Oregon State University
College of Earth, Ocean, and Atmospheric Sciences

Supporting Transdisciplinary Collaborations in Graduate Education:
Data Informed Analysis

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Project Objective:

The objective of this study is to evaluate the *impacts* and the *training elements* of the OSU NRT program on collaborative transdisciplinary education in marine coastal science.

Background:

- The Oregon State University NRT program seeks to *engage graduate students in transformative research, education, and professional experiences to address the effects of human actions and climate change on marine systems* (Fig. 1).
- Key three core concepts of the OSU-NRT are: 1. **risk and uncertainty** (R&U) quantification, 2. **data analytics** (DA), and 3. **coupled natural-human systems** (CNH).
- Trainees work in teams of 3-5 to address research commissioned by stakeholders and/or advising faculty, and that contains elements of the three core concepts.
- The training elements of the NRT program include technical coursework in RU, CNH, and DA, professional training in synthesis, collaboration and communication, internship, and collaborative research (Fig. 1).
- The OSU NRT has been in place since September 2015.
- A total of 44 trainees, working in 12 teams have been involved in the program. Trainees are on both MS and PhD tracks, from six different Colleges (Table 1 and photos).
- Trainees enter the program in the second or later year in graduate school, and spend 1 year in NRT training.
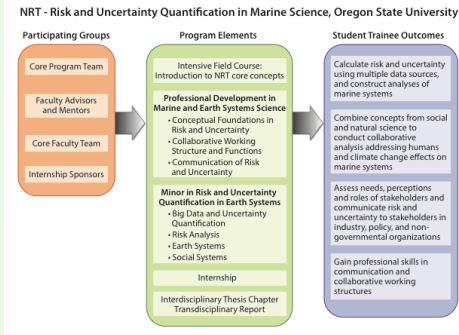

Figure 1: OSU NRT Logic Model describing participating groups, the training elements of the OSU NRT, and expected outcome.

Methods

- We analyzed responses to surveys administered to students and advising faculty at the end of the program's training and to alumni who had been at least 1 year post-training. The survey included Likert scale items and open-ended prose questions to assess both *impacts* of the NRT training and *sources of support* for the stated impacts.
- Only responses from the first three cohorts of students (n=34) and advising faculty (n = 37-42) are included in these results.
- Survey results are discussed reflecting on the personal experiences by the leadership team during the program's existence

Table 1: List of OSU NRT trainees, their disciplinary expertise, and the title of team-based research. N = number of trainee in a research team.

Cohort	N	Project title	Disciplinary Expertise
I	4	Ocean condition forecasting	Social sciences, Cartography, Oceanography
I	3	Uncertainty quantification of tsunami forecasting models	Mathematics, Statistics, Civil Engineering
I	4	Validity and value of wave energy generation as blackout risk mitigation for the central Oregon coast	Marine Policy, Electrical and Mechanical Engineering
II	5	Connecting crabs, currents, and coastal communities	Marine ecology, Oceanography, Mathematics, Social sciences
II	3	Emerging technologies in fisheries science	Fisheries ecology, History and arts, Computer sciences
II	3	Applying ecological frameworks to Human and cultural keystone species relationships	Anthropology, Ecology, Mathematics
III	4	Integrating ecological, oceanographic, and human dimensions to support marine decision-making	Marine Policy, Statistics, Oceanography, Ecology
III	3	Assessing the feasibility of a sea otter reintroduction to Oregon through a coupled natural-human lens	Marine Policy, Ecology, Genetics
III	5	Mo'orea's socio-ecological system: a transdisciplinary and nutrient-based perspective on Mo'orean coral reef	Cartography, Microbiology, Coral reef ecology, Statistics, Anthropology
IV	4	Connectivity and socio-hydrogeomorphic vulnerability of the Oregon Coast	Geomorphology, Hydrology, Statistics, Policy Science
IV	3	Evaluating the potential effects of multiple stressors on living marine resources in the Gulf of Alaska	Marine Policy, Fisheries ecology, Computer sciences
IV	3	Microplastics in the ocean	Communication science, Mathematics, Fisheries ecology

Results

- Students and faculty report that the NRT program had a positive impact on students' knowledge and skills (Fig. 2). In particular, they report:
  - increased capacity to **conduct interdisciplinary research**,
  - greater skills in **communication and collaboration**,
  - increased abilities to assess **stakeholders' needs, perspectives and roles**.
- The training elements viewed by students as most beneficial were (Fig. 3):
  - conducting an **interdisciplinary research project**,
  - **collaborating in an interdisciplinary team**,
  - completing program's required **internship** and the course focusing on collaborative working structures.
- 27 out of 30 (90%) of the trainees reported now being **more prepared to participate in collaborative interdisciplinary projects** (Fig. 4),
  - 18 out of 30 (60%) indicated being more motivated to participate in such projects and 23% reported being equally motivated
  - those students citing lower motivation levels (n=5) mentioned being more aware of the intellectual, interpersonal, and logistical challenges involved in conducting collaborative interdisciplinary research.
  - 82.5% alumni indicated that the NRT training has given them **competitive edge when applying for other professional opportunities**
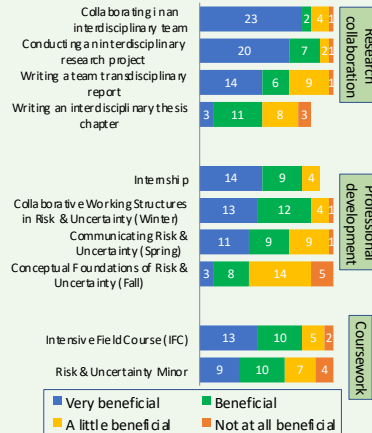
Training elements

Figure. 3: Training Elements Rated as Beneficial by Students (# of students, Cohorts 1, 2 and 3).

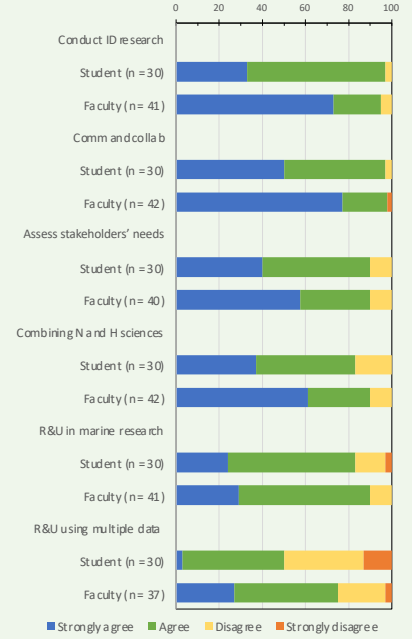### Impacts on Knowledge and Skills: Student and faculty perspectives

Figure. 2: Program impacts on Students' knowledge and skills, as reported by students and faculty. Percentage of total responses, Cohorts 1, 2 and 3.

Conclusions

Results indicate that early exposure to interdisciplinary and transdisciplinary training has positive impacts on student's collaborative research skills, interdisciplinary communication, and engagement. Based on our experience we conclude that beneficial impacts of the training require:

- **Active, Engaged Support**. Fostering positive collaborations requires active engagement of the program leadership in disciplinary coursework and professional training, including synthesis, communication, and collaboration.
- **Time to converge**. The process of team convergence has to occur from the very start, by providing trainee with time and a safe space to express their opinions, potential contributions, and eventually to agree on a common research question and methodologies to address it.
- **Balance between process and product**. Trainee need space to develop trust in each other and in their individual capacities (the process), while having clear guidelines for developing their goals, approach, and assessing success (the product).
- **Inclusive environments**. Our experience clearly points to the fact that highly diversified teams can produce highly successful and innovative research projects and processes. Having trainees with diverse identities and diverse backgrounds allows groups to develop multifaceted approaches to solving problems. However, the program leadership must provide training and opportunities to practice *inclusive and respectful communication*, *awareness of implicit biases toward certain disciplines*, *ethnicities*, and *gender*, and *associations between disciplinary expertise with gender and ethnic groups* (intersectionality).
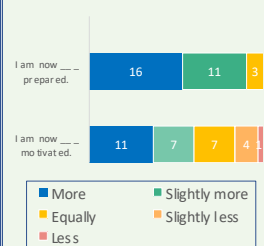
Impacts on preparedness and motivation

Figure. 4: Impact of NRT Program on Preparedness and Motivation to participate in collaborative interdisciplinary research projects (# of students, Cohorts 1, 2 and 3).