FOUNDATIONS OF FISHERIES AND WILDLIFE POPULATION ECOLOGY AND MANAGEMENT

Fall 2007, FIW 5984, CRN 97424, 3 Credit Hours

General Student Learning Objectives:

1. **Gain knowledge of historical and contemporary ecological literature with direct relevance to fisheries and wildlife population management and biological conservation.**
2. **Review major lines of ecological development with respect to fish and wildlife populations, from past to present.**
3. **Gain exposure to research concepts in ecological sub-disciplines.**
4. **Acquire experience in written and oral scientific communication in the context of the literature and your own graduate research.**

This course will cover the foundations of population ecology and some evolutionary ecology and ecosystem ecology with direct application to the fields of fisheries and wildlife management and conservation. The goal is to introduce students to the foundations of ecology most relevant to present-day and future FiW management and conservation through a combination of lectures, literature review and discussion, and a grant-writing project. The course is intended to introduce beginning and continuing graduate students to how some of the major population and evolutionary ecology concepts originated and continue to be developed in fisheries and wildlife management and conservation. We also will spend some time discussing a few key concepts in ecosystem ecology that are critical to managing fish and wildlife populations. Theme-specific learning objectives will be provided during the course.

The course will focus primarily on population ecology, and secondarily on evolutionary ecology and ecosystems, with very little emphasis on communities and animal behavior to avoid overlap with other courses on campus. The syllabus has been developed with input from faculty and students in the Departments of Fisheries and Wildlife Sciences and the Department of Biology so that course material complements and prepares students for additional coursework in Advanced Fisheries and Population Dynamics (with Professors Kelly, FiW 5984, and Jiao, FiW 5514), Population and Community Ecology (BIO 5024, Professor Belden), Vertebrate Population and Habitat Analysis (FiW 5214, Professor Stauffer), Behavioral Ecology (BIO 6004, Professor Walters), Conservation Genetics(FiW 5114, Professor Hallerman), and Simulation Modeling and Visual Basic in FiW (FiW 5984). These faculty members may appear as associate guest lecturers in areas of their own expertise.

Format and Assessment: Material will be covered through a combination of lectures, student/instructor led discussions of historical, classic and modern ecology and FiW literature, and an individual-based project. In the project, students will prepare a short introduction of a research topic that includes a range of background papers from the classic to modern in the style of an NSF, EPA, or NMFS graduate fellowship application. Grades will be based on daily in-class participation in discussions and short written paper summaries (50%), discussion leader responsibilities (25%), and the grant-writing project (25%).

a) Lectures (0% grade): Weekly, instructor will provide overviews of key concepts in ecology and fisheries and wildlife sciences that will be developed in the weekly readings. Lectures are intended to make the concepts communicated in the papers cohesive and relevant to the present-day field of study.

b) In-class participation in discussions and short-written paper summaries (50%): Readings are organized into topics reflecting major lines of thought developed at different levels of organization during the history of population ecology and FiW sciences. Readings have been selected from several compilations of key papers in these fields as well as the primary literature. Criteria for inclusion in these compilations and this course syllabus include 1) significance of the contribution, primarily judged by citation rate (Cushing 1983, Kormondy 1965), 2) evidence of exemplary scientific procedure (Hazen 1975), or 3) lasting impacts on the field (Real & Brown 1991).

For every major theme in the course, one historical paper-group from Kormondy (1965, cited below), 2-3 classic papers from the primary literature, and 2-3 modern papers from the primary literature will be studied and discussed with reference to these themes.

For each class period during which classic and modern papers are discussed, each individual student is responsible for bringing to class and handing in a short written summary of two papers as follows (5 pts/summary). Late summaries will not be accepted. This should not take much more time than reading the papers alone, and it is intended to encourage processing of key points, to develop succinct summary skills, and to facilitate in-class discussions. The written summaries should only be six sentences long per paper (so twelve sentences per class) as follows:

a. One sentence that states the question addressed in the study and explains why the question is important (e.g. introduction),
b. One sentence that tells how the question is answered (e.g. methods)
c. One sentence that shows the key outcome of the experiment (e.g. results)
d. One sentence that suggests of the impact of these results (e.g. discussion)
e-f. Two questions that you have about the paper (any component of it).

c) Discussion leader responsibilities (25%) For each class period designated for discussion and analyses of modern papers, the class will be co-lead by the instructor and 1-2 students (depending on class size). The designated students will decide which modern papers will be read by the entire class at **least two weeks before the class period** in consultation with the instructor. The modern papers will be assigned and distributed **no later than one week before the discussion class period**. Modern articles will be chosen by the students, perhaps using a forward citation search from the Kormondy (1965) historical papers or classic papers.

Each 1-2 student team, assisted by the instructor, will lead the class in discussions. The students will also prepare summary handouts to accompany the discussions for all class members to keep in their own files. This summary will be used to prompt discussion by all along with each individual's paper summaries (see above). For the class period that

you are leading the discussion, you do **not** need to hand in separate short paper summaries. The student leader summary for each paper (approximately 2 pages, only required when you are leading the class discussion) should include the:

a. Major Themes Covered
b. Stated Purpose or Goals Asked (Questions asked, hypotheses tested)
c. How well did the article fulfill its states goals or purposes?
d. Significance in the historical development of the theme or topic
e. New contributions to the line of thought,
f. Questions for the class to discuss concerning future research, suggestions for management implications, etc.

Discussions leaders will receive a maximum of 85 pts (25% of grade) for this responsibility as follows: 60 pts for written summary delivered to class for pts (a-f) from above plus 25 pts for discussion leading in class. See the suggestions for successful discussions and discussion leading offered at the end of this syllabus. For each discussion class period, one person (not the leader) will be responsible for taking notes and distributing them to the class at the next meeting.

d) Grant-writing project (25%) Each student, with guidance by the instructor, will prepare a **1.5-page paper (single-spaced)** that could serve as an introduction to a grant proposal on a research topic of their choice. In this paper, the students will state the problem to be studied and hypotheses to be tested, the scientific significance and originality of the work, and its relationship to classic and contemporary studies. The goal is to provide students with experience in writing the introduction or proposed plan of study for a research proposal such as an NSF graduate research fellowship. Students may choose to work with their advisors or committees to develop a full length proposal using the introduction from this class. Students will only be graded on the introduction. The papers will be due at approximately the 2/3rd point of the course for peer review and constructive critiques and then will be presented to the class and graded by the instructor in the last week of the semester. Presentations are intended to introduce the class to a breadth of current research, linking the research to the theoretical foundations of ecology and FiW sciences.

The grant-writing project will be worth a maximum of 85 pts as follows: 20 pts for providing a constructive peer review of two colleagues' proposals according to a set format, 40 pts for your own final written document, 25 pts for your own presentation. A detailed rubric is provided at the end of this syllabus for each of these tasks. A detailed description of format and content of the grant-writing project is provided separately.

Historical readings have been selected from:

- Kormondy, E. J. 1965. *Readings in Ecology.* Prentice Hall, Englewood Cliffs, New Jersey. (Edited highlights of original papers)

Classic readings have been primarily selected from the primary literature and the following two compilations:

- Cushing, D.H, editor. 1983. *Key papers on fish populations.* IRL Press, Washington, D.C.

- Real, L., and J. H. Brown, editors. 1991. *Foundations of Ecology: Classic Papers with Commentaries*. University of Chicago Press, Chicago.

- Hazen, W. E. 1964. *Readings in Population and Community Ecology.* Saunders, Philadelphia & London. 388 pp.

All papers are available on Blackboard and an optional supplemental reading list will be provided. Modern papers will be selected by students in consultation with the instructor during the course and provided to the entire class at least one week prior to class meeting.

General Dates and Class Theme	Class Format and Readings • **CLASS NUMBERING ASSUMES 3 hours per week, 2-1.5 hour classes.** • **Class times will be determined to fit schedules of registrants and instructor**
Aug 20-24 Defining Ecology, Fisheries, Wildlife Management	**CLASS 1_Aug 20** Course overview and description of assessments and responsibilities Introductory lecture on historical definitions of Ecology, FiW Management, Conservation Biology **CLASS 2_Aug 22** Discussion of Review and Classic Papers Review Papers: Kormondy, E. J. 1965. *Readings in Ecology.* Prentice Hall, Englewood Cliffs, New Jersey. • pp. xiii–xiv: Early definitions, Reiter (1865) , St. Hilaire (1859), Haeckel (1866) , Mivart (ca. 1850's) • pp. 1–10: Early Natural History, Theophrastus (300 B. C.) de Reaumur (ca. 1742), Linnaeus (1750) Classic Papers: • Real, L., and J. H. Brown, editors. 1991. *Foundations of Ecology: Classic Papers with Commentaries*. University of Chicago Press, Chicago., S.E. Kingsland (1991) Defining Ecology as a Science, pp. 1–13. • Magnuson, J.J. 1991. Fish and fisheries ecology. Ecological Applications. 1(1): 13-26.
Aug 27-31, Sept. 3-5 Interactions between organisms and the environment	**CLASS 3_Aug 27** Intro lecture on interactions of organisms and the environment, the niche concept, Discussion of Review Papers Review Papers: Kormondy, E. J. 1965. *Readings in Ecology.* Prentice Hall, Englewood Cliffs, New Jersey. • Environmental factors affecting organisms: pp. 11–31, Justus Liebig (1840), F. F. Blackman (1905) , Victor E. Shelford (1911), Lawrence J. Henderson (1913), R. Geiger (1941), G.L. Clarke (1939), • Organism responses to the environment: pp. 40–60, T. H. Bullock (1955), H. S. Jennings (1904), J. Loeb (1918), D. H. Spalding (1872), K. Lorenz & N. Tinbergen (1938), A. D. Hasler & W. J. Wisby (1951) **CLASS 4_Aug 29** Classic Papers: Short summaries of 2 papers due in class • Hutchinson, G. E. (1957) Concluding remarks. Cold Spring Harbor Sympos. Quant. Biol. 22: 415–427. • Kerr, S.R. and E.E. Werner (1980) Niche theory in fisheries ecology. Transactions of the American Fisheries Society 109: 254-260. **CLASS 5_Sept 3** Discussion of Modern Papers and Weekly Summary, Led by Instructor as an example for future weeks to be led by students Modern Papers: Short summaries of 2 papers due in class • Pulliam, H. Ronald (2000) (13 pp.) On the relationship between niche and distribution. Ecology Letters 3:349-361. • Austen, D.J., P.B. Bayley, B.W. Menzel. 1994. Importance of the guild concept to fisheries research and management. Fisheries 1994: 12-20.

Sept 5-7, 10-14 Population Growth (Density-dependence, single-species, single population growth)	**CLASS 6_Sept 5** Intro lecture on population growth Discussion of Review Papers Review Papers: Kormondy, E. J. 1965. *Readings in Ecology.* Prentice Hall, Englewood Cliffs, New Jersey. pp. 62–76, T. R. Malthus (1798), P. F. Verhulst (1838), R. Pearl and L. J. Reed (1920), R. N. Chapman (1928), C. S. Elton (1924) **CLASS 7_Sept 10** Discussion of Classic Papers Classic Papers: Short summaries of 2 papers due in class • Volterra, V. 1926. Fluctuations in the abundance of a species considered mathematically. Nature 118: 558-560. • Krebs et al. (1973) Population cycles in small rodents. Science. 179: 34-41. • Beverton, R.J.H. and S.J. Holt (1956). The theory of fishing. In Sea Fisheries: their investigation in the United Kingdom, M. Graham (ed.) Arnold, London, pp372-441. **CLASS 8_Sept 12** Discussion of Modern Papers and Weekly Summary, Short summaries of 2 papers due in class Modern Papers: (Two papers selected by student leaders)
Sept 17-21, 24-26 Population regulation I: historical developments and intra-specific regulation	**CLASS 9_Sept 17** Intro lecture on population regulation, historical development and intra-specific regulation mechanisms Discussion of Review Papers Review Papers: Kormondy, E. J. 1965. *Readings in Ecology.* Prentice Hall, Englewood Cliffs, New Jersey. • pp. 102–117, D. Lack (1948) , L. C. Birch (1957), A. J. Nicholson (1957) **CLASS 10_Sept 19** Discussion of Classic Papers Classic Papers: Short summaries of 2 papers due in class • Andrewartha, H.G. and L.C. Birch. 1954. A general theory of the numbers of animals in natural populations. Reprinted from pp 648-665 of The distribution and abundance of animals, University of Chicago Press. • Wynne-Edwards, V.C. 1965. Self-regulating systems in populations of animals. Science 147: 1543-1548. • Ricker, W.E. 1954. Stock and recruitment. Journal of the Fisheries Research Board of Canada 11: 559-623. **CLASS 11_Sept 24** Discussion of Modern Papers and Weekly Summary, Short summaries of 2 papers due in class Modern Papers: (Two papers selected by student leaders)

Sept 26-28, Oct 1-5 Population Regulation II Population interactions: predation and competition, multiple factors	**CLASS 12_Note: I would like to move this class to Friday Sept 28th, 2:30-3:45. I will remind you before the change.** Intro lecture on population regulation, predation, competition, multiple factors Discussion of Review Papers Review Papers: Kormondy, E. J. 1965. *Readings in Ecology.* Prentice Hall, Englewood Cliffs, New Jersey. • pp. 77–101, P. R. Burkholder (1952), G. F. Gause (1934), J. H. Connell (1961), H. E. Howard (1920), , W. M. Wheeler (1918), W. C. Allee (1926) **CLASS 13_Oct 1** Discussion of Classic Papers Classic Papers: Short summaries of Hixon et al. and 1 other paper due in class. • Hairston, N.G., F.E. Smith, and L.B. Slobodkin. 1960. Community structure, population control, and competition. Amer. Nat. 94: 421-425. • Wagner, F.H. and L.C. Stoddart. 1972. Influence of coyote predation on black-tailed jackrabbit populations in Utah. Journal of Wildlife Management. 36: 329-342. • Hixon, M.A., S.W. Pacala, S.A. Sandin. 2002. Population regulation: historical context and contemporary challenges of open vs. closed systems. Ecology 83(6): 1490-1508. **CLASS 14_Oct 3** Discussion of Modern Papers and Weekly Summary, Short summaries of 2 papers due in class Modern Papers: (Two papers selected by student leaders)

Oct. 8-12, 15-17 Population Regulation III: harvesting and direct management	**CLASS 15 Note_No class Oct 8th. We will try and shift dates this week. This class will be Oct 10th.** Intro lecture on population regulation: harvesting and direct management **CLASS 16 Oct. 12th if possible** Discussion of Classic Papers Classic Papers: Short summaries of 2 papers due in class • B.E. Brown, J.A. Brennan, M.D. Grosslein, E.G. Heyerdahl, and R.C. Hennemuth. 1976. The effect of fishing on the marine fish biomass in the Northwest Atlantic from the Gulf of Maine to Cape Hatteras. Research Bulletin of the International Commission for the Northwest Atlantic Fisheries. 12: 49-68. • Mosby, H.S. 1969. The influence of hunting on the population dynamics of woodlot gray squirrel population. Journal of Wildlife Management. 33:59-73. • Larkin, P. 1977. An epitaph for the concept of maximum sustained yield. Trans. Am. Fish. Soc. 106: 1-11. **CLASS 17 Oct. 15** Short summaries of 2 papers due in class Modern Papers: (Two papers selected by student leaders)
Oct. 17-19, 22-24 Metapopulations	**CLASS 18 Oct 17** Intro lecture on metapopulations Discussion of Classic Papers Classic Papers: Short summaries of 2 papers due in class • Pulliam, H. R. (1988) (10 pp.) Sources, sinks, and population regulation. Amer. Nat. 132: 652–661. • Hanski, I. and M. Gilpin. 1991. Metapopulation dynamics: brief history and conceptual domain. Biological Journal of the Linnean Society. 42: 3-16. **CLASS 19 Oct 22 DRAFT OF GRANT-WRITING PROJECT DUE IN CLASS FOR REVIEW** Modern Papers: Short summaries of 2 papers due in class (Two papers selected by student leaders)

Oct 24-26, 29-31 Evolution of life histories as applied to FiW management and conservation	**CLASS 20 Oct 24** Intro lecture on evolution of life histories and FiW management and conservation Discussion of Classic Papers Classic Papers: Short summary of 1 paper due in class • Stearns, S.C. 1977. The evolution of life history traits: a critique of the theory and a review of the data. Annual Review of Ecology and Systematics. 8:145-171. • Gould, S.J. and Lewontin, R.C. (1979) The spandrels of San Marco and the Panglossian paradigm: a critique of the adaptationist programme. Proceedings of the Royal Society of London B 205:581-598 • G.C. Williams. 1966. Natural selection, the costs of reproduction, and a refinement of Lack's principle. American Naturalist. 100: 687-690. **CLASS 21 Oct 29 REVIEWS OF GRANT-WRITING PROJECT DUE IN CLASS** Discussion of Classic Papers Continued Classic Papers: Short summaries of 2 papers due in class • Gavin, T.A. 1991. Why ask why: the importance of evolutionary biology in wildlife science. Journal of Wildlife Management 55: 760-766. • Semel, B. and P.W. Sherman. 1995. Alternative placement strategies for wood duck nest boxes. Wildlife Society Bulletin. 23(3): 463-471.
Oct 31-Nov 2 Evolution of life histories as applied to FiW management and conservation	**CLASS 22 Oct 31** Modern Papers: Short summaries of 2 papers due in class (Two papers selected by student leaders)

Nov 5-9 Ecosystem Organization and Boundaries	**CLASS 23 Nov 5** Intro lecture on ecosystem concepts, defining and limiting objectives for this large topic Discussion of Review Papers <u>Review Papers</u>: Kormondy, E. J. 1965. *Readings in Ecology.* Prentice Hall, Englewood Cliffs, New Jersey. • Ecosystem concepts: Pp 166-170, F.C. Evans (1956), S.A. Forbes (1887) • Ecosystem energetics: Pp 179-193, Lindeman (1942), Clarke (1946), Odum (1957), Harvey (1926) • Ecosystem organization and regulation: Pp 196-219, Redfield (1958), A. Leopold (1941), G.E. Hutchinson (1959), R.H. MacArthur and J.W. MacArthur (1961), E.P. Odum (1962), R. Margalef (1963) **CLASS 24 Nov 7** Discussion of Classic Papers <u>Classic Papers, Trophic cascades and boundaries</u>: Short summary of 1 paper due in class • Naiman, R.J., H. Decamps, J. Pastor, C.A. Johnston. 1988. The potential importance of boundaries to fluvial systems. H. N. Am. Benthol. Soc. 7(4): 289-306. • Hynes, H.B.N. 1975. The stream and its valley. Verh. Int. Verein. Limnol. 19: 1-15. • Carpenter, S.R., J.F. Kitchell, J.P. Hodgson. 1985. Cascading trophic interactions and lake productivity: Fish predation and herbivory can regulate lake ecosystems. BioScience 35: 634-639. • Carpenter, S.R., and J.F. Kitchell. 1992. Trophic cascade and biomanipulation: Interface of research and management-A reply to the comment by DeMelo et al. Limnology and Oceanography. 37(1): 208-213.
Nov 12-16 Ecosystem Organization and Boundaries	**CLASS 25 Nov 12** <u>Modern Papers, Aquatic Focus</u>: Short summaries of 2 papers due in class (Two papers selected by student leaders) **CLASS 26 Nov 14** <u>Modern Papers, Terrestrial Focus</u>: (Two papers selected by student leaders) Short summaries of 2 papers due in class
Thanksgiving Break	No classes
Nov 26-30 presentations	**CLASS 27-28 Nov 26 and 28 FINAL GRANT-WRITING PROJECT DUE** Presentations of grant-writing project
Dec 3-5 presentations	**CLASS 29 Dec 3, Dec 5** Presentations of grant-writing project and wrap-up

Keys to Successful Discussions in the Classroom

From: J. Eison, University of South Florida, "Leading Discussions Skillfully," January 2003

Discussions can be categorized into four categories: (1) boring and non-productive, (2) boring and productive, (3) interesting yet non-productive, (4) interesting and productive. Clearly, we are aiming to have interesting and productive discussions in this class. Eison (2003) summarized some characteristics of the four discussion types. We should be cognizant of the direction that our discussion is going and aim for the 4th category descriptives!

Boring and non-productive discussions:

- Clear goals have not been set or do not emerge
- Discussion structure and ground rules have not been clearly established or communicated
- The facilitator and participants are not adequately prepared, motivated, or are close-minded
- The discussion topic is inappropriate (too-limited, too difficult, too broad)
- The discussion lacks challenge or spontaneity
- The pace is too rushed or too slow

Boring but productive discussions:

- The facilitator determines the topic, content, tasks, and pace of the discussion
- The topic is of little interest to students
- The discussion topic is too easy, reviews simple material
- The discussion is dominated by a few individuals

Interesting but non-productive discussions:

- The discussion strays too far off topic
- Participants' desire to be funny becomes contagious and distracting
- It becomes a "non-winnable debate" leading to increased polarization of different viewpoints
- External interruptions break the continuity
- When time constraints do not allow adequate coverage of an interesting issue
- The facilitator loses control of the discussion

INTERESTING AND PRODUCTIVE DISCUSSIONS:

- **The facilitator and participants trust each other**
- **The facilitator and participants are well-prepared and highly motivated**
- **The participants engage in a high level of critical and creative thinking**
- **The facilitator allows the participants to "do" the learning**
- **The facilitator and/or participants summarize the discussion outcomes effectively**

Six Essential Discussion Leading Skills

From: Hyman, R.T. (1980) Improving discussion leadership. NY: Teachers College Press.

1. The Skill of Contributing: Make comments that add to the topic at hand!
   - Provide needed information that other discussants do not contribute themselves.
   - Correct errors that are deemed critical and those other discussants do not correct.
   - Enter the discussion when it is apparent that an important point that is needed will not be made by others.
   - Respond to requests by discussants
   - Offer new ways to view a point already raised
   - Do not dominate by lengthy or frequent contributions

2. The Skill of Crystallizing: State in a concise way another discussant's remarks
   - Clarify points made by discussants who may not even be aware of the various messages being sent out to the group.
   - Offer a sharp, alternative way to perceive the meaning of the speaker's remarks.
   - Reflect to the group what the impact of their remarks is
   - Indicate to the speakers that you are listening attentively

3. The Skill of Focusing: Put the discussion onto its intended course or redirect it onto another path that is desirable.
   - Keep the discussion going along on the desired path and prevent the "spinning of wheels"
   - Set limits on what is to be discussed and what is off-limits
   - Provide opportunity for quieter participants to talk and gently remove dominant speakers from limelight

4. The Skill of Introducing/Closing: This is important to get the discussion started and to bring it to a meaningful end
   - Be brief
   - Initiate the interaction by clarifying the topic and sub-topic for discussion
   - Clarify the specific topic for discussion with a question that provides for a set of responses to be talked about by the participants
   - In closing the discussion, recapitulate the high points and launch future activities
   - Close when the allotted time allows, or when the discussant's attention lapses, or preferably when you have reached the goal.

5. The Skill of Questioning: This is important to involve all discussants and to bring forth the needed ideas.
   - Question when data, opinions, explanations, and generalizations are needed for the flow of the discussion.
   - Probe when further points will add to the topic for other discussants to build on.
   - Question with a tone that expresses a seeking of information.
   - Avoid threatening and embarrassing the respondent.
   - After asking a question, pause for at least 5-10 seconds to allow time for people to respond.

6. The Skill of Supporting: Encourage discussants with praise, relieve tension, elicit participation of shy group members.
   - Listen attentively and be patient
   - Use nonverbal techniques related to room environment, seating arrangement, proximity, eye contact, and body language to demonstrate encouragement.

Questions that can be used to foster critical thinking.
Paul, R.W. 1995. Socratic questioning and role-playing. Foundation for Critical Thinking. Santa Rosa, CA.

Questions of clarification:

- What do you think is the main issue here?
- Is your basic point____ or _____?
- Could you explain that further?
- Could you give me an example?
- Why do you say that?

Questions that probe assumptions:

- What are you assuming?
- What could we assume instead?
- Your reasoning depends on the idea that_____. Why have you based your reasoning on ____ rather than ____?
- Is this always the case? Why do you think the assumption holds here?

Questions that probe reasons, evidence, and causes:

- What are your reasons for saying that?
- What other information do we need to know?
- Could you explain your reasons to us?
- Is that could evidence for believing that?
- Is there reason to doubt that evidence?
- What do you think the cause is?
- By what reasoning did you come to that conclusion?
- How could we go about finding out whether that is true?
- What could convince you otherwise?
- Can someone else give evidence to support that response?

Questions that probe implications and consequences:

- What are you implying by that?
- When you say_____, are you implying_____?
- But if that happened, what else would also happen as a result?
- What effect would that have?
- If this and this are the case, then what else must be true?

Questions about the question:

- How can we find out?
- Do we all agree that this is the question?
- To answer this question, what other questions would we have to answer first?
- Can we break this question down at all?
- What does this question assume?

** Note, it is estimated that after 5 or 6 comments on a particular topic or question, the participants lose interest and the facilitator should take the lead again in the discussion. (Lowman, J. 1984. Mastering the techniques of teaching. San Francisco. Jossey-Bass.

Grading Rubric for Grant-Writing Assignment and Presentations. Also, use this form to guide peer review. (40 pts max possible for final grant writing assignment (W), 25 points max for presentation (P), for each peer review that you complete constructively you receive 10 pts)

Criterion listed in Assignment (Points received)	*Does not meet Expectations*	*Meets Expectations*	*Exceeds Expectations*	Points / Possible
Problem to be Studied	Topic and problem to be studied are unclear. (W: 0-2 pts; P: 0-1 pts)	Problem stated but not clearly placed in context with the remainder of document (W: 3-4 points; P: 2 pts)	Problem to be studied clearly and concisely identified and placed in context (W: 5 points; P: 3 pts)	/5 (W) /3 (P)
Hypotheses Stated	Hypotheses not stated or are listed unclearly or not in a proper format (W: 0-2 pts; P: 0-1 pts)	Hypotheses simply stated. (W: 3-4 points; P: 2 pts)	Null and alternative hypotheses clearly and concisely stated and are relevant to identified problem (W: 5 points; P: 3 pts)	/5 (W) /3 (P)
Scientific Significance and Originality	Problem statement and hypotheses provide no new scientific knowledge, or the significance and originality are not clear to the reviewer (W: 0-2 pts; P: 0-1 pts)	The scientific significance and originality are valid and clearly stated. (W: 3-4 points; P: 2 pts)	The scientific significance and originality are valid and clearly stated and placed into context with the entire document, including broader impacts (W: 5 points; P: 3 pts)	/5 (W) /3 (P)
Context of this Study in Published Literature	References to published literature are unclear and/or illogical from the given problem statement and hypotheses. (W: 0-2 pts; P: 0-1 pts)	Previous research and published literature relevant to the problem statement and hypotheses are identified and properly cited. (W: 3-4 points; P: 2 pts)	Previous research and published literature relevant to the problem statement and hypotheses are identified and properly cited. There is a clear use of previous work as the foundation for new ideas and directions. (W: 5 points; P: 3 pts)	/5 (W) /3 (P)
General Methods	No methods identified, or methods are unrealistic (W: 0-2 pts; P: 0-1 pts)	General, realistic methods are identified in proper context. (W: 3-4 points; P: 2 pts)	General, realistic methods are identified in proper context and the rationale for using those methods is clear. (W: 5 points; P: 3 pts)	/5 (W) /3 (P)
Anticipated Results	No anticipated results stated, or anticipated results do not follow logically from problem statement, hypotheses, and methods (W: 0-2 pts; P: 0-1 pts)	Anticipated results clearly stated and they follow logically from problem statement, hypotheses, and methods (W: 3-4 points; P: 2 pts)	Anticipated results clearly stated and they follow logically from problem statement, hypotheses, and methods, clear link between anticipated results and broader impacts. (W: 5 points; P: 3 pts)	/5 (W) /3 (P)
Broader Impact	No broader impacts identified, or those identified are unrealistic or not linked to the main proposal (W: 0-2 pts; P: 0-1 pts)	Broader impacts, as defined by NSF, are clearly stated (W: 3-4 points; P: 2 pts)	Broader impacts, as defined by NSF, are clearly stated and linked to the methods and anticipated results (W: 5 points; P: 3 pts)	/5 (W) /3 (P)
Continuity and flow of document/presentation	Document does not read smoothly, sections do not flow logically (W: 0-2 pts; P: 0-1 pts)	Document reads smoothly and clearly and there is a logical progression of ideas and linkages of concepts (W: 3-4 points; P: 2 pts)	Document is clear and concise. The reviewer is left with confidence that the problem can be addressed and the anticipated results achieved. (W: 5 points; P: 3-4 pts)	/5 (W) /4 (P)