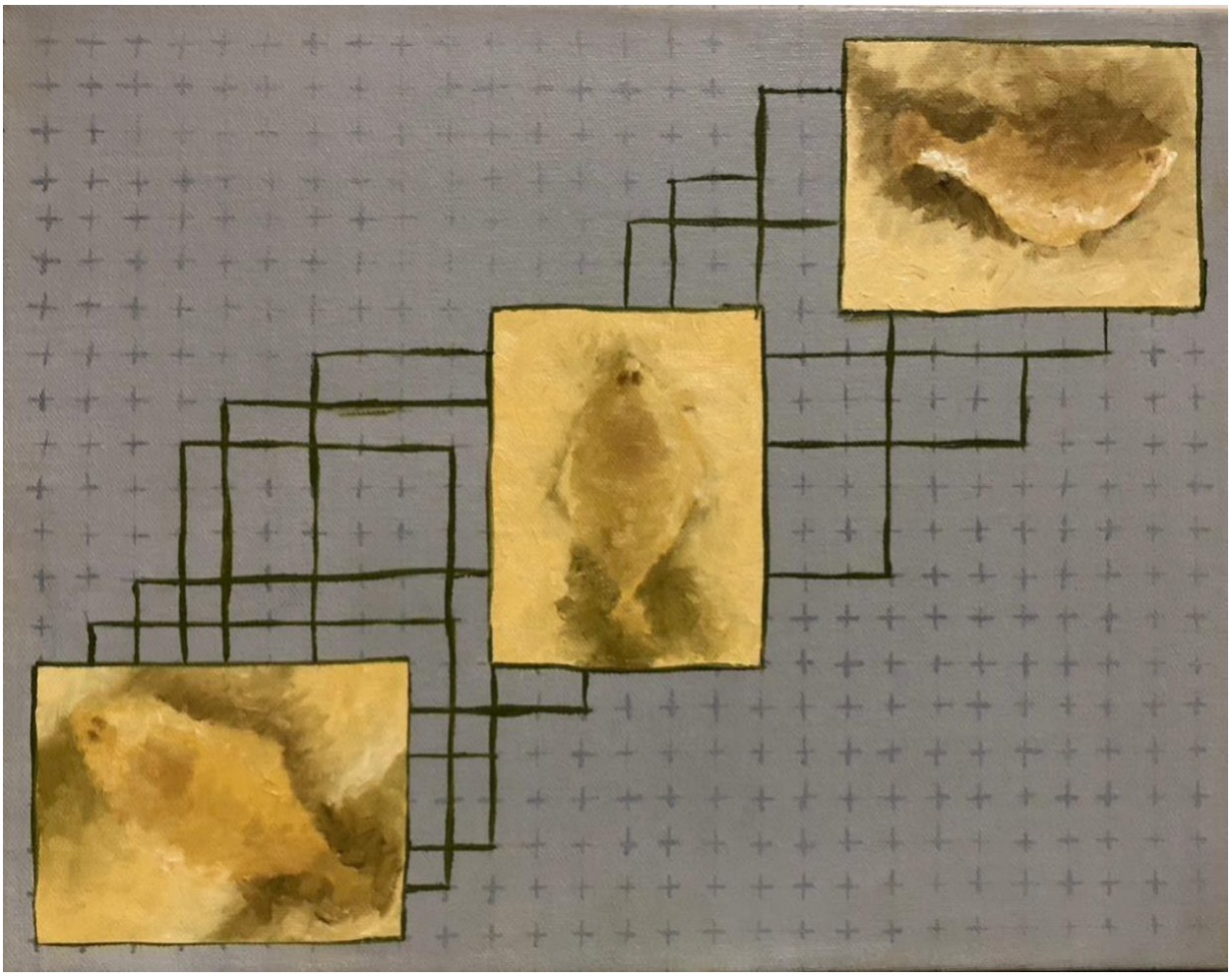
NRT Risk and Uncertainty Quantification in Marine Science

Program Handbook

Oregon State University



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Artwork by Samantha Newton, NRT Fellow *REV. 1/13/20*

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I. NRT in Risk and Uncertainty Quantification in Earth Systems Program

A. Vision:

Engaging graduate students in transformative research, education, and professional experiences to address the effects of human actions and climate change on marine systems.

B. Mission:

We envision a future in which scientists and managers work seamlessly using large and ever-expanding data resources, to understand the top-down effects of human actions and the bottom-up effects of climate change on the ocean system. These collaborations will have as a fundamental component quantification and communication of the risks and uncertainties that are inherent in model forecasts and policy actions, and the ultimate goal of devising management solutions in the face of these changes and uncertainties.

C. Program Synopsis and Core Concepts:

The Oregon State University (OSU) National Science Foundation Research Traineeship (NRT) award prepares a new generation of natural resource scientists and managers who combine mathematics, statistics, and computer science with environmental and social sciences to study, protect, and manage ocean systems. Besides fulfilling current educational gaps in marine science and management, the OSU NRT program promotes: 1) a transformative and scalable new marine science and policy graduate minor that teaches students to quantify and communicate risk and uncertainty of data-based model forecasts and policy scenarios; 2) the discovery of mechanisms that control the response of marine systems to climate change and human pressures; 3) the development of evidence-based practices for recruiting, training, and retaining diverse graduate students and for placing them into successful careers in Science, Technology, Engineering and Mathematics (STEM).

Trainees learn to work in transdisciplinary research groups on user-inspired problems using large and ever-expanding data resources. Through a combination of technical coursework, national and international internships, stakeholder engagement, and involvement in transdisciplinary research projects, OSU NRT trainees learn about the science of big data, risk and uncertainty quantification and communication and sustainability. They learn tools and techniques to assist communities in managing resources through change and to recover quickly in the event of a disaster. Students with diverse expertise, developed through either science or policy internships, leverage each other's strong disciplinary knowledge and skills as they collaborate to address complex stakeholder-identified climate and policy problems. These collaborations have the ultimate goal of devising management solutions in the face of change and uncertainty.

The OSU NRT research and disciplinary training is based on three interconnected core concepts:

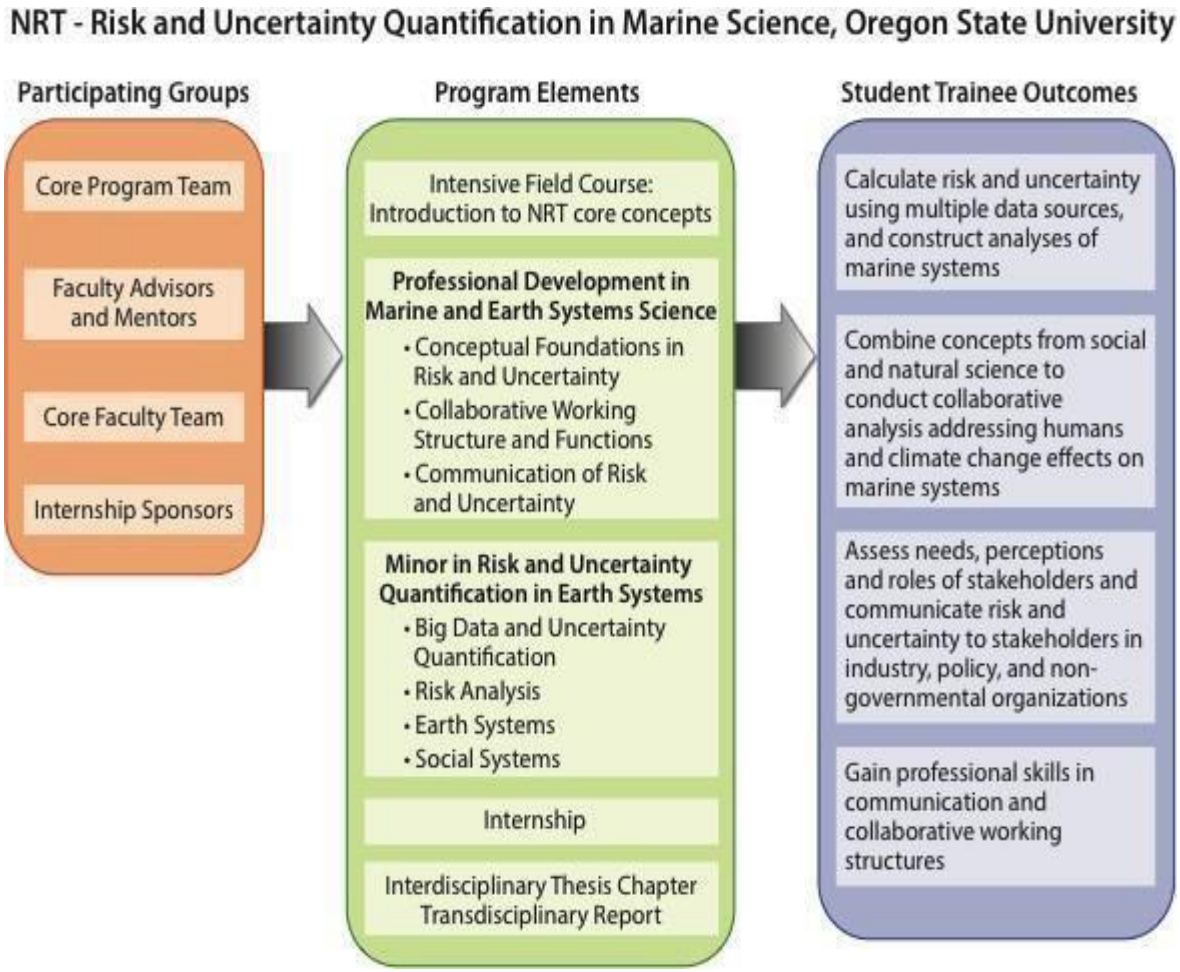
- **Coupled Natural Human** (**CNH**) systems: include human and biophysicalsystems, and their connections.
- **Big Data** (**BD**): Large volume of data with high throughput. Big data can be temporal, spatial, or dynamic; structured or unstructured.
- **Risk and Uncertainty analyses and communication** (**R&U**): A risk is quantified by some measure of the expected cost, involving probabilities and magnitudes, of an undesirable event. Uncertainty is driven by unknown processes and data quality.

D. NRT Leadership Team:

- Lorenzo Ciannelli (PI), CEOAS, Fisheries Oceanography
- Flaxen Conway (Core member), CEOAS, Marine Resource Management
- Alix Gitelman (Co-PI), Statistics, Environmental Statistics
- Julia Jones (Co-PI), CEOAS, Geography
- Ana Spalding, School of Public Policy
- Michael Banks (Core member), Fisheries and Wildlife, Genomics
- Alexander Kurapov (Core member), CEOAS, Physical Oceanography
- Juan Restrepo (Co-PI), Mathematics, Uncertainty
- Enrique Thomann (Core member), Mathematics, Stochastic Modeling
- Sinisa Todorovic (Co-PI), Computer Science, Machine Learning
- Ed Waymire (Core member), Mathematics, Risk Analysis
- Cynthia Char (Evaluator), Char Associates, Human Development
- Katherine Hoffman (NRT Coordinator), CEOAS

E. ***Logic Model:***

The Logic Model below defines specific learning objectives for the Program overall and for each course in the MRM series.



II. Information for Faculty Mentors

A. Mentoring of Students:

Mentoring *all* the students in the cross-disciplinary research cluster is key to the success of each student in the program. There are three levels of mentoring (see Fig. 1):

- Among faculty whose students are involved in a cluster
- Among faculty and student advising a cluster
- Among students within a cluster and within the NRT program

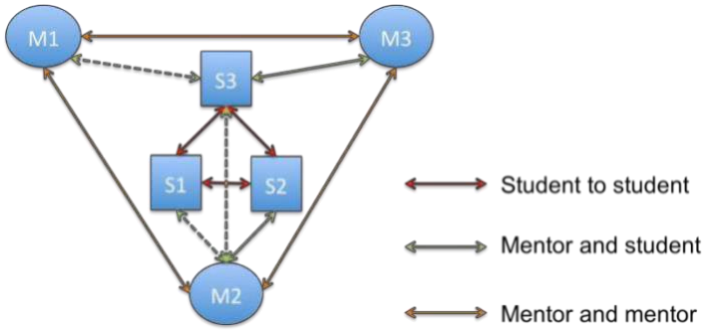


Figure 1: Mentoring schematic. S = student, M = mentor. Students are organized in cross-disciplinary research clusters. Each student is mentored by his/her respective primary faculty and other faculty whose students are also involved in the cluster.

B. Advisor Expectations:

Because of the important role that faculty mentors have in guiding student activities, we ask that those who are interested in being an advisor agree to the following requirements. Failure to do so will result in the reneging of your student's fellowship.

- Faculty mentors must propose a research idea that will form the basis of the students' collaborative research.
- Faculty mentors must develop and follow an Individual Development Plan (IDP) with the primary student.
- Faculty mentors must agree to attend the IFC (Intensive Field Course) on the day where the Student's IDP (Individual Development Plan) is discussed. The IFC is typically held at the Hatfield Marine Science Center (HMSC) in Newport, OR, the week prior to when fall classes start; and the IDP session is usually held the firstday. The NRT Program Coordinator will confirm these dates.
- Faculty mentors must be actively engaged in their student's research cluster activities and attend all cluster meetings.
- Faculty are encouraged to engage in other training activities through MRM professional series classes. (Please see pages 8-9 of this handbook).
- Faculty mentors may be asked to serve as a student's Minor Professor by the students in your research cluster (Please see pages 12-13 of this handbook). The student CANNOT be from the same College as the Minor professor. If a faculty is asked to serve as a Minor professor and agrees to be nominated, please contact Katherine.Hoffman@oregonstate.edu.
- Faculty mentors must understand that the interdisciplinary chapter is an important and significant part of the student's thesis; and that the transdisciplinary report is an essential expected product for the NRT.

C. Advisors/Students Agreement Document:

Students and advisors must sign the Student/Advisor Agreement Document prior to student's matriculation into the NRT Program. (Please see Appendix A).

III. Information for Students

A. Application and Admissions Process:

1. Prospective Students

The NRT program accepts graduate students who have completed at least one year of graduate studies at Oregon State University. We specifically seek students who are interested in working collaboratively to address marine related topics that encompass science and policy connections.
Characteristics of ideal candidates include the ability to recognize expertise that others bring to the group, while also recognizing their own strengths; the ability to listen to instructions and complete tasks ahead of time; and the ability to listen and defer to others, but also to take initiative when leadership is needed.

Participation in the NRT program involves the development of a group project and the completion of a number of training and professional activities. The main requirements for the group projects are that they involve some aspect of marine resource management, have a policy as well as a science question in it, are based on the analysis of large data sets, and involve risk and uncertainty quantification.

2. Application Instructions

Students must apply to one of the existing projects listed on our website. In preparation for putting together their application packets, students MUST contact the project lead as well as make sure that his/her advisor is engaged in a discussion of the project where all three of the NRT Core Concepts are represented.

Complete student applications should include the following:

- Letter of interest from student
- Letter of support from student's major advisor(s)
- Unofficial graduate and undergraduate transcripts
- Indication of US citizenship or permanent residency, if applying for a NRT fellowship (e.g. A copy of passport)
- Student ID number and e-mail address

The letter of interest from the student should include:

- Statement of your academic, research, and personal experience and interests as they relate to the NRT program. (Please visit the "Research" and "Training" pages on the NRT website for additional information on the NRT program).
- Statement of your commitment to engaging in collaborative activities (e.g. use others' work in your work, participate in a peer colloquium, craft a collaboration chapter/publication, participate in a longitudinal evaluation, design a viable completion plan) with your peers. This is important as you will be working on transdisciplinary teams during the NRT fellowship year.
- Description of how your participation in the NRT program will help you achieve your academic and professional goals.
- identify which project you wish to work on and how you could potentially contribute to it.
- Description of your funding plan for completing your degree. If requesting to be considered for a one-year NRT fellowship, state so in the letter. Limited number of one-year NRT fellowships are available for U.S. Citizens and permanent residents, and will be assigned based on financial needs and academic accomplishments. Fellowships include stipend, tuition and most fees, some internship and research financial support, and benefits. Research funds may be available (see Appendix H).

The letter of support from your advisor should include:

- Description of how the student can succeed in the NRT program from the three core concepts listed above, specifically addressing the potential to develop both strong quantitative skills and deep understanding of the natural and social sciences, management, and policy approaches. (Please visit the "Research" and "Training" pages on the NRT website for additional information on the NRT program).
- Description of how the student fits in to the research project.
- Examples of how the student will/has succeed (ed) in collaborative, cross-disciplinary team settings.
- Evidence of a viable plan for funding for the student for his/her entire degree program.
- Describe your plans for working with the student and other NRT faculty in the training aspects of the program. Specifically, address how you will:
    - Follow student's progress to finalization of degree.
    - Participate in NRT activities when requested.
    - Engage with other NRT faculty who are collaborating with your student.

B. NRT Program Elements and Timeline

Shaded area indicates the NRT fellowship period

Year in graduate school	Course work and internship	NRT Program Products
Year 1 fall	Disciplinary course work	
Year 1 winter	Disciplinary course work	
Year 1 spring	Disciplinary course work	
Year 2 early fall	NRT IFC (intensive field course)	Student gets familiar with the NRT Program and team disciplinary expertise
Year 2 fall	Minor course work and MRM 525 professional training	Develop Intro of TD report and define goals for ID chapter
Year 2 winter	Minor course work and MRM 525 professional training	Develop methods and preliminary results of TD report and write intro of ID chapter
Year 2 spring	Minor course work and MRM 525 professional training	Write Executive Summary of TD report Continue working on ID chapter Become familiar with how to talk about this work with stakeholders.
Year 2 summer	• Internship (must relate to core components of NRT) Complete Minor	Complete TD report and ID chapter

Classes in College of Earth, Ocean, and Atmospheric Sciences, Geography, Environmental Science, Marine Resource Management, Statistics, Mathematics, Computer Science, Liberal Arts

1. Interdisciplinary Training

a. Intensive Field Course (IFC):

Students are REQUIRED to enroll in GEO 508: Intensive Field Course (IFC): Introduction to NRT core concepts (3 credits). The course is usually held the week before the fall term begins, at the Hatfield Marine Science Center in Newport, OR. During this time, students are exposed to the core concepts of the program via lectures and fieldtrips; and they have the opportunity to meet prior NRT program participants. The evolution of their progress is documented with Concepts Maps and videotaping of initial project presentations. Students will begin working on their (IDP) Individual Development Plan and meet with their research clusters.

b. Learning Objectives of MRM 525 Professional Training Models

i. Fall Term: MRM 525 Special Topics, part 1: Marine and Earth Systems Sciences - Conceptual Foundations of Risk and Uncertainty (2credits).

ii. Winter Term: MRM 525 Special Topics part 2: Marine and Earth Systems Sciences - Collaborative Working Structure and Functions (2 credits).

iii. Spring Term: MRM 525 Special Topics, part 3: Marine and Earth Systems Sciences - Communication of Risk and Uncertainty (2 credits).

Table 2: Learning Objectives of IFC and MRM 525 Professional Training Model

Professional training elements	IFC Introduction of the NRT core concepts	MRM 525 Conceptual Foundations Knowledge and Comprehension	MRM 525 Collaboration Apply and analyze	MRM 525 Communication Synthesize and Evaluate
Concepts: Risk and Uncertainty Big data CNH systems	Students will recognize myriad perceptions of the concepts, describe them, and relate them to groups and disciplines	Students will describe and explain the concept from multiple disciplinary perspectives (e.g., natural science, social science, statistics and mathematics) and they will distinguish, compare, and contrast those perspectives	Students will demonstrate how alternative perspectives on the concept affect group formation and dynamics including challenges and rewards of collaborative working structures, and practice the application of those alternative perspectives to produce a collaborative research proposal	Students will identify target audiences, assess their perception of the concept, and design and compose communication/engagement strategies (a communication plan) about the concept. Students will initiate the implementation of the communication plan, evaluate the effectiveness of the communication plan, and re-assess and re-construct as needed.

c. NRT Minor:

Students are expected to enroll in a graduate minor in Risk and Uncertainty Quantification in Marine Science. This interdisciplinary minor will provide graduate students with knowledge and skills to quantify and communicate risk and uncertainty derived from the analyses of large data sets in earth system science. The minor is focused on marine science and resource management, yet will be relevant to students from a variety of fields. Students will extend their ability to perceive and solve problems in a transdisciplinary context related to ability to

perceive and solve problems in a transdisciplinary context related statistical inference, uncertainty quantification, risk analyses, earth system science, and social systems. Students will also acquire professional skills in communication and collaboration. The minor is open to all graduate students. The Minor requires 18 credits for Ph.D. students and 15 credits for M.S. There are four focal areas in the Minor, including: 1. Earth Systems, 2. Social Systems, 3. Risk and Uncertainty Analysis, and 4. Big Data Analytics. Ph.D. student are required to take at least one course from each of the focal areas, while M.S. students are only expected to take courses from three of the focal areas (they can choose to leave out focal area 3 or 4). The MRM 525 professional development series is also part of the minor, and required for both Ph.D. and M.S. students.

i. Four areas of the minor:

EARTH SYSTEMS

Students will develop an integrated understanding of the Earth System, including biological, physical and geological mechanisms that affect earth climate, species dynamics and interactions, elemental cycles and ecosystem services. The emphasis will be on understanding the linkages between physics, biology, geology, and chemistry from a system theory perspective, and on how these linkages affect earth's biogeochemical processes. Disciplinary components of the Earth System module include biological, chemical and physical oceanography, biogeochemestry, geology, climate and atmospheric sciences, and ecology.

SOCIAL SYSTEMS

The "social or human system" component is one of the key elements of a coupled natural human system. Specifically, it encompasses the social, cultural, economic, management, and policy aspects of the system, and how they interact with each other and with their environment. Disciplinary approaches to the human system include Anthropology, Sociology, Policy, Economics, etc. The goal of the "social systems" training component of the graduate RU minor is to learn about social science methods, theory and/or applications as they relate to a marine, coupled natural human system. We expect RU minor students to complete the requirements by taking at least one course in this area. The course must allow students to:

(1) Recognize the perspective of the particular discipline or area of study,

Understand and respect the various methodological approaches used in the social sciences (qualitative and/or quantitative), their possibilities and limitations, and how these may be best integrated to the earth systems, big data or R&U component of the minor, (3) Explain and extract the scalar nature of the course material, whether it is related to cultural, social, institutional, management, or policy aspects of a system, and (4) Critically assess gaps or opportunities for inclusion of social, cultural, or economic elements of a natural system, and vice versa. NRT (National Research Traineeship) students with STEM backgrounds will be expected to understand and become literate and conversant in the qualitative aspects of risk and uncertainty.

RISK AND UNCERTAINTY ANALYSIS

The goal of the risk and uncertainty quantification training component of the graduate RU minor is to understand and acquire mastery of some of the fundamental mathematical/computational and statistical methods for quantifying uncertainty and analyzing risk for decision making. NRT students seeking the graduate minor are expected to acquire mathematical, computational, and statistical) tools that can be used to describe and assess risk and uncertainty in problems related to the marine, coupled natural human system. Students have options to choose from a variety of courses dealing with the mathematical foundations of risk and uncertainty involving mathematical techniques in (i.) decision making under uncertainty (ii.) ruin probabilities (iii.) measures of variability (iv.) probabilities of rare events and large deviations (v.) Monte Carlo simulation (vi.) optimization and dynamic programming and (vii.) stochastic models in biology pertaining to spread of disease and related phenomena. Students are expected to acquire experience in a combination of computational, simulation and/or theoretical approaches. NRT (National Research Traineeship) students with a social science or human dimension component will be expected to understand and become literate and conversant in the quantitative aspects of risk and uncertainty quantification.

BIG DATA ANALYTICS

Issues surrounding massive data sets ("big" data) are intertwined with data-enabled science and engineering. The goals of the big data training component are for students (1) to acquire computational and data-management skills necessary for handling and processing large data sets, and (2) to assess the value of information obtained from big data with respect to such issues as observation bias, signal versus noise, spurious relationships, and incidental endogeneity. Much of the training in big data management and processes is acquired through hands-on experiences. Specific components of the big data module include handling and processing massive datasets; being able to identify and articulate the limitations of big data sets; implementing classification, clustering and/or network analyses.

ii. Credit hours:

Minor Credit Hours: The OSU Graduate School's base rule on credit for minor: Some can be concurrent with graduate program. (i.e. "double- dipping" is allowed in some cases). A class can rarely be used for two minors or a minor and a concentration/certification concurrently. Some departments have different rules over and above

the base rule, e.g. for MS, 15 credits for the minor is required above the base 45 credits required for the M.S. Program of Study, where for a Ph.D., the minor can be from within the required 108 credits. Please check specifics in your home college/program and degree-level.

iii. Class substitutions: In some cases, a student may petition for a class(es) which is/are not listed as part of the minor, on a case-by-case basis. The prospective class must be representative of one of the 4 areas: Risk Analysis, Uncertainty Quantification, Social Systems, or Earth Systems. The substitution form (Please see Appendix F) must be submitted to Katherine Hoffman. Students are required to send in the proposed substitute course syllabus along with the substitution form. Forms must be turned in no later than the end of the second week of classes. If approved, the substitute class will ultimately need to be signed off by the student's minor professors on the student's program of study.

iv. Student minor professor: Expectations and list of minor professors Students must identify a minor professor from see list below. It is encouraged that it be a professor whom the student has taken a class from. This person must not be from the student's same college or major, and must not be the GCR on their committee. Please be advised that some professors may decline requests based on workload, etc. If another faculty member is desired, we can nominate him/her. Please contact Katherine Hoffman for more information.

Expectations of a minor professor include the following: Must provide guidance to the student research and coursework in professor's area of expertise; Must be familiar with the learning outcome (page 9) of the Minor in R&U (Risk and Uncertainty), and ultimately approve/disapprove the course list and proposed substitutions; and Must sign off on student's minor with designated classes making sure classes and credit hours are met (http://gradschool.oregonstate.edu/forms#program).

1. F. Conway-MRM
2. A. Spalding- SCHOOL OF PUBLIC POLICY
3. L. Ciannelli-CEAOS
4. E. Cortilla-Sanchez-COMPUTER SCIENCE
5. S. Todorovich-COMPUTER SCIENCE
6. J. Jones-CEOAS/GEOGRAPY
7. A. Gitelman-STATISTICS
8. R. Kennedy-CEOAS
9. C. Fuentes-STATISTICS
10. H. Yeh-CIVIL AND CONSTRUCTION ENGINEERING
11. B. Dupont-M.E.
12. N. Gibson-MATH
13. T. Ozkan-Haller-C.E/CEOAS
14. D. Koslicki, MATH
15. L. Torres-FISHERIES AND WILDLIFE
16. R. Vega-Thurber-MICROBIOLOGY
17. K. McLaughlin-STATISTICS
18. J. Miller-FISHERIES AND WILDLIFE
19. M. Banks-FISHERIES AND WILDLIFE
20. K. Grorud-Colvert-INTEGRATIVE BIOLOGY
21. D. Gerkey-ANTHROPOLOGY

2. Collaborative Research Project

a. General Research Cluster Guidelines:

A NRT Research Cluster is composed of all students in a research team, their respective faculty, and one NRT core faculty representative. Below we describe the role of each group in the Research Cluster

Who/Role:

***Students*:** Each NRT student involved in the NRT-supported project team is also part of the Research Cluster, and as such is expected to participate fully in all cluster meetings. Each student brings their disciplinary knowledge to the meeting, yet they are also expected to be open to considering other viewpoints and be willing to become comfortable stepping out of their 'comfort" zones. The goal of this is to work together to define a truly transdisciplinary problem/project that the student team can focus on over the course of their NRT fellowship.

Specific guidelines to achieving this goal are illustrated in the "Projects form" guidelines listed on the NRT website. http://marinerisk.ceoas.oregonstate.edu/for-students/

Students are expected to:

- Design the Research Cluster meeting agenda, provide it to the Research Cluster in a timely manner, and to facilitate the meeting
- Appoint a secretary from their team to take notes during each meeting
- Use these meetings as an opportunity to solicit feedback

Faculty mentors: Each faculty advisor for their respective student is part of the Research Cluster. Advisors should be aware that the mentoring they provide applies to their student and to other students and faculty members in their respective clusters; the goal of which is "cross-pollination."

Faculty mentors are expected to:

- Fully participate in each cluster meeting as per the NRT student/advisor agreement form
- Provide constructive feedback on progress and address questions during meeting
- Support the student project team as *they* uniquely define the research question that their team will address
- Promote a shared understanding of the NRT products across the Research Cluster and the student team: the interdisciplinary chapter (*see guidelines) and the Transdisciplinary Report (*see guidelines)
- Be an active participant in grading the Transdisciplinary Report.

*http://marinerisk.ceoas.oregonstate.edu/for-students

***NRT Core Faculty Representative*:** This person helps facilitate these steps by providing additional

information on the NRT core concepts and supporting the understanding and practice of communication among participants as the team converges on a doable research project question. The NRT representative also reports back to others in the NRT Core group so that any feedback from the Research Cluster can be incorporated in the guidelines of the NRT program. He/She could also be involved at any step of the team-based research project, but at the very least should be present during each Research Cluster meeting. The NRT representative could also be a source of support as the students make their progression through the NRT fellowship.

Frequency of cluster meetings: 1-2/quarter

b. Specific Research Cluster Guidelines:

Project title:_____

Faculty in the research cluster: _____

Students in the research cluster: _____

NRT faculty: _____

What is this document and how should you use it

This document is a research and communication resource for you and your team members to:

1. Become familiar with the research expertise of team members
2. Identify and address communication challenges due to language barriers
3. Develop research questions that include other team members expertise and contributions, and that are relevant to the three core concepts of the OSU-NRT program
4. Provide and receive feedback from OSU-NRT faculty

The steps in this document are meant to be addressed as a group (two or more people) of faculty, students, or faculty + students. The ideal way to move through this document is to have both faculty mentors and students go through it, separately. Then, as a cluster of faculty AND students, compare and discuss your outcome and come up a unified document. Alternatively, faculty and students can work through the steps together, but students should take a primary role, while faculty advice.

The NRT faculty will help you through these steps by providing additional information on the NRT core concepts and by helping communication and convergence of your research questions. He/She can be involved at any step, but at the very least should be present when you discuss the outcome as a cluster (student + faculty).

We suggest that you start working through this set of questions during the Intensive Field Course in September. However, because development and convergence of your research questions is an iterative process occurring during the first academic year, we also recommend establishing a process (e.g., by-weekly meetings) to repeat these steps. During the first academic year there will also be other opportunities to meet as a group and work together (e.g., MRM 525 series).

Please see the core concept diagram below. Considering these three core concepts, work through the following points as a team:

1. **Each student/faculty describes his her expertise to the others, and try to place her/himself within one or multiple OSU-NRT core-concepts, or linkages between core-concepts, shown in the diagram below.** The goal of this exercise is to *a)* become familiar with the disciplinary expertise of your peers, and *b)* assess whether your team has a balanced blend of disciplinary background to address research questions from the perspective of the three NRT core concepts.

2. **Each student defines the three core NRT concepts based on his/her previously acquired knowledge and disciplinary background and shares and discusses these definitions with the rest of the team**. The goal of this exercise is that of exposing potential convergence/divergence of concepts that are key to the NRT program and to the team research. At this point it is not necessary to resolve ambiguity, but rather to expose it.

3. **Each student expresses her/his expectations for the NRT project**. Possible (valid) outcome include the balance between process vs product, timing to completion, individual vs team based activities. The goal here is to facilitate developing a *collective intentionality*, which involves shar*ing* goals and expectations.

4. **Each student/faculty writes down and discuss with the others 1 or 2 researchable questions from his/her disciplinary perspective.** Assuming that your group is composed of three students/faculty, you should end up with 3 to 6 researchable questions. The goal here is to understand the research interests that are represented in your team.

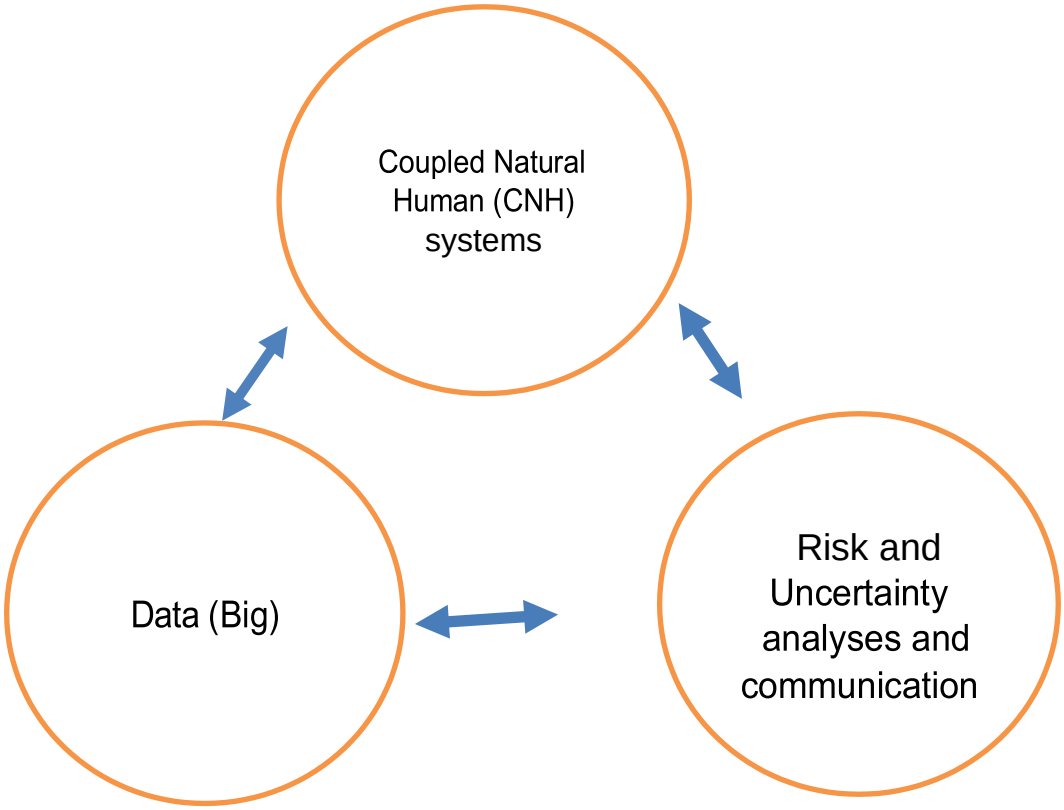
5. **Related to each of these researchable questions, discuss how each team member expertise and research interests is informing the other, for example by adding new insight to your question, or new research techniques.** The goal here is to form linkages between research questions and students.

6. Now that you have taken the time to address the previous 5 steps and familiarized yourself with the research opportunities and challenges perceived by each member of your team**, repeat steps 3-4-5. Collectively, can you come up with 1 or 2 researchable research questions, taking into account the contributions and expectations from all expertise included in your team?** The goal here is to start converging on your thinking in ways that include other team member expertise and contributions, and are relevant to the three core concepts of the OSU-NRT program. This will be an iterative process.

NRT Core concepts

1. *Coupled Natural Human* (CNH) systems: include human and biophysical systems, and their connections.
2. *Data* (which happens to be big, BD): Large volume of data with high throughput. Big data can be temporal, spatial, or dynamic; structured or unstructured.
3. *Risk and Uncertainty* (R&U): A risk is quantified by some measure of the expected cost, involving

probabilities and magnitudes, of an undesirable event. Uncertainty is driven by unknown processes and data quality.



c. Transdisciplinary (TD) Research Question Guidelines

By the end of the Fall term we ask that each team writes a **six** pages essay containing the following information about the TD research question:

1. *Problem definition*: What is the nature of the problem that you are addressing and its relationship to the 3 NRT core concepts?
2. *Determining the researchable question*: What is your agreed overarching TD question? Describe the process for how it has evolved over the term. What are potential source of data/assets/methodologies available to address the TD question? Describe the process for how you have further refined these over the term your choice of data/assets/methodologies.
3. *Integration*: What are the opportunities for each member to contribute to the question and what is the potential for integration across the team contributions?
4. What is the potential for *societal and academic relevance* of the TD question?

The intent of these guidelines is that of facilitating the development of the team transdisciplinary research question by unpacking its complexity in the four components listed above. Further, by completing this essay your team will have text that can be directly integrated in the TD report. The faculty mentors, through the cluster meetings, should be involved in the process of developing and writing this essay.
The essay may also contain supporting figures, tables, and reference list, but everything should be limited to the aforementioned six pages. Turn in the essay to Katherine Hoffman by **Friday November 29th**. The NRT curriculum committee and students from the other NRT teams will be asked to provide feedback on it.

d. NSF Research Traineeship Guidelines for Students for Interdisciplinary Chapter and Transdisciplinary reports

Outcome of collaborative work
Each student engaged in the OSU-NRT program will work on a NRT Team Project. The NRT Team Project is a collaborative effort to address a topic / question that all members of the team collectively define and determine. The NRT Team Project must contain elements of the NRT Core Concepts: data analytics, risk and/or uncertainty quantification and communication, and coupled natural-human marine system science.

There are **two products** resulting from the students' collaborative work on the NRT Team Project (Table 1).

Interdisciplinary chapter
Each student will complete an *interdisciplinary chapter* for their MS thesis or PhD dissertation, based on their NRT Team Project. The distinguishing element of the interdisciplinary chapter is that of being **based on a topic or research question that has been collectively defined by your group before addressing it**. This topic or questions must include elements of data (which are big), risk and/or uncertainty quantification, and coupled natural-human marine system science. **However, each individual interdisciplinary chapter does not need to contain all three of these elements**. It is up to the student to decide which of these three elements is covered in the interdisciplinary chapter.

The formatting of the interdisciplinary chapter should reflect that of a typical thesis chapter: introduction / background, method, results and discussion, and conclusion. NRT Team members ***may share similar (even identical) introduction / background, and conclusions*** **in their interdisciplinary chapters.** It will be **the *methods, results and discussion -- based on their disciplinary expertise and research challenges* – that will be unique.** Note that these chapters may refer readers to (aka cite) the other Team member's chapters. If the chapter is published, each student should consider including other student team members and/or advisors as co- authors, depending on their level of engagement in developing the question and carrying out the study to a
peer-reviewed level of quality (Table 1). We ask that you clearly identify the ID chapter within the thesis, with a sentence: '*This chapter was competed in partial fulfillment of the OSU-NRT program in Risk and Uncertainty quantification in marine science and policy*.'

Examples of completed ID chapter from previous NRT students are available through the OSU Scholar Archives portal. Please inquire with us if you want to see past ID chapters.

Transdisciplinary report

The students in each NRT Team must also **collaboratively complete a *transdisciplinary report*.** This might be a figurative mixture of the interdisciplinary chapters, and as such it should involve no or minimal use of additional data. However, **in the *transdisciplinary report,* the disciplinary expertise of each student is no longer "traceable" as it's written in "one voice."** In other words, all contributions are merged to address the NRT Team Project's topic / research question and the collaborative effort. While publication might be a desired outcome, publication is NOT a requirement. *However, we recommend depositing the report in a publically accessible repository, such as OSU Scholars Archives*.

The transdisciplinary report *does not exceed **40 pages** including:*

1. Two-page **executive summary**, containing: a) research questions and relevance, b) methods, c) main results, and d) significance of study to science and societies
2. **Introduction** containing: a) statement of problem and intended audience for the report, b) academic and societal relevance, c) need for TD approach, and d) objectives and anticipated results,
3. **Data and Methods**
4. **Results,** with a unified voice.
5. **Discussion and Conclusions**, containing: a) brief summary of main nuggets (1-pragraph), b) compare/contrasts results with existing knowledge in the field, c) significance of results for academic research and societies, d) caveats and future work.

6. **Team reflections**: Clear description of each student's contribution to the report and team reflection of the TD process (e.g., frequency of meetings, delegation vs team work, major takeaways)
7. **Reference List**

All of this (1-7) **to not exceed 40 pages**. If necessary, students can add an Appendix which goes beyond the 40 pages.

When and how to write the interdisciplinary chapters and transdisciplinary reports

The first step is that of collectively identifying the NRT Team Project: the **topic or research question that will be collectively addressed by your Team**. Defining a question before addressing it sounds the obvious thing to do, but when it comes to implementation of inter- or transdisciplinary research, this seemingly logical course of action is not always followed. We request that you will do that by the end of Fall term in your first NRT year.

Once this has been accomplished, Team members should start working on the methods and produce preliminary results. We request that you will do that by the end of the winter term. Lastly, the Team will continue producing results and start writing the discussion section. We request that you provide a two-page Executive Summary of your TD report by the end of the Spring term.

Table 1: Guidelines for Interdisciplinary chapters and transdisciplinary reports

	Interdisciplinary chapter	**Transdisciplinary report**
Who are authors?	Individual student	All students in an NRT team
Where does it appear?	In the thesis	As a separate document from thesis
How related to each other?	Information in the chapter is an in-depth treatment of each student's contribution to the transdisciplinary report	Transdisciplinary report is based on the research conducted by the team. May have similar introduction of the ID chapters, but the methods, results and discussions are new, and directly address ALL aspects of the NRT Team Project goals
What is the topic?	• One aspect of the NRT Team Project that best relates to the student's individual research topic • May involve new data collection if it was part of the student's individual research topic, but new data is not required specifically around the Team topic • Contains *at least* one of the NRT Core Concepts: big data, risk and/or uncertainty quantification, and coupled natural-human marine system science.	• Topic of the NRT Team's Project • Minimal or no acquisition of new data in the form of interviews, experiments, or field collections • Contains all three of the NRT Core Concepts: big data, risk and/or uncertainty quantification, and coupled natural-human marine system science.
What is the format?	• A typical thesis chapter: introduction / background, method, results and discussion, and conclusion • NRT Team members may share similar (even identical) introduction / background, and conclusions • Must be clearly identified within the student thesis with a sentence: '*This chapter was competed in partial fulfillment of the OSU-NRT program in Risk and Uncertainty quantification in marine science and policy*.'	Includes in **no more than 40 pages**: 1. Executive Summary 2. Intro 3. Data & Methods 4. Results 5. Discussion and Conclusions 6. Team reflections 7. Literature Cited

When is it written?	• By the end of Fall term of NRT year: define NRT Team Project topic / question • By the end of Winter term of NRT year: complete Intro • By the end of spring and summer of NRT year: complete the main text (introduction, methods, results, discussion) • Complete chapter by the time the thesis is delivered to graduate school	• By the end of Fall term define research question and intro • By the end of Winter term write methods and produce preliminary results • By the end of the Spring term write two-page Executive Summary • By early summer receive and address comments from NRT curriculum committee • By the end of Summer term complete report
Who reads it and provide comments	• Student's major professor and thesis committee	• NRT Cluster for that Team project (continuously)

		• NRT curriculum committee (after delivery), see assessment rubric
What are the publication goals?	• Student and advisor may try to publish • Student is first author • Students and faculty in the cluster (including minor professor) may need to be included depending on their involvement • Acknowledge NSF-NRT support	• Student team may try to publish • Order of authorship is agreed upon based on contributions to the report • Faculty in the cluster may need to be included depending on their involvement • Acknowledge NSF-NRT support • Need to address reviewers feedback prior to sharing and publishing report

Frequency of cluster meetings: 1-2/quarter

3. Professional Training

a. Individual Development Plan (IDP)
Students must complete their IDPs with their advisor(s), and turn it in no later than the end of the second week of fall classes. (Please See Appendix E.) Document can also be found: http://marinerisk.ceoas.oregonstate.edu/for-students/

b. Student Internship
Trainees are expected to complete an internship. Students can arrange for this on their own, or select from the NRT program's list or partners, or have their advisors assist them. Students generally take the internship in summer term and sign up for 3 hours of thesis credits or 3 hours of internship credits. If you wish to sign up for internship credits, please contact your home department for the logistics of this. Conference costs are not an allowable expense for internships. (Please see Appendix G.) The form can also be found can be found: http://marinerisk.ceoas.oregonstate.edu/for-students/

Upon completion, students will be expected to write a two-page essay on their experience and how their goals were met.

4. Final Products

a. Interdisciplinary Thesis Chapter (ID)
Each student will complete an *interdisciplinary chapter* for their M.S. thesis or Ph.D. dissertation, based on their NRT Team Project. The distinguishing element of the interdisciplinary chapter is that of being based on a topic or research question that has been collectively defined by your group before addressing it. This topic or questions must include elements of big data, risk and/or uncertainty quantification, and coupled natural-human marine system science. However, each individual interdisciplinary chapter does not need to contain all three of these elements. It is up to the student to decide which of these three elements is covered in the interdisciplinary chapter.

The formatting of the interdisciplinary chapter should reflect that of a typical thesis chapter: introduction /background, method, results and discussion, and conclusion. NRT Team members *may share similar (even identical) introduction / background, and conclusions* in their interdisciplinary chapters. It will be the *methods, results and discussion -- based on their disciplinary expertise and research challenges* – that will be unique. Note that these chapters may refer readers to (aka cite) the other Team member's chapters. If the chapter is

published, each student should consider including other student team members and/or advisors as co-authors, depending on their level of engagement in developing the question and carrying out the study to a peer-reviewed level of quality.

b. Team Transdisciplinary Report (TD)

The students in each NRT Team must collaboratively complete a *transdisciplinary report.* This might be a figurative combination of their interdisciplinary chapters, and as such it should involve no or minimal use of additional data. However, in the *transdisciplinary report,* the disciplinary expertise of each student is no longer "traceable" as it should be written in "one voice." In other words, all contributions are merged to address the NRT Team Project's topic /research question and the collaborative effort. While publication might be a desired outcome, publication is NOT a requirement. However, we recommend depositing the report in a publically accessible repository, such as OSU Scholars Archives.

The transdisciplinary report can take multiple forms, depending on how you intend to merge your disciplinary perspectives and experience working together.

Some examples might be:

- An integrated literary *synthesis* addressing common research goal(s) from multiple disciplinary perspectives. Example: a review of large pelagic management practices around the world, and identification of knowledge gaps from human and biological perspectives.
- A *mathematical* or *statistical model* that includes qualitative or quantitative insight from all team members. Example: a bioeconomic model of fleet and resource dynamics that includes environmental- and human-driven uncertainties.
- A *policy analyses* that includes knowledge (qualitative and quantitative) from all team members. Example: a management strategy evaluation, such as an assessment of marine spatial planning policies under human and biophysical constraints.
- A *visualization tool* that captures the skills of all team members. Example: the display of uncertainties in model forecast.
- A *conceptual model* to quantify and implement a new management strategy. Example: a strategy to examine the placement, typology, and size of marine reserves in a well-defined geographic region.
- A *vulnerability assessment* of a system. Example: an assessment of the exposure, sensitivity, and adaptive capacity of XX groups to phenomenon YY.

c. When and How to Write the Interdisciplinary Chapters and Transdisciplinary Reports

The first step is that of collectively identifying the NRT Team Project: the topic or research question that will be collectively addressed by your Team. Defining a question before addressing it sounds the obvious thing to do, but when it comes to implementation of inter or transdisciplinary research, this seemingly logical course of action is not always followed (for example, agencies technical reports). Ideally, you will do that by the end of Fall term in your first NRT year.

Once this has been accomplished, Team members should start working on the outline of their interdisciplinary chapters and transdisciplinary report. An outline is a roadmap for the completion of the chapter and report. It is 2-3 pages long, containing NRT Project Topic/research question, background and rationale/justification, approach/methods, anticipated results, and significance. Outline should be completed by the end of Winter term in your first NRT year. Recall that the introduction section of an interdisciplinary chapter is a product of your collaborative thinking and is shared among Team members. So, preparing an outline for your chapters also requires a collaborative effort. For the rest of the NRT year (spring and summer), students complete their interdisciplinary chapters, and the transdisciplinary report.

When is it written?	• By the end of Fall term of NRT year: define NRT Team Project topic / question • By the end of Winter term of NRT year: complete outline • By the end of spring and summer of NRT year: complete the main text (introduction, methods, results, discussion) • Complete chapter by the time the thesis is delivered to graduate school	• By the end of summer term during your NRT fellowship year. For this year the due date for this is Aug. 30th, 2018. One or more of your team will be asked to present your Project and this report at the IFC field course for the incoming NRT cohort.
Who reads it and provide comments	• Student's major professor and thesis committee	• NRT Cluster for that Team project (continuously) • NRT curriculum committee (after delivery), see assessment rubric • Two external referees, see assessment rubric
What are the publication goals?	• Student and advisor may try to publish • Student is first author • Students and faculty in the cluster (including minor professor) may need to be included depending on their involvement • Acknowledge NSF-NRT support	• Student team may try to publish • Order of authorship is agreed upon based on contributions to the report • Faculty in the cluster may need to be included depending on their involvement • Acknowledge NSF-NRT support • Need to address reviewers feedback prior to sharing and publishing report

d. NRT Faculty Grading Rubric

(Please see Appendix I.) for a grading rubric for the transdisciplinary report.

C. General Program Policies

1. Stipend and Tuition Information
   All students should expect to receive and sign the Stipend Offer Letter and the Graduate Tuition Relief forms from the Graduate School in a timely manner. Please check your e-mail frequently in the summer for these forms and other important matters. Failure to do so may result in not being granted a fellowship. You must be signed up for 12 credits for the F, W, Sp terms and 3 credits only in the summer in order to receive your stipend. Although the Tuition Remission does not mention summer term coverage, you will still have your tuition and fees paid for by the grant. In most cases, the stipend period will commence Sept. 16th, 20XX and end Sept.
   15th, 20XX for incoming students. In other words, you will be paid on Sept. 16th 20XX for ½ a month and then full stipends beginning in Oct. Your first and last stipend check will be ½ a regular stipend payment on Sept. 1stth the following year. By definition, a stipend payment is granted at the first of the month to defray the cost

2. Taxes In Relation to a Fellowship: Trainees on fellowships are not considered bona fide employees. There are no taxes are taken out of their stipends. Guidance on how to file taxes for this particular situation is below.

http://gradschool.oregonstate.edu/finance/fellowships-and-scholarships/policies - tax

"Tax Liability

OSU does not withhold taxes from fellowship stipend payments made to US citizens and resident aliens and does not currently report stipend payments on an annual IRS Form 1099 (Miscellaneous Income) for these individuals. However, graduate fellows who are US citizens and resident aliens are responsible for paying all income taxes that may become due as a consequence of receiving graduate fellowship stipend payments.

[see linked page for information about end-of-year 1099 forms showing health insurance subsidy and administrative fee assistance, but not showing stipend]

Oregon State University staff members are not tax professionals and cannot provide tax guidance to students. There are a number of IRS forms and publications that may be helpful for determining tax liability, including the following:

- *IRS Publication 970, Tax Benefits for Education*
- *IRS Form 8863, Education Credits (Hope & Lifetime Learning Credits)* **** LLC especially useful*
- *IRS Form 1042, Annual Withholding Tax Return for US Source Income of Foreign Persons*

For more information, students are encouraged to contact the Internal Revenue Service at http://www.irs.gov/; 1-800-829-1040 and/or consult a tax professional."

3. Health Insurance: Health insurance is mandatory for Graduate Fellows. All Graduate Fellows are required to submit documentation to enroll in or waive out of the insurance plan offered by the University. You must submit the necessary paperwork within the first 30 days of the start of your Graduate Fellowship appointment. If you choose to waive the coverage offered by the University, you must have medical, dental and vision coverage that is deemed comparable by the University. You authorize the University to post a monthly charge to your student business office account for the health insurance premium for the level of coverage for which you have enrolled. If you are not appointed as a Graduate Fellow during summer term, you are eligible to enroll in coverage for the summer months (July, August and September) and pre-pay for those premiums in the month of May. You must submit the necessary summer paperwork to the University Student Health Services by May 1st.

For additional information visit http://studenthealth.oregonstate.edu/insurance/ or send an email to osustudent.insurance@oregonstate.edu.

4. Credit Hours: The OSU Graduate School's base rule on credit for minor: Some can be concurrent with graduate program. (i.e. double-dipping is allowed in some cases). A class can rarely be used for two minors or a minor and a concentration/certification concurrently. Please check specifics in your home college/program and degree-level. Some departments have different rules over and above the base rule, e.g for MS, 15 credits for the minor is required above the base 45 credits required for the M.S. Program of Study, where for a Ph.D., the minor can be from within the required 108 credits.

5. Student Research Funds

Students may apply for limited research funds for conference costs and equipment. (Please see Appendix H.) Also, the form can be found: http://marinerisk.ceoas.oregonstate.edu/for-students/

6. NRT Graduate Student Representative

An NRT student will be nominated by his/her peers to serve as a Student Representative who will attend the monthly NRT Meetings and be the voice of the cohort. This student will bring feedback to the NRT Core Faculty and also relay information back to the group. Serving as a student representative is a great opportunity for a student to develop skills which could be highlighted on their CV

APPENDIX A

STUDENT/ADVISOR CHECK-OFF SHEET

I,_____, understand that as an agreement for receiving an NSF NRT one year fellowship, that I am required to engage in the following activities as a student. Please review with your advisor and check off each box indicating that you understand, sign along with your advisor, and return to Katherine Hoffman, mailbox in CEOAS Administration Building or e-mail Katherine.Hoffman@oregonstate.edu. Please keep a COPY for yourself for reference.

- Student takes the IFC (Intensive Field Course in early fall : 9/16/19--9/20/19 at HMSC
- Student receives the minor including taking the MRM 525 series professional courses: http://marinerisk.ceoas.oregonstate.edu/minor/

  15 hours M.S., 18 hours Ph.D. Students are strongly advised to complete minor in year of receiving fellowship. Please see additional requirement above on link.
- Student actively participates in project's group meetings.
- Student works and completes interdisciplinary chapter as a chapter of thesis and contributes to completion of team transdisciplinary report. Please see http://marinerisk.ceoas.oregonstate.edu/for-students/ to review material.
- Student makes arrangements for internship and fulfills it.
- Student seeks approved minor professor who is NOT part of their college (please ask Katherine Hoffman for a list).
- Student understands the Graduate School's policies and knowledge of filling out a program of study or petition to change form adding the minor.
- Student understands stipends are sent to current address andthe option of having them directly deposited.
- Student must be signed up for 12 credit hours during F, W, Sp terms.
- Student must be signed up for 3 credits only during the summer in order to receive anNRT stipend.
- It is student's responsibility to explore the tax rules concerning receivinga stipend.

My Advisor understands the expectations of her/him below:

- Attend and participate in one day of the IFC (Intensive Field Course) at the Hatfield Marine Science Center in Newport, OR. Course date: 9/16/19--9/20/19
- Engage in other training activities, as needed, through MRM professional series.
- Actively participate and engage with ALL students on team in mentoring activities ofNRT group project, including cluster and faculty meetings, etc.
- Understand that the interdisciplinary chapter is an important andsignificant part of the student's thesis.
- Develop and follow an IDP (Individual Development Plan) with the primarystudent.
- Agrees to assess the Team's Transdisciplinary report

Signatures of student and faculty required.

APPENDIX B
MIDTERM STUDENT/ADVISOR PROGRESS REPORT

NRT R & U Student Checklist/ Mid Term Progress Report
To be filled in Winter of NRT tenure *rev. 1/24/19*

Student's name:	Term/year entered program:
Department :	Advisor(s):

NRT expectations: To be completed by student and advisor	**To be completed by student** Check off if you agree with/understand these policies
☐ Student took the IFC (Intensive Field Course in summer term). ☐ Student is working towards the minor including taking the MRM 525 series professional courses: http://marinerisk.ceoas.oregonstate.edu/minor/ 15 hours M.S., 18 hours Ph.D. Students who are receiving a M.S. must complete the minor during their fellowship year ☐ Student and advisor are actively participating in project's group meetings. ☐ Student is working towards interdisciplinary chapter as a chapter of thesis and contributes to completion of team transdisciplinary report. ☐ Student is making arrangements for internship. ☐ Student has sought approved minor professor who is NOT part of their college. ☐ Student understands the Graduate School's policies and knowledge of filling out a field of study or petition to change form adding the minor. ☐ Student has prepared an IDP and monitoring its progress ☐ My Advisor understands the expectations of her/him below: • Attend and participate in one day of the IFC. • Engage in other training activities when requested through MRM professional series. • Actively participate and engage with ALL students in the team in mentoring activities of NRT group project, including cluster and faculty meetings, etc. • Work with student on the IDP • Understand that interdisciplinary chapter is an important and significant part of the student's thesis. • Agrees to assess the Team's Transdisciplinary report	☐ I am receiving my stipend monthly without issues. ☐ I must be signed up for 12 credit hours during F, W, Sp ☐ I must be signed up for 3 credits during the *summer in to receive* an NRT stipend. The grant will pay for Summer tuition and fees for 3 credit ONLY. ☐ It is student's responsibility to explore the tax rules concerning receiving a stipend. I understand this. COMMENTS:

Student's Signature_____ **Date**_____

Advisor(s) Signature_____ **Date**_____

Individual Development Plan for NRT Trainees

Name of NRT Trainee: _____

Name of the faculty mentor: _____

Department/College: _____

Start date of traineeship: _____

Name of the NRT faculty mentoring the cluster: _____

Signed by:

_____ _____
NRT Trainee date

_____
Mentor (name in print)

_____ _____
Mentor (sign) date

_____ _____
Mentor (if more than one) date

What is an IDP?

The IDP (Individual Development Plan) is a planning and communication tool used by the student, his/her advisors, and the NRT faculty to:

1) self assess students' skills, interests, and values,
2) identify career options that best match students' skills, interests, and values,
3) set individual short- and long-term career and professional training goals,
4) monitor progress toward the implementation of short- and long-term career and professional training goals
5) assess the effectiveness of NRT training elements in helping trainees achieve professional and career goals

How should I use it?

Upon entering the NRT program, trainees will be first asked to complete the AAAS Individual Development Plan IDP (a.k.a., MyIDP), following the template shown here: http://myidp.sciencecareers.org/. After completing MyIDP, students will be asked to also complete the IDP template shown below in this document. We refer to the template below as the *NRT-IDP*. The NRT-IDP was adapted from the OSU post-doctoral scholar IDP. You can find more information about the OSU post-doc IDP here: http://gradschool.oregonstate.edu/postdocs/individual-development-plan.

Why do I need to work on two IDPs templates?

Both the NRT IDP and MyIDP refer to the six competency skills for a scientist that were assembled by the National Post-doctoral Association (http://www.nationalpostdoc.org/?CoreCompetencies) to assess students' skills, interests, and values. Additionally, the NRT-IDP includes competency skills related to professional goals of our program, namely *cross-disciplinary knowledge and communication of NRT core concepts*, *development of collaborative trans-disciplinary research skills*[1], and proficiency with concepts and practices of *Diversity, Equity and Inclusion*.

While the MyIDP template has a user-friendly portal to easily navigate through the questionnaire, store responses, and evaluate them, we think that it falls short of monitoring progress toward the accomplishment of your short- and long-term career and professional training goals via the NRT Program. Also, the AAAS MyIDP is focused on academics. In contrast, the NRT-IDP template highlights resource planning and monitoring your progress throughout graduate school here at OSU. Additionally, it helps to set up communication and expectations with your mentor and focus on professional skills that are germane, and of interest to a broader group of students and professionals (i.e., not only academics). This is why we ask you to fill both templates.

Where can I get help to work with the IDP?

Your faculty mentor should be the primary resource in helping you through the IDP. In addition, we have assigned a NRT faculty member[2] to each research cluster (students + faculty mentor). The NRT faculty will:

1. help you walk through the NRT IDP and MyIDP templates
2. provide insight on the disciplinary and professional training available through the NRT program
3. in collaboration with the NRT external evaluator, use the IDP as an assessment tool of the NRT program activities

We also have a 1.5 hour IDP primer during the IFC, and we require that your faculty mentor attend that session to work on the NRT IDP with you.

[1] By cross-disciplinary we refer to some unspecified level of merging across disciplines. Multidisciplinary is the simplest level of merging, without clear linkages across disciplines. Interdisciplinary is an intermediate level of merging, often involving two-way interactions across disciplines (e.g., from math to biology and from biology to math). Trans-disciplinary is the highest level of disciplinary merging, where boundaries across disciplines are no longer

recognizable (e.g., mathematical biology), often applied to an applied problem.
[2] Assignment is TBD

When should I start working on the IDP?

The sooner, the better. Ideally, individual trainees and their mentor(s) will work through MyIDP before attending the GEO 508 Intensive Field Course (IFC). During the first day of the IFC, trainees will receive additional background information about IDPs, and will have an opportunity to start filling in the NRT-IDP.

Bear in mind that the IDP is an evolving document. We ask you to return a copy of your IDP two weeks after the end of the IFC. That will be your first attempt at this. Later in the year, during the Winter Benchmark meeting[3], we will ask you and your faculty mentor to check progress on the NRT-IDP so that you can update it with new knowledge acquired during the academic year.

NRT-IDP template

Before answering these questions we require that each student goes through the steps of the AAAS Individual Development Plan (MyIDP, http://myidp.sciencecareers.org/) and becomes familiar with the six competency skills based on the National Post-Doctoral Association (http://www.nationalpostdoc.org/?CoreCompetencies). If you would like, you can print out your answers from the MyIDP portal for your own use.

A. Career Goals (to be filled out by the NRT trainee).

- What are your short-term career goals? Describe your time line for achieving them.
- What are your long-term career goals? Describe your time line for achieving them.
- When will you begin a job search? If you do not know, estimate. If you have already begun a search, briefly describe.

B. Research Project(s) (to be filled out by the NRT trainee and validated by the mentor(s))

- Briefly describe the aims and experimental approaches of your current research project(s), including the NRT interdisciplinary chapter and other chapters done in fulfillment of your graduate degree at OSU. At the beginning of the NRT program you may not yet have a clear idea of what your interdisciplinary project will look like. That is OK, you will be able to refine the project idea later in the program.

C. Expectations for Contribution to Research Project(s) (to be filled out by the mentor(s) and validated by the trainee)

- Please provide a detailed list. Examples: supervise 1 undergraduate student on independent research project that will produce a poster; complete experiment xx described on pages yy-zz of the student's proposal; complete data analyses for experiments xx and xx and submit summary to mentor; etc.

D. Professional Development Plan (to be filled out by the trainee and mentor(s) in collaboration). See Tables below.

For more information and links to resources, download the complete Core Competencies document.

Competency	***Goals from your own discipline*** (What do you, the trainee, expect as outcomes?)	***Expected activities/efforts of trainee*** (For each goal, think about how you will achieve it. By which mechanism(s)?)	***Responsibilities of faculty mentor(s)*** (For each goal, think about how you will support your student to achieve it. By which mechanism(s)?)
(1) Discipline specific conceptual knowledge (gain understanding of a new theory or concept, develop fluency with respect to a methodology/method of analysis, learn how to use a new computational tool)			
(2) Research skill development (includes experimental design, new measurement or analysis technique, data analysis, peer review process)			
(3) Communication skills (includes writing publications and grants, CV, teaching portfolio, job interview skill, poster and oral presentations, teaching, networking, with diverse audiences)			
(4) Professionalism (can include interpersonal relationships, multicultural competency,			

(5) Leadership and management skills (can include staff and project management; time management; budget preparation and management; strategic planning, serving as mentor and role model; running meetings; delegating responsibilities)			
(6) Responsible conduct of research (can include data sharing and ownership; authorship criteria; human subjects, animal research and IRB; scientific misconduct –			

Table 2. Competency skills of an OSU NRT program participant

Competency	***Goals*** (what do you, the trainee, expect as outcomes?)	***Expected Activities/Efforts of trainee*** (for each goal, think about how you will achieve it. By which mechanism(s)?	***Responsibilities of NRT mentors(s)*** (For each goal, think about how you will support your student to achieve it. By which mechanism(s)?)
(1) Cross-disciplinary conceptual knowledge of the OSU NRT core concepts (includes a) Coupled Natural Human systems - CNH b) Risk and Uncertainty Quantification and Communication – R&U c) Analyses of Data as Evidence- DE)		Examples: Geo 508, MRM series, classes which constitute the minor	
(2) Development of **collaborative research skills** (can include learning about challenges and rewards of collaborative working structures; how alternative disciplinary perspectives on a concept affect group formation; and applying those alternative perspectives to produce collaborative research)		Examples: - Complete MRM professional series - Engage in internship with …..	
(3) Cross-disciplinary communication (can include writing publications, posters and oral presentations; networking, etc. regarding the three core concepts and the complexity of cross-		- Attend professional training on communication provided by OSU Graduate School	

communication in groups composed of multicultural and multidisciplinary disciplinary experts; exploring implicit biases; developing cultural sensitivity and awareness		- Engage in internship with ….. - Actively participate in guided self-reflection activities during IFC - Attend and engage with all diversity, equity, and inclusion elements of the MRM professional series - Demonstrate respect within NRT groups (students,	- Co-create clear guidelines for meeting (process, interpersonal relationships, mediation, conflict resolution, etc.)

APPENDIX F
NRT STUDENT CLASS SUBSTITUTION

Dear Students,

If you are wanting to substitute a class with a course which can be substituted with another one from the 4 areas of a minor (please see link below), please out this form and return *with the syllabus.*

We do not generally accept slashed courses (4XX/5XX) if the course can be taken for undergraduate credits as well.

http://catalog.oregonstate.edu/MinorDetail.aspx?Minor=5050&college=24

Name_____

New class_____

Which class you would like to substitute for:_____

Justification for class (please provide syllabus):

Which area of the minor does the class fall into: Big Data and Uncertainty Quantification, Risk Analysis, Earth Systems, Social Systems?

APPENDIX G
NRT STUDENT INTERNSHIP APPLICATION

NRT Internship Application/Report Guidelines:

You must complete and turn in this form no later than 1 month prior to the start of your internship.

Application Instructions: Please address ALL categories (a.)-(g.) below. Please use this page **only** as a guideline and turn in a 1.5-2-page formal application document (Word, PDF.).

a.) Name:_____
b.) Proposed Internship Site:_____
c.) Proposed Mentor(s):_____
d.) Specific Dates:_____
e.) Term:_____
f.) Goals of Internship: **(**please elaborate fully on this, addressing a), b), and c) below

Internships should provide an opportunity to a) engage with stakeholders, b) have experiential learning opportunities on topics relevant to the OSU NRT, and c) get professional training, in line with your career expectations (from IDP). Please clearly explain below how your internship will meet these goals:

g.) Budget: *(please see next page)*_____

Financing your internship

Students are allowed to receive up to $2,000 maximum combined funds for internship and research cost requests. For example, if you were awarded $1,100 in internship costs, you could apply for $900 in research funds. Please note, all requests will still need to go through the approval process. And the stipulations for the each fund solicitation still apply.

The NRT can provide support for travel up to and from internship sites but not for living expenses such as per diem.

- Lodging for up to $600 may be considered *if the student has a compelling reason* as to why the stipend would not over lodging costs.
- Rent for Corvallis while the student is away is not an allowable expense. Internship funds must be used for internship-related travel only.
- Attending or presenting research at a conference does not fulfill the internship requirements, and therefore funding requests for attending conferences will not be considered.
- It might be advantageous to take the internship in the summer as you will still receive your stipend and will only need to be signed up for 3 credit hours.
- You MUST check with your Research Group to make sure you will still be engaged with them during your absence.

How to register for internship

If you are planning on taking your internship in the summer, please sign up for no more than 3 credit hours. You may take these as thesis or internship credits. If you decide to take them as internship credits, please check with your home department on the specifics of this.

*(In addition, no later than one month after the end of the internship you must complete a **two-page essay** with reflections on how the internship has provided a) experiential learning, b) engagement and other professional development opportunities (e.g., communication, project coordination, etc.), c) career opportunities-get professional training, in line with your career expectations (from IDP).*

Please send internship application document to:

Katherine.Hoffman@oregonstate.edu

APPENDIX H
NRT STUDENT RESEARCH FUNDS APPLICATION

Students are allowed to receive up to $2,000 maximum combined funds for internship and research cost requests. For example, if you were awarded $1,100 in internship costs, you could apply for $900 in research funds. Please note, all requests will still need to go through the approval process. And the stipulations for the each fund solicitation still apply.

Name_____

In about one page, please address the following points

1. Brief description of the research/travel to be conducted

2. Timeline for conducting such research/travel

3. How does the research/travel address the student's a) interdisciplinary chapter, and/or the team's b) transdisciplinary report?

Please turn into to Katherine Hoffman, 104 Burt Hall Katherine.Hoffman@Oregonstate.edu

4. Budget and justification for the research or travel. $150-200 is available to each student for research or towards a conference.

Please turn into to Katherine Hoffman, 104 Burt Hall Katherine.Hoffman@Oregonstate.edu

APPENDIX I
RUBRICS FOR ASSESSING TRANSDICIPLINARY REPORT

Rubrics for Assessing Transdisciplinary Report for NRT Faculty

The goal of this rubric is to list criteria for assessing and providing **essential constructive** *feedback* to the student transdisciplinary reports. Please circle your grade for each category based on the criteria provided.

Provide a brief narrative explaining your assessment of each of the five criteria listed *in the Justification* section of the Table and for the two general questions listed *below* the Table.

Criteria **Please circle one assessment for each of the 5 criteria below**	**Non-satisfactory**	**Fair**	**Good**	**Excellent**
Societal and academic relevance*: Problem-oriented goal that crosses boundaries of the academic (scientific discovery) and societal relevance (policy, industry, resource management, conservation)* ***[Introduction]***	TD report is strictly based on academic research with unclear or unrealistic links to societal implications *Or* Is strictly based on societal implications with unclear links to scientific discovery	TD report is relevant to academia and societies, but has very limited applicability to one of the two spheres	TD report is relevant to academia and societies and has clear applicability to both spheres	TD report is an exemplary integration research for academic discoveries and societal relevance. Should be used as example of societally and academically relevant research and synthesis for ag industry, and NRT students.
Please provide your justification from your assessment above:				
Cross-disciplinary*: Inclusion of NRT core concepts (Risk and Uncertainty, Big Data Analytics, Coupled Natural Human Systems)* ***[Entire Text]***	TD report is mostly focused on one NRT concept with superficial treatment of other core concepts	TD report is mostly focused on two OSU-NRT core concepts with superficial treatment of the other core concept	TD report has an in-depth treatment of all three OSU-NRT core concepts	TD report has an in-depth treatment of OSU-NRT core concepts and has related to ther disciplines as well
Please provide your justification from your assessment above:				
Synthesis and integration *of NRT core concepts* ***[Entire Text]***	Core concepts are not integrated, and the report reads as a multi-disciplinary endeavor	Core concepts are integrated, but there are clear and recognizable disciplinary boundaries	Core concepts are integrated, and the report reads as a single voice with no clear separation of disciplinary expertise	TD report is an exemplary demonstrate integrated NRT core concepts. The re to new principles broadly applicable t systems for studying and integrating concepts. Should be used as a reference future NRT cohorts
Please provide your justification from your assessment above:				

Team communication skills and contribution *to TD report: formulation of goals, methodological approaches, and writing* ***[Individual Contributions and team reflections]***	TD report was led by subset of team members. Conflicts within the team were not addressed	All team members contributed to the TD report. Conflicts were addressed but not resolved	All team members contributed to the TD report. Team encountered significant challenges, but through communication and team building practices, were able to overcome them.	All team members contributed to the Team approach conflict in such a way significant challenges were avoided and active use of communication and team practices.
Please provide your justification from your assessment above:				
Clarity and grammar ***[Entire Text]***	TD report lacks clarity. No attention has been paid to editing, grammar, and overall flow of information	TD report is clearly written, but there are grammar and editing issues, such as inaccurate figures and table legends, missing references, etc. Only experts can read and understand it.	TD report is clearly written and edited, but some concepts are only understandable by specialized readers.	TD report is an exemplary essay for NRT students. It is clearly written and carefully edited. Report has the clarity published article and is understandably experts in each of the NRT core discipline.
Please provide your justification from your assessment above:				

Is this report ready to be shared with stakeholders and/or published in peer-reviewed journals?

What are your final recommendations for improving the report?