



# Aquatic Molecular Ecology (AquaMoleE) VIP

Chris Caudill (with Drs. Stacey Nerkowski and Shannon Blair)

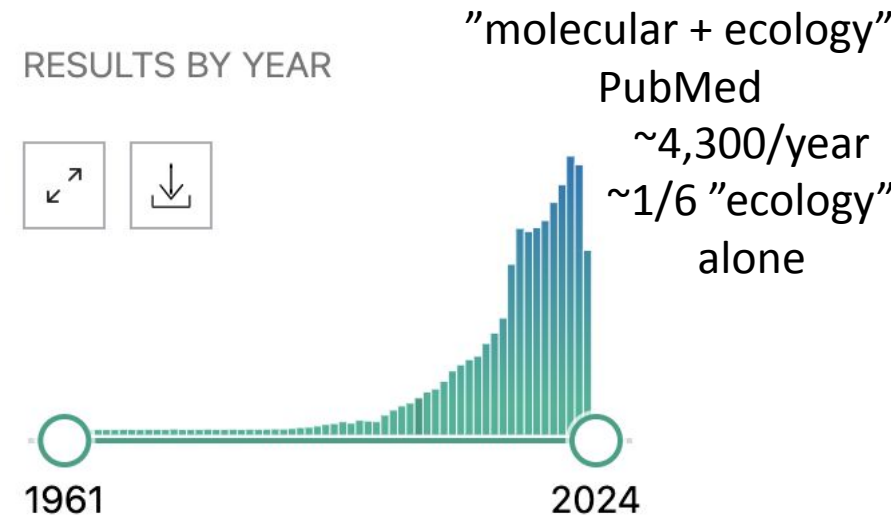
University of Idaho

Department of Fish and Wildlife Sciences



This research is made possible by Idaho  
NSF-EPSCoR Program (award OIA-1757324)

- **Motivation:** molecular tools are becoming routine in natural resource management, conservation, and environmental monitoring
  - Columbia Basin salmon and steelhead: genetic fin clips are collected from all hatchery and many wild fish
  - eDNA detection of rare, endangered or invasive species
  - Collected by field biologists, i.e. recent graduates



- Introduce “molecular toolbox”, key underlying concepts and methods
- Complement existing courses in Conservation Genetics and Population Genomics
- Target research-track undergraduates/graduates AND management/policy-track students desiring understanding of management tools

# Modular VIP structure



**FISH 204 Field Techniques**  
Intro Biol or Genetics 1 cr.

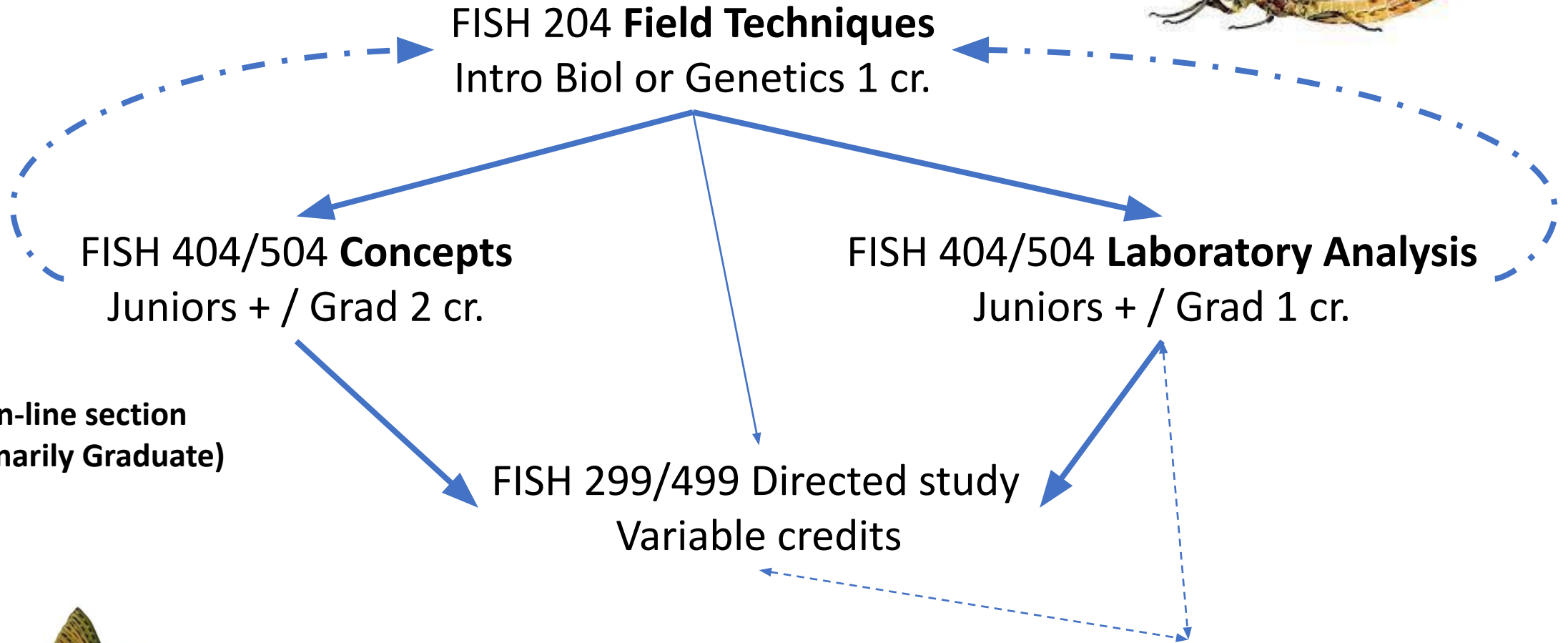
**FISH 404/504 Concepts**  
Juniors + / Grad 2 cr.

**FISH 404/504 Laboratory Analysis**  
Juniors + / Grad 1 cr.

**On-line section**  
**(Primarily Graduate)**

**FISH 299/499 Directed study**  
Variable credits

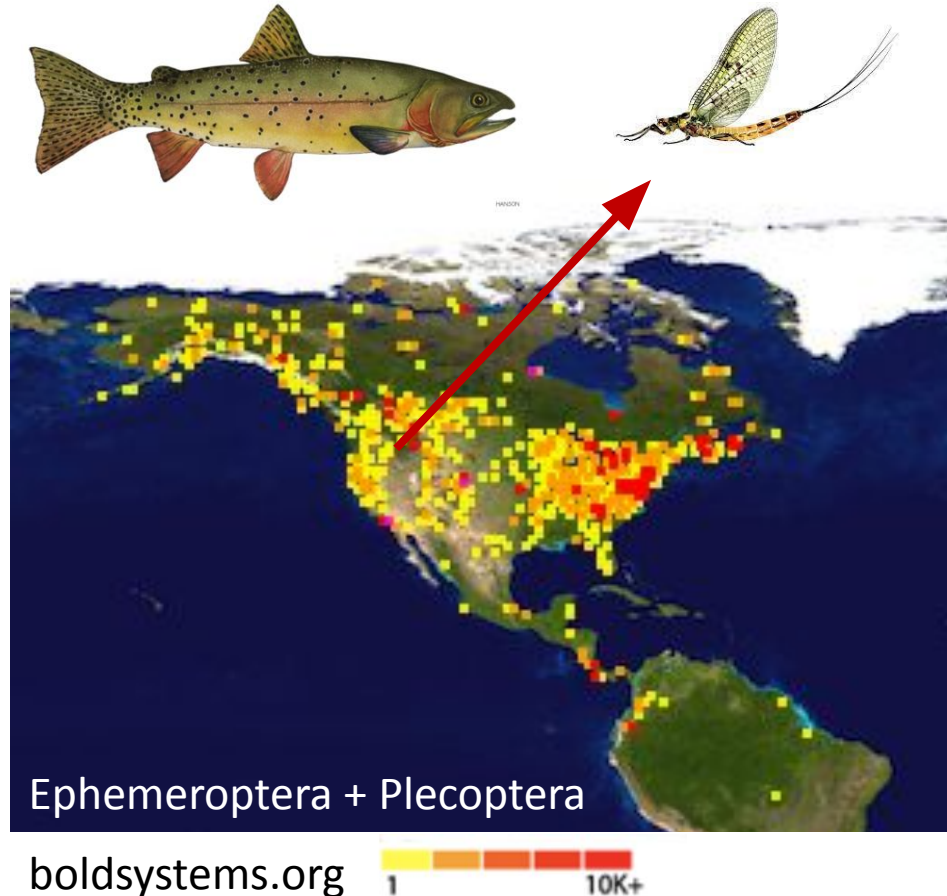
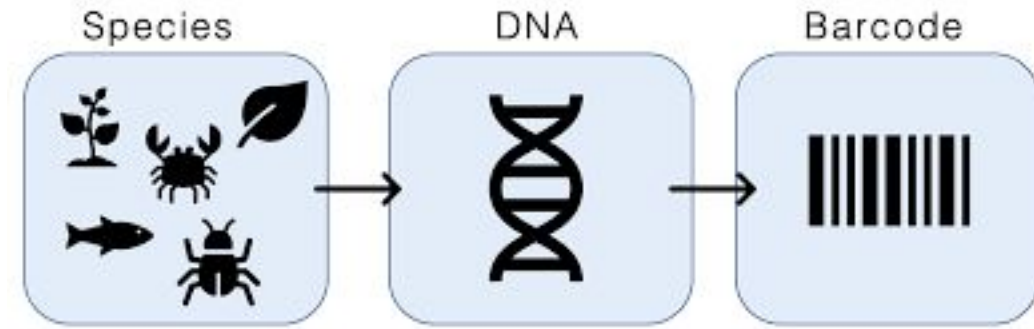
**FISH 450/550 Freshwater Invertebrates**  
**FISH 481 Ichthyology**



# DNA Barcoding



- Species-specific DNA sequence or “barcode”
- Illustrates core concepts and methods
- Basis for many molecular ecology studies
  - eDNA
  - Diet metabarcoding
- Require accurate reference ‘libraries’ with barcodes of known ID
- Idaho is a barcode ‘desert’!
  - Barcode of Life (BOLD) database: global: 14.1 M barcodes for 251,000 animal species
  - Idaho: 1,843 records (0.01%) for 646 taxa
  - **Only a single mayfly and 3 stonefly barcodes!**



# FISH 204: AquaMole Field Methods

- Key aim: Hook students with a field experience and conservation-relevant research questions
- Background lectures and two lab modules
  - Aquatic Ecology
  - Toolbox overview
  - Sampling and study design
- Weekend field trip
- Post-trip reflection
  
- (e)DNA barcoding samples:
  - 2022: Trout microbiome (GEM3 Seed Grant)
  - 2023: Elevation and macroinvertebrate diversity





# Building DNA Barcode Libraries, September 2022





# eDNA field sampling techniques



Mosope Abanikannda  
(PhD Student w/ Jacob Bledsoe)



# Trout microbiome

Dr. Jake Bledsoe





# Bonus Trip! November 2022

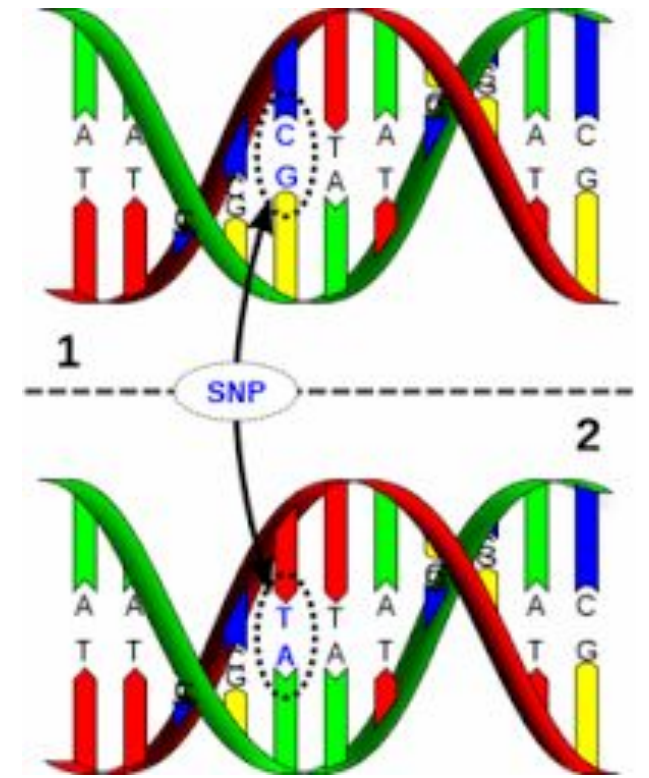


Former SARE  
student Wiley  
Dowler



# FISH 404/504 AquaMolE Concepts

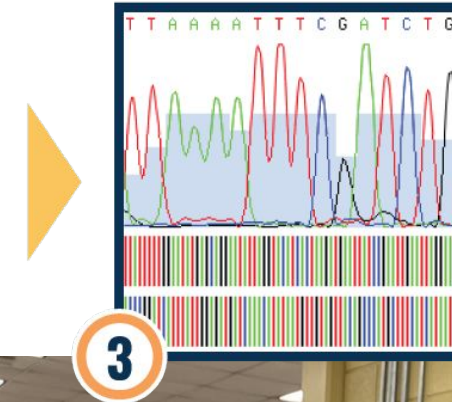
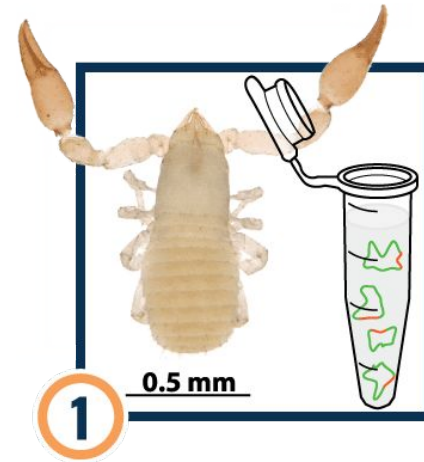
- Key aims (Instructor-led):
  - Core **molecular ecology** and evolution concepts
  - Key aspects of **aquatic ecology and taxonomy**
  - Survey of the "molecular ecology toolbox" and applications
  - Research methods and scientific method
- Proposal development
  - 1:1 meetings to develop question, refine proposal, prepare presentation
  - Draft and final proposals
  - Proposal flash talks (including brief budget for grad students)
- Student-led lectures
  - Graduate student-led topics, 1:1 meetings



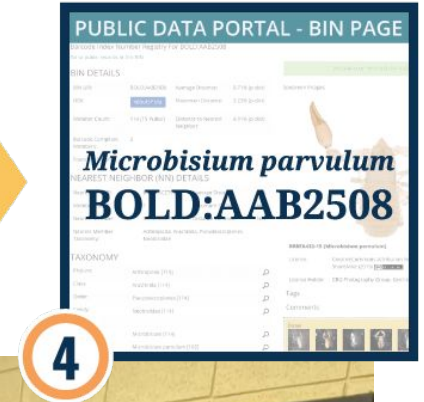


# FISH 404/504: AquaMole Laboratory

## Analyses



<https://ibol.org/bioscan/>



- Experiential Learning:
  - Basic molecular lab protocols and procedures
  - DNA extraction and PCR
  - Generate new barcodes
  - BOLD and basic barcoding bioinformatics
- 2022: 2 Undergrad and 1 Grad



Dr. Nerkowski



# Outcomes and Synergies

- Increased capacity: Three dedicated DNA extraction and PCR workbenches
- 2 Lab modules on DNA and eDNA basics (Katy Reidy, MOSS)
- 22 students
  - Field: 15 students (8 in 2022, 7 in 2023)
  - Concepts: 6 undergraduate, 4 grad (2022)
  - Lab Analysis: 2 undergraduate, 1 grad (2022)
  - Independent study: 1 undergraduate (2023)
- Callie Story: FISH 204  2023 SARE student  post-SARE student
- Rafe Richardson: Summer 2023 SARE student. Barcoded archived museum voucher specimens
- 3 Undergraduate work study students
- 46 barcodes for 10 species to date!

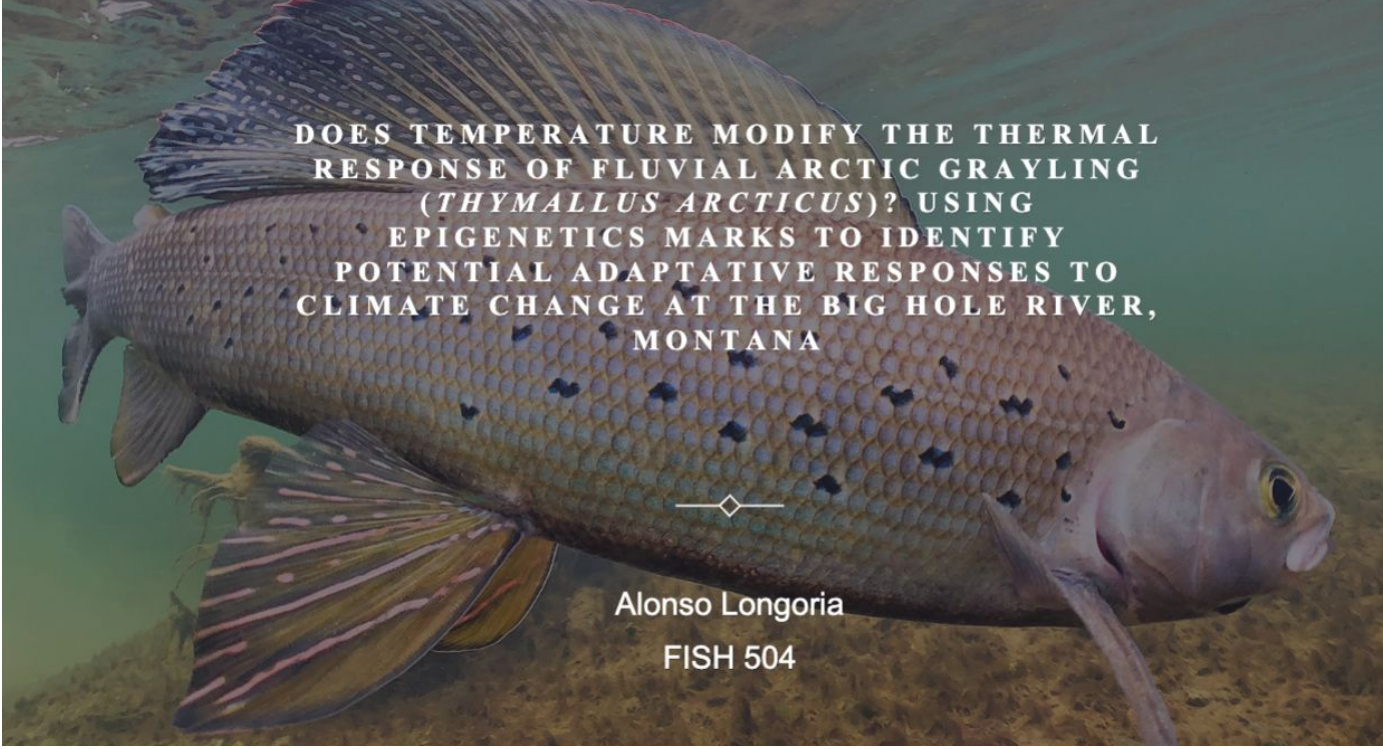
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CGGCTCGGATTAATAAAGTAAACGAAGTACCAACCATT
CCTGATCAGGCTCCGAAAATAAGTAGAGGGTCCCAATATCT
TT
```

*Cinygmula* sp.

Second Idaho  
mayfly barcode!







DOES TEMPERATURE MODIFY THE THERMAL  
RESPONSE OF FLUVIAL ARCTIC GRAYLING  
(*THYMALLUS ARCTICUS*)? USING  
EPIGENETICS MARKS TO IDENTIFY  
POTENTIAL ADAPTATIVE RESPONSES TO  
CLIMATE CHANGE AT THE BIG HOLE RIVER,  
MONTANA

Alonso Longoria  
FISH 504



# Monitoring, Identifying, and Metabarcoding fish samples in Payette Lake

AquaMolE Fall 2022

By: Kendall Hawley



Using GSI and PBT to  
Identify if Waterways in  
Alaska are Seeing  
Hybridization between  
Wild and Hatchery Fish

Beth Kennedy

## Fish Management and Conservation



# Dietary Analysis of the *Manta Alfredi* Population of Kona, Hawaii: Project Proposal



Holly Hokenson

Foraging Ecology



Genetics of Behavior

**BEHAVIORAL SYNDROME GENOME SEQUENCING OF DAFFODIL CICHLID**

Reagan Raat  
FISH 404





Using eDNA  
and  
Metabarcoding  
to Identify  
Source of  
Bluetongue  
Virus (BTV)

By: Jonathon Dixon



Monitoring Sea  
Star Wasting  
Disease (SSWD)  
with Molecular  
Tools

Veronica Myrsell



Gene Expression of the Columbia  
Spotted Frog Infected with Chytrid  
Fungus  
By Austin Kobernuss

Disease Ecology



# Thanks!

These efforts were made possible by Idaho NSF-EPSCoR Program (award OIA-1757324).

- Jacob Bledsoe and Mosope Abanikannda
- Stacey Nerkowski, Shannon Blair, Lisette Waits
- Tami Noble, Rick and Andy
- Donna Llewellyn and GEM3 WFD Team

*“I honestly did not have much interest in fish prior to this semester, but this course/project along with the field methods section gave me a whole new perspective on the field. It was really great to learn new things and find new areas of passion and interest through your classes so thank you for that! **I'm actually thinking about graduate school now!**”*

Student from 2022 AquaMolE Field and Concepts courses



**GEM3**  
Genes by Environment  
Modeling · Mechanisms · Mapping





# Challenges and Opportunities

- Will get own set of course numbers in 2024-2025
- Curriculum challenge: not much room for students to fit additional courses
  - Recruit early
- Integrate with new Ecology major within CNR
- Can be substituted to fulfill upper division major requirements
  
- Sustaining course costs in future: student fees as recruitment barrier
- Expect undergrad enrollment to remain modest but to grow the Concepts grad enrollment, esp. online MNR