



Recent Advances in Conservation Genetics (ConGen Global)
June 21- July 1, 2023
St. Francis University, Loretto, Pennsylvania, USA

COURSE INFORMATION

Course Format

The Recent Advances in Conservation Genetics (ConGen Global) 2023 course is as an intensive 9-day practicum dedicated to the application of genomic technologies towards the conservation of biodiversity. Through a combination of lectures, discussions, and hands-on training tutorials, participants will learn the theory and practical application of evolutionary and population genomic analyses to conservation science. The course faculty represent an amazing group of people from around the world who will teach and share their current research and conservation stories, as well as interact with the course participants. The course has been running since 1996, with editions being held at different locations worldwide. The 2023 edition is being held on the beautiful 600-acre campus of Saint Francis University in Loretto, Pennsylvania, USA. Faculty and course participants will be staying in **Christian Hall**, one of the residence halls on the Saint Francis University campus. Meals (breakfast, lunch, and dinner) will be provided in the **Torvian Dining Hall**.

Course Description

This course provides a survey of the theory, methods, and software used in conservation genomics research. Participants will learn how to handle bioinformatics pipelines and algorithms for analyzing next-generation sequencing data through lectures and hands-on computer tutorials. Topics to be covered include:

- Study design for conservation genomic projects
- Overview of genome sequencing and reduced representation methods
- Genome assembly and annotation
- Read mapping and variant discovery
- Analysis of genetic diversity and inbreeding
- Identification of deleterious variants
- Estimation of demographic history

Each evening will feature a keynote-style open lecture by guest faculty on their seminal research advances and interpretations in conservation biology and genomics. The course also includes a full-day field trip to a nearby elephant conservation center, memorial site, and/or museum.

Course Sponsors



Saint Francis University Campus Map



Campus Legend:

- | | | |
|---|---|--|
| 1. Admissions Welcome Center | 23. Lake Saint Francis* | 44. Scotus Hall/ Office of the President |
| 2. Amici Hall | 24. Lakeview Snow Tubing Park * | 45. Small Business Development Center |
| 3. Ave Maria Hall | 25. Mail Services | 46. Softball Field |
| 4. Bach Family Honors House* | 26. Main Campus Entrance | 47. South Campus Entrance* |
| 5. Bell Tower | 27. Maurice Stokes Athletics Center & DeGol Arena | 48. Southern Alleghenies Museum of Art |
| 6. Christian Hall | 28. Mount Assisi Friary & Gardens* | 49. Spalding Cottage |
| 7. Commuter Parking | 29. Our Lady of Lourdes Grotto, Pieta Shrine | 50. Stokes Soccerplex |
| 8. DeGol Field House | 30. Padua Hall | 51. Sullivan Hall |
| 9. DeGol Field & Fr. Bede Track | 31. Pine View Terrace Townhouses | 52. Torvian Dining Hall |
| 10. DiSepio Institute for Rural Health & Wellness | 32. Raymond Hall | 53. Track Throws Area |
| 11. Dorothy Day Outreach Center* | 33. Roundstone Cottage | 54. University Police |
| 12. East Campus Entrance | 34. Sacred Heart Friary | 55. Visitor Parking |
| 13. East Gate Hall* | 35. Saint Agnes Hall | 56. Connors Family Fine Arts Center |
| 14. Occupational Therapy Building | 36. Saint Clare Hall | 57. Hoop House |
| 15. Franciscan Cemetery | 37. Saint Elizabeth Hall | |
| 16. Giles Hall | 38. Saint Francis Fountain | |
| 17. Health Sciences Experiential Learning Commons | 39. Saint Francis Hall | |
| 18. Immaculate Conception Chapel | 40. Saint Joan of Arc Hall | |
| 19. Immergrün Golf Course | 41. Saint Louis Hall | |
| 20. JFK Student Center, Frankie's Campus Club, and Campus Bookstore | 42. Schwab Hall & Adamucci Cafe | |
| 21. St. Joseph's Physical Plant | 43. Science Center | |
| 22. Library and Keirn Family World War II Museum | | |

Accessibility Map
available upon request

*Not Shown

PERSONNEL

ConGen Global organizers

Stephen J. O'Brien, Ph.D., Director; Professor, Nova Southeastern University, Ft. Lauderdale, Florida, USA

Eduardo Eizirik, Ph.D., Professor, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil

Laurie Goodman, Ph.D., Publishing Director, GigaScience Press, Hong Kong, China

Klaus-Peter Koepfli, Ph.D., Senior Research Scientist, Smithsonian-Mason School of Conservation, George Mason University, Front Royal, Virginia, USA

Taras Oleksyk, Ph.D., Assistant Professor, Oakland University, Rochester, Michigan, USA

Anne Schmidt-Kuntzel, D.V.M., Ph.D., Assistant Director for Animal Health and Research, Cheetah Conservation Fund, Otjiwarongo, Namibia

Local hosts and organizers

Justin Merry, Ph.D., Associate Professor of Biology and Chair of Biology, Saint Francis University, Loretto, Pennsylvania, USA

Peter Skoner, Ph.D., Professor and Dean of the School of Science, Technology, Engineering, Arts, & Mathematics (STEAM), Saint Francis University, Loretto, Pennsylvania, USA

Tutorial teaching faculty

Pavel (Pasha) Dobrynin, Ph.D., Postdoctoral Scientist, University of Houston, Houston, Texas, USA

Henrique Figueiró, Ph.D., Research Scientist, Vale Institute of Technology - Sustainable Development, Belém, Brazil

Ekaterina (Katya) Noskova, M.Sc., Research Scientist, University of Fribourg, Fribourg, Switzerland

Walter Wolfsberger, M.Sc., Research Assistant, Oakland University, Rochester, Michigan, USA

Guest lecturers

Fred Allendorf, Ph.D., Regents Professor of Biology Emeritus, University of Montana, Missoula, Montana, USA.

Agostinho Antunes, Ph.D., Professor, Interdisciplinary Center for Marine and Environmental Research (CIMAR), University of Porto, Porto, Portugal

C. Scott Baker, Ph.D., Professor and Associate Director, Marine Mammal Institute, Oregon State University, Newport, Oregon, USA

Carlos Driscoll, D.Phil., Galton Corp., Frederick, Maryland, USA

Cindy Harper, Ph.D., General Manager, Veterinary Genetics Laboratory at the Faculty of Veterinary Science, University of Pretoria at Onderstepoort, South Africa

Jose (Joe) Lopez, Ph.D., Professor, Nova Southeastern University, Ft. Lauderdale, Florida, USA

Audrey Majeske, Ph.D., Professor, Oakland University, Rochester, Michigan, USA and University of Puerto Rico-Mayaguez, Mayaguez, Puerto Rico

Laurie Marker, D.Phil., Executive Director, Cheetah Conservation Fund, Otjiwarongo, Namibia

William Murphy, Ph.D., Professor, Texas A&M University, College Station, Texas, USA

Rachel Nuwer, M.Sc., science journalist and author, Brooklyn, New York, USA

Polina Perelman, Ph.D., Lead Scientist, Siberian Branch, Russian Academy of Sciences, Novosibirsk, Russia

Alfred Roca, Ph.D., Professor, University of Illinois at Urbana-Champaign, Urbana-Champaign, Illinois, USA

Oliver Ryder, Ph.D., Kleberg Endowed Director of Conservation Genetics, San Diego Zoo Wildlife Alliance, Escondido, California, USA

Beth Shapiro, Ph.D., Howard Hughes Medical Institute Investigator and Professor, University of California, Santa Cruz, California, USA

Cynthia Steiner, Ph.D., Associate Director in Conservation Genetics, San Diego Zoo Wildlife Alliance, Escondido, California, USA

DAILY SCHEDULE

Morning lectures and afternoon tutorials will be held in Room 024 (bottom floor) of the Science Center (#43 on campus map).

Evening lectures will take place in Room 024 of the Science Center on June 22, 23, 24 and 30 and in the Auditorium of the JFK Student Center (#20 on campus map) on June 26, 27, 28, and 29.

Wednesday, June 21, 2023

- 12:00 – 7:00pm: Arrival and check-in: Pick up participants and faculty by shuttles from University Park Airport, State College, PA (SCE) or Pittsburgh International Airport, Pittsburgh, PA (PIT)
- 5:30 – 6:30 pm: DINNER
- 7:00 – 9:00 pm: **Introductions:** participants and faculty

Thursday, June 22, 2023

- 8:00 – 9:00am: BREAKFAST
- 9:00 – 9:30am: **Welcome and housekeeping** (Course faculty)
- 9:30 – 10:00am: **Walk-through of course topics** (Klaus Koepfli, Taras Oleksyk)
- 10:00 – 10:55am: **Lecture:** “Noninvasive genetics” (Anne Schmidt-Kuntzel – via Zoom)
- 11:00 – 11:55am: **Lecture:** "Study design for conservation genomics projects" (Klaus Koepfli)
- 12:00 – 1:00pm: LUNCH
- 1:00 – 2:30pm: **Tutorial:** Introduction to Unix, using the Oakland University server, and application of AI generative models to bioinformatics (Walter Wolfsberger)
Tools\Instruments: Command line, PuTTY, ssh, bash\zsh, chatgpt\bard
- 2:30 – 3:00pm: BREAK
- 3:00 – 5:00pm: **Tutorial:** Next-generation sequencing and quality control (Henrique Figueiró)
Tools\Instruments: FastQC, AdapterRemoval
- 5:30 – 6:30 pm: DINNER
- 7:30 – 8:30pm: **Evening Lecture (Room 024, Science Center):**
"A Moving Landscape of Wildlife Genetics-Uncommon Glimpses Yesterday and Today" (Steve O'Brien)

Friday, June 23, 2023

- 8:00 – 9:00am: BREAKFAST
- 9:00 – 9:55am: **Lecture:** “RhODIS: How simple molecular tools are helping conserve African rhinoceros” (Cindy Harper – via Zoom)
- 10:00 – 10:55am: **Lecture:** "Conservation genomics of the Caribbean 1" (Taras Oleksyk)
- 11:00 – 11:55am: **Lecture:** "Conservation genomics of the Caribbean 2" (Taras Oleksyk)
- 12:00 – 1:00pm: LUNCH
- 1:00 – 2:30pm: **Tutorial:** Genome assembly 1 (Pasha Dobrynin)
Tools\Instruments: SPADES
- 2:30 – 3:00pm: BREAK

3:00 – 4:30pm: **Tutorial:** Genome assembly 2 and evaluating genome assemblies (Pasha Dobrynin)
Tools\Instruments: BUSCO

4:30 – 5:15pm: **Lecture:** “*Ex-situ* conservation and clouded leopards” (Klaus Koepfli)

5:30 – 6:30 pm: DINNER

7:30 – 8:30pm: **Evening Lecture (Room 024, Science Center):**
 “A horse’s tale: the remarkable saga of the evolution and conservation of the Przewalski’s horse” (Oliver Ryder)

Saturday, June 24, 2023

8:00 – 9:00am: BREAKFAST

9:00 – 9:55am: **Lecture:** “‘Nothing in biology makes sense except in the light of Evolution’ – Theodosius Dobzhansky – Celebration of the 50th anniversary” (Stephen O’Brien)

10:00 – 10:55am: **Lecture:** “Assessing genetic variation and genetic load throughout the development of conservation biology” (Oliver Ryder)

11:00 – 11:55am: **Lecture:** “Integrating genomics into conservation management” (Cynthia Steiner)

12:00 – 1:00pm: LUNCH

1:00 – 2:30pm: **Tutorial:** Genome annotation 1 (Pasha Dobrynin)
Tools\Instruments: BUSCO, AUGUSTUS, RepeatMasker

2:30 – 3:00pm: BREAK

3:00 – 5:00pm: **Tutorial:** Genome annotation 2 (Pasha Dobrynin)

5:30 – 6:30 pm: DINNER

7:30 – 8:30pm: **Evening Lecture (Room 024, Science Center):**
 “Genetics and conservation: allozymes to genomes” (Fred Allendorf)

Sunday, June 25, 2023

8:00 – 9:00am: BREAKFAST

9:00 – 9:55am: **Lecture:** “Evolutionary and conservation genomics of Neotropical carnivores” (Eduardo Eizirik)

10:00 – 10:55am: **Lecture:** “How can we use genetics to predict and improve population viability?” (Fred Allendorf)

11:00 – 11:55am: **Lecture:** “‘The Cove’ to the market - tracking trade in whales and dolphins with DNA” (Scott Baker)

12:00 – 1:00pm: LUNCH

1:00 – 2:30pm: **Tutorial:** Read mapping and variant calling 1 (Henrique Figueiró)
Tools\Instruments: Minimap2, Picard, GATK

2:30 – 3:00pm: BREAK

3:00 – 5:00pm: **Tutorial:** Read mapping and variant calling 2 (Henrique Figueiró)

6:00 – 9:00 pm: MID-COURSE DINNER and PARTY

Monday, June 26, 2023

8:00 – 9:00am: BREAKFAST

9:00am – 3:00pm Trip to **Pittsburgh Zoo & Aquarium International Conservation Center**, Somerset, Pennsylvania; **Flight 93 National Memorial**, Stoystown, Pennsylvania; and/or **Johnstown Flood Museum**, Johnstown, Pennsylvania

3:00 – 6:00pm Free time

5:30 – 6:30 pm: **DINNER**

7:30 – 8:30pm: **Evening Lecture (Auditorium, JFK Student Center):**
"Whales in a bottle - environmental DNA for identification of whales and dolphins" (Scott Baker)

Tuesday, June 27, 2023

8:00 – 9:00am: **BREAKFAST**

9:00 – 9:55am: **Lecture:** "Application of population structure to conservation" (Klaus Koepfli)

10:00 – 10:55am: **Lecture:** "Genetic management of jaguar populations" (Eduardo Eizirik)

11:00 – 11:55am: **Lecture:** "How to write a scientific manuscript and rules for AI technology" (Laurie Goodman)

12:00 – 1:00pm: **LUNCH**

1:00 – 2:30pm: **Tutorial:** Genome-wide heterozygosity, SNV density, visualization (Henrique Figueiró)
Tools\Instruments: ANGSD, VCFtools

2:30 – 3:00pm: **BREAK**

3:00 – 5:00pm: **Tutorial:** Phylogenomics (Henrique Figueiró)
Tools\Instruments: TBD

5:30 – 6:30 pm: **DINNER**

7:30 – 8:30pm: **Evening Lecture (Auditorium, JFK Student Center):**
"Publishing Ethics and Women in Science" (Laurie Goodman)

Wednesday, June 28, 2023

8:00 – 9:00am: **BREAKFAST**

9:00 – 9:55am: **Lecture:** "40 years of cheetah genetics and conservation" (Laurie Marker – via Zoom)

10:00 – 10:55am: **Lecture:** "Conservation genetics: potential pitfalls to avoid" (Alfred Roca)

11:00 – 11:55am: **Lecture:** "Can we (and should we) use biotechnologies to reverse extinction?" (Beth Shapiro – via Zoom)

12:00 – 1:00pm: **LUNCH**

1:00 – 2:30pm: **Tutorial:** Population structure and admixture (Walter Wolfsberger)
Tools\Instruments: PLINK, ADMIXTURE

2:30 – 3:00pm: **BREAK**

3:00 – 5:00pm: **Tutorial:** Inbreeding and runs of homozygosity (Walter Wolfsberger)
Tools\Instruments: PLINK, BCFtools, Beagle, R(Studio), roh

5:30 – 6:30 pm: **DINNER**

7:30 – 8:30pm: **Evening Lecture (Auditorium, JFK Student Center):**
"Inside the Dark World of Wildlife Trafficking" (Rachel Nuwer)

Thursday, June 29, 2023

8:00 – 9:00am: **BREAKFAST**
9:00 – 9:55am: **Lecture:** "Exploring the Biodiversity of Marine Invertebrates from the Shallow to Deep" (Joe Lopez)
10:00 – 10:55am: **Lecture:** "Reef Royalty: Protecting the Royal Crown of the Reef" (Audrey Majeske)
11:00 – 11:55am: **Lecture:** "Adaptation and Conservation in a World of Change" (Agostinho Antunes)
12:00 – 1:00pm: **LUNCH**
1:00 – 2:30pm: **Tutorial:** Identifying deleterious variants (Pasha Dobrynin)
Tools\Instruments: SAMtools, BCFtools, SnpEff, SnpSIFT
2:30 – 3:00pm: **BREAK**
3:00 – 5:00pm: **Tutorial:** Analyzing deleterious variants (Pasha Dobrynin)
5:30 – 6:30 pm: **DINNER**
7:30 – 8:30pm: **Evening Lecture (Auditorium, JFK Student Center):**
"Conservation genomics of two African elephant species"
(Alfred Roca)

Friday, June 30, 2023

8:00 – 9:00am: **BREAKFAST**
9:00 – 9:55am: **Lecture:** "Domestication, Evolution, and Conservation" (Carlos Driscoll)
10:00 – 10:55am: **Lecture:** "The importance of T2T genome assemblies for understanding biodiversity" (William Murphy)
11:00 – 11:55am: **Lecture:** "Comparative genomics" (Polina Perelman)
12:00 – 1:00pm: **LUNCH**
1:00 – 2:30pm: **Tutorial:** Demographic inference 1 (Katya Noskova – via Zoom and Pasha Dobrynin)
Tools\Instruments: GADMA, PSMC, GONe
2:30 – 3:00pm: **BREAK**
3:00 – 4:30pm: **Tutorial:** Demographic inference 2 (Katya Noskova – via Zoom and Pasha Dobrynin)
4:30 – 5:00pm: **BREAK**
5:00 – 6:00 pm: **Evening Lecture (Room 024, Science Center):**
"Lessons learned from studying the mammalian tree of life" (William Murphy)
6:00 – 10:00pm: **DINNER and CLOSING PARTY**

Saturday, July 1, 2023

8:00 – 9:00am: **BREAKFAST**
9:00 – 10:00am: **Group Discussion:** Career paths
10:00 – 11:00am: **Course evaluation**
11:00 – 11:15am: **Group photo**
11:15am – 12:00pm: **Check-out and departure:** Droop off participants and faculty by shuttles from University Park Airport, State College, PA (SCE) or Pittsburgh International Airport, Pittsburgh, PA (PIT)

SUGGESTED READINGS

Allendorf, F. W., Funk, W. C., Aitken, S. N., Byrne, M., & Luikart, G. (2022). *Conservation and the Genomics of Populations*, Third Edition. Oxford University Press, Oxford, United Kingdom, 750 pages.

Bertorelle, G., Raffini, F., Bosse, M., Bortoluzzi, C., Iannucci, A., Trucchi, E., Morales, H. E., & van Oosterhout, C. (2022). Genetic load: genomic estimates and applications in non-model animals. *Nature Reviews Genetics* 23(8), 492–503. <https://doi.org/10.1038/s41576-022-00448-x>

Bursell, M. G., Dikow, R. B., Figueiró, H. V., Dudchenko, O., Flanagan, J. P., Aiden, E. L., Goossens, B., Nathan, S. K. S. S., Johnson, W. E., Koepfli, K. P., & Frandsen, P. B. (2022). Whole genome analysis of clouded leopard species reveals an ancient divergence and distinct demographic histories. *iScience*, 25(12), 105647. <https://doi.org/10.1016/j.isci.2022.105647>

Ceballos, F. C., Joshi, P. K., Clark, D. W., Ramsay, M., & Wilson, J. F. (2018). Runs of homozygosity: windows into population history and trait architecture. *Nature Reviews. Genetics*, 19(4), 220–234. <https://doi.org/10.1038/nrg.2017.109>

Díez-Del-Molino, D., Sánchez-Barreiro, F., Barnes, I., Gilbert, M. T. P., & Dalén, L. (2018). Quantifying Temporal Genomic Erosion in Endangered Species. *Trends in ecology & evolution*, 33(3), 176–185. <https://doi.org/10.1016/j.tree.2017.12.002>

Fuentes-Pardo, A. P., Ruzzante, D. E. (2017). Whole-genome sequencing approaches for conservation biology: advantages, limitations and practical recommendations. *Molecular Ecology* 26(20): 5368-5406. <https://doi.org/10.1111/mec.14264>

Hendricks, S., Anderson, E. C., Antao, T., Bernatchez, L., Forester, B. R., Garner, B., Hand, B. K., Hohenlohe, P. A., Kardos, M., Koop, B., Sethuraman, A., Waples, R. S., & Luikart, G. (2018). Recent advances in conservation and population genomics data analysis. *Evolutionary Applications*, 11(8), 1197–1211. <https://doi.org/10.1111/eva.12659>

Kardos, M., Armstrong, E. E., Fitzpatrick, S. W., Hauser, S., Hedrick, P. W., Miller, J. M., Tallmon, D. A., & Funk, W. C. (2021). The crucial role of genome-wide genetic variation in conservation. *Proceedings of the National Academy of Sciences of the United States of America*, 118(48), e2104642118. <https://doi.org/10.1073/pnas.2104642118>

Lou, R. N., Jacobs, A., Wilder, A. P., & Therkildsen, N. O. (2021). A beginner's guide to low-coverage whole genome sequencing for population genomics. *Molecular Ecology*, 30(23), 5966–5993. <https://doi.org/10.1111/mec.16077>

Robinson, J., Kyriazis, C. C., Yuan, S. C., & Lohmueller, K. E. (2023). Deleterious Variation in Natural Populations and Implications for Conservation Genetics. *Annual Review of Animal Biosciences*, 11, 93–114. <https://doi.org/10.1146/annurev-animal-080522-093311>

Segelbacher, G., Bosse, M., Burger, P., Galbusera, P., Godoy, J. A., Helsen, P., Hyilsom, C., Iacolina, L., Kahric, A., Manfrin, C., Nonic, M., Thizy, D., Tsvetkov, I., Veličković, N., Vilà, C., Wisely, S. M., & Buzan, E. (2022). New developments in the field of genomic technologies and their relevance to conservation management. *Conservation Genetics* 23, 217–242
<https://doi.org/10.1007/s10592-021-01415-5>

Theissinger, K., Fernandes, C., Formenti, G., Bista, I., Berg, P. R., Bleidorn, C., Bombarely, A., Crottini, A., Gallo, G. R., Godoy, J. A., Jentoft, S., Malukiewicz, J., Mouton, A., Oomen, R. A., Paez, S., Palsbøll, P. J., Pampoulie, C., Ruiz-López, M. J., Secomandi, S., Svardal, H., ... European Reference Genome Atlas Consortium (2023). How genomics can help biodiversity conservation. *Trends in Genetics* 39(7), 545–559.
<https://doi.org/10.1016/j.tig.2023.01.005>