Preliminary Syllabus for
BIOL 492 / 692, Arctic Vegetation Ecology: Lecture, Spring 2012

1. Course information

Title: Special Topic, Arctic Vegetation Ecology: Lecture
Number: BIOL 492 / 692
Credits: 3
Prerequisites: BIOL 115 & 116, Introduction to Plant Biology (BIOL 239) or Principles of Ecology (BIOL 271) or instructor approval
Location: 183 AHRB
Meeting time: T/Th, 2:00 pm – 3:30 pm

2. Instructor

Prof. D.A. (Skip) Walker, Alaska Geobotany Center, University of Alaska Fairbanks, AHRB, Room 254, 474-2460, dawalker@alaska.edu. Office hours: Generally available, call before coming.

3. Course readings/Material

Numerous papers will be read and are in the assignments listed in the course calendar and will be posted on line at http://www.geobotany.uaf.edu/teaching/biol492/. These three references provide a good overview of the Arctic Vegetation in North America and Russia and the current issues relevant to Arctic vegetation:

1. Bliss, L.C. 1997. Arctic Ecosystems of North America. Polar and Alpine Tundra. Elsevier. Amsterdam. pp. 551-683.
2. Callaghan, T.V., Bjorn, L.O., Chapin III, F.S., et al. 2005. Chapter 7, Arctic tundra and polar desert ecosystems. Arctic Climate Impact Assessment - Scientific Report. Cambridge University Press. Cambridge. pp. 243-352.
3. Chernov, Y.I., Matveyeva, N.V. 1997. Arctic ecosystems in Russia. Polar and Alpine Tundra. Elvesier. Amsterdam.3 pp. 361-507.

4. Course description

Course catalog description:
BIOL F492 / 692 Special Topic, Arctic Vegetation Ecology: Lecture
3 Credits Offered Spring 2012
Detailed study of Arctic plant communities including their composition, structure, paleo-history, biogeography, major environmental controls, applications of Arctic vegetation methods to current Arctic issues including climate change, wildlife management, and changing land-use in the Arctic. Special fees apply. Stacked with BIOL F692 (2 + 0.5 + 0.5)

More detailed description of course contents:

1. Lectures: This portion will examine the tundra plant communities and ecology of Arctic tundra. The emphasis will be on the factors controlling vegetation patterns, including climate, permafrost, geomorphology, soils, animals, zonation, paleogeography, biogeographic history, plant adaptations, and succession patterns.
2. Literature discussion and student presentations: Weekly discussion groups to

explore the key literature related to the lectures.

3. Student oral presentations of research topics: Oral presentations of in-depth literature review on Arctic Vegetation topic of choice.
4. Snow Ecology component: Lecture plus a Saturday excursion to Eagle Summit (or a possible alternative field trip to the Cantwell cabin over spring break) to examine the alpine system in winter conditions. The focus will be on subnivian environments, and the effects of topography and snow distribution patterns on plant habitat distribution

This course is part of a 3-course offering in vegetation science that includes (1) BIOL 492 / 692, Arctic Vegetation Ecology: Lecture, (2) BIOL 493 / 693, Arctic Vegetation Ecology: Excursion, and (3) BIOL 4__ / 6__ Vegetation Description and Analysis. The courses are designed to give students a thorough practical background and training in vegetation sampling and analytical methods adapted to northern ecosystems.

5. Course goals and student learning outcomes:

The goals for the course are to: (1) Provide students with an in-depth knowledge of Arctic vegetation and application of vegetation science to current Arctic issues. (2) Provide a winter field trip to understand snow-vegetation interactions and snow-related phenomena. (3) Give students exposure to key Arctic vegetation literature and opportunity to actively discuss and debate this literature.

6. Instructional method and evaluation criteria:

Lectures:

- Thirteen lectures will examine the tundra plant communities and ecology of Arctic tundra. Generally, two lectures will address a given topic, followed by a class period that will be devoted to discussion of literature that addresses the topic. Usually there will be time during and at the end of the lecture to discuss the assigned readings and the contents of the lecture.
- Students are expected to attend the lectures and read the assigned literature and participate in the discussion.
- There will be no tests over the lectures. 10 points will be awarded for attendance at each lecture.

Literature discussion sessions:

- **Six literature discussion sessions** will be devoted to analysis of some of the key literature related to the lectures.
- A **graduate student moderator** designated for each session will be responsible for reading both papers, introducing the main speakers, asking for questions and input from the rest of the class, and keeping the discussion on time. The moderator will receive 50 points for this service.
- The class will be divided into **two discussion groups** at the beginning of the semester. Discussion Group 1 will read Paper 1 in preparation for the discussion, and Discussion Group 2 will read Paper 2.
- For each paper, **one student presenter for each group** will be assigned by the instructor to present a 15-20-minute summary of the paper to the class. These overviews should present a summary of the background, methods, results and the

principal points of the paper or an overall summary of the paper if is a review paper. The presentations can include slides of key figures from the paper as discussion points. Students making the presentation will be graded on criteria that will be handed out early in the semester (100 possible points).

- The **rest of the group** will then fill in with other points and comments about the paper. Each discussion group will have 30 minutes including discussion. Both discussion groups in total should take about 1 hour total to present the two papers.
- After both papers have been presented, there will be a **general discussion of both papers**. This will include comparisons of methods, how they might be related to each other and significance and relevance of the papers to Arctic Ecology. Students will receive credit for their active participation in the discussions (15 points per session).

Research topics:

- Each student will select a research topic of their choosing early in the semester.
- At the end of the lecture series (Lesson 23-25), students will present 30-minute oral summaries of individual library research topics.
- Graduate students will submit a 3000 to 4000-word research paper on an Arctic Vegetation topic of their choice at the end of the course, which can cover the same material as the oral presentation.
- **Guidelines for oral and written presentations** are at: http://www.geobotany.uaf.edu/teaching/biol492/grading_criteria.pdf.

Snow Ecology component:

- One lecture plus a Saturday excursion to Eagle Summit (**or** Cantwell, see below) to examine the alpine system in winter conditions.
- The focus will be on subnivian environments, and the effects of topography and snow distribution patterns on plant habitat distribution.
- Fun day and students will only be graded on attendance.

Possible field trip over Spring Break (Mar 13-15) to Cantwell cabin:

- 3-day field trip, 13-15 Mar to the UAF cabin at Cantwell near treeline of Denali Park with David Klein.
- Details of the trip and content of the field trip will be made during the course.
- If everyone can go on the trip, the trip will replace the Saturday field trip to Eagle Summit on April 7 and the last three lessons on April 19, 24 and 26, while Dr. Walker is in Montreal for a conference.
- Otherwise we will have guest lectures on Apr 19, 24 and 26.

7. Course schedule and reading assignments:

Lesson	Date	Topic	Reading assignment (available online at the course web site http://www.geobotany.uaf.edu/teaching/biol492/):
1	Jan 19	Introduction	

2-3	**Jan 24, 26**	**Lectures 1-2:** Overview of Arctic Ecosystems: The role of climate and topography	Callaghan, T.V., Bjorn, L.O., Chapin III, F.S., et al. 2005. Chapter 7, Arctic tundra and polar desert ecosystems. Arctic Climate Impact Assessment - Scientific Report. Cambridge University Press. Cambridge. pp. 243-352. **This is an excellent summary of the current state of knowledge of Arctic terrestrial ecosystems. Use as a standard reference, skim it now, begin reading and complete by Mar 1, Lesson 12.**
4	**Jan 31**	**Literature discussions 1**	**Discussion group 1:** Bliss, L.C. 1997. Arctic Ecosystems of North America. Polar and Alpine Tundra. Elsevier. Amsterdam. pp. 551-683. **Focus on p. 551-568.** **Discussion group 2:** Chernov, Y.I., Matveyeva, N.V. 1997. Arctic ecosystems in Russia. Polar and Alpine Tundra. Elvesier. Amsterdam.3 pp. 361-507. **Focus on p. 361-387.** **Everyone skim both chapters. Both are long but excellent summaries for North America and Russia. Speakers should present overview of their respective chapters, but focus on the specified pages. Be prepared to discuss similarities and differences between the chapters. Why do you think the Russian and American approaches are so different?**
5-6	**Feb 2, 7**	**Lectures 3 and 4:** The role of soils: pH, texture, moisture, loess ecosystems and the Mammoth Steppe	Walker, D.A., Everett, K.R. 1991. Loess ecosystems of northern Alaska: regional gradient and toposequence at Prudhoe Bay. Ecological Monographs. 61:(4): 437-464. Walker, D.A., Bockheim, J.G., Chapin, F.S., III, et al. 2001. Calcium-rich tundra, wildlife, and "the Mammoth Steppe". Quaternary Science Reviews. 20:149-163. Walker, D.A., Auerbach, N.A., Bockheim, J.G., et al. 1998. Energy and trace-gas fluxes across a soil pH boundary in the Arctic. Nature. 394:469-472.
7	**Feb 9**	**Literature discussions 2**	**Paper 1:** Guthrie, R.D. Mammals of the mammoth steppe as paleoenvironmental indicators. In: Hopkins et al. 1987. *Paleoecology of Beringia,* New York: Academic Press, p. 307-326. **Paper 2:** Guthrie, R.D. 2001. Origin and causes of the mammoth steppe: a story of cloud cover, wooly mammal tooth pits, buckles, and inside-out Beringia. *Quaternary Science Reviews* 20: 549-574. **Speaker 1 focus on Guthrie's presentation of the Pleistocene vegetation environment of Beringia and how this affected the animal distributions.** **Speaker 2 focus on recent information that has changed our picture of Beringia.**
8-9	**Feb 14, 16,**	**Lectures 5 and 6:** The role of	Walker, D.A., Epstein, H.E., Romanovsky, V.E., et al. 2008. Arctic patterned-ground ecosystems: A synthesis of field studies and models along a North American

		permafrost, biocomplexity of small patterned-ground features	Arctic Transect. Journal of Geophysical Research - Biogeosciences. 113:G03S01. Raynolds, M. K., D. A. Walker, C. A. Munger, C. M. Vonlanthen, and A. N. Kade (2008), A map analysis of patterned-ground along a North American Arctic Transect, *J. Geophys. Res*., 113, G03S03, doi:10.1029/2007JG000512. Walker, D.A., Kuss, P., Epstein, H.E., Kade, A.N., Vonlanthen, C.M., Raynolds, M.K. Daniels, F.J.A. 2011. Vegetation of zonal patterned-ground ecosystems along the North American Arctic Transect. *Applied Vegetation Science,* 14: 440-463.
10	**Feb 21**	**Literature discussions 3**	**Paper 1:** Davis, N. 2001. Chapter 3. When the ground freezes. In: *Permafrost: A Guide to Frozen Ground in Transition.* Fairbanks: University of Alaska Press, p. 15-99. **Paper 2:** Davis, N. 2001. Chapter 4. Land forms created by cryogenic action. In: *Permafrost: A Guide to Frozen Ground in Transition.* Fairbanks: University of Alaska Press, p. 101-200. **Speaker 1 should focus on presenting an overview of the key processes described in the formation of permafrost.** **Speaker 2 focus on describing how these processes form the permafrost landforms observed in Nature.**
11-12	**Feb 23, 28**	**Lectures 7 & 8:** Snow Ecology	Walker, D.A., J.G. Molenaar, and W.D. Billings. 2001. Snow-vegetation interactions in tundra environments. In: Jones, H.G., J. Pomeroy, D.A. Walker, and R. Hoham (eds.) *Snow Ecology*. Cambridge: Cambridge University Press, pp. 264-322. Borner, A.P., K. Kielland, and M.D. Walker. Effects of simulated climate change on plant phenology and nitrogen mineralization in Alaskan Arctic tundra. *Arctic, Antarctic, and Alpine Research,* 40: 27-38. Sturm, M., J. P. McFadden, G. E. Liston, F. S. Chapin, III, C. H. Racine, and J. Holmgren, 2001. Snow-shrub interactions in Arctic tundra: a hypothesis with climatic implications. *Journal of Climate,* **14***,* 336-344.
13	**Mar 1**	**Literature Discussion 4**	**Discussion Group 1:** Pomeroy, J.W. and E. Brun. 2001. Physical properties of snow. In: Jones, H.G., J. Pomeroy, D.A. Walker, and R. Hoham (eds.) *Snow Ecology*. Cambridge: Cambridge University Press, pp. 45-117. And Sturm, M. et al. 2001. Snow-shrub interactions in Arctic tundra: a hypothesis with climatic implications. *Journal of Climate,* **14***,* 336-344. **Discussion Group 2:** Tranter, M. and G. Jones. 2001. The chemistry of snow: Processes and nutrient cycling. In: Jones, H.G., J. Pomeroy, D.A. Walker, and R. Hoham (eds.) *Snow Ecology*. Cambridge: Cambridge University Press, pp. 127--156. And Borner, A.P., K.

			Kielland, and M.D. Walker. Effects of simulated climate change on plant phenology and nitrogen mineralization in Alaskan Arctic tundra. *Arctic, Antarctic, and Alpine Research,* 40: 27-38.
	Mar 6 & 8	**No class! Field trip instead Mar 9-11.**	
14-15	**Mar 9-11**	***Spring Break field trip to Cantwell cabin***	
16-17	**Mar 20, 22**	**Lectures 9 & 10:** Cumulative effects of oil development on Arctic ecosystems	NRC, Orians, G., Albert, T., et al. 2003. Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope. National Academies Press. Washington, D.C.: pp.: 288. **This volume summarizes the entire issue related to cumulative effects of oil development in Alaska. The effects on vegetation are summarized in chapter 7, p. 76-97.**
18	**Mar 27**	**Literature discussions 5**	**Paper 1:** Walker, D.A., Forbes, B.C., Leibman, M.O., et al. 2011. Cumulative effects of rapid land-cover and land-use changes on the Yamal Peninsula, Russia. Eurasian Arctic Land Cover and Land Use in a Changing Climate. Springer. New York.VI pp. 206-236. **Paper 2:** Chapter 7. Effects of the Vegetation. In: NRC, Orians, G., Albert, T., et al. 2003. Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope. National Academies Press. Washington, D.C.: pp.: 76-97.
19-20	**Mar 29, Apr 3**	**Lectures 11 and 12:** Climate change and circumpolar Arctic vegetation	Bhatt, U.S., Walker, D.A., Raynolds, M.K., et al. 2010. Circumpolar Arctic tundra vegetation change is linked to sea-ice decline. Earth Interactions. 14:(8):1-20.
21	**Apr 5**	**Literature Discussion 6**	**Discussion Group 1:** Callaghan, T.V., Bjorn, L.O., Chapin III, F.S., et al. 2005. Chapter 7, Arctic tundra and polar desert ecosystems. Arctic Climate Impact Assessment - Scientific Report. Cambridge University Press. Cambridge. pp. 243-291. **Discussion Group 2:** Callaghan, T.V., Bjorn, L.O., Chapin III, F.S., et al. 2005. Chapter 7, Arctic tundra and polar desert ecosystems. Arctic Climate Impact Assessment - Scientific Report. Cambridge University Press. Cambridge. pp. 291-335.
22	**Apr 10**	**Lecture 13** Arctic	Walker, D.A., Walker, M.D., Gould, W.A., Mercado-Diaz, J.A., Auerbach, N.A., Maier, H.A., and Neufeld,

		Vegetation Mapping	G.P., 2010, Maps for monitoring long-term changes to vegetation structure and composition, Toolik Lake, Alaska: *Viten*, 1: 121-123. Walker, D.A., Raynolds, M.K., Maier, H.A., Barbour, E.M., and Neufeld, G.P., 2010, Circumpolar geobotanical mapping: A web-based plant-to-planet approach for vegetation change analysis: *Viten*, 1:. 125-128. Walker, D.A., Raynolds, M.K., Daniëls, F.J.A., et al. 2005. The Circumpolar Arctic Vegetation Map. Journal of Vegetation Science. 16:(3):267-282.
23-25	**Apr 12 & 17**	**Student oral presentations (3 each lesson)**	
	Apr 19, 24, 26	**No class, Montreal IPY meetings**	
26	**May 1**	**Student oral presentations (3 each lesson)**	
	May 4	**Written papers (graduate students) due**	

8. Course policies:

Attendance policy:

Students are expected to attend every class and lab and be seated at the beginning of the class. Student will receive 10 points for attendance at each lecture, discussion group and student oral presentations.

Academic integrity:

Plagiarism and cheating will not be tolerated. Plagiarism is presenting another's work as new or original without citing your source. For additional detail, see http://library.uaf.edu/ls101-plagiarism

Please speak with me if you have any questions about how to properly use other people's work.

9. Evaluation:

Summary of grading points:

Undergraduate student grading (BIOL 492 students):

Attendance at lectures (10 points each)	130
Participation in literature discussions (15 pts/ session)	90
Presentation of literature summaries	100
Oral presentation of research topic	200
Snow Ecology exercise participation	100
TOTAL	620 points

Graduate student grading (BIOL 692 students):

Attendance at lectures. (10 points each)	130
Participation in literature discussions (15 pts/ session)	90
Presentation of literature summaries	100
Oral presentation of research topic	200
Snow Ecology exercise participation	100
Final research paper	300
Lead literature discussion session	50
TOTAL	970 points

These criteria may be modified somewhat as the course progresses.
Final grades will be as follows: greater than or equal to 90% = A; 80-89% = B; 70-79% = C; 60-69% = D; < 60% = F.

All students are expected to accomplish the following:

(a) Attend all lectures and discussion groups (10 points each lecture attended, 13 total). There will be no make-up for missed lectures, but good reasons for missing the lectures will be accepted if cleared before the lecture.
(b) Attend all the literature discussion sessions, read the assigned reading, and participate actively in each session (15 points for each session, six total),
(c) Give oral summaries of one paper for the literature discussion sessions (100 points).
(d) Give a 15-minute oral presentation of a literature review of a topic of interest related to Arctic vegetation (200 points). Guidelines for the presentations and grading criteria for the presentations will be handed out early in the semester.
(e) Attend the Saturday April 7, snow ecology field trip (100 points).

Additional expectations for graduate students:

(f) Write a 2000-3000-word research paper on an Arctic Vegetation topic of your choice. This paper should have at least 10 literature citations and can include additional tables and figures. This can be the same topic as that of your oral presentation. Late papers will receive a deduction of 15 points of the 300 total for every day late and no credit beyond 3 days late. Students should arrange for an incomplete grade if they cannot meet this deadline (300 points).
(g) Lead one of the literature discussion sessions. This will involve thorough reading of the papers to actively lead the discussion and act as moderator for the session (50 points for each session).

10. Support Services:

Students are encouraged to contact the instructor with any questions, or to clarify the lecture or the assignments. I will be happy to review drafts of assignments and answer questions any time. AHRB Room 254. Phone 474-2460, dawalker@alaska.edu. Home phone: 451-0800.

11. Disabilities services:

The instructor will work with the Office of Disabilities Services (203 WHIT, 474-7043), to provide reasonable accommodation to students with disabilities.