2015.
 Editorial Team Member for Myanmar's Asian Elephant Conservation Action Plan, Nay Pyi Daw, Myanmar, January 2015-February 2018.
 Invited Expert to lead workshop on *"Human-Elephant Conflict Management"*, hosted by WWF Myanmar in Nay Pyi Daw, Myanmar, 5-6 July 2016
 Invited Expert to advise on elephant conservation and management using satellite tracking to assess success of elephant translocations. Malaysian Department of Wildlife Conservation and National Parks, October 2010.
 Invited Expert to lead workshop on *"Mapping conservation priorities using GIS and remote sensing."* WWF Asian Rhino and Elephant Action Strategy (AREAS), India (2009)

Invited Consultations on *“Reintroduction and management of released Przewalski’s horses in China. Xinjiang Wildlife Department, Xinjiang, China”* (2006, 2007, 2008, 2009)

Invited Expert to lead workshop on *“Management and care of captive elephant populations in Myanmar.”* Myanma Timber Enterprise, Myanmar (2005)

Advisory Expert:

Science Advisory Committee for Oncafari, 01/20-present

Wildlife Insights Steering Committee, 09/18-present

Advisory Committee for Mongolia Project at Senckenberg Museum, Germany, 01/19-present

Scientific Advisory Board for Save The Elephant (STF), 06/12-present

IUCN Asian Elephant Specialist Group (AsESG), 2003-present

Sahara Conservation Fund Science Committee, 2014-present

Science Advisor, Shenandoah Valley Discovery Museum, 2017-2018

Executive Board Member, Shenandoah Valley Discovery Museum, 02/12-12/16

Co-Founder and Member of Elephant Conservation Group (ECG)—Professional Network of Asian Elephant Experts 2012-present

Conservation Advisor to AZA Elephant Taxonomic Advisory Group (TAG), 05/10-12/2014

Member of NASA-conservation NGO working group, 2002-2007

BIOGRAPHICAL SKETCH

Provide the following information for the key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME	POSITION TITLE		
Crosier, Adrienne, E.	Biologist		
eRA COMMONS USER NAME	Smithsonian Conservation Biology Institute		
EDUCATION/TRAINING <i>(Begin with baccalaureate or other initial professional education, such as nursing, and</i>			
INSTITUTION AND LOCATION	DEGREE <i>(if applicable)</i>	MM/YY	FIELD OF STUDY
North Carolina State University, Raleigh, NC	B.S.	05/96	Animal Science
North Carolina State University, Raleigh, NC	Ph.D.	05/01	Physiology
National Zoological Park, Washington DC, and Cheetah Conservation Fund, Namibia	Postdoctoral	05/05	Reproductive Physiology

A. Personal Statement

I am a biologist with the Smithsonian Conservation Biology Institute and manager of the cheetah reproductive and research program. I trained as a postdoctoral fellow in Namibia, at the Cheetah Conservation Fund, where I developed a multi-disciplinary approach to addressing cheetah health and reproduction challenges. My current research program involves developing and utilizing assisted reproductive technologies for improved carnivore reproduction, understanding management-based causes of infertility in captive carnivores, improving cheetah management and health for more efficient reproduction. Currently, the program supports one postdoctoral fellow, one graduate student, one intern, and two animal care staff, all focused on improving carnivore management and health for more efficient reproduction, with a specific emphasis on the cheetah. I am also the Association of Zoos and Aquariums Species Survival Plan Program Leader for Cheetahs, leading the 54 North American cheetah holding facilities in collaborative research and management programs.

B. Positions and Honors

Positions and Employment

1995 National Science Foundation Fellow, Zoological Society of San Diego
1996 - 2001 Graduate Research and Teaching Fellow, North Carolina State University
2001 - 2005 Smithsonian Postdoctoral Fellow, Smithsonian National Zoological Park and the Cheetah Conservation Fund
2005 - 2008 Research Associate, Smithsonian National Zoological Park
2008 - Biologist, Cheetah Program Manager, Smithsonian Conservation Biology Institute
2008 - Affiliate Professor, George Mason University, Department of Environmental Science and Policy
2014 - Adjunct Faculty, University of Maryland, Department of Animal and Avian Sciences
2014- AZA Cheetah Species Survival Plan Program Leader

Professional Memberships

Association of Zoos and Aquariums
Society for the Study of Reproduction

Honors

1997, 1998 Outstanding Graduate Student Teaching Assistant, Department of Animal Science, North Carolina State University

2002	Outstanding Graduate Student Research Award, Department of Animal Science, North Carolina State University
2004	Morris Animal Foundation Fellow
2013-2014	Chair, Steering Committee of the Cheetah Breeding Centers Coalition
2014	Outstanding Young Alumni Award, College of Agriculture and Life Sciences, North Carolina State University
2014 -	Scientific Advisory Board, Cheetah Conservation Fund

C. Selected peer-reviewed publications (Selected from 30 peer-reviewed publications).

Most relevant

1. **Crosier AE**, Marker LL, Howard JG, Pukazhenthathi BS, Henghali JN and Wildt DE. (2007). Ejaculate Traits in the Namibian Cheetah (*Acinonyx jubatus*): influence of age, season and captivity. *Reprod., Fertil. Dev.*, 19: 370-382.
2. Terrell KA, Wildt DE, Anthony N, Bavister BD, Leibo SP, Penfold L, Marker LL and **Crosier AE**. (2011). Glycolytic Enzyme Activity is Essential for Domestic Cat (*Felis catus*) and Cheetah (*Acinonyx jubatus*) Sperm Motility and Viability in a Sugar-Free Medium. *Biol. Reprod.*, 84: 1198-1206.
3. **Crosier AE**, Comizzoli P, Baker T, Davidson A, Munson L, Howard JG, Marker LL and Wildt DE. (2011). Increasing Age Influences Uterine Integrity, but Not Ovarian Function or Oocyte Quality in the Cheetah (*Acinonyx jubatus*). *Biol. Reprod.*, 85: 243-253.
4. Koester D.C., E. Freeman, J.N. Brown, D.E. Wildt, K.A. Terrell, A.D. Franklin, **A.E. Crosier**. (2015). Motile Sperm Output by Male Cheetahs (*Acinonyx jubatus*) Managed *ex situ* is influenced by public exposure and number of caregivers. *Plos1. Sep 2;10(9):e0135847*. doi: 10.1371/journal.pone.0135847. eCollection 2015.
5. Franklin A.D., Schmidt-Küntzel A., Terio K.A., Marker L.L., **Crosier A.E.** (2016). Serum Amyloid A protein concentration in blood is influenced by genetic differences in the cheetah (*Acinonyx jubatus*). *J. Hered.* 107: 115-121. doi: 10.1093/jhered/esv089.

Additional recent publications (in chronological order)

1. Terrell KA, Wildt DE, Anthony N, Bavister BD, Leibo SP, Penfold L, Marker LL and **Crosier AE**. (2011). Oxidative Phosphorylation is Essential for Felid Sperm Function, but is Substantially Lower in Cheetah (*Acinonyx jubatus*) Compared to Domestic Cat (*Felis catus*) Ejaculate. *Biol. Reprod.*, 85: 473-481.
2. Terrell KA, Wildt DE, Anthony N, Bavister BD, Leibo SP, Penfold L, Marker LL and **Crosier AE**. (2012). Different Patterns of Metabolic Cryo-Damage in Domestic Cat (*Felis catus*) and Cheetah (*Acinonyx jubatus*) Spermatozoa. *Cryobiology*, 64: 110-117.
3. Finkenwirth C, Jewgenow K, **Crosier A**, Penfold L, Ringleb J and Dehnhard M. (2012). PGFM (13,14-dihydro-15-keto-PGF₂α) in Feces as a Non-invasive Pregnancy Marker for Felids. *Theriogenology*, 77: 1088-99.
4. Stewart RA, Pelican KM, **Crosier AE**, Pukazhenthathi BS, Wildt DE, Ottinger MA and Howard J. (2012). Oral Progestin Priming Increases Ovarian Sensitivity to Gonadotropin Stimulation and Improves Luteal Function in the Cat. *Biol. Reprod.*, 87: 1-11.
5. Brickner KM, Grenier MB, **Crosier AE** and Pauli JN. (2013). Foraging Plasticity in a Highly Specialized Carnivore, the Endangered Black-Footed Ferret. *Biol. Conserv.* 169: 1-5.
6. **Crosier AE** and Maslanka MT. (2013). Carnivora Husbandry and Care. In *Zookeeping: An Introduction to the Science and Technology*, edited by M. Irwin, J. Stoner and A. Cobaugh. Chicago: University of Chicago Press.
7. Stewart R.A, **A.E. Crosier**, K.M. Pelican, B.S. Pukazhenthathi, B.D. Sitzmann, T.E. Porter, D.E. Wildt, M.A. Ottinger and J. Howard. 2015. Progestin Priming Before Gonadotrophin Stimulation and Artificial Insemination Improves Embryo Development and Normalises Luteal Function in the Cat. *Reprod., Fertil. Dev.*, 27:360-71. <http://dx.doi.org/10.1071/RD13274>.
8. Koester D.C., E. Freeman, D.E. Wildt, K.A. Terrell, A.D. Franklin, K. Meeks, **A.E. Crosier**. (2015). Group Housing Affects the Reproductive Function of Male Cheetahs (*Acinonyx jubatus*). *Reprod., Fertil. Dev.*, accepted for publication.