Sustainable Systems

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Program Overview

This specialization focuses on the science and management of designed and domesticated ecosystems. Graduates have a strong understanding of the functional dynamics of an ecosystem, comprehensive appreciation of ecosystem responses to manipulation, and the ability to link ecosystem processes to human and environmental health and economic output. Students may concentrate efforts toward understanding terrestrial, aquacultural, or environmental impact and system function. Expertise is developed in production of food, fiber, ornamental, and utility products from domesticated systems and the potential interactions with natural enemies and indigenous species.

Coursework addresses natural ecosystem functions, management of designed ecosystems, numerical methods, environmental policy, land use planning, environmental law, and economics.

Track Chair: Dr. David Bengtson

http://www.uri.edu/cels/favs/FAV_Dbengtson.html
Track Requirements

Core courses (21-25 credits), including:

**Natural Sciences** (12-16 credits)
- Natural Ecosystems (at least 3 credits)
- Managed Ecosystems (at least 3 credits)

**Social Sciences** (6 credits)

**Quantitative Methods** (3 credits)

**Elective courses** (6-10 credits)

**Independent study** (3 credits: EVS 598)

**Graduate seminar** (2 credits)
Natural ecosystems courses

- AFS 415 Fishery Science
- AFS 500 Pathobiology
- BIO 524 Meth. Plant Ecol.
- BIO 560 Sem. in Plant Ecol.
- ENT 519 Insect Biol. Control
- ENT 544 Insect Ecol
- ENT 561 Aquatic Ent.

- NRS 406 Wetl. Wildl.
- NRS 440 Ecosys. Proc. in Land/Water Mgmt
- NRS 534 Ecol. Frag. LS
Managed ecosystem courses

- AFS 425 Aq. & Environ.
- AFS 426 Ecol. Aq.
- AFS 432 Mar. Fish. Cult.
- AFS 483 Salmonid Aq.
- AFS 486 Fish Physiol.
- AFS 531 Fish Stock Assess.
- AFS 581 Molluscan Aq.
- AFS 586 Fish Nutr.
- AVS 412 Animal Nutr.
- AVS 420 Anim. Breed. Gen
- ENT 555 Insect Pest Mgmt
- ENT 571 Insect Microbiol.
- PLS 405 Dis. Turf & Orn.
- PLS 471 Plant Improvement
Social science courses

- CPL 539 Environ. Law
- EEC 410 Fish. Wildl Econ
- EEC 432 Env. Econ Pol.
- EEC 440 Benefit-Cost An
- EEC 528 Microec Theory
- EEC 535 Envir. Econ.
- MAF 523 Fish Law Mgmt
- MAF 582 Coastal
- PSC 402 Env. Policy and Politics
Internship Opportunities

You might consider doing an internship with
RI CRMC Aquaculture Coordinator
RI DEM Div. of Fish & Wildlife
NMFS Regional Office – Gloucester (either fisheries or aquaculture)
USDA-NRCS (Warwick)
## Major Paper Topics

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<thead>
<tr>
<th>Name</th>
<th>Topic</th>
<th>Audience</th>
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<tbody>
<tr>
<td>Brendan Sweeny</td>
<td>Sustainability of fisheries and aquaculture</td>
<td>N/A</td>
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<tr>
<td>Bryan Oakley</td>
<td>Sustainability of small-scale animal agriculture in New England</td>
<td>Prospective farmers</td>
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<td>Kathleen Smith</td>
<td>Integrated pest management strategies</td>
<td>USDA/NRCS</td>
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<td>Chandra Benevento</td>
<td>Educating about sustainability</td>
<td>Educators</td>
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Careers

- Graduates find employment with private-sector firms in the production of food, fiber, ornamental, and utility products from domesticated systems and have ample opportunity with government advisory and regulatory agencies.
Student Stories

• Brendan Sweeny is working for a major seafood buyer ensuring that sources of product, either fisheries or aquaculture, are sustainable
Sustainable Systems

• Everybody wants everything to be sustainable these days, so what’s unique about this?

• Emphasis on food production
  – Plant and animal on terrestrial farms
  – Aquaculture under water (mostly marine)
  – Wild-harvest fisheries
Sustainable Systems

• RI needs small-scale sustainable agriculture
  – Small farms where other sources of income are often available (farmer’s markets, Rhody Fresh milk, Rhody Meats, etc.)
  – Ties to USDA/NRCS

• RI also needs sustainable fisheries
  – Ecosystem-based approach to fisheries
  – Downsizing the fleet

• And sustainable aquaculture
  – Oyster aquaculture industry has grown quickly
Peckham Farm
Department of Fisheries, Animal and Veterinary Science (FAVS)
Peckham Farm

- Approx. 350 acres, of which we use about 20 for animal science
- Mixed function (trying to be seamless)
  - Teaching
  - Research
  - Extension and outreach
- Our goal is to develop the farm as a demonstration site for sustainable small-scale animal agriculture in RI
Sustainability

- Dimensions
  - Environmental
  - Economic
  - Social

- Sustainable animal agriculture in RI
  - Pigs
  - Goats
  - Sheep
  - Cattle
  - Other (poultry)
Involvement with USDA/NRCS

• Geo-textile fabric under paddock to prevent infiltration by diverting nutrients to a treatment area
Involvement with USDA/NRCS

- Aerated composting facility, which will be solar powered
Aquaculture & Fisheries
Wild-capture fisheries and aquaculture
The future…

FIGURE 47
World fish production and food use consumption 1976–2030

- Million tonnes
- 200
- 150
- 100
- 50
- 0

- Aquaculture, China
- Aquaculture, world excluding China
- Capture fisheries, China
- Capture fisheries, world excluding China
- Food use, world

Note: Data are from the Global 1 report; in general they are supported by the Global 2 report.
Aquaculture in China
A negative example from Fujian Province in China – maximum 30% survival and very poor water quality. This is NOT what we want to see in Southeast Asia.
Culture of mollusks

- Scallops
- Mussels
- Oysters
- Clams
- Geoducks
Mussel aquaculture in NZ and NH
Bay scallop culture
Atlantic salmon aquaculture
Environmental Risks of Marine Aquaculture

**Predator Control Program**
- Animals targeted to control predation of farmed fish

**Introduction of Non-Native Species**
- For example: Atlantic salmon eggs (seed stock) from Europe

**Fish Meal and Fish Oil**
- Made from oily fish, such as anchovies and mackerel

**Drugs**
- Antibiotics
- Hormones
- Anesthetics
- Pigments
- Vitamins

**Herbicides**
- Controls algae growth on nets, pens

**Incubation of Local Diseases**
- Caused by a high concentration of fish

**New Diseases and Parasites**
- Introduced by seed stock

**Fish Sewage**
- Contains uneaten food, waste products, disease, and pathogens

**Genetically Modified Organisms (GMOs)**
- Compete with native fish for food and habitat

**Escape of Non-Native Species**
Integrated Multi-trophic Aquaculture (IMTA)
IMTA in New Brunswick
Offshore aquaculture
Aquaculture carrying capacity

- Physical CC – that which will physically fit in an area
- Production CC – maximum amount that does not unacceptably impact the farm itself
- Ecological CC – maximum amount that does not unacceptably impact the ecosystem
- Social CC - maximum amount that does not unacceptably impact the human system
ECC for oyster aquaculture in RI

• Much, much larger than current oyster production (i.e., can produce much more without having unacceptable impacts on the environment)

• Real question is: what is the Social Carrying Capacity for oyster aquaculture in RI? (Based on resolution of user conflicts)
Ecosystem-based fisheries management (EBFM)

• We have traditionally managed fisheries on a single-species basis
• We haven’t done a very good job
• EBFM may be a better way to do it, taking a multi-species or ecosystem approach (food-web models)
• Comparison of large ecosystems around the Northern Hemisphere (Bering Sea, Gulf of Alaska, Georges Bank, North Sea, etc.)
• Aggregate-species production models
Improved fishery management

• Managing people, not fish
• Involve fishermen in the process
  – Local Ecological Knowledge (LEK)
  – Co-management?
• Lessons for MESM students
  – Take courses in science, policy and economics
Lots of problems, lots of opportunities
Questions?