Simon Fraser University
Faculty of Environment

Handbook

Ph.D. Policies and Procedures

School of Resource and Environmental Management

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Handbook
Ph.D. Policies and Procedures

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Ph.D. Program

Introduction

The Doctorate of Philosophy (Ph.D.) program in Resource and Environmental Management provides an innovative environment for carrying out interdisciplinary research and training in the area of resource and environmental management. Coursework and research supervision are offered in a wide range of natural and social sciences, including: resource and community planning, water planning and management, environmental impact and risk assessment, environmental toxicology and management, earth system science and global change, regional development, ecological risk assessment, energy economics and management, forest ecosystem dynamics, population ecology, conservation biology, conservation policy, landscape ecology, tourism planning and development, ecological economics, environmental law and regulation, the political economy of environmental management, institutional design, applied marine ecology, fisheries management, cultural heritage conservation, and parks and recreation planning.

The purpose of the REM Ph.D. program is to provide students with an environment in which they can develop and demonstrate their competence to conduct independent and original research in the multidisciplinary field of resource and environmental management. We expect that students will complete all aspects of their theses in an independent manner that meets the highest academic standards. The senior supervisor, the supervisory committee, and the REM program as a whole provide students with an environment conducive to meeting this objective. Faculty should provide the student with direction and guidance, feedback on progress and ideas, a stimulating and creative environment (e.g., by organizing research team meetings, attending conferences, providing contacts), access to relevant courses and physical infrastructure, access to people and organizations, and financial resources (if needed and possible). The student must demonstrate cross-disciplinary breadth in two ways during their tenure in the REM Ph.D. program. First is the combined comprehensive examination and defense of the thesis proposal, which requires students to demonstrate knowledge of three core areas (environmental and ecological economics, resource policy and planning, and environmental science) in the context of their research. Second is the thesis itself, which must have components integrated across at least two of these disciplinary areas. By the conclusion of their PhD studies in REM, students will be broadly informed about problems in resource and environmental management and will have an integrative, synthetic approach to thinking about the challenges facing society in these areas and their solutions.

This document contains policies and procedures regarding the REM Ph.D. program, which conform to the more general SFU policies. General information about SFU policies and procedures relevant to a Ph.D. program is available at the website of the

SFU Office of Graduate Studies and Post-Doctoral Fellows (http://www.sfu.ca/dean-gradstudies/). That website includes links to the SFU Graduate Student Admission Handbook and the SFU Graduate General Regulations. The purpose of this REM PhD Handbook is to detail the policies and procedures that are specific to the REM Ph.D. program. In case of any conflict between these REM procedures and the overall SFU regulations, the university regulations have precedence.

Application and Admission

Application Requirements

To qualify for admission, an applicant must satisfy all university admission requirements as outlined in the SFU Graduate General Regulations and other university policies.

Applicants should have:

- Demonstrated ability or demonstrated potential to carry out innovative, independent and original Ph.D. level research in their field;
- High academic standing in previous university work; and
- A Master's degree in a related discipline.

All applicants must submit their applications electronically and upload the required documents using SFU's online application system (see the REM website for the link and instructions). Applications must including the following:

1. All university transcripts.

2. A short curriculum vitae providing evidence of awards, academic performance, publications, and relevant research and work experience.

3. A 500- to 1000-word "Statement of Interest" describing how REM's Ph.D. program aligns with the applicant's research plans and career objectives.

4. Three references from respected academics/researchers having first hand knowledge of the applicant's research capabilities and academic training. The applicant lists the names and e-mail addresses of the referees as part of the electonic application. The referees then receive an email directly from SFU that allows them to log into SFU's application system to complete and submit their references electronically.

5. Results from the GRE Test. (At the discretion of the REM Graduate Studies Committee, the GRE requirement may be waived on a case-by-case basis.)

6. Applicants whose first language is not English and whose previous education was conducted in another language must provide official results from the TOEFL and TWE, or the IELTS, or the PTE Academic (Pearson Test of English Academic) exams. The minimum SFU requirements for test scores are as follows:

- IELTS (International English Language Testing System) with a minimum overall band score of 7 (on the academic NOT the general test), and with a minimum of 6.5 in each individual category: listening, reading, speaking, and writing components; or
- TOEFL IBT (Test of English as a Foreign Language Internet Based Test) with an overall score of 93 or better (0-120 scale) and with a minimum score of 20 in each module; or
- TOEFL PBT (Test of English as a Foreign language Paper Based Test) with a minimum score of 580 (310-677 scale) including a minimum essay score (TWE) of 5 (1-6 scale); or
- PTE Academic (Pearson Test of English Academic) with a minimum overall score of 63, and a minimum of 65 in speaking and writing.

International applicants whose primary language is not English may not be required to complete an English-language test if they have completed a degree (of at least 4 years) at an institution where the language of instruction and examination was in English, in a country where English is the primary language. It should be noted that in order to maintain a high academic standard, very few waivers are granted. Therefore, it is recommended that those applicants whose primary language is not English submit an English language proficiency test with their application. For more information see the website of the SFU Office of Graduate Studies and Postdoctoral Fellows.

7. Applicants must be selected by a senior supervisor prior to admittance to REM. Ph.D. applicants are strongly advised to contact prospective supervisors early in their consideration of REM and to visit the university for an interview prior to the application deadline for the year of requested admission. See SFU Graduate Regulation 1.3 “Admissions”.

Transfer from the REM Master’s Program to the REM Ph.D. Program

Exceptional students enrolled in the REM Master’s program may be allowed to transfer directly into the REM Ph.D. program without completing the Master’s degree. Transfer applicants must (1) demonstrate the ability to carry out innovative, independent and original Ph.D. level research in their field; (2) have the potential to expand in an interdisciplinary manner; (3) have achieved high academic standing in previous university work; and (4) have the support of both their Master’s supervisor and proposed Ph.D. supervisor (this may be the same person). All university regulations governing transfers must be met. Transfers are only permitted when the student has been in the REM Master's program for at least two but not more than four terms. Transfer applicants should apply to the REM Graduate Studies Committee in the normal REM application process during the winter (by February 1) of their first year in the program to be accepted into the Ph.D. program for the following academic year (September). A final determination of the success of their application, however, will normally not take place

until they have completed two full semesters in the program. Their application must include:

1. Evidence of outstanding overall ability;

2. Evidence of the ability to produce Ph.D. thesis-level research;

3. A strong written statement from the senior supervisor in support of the student's application. The statement should provide a rationale for the student's transfer into the Ph.D. program by summarizing and citing evidence of the student's abilities, including the ability to conduct innovative, independent research.

Transfer applications must be approved by the student's supervisory committee, the REM Graduate Studies Committee, and the SFU Dean of Graduate Studies. The Dean of Graduate Studies requires a letter of support for the student's application from the REM Graduate Studies Committee expressing confidence in the student's ability to complete the Ph.D. program (and thus a very low expectation of dropping out and failing to achieve even the Master's degree). Transfer students will be eligible to earn only the Ph.D. degree.

Notes of Advice & Caution

- Students interested in the REM Ph.D. program should contact the REM Graduate Program Assistant and potential supervisors early in their consideration of the possibility of applying to REM. Establishing a dialogue with a prospective supervisor is essential. Students are only admitted to the Ph.D. program upon endorsement from a faculty supervisor.

- Plan early for funding. Prospective students should investigate and apply for scholarships and/or other sources of funding in conjunction with applying to the Ph.D. program. Deadlines for scholarship applications may precede the deadlines for application to REM by several months (see the REM website for up-to-date information). Therefore, students should discuss funding strategies a full year before admission with potential supervisors and continue this discussion after admission.

- Students considering a transfer from the REM Master's program into the REM Ph.D. program should be aware that if they do not complete the Ph.D. program they may not revert to the Master's program without re-applying for admission. Students who fail to complete the Ph.D. degree may re-apply to the REM Master's program, but re-admission is not guaranteed.

- Students who are not successful in their application to transfer to the Ph.D. program are encouraged to remain in the MRM program to complete their Master's degree.

Registration and Enrolment

All Ph.D. students in REM must satisfy the following registration and enrolment requirements.

1. Ph.D. students must identify a potential senior supervisor at the time of application.

2. Residence requirement: A Ph.D. candidate must be registered and in residence at Simon Fraser University for the minimum number of terms (currently five) specified in the SFU Graduate General Regulations. On-leave terms do not count toward this minimum.

   a) Ph.D. students entering the program with a Master's degree shall normally be in residence for a minimum of five full-time equivalent terms. This will normally occur during the student's first and second years in the program. During this time, we expect that preparation for the Ph.D. research and the comprehensive examination will be their primary, full-time occupation. Exceptions must be approved by the senior supervisor.

   b) Students who have transferred to the Ph.D. program from the Master's degree program at REM without completing the Master's degree shall be in residence for a minimum of eight full-time equivalent terms (including time in the Master's program).

3. Any application to be enrolled as an on-leave student must be approved by the student's supervisory committee and the REM Graduate Studies Committee.

4. The university regulations stipulate that students in a Ph.D. program must maintain a cumulative GPA of at least 3.0. Failure to do so is evidence of unsatisfactory progress and requires immediate review by the REM Graduate Studies Committee (see SFU Graduate General Regulations 1.5.4 and 1.8.2). Under no circumstances will a student whose CGPA is below 3.0 be awarded a Ph.D. degree. Additionally, REM Ph.D. students are required to maintain at least an A- average across all required REM core courses for the Ph.D. program, including any of these core courses taken as a REM Master's student before entering the PhD program (see below).

Student Supervision

The Senior Supervisor

Acceptance of a student into the Ph.D. program requires endorsement from a senior supervisor. The senior supervisor must be a REM tenure-track faculty member with experience in graduate supervision, including experience with Ph.D. students (e.g., by active membership on Ph.D. student supervisory committees) and knowledge of the REM Ph.D. process.

The senior supervisor's roles include:

1. To facilitate, and if needed, lead discussions of potential Ph.D. thesis topics with the student.

2. To establish (with input from the student) a supervisory committee.

3. To act as chair of the supervisory committee.

4. To recommend, and, if appropriate, approve student course selections.

5. To ensure that all members of the supervisory committee are fully aware of pertinent program procedures and requirements of the REM Ph.D. program.

6. To ensure that supervisory committee members understand the differences between the REM Ph.D. program and a single-discipline Ph.D. program.

7. To participate in a leadership capacity in all aspects of the student's program and supervisory committee.

The First Term and the Initial Supervisory Committee

Upon acceptance, students are assigned an initial supervisory committee, consisting of the senior supervisor and at least one other REM faculty member. The role of this initial committee is to advise the student on course selection and other issues that might arise early in their program.

The Second Term and the Ongoing Supervisory Committee

During the second term, students are expected to take REM 802, the Ph.D. preparation course (see course description below). Students should have assembled a supervisory committee by the beginning of their second term, and must do so no later than March 1 of their first year in the program. The supervisory committee's initial duties include assisting the student in defining a research topic, and providing feedback to the student on the draft thesis proposal prepared by the student for presentation and defense in a mock oral exam at the end of REM 802. The supervisory committee should meet at least once prior to this oral exam.

The composition of the supervisory committee should meet the following requirements:

1. The minimum size of this committee is three (including the senior supervisor).

2. At least three members of the supervisory committee must have a Ph.D.

3. At least two members of the supervisory committee must be SFU tenure-track faculty members.

4. The membership of the supervisory committee must include expertise in two of the three core research areas for a REM PhD (environmental science, resource planning and policy, and environmental and ecological economics).

In order to obtain specialized expertise it is often desirable to draw members of the supervisory committee from outside SFU. Students are cautioned against having more than one member of their committee who is not readily accessible. Supervisory committees dominated by non-local members often demand excessive investments in logistics and communications. In any case, REM encourages students to solicit input from experts in their research area whether or not those experts are members of the supervisory committee.

The roles of the student's supervisory committee include:

1. Provide advice on the selection of a suitable thesis topic.

2. Make recommendations about the student's course selections.

3. Provide advice on the student's draft thesis proposal, to be written as part of the REM 802 course deliverables.

4. Evaluate the student's preparedness to commence the thesis research. All members of the supervisory committee will review and evaluate the thesis proposal. In addition, the supervisor and at least one other member of the supervisory committee will participate in an oral comprehensive examination of the student based on the proposal (the comprehensive exam/thesis proposal defense—see details below).

5. Monitor and evaluate the student's progress throughout the Ph.D. program, offering advice regarding content, timing, and process for thesis completion.

6. Approve, or not approve, of on-leave status, as appropriate.

7. Evaluate the student's preparedness for the thesis defense.

8. Take part in the thesis examination and evaluate the thesis and the defense.

Once the student has passed REM 802 and the comprehensive exam/thesis proposal defense, the student's supervisory committee must meet with the student at least once every academic year (i.e., every 3 terms). It is recommended that the student and senior supervisor organize two meetings per year to consult with the supervisory committee concerning the student's progress through the Ph.D. program and related challenges and opportunities. Students should strive to provide ample advance notice (e.g., 1 month) when they organize supervisory committee meetings. REM expects that supervisory committee members will make themselves available in person or electronically for committee meetings if reasonable advance notice has been given.

The Annual Report and Student Progress Evaluation

Once each academic year (before October 15), the student must submit a progress report to the REM Graduate Studies Committee. The form for the progress report is available from the REM Graduate Program Assistant. In this report, the student summarizes the student's progress and each member of the supervisory committee indicates (a) whether or not progress has been satisfactory (SFU Graduate General Regulation 1.8.1) and (b) whether they recommend that the student continue in the Ph.D. program or withdraw from the Ph.D. program. A requirement to withdraw normally occurs only after at least one previous finding of unsatisfactory progress. The progress report must be signed or electronically approved by every member of the supervisory committee. When a member of the supervisory committee (other than the senior supervisor) is not available to approve an annual progress report because of exceptional circumstances, the Chair of the REM Graduate Studies Committee may waive the requirement for that committee member's approval.

If a student's progress appears to be unsatisfactory, the supervisory committee shall make a written report to the REM Graduate Studies Committee. The Graduate Studies Committee shall consider this assessment of unsatisfactory progress. If the Graduate Studies Committee and the supervisory committee are in agreement that the student's progress is unsatisfactory, the Graduate Studies Committee in consultation with the supervisory committee may:

a) require the student to withdraw, or

b) inform the student of the unsatisfactory progress and require the student to improve their performance in specific ways in a specified amount of time. This requires the supervisory committee to identify specific progress targets (in writing) that have to be met in a specific time period to the satisfaction of the supervisory committee

(see SFU Graduate General Regulation 1.8.2).

A student in this circumstance has the right to appear before the REM Graduate Studies Committee when the case is considered and may submit any materials relevant to their case. A student who is required to withdraw shall be informed, in writing, with copies to

the Dean of Graduate Studies and the Director, Graduate Admissions and Records. If the student is required to demonstrate improved progress within a specific amount of time, the student shall be informed, in writing, as to what is required of them, with copies recorded in the student's file and sent to the Dean of Graduate Studies and the Director, Graduate Admissions and Records.

Any decision of the REM Graduate Studies Committee under the provisions of this section may be appealed to the Senate Graduate Studies Committee through the Dean of Graduate Studies. According to the Graduate General Regulations, the student has the right to appear before the Senate Graduate Studies Committee when the case is heard, and the decision of that committee is final.

Courses

All REM Ph.D. students must complete and maintain at least an A- average across all core courses.

Required core courses for Ph.D. students include:

> REM 698-3 Field Resource Management Workshop (normally taken in the first fall term in the program)
> REM 802-5 Research Approaches for REM Ph.D. Students (normally taken in the first spring term in the program)

Students will also take at least one course in each of the three REM core areas (environmental sciences, resource and environmental policy and planning, and environmental and ecological economics). The timing of when each of these courses is taken will be determined by the student and the senior supervisor in conjunction with the student's initial committee or the ongoing supervisory committee. However, the student is required to have knowledge of each of these core areas as they relate to their research at the time of the comprehensive examination/thesis proposal defense. The recommended courses to fulfill this requirement are:

> REM 611-5 Apllied Population and Community Ecology
> REM 621-5 Ecological Economics
> REM 644-5 Public Policy Analysis and Administration

Substitutions of other courses to fulfill the core requirements can be determined by the supervisory committee, with the approval of the REM Graduate Studies Committee.

One of these REM core courses may be waived based on substantial prior equivalent course experience, with agreement from the supervisory committee and the REM course instructor. If a Ph.D. student receives a course waiver, the student is not required to replace the course for which the waiver was received with another course.

Course selection must be approved by the senior supervisor or supervisory committee, who may recommend that additional courses be taken in order to strengthen the student's background in areas directly related to their thesis research. Elective courses intended to support the student's preparation for comprehensive examinations and/or thesis research may be taken outside REM (or SFU), if approved by the student's supervisory committee. Students who transfer from the REM Master's program into the REM Ph.D. program may obtain course waivers for REM 611-5, 621-5, 644-5 and 698-3 if they have already received credit for these courses with an A- average.

If it has been more than six years since the student took university courses, the supervisory committee should consider whether this is an issue for the student's background and preparedness for the comprehensive exam process and may require supplementary coursework or independent study.

All required courses will normally be completed during the student's first two terms in REM. The combined comprehensive examination/thesis proposal defense will occur no later than the end of the student's fifth term in the program. Permission to vary from this schedule must be sought in writing by the senior supervisor from the REM Graduate Studies Committee.

REM 802 is the capstone course of the core course requirements and will: 1) focus on integrative methods and thinking about knowledge in resource and environmental management, 2) address key issues in research philosophy, design, and methodology, and 3) prepare students for their research proposal and comprehensive examination. The main purpose of REM 802 is to prepare Ph.D. students for the combined comprehensive exam/thesis proposal defense. Each student must complete REM 802 successfully in the spring of their first year in the program, unless they begin the program in January, in which case they must complete REM 802 in the spring of their second year. As part of the requirements of REM 802, students will complete:

1) a first draft of their research proposal, indicating the interdisciplinary direction of their proposed research, and
2) a mock oral examination with the course instructor, the student's senior supervisor and other REM faculty members, modeled on the combined comprehensive exam/thesis proposal defense.

Comprehensive Examination and Defense of Thesis Proposal

Overview

The combined comprehensive exam/thesis proposal defense shall take place no later than at the end of the fifth term, and has two components: 1) written submission of the formal thesis proposal, and 2) an oral examination administered by members of the student's supervisory committee and any additional examiners added for the purpose of ensuring adequate examination of breadth. The student receives one combined pass/fail evaluation of their performance on the comprehensive exam/thesis proposal

defense based on its written and oral components. The comprehensive must be passed to remain in the program (see table of outcomes of the comprehensive exam/thesis proposal defense below).

The purpose of the comprehensive exam/thesis proposal defense is to demonstrate:

1. The student's general background and preparedness in the three core disciplines of REM (as set out in the lists of key concepts in the Appendix to this handbook);

2. The student's general background and preparedness in relation to the areas of research described in the thesis proposal;

3. The student's specific readiness to conduct the proposed research; and

4. The feasibility of the proposed research, its merit, and its adequacy to form the basis of a Ph.D. thesis.

The Thesis Proposal

The thesis proposal should clearly outline the theoretical and applied background for the proposed research, research objectives, proposed methods, and how the student plans to construct a thesis from the data they propose to collect. The proposal should demonstrate that there is a reasonable expectation that the data the student proposes to collect can be collected in practice, within the constraints of the available budget, and within a reasonable time frame, with the proposed methods. The student should also anticipate potential problems in conducting the research and explain what contingency plans may be necessary if problems occur. The proposed methods should be provided in sufficient detail for examiners to evaluate both the soundness of the proposed research and the student's understanding of the methodological issues involved. It is critically important that the proposal appropriately places the student's work in a theoretical and conceptual context and provides sufficient detail about the planned research to assess the process of the proposed research.

The proposal should adopt the following outline (or something functionally equivalent):

1. Title.
2. Introduction, background context, and rationale (this includes a review of the relevant literature to identify and frame the problem, issue, or challenge to be addressed in the thesis). The student should indicate specifically how the proposed research differs from past research and what the distinct contribution will be.
3. A clear statement of the research objectives.
4. An explanation of the interdisciplinary elements of the proposed research and their significance.
5. The methodological approach.

6. A proposed outline for the thesis (i.e., proposed thesis chapters and proposed publications that will follow from the research).
7. A timeline for conducting the research.
8. A list of required resources (e.g., instruments, space, financial resources) and their availability and/or plans for obtaining them.
9. A list of any external approvals that are required and a plan for obtaining them (e.g., ethics approvals, animal care approvals).

The thesis proposal should be a maximum of 25 pages, double-spaced, size 12-point text, non-condensed spacing. Figures, tables, references and appendices may be additional to this page limit. Items 6-9 in the outline above can be presented as tables. The thesis proposal should be submitted to the student's supervisory committee and the examination committee (see next section) no later than 3 weeks before the comprehensive exam/thesis proposal defense.

The Comprehensive Exam/Thesis Proposal Examining Committee

The examining committee for the combined comprehensive examination and thesis proposal defense will consist of at least two members of the student's supervisory committee (including the supervisor) plus any additional examiners needed for the purpose of ensuring adequate examination of the student's breadth (all three of REM's core disciplines must be represented on the examining committee). This examining committee must be approved by the REM Graduate Studies Committee, and makes its final recommendation concerning the outcome of the exam to the Graduate Studies Committee. The comprehensive exam/thesis proposal defense is not public.

Composition of the examining committee:

1. The examining committee for the comprehensive exam/thesis proposal defense consists of at least two members of the student's supervisory committee, with additional representation as needed.

2. The examining committee must include at least one examiner representing each of the three core areas. If the supervisory committee lacks coverage of one or more of the three areas, then the Chair of the REM Graduate Studies Committee, in consultation with the senior supervisor, must add additional members to the examination committee. These members must hold a Ph.D. and preferably should be REM faculty members.

3. The Chair of the Graduate Studies Committee must ensure that all members of the examining committee receive the pages from this handbook relevant to the examination process, including the Appendix listing the breadth content that students are required to understand. The Chair of the Graduate Studies Committee will provide this information and emphasize its importance, especially to non-REM members of the examining committee. In some cases, the Chair of the Graduate Studies Committee may decide that some members of the examining committee

should confer with senior REM faculty members with experience in the REM breadth comprehensive process.

4. The Chair of the Graduate Studies Committee or a delegate will chair the oral examination. The chair of the examination cannot be a member of the student's supervisory committee. The chair of the examination will make sure that the student and examining committee are aware of all rules and protocols regarding conduct of the exam. The chair of the examination does not normally take part in the examination process or in the decision-making regarding the outcome of the exam, but can intervene when they feel it is appropriate.

Format of Oral Examination

At the oral examination, the student opens the proceedings with a prepared talk of 15-20 minutes in length. Thereafter, the student will respond to a series of questions posed by each examiner in turn. There will normally be two rounds of questions from the examiners, with the option for a third round if examiners feel it is needed. In the first round, each member of the examining committee has 15–20 minutes to pose questions on the thesis proposal or the three core areas related to the student's thesis research. The chair of the examination will determine the sequence of questioning, except that the senior supervisor must go last in each round of questioning. Typically, each round of questions will begin with the member of the examining committee that is least connected with the student and the student's research, and then move to those committee members who are more closely connected with the student and the student's research. Normally, the second and subsequent rounds of questions should be approximately 5-10 minutes per examiner. In total, participants should allow between two and four hours for the examination, depending on the size of the examining committee and the student's ability to demonstrate their knowledge.

The proposed thesis research forms the context for the examination. Within this context the examiners will seek to confirm the student's broad cross-disciplinary understanding of issues in resource and environmental management.

After the final round of questions, the student is asked to leave the room and the examining committee determines the outcome. A single pass/fail evaluation of the student's performance on the exam is to be determined by the committee. A student can fail the exam either for reasons related to their thesis proposal and knowledge of their research area or for reasons related to their cross-disciplinary breadth. Each member of the examination committee should provide an independent assessment of the student's performance. This should be followed by a discussion and a decision. The examination committee must reach a consensus decision. If a consensus is not attained, the committee may delay the decision and request other REM faculty members to provide help with its deliberation. After a result has been determined, the student is invited back into the room and informed of the result.

Outcomes of the Comprehensive Exam/Thesis Proposal Defense

The comprehensive exam/thesis proposal defense has the following potential outcomes and consequences:

Exam Outcome	**Consequences**
1. Pass oral exam, no revisions required to thesis proposal, no further breadth requirements specified.[1]	The examining committee informs the REM GSC in writing that the student has passed the comprehensive exam/thesis proposal defense.
2. Pass oral exam, revisions are required to thesis proposal and/or breadth requirements are specified to address deficiencies.	The examining committee informs the student of the details of, and the deadline for, revisions to the proposal and/or completion of additional breadth requirements, and by whom the revisions and completion of breadth requirements will be evaluated. Depending on the magnitude of revisions, evaluation may be the responsibility of the senior supervisor alone or may include some or all members of the examining committee. When satisfactory revisions have been completed and all breadth requirements have been met, the examining committee will inform the REM GSC that the student has passed the comprehensive exam/thesis proposal defense. If the revisions or completed breadth requirements are unsatisfactory, the student shall be considered to have failed the comprehensive exam under Option A below, and must retake the oral exam after further revisions to the thesis proposal, as determined by the examining committee.
3. Fail exam: Option A.	The examining committee informs the student and the REM GSC that the student has failed the exam and must re-take the oral exam. If the reason for failure relates to the thesis proposal and the proposed research, the student must rewrite the thesis proposal. If the failure relates to issues of breadth, rewriting the proposal may not be necessary. The examining committee will set a deadline for the rewritten proposal and for the oral exam.

[1] Note that the student should still seek further opportunities to develop their cross-disciplinary background, skills, and experience. However, no such requirements are being specified in a remedial sense by the examining committee.

4. Fail exam: Option B	The examining committee informs the student and the REM GSC that the student has failed the comprehensive exam/thesis proposal defense and must withdraw from the Ph.D. program immediately.

Timeline for the Comprehensive Examination/Thesis Proposal Defense Process

The REM Graduate Program Assistant will assist with coordinating the planning of the exam and ensuring that the student and the examining committee are notified sufficiently in advance of deadlines.

Term 1 (Fall).

- Initial supervisory committee created and meets at least once.
- Student addresses gaps in multidisciplinary background by taking required courses and/or independent study.
- The student should review past thesis research proposals and prepare ideas for research topics.
- All students planning on taking REM 802 the following term should meet as a group at least once with the faculty member who will be teaching REM 802.

Term 2 (Spring: Jan-April)

- Student takes REM 802.
- In conjunction with REM 802, student submits a preliminary thesis proposal and is examined orally by their senior supervisor, the course instructor and other participating REM faculty members.
- The student must have established a supervisory committee by March 1 that meets the requirements described in this handbook.

Terms 3 and 4 (Summer and Fall)

- The student conducts preparatory research for the thesis.
- The student prepares for the comprehensive exam/thesis proposal defense by revising and refining the thesis research proposal with the support of the senior supervisor and the supervisory committee.
- If the ongoing work of conceptualizing and writing the thesis proposal—or the result of the mock oral exam—leads the student in a direction substantially different from the draft proposal in 802 or that previously approved by their supervisory committee, the student must seek approval for these changes from their supervisory committee.

Term 4 or 5 (Fall or Spring)

- The student should submit the thesis proposal no later than March 20th, so that an exam can be scheduled before mid-April.
- The senior supervisor, in consultation with the Chair of the REM Graduate Studies Committee, will schedule the comprehensive exam/thesis proposal defense.

A student may not normally be registered as on-leave until the comprehensive exam/ thesis proposal defense has been completed successfully. Extenuating circumstances such as prolonged sickness or death in the family will be valid reasons for postponing the deadline for completion of the comprehensive exam or any components of it. Under such circumstances, the student's senior supervisor should make a written request on behalf of the supervisory committee to the Graduate Studies Committee for postponement of the deadline for the completion of the comprehensive exam/thesis proposal defense. If approved by the Graduate Studies Committee, the supervisory committee and the examining committee will agree on a new date for the examination.

Except in extraordinary circumstances, failure to pass the comprehensive exam/thesis proposal defense and submit an approved thesis proposal by the end of the *seventh* term will lead to the student's dismissal from the Ph.D. program.

Required Approvals for Research Involving Human Subjects or Animals

All research involving human subjects or human biological materials must be reviewed and approved by the university's Research Ethics Board (SFU policy R20.01 "Ethics Review of Research Involving Human Participants"). Failure to obtain this approval prior to conducting the research is a violation of university policy and is grounds for the library to refuse to accept the completed thesis, preventing the student from completing their degree.

Any proposal for the use of animals in research or teaching must be approved in advance by the SFU University Animal Care Committee (SFU policy R20.03 "Treatment of Animals in Research and Teaching"). ***This requirement applies to observational field research on wildlife as well as more intrusive studies involving wildlife or other animals in the field or lab***. The approval process may involve external review, so students should apply at least 2-3 months before they anticipate starting the research in order to ensure that all permits can be obtained before the research begins. Failure to obtain approval prior to conducting the research is a violation of university policy and may prevent the student from completing their degree.

Thesis and Thesis Defense

The Thesis

Defense of a written thesis based on the candidate's original research in resource and environmental management is the final requirement of the Ph.D. program. The thesis must include original research reflecting at least two of the three core disciplinary areas (such as ecology and policy, or toxicology and law). The topic of the research must be approved via a defense of the proposal as noted above and the student's progress will

be evaluated annually in accordance with the SFU Graduate General Regulations. All students must present their research publicly in a REM seminar sometime between successfully defending their thesis proposal and scheduling their final thesis defense. When the thesis is completed to the satisfaction of the supervisory committee, the committee will approve the scheduling of the final thesis defense (see the detailed instructions in the next section). All Ph.D. candidates must pass the formal thesis defense, which is conducted in accordance with the SFU Graduate General Regulations and the policies of the SFU Office of Graduate Studies and Post-Doctoral Fellows. All other Ph.D. general requirements are as outlined in the Graduate General Regulations.

The culture of what is an acceptable thesis in scope, theoretical framework, magnitude, and format varies substantially across disciplines and among research groups within REM. For instance, some faculty members prefer a thesis comprised of a series of thematically linked papers while others prefer a more traditional thesis format. It is important to understand the culture of the research group and field in which you are participating. It is critical that students obtain approval from their supervisory committee for their choice of format and scope early in the writing process.

SFU Graduate General Regulation 1.12.3 states: *"A student shall complete all the requirements for a doctoral degree within eight calendar years of initial enrolment as a doctoral student or, in the case of a student who has transferred from a Master's program into the doctoral program without completing the Master's degree, within eight calendar years of initial enrolment as a Master's student*." Normally, we expect that the REM thesis will be completed and successfully defended within 4-6 years of entry (i.e., by the 12th to 18th term of full-time enrolment).

Students should not underestimate the considerable time and effort involved in writing a thesis. With the supervisor, they should plan financial support for this period and should begin writing appropriate sections as early in their tenure as is feasible.

It is customary that the senior supervisor will carefully review and edit one or more drafts of the entire thesis before the student distributes it to the full supervisory committee. This approach should ensure that the draft thesis is of high quality and likely to be found acceptable by the supervisory committee members. Where specialized input is required from other committee members earlier in the editorial process, those sections can be reviewed by the relevant committee members at that time. After the student has distributed the draft thesis to the entire supervisory committee, members of the committee will respond to the student on the quality of the thesis within a reasonable time period (i.e., within approximately 1 month). It is typical that the student completes several drafts before the committee members find the draft thesis acceptable for defense.

To demonstrate that the requirements of interdisciplinarity have been met, the introduction to the thesis shall contain a statement explaining how interdisciplinarity has been met at the various stages. At the oral defense, the student will make available for

all attendees a brief document with the following content: 1) abstract, 2) summary of student's program of study, 3) publications and presentations, and 4) statement of interdisciplinarity.

The final version of the thesis must be prepared in the format specified by the SFU library. Students should make themselves aware of all library requirements early in their writing process, by consulting the SFU library thesis website and contacting the library's thesis assistant.

Defense of the Thesis

(See also the guides and information available at the website of the Office of Graduate Studies and Post-Doctoral Fellows http://www.sfu.ca/dean-gradstudies/)

Step 1: All Ph.D. students must present their research at a public REM seminar sometime between defending their thesis proposal and the final defense of their thesis. The presentation of the research at a REM seminar must be scheduled or have taken place **before** the final thesis defense can be scheduled. Except in special circumstances, the seminar presentation will occur at least one month prior to the thesis defense.

Step 2: Normally, the senior supervisor will approve the draft thesis before it is sent to the rest of the supervisory committee. After all supervisory committee members find the thesis acceptable, the senior supervisor will inform the Chair of the REM Graduate Studies Committee that the student's thesis is ready to be defended. At this time, the senior supervisor will also inform the Chair of the REM Graduate Studies Committee of the recommendations of the supervisory committee concerning the composition of the examining committee and the date, place and time of the thesis examination. These recommendations will include proposals, with supporting documentation, for candidates to be internal and external examiners. The examining committee will have no less than five members, and shall include all members of the student's Ph.D. supervisory committee, an internal examiner and an external examiner. The Chair of the REM Graduate Studies Committee, or designate, will be the non-voting chair of the examining committee. If the Chair of the Graduate Studies Committee is also the senior supervisor or is a member of the student's supervisory committee, the Chair of the Graduate Studies Committee will designate another REM faculty member to chair the examining committee.

The proposed internal and external examiners are subject to the approval of the REM Graduate Studies Committee and the SFU Dean of Graduate Studies, and must meet the following requirements:

1. The internal examiner shall be a regular SFU faculty member or adjunct faculty member who is not on the student's supervisory committee.

2. The external examiner shall be a distinguished scholar who is a recognized expert in the student's research area and who has had minimal previous contact with the student and the senior supervisor. The external examiner cannot be an SFU faculty member. She or he need not hold a faculty position at another university, but must have a Ph.D. and must have particular experience in the field of the thesis research. The external examiner must also have prior experience supervising doctoral students through completion of a Ph.D.

3. The external examiner shall be free from potential conflict of interest, which may arise, for example, from research collaboration with the student or past employment of the student or supervisor.

Typically, the senior supervisor makes the initial contact with the internal and external examiners to determine whether they are available and willing to review the thesis, and to discuss possible dates for the exam. The senior supervisor should also obtain a current curriculum vitae from the external examiner, including confirmation of previous experience supervising Ph.D. students. The student is not permitted to have any contact with the external examiner during this process. This includes contact for the purposes of scheduling the exam, organizing travel, distributing the thesis, or arranging technology such as telephone and video connections for the exam.

(See also the SFU Graduate General Regulations and the policies of the Office of Graduate Students and Post-Doctoral Fellows.)

Step 3: Upon approval by the REM Graduate Studies Committee, the recommendations concerning the composition of the examining committee and the proposed date, place and time of the thesis examination—along with the thesis title, abstract, a digital copy of the thesis, and the curriculum vitae of the external examiner—shall be sent to the Dean of Graduate Studies for final approval. These items must reach the Dean of Graduate Studies no less than six weeks before the proposed examination date.

Step 4: Upon approval by the Dean of Graduate Studies, the thesis examination committee is formally established and the Dean of Graduate Studies will formally invite the external examiner and send digital copies of the completed thesis to the full examining committee. The chair of the REM Graduate Studies Committee will notify the university community of the intended time and place of the examination.

Step 5: At least 10 days before the examination date, the Chair of the REM Graduate Studies Committee will notify the student, the thesis examination committee, the deans of concerned faculty, and the Dean of Graduate Studies of the date, place and time of the thesis examination. This date shall not be earlier than the originally proposed date. The Dean of Graduate Studies will notify the university community.

Step 6, Report of external examiner: The Dean of Graduate Studies will ask the external examiner to report on the thesis, to the Dean of Graduate studies only, before the examination. If the report states that the thesis is ready for defense, a copy will be sent

to the chair of the examining committee by the Dean of Graduate Studies for distribution to all members of the examining committee before the examination. The contents of the report will not be communicated to the student. If the report recommends that the examination be postponed, the Dean of Graduate Studies will send a copy to the chair of the examining committee, the senior supervisor and the Chair of the REM Graduate Studies Committee. In this case, the Chair of the REM Graduate Studies Committee and the senior supervisor will inform the student of the content of the report. Following discussions with the student and the supervisory committee, the Chair of the REM Graduate Studies Committee will report to the Dean of Graduate Studies as to whether the examination will take place as scheduled or be postponed.

Step 7, Thesis examination:

a) Attendance by the external examiner. While it is ideal that the external examiner participate in person at the thesis defense, this may not be feasible, either because of financial constraints or the external examiner's schedule. Any expenses associated with the external examiner attending the exam must be borne by the senior supervisor. The ultimate decision about whether the external examiner will participate in person or in absentia, including the possibility of a conference telephone connection or similar means, is made by the Dean of Graduate Studies, who will take into account the department's views. In the event of an examination by the external examiner in absentia, the report of the external examiner should be quite extensive and should give a specific recommendation as to whether the thesis ought to pass, fail, or be subject to revision (see section 1.10.2 of the SFU Graduate General Regulations). The report may contain specific questions the external examiner would like to be posed to the candidate. Those specific questions shall be directed to the candidate during the examination by members of the examining committee selected by the chair of the examining committee.

b) Attendance by the rest of the examining committee. The Dean of Graduate Studies has established criteria for the minimum physical attendance at a Ph.D. thesis defence. These criteria are designed to ensure that the student, and their thesis, will receive a fair and rigorous examination to the standards of academia in general and SFU in particular. These criteria require that:

the chair be present
the senior supervisor be present
the candidate be present
the internal examiner be present

In addition to these criteria, the Dean of Graduate Studies allows for no more than one committee member coming in via remote or acting in absentia. General Graduate Regulations (1.9.5) already allows for the possibility of the external examiner coming in via remote or acting in absentia.

Technology is not infallible. Thus, it is recommended that whenever possible contingency plans are made in the event that the primary conferencing platform is lost. Such contingencies can include voice only conferencing technology. In all cases where there is technology failure it will be up to the chair of the defence to judge whether the defense can continue or needs to be postponed.

In very rare, exceptional, and unavoidable circumstances it may be the case that it is impossible for either the student or the senior supervisor (but not both) to be physically present at the defense. If the circumstances are, indeed, exceptional and unavoidable then the Dean of Graduate Studies may allow the defense to proceed. In such cases, video-conferencing interfaces must be used and if the technology fails during the defense then the defense will be postponed until such a time as both the student and the senior supervisor can be physically present. Also in such cases, no more than one additional member of the examination committee may be physically absent from the defense either coming in via remote connection or acting in absentia.

c) Conduct of the defense. The defense begins with the chair introducing the candidate and the members of the examining committee. The candidate then gives a 20-30 minute oral presentation of the Thesis. This is followed by sequential questioning of the candidate by the examining committee. The order of questioning is from most “external” to most “internal”: external examiner, internal examiner, non-SFU members of the supervisory committee, non-REM members of the supervisory committee, REM members of the supervisory committee, senior supervisor. Each examiner will have up to 20 minutes for their first round of questions. Ideally, each examiner will limit their questioning in the second and subsequent rounds to 10 minutes. While two rounds of questioning is the norm, the thesis examination committee is allowed to question the student for as long as is necessary to make their determination. The defense is open to the public and, after the conclusion of questioning by the examiners, questions are normally allowed from anyone in attendance, although the chair of the thesis examination committee has the discretion to ensure that the process does not extend beyond a reasonable time period.

Outcomes of the Thesis Defense

There are four possible outcomes of the thesis defense (see Graduate General Regulation 1.10.2):

1. Pass as submitted.
2. Pass on condition that minor revisions be completed to the satisfaction of the senior supervisor.
3. Defer judgment until major revisions have been completed (in a specified time frame), at which time the thesis examination committee may require formal re-examination or simply an informal written review of the new version (decision

made by meeting of the committee, or conference call, or written submissions). The committee may not defer judgment a second time.

4. Fail. In this case, the student must withdraw from the university.

The decision of the thesis examining committee is made by simple majority vote, except that the committee may not pass the thesis or defer its judgment without the concurrence of the external examiner. A decision to pass the thesis or to defer judgment may not be reached on a tie vote of the examining committee. If at first a majority vote to pass the thesis cannot be reached, and subsequently, if a majority vote to defer judgment cannot be reached, the thesis will be failed (Graduate General Regulation 1,10.2).

Once the examination has taken place, and if the thesis is passed, the external examiner shall send a brief report to the senior supervisor which indicates the general quality of the thesis. That report (which may be either a copy of the initial report to the Dean of Graduate Studies or a report prepared after the thesis defense) shall accompany the recommendation for award of the degree.

When a student has successfully defended the thesis, and made any necessary revisions, the thesis examination committee shall recommend award of the Ph.D. This recommendation goes for approval respectively to the REM Graduate Studies Committee, the Faculty of Environment Graduate Studies Committee, and the Senate Graduate Studies Committee, which has the final authority to award the degree.

The student must submit the final approved version of the thesis in electronic form to the SFU library using the library thesis registration system (see the library's thesis website), along with a memorandum from the senior supervisor certifying that all required revisions have been made. The student must also submit an electronic copy of the final approved thesis to the REM Graduate Program Assistant. When the library representative of the Dean of Graduate Studies has checked the thesis and accepted the format, the representative will notify the director of graduate programs, admissions and records. No degree will be approved by senate until the director of graduate programs, admissions and records has been so notified.

Timeline for the Ph.D. Program

The following table presents an overview of important activities throughout the Ph.D. program. The table should be used as a guide. Actual dates may vary from year to year, and exact deadlines can be obtained from the REM Graduate Program Assistant.

Date	**Activity**
February [Before commencing the Ph.D. program]	- Deadline for new applications to the Ph.D. program and for applications to transfer from the Master's to the Ph.D. program
September 1, 1st year of the Ph.D.	- Normal start of the Ph.D. program.

program	
1st term	- Student takes most courses required for Ph.D. - Student develops a thesis topic - Student prepares for thesis research
2nd term	- Student takes REM 802 - Student continues to develop the thesis topic - Student sets up a supervisory committee if this has not yet happened (deadline: March 1)
April, 1st year of the Ph.D. program	- Student submits draft research proposal and takes mock oral exam in REM 802 - One committee meeting must have been held by this date
3rd term	- Student develops thesis topic and conducts pilot research - Student revises and refines thesis research proposal and prepares for comprehensive exam/thesis proposal defense
August 15, 1st year of the Ph.D. program	- Student must have had a supervisory committee meeting by this date or must withdraw from the Ph.D. program.
4th term September, 2nd year of the Ph.D. program	First annual progress report is due
4th term	- Student continues to develop thesis research proposal - Student prepares for comprehensive exam/thesis proposal defense -Student may take comprehensive exam/thesis proposal defense
5th term	- Student continues to develop thesis research proposal - Student prepares for comprehensive exam/thesis proposal defense - Student must take comprehensive exam/thesis proposal defense by the end of this term - Student may take additional courses required for their reseach - Student prepares for/conducts thesis research
6th term	- Student conducts thesis research
September, 3rd year of the Ph.D. program	- Second annual progress report is due
7th and following terms	- Student conducts thesis research
September, each year	- Annual progress reports due

Appendix – Information for Comprehensive Examination/Thesis Proposal Defense

1. General Suggestions for the Oral Exam

Have the following at your fingertips:
- Literature – recent and foundational papers (read it using highlighting and annotations to make referring back to that material more efficient).
- The key schools of thought, time trends, and paradigms in each field.
- Key methods of analysis and their pros and cons.
- Depth of knowledge.

When you respond to questions:
- Stick to the topic.
- Don't try to bluff with a vague answer; if you don't know the answer, say so, but add what you would do to find the answer.

Other tips
- Work on your weak points ahead of time.
- Learn from other students' oral exams.
- Do trial oral exams of your own with some colleagues (as well as in 802).
- Interact extensively with fellow students, especially Ph.D. students.

2. Key Concepts in Environmental Science

A. Systems thinking: Understanding the causes, consequences, and management implications of dynamic processes in ecological systems

Environmental systems are dynamic. In order to understand and manage them, a mere description of their structure is not sufficient. Instead, you must know about the processes that generate the dynamics (i.e., structure vs. function). To that end, you should be very familiar with the following key concepts.

1. What are positive and negative feedbacks? What are direct and indirect effects?
   - Give examples of each in ecological systems. It might help you to think about examples in physical systems too.
   - What are the implications of such feedbacks and indirect effects for the resulting system dynamics?

2. Lag effects, cumulative effects, thresholds (tipping points)
   - Give examples in the areas of toxicology and ecological systems.
   - Why are these concepts important in resource and environmental management, as well as in research conducted on these systems?

3. Hierarchical structure
   - Give examples of hierarchical structure in ecological systems.
   - What are the implications for the concept that "everything is connected to everything else" of such a hierarchical structure, as well as the processes mentioned above – positive and negative feedbacks, direct and indirect effects, lag effects, cumulative effects, and thresholds?

4. Multiple stable states, also known as multiple equilibria
   - Give examples in ecological systems (e.g., terrestrial vegetation, lakes, marine ecosystems). It might also help you to think about examples in physical systems (e.g., the oceans or atmosphere).
   - What conditions create multiple stable states? What conditions might trigger a switch from one state to another?
   - How common are those conditions?
   - Why are multiple stable states important in resource and environmental management?
   - What should environmental management agencies do in their presence?

5. Simultaneously operating processes are common in environmental systems, and these make it difficult to determine causes of observed spatial or temporal patterns.
   - Think up at least three answers/explanations/hypotheses to explain some observation in your field of interest. Then describe what information would be needed to distinguish among the confounded alternative hypotheses (i.e., to identify which ones are most important for explaining the observations).

- For example, field data for Fraser River sockeye salmon show a clear long-term decrease in survival rate from juveniles to adults starting in the early 1990s. Some alternative hypotheses that might explain that downward trend are (1) an increase over time in industrial pollutants, (2) an increase in pathogens (parasites, viruses, bacteria) derived from fish farms, (3) increased predation by the growing number of marine mammals, and (4) decreasing food in the ocean for juvenile salmon. To distinguish the relative importance of these confounding factors, it would be necessary to examine data on variables reflecting different magnitudes of these factors in different spatial and temporal locations, conduct appropriate analyses, and/or conduct large-scale policy experiments, etc.

B. Other key topics not necessarily related to system dynamics

6. Explain the difference between active and passive adaptive management.
- Discuss examples in which opportunities for applying active adaptive management have been missed and explain what would have been gained by applying it.
- Discuss the barriers that exist to implementing active adaptive management and how those barriers might be overcome.

7. Why do sampling/monitoring programs need to be carefully designed following rigorous principles?
- What will generally be the result of implementing a sampling program that has few samples, considerable observation error (i.e., imprecision), and/or large natural variability?
- What are the management implications of such results? Give examples.

8. Define environmental risk assessment and discuss why it so important.
- What are the management implications of not explicitly considering uncertainties in analyses of options for managing ecological systems?
- Give examples of such implications (e.g., designing a dam for the "once-in-a-100-years flood")

9. Researchers in both natural and social sciences use models (either conceptual or quantitative) to help describe the current state and/or forecast future states of a system.
- How is the quality or appropriateness of such models evaluated in your field?
- What role do alternative hypotheses play in such evaluations?
- What role do the various types of uncertainty play in those evaluations?
- How should such models be used to provide advice to environmental managers?

10. Be prepared to evaluate/interpret contemporary and historical debates in the literature on major ecological themes (i.e., top-down vs. bottom-up control, population regulation, supply-side ecology)
- Recognize "schools of thought" in literature (e.g., Lomborg et al.)
- Importance of watching for style vs. substance in those debates

11. What are the main scientific reasons for placing high priority on maintaining biological diversity?

3. Environmental & Ecological Economics Concepts

1. **Weak sustainability and strong sustainability**
   How do these concepts differ in terms of their treatment of substitutability between natural and manufactured capital?

2. **Environmental Kuznets Curve**
   What does this concept assert about the relationship between economic growth and environmental quality?

3. **Steady State Economy (Herman Daly)**
   What is required to achieve this?

4. **Total Economic Value (TEV)**
   What does this concept refer to? How does it account for ecosystem services?

5. **Willingness to pay (WTP)**
   What is marginal willingness to pay? Relate this to valuing changes in environmental quality.

6. **Non-market valuation**
   Distinguish between the direct or expressed preference, indirect or revealed preference and production function approaches to non-market valuation.

7. **Externalities**
   How is an externality an example of market failure?

8. **Public goods**
   What is a public good? Describe this in terms of exclusiveness and rivalry. Provide an example related to the environment.

9. **Optimal level of pollution**
   How is this determined? Describe in terms of the marginal damage function and marginal abatement costs.

10. **Coase Theorem**
    What does this theorem assert about the attainment of an optimal level of pollution and what is the key condition required for this to occur?

11. **Economic instruments for pollution control**
    Distinguish between a Pigovian tax and a marketable permit scheme as economic instruments to address pollution.

12. **Economic rent**
    What is economic rent? How does differential or Ricardian rent differ from scarcity rent?

13. **Hartwick Rule**
    How does this rule link sustainability to the use of natural resources?

14. **Hotelling Rule and non-renewable resource use**
    What does this rule require if a resource extractor is to maximize economic rent over time from extraction of a non-renewable resource?

15. **Open access resource regime**
    What are the consequences for economic rent when a common pool resource has unrestricted access and no property rights?

16. **Game theory and strategic behavior**
    How does Nash equilibrium demonstrate strategic behavior and why (or in what situations) is this important for environmental management?

17. **Safe Minimum Standard (SMS) of conservation**
    What is an SMS and how does it demonstrate precautionary thinking?

18. **Gains from trade and the environment**
    How does the presence of comparative advantage lead to gains from trade? What are the consequences of agricultural trade for the environment?

4. Key Concepts in Public Policy and Planning

- Definitions: public policy; policy making process; policy analysis; planning; types of planning, including technocratic planning, advocacy planning, comprehensive planning, ad hoc planning and collaborative planning.

- Broad theories of the policy process:
    - Policy cycle (stages) model
    - Multiple streams (garbage can) model
    - Institutional analysis and development framework
    - Punctuated equilibrium theory
    - Innovation and diffusion
    - Models of policy subsystems
        - Networks, regimes, advocacy coalitions

- Problem definition and why it is important in policy making.

- Roles of key actors in the policy process (elected officials, civil servants, scientists, stakeholders).

- Basic understanding of the analytical tools available for evaluating policy options (e.g., benefit cost analysis, cost effectiveness analysis, risk assessment, multi-attribute or multi-criteria analysis, environmental and social impact assessment, SWOT).

- Types of policy instruments that are available to achieve policy aims (e.g., information/moral suasion, market-based instruments, regulation, acting directly); strengths and weaknesses of each.

- Rational model vs. incremental model (muddling through) of decision making.

- Impediments to rational policy making (e.g., regulatory capture, bureaucratic self-interest, diffused costs/concentrated benefits).

- Models of implementation (top-down, bottom-up, mixed).

- Policy termination, why it is difficult and how the difficulties can be overcome.

- Institutions, how they operate and why they are important.

- Property rights, common pool resources, tragedy of the commons, alternative forms of ownership/management.

- Precautionary principle, precautionary approach, precautionary measures.

- Models of participation in planning and decision making; advantages and disadvantages.
- Possible criteria for evaluating policy making and planning processes, including best practices for planning.

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