

**Northern Arizona University**  
**Maintaining Leadership in Innovative Forestry Education**

**Report of the Professional Curriculum Review  
Committee to the School of Forestry Faculty**

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Revisions to Semester A table of “Expected Outcomes, Activities, and Assessment”  
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## **i. Summary of Proposed Curriculum Changes**

### **A. Lower Division**

1. Delete: GLG 101 Physical Geology  
GLG 103 Physical Geology Lab  
ECO 285 Macroeconomics
2. Add: New course FOR 213 Intro to Forest Soils (3 credits)
3. Impact on Liberal Studies: neutral
4. Require: FOR 220 Field Plant Tax
5. Offer FOR 101, 212, 213 on the web as distance learning classes

### **B. Upper Division**

1. Reduce current FOR 311 to 13 credits by spinning off soils and plant tax in FOR 213 and 220, respectively.
  - a. Renumber to FOR 313, 314, 315, 316
  - b. Rename to Forest Ecology and Silviculture
2. Reduce current FOR 312 to 13 credits by generally proportionally reducing course material.
  - a. Renumber to FOR 323, 324, 325, 326
  - b. Rename to Forest Management
3. Reduce current FOR 421 to 12 credits, split 6 credits in Fall and 6 credits in Spring
  - a. Rename/Renumber:  
FOR 413, 414 Forest Assessment (Fall)  
FOR 415, 416 Forest Planning (Spring)
4. Add a pre or co-requisite to FOR 415 of one of the following three courses:  
POS 344, 359
5. Add a REQUIRED 12 credit hour emphasis area
6. All professional forestry courses are restructured to be consistent with general university policy regarding credit given for number and type of content hours.

## **I. Charge to the Committee**

The Professional Curriculum Review Committee was established in February 1998 by the School Chair Don Arganbright. In general the Committee was given a very broad charge to examine all aspects of the undergraduate forestry programs. Only two issues were excluded – teaching load and faculty workload policy. These issues were excluded only because other committees had recently completed work or work was in progress on these topics. The following list of specific topics was given to the chair P.J. Daugherty to be considered by the committee:

1. Reassess the basic philosophy behind the School's unique approach to undergraduate forestry education, that is immersion/integration/team teaching. Please report upon its validity in 1998 given the changes in forestry since its inception in 1972.
2. Review our lower division forestry required courses – FOR 101, 211, and 212. Develop a clear statement of expectations/philosophy for each individually and the three collectively. Advise the faculty as to acceptable alternatives if any for all three. Also examine their impact on transfer students and attracting and retaining students.
3. Assess actual integration both within and among Semesters A, B, and C. Report on the level of integration and make recommendations where appropriate.
4. Examine actual learning assessment in the Forestry major, and again make recommendations as to what the School needs to do to adequately assess student learning.
5. Review the School's supplemental learning services including the writing tutor, a possible mathematics tutor, the undergraduate computer facility and its monitor, and the Minor Study Center. Advise on their utility and if changes or additions are needed. Also consider the desirability of using a graduate assistantship as a general tutor with the Minor Study Center.
6. Consider the future of web-enhancement and web-based courses and/or instructional segments for the forestry major.
7. Reexamine the role of more formally emphasizing traditional ecological knowledge into the major.
8. Examine the concept of offering emphasis areas within the professional program.

The charge to the Committee was daunting and limited progress was made until September 1999 when the Interim School Chair Bruce Fox added the following items to the Committee's charge:

1. "Overall, I believe it of prime importance that the committee address the issue of how to maintain and enhance the School of Forestry's undergraduate

forestry program as a premier Bachelor of Science degree. This would involve, among other issues, comparing ourselves to peer programs and employer needs.”

2. “Related to issue 1, I would like the committee to then look at what other role(s) the School should pursue. For example, should we think about other undergraduate/graduate degree programs? Enhance our research role? This component of the charge should be secondary, at this point, in that I would like the committee to look more at the “What if” or “What could be” rather than detailing the “How tos” of different options. Within this framework, we need to always include in our discussions the role, importance, and needs of the PRM program.”

Finally, also in September 1999 the current chair met extensively with the Interim Dean Don Arganbright and the following questions emerged from those interactions:

1. Is the NAU School of Forestry teaching model still working? If not, what changes are needed?
  - a. How do we compare with other forestry schools? Do we need competency/exit standards?
  - b. Should we shift toward the Pinchot Institute Model with more focus on interpersonal skills and reduce the emphasis on technical schools?
2. If the integrated approach to forestry education is superior to other approaches, why aren't we flooded with students?
3. Should we attempt to project the NAU model nationwide? Who should we target with any distance learning program – general interest, adult education, continuing education, transfer students? What should be included in the distance learning package – textbooks, Ecostar, SAF continuing education?
4. What route should NAU take to achieve national stature among forestry schools? Do we want to be known only for our undergraduate teaching or do we also want national stature in research?
5. Do we want to integrate/formalize Native American content (traditional ecological knowledge) in the curriculum?

## **II. Current Issues Context**

In the fall of 1999, the Committee reviewed the central mission of Northern Arizona University. This was relevant because NAU had recently undergone an extensive review of its mission and proposed the following 7 specific goals for the next decade:

1. To be recognized as a premier undergraduate residential campus in the western region of the United States.
2. To be recognized nationally and internationally for research and graduate programs that build from our regional base on the Colorado plateau and our work with communities throughout rural Arizona.

3. To become recognized as a leader in partnerships with community colleges and K – 12 education.
4. To become recognized as a national leader in the use of technology for distance learning.
5. To be a national leader in providing educational opportunities for Native American students, in providing service to Native American tribes, and in research in contemporary Native American policy issues.
6. To strengthen NAU's commitment to diversity
7. To generate a consistent, healthy operating budget based on sufficient state support and supplemented by increasing external support, and to ensure a clear and strong understanding about the relevance of enrollment growth to the welfare of the campus community.

In addition the committee identified 3 context issues (transfer students, retention and employment experience) that are relevant to our undergraduate program. The transfer student issue related to the fact that many students prefer to complete the first year or two of their undergraduate education at a community college or campus near their home and then transfer to our forestry program. Few of those other educational institutions offer courses that fully meet our curriculum requirements. Therefore students who transfer to NAU Forestry are faced with additional semesters of course work. Any curriculum changes must consider how that change would affect transfer students. The retention issue has been recognized in the past few years particularly from analyses done by Jim Cole, the school's first Coordinator of Student Services, in the past couple of years. There seems to be a general pattern that many students leave the forestry program after the freshman or sophomore year. Curriculum changes must include ideas to improve retention of pre-professional students. Finally the Committee considered that the employment success of our students was an important criteria by which we could judge our program. While the general feeling of the Committee was that our students do well in the workplace there is an emerging national discussion about how well forestry schools prepare their students. This point is well illustrated in the Sample et al. 1999 article on forestry education (JOF September 1999).

### **III. Definition of Terms**

The Committee decided it was important to clarify terms that we commonly use to describe our unique teaching format. The following four terms were defined:

**Team teaching:** The simultaneous participation of multiple faculty members within an instructional unit. Team teaching requires that all faculty members present actually participate either through shared lectures or discussion.

**Sequential teaching:** (synonym: tag team teaching): multiple faculty members teaching independent sections. Faculty members may coordinate their presentations but the format is a single faculty member presenting their material without the

presence or participation of other faculty.

**Integrated teaching:** A deliberate effort on the part of faculty to relate their educational material with that presented by another faculty member. Integrated teaching is multidisciplinary and requires faculty to present material from a variety of perspectives and to link material to ideas taught previously in the course. A single discipline approach that does not recognize well established opposing perspectives would not be considered “integrated.”

**Immersion teaching:** Immersion teaching is a format in which students are exclusively taught a single topic. This term is often used to describe language training. A forestry immersion course would be one which students enroll in forestry courses only. The traditional FOR 311 – Semester A model would be considered a typical immersion teaching format. Immersion teaching does not necessarily result in integrated teaching and may or may not be team taught.

#### **IV. Desired Characteristics of NAU Graduates**

The Committee reviewed a number of published articles and reports on the desired characteristics of forestry graduates. The general consensus was that a competency-based approach to describing the desirable characteristics of the NAU graduate was appropriate. We use the term “transferable skills” to include things like writing, oral communication, leadership, decision making, working in groups etc..(see section VII for more details). In addition, a desirable NAU graduate would have subject competencies in areas like wildlife, ecology, silviculture, pest management, economics and multi-subject competencies such as valuation, integrated resource planning (developing alternatives), conflict resolution etc.. This approach is very consistent with ideas presented by Sample et al. 1999 (JOF) and with changing philosophy regarding Society of American Foresters accreditation standards.

The Committee spent considerable time debating which of the above transferable skills and subject matter competencies were adequately included in our curriculum. Needless to say, we did not achieve consensus on all areas discussed. However the following five areas were generally agreed upon as important competencies that we needed to specifically identify and perhaps enhance in our program:

1. Working in teams particularly with a focus on how to formally structure and manage a resource analysis or management team.
2. Public presentation experience perhaps (speaking across the curriculum) in the format of writing across the curriculum to improve confidence in students to speak before public and professional groups.
3. Dispute resolution and negotiating skills
4. Business and organizational management skills in leadership, financial management, and organizational development. This was an area for perhaps

some enhancement but with the recognition that these skills are often developed “on-the-job.”

5. Recognition of personal vs. professional ethics. How do ethical beliefs develop and how do we balance personal ethics with professional activities?

## V. Structural Curricular Context

### A. Pre-professional Curriculum

#### 1. Structure and Flow

We recommend that additional ‘structure’ be placed onto the pre-professional program to more adequately address the needs of our students and to facilitate student advising and course planning. A sample incoming freshman’s program (half our students) would be as follows: Section VI has more information on the content of these courses.

<b>First-Year Fall Semester</b>	<b>First-Year Spring Semester</b>
<b>FOR101</b> (3 credits) – “Introduction to Forestry”: the profession, current issues, and our program; build connections to UC101, emphasis areas and student organizations/activities.	<b>FOR212</b> (2 credits): “Trees and Forests of North America”: more complete taxonomy and silvics of important gymnosperms and angiosperms.
<b>UC101</b> (3 credits)	<b>BIO181</b> (4 credits) – with laboratory
<b>FOR220</b> (2 credits) – “Forest and Range Plants”: field plant identification, time in the woods.	<b>ENG105</b> or perhaps <b>205</b> (4 or 2 credits, respectively)
<b>MAT125</b> (3 credits) – or remedial if needed	<b>MAT125</b> (post remedial) or <b>STA270</b> (4 or 3 credits) before FOR211
Liberal studies/electives/emphasis area (3 credits)	<b>CIS120</b> (3 credits) - before FOR211, with laboratory
	LS/electives/emphasis area (3 credits) - if room
<b>TOTAL: 14 credits</b>	<b>TOTAL: 16-17 credits</b>
<i>&lt;SUMMER WORK EXPERIENCE&gt;</i>	
<b>Second-Year Fall Semester</b>	<b>Second-Year Spring Semester</b>
<b>FOR211</b> (3 credits): “Forest Ecosystem Measurements”: (MAT 125 required)	<b>New FOR213</b> (3 credits): “Forest Soils”: replaces geology, preparation for Semester A
<b>CHM130/151L</b> (5 credits)	<b>BIO182</b> (4 credits)
<b>STA270</b> - last chance, concurrent with FOR211	<b>FOR211</b> (3 credits) - a small section for transfers
<b>ENG205</b> (2 credits) if needed	<b>COM111</b> (3 credits)
<b>FOR220</b> (2 credits) if needed	<b>ECO284</b> (3 credits)
Liberal studies/elective/emphasis area (3 credits)	<b>FOR212</b> (2 credits) if needed
	Liberal studies/elective/emphasis area (3 credits)
<b>TOTAL: 15+ credits</b>	<b>TOTAL: 15+ credits</b>
<i>&lt;SUMMER WORK EXPERIENCE&gt;</i>	

Several points from this table are very important for advising students:

- 1) Students need to complete two laboratory/field courses nearly every semester in order to stay on track. Lab courses include FOR211/213/220, CIS120, CHM 151L, and BIO 181/182.
- 2) Students should be in a forestry course each semester (retention).
- 3) Students need to take math and statistics timely – don't delay due to math anxiety.
- 4) ENG must wait until the second semester; CHM 130 may be available only in the Fall and is not a good idea for first-year students.

## **2. Transfer Student Implications**

Transfer students with substantial transfer credit (i.e., math, science and English credits) should be able to prepare for Semester A in a single year. For example, those students can take FOR211/STA270/CIS120/ENG205 (plus other needed courses) in the Fall and FOR212/FOR213 (plus others) in the Spring, depending on their exact status. A Spring section of FOR211 would help with scheduling issues surrounding math credits.

## **3. Relationship to Emphasis Areas**

These structural changes, with the below changes in curriculum content, help to create room in the student program for lower-division emphasis area courses where applicable. Refer to the table above for potential time slots for said courses. Emphasis Areas are discussed in detail in Section IX.

### **B. Professional Program**

#### **1. Introduction and Goals of the Professional Program**

The underlying educational philosophy of the Forestry Professional Program focuses on the integrated instruction of students in ecosystem science and management. This currently includes a team-taught immersion approach taught in three block courses across three semesters.

The recommended changes in the forestry professional program described below reflect our desire to maintain our integrated approach to teaching, which is recognized nationally as a significant and unique strength of our forestry program, as well as allowing students to explore an emphasis area. We propose adding a required emphasis area to the professional program (described in detail in Section IX of the report) to allow students to expand their knowledge of ecosystem management in a particular area (e.g. international forestry, forest health, or ecological restoration). This and other suggested changes are based on recommendations made by students, alumni, forestry professionals, and a comparison with our peer forestry institutions.

A comparison of NAU's curriculum to the Pinchot Institute Study reported in the Journal of Forestry (Sample et al. 1999) revealed there were topics that might increase and topics that might decrease in time allocated in our program. Topics that should be considered

for enhancement based on this report includes working in teams (add formal training), oral presentations (more experience in FOR 311), dispute resolution, business management (including managerial leadership, financial management, organizational development) and ethics. Topics that could decrease in time allocated included range, wildlife, ecology, silvics, planning management and field skills. In an effort to balance the Pinchot Institute Study with SAF accreditation objectives of providing an "in-depth coverage with a global perspective of forest ecology and biology, measurement, management, and policy and administration", the content and structure of the upper division professional program have been modified as described below. In addition, changes made in the content and structure of the Professional Program also reflect a comparison with 14 other peer forestry programs around the country.

The proposed upper division core professional program will include four courses:

FOR 313-316	Forest Ecology and Silviculture	– 13 credits
FOR 323-326	Forest Management	– 13 credits
FOR 413,414	Forest Assessment	– 6 credits
FOR 415,416	Forest Planning	– 6 credits

FOR 313-316 is designed to be taken in the fall semester and focuses on forest ecology and silviculture. FOR 323-326 is to be taken in the spring semester and addresses human dimensions of ecosystem management, specifically managing forest resources to meet multiple goals. The capstone forestry courses, FOR 413, 414 and 415, 416, will be taken over two semesters and enable students to apply knowledge and concepts acquired throughout their pre-professional and professional program courses and apply them toward developing a management plan for a resource area.

The implications of implementing these proposed changes in the professional program are discussed in the sections that follow. These implications include improving the integration and flow within and among professional program courses, structural changes in the professional program, and how this new curriculum compares with other forestry programs. The desired competencies, learning activities, and assessment methods for each of the four professional program courses are provided in the last section.

## **2. Improving Integration and Flow**

### **a. Flow and Transition Across the Forestry Curriculum**

The professional forestry courses are designed to build on knowledge and skills acquired in the pre-professional program, including forestry and non-forestry pre-requisite courses. The transition from the pre-professional to the professional program can be facilitated by faculty introducing transferable skills such as writing, working in groups, use of technology, ethics, and professionalism early in the pre-professional forestry curriculum and continuing to strengthen those skills in the professional program.

The proposed changes in the professional program reflect a renewed commitment to the goal of integration and flow across the professional program courses. The professional program courses are designed to build upon and complement one another, culminating in a capstone experience. FOR 413, 414 and 415, 416 require the integration of materials learned in FOR 313-316, Forest Ecology and Silviculture, and FOR 323-326, Forest Ecosystem Management, as well as skills learned in Liberal Studies and Forestry emphasis area courses. The primary instructional technique used in FOR 413, 414 and 415, 416 is learning by doing whereby students must integrate knowledge gained previously in order to accomplish the tasks needed to complete the course. Infrequent formal lectures provide direction and help in getting started, but more often faculty serve as consultants working with students individually or in small groups to answer questions and to discuss approaches to problems. Students are often required to work independently in inventory design, data collection, and data analysis. The process followed by students is similar to that followed by real world forest managers and planning analysts in ecosystem assessment. In this process, students are expected to apply their knowledge of ecological and management principles, professional judgement, and logical thought to derive sound and creative solutions to typical forest inventory problems and forest change projection, while working within time constraints. Faculty are available, upon request, to provide advice like that which would be provided by supervisors and resource specialists.

In addition to supporting FOR 423, 414 and 415, 416 as the capstone, integrative experience for forestry students, we offer suggestions to facilitate and encourage a smooth and logical transition and flow among the professional program courses:

- Faculty teaching in the professional program are encouraged to be familiar with the content of the professional courses to avoid unnecessary redundancy and overlap.
- Coordinators of the professional program courses are encouraged to continue to provide binders in the faculty lounge with syllabi and other relevant materials from professional program courses for faculty to peruse.
- A case study, discussion questions (e.g., “what is ecosystem management and what do you need to know to do it?”), or similar exercises could be introduced in FOR 313-316 that could be re-introduced and revisited and expanded upon in FOR 323-326 and carried on into FOR 423, 414 and FOR 415, 416.
- The Centennial Forest should be used as the common resource base for the three professional program courses.
- Faculty from FOR 323-326 could be introduced at the end of FOR 313-326 and FOR 413, 414 faculty introduced at the end of FOR 323-326.

## **b. Flow and Integration Within the Professional Forestry Courses**

In addition to improving integration among the professional program courses, the proposed changes in the professional program are designed to improve integration and flow within the individual courses themselves. We reaffirm the School of Forestry's commitment to integrated teaching within the professional program courses wherein there are not stand-alone sections but truly integrated discussions and activities. Changes in the program and suggestions for improving flow and integration in the professional program include:

- One of the most significant changes proposed for FOR 323-326 is the addition of spatial structure as an orienting focus for talking about multiple subjects relevant to that particular structure. A similar hierarchical scaling structure is used in FOR 313-316, which will also help in the transition between FOR 313-326 and FOR 323-326.
- FOR 323-326 lab times have also been restructured to provide the opportunity for an all-day integrated lecture/discussion/lab period.
- Coordinators of all four professional semesters are encouraged to hold regularly scheduled meetings of involved faculty to facilitate integration and collaboration and avoid undue repetition and overlap.
- faculty teaching in the professional program need to be committed to being integrative and collaborative.

## **VI. CHANGES IN CURRICULUM CONTENT**

### **A. Pre-professional**

#### **1. Goals and competencies**

The pre-professional sequence of courses has five fundamental goals:

- Prepare students specifically for the Professional Forestry Program: the development of content knowledge (terminology, concepts and issues) and skill sets for success in our program.
- Provide consistent outstanding academic experiences for recruitment and retention during our students' first years, including preparation for and access to summer employment.
- Educate liberally and broadly, with constant connections to forestry in general and/or an emphasis area (i.e., why math and chemistry are important).
- Provide opportunities for persons accessing the University's distributed (distance) learning system, with implications for recruitment and retention.
- Increase class enrollment and number of majors.

The following table further defines the first goal, developing competencies in our students, using desired outcomes, activities, and assessments for 5 lower-division forestry courses that we propose to require of all students.

Desired Outcome	Activity	Assessment
<b><i>FOR101 Introduction to Forestry</i></b>		
Understanding of the forestry profession: terminology, concepts, and current topics - broad and engaging.	Readings	Exams and/or quizzes
Excitement about our profession.	Lectures	Writing evaluation – may include some computations
Introduction to our curriculum and potential emphasis areas.	Discussion groups	Participation grades
<b>3 credits</b>	Field trips	
	Writing assignments	
	Professional development	
<b><i>FOR211 Forest Ecosystem Meas.</i></b>		
Natural resources sampling and inventory knowledge and skills.	Readings	Exams
In-office data analysis, summary and interpretation.	Lectures	Lab evaluations
<b>3 credits</b>	Field labs	
	Weekly lab write-ups	
<b><i>FOR213 Forest Soils.</i></b>		
Basic geology, geomorphology and soil taxonomy	Readings	Exams and quizzes
Soil physical, chemical and biological properties	Lectures	Report evaluation
<b>3 credits</b>	Outdoor labs	
	Report writing	
<b><i>FOR212 Trees and Forests of N. A.</i></b>		
Tree taxonomy and silvics	Readings	Exams and quizzes
Forest types	Lectures	Report evaluation
<b>2 credits</b>	Information searches	
	Report writing	
<b><i>FOR220 Forest and Range Plants</i></b>		
Field plant identification	Field trips	Frequent quizzes
Taxonomy	Field lectures	
Basic autecology		
<b>2 credits</b>		

Note the addition of **FOR213 Forest Soils** to the pre-professional program; the rationale for this is discussed below. Note also that FOR220, an existing parallel class to Semester A, Taxonomy, has been placed in the pre-professional program and its content removed from 311. Since this course has been available for several years, a few forestry students have taken it (on Thursday) a year or two before they cover the same material (on Tuesday) in Semester A. This structural change is recommended to provide a fun,

outdoor experience to students who are “thinking about” forestry or who are early in their major. It is a nice companion to FOR101.

## **2. Transfer Student Implications**

This pre-professional sequence of forestry courses (FOR101-211-212-213-220) would be required for students who enter NAU as a freshman but more flexibility would be allowed for transfer students. Requirements for transfer students would be based on the similarity of their previous coursework and employment to our pre-professional competencies:

FOR101 and FOR212 can be most easily substituted for (i.e., these might not be required courses to be made up by transfer students prior to admission into FOR 313-326 if students are otherwise ready to go). These courses are excellent choices to make available via distributed learning to minimize these issues and to aid in recruitment.

FOR211 should be strictly evaluated for replacement only by a “Forest Measurements” class (i.e., “Plane Surveying” will no longer suffice); however, Spring semester availability should ease scheduling problems for most transfers.

FOR213 (the new course) also should be strictly evaluated for replacement only by another Forest or Agricultural Soils class; otherwise, it must be taken here the Spring semester before or concurrent with FOR 313-326.

FOR220 must be taken here prior to or concurrent with FOR 313-326.  
must be taken by transfer students before FOR 313-326.

In summary, FOR 211 and 213 are critical in this issue, and both could be available Spring semester prior to FOR 311 for the few transfer students that schedule only one pre-professional semester. The offering of FOR 211 in both fall and spring should be made by the Chair of the School of Forestry after consultation with the faculty involved. Very few students transfer directly into FOR 313-326.

## **3. Comparison to other schools**

A comparison with other SAF-accredited forestry programs in the United States (Appendix I) led to the following two recommended changes to the content of our pre-professional program.

1. Few programs require geology but most have a more substantial “soils” component. We therefore recommend that we drop the 4-credit GLG 101/103 requirement (which has little soils) and create a separate “Forest Soils” course, since there is not room for a substantial increase in soils within Semester A. This new 3-credit FOR 213 course, with 2 lectures and a lab each week, would cover the basics of geology as it relates to

soil geomorphology and properties, but would also focus on the relevance of soils to forestry. CHM 130 and 151L will substitute into the Lab Science Liberal Studies requirement, with STA 270 back filling into Applied Science Liberal Studies for chemistry.

2. Few programs require macroeconomics. We therefore recommend that we drop the 3-credit ECO285 requirement to create more room for Emphasis Area courses and/or electives. COM111 will substitute into the Social and Political Worlds Liberal Studies requirement.

#### **4. Relationship with Emphasis Areas**

Reducing and altering the content of the pre-professional program was influenced by the addition of Emphasis Areas, in addition to the competency needs of professional program and a comparison with other schools. We believe the recommended changes still provide a needed breadth of exposure, a breadth that will complement the focus of an Emphasis Area.

#### **5. Summary**

In summary, the structural and content changes in the pre-professional program are as follows:

<b>Current 1999-2001 forestry major:</b>		<b>2001+ forestry major with emphasis areas:</b>	
Liberal Studies	35	Liberal Studies	35
“Net” additional pre-professional with FOR101/211/212 with GLG and ECO285	27	Net additional pre-prof. with FOR101/211/212/ 213/220 no GLG or ECO285	25
Prof. upper-division core	48	Prof. upper-division core	38
Electives	<u>10</u>	Emphasis Areas	12
	120	Electives	7
		Upper-Division Co-requisite in Political Science	<u>3</u>
			120

A new advising sheet consistent with these recommendations is attached in Appendix II.

#### **B. Professional Program**

##### **1. FOR 313-316: Forest Ecology and Silviculture**

###### **a. Course Objectives**

The goal of FOR 313-316 is to provide students with up-to-date knowledge of silviculture and forest ecology. Course topics for ecology include autecology,

communities, wildlife, entomology/pathology, disturbance/recovery, and ecosystem processes and classification. The ecology section is organized progressively across the semester from the individual tree and its relation to its environment at the beginning of the semester, scaling up to community level during mid-semester and finally to the ecosystem spatial scale in the last one-third of the semester. Where possible, silvicultural and ecological concepts are linked throughout the semester. An explicit transition from FOR 313-316 to FOR 323-326 has been created in the form of an ecosystem-level project that gets started at the end of FOR 313-316 and concludes in the beginning of FOR 323-326.

In addition to teaching forest science, the faculty of FOR 313-316 are committed to teaching and facilitating student development in transferable knowledge, skills and abilities in quantitative skills, field measurements, forest sampling, technical writing, computer skills and career development skills. One or more of these transferable skills are emphasized in the teaching of each unit.

### **b. Proposed Changes to FOR 313-316**

FOR 313-316 will be reduced from the current 16 semester hours to 13 semester hours. The 13 hours will consist of 10 credit hours of lecture and 3 credit hours of laboratory compared to 12 credits of lecture and 4 credits of lab under the 16-credit structure. The reduction in credit hours will be accomplished by implementing the following changes:

- The taxonomy lab will be removed and will become a separate course (FOR 220). Students transferring without this course can take it concurrently with Semester A.
- The soils component of FOR 313-316 was removed and established as a separate course (FOR 213) while geology was dropped as a prerequisite course.

A policy needs to be created to accommodate transfer students who do not have access to a soils course prior to arriving at NAU. For example, if a transfer student has taken all the other prerequisite courses prior to their arrival at NAU, he/she might take soils concurrently with the professional program. Historically, most of our transfer students need to take additional prerequisite courses at NAU before entering the professional program. Therefore, these students could take soils in the spring semester prior to FOR 313-316. Efforts must be made to schedule FOR 323-326, soils (FOR 213) and the measurement courses (FOR 211) so there are no time conflicts.

- The Monday all-day "integrative" lab was reduced from 9:10-4:30 to 10:20-4:20. (This is equivalent to 2 – 3 hour lab periods)
- Classes on Wednesday and Friday were reduced from two 75-minute sessions to two 50-minute sessions and will meet from 10:20-11:10 and 11:30-12:20. The

Tuesday/Thursday classes will remain unchanged and will meet from 9:35-10:50 and 11:10-12:25.

- Silviculture will represent 5.5 of the 13 credits in FOR 313-316 compared to the current 6 credits. It will meet for lecture on T/Th 11:10-12:25 and Fridays 11:30-12:20 for a total of 4 credits of lecture. Silviculture lab was moved from Thursday, 1:30-4:30 to Wednesdays 12:50-3:50 for a total 1 credit of lab plus 0.5 credits of additional lab time on Mondays.
- Ecology will represent 7.5 credits of the 13 credits in FOR 313-316 compared to the current 10 credits. It will meet for lecture on T/Th 9:35-10:50, Wednesdays 10:20-11:10 and 11:30-12:20 and on Friday 10:20-11:10 for a total of 6 credits of lecture. Ecology will also have 1.5 credits of lab on Mondays.
- A section on career development was added. Lecture and lab hours for this section will be credited equally to ecology and silviculture (approximately three 50-minute classes plus one 3-hour lab).
- A section on wood product resources was added to the ecology portion of the course.

The following Table summarizes the changes in subject areas and credits hours between the current FOR 313-316 and proposed.

<b>Subject</b>	<b>Topic</b>	<b>Current Credits</b>	<b>Proposed Credits</b>
Ecology	Adaptation	0.9	0.8
	Soils	1.2	0.0
	Wildlife Ecology	1.1	1.0
	Entomology/Pathology	1.3	1.2
	Community Ecology	1.0	0.9
	Disturbance/Recovery	1.4	1.3
	Ecosystem Processes	1.4	1.3
	Ecosystem Classification	0.7	0.6
	Wood Products	0.0	0.4
Silviculture		6.0	5.5
Plant Taxonomy		1.0	0.0
<b>Total</b>		<b>16.0</b>	<b>13.0</b>

## 2. FOR 323-326: Forest Ecosystem Management

**a. Course Objectives**

The goal of FOR 323-326 is to provide students with up-to-date knowledge for managing forestland resources in a social context. We examine the techniques for producing wood, water, and livestock commodities, and recreation and wildlife amenities. The specific topics of this course include sustainable, integrated ecosystem management, recreation management, biometrics, timber management, wildlife habitat management, policy, forest operations, and range management. Our primary purpose is to help students grasp the integrated nature of forest management; not only are the production activities noted above components of an interrelated ecological system, they are parts of a complex social system as well. Thus, an underlying, but unifying theme for the semester is decision-making based on economic and political realities. Students will learn not only how to produce commodities and amenities from our forestlands, but will also be exposed to ideas concerning how much, for whom, and why.

We recommend adding a spatial component to FOR 323-326 wherein subject areas are examined from stand, forest, and landscape levels. This provides an integrating perspective from which to study the complex multi-resource decisions that must be made in managing forest resources for multiple outputs and understanding the trade-offs that are often necessary to meet multiple goals.

In addition to teaching forest ecosystem management, the faculty of FOR 323-326 are committed to teaching and facilitating student development of integrating skills and abilities. These transferable skills and abilities, which include writing, leadership, oral communication, decision making, GIS/ITAC, and working in groups, are crucial to the development of forestry professionals and are developed across the professional program curriculum, including FOR 323-326.

**b. Proposed Changes to FOR 312**

FOR 312 will be reduced from the current 16 semester hours to 13 semester hours. Previously, this unit was divided into four courses with the following topics and associated credits:

	<u>Subject Area</u>	<u>Credit Hours</u>
323:	Week 1 Introduction	1.1
	Stand-Level Timber Management	1.9
	Final Integrated Case Study	1.1
324:	Biometrics	1.0
	Forest-Level Management	3.2
325:	Forest Operations	2.2
	Habitat Management	2.3
326:	Policy	1.5
	Recreation Management	1.7
Total		16.0

The proposed 13-credit structure for FOR 323-326 consists of the following breakdown:

<b>Subject Area (based on SAF categories)</b>		<b>Credit Hours</b>
Management of Forest Resources	Recreation management	1.5
	Habitat management (wildlife & range)	1.5
	Timber management	2.5
	Harvesting	0.5
	Access and roads **	0.5
	Watershed management**	0.5
Measurement of Forest Resources	Biometrics	1.0
Forest Resource Policy/Administration	Policy	1.5
	Economics	1.5
	Sustainable, integrated ecosystem management**	2.0
<b>Total</b>		<b>13.0</b>

\*\* not directly mentioned in the SAF study area descriptions

The reduction in credit hours in FOR 323-326 from 16 to 13 will be accomplished by implementing the following changes:

- Note from the list above that all subject areas previously taught in FOR 312 were reduced proportionately by the same amount.
- Range management was added to the curriculum.
- An integrative lab was added on Tuesdays.
- Classes on Monday, Wednesday and Fridays were reduced from two 75-minute classes to two 50-minute classes that will meet from 9:10-10:00, and 10:20-11:10. The Thursday classes remain unchanged at two 75-minute classes which meet from 9:35-10:50 and 11:10-12:25 but the time of the laboratory has been moved from 1:30-4:30 to 2:20-5:15. On Tuesday there were formerly two 75-minute lectures (9:35-10:50 and 11:10-12:25) plus a lab from 1:30-4:30. The proposed change eliminates the 11:10-12:25 lecture and 1:30-4:30 lab and replaces it with a lab that runs from 11:10-3:35.

**3. For 413/414: Forest Resource Assessment & FOR 415-416: Forest Resource Planning**

This section is a little confusing but can be summarized as follows:

<b>Current Course</b>	<b>Currently Offered</b>	<b>Proposed Course</b>	<b>Proposed Offering</b>
421A	Fall	413	Fall
421B	Fall	414	Fall
421C	Fall	415	Spring
421D	Fall	416	Spring

#### **a. Course Objectives - Overview**

In addition to serving as the capstone experience in the professional forestry program, FOR 413/414 and 415/416 serve to fulfill the NAU Liberal Studies Senior Capstone Experience. As a capstone experience, this course requires all forestry students to acquire new knowledge and skills, and synthesize the new knowledge and skills with previously acquired knowledge and skills (from both Liberal Studies courses and from other prerequisite courses). The students combine these new and previously acquired skills and knowledge to develop both a strategic and tactical ecosystem forest management plan. The course is divided in four components; two are taught in the fall semester and the remaining two components are taught in the spring semester.

While the fall and spring courses both teach and demand that students show proficiency in many of the identified Liberal Studies essential skills, the courses will specifically assess the following three skills: effective writing, quantitative/spatial analysis, and use of computer technology. In addition, transferable skills including technical writing, oral communication, computer skills, group processes, leadership, and time management are emphasized throughout FOR 413, 414 and FOR 415, 416.

#### **ii. FOR 413, 414: Forest Ecosystem Assessment (fall semester) – Course Objectives**

The fall sections focus on the assessment of current forest structure and condition as needed to conduct an ecosystem management analysis and forms the first segment of a capstone experience, which integrates material learned in previous forestry courses as well as introducing new concepts. The course includes assessment of information needs, land classification, inventory design, inventory techniques (including field data collection, map preparation, data entry, and database development), forest change modeling, and analysis of current condition.

Instruction revolves around the development of an ecosystem assessment, which considers multiple resources as well as overall ecosystem health. Initially, students work with a provided set of goals, issues and concerns related to a forested management unit. Working in crews, students conduct an ecosystem inventory of the unit. Students are required to develop information needs, land classification, inventory design, inventory techniques (including field data collection, map preparation, data entry, and database development). Students compile and analyze the inventory data to determine current

condition, and potential future condition. The current and potential future conditions are compared to goals to provide a first approximation of the changes needed to achieve goals.

**iii. Proposed Changes to FOR 421A and FOR 421B**

FOR 421 A and B will be reduced from the current 4 semester hours each to 3 semester hours each (reduction from 8 to 6 semester hours). These courses will become FOR 413 and FOR 414. The inventory portion of the course has been modified to reduce the amount of time physically collecting data, and increase the time spent on stand-to landscape-level management and resource planning. The following table shows the distribution of credit hours by subject under the previous 8-semester hour structure and under the proposed 6-semester hour structure. The new structure of FOR 413, 414 decreases the field inventory component, adds explicit competencies in addressing spatial scale, and adds a component of resource planning previously covered in FOR 421C (now FOR 415), as detailed in the table below.

Subject Areas and Credit Hours for Previous (1999)(FOR 421 A and B) and proposed FOR 413 and FOR 414:

Subject Area	Previous Credit Hours	Proposed Credit Hours
Measurement:		
Inventory	4.0	1.3
Volume estimates	1.0	0.5
Sampling: Design and Techniques	1.0	0.5
Surveying and Mapping:		
Photogrammetry	0.5	0.5
GIS Applications	0.5	0.5
Forest Management		
Stand → landscape scale	0.0	0.6
Multi-resource	0.5	0.5
Silviculture		
Growth	0.5	0.5
Forest Policy		
Resource Planning	0.0	0.8
<b>Total</b>	<b>8.0</b>	<b>5.7</b>

**b. FOR 415, 416: Forest Ecosystem Management Planning (spring semester) - Course Objectives**

The spring sections focus on conducting an ecosystem management analysis and the development of a forest ecosystem management plan, which considers multiple resources and ecosystem health desired conditions. Starting with the current forest condition quantified in FOR 423, 414, students develop desired future conditions for a legacy forest (i.e., forest left to future generations 40 years in the future). Students develop desired legacy forest conditions based on forest ecology and ecosystem management principles learned in FOR 313-316, FOR 323-326, and emphasis area courses.

During the initial phase of strategic planning, students conduct analyses to determine, the specific management which should be undertaken over the next 40 years to achieve goals and address issues and concerns. Criteria for measuring goal achievement are identified and a target is set for each criterion based up natural resource principles. A computerized decision support system is then employed to develop and compare various alternatives for managing the land.

Strategic planning results provide general information on the management which should be implemented during each entry to achieve desired future conditions (the legacy forest). The next planning phase, implementation (tactical) planning, focuses on the first entry. In this phase, more attention is given to the spatial location of management activities identified during strategic planning, and additional criteria, not considered during the strategic analysis, are applied.

The third phase of the analysis involves modifying the strategic to address difficulties (e.g., spatial constraints not modeled at the strategic level) discovered in the implementation planning. Students present this final analysis and a second phase of implementation in a written management plan and an oral presentation of analysis results. The final phase of analysis requires identifying information needs (inventory and monitoring) to assess plan implementation and modify the plan in an adaptive manner.

## **ii. Proposed Changes to FOR 413-416**

For 421 C and D will be reduced from the current 4 semester hours each to 3 semester hours each (reduction from 8 to 6 semester hours). The course content has been changed to increase the focus on goal formation through public participation, spatial analysis, and forest health and sustainability. The following table shows the distribution credit hours by subject under the previous 8-semester hour structure and under the proposed 6-hour structure. The new structure of FOR 415, 416 increases the focus on forest health and sustainability, and adds explicit competencies in addressing spatial analysis, and public participation, as detailed in the following table.

Subject Areas and Credit Hours for Previous (1999)(FOR 421 C, D) and proposed FOR 415, 416:

Subject Areas	Previous Credit Hours	Proposed Credit Hours
Measurement:		
GIS Applications	0.2	1.0
Forest Management		
Forest Health and Sustainability	1.0	1.5
Multi-resource	3.0	1.5
Forest Access	1.3	0.5
Harvesting	0.5	0.5
Policy/Administration		
Public participation	0.0	0.5
Resource planning	1.5	0.0
Budgeting / Finance management	0.5	0.5
<b>Total</b>	<b>8.0</b>	<b>6.0</b>

#### 4. Summary of Proposed Structural Changes to the Professional Program

Course	Monday	Tuesday	Wednesday	Thursday	Friday
FOR 316-316	10:20-4:20 All-day Integrative Lab	9:35-10:50 Lecture	10:20-11:10 Lecture	9:35-10:50 Lecture	10:20-11:10 Lecture
		11:10-12:25 Lecture	11:30-12:20 Lecture	11:10-12:25 Lecture	11:30-12:20 Lecture
			1:00-4:00 Lab		
Summary: Four 50-minute lecture periods + four 75-minute lecture periods per week = 10 credits Three 150-minute lab periods per week = 3 credits Total: <b>13 credits</b>					
FOR 323-326	9:10-10:00 Lecture	9:35-10:50 Lecture	9:10-10:00 Lecture	9:35-10:50 Lecture	9:10-10:00 Lecture
	10:20-11:10 Lecture	11:10-3:35 Lab	10:20-11:10 Lecture	11:10-12:25 Lecture	10:20-11:10 Lecture
				2:20-5:15 Lab	
Summary: Six 50-minute lecture periods + three 75-minute lecture periods per week = 10.5 credits 2.5 150-minute lab periods (+ breaks) = 2.5 credits Total: <b>13 credits</b>					
FOR 413-414	9:10-10:00 Lecture		9:10-10:00 Lecture		9:10-10:00 Lecture
	10:20-1:30 Lab		10:20-1:30 Lab		10:20-1:30 Lab
	1:50-4:20 Lab*				
* Beginning in week #8, this lab will move to Fridays					
Summary: Three 50-minute lecture periods + nine 50-minute labs per week = <b>6 credits</b>					
FOR 415-416	9:10-10:00 Lecture		9:10-10:00 Lecture		9:10-10:00 Lecture
	10:20-1:30 Lab		10:20-1:30 Lab		10:20-1:30 Lab
Summary: Three 50-minute lecture periods + Three 150-minute labs per week = <b>6 credits</b>					

## 5. Consequences of Structural and Content Changes

The overall objectives of the four professional semesters are to provide breadth in forest science and management as they have before, but the emphasis areas will provide an opportunity for depth in specified integrative areas. The reduction in credit hours, the alignment of class times with NAU class times, and the rescheduling of days on which laboratories occur will provide numerous opportunities for students to take additional courses to support their emphasis area selection concurrent with the new structure. The table above indicates times available during each semester for students to take other courses. For example, time is available during FOR 313-326 for students to take classes at 8:00 on T/Th, 8:00 and 9:10 on M, W, F, and after 12:25 on T/Th afternoons. During FOR 323-326, time is available for students to take additional courses at 8:00 every day, and after 11:10 on M, W, F. During FOR 413, 414 and 415, 416 students can take additional courses on T/Th and there is time after 1:30 PM on M, W, F during the spring semester. This should be sufficient time for students to acquire the additional credits needed to complete the emphasis area requirement. Efforts must be made when scheduling courses for the emphasis areas to avoid conflicts with the professional program, to the extent possible.

The benefit of adding flexibility to our professional program does come at a cost. FOR 313-316 has been reduced by 2 credits (the third credit represents the Taxonomy course so is not really lost), FOR 323-326 has been reduced 3 credits, and FOR 421 A, B, C, D has been reduced 4 credits. These reductions in credit hours translate into less time available for the subjects taught in these courses. However, as the Table below illustrates, we are still within the range (although slightly below average in most cases) of the credit hours of subjects taught at other peer forestry schools (Appendix I) based on the subject areas required for SAF accreditation.

Credit Hours by Subject Area for the Professional Program and FOR 211, 212, 213, 220.  
(Bolded Categories are based on SAF Areas of Study)

Subject Area	NAU	Other Programs	
<b>Forest Ecology/Biology</b>		(range)	(average)
Dendrology	2.0	3-10	4.1
Forest Ecology	7.5	3-16	9.1
Soils	3.0	3-10	4.5
<b>Total</b>	<b>12.5</b>	<b>7-16</b>	<b>11.0</b>
<b>Measurements</b>			
FOR211	3.0		
Biometrics (FOR 312)	1.0		
FOR 413-416	4.3		
<b>Total</b>	<b>8.3</b>	<b>11-30</b>	<b>20.5</b>
<b>Management (includes social component)</b>			
FOR 323-326	7.0		
Silviculture - FOR 313-316	5.5	3-8	5.2
- FOR 413-416	0.5		
FOR 413-416	5.1		
<b>Total</b>	<b>18.1</b>	<b>6-21</b>	<b>12.0</b>
<b>Forest Resource Policy/Administration</b> (includes social component)			
FOR 323-326	5.0		
FOR 413-416	1.8		
<b>Total</b>	<b>6.8</b>		

**a. FOR 313-316 (Semester A) Subject Area Outcomes, Activities and Assessment - revised and approved by SOF faculty October 11 2004.**

Desired Outcomes	Activities	Assessment
<b>Transferable Knowledge, Skills and Abilities</b>		
Quantitative skills	Math-based field/lab exercises	Written reports; graded calculations Graphical presentations
Field measurements	Field/lab exercises; use of measurement technologies	Written reports; graded calculations
Forest sampling	Field/lab exercises	Written reports
Technical writing	Reports	Written reports; Tutoring if needed
Computer skills	Computer labs and homework	Spreadsheet/computer-based assignments
Career Development	Skills identification, mock interviews, resume development, letters of application	Faculty and peer review, self evaluation

<b>Silviculture</b>		
Knowledge/comprehension of land forces controlling forest vegetation – $FV = f(S, CMC, F, H, MM, SSW)*P*T$	Lecture	Exams, in-class quizzes Homework assignments Weekly lab write-ups
Knowledge/comprehension of the stages of forest stand dynamics and its manipulation	Readings and lecture	
Knowledge/comprehension of basic tree morphology and plasticity and its manipulation – density, crowns & boles	Readings and lecture	
Knowledge/comprehension of tree physiological responses to silviculture – leaves and crowns	Readings and lecture	
Knowledge/comprehension of site productivity and its manipulation – site index curves and equations	Readings and lecture Class exercises, Lab	
Knowledge/comprehension of stand density effects and its manipulation – SDI and density management diagrams	Readings and lecture Class exercises Homework, Lab	
Knowledge/comprehension of the role of tree breeding programs – phenotypes (plus trees) and genotypes, seed orchards and grafting	Readings and lecture Lab	
Knowledge/comprehension of nurseries and nursery stock types – bare-root, containerized and combinations	Readings and lecture Classroom demonstration	
Knowledge/comprehension of even-aged stand management: purpose, advantages, concepts and terminology – clearcut, seedtree and shelterwood	Readings and lecture	
Knowledge/comprehension of multi-aged stand management: purpose, advantages, concepts and terminology – individual-tree and group selection, BDq	Readings and lecture Classroom exercises Lab	
Knowledge/comprehension of site preparation and competition control tools and techniques – fire, mechanical, chemical and combinations	Readings and lecture	
Knowledge and comprehension of how ecological characteristics and	Lecture, class discussion	Exam

silvicultural practices can affect, and be affected by extraction of forest products		
Knowledge/comprehension of artificial regeneration: purposes, advantages, concepts, tools and techniques – direct seeding and planting, seedling survival and spacing	Readings and lecture Lab	Exams, in-class quizzes Homework assignments Weekly lab write-ups
Knowledge/comprehension of natural regeneration: purposes, advantages, concepts, tools and techniques – seed production, dispersal and survival, spatial and temporal patterns	Readings and lecture Lab	
Knowledge/comprehension of prescribed fire and underburning - tools and techniques, fuel types and surveys, ecological restoration	Readings and lecture Lab	
Knowledge/comprehension of thinning tools and techniques – marking guidelines (spacing and limits) and procedures, ecological restoration	Readings and lecture Classroom exercises Lab	
Knowledge/comprehension of harvesting equipment and proper use – concepts, advantages and terminology	Readings and lecture Videos Lab	
Prescriptions for various management objectives: timber production, forest health restoration and maintenance, agroforestry, wildlife habitat enhancement – micro- and macro-scale, watershed and riparian	Readings and lecture Lab	
Knowledge/comprehension of ecosystem management and community/urban forestry implications for silvicultural prescriptions	Readings and lecture Lab	
Knowledge/comprehension of dominant silvicultural themes in various regions of the United States	Readings and lecture Lab	

<b>Ecology: Physical Environment/Adaptation</b>		
Comprehension of how environmental and genetic factors affect phenotypes, adaptation, and competition	Lectures/discussions/lab/readings	Comprehensive lab report
C <sub>3</sub> /C <sub>4</sub> pathways, implications for range plant communities	Lectures/discussions/readings	No specific assessment
<b>Ecology: Biotic Environment - forest and range communities</b>		

Knowledge and comprehension of the role of insects and fungi in forest ecosystems	Lecture, discussions, review of class notes	Exam           Quizzes, lab report, essay
Knowledge of concepts of forest health	Lecture, discussions, reading of selected literature	
Comprehension of biology, epidemiology, and management of major southwestern forest insects and diseases	Lecture and field trips on recognition of pests	
Comprehension of how forest insects and diseases affect all forest resources including recreation, wildlife, timber Review use of population models in ecology	Lecture, class question and answer, discussions Lectures, discussions	
Knowledge of factors that influence population size	Lectures, discussions	
Knowledge and comprehension of predator-prey relationships	Lectures, discussions, lab	
Knowledge of approaches to inventory wildlife populations and important habitat elements (e.g. snags)	Lab	
Review roles of vertebrates in forest ecosystems	Reading, Essay	
Knowledge and understanding of wildlife habitats and habitat relationships including the role and characteristics of ecotones	Lectures, discussions, reading,	
Knowledge and understanding of how to interpret research on wildlife habitat.	Lectures, discussions	
Knowledge and comprehension of wildlife and domestic ungulate impacts on vegetation	Lecture, discussion	
Knowledge and comprehension of theories of plant species association	Lecture/discussions/lab/readings	Exams, lab report
Knowledge of definitions, measurement, and arguments about biodiversity	Lectures/discussions/readings	
Knowledge and comprehension of factors that influence community biodiversity	Lecture/discussions/lab/readings	
Knowledge of management approaches for maintaining biodiversity	Lectures/discussions/readings	
Knowledge and comprehension of definitions of disturbance	Lecture/discussions/lab/readings	

Knowledge of the concept of scale in disturbance, different types of disturbance and their effects on forest and range condition, evolutionary context of disturbance	Lecture/discussions/lab/readings	
Knowledge and comprehension of the implications of changing disturbance regimes	Lecture/discussions/lab/readings	
Knowledge and comprehension of succession terminology, and environmental changes during succession	Lectures/discussions/readings	
Knowledge and comprehension of life history characteristics of early and late successional plants	Lectures/discussions/readings	
Knowledge and comprehension of different theories of succession	Lecture/discussions/lab/readings	
Knowledge and comprehension of factors that affect rate of succession	Lecture/discussions/lab/readings	
<b>Ecology: Ecosystems</b>		
Knowledge and comprehension of the hydrological cycle, its components, and factors that influence these components	Lecture/discussions/lab/readings	Exam
Knowledge and comprehension of flows and cycles of elements and energy in ecosystems	Lecture/discussions/lab/readings	
Knowledge of the major factors that influence flows and cycles of elements and energy in ecosystems	Lecture/discussions/lab/readings	
Knowledge and comprehension of the definition, measurement, importance, and major factors that influence ecosystem net primary production	Lectures/discussions/readings	
<b>Ecology: Landscape Ecology</b>		
Knowledge and comprehension of the importance of landscape ecology (different than a study over a large area)	Lectures, discussion, readings, exercise	Exam
Knowledge of systems of and comprehension of the importance of temporal and spatial scale	Lectures, discussions, readings, lab on spatial scale	

Knowledge and comprehension of how landscape pattern are generated by topography, geology, natural disturbances, animals, human activities.	Lectures, discussions, readings, tie in with earlier modules	
Knowledge and comprehension of how landscape patterns affect forest ecosystems (effects of patch size and shape, interactions of pattern and process; concept of metapopulation)	Lectures, discussions, readings; tie in with earlier modules; Exercise on identification of patches & scale matters	
Knowledge of landscape ecology tools (remote sensing, GIS); spatial metrics, simulation modeling, etc.	Lectures, discussions, readings, lab using ArcExplorer; lab on metrics	
Transition to Semester B: vegetation/habitat classification as management tool; uses of landscape ecology in management	Lectures, discussions	

<b>Career Development</b>		
Knowledge of how to write a professional résumé	Lecture, written assignment	Graded résumé
Knowledge and practice interviewing for professional employment	Lecture, practice	Mock interviews

**b. FOR 323-326 Subject Area Outcomes, Activities, and Assessment**  
**ii. Integrated Resource Management**

<b>Desired Outcomes</b>	<b>Activity</b>	<b>Assessment</b>
Students understand planning processes and decision-making in a multi-goal and multiple resource context	Integrated case study --Oral presentations --Lecture --Group discussion	Integrated case study --Oral presentation -- Final paper
Students can identify and apply appropriate forestry principles in developing integrated forest plans.	Integrated case study --Oral presentations --Lecture --Group discussion --Case study	Integrated case study --Oral presentation -- Final paper
Students understand how to work as analysts to incorporate stakeholder issues and concerns in goal identification and tradeoff analysis	Integrated case study --Oral presentations --Lecture --Group discussion --Case study	Integrated case study --Oral presentation --Final paper
Students are able to apply forest management principles in a unique, culturally influenced context and are aware of benefits which can accrue to creative forest management.	Integrated case study --Oral presentations --Lecture --Group discussion --Case study	Integrated case study --Oral presentation --Final paper

**Recreation Management**

<b>Desired Outcomes</b>	<b>Activities</b>	<b>Assessment</b>
Students will understand the human-nature relationship as reflected in recreation and attitudes toward forest management	Readings on the social acceptance of forest management, Lecture, Discussion	Exam
Students will understand the current demographics of recreation use of wildlands	Lecture Class discussion	Exam, Essay writing assignment
Students can describe and apply the prominent recreation management frameworks, including methods for inventorying recreation resources.	Readings ROS lab, writing assignment; Benefits-based management essay Discussions of regional recreation planning and management	Benefits-based paper Exam ROS lab, writing assignment
Students can describe the most widely used methods used to assess the economic value of recreation	Travel cost, CV, hedonic price method lectures, readings User fee lab; user fee paper	User fee paper Exam

Students can describe the predominant techniques used to assess visual quality	Scenery management system (SMS) and SBE model discussions Guest lecture, readings Visual quality writing exercise	Visual quality writing exercise Exam
Students understand the types of resource impacts associated with recreation use and can describe methods for mitigating impacts.	Impact readings, discussion; Limits of Acceptable Change (LAC); Visitor Experience and Resource Protection (VERP) frameworks readings and discussion	Exam
Students understand the social impacts of recreation on local communities	Readings, discussion Guest lecture	Exam

### Biometrics

Desired Outcomes	Activity	Assessment
Students recognize the significance of different spatial scales	Discussion	Exam
Students learn to apply more sophisticated field methods to estimate forest growth	Lecture Readings	Exam
Students acquire theoretical and practical knowledge on empirical growth and yield modeling --whole-stand, size-class and individual-tree stand-growth models -- Multi-stand modeling systems (FVS, LMS)	Lecture Forest Vegetation Simulator lab	Lab report Exam
Students acquire a basic understanding of the fundamental aspects of process-based growth modeling	Lecture	Exam

### Timber Management

Desired Outcomes	Activities	Assessment
Students know how goals influence timber management decisions	--Lectures --Labs and assignments demonstrating how stand management decisions are influenced by volume maximization, economic efficiency and other goals --Lecture, discussion on stand summation and interaction	Lab assignment Exam
Students are able to conduct basic valuation and financial analyses, including timber sale appraisal	--Lectures --Utilized in most stand level labs	Exam

Students can calculate and interpret the physical and financial criteria used to determine optimal management regimes for timber stands	--Lectures --Lab exercises	Lab assignment Exam
Students understand how silvicultural activities can be employed to enhance goal achievement at the forest level	--Lectures --Lab exercises	Lab assignment Exam
Students understand the functions of problem identification, goals, criteria, variables, constraints, and objective functions in decision analysis	--Lectures --Lab assignment --Homework	Lab assignment Homework grades Exam
Students recognize the need to incorporate risk and uncertainty in decision analysis	--Lecture --Labs --Homework	Lab assignment Homework grades Exam
Students understand the regulated forest concept and how to achieve regulation under both area and volume control	--Lecture --Labs --Homework	Lab assignment Homework grades Exam
Students are able to formulate mathematical programming models, to apply these models in problem-solving, and to interpret solutions	--Lecture --Labs --Homework	Lab assignment Homework grades Exam
Students can formulate contemporary forest management models using linear programming	--Lecture --Labs --Homework	Lab assignment Homework grades Exam
Students understand the concept of product definition and utilization, e.g., logs and log-rules, and their effect on valuation.	--Lecture --Labs --Homework	Lab assignment Homework grades Exam

### Wildlife Habitat Management

<b>Desired Outcomes</b>	<b>Activities</b>	<b>Assessment</b>
Students will learn how to manage the factors that affect the ability of animals to survive and reproduce	-Lectures (review) of population ecology -Lectures on wildlife habitat relationships -Group discussions -Computer simulation of wildlife habitat management -Group habitat management report -Lectures on landscape-level movements and considerations	- Group report grade -Tests - Quiz
Students will learn how management of other resources	-Lectures on habitat management and impacts on wildlife	-Lectures -Group presentation

affects wildlife populations	-Readings on regional wildlife habitat management strategies -Oral presentations Computer simulation of wildlife habitat management -Group habitat management report	grades
Students will learn how agencies manage wildlife	-Agency Forum (class discussion with representatives from AZ G&F, FS, FWS)	-Exams
Students will understand wildlife as a commodity and of the impact of wildlife on other commodities	-Agency Forum -Lectures	-Exams
Students will identify and understand single-species and multi-species approaches to management	-Lectures and readings on indicator species concept (ecological indicators, umbrella species, keystone species, functional groups, etc) -Lectures and readings on indicator species concept -Group discussions -Oral presentations (some presentations include monitoring issues)	-Oral presentation grades -Tests
Students will learn how to inventory, evaluate, and monitor wildlife populations and their habitats	-Lectures and readings on monitoring wildlife at stand, forest, and landscape level (implementation, validation, and other types of monitoring) -Computer simulation of wildlife habitat management -Group habitat management report	-Exams
Students will contrast wildlife and habitat management values by considering traditional ecological knowledge	-Lecture on sustainability of wildlife resources from several Native American cultures (given by Dr. Thom Alcoze) -Alaska Controversy lab—team-taught with Ron Trosper)	
Students will discuss ethical issues in wildlife management	-Group discussions -Problem solving exercise	-Problem solving exercise grade
Students will discuss key wildlife-forestry issues and tools	-Readings -Oral presentations	-Oral presentation grades

## Policy

Desired Outcomes	Activities	Assessment
Students can distinguish levels of decision-making: constitutional, social choice, and operational	Readings on levels of decision-making	
Students can identify fundamental	Readings on environmental ethics, religion,	

sources of values and ideas for the purposes of forest policy in the United States	and sustainability Self-assessment with Kluckholm Value Orientation questionnaire	
Students can connect fundamental values and ideas with the periods of forest and range policy in the United States	Lectures on emergent properties of culture, structure, and agents in the 19 <sup>th</sup> century, relevant to levels of decision-making	
Students recognize and analyze two contrasting models for public decision-making in the United States, that of the “procedural republic” and “collaboration and politics of place.”	Laboratory Report: Comparison of the Procedural Republic and the Politics of Place (“Decide, announce, defend” vs. “assess, discuss, decide, monitor”) Readings Lectures	Lab report grades
Students can describe the different ways to define community	Readings on spatial, interest, and cultural definitions of community	
Students can place major past and present policy direction in the US forest sector within one or the other of these two models.	Group presentations on questions describing emergent properties in the 20 <sup>th</sup> century relevant to forest policy and decision-making.	Group presentation grades
Students can describe methods of dispute resolution in the procedural republic or local collaboration and communities of place.	Paper evaluating the Committee of Scientists Report	Paper grade
Students can describe the relationships among assessments and decisions at large landscape, small landscape, and project levels.	Reading the COS Report proposals on structuring planning processes. Readings on regional assessments Paper evaluating the Committee of Scientists Report	Paper grade
Students can describe the distinctive features of a profession and how the profession of forestry is a profession, including the role of ethics in the self-image of a profession.	Group presentations comparing the role of professionals and scientists in the procedural republic compared to collaborative planning/communities of place	Group presentation grades
Students can define science in a public context, the disputes about the role of science in planning, and the connection between the science of forestry and the profession of forestry.	Essay on the role of science: local planning Essay on the role of science: regional assessments and national policy-making	Essay grades

### Forest Operations

Desired Outcomes	Activities	Assessment
Demonstrate their knowledge of the basic concepts of professional ethics	In-class discussions and presentations.	Final exam questions
Demonstrate characteristics of	In-class discussions and presentations	Final exam questions

effective leadership	Field leadership lab and assignment	Quizzes Lab assignment
Demonstrate knowledge of the basic elements of road design, maintenance, closure, and rehabilitation and how these elements impact forested watersheds	In-class discussions and presentations Reading assignments Field lab assignment	Final exam questions Field lab exercise Quizzes Lab assignment
Evaluate the impacts of forest management alternatives on erosion and sediment yield, peak flow, and water yield	In-class discussions and presentations Reading assignments Field lab assignment	Final exam questions Field lab exercise Quizzes

### Range Management

<b>Desired Outcomes</b>	<b>Activities</b>	<b>Assessment</b>
Students will understand the concept of rangeland and how rangelands differ around the world		
Students will understand the social value of rangeland		
Students will understand the effect of herbivory on rangelands		
Students will demonstrate their knowledge of the process of range assessment and the concept of range condition		
Students will understand the concept of managing for proper use/carrying capacity of rangelands (e.g., stocking rate, AUMs, distribution, wildlife considerations, and grazing systems)		

**c. FOR 413-416: Transferable Skills, Activities, and Assessments**

Essential Skill	Activity	Assessment Measures
Effective writing	Report writing	Management plan introductory chapters Ecosystem management plan Implementation plan (oral and written)
Quantitative/spatial analysis	Inventory mapping Linear and goal programming analysis Implementation plan trade-off analyses Implementation plan spatial allocation of treatments and road system design	Field and office reviews of map products In-laboratory consultation with faculty Management plan Implementation plan (oral and written) Implementation plan (oral and written)
Use of technology	Use of field inventory equipment Use of computer software Use of computer-based DSS	Faculty field checks of inventory Faculty reviews of data entry quality and completeness Management plan In-laboratory faculty consultation Management plan

Additional assessment measures for the course are being investigated. These measures include sending a sample of management and implementation plans for review by forestry professionals outside the university and video taping implementation plan presentations and requiring students to assess their own presentations. Currently, outside forestry professionals are invited to assess the oral presentation component of the implementation plans.

In addition, as part of the final segment of the course, students are asked to write a cover statement for their learning portfolio in which they explain how the pieces in their portfolio link what they have learned in their major to what they have learned in their liberal studies program. In this statement, they should discuss their strengths and describe their goals for their future development.

There are also specific transferable skills associated with FOR421 and 422. These are listed in the Table below:

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**FOR 413, 414**

**FOR 415, 416**

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**Transferable Skill**

Technical Writing  
 Oral Communication  
 Computer Skills  
 Group Processes  
 Leadership  
 Time Management

Technical Writing  
 Oral Communication  
 Advanced Decision Support Skills  
 Effective Business Skills  
 Public Participation Skills  
 Time Management

**ii. FOR 413, 414: Outcomes, Activities and Assessment**

<b>Desired Outcome</b>	<b>Activity</b>	<b>Assessment</b>
Understanding of the relationships between goals and objectives and information needs.	Problem assessment. Definition of inventory needs	Goals, issues, and concerns report. Inventory design and procedures paper.
Understanding of the relationships between inventory design and information needs.	Field inventory design, critical review of literature, lectures	Inventory examination. Inventory design and procedures paper.
Understanding of Continuous Forest Inventory (CFI) plots and relation to forest change estimation	Field inventory design, critical review of literature, lectures	Inventory examination Inventory design and procedures paper.
Ability to conduct forest land classification, and use for transfer of information	Lectures, exercise on land classification. Stand type delineation of analysis area.	Maps of stands and strata (land-types). Land classification exercise report
Introductory understanding of non-traditional forest product inventory, e.g., manzanita, mushrooms	Design of and carrying out special product inventory (product will depend on participating faculty expertise)	Section in current conditions report.
Introductory understanding of human assessment, e.g., assessment of community dependence on forest resources.	Lectures, review of literature, problem assessment.	Goals, issues, and concerns report.
Understanding of Field/office inventory skills	Field inventory	Peer check cruising Faculty check cruising Inventory examination
Knowledge of project organization / management	Develop time schedule, field inventory procedures, and progress reports.	Plot-specific project work plan, progress reports.
Introductory understanding of	Lecture, field inventory	Faculty evaluation of data

database design, ability to effectively use existing database application, understanding of data verification process.	data entry, database verification - quality assurance evaluation.	quality in completed database.
Moderate level understanding of growth and yield modeling	Growth and yield modeling of current conditions and sustainable forest structures	Management plan chapters on current condition and sustainability analysis.
Ability to write technical reports	Report writing	Management plan chapters 1 (Introduction), 2 (Unit description), 3 (field inventory procedures), 4 (current conditions), 5 (sustainability)
Knowledge of effective Geographic Information Systems (GIS)	Mapping component of field inventory, use of Arcview	Inventory maps and database
Ability to work effectively as part of a team	Crew work	Project work plan and progress reports
Ability to lead teams	Leading inventory crew, leading peer check cruise,	Timely completion of inventory tasks; Peer check cruise memos, inter- and intra-crew evaluations.
Effective oral communication of technical material	Current condition oral report	Faculty evaluation of oral report
Understanding of and ability to develop estimates of current forest condition	Integration of all of the above.	Management plan chapters on current condition and sustainability analysis.

**iii. FOR 415, 416: Outcomes, Activities and Assessment**

<b>Desired Outcome</b>	<b>Activity</b>	<b>Assessment</b>
Understanding the process of goal formation through public participation,	Interaction with groups interested in the forest area (stakeholder) (role playing)	Goals, issues & concern statement

Understanding of the process of how goals and objectives are modified through planning and public participation.	Public participation exercise; dispute resolution exercise	Revised goals issues & concerns
Understanding of the relationships between goals and objectives and management analysis.	Problem assessment. Definition of goal criteria to represent goals, issues, and concerns.	Management plan justification of goal criteria
Ability to specify forest management goals in terms of desired future conditions.	Selection of goal criteria, specification of forest structure.	Management plan justification of desired forest condition.
Ability to quantify desired future conditions.	Selection of goal criteria goal target levels, and desired distribution of structural stages.	Management plan description of desired forest condition for single and multi-resource alternatives.
Ability to translate forest management problems into mathematical models.	Formulation of forest management models.	Mathematical programming exam; management plan description of model formulation.
Ability to apply principles of timber, recreation, and wildlife management (e.g. economics, ROS and scenery management system, and wildlife habitat relationships) in developing and analyzing management activities.	Timber, recreation and wildlife baseline analysis	Timber, recreation and wildlife baseline reports.
Ability to select silvicultural prescriptions to accomplish specific forest goals.	Selection of forest health, recreation, and wildlife prescriptions.	Management plan sections on prescriptive constraints for forest health, forest protection, and recreational opportunities.
Understanding of biotic factors that influence forest condition and sustainability as related to management goals.	DMR&DMI calculations and interpretation. Bark Beetle risk rating determination. Analysis of post silviculture prescriptions-ratings	Report on Forest health opportunity
Ability to develop stand-	Develop stand specific	Analysis and

specific prescription/marketing guide to address Dwarf Mistletoe concerns WRT goal	prescription management guidelines. Implement the prescription in analysis model.	implementation report.
Advanced DSS skills, ability to analyze and interpret output of mathematical models.	Decision support system analysis, mathematical programming analysis.	Mathematical programming exam; management plan descrip. of model results.
Ability to analyze management plan results in terms of goals, goal criteria, and desired future conditions.	Decision support system analysis.	Management plan justification of selected baseline and final alternatives.
Ability to develop and analyze implementation activities, ability to recognize need for revised planning analysis.	Implementation analysis; revised implementation analysis.	Report on management plan implementation problems; implementation plan.
Ability to conduct revised planning analysis.	Planning analysis to address implementation problems.	Report on management plan revision process.
Ability to refine information needs (inventory and monitoring) based on planning and implementation analysis.	Inventory and monitoring needs analysis.	Revised inventory and monitoring design and procedures paper.
<hr/>		
Effective business skills, ability to conduct business resource analysis.	Analysis of human, financial, and capital resource capabilities for plan implementation.	Implementation plan presentation
Ability to write technically	Management plan prep.	Management plan
Ability to manage individual time	Project plan development for analysis	Project plan and progress reports
Ability to make oral presentation, and understanding of presentation software	Implementation plan preparation	Implementation plan presentation
Understanding of effective GIS analytical skills	Preparation of management plan and implementation plan maps, tables, and figures	Management plan Implementation plan Implementation plan presentation
Understanding of and ability	Decision support system	Management plan

to conduct ecosystem analysis, integration of all  
management (multi-resource) of the above.  
trade-off analysis

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#### **d. Co-requisite**

To enhance overall student education and to build knowledge in the area of policy, the Committee recommends the inclusion of an upper-division co-requisite class in political science. The course must be taken during one of the four professional semesters and can be selected from a suite of offerings currently identified as POS 344, 359.

## **VII. Integrating Themes**

We believe that beyond sound technical competence, students graduating from the School of Forestry, regardless of major, must possess and demonstrate competence in two additional areas of knowledge: a set of what we call "transferable" skills and a grounding in professionalism. Transferable skills consist of those knowledges and abilities that transcend the profession and have applicability and importance for the career and life success of any graduate regardless of their chosen career path. These skills include such abilities as critical reading and thinking, effective oral and written communication skills, the use of technology, career awareness and acquisition skills. Professionalism includes an understanding of professional ethics, the role of the professional, and professional standards. The transferable skills of career awareness and job acquisition skills link to this larger topic of professionalism. Recognizing these needs, the faculty have already put into place curriculum components to assist students in acquiring and mastering these skills. The purpose of this section is to briefly summarize these existing components and to recommend enhancements to them.

### **A. Writing Across the Curriculum (WAC)**

As part of on-going review of the curriculum during the mid-1990's, the faculty identified a need to improve the quality of student writing skills. This identified need resulted in a set of curriculum changes that although not ever explicitly or approved as such, came to be known as "Writing Across the Curriculum."

To begin, after consultation with the English Composition Program faculty, the forestry faculty approved replacing ENG 302 (Technical Writing) with ENG 205 (Writer's Workshop). The goal of this change was to provide students with a more directly complimentary second English composition course than that provided by ENG 302. Second, again with consultation with the faculty in the English composition program, the

forestry faculty began the process of developing more explicit writing expectations for students within the forestry curriculum. Desired student learning outcomes were identified, and sequenced through the curriculum. Third, the forestry faculty agreed to fund a graduate student from the English department who would work for the School on a half-time basis during the academic year. The graduate assistant (known by various titles, including "Writing Tutor", "Writing Coach", and "Writing Consultant") had the role of assisting both faculty and students with writing. This assistance included working with faculty in the development of an overall evaluation rubric for the programmatic writing expectations, working with individual faculty in the design and evaluation of individual writing assignments, and serving as a source of writing assistance for students.

We feel that the Writing Across the Curriculum program has been, on the whole, very successful. Anecdotally, faculty believe that student writing is improved, and that students and faculty have a clearer understanding of how individual writing assignments fit into the larger programmatic writing goals. To improve WAC, the Curriculum Review Committee makes the following recommendations:

1. That given the implementation of the undergraduate forestry course in soils, that the desired learning outcomes for this course explicitly recognize and include writing outcomes;
2. That the faculty adopt McMillan, *Writing in the Biological Sciences* as the one REQUIRED writing text for all forestry courses;
3. That a faculty leader be identified who has the responsibility, and commensurate authority, to ensure the coordination of all aspects of the WAC effort, including the consistent use of the common forestry writing rubric across all forestry courses in the curriculum;
4. That faculty meet with the writing consultant to help ensure that writing assignments have clear and consistent expectations; and
5. That WAC goals need more explicit articulation and the identified faculty WAC leader should take the lead role in this process.

### **B. Information Technology Across the Curriculum (ITAC)**

During the Summer of 1999, Don Arganbright, Chair of the School of Forestry, asked a group of faculty to review the technological teaching needs and goals for the School. As a result of these discussions, this faculty group, led by Margaret Moore, developed the "Information Technology Across the Curriculum" (or ITAC) proposal. This proposal identified both desired educational outcomes for forestry students and the hardware necessary to implement the program. The educational outcomes followed the same general pattern as that developed for the WAC, in that desired competencies build through the professional forestry program. The first round of hardware was purchased for ITAC, but budget rescissions for the 1999-2000 and 2000-2001 Academic Years have temporarily delayed the additional hardware purchases. The Committee believes that ITAC well serves our forestry students and recommends its continuation, but with the following recommendations:

1. That ITAC goals be reviewed and revised in light of these proposed curriculum changes and the interruption in the original equipment purchase schedule;
2. That ITAC hardware purchase needs be reviewed and revised as necessary; and
3. That the new ITAC Coordinator, P.J. Daugherty, take the lead role in these tasks.

### **C. Professionalism**

Professionalism, in all its manifestations, rests at the core of the forestry program. The current curriculum includes explicit professional elements, from an introduction to forestry careers in FOR 101, through discussions on professional ethics in FOR 313-326 and FOR 323-326, required readings from the *Journal of Forestry* in FOR 313, additional career exploration in FOR 323-326, and leadership skill building in FOR 323-326. The Curriculum Review Committee believes that such professional elements are fundamentally important to the major and must be continued. It also believes, however, that the inclusion and treatment of professionalism must receive more deliberate attention throughout the curriculum.

Therefore, the Curriculum Review Committee offers up the following recommendations:

1. The continuation of career awareness elements throughout the professional curriculum, with an increased emphasis on the lower division courses;
2. The relocation of the career development module included in FOR 313-316 in Spring 2000 to FOR 313-316 starting Fall 2000 [already implemented];
3. The continuation of the leadership module in FOR 323-326;
4. That required readings from the *Journal of Forestry* be continued throughout the upper division professional curriculum;
5. The continuation of the professional ethics subject matter in all professional semesters
6. That students be encouraged to become active members of a professional society; and
7. Whenever possible, faculty structure assignments to encourage student participation in region and/or national professional meetings

## **VIII. EMPHASIS AREAS**

The Curriculum Review Committee recommends that the School adopt thematic “Emphasis Areas” as a 12-credit requirement within the 120-credit professional forestry BS degree. At least 6 of than 12 credits must be upper division, and the package should be 12 credits. The Emphasis Areas allow the students to use the 12 credits plus 7 credits of elective credits available to them, to gain more knowledge in forestry related topics. Each Emphasis Area will have a one-page advising sheet to assist faculty; however, a student may choose to design their own 12-credit series by selecting a general forestry emphasis area. This emphasis area requires 12-credits (6 upper + 6 lower division)

selected from any regular course with a FOR or PRM prefix. For example, students could assemble a thoughtful mix of two emphasis areas or choose any series of courses within approved emphasis areas to obtain the 12-credit emphasis area. The 12 credits of emphasis area courses derives from reductions in the professional program and emphasis area courses should be professional in nature. The courses used in the Emphasis Area must be approved by the Emphasis Area coordinator(s) and the advisor.

Emphasis Areas are an extension of our professional forestry program, meeting student needs for detailed training (depth and polish) above and beyond a broad forestry degree in an area of their specific interest for study and/or employment consistent with our professional program. Emphasis Areas should be unique and integrative across disciplines. Thus, an Emphasis Area will enhance a student’s overall education while at NAU. We also believe that Emphasis Areas will assist the School’s recruitment goals of new students and transfers from other programs, their retention over time, and ultimate employability. Finally, the unique and integrating nature of our Emphasis Areas will promote our national standing among forestry programs.

**A. Structural Template**

The first set of Emphasis Areas, six in total, for 2001 will be comprised of the proposals received to date. New proposals will be reviewed each year by the SOF Curriculum Committee. New proposals must demonstrate that they are unique and sufficiently different from those already approved. Following is a DRAFT summary of the six proposals.

Title	Course Requirements (number of courses)			Audience
	Lower Division	Upper Division	New Courses	
<u>Currently ready:</u>				
Conserving Biodiversity	2	2	0	FOR, others
Ecological Restoration	0	4	0	FOR, others
Forest Health	0-1	3-4	0	FOR, others
International Forestry	2	2	0	FOR,PRM,GGR
Indigenous Forestry	1	3	1	FOR
General Forestry	2	2	0	FOR
<u>Planned:</u>				

## B. Approval and Renewal Process

Details on the content of the above Emphasis Areas can be gathered from their specific proposals (proposals appended to this report). These proposals, and any future proposals, should include five basic sections:

- 1) Introduction, background and rationale for the emphasis area, including a statement about the uniqueness and integrative nature of the Emphasis Area.
- 2) Course requirements, that clearly delineate existing lower- and upper-division courses, other courses available or planned beyond the core 12 credits (i.e., other good supporting electives), and new courses that need to be developed to support the Emphasis Area.
- 3) Suggested Liberal Studies classes, as a short-list from which students might choose.
- 4) Likely sequence that a student would follow, detailing courses and activities prior to the professional program versus during the professional program. This becomes the one-page advising sheet.
- 5) Outcomes and assessments of effectiveness for that emphasis area.

Proposals will be actively promoted to students for **five years only** beginning the year of approval (i.e., they are planned with a sunset clause); after that time period, the proposal must be resubmitted by its originator(s) with any necessary or desired modifications. Enrollment numbers in individual courses and a cost:benefit analysis associated with that enrollment will be only part of the evaluation of an Emphasis Areas. There is no particular maximum number of Emphasis Areas, but the Committee is concerned that too many will negatively influence the cost:benefit analysis - too few students in too many classes.

## IX. Curriculum Assessment

Assessment within the forestry curriculum has two components: the assessment of individual student learning outcomes and overall program assessment.

With regards to the former, the Review Committee believes that our current unit/course-based evaluation system provides sound and comprehensive methods of evaluating individual student learning outcomes. The evaluation of students has many desirable elements including multiple evaluation modes (*e.g.*, oral presentations, written examinations, writing portfolios, field examinations, etc.) and clear evaluation criteria (*e.g.*, the writing rubric). What the major does not have is a single, comprehensive "exit"

examination. Given the measures already in place, and the cost and resources necessary to implement such a comprehensive examination, the Review Committee recommends against such a requirement.

The Committee believes that we can improve the assessment of the program through a more systematic and deliberate use of the FOR 413-416 management planning documents produced by students. By reviewing a subsample of these documents on a regular and on-going basis, the faculty has an extremely powerful tool for program assessment. To maximize the power of this procedure will require that the faculty devote time to the development of explicit evaluation criteria against which we can review the planning documents.

See Appendix III for detailed Assessment Plan for the School of Forestry.

## **X. Distance Education: Priorities and Opportunities.**

### **A. Introduction**

Distance Education is part of Northern Arizona University's mission statement, "To offer instruction through educational partnerships throughout the state that employ a variety of strategies to support distance learning and provide opportunities for faculty and staff development." The specific goal is "To become recognized as a national leader in the use of technology for distance learning."

Dr. Arganbright, Dean of the College of Ecosystem Science and Management, states that the President of the University has set enrollment as the number one priority, and sees Distance Education as the primary source for enrollment growth. On campus enrollment has been flat over the past five years and NAU's state budget is based on student head count. The Dean states that there is a real commitment for on-line courses and distance education. Thirty percent (30%) of tuition revenue from on-line courses returns to the Dean. He suggested that the College would retain 10% of the 30% (3% of the tuition revenue) for building a source of startup funds for distance education. The remaining would be returned to the faculty for salary, release time, and/or other uses. He emphasized that he was not interested in faculty merely sticking existing courses online, but rather on developing innovative, interactive courses (both existing and new courses) designed to take advantage of distance education technology.

The curriculum review committee sees potential for distance education to alleviate problems in course offerings for transfer students. A second opportunity involves positioning the School as a leader in distance education for Forestry courses, with the possibility of capturing a larger market of students. This section of the report will discuss the priorities and opportunities for distance education, including: definitions and background, defining target audience, identifying distance learning packages at NAU, and recognizing and evaluating faculty participation.

## B. Definitions and Background<sup>1</sup>

Distance Education is instructional delivery that does not constrain the student to be physically present in the same location as the instructor. The term Distance Learning is often interchanged with Distance Education. However, this is inaccurate since institutions/instructors control educational delivery while the student is responsible for learning. Distance Learning is the result of Distance Education. Another term that has experienced some recent popularity is Distributed Education. This term may represent the trend to utilize a mix of delivery modes for optimal instruction and learning.

The defining elements of distance education include:

- The separation of teacher and learner during at least a majority of each instructional process.
- The use of electronic media to unite teacher and learner and carry course content.
- The provision of two-way communication between teacher, tutor, or educational agency and learner.

There are two categories of distance education delivery systems, synchronous and asynchronous. Synchronous instruction requires the simultaneous participation of all students and instructors. The advantage of synchronous instruction is that interaction is done in real time. Asynchronous instruction does not require the simultaneous participation of all students and instructors. Students may choose their own instructional time frame and gather learning materials according to their schedules. Asynchronous instruction is more flexible than synchronous instruction. Forms of asynchronous delivery include email, listservs, audiocassette courses, videotaped courses, correspondence courses, and WWW-based courses (though WWW will probably offer synchronous formats in the near future). The advantages of asynchronous delivery include student choice of location and time, and (in the case of telecommunications such as email) interaction opportunities for all students. A disadvantage to consider with email-based interaction is the considerable written exchange, which could really pile up. There are numerous distance education modes: print correspondence - the traditional method of distance education; audiographics; instructional television and videotape; teleconferencing, audio/video conferencing, and computer conferencing; Interactive Relay Chat (IRC), Multi-User Dimension Object Oriented (MOO) and Multi-User Dimensions (MUD); email and listservs; and the WWW. When choosing a distance education mode, one must look at each technology and think about how it might fit the teaching goals. If there are several courses, one must investigate how the technology might fit each course. One must also assess the characteristics and needs of the learning audience. For example, if target students have older computers and slower modems, one will not want to teach the course entirely by IRC, MOO, or WWW. Investing in a variety of technologies should allow for increased adaptability as technologies improve.

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<sup>1</sup> Adapted from WestEd Technology in Education program, 1995,  
<http://www.wested.org/tie/dlrn/distance.html>

### C. Target Audience (geographic, ethnic, level)

Distance education can serve two distinct target audiences: 1) undergraduate students planning to transfer to the School of Forestry professional forestry program and 2) a larger market, which could include a broad student segment interested in the environment, forestry students at other institutions and forestry professionals seeking continuing education.

The proposed forestry curriculum has increased the number of forestry courses required as lower division prerequisites. Under the proposed curriculum, FOR 101, 211, 212, 213, and 220 are required courses and are offered only at NAU. While FOR 101 has a variety of transfer courses that can be used as substitutes, the other courses have no effective substitutes at the Community College level.

The committee **recommends** that distance education be used as a means of alleviating this transfer credit problem. Specifically, the committee recommends that:

- FOR 101 and FOR 212 should be developed as distance education courses to help alleviate the transfer credit problem.
- FOR 213 should be developed as a distance learning course.
- Independent evidence on number of students using, and the effectiveness of, the distances education mode should be used to select the mode used for these courses.
- Investigate the potential to offer FOR 211 as a distance educational course with the idea of offering a lecture portion of this course via distance education.
- All pre-professional courses should be scheduled so as to create a seamless transition for transfer students to enter the professional program. This may include offering 220 and 211 in the spring semester and increasing the availability of all pre-professional courses.

Distance-delivered forestry courses may also improve enrollment in lower division forestry courses, and help alleviate on campus classroom availability problems.

The second target audience reflects the committee's perception that no one is currently offering distance education in forestry. Given the lack of competitors, interested faculty could use distance education to capture a portion of the 5000 students who enter college every year as forestry majors. A well design distance education, lower division forestry course has the potential to attract students from all over the United States. The development of such courses has the potential to:

- provide another means of gaining national stature in innovative teaching approaches,
- provide basis for partnership with the Society of American Forester to offer continuing education course to all forestry professionals, and

- provide a lucrative return to entrepreneurial faculty, who are willing to invest in the high up-front costs of developing innovative courses.

#### **D. Distance Education Packages at NAU**

At NAU, there are several main modes used in delivering distance education (as exemplified by the Statewide Academic programs): IITV, Interactive Instructional Television Courses; EchoStar, Universityhouse Satellite Courses; and Web courses.

IITV refers to all courses offered via television, cable, microwave, direct broadcast satellite (DBS), common carrier or videotape throughout the state. Interactive instructional television uses two-way audio/video communications to link the statewide classroom with selected classrooms on the Flagstaff campus and at other statewide sites. Students at all campuses are taught simultaneously. They can ask questions and interact with their professor or with other classmates, as if all students were together at one site. These course delivery methods offer alternatives to the fixed schedule, place, program, and structure of traditional classroom-based education.

EchoStar refers to courses delivered via satellite by the EchoStar service through the DiSH Network™. NAU operates the Universityhouse Channel on EchoStar's direct broadcast satellite (DBS) service, available throughout the United States and its territories. Students must have a DiSH Network™ satellite dish and receiver, and a subscription to the DiSH Network™ basic service package. There are thousands of dealers nationwide selling DiSH Network™ equipment, with over 3.7 million homes subscribing to this service. The satellite dish and receiver should cost about \$200 to \$300 installed. Some receiver models that automatically program the VCR will cost around \$408. The DiSH Network™ basic service subscription fee for the educational package (including the Universityhouse Channel) runs \$24.99 per month. In addition, students must be admitted to NAU, register, and pay regular tuition and fees.

Distance education Web courses fall into two categories, web-based and web-cast (also known as "video streaming. In a web-based course students attend lectures and receive and complete assignments through web access. A web-cast course differs from a web-based course in that you watch a live version of the class or video delay of a previously taught class on your computer.

#### **E. Recognizing and Evaluating Distance Education Participants**

Given that the committee recommends the use of distance education, the committee recommends that specific recognition and evaluation measures be developed for those faculty who choose to participate in distance education. The committee agrees that there should be financial incentives or release time to compensate faculty for the time spent on developing distance education. Coupled with the incentives, the committee sees the need for oversight measures to ensure that distance education courses maintain high standards and are done correctly. Specifically, the committee recommends that:

- faculty involved in distance education receive the majority of tuition revenue returned to the Dean
- financial and technical support for initial distance education development should be provided by the College; this support could be solicited by a proposal submission process for new distance education course.
- statement of expectations should be adjusted to reflect the risk and effort involved in developing new distance education courses,
- the School should examine the possibility of hiring specialty faculty/staff to lead the effort in distance education; these positions might be adjunct or instructor positions, with their salary linked to enrollment.

## **XI. Impact of Proposed Changes on Liberal Studies**

The proposed changes are neutral with respect to NAU Liberal Studies requirements. Although three lower division prerequisite courses that currently count towards Liberal Studies (ECO 285 and GLG 101 and GLG 103 for a total of 7 credits) are being dropped, they are replaced by EXISTING prerequisite courses of COM 111 (for ECO 285 in the Social and Political Worlds block) and CHM 130 and 151L (for GLG 101 and GLG 103 in the Laboratory Science block).

In addition, NAU’s Liberal Studies Council has approved FOR 323-326 as the major’s “Junior Year Writing Requirement” course, and FOR 413-416 as the “Senior Capstone” course required as part of NAU’s Liberal Studies program. Once the curriculum changes proposed here have been approved, we will need to inform the Liberal Studies Council of these changes. However, the Review Committee does not anticipate any difficulty with respect to these curriculum changes and Liberal Studies requirements.

## **XII. Implications of Proposed Changes on Supplemental Learning Support**

The School of Forestry offers a variety of supplemental learning support to complement classroom learning, increase student retention, and improve the job readiness of our forestry graduates.

<b>Type</b>	<b>Person</b>	<b>Activities</b>
Writing assistance	Writing consultant (Graduate student in English)	Weekly appointments available for tutoring in grammar, content, and writing style. Writing tutor meets with faculty to learn writing assignment expectations.

<b>Type</b>	<b>Person</b>	<b>Activities</b>
Math assistance	Campus Learning Assistance Center	Weekly appointments available for tutoring in math and statistics.
Career services	Student Services Coordinator	Jobs are advertised to students through the Career Center, job bulletin boards, and through weekly emails. Workshops are offered on resume writing, cover letters and interviewing techniques. A comprehensive job search skills curriculum is provided in the professional program culminating in a mock interview lab exercise.
Financial support	Financial Aid Representative and College Development Officer	Assistance is provided in preparing the FSFA and answering financial aid questions. Weekly emails alert students to scholarship information, and scholarship notices are posted on bulletin boards.
Student clubs	Forestry Club, Xi Sigma Pi Honor Society, and Student Ambassadors	Clubs develop leadership skills and provide opportunities for community involvement, volunteering, peer mentoring, career exploration, and networking with local professionals.
Computer labs and technical support	Computer labs and computing support staff	Undergraduate computer lab will contain 20, 333 MHz PCs, 4 BW LJ printers, 1 Color Inkjet printer, 1 flatbed scanner, 10 tablet digitizers, and 1 larger format digitizer. Lab receives two-year-old computers every two years. Available software can be viewed at <a href="http://www.cesm.nau.edu/nauinfo/under/computer/labs/ugl/swhw.html">http://www.cesm.nau.edu/nauinfo/under/computer/labs/ugl/swhw.html</a>  Hours Spring / Fall Semesters: 7 AM - 10 PM Monday – Thursday 7 AM - 6 PM Friday 6 PM - 10 PM Sunday (Lab Monitor)

The proposed changes in the professional curriculum provide an opportunity to reexamine the types of assistance offered to forestry students. Specific recommendations to further enhance the School’s supplemental learning support are:

**A. Writing assistance**

- Require students to purchase McMillan V. E. 1997. *Writing Papers in the Biological Sciences*. Bedford Books, Boston. as a writing resource and recommend that faculty refer to and incorporate the text throughout the curriculum. Encourage students to keep the text throughout their forestry academic career.
- Develop a faculty writing coordinator position to organize and direct Writing Across the Curriculum (WAC) objectives and to facilitate usage of the writing consultant.

- Compile and distribute a writing handbook for students.
- Improve flexibility in student class schedules to set up appointments with the writing consultant due to the reduction in credit hours in Semesters A and B and the division of Semester C into two semesters.

### **B. Math assistance**

- Assess interest among Xi Sigma Pi forestry honor students to serve as peer math tutors to assist students in pre professional courses such as precalculus, statistics, and chemistry as well as tutor students in FOR 211.
- Explore the feasibility of requesting a graduate assistantship where a portion of the assistantship includes serving in a math tutoring capacity.

### **C. Career services**

- Provide a career panel of local professionals in Forestry 101 to introduce students to employment fields in forestry.
- Offer a comprehensive job search skills curriculum and mock interview workshop in Semester A in order to give students the job readiness skills needed to secure internships, seasonal positions and regular, full-time employment.
- Present workshops outside of the classroom on the following topics: “Starting your job search and identifying your skills”, “Preparing resumes, cover letters and applications”, and “Successful interviewing strategies”.
- Advertise internship and job openings on the School’s web site as well as through weekly emails and postings on the job bulletin board.
- Develop partnerships with the campus Career Services Office to augment appointment times for 1:1 job counseling assistance.

### **D. Financial support**

- Market the availability of the School’s dedicated financial aid counselor. Introduce the financial aid counselor at each semester’s New Student Orientation program.

### **E. Student clubs**

- Improve flexibility in student schedules to devote more time to club activities due to the reduction in credit hours in FOR 313-316 and FOR 323-326 and the division of FOR 421 (now FOR 413-416) into two semesters.
- Improve continuity of club leadership and the involvement of seniors with the restructuring of Semester C into two semesters.
- Continue the practice of encouraging students to attend local professional association conferences by scheduling assignments and exams to not conflict with conference dates.

## **F. Computer labs and technical support**

- Improve availability of “open” lab time where students can work collaboratively and use specific software that is only available in the building’s computer lab by:
  - ◆ Scheduling and coordinating sporadic labs better;
  - ◆ Scheduling open time for professional forestry students that doesn’t conflict with class times in the four semester professional program;
  - ◆ Encouraging faculty to reserve the lab during class time only to teach material that is lab dependent;
  - ◆ Pursuing the option of allowing undergraduate students to use the graduate lab at selected times; and
  - ◆ Determining weekend hours that will maximize student usage.
- Increase coordination with computing staff as ITAC continues to develop to insure that computer resources are available and complement new ITAC initiatives.

## **XIII. Implications on Our National Stature**

### **A. Teaching**

The curricular changes described earlier will likely affect the NAU School of Forestry’s national stature in undergraduate forestry education. First, we present our predictions about how the proposed curricular changes will be viewed nationally. Next, we address specifically how the revised curriculum corresponds with both current and proposed revisions of the Society of American Foresters (SAF) accreditation standards.

We predict the following national implications of our proposed revised curriculum:

- The emphasis areas that we propose (Conserving Biodiversity, Ecological Restoration, Forest Health, Indigenous Forestry, International and Community Forestry, Humans and Nature) will bolster our national stature because they offer multidisciplinary training in important emerging fields in forestry and natural resources. These emphasis areas are significantly different than areas of specialty offered by most undergraduate forestry programs in the US (e.g., wildlife management, industrial forestry, timber production, urban forestry, wood technology, etc...). Moreover, each of these emphasis areas have the potential to be a nationally recognized educational model in these emerging fields of study. This recognition has already occurred for the proposed Ecological Restoration Emphasis Area.
- The incorporation of distance-learning opportunities into our curriculum will identify the NAU School of Forestry as an innovative program that embraces emerging educational technologies. Aside from being recognized as innovative, our national stature may be additionally enhanced if the distance-learning courses are successful in facilitating enrollment of transfer students, increasing overall forestry majors, providing continuing education to forestry professionals, and otherwise providing

educational opportunities to the public. On the other hand, our national stature may be diminished if the planning, staffing, implementation, and marketing of these courses are poor.

- The revised curriculum should increase student competency in many interpersonal and ‘non-technical’ skills that were recently identified by forestry employers as being needed for long-term success in forestry but where current student performance is lacking (Sample et al. 1999. *Forestry Education: Adapting to the changing demands*. *J. For.* 97(9):4-10). These skills include: ability to work in teams, ability to listen to and address public questions, innovative approaches to forest management, innovative approaches to working with the public, ethics, collaborative problemsolving, and dispute resolution. The revised curriculum also emphasizes written and oral communication, skills that employers have identified for improvement in forestry graduates.
- Curriculum revisions could result in the loss of our unique “fully integrated” curriculum. Also these changes might create a more complex curriculum path for faculty and students.

Accreditation of our undergraduate forestry program by the SAF is a concrete measure of our national stature in teaching, and our program has been accredited for many years. The current standards encourage “challenging, imaginative programs that enhance the individual’s understanding of concepts and principles and promote individual capability for applying new science and technologies...” Also, the current standards emphasize that:

“Academic programs may alter their goals and objectives over time. As significant change results, the program and curriculum should be modified accordingly, and these changes must be reflected clearly in the program’s literature and self-evaluation report.”

Thus, revision of our curriculum is consistent with these accreditation guidelines.

The present standards for SAF accreditation require “coverage” of four areas in the general education component of the curriculum (communication, science and mathematics, social sciences and humanities, electives), and four areas in the forestry curriculum (forest ecology/biology, measurement of forest resources, management of forest resources, forest resource policy and administration). Guidelines for this “coverage” within each of these areas are flexible: emphasized topics are suggested, but not required, for accreditation. With the current flexible guidelines, we anticipate reaccreditation.

However, SAF accreditation guidelines may change soon, as a task force on accreditation has recently (May 2000) recommended considerable changes. Currently, these changes are only recommendations and could be altered following comments and debate by SAF membership. However, implementation of these recommendations as accreditation standards may complicate accreditation of our revised curriculum.

Similar to the existing SAF curriculum standards, the proposed new standards require “coverage” and student competency in four areas of general education and four areas in the forestry curriculum. For general education, three of the areas are the same in the existing and proposed new SAF accredited curriculum (communication, science and mathematics, social sciences and humanities). However, the fourth required area has been changed from “electives” to “computer literacy.” This proposed change in SAF accreditation standards should not affect accreditation of our proposed revised curriculum because our students are and will be computer literate by taking CIS120, CIS120L, and through our emphasis on computer use in the four professional semesters via ITAC.

The proposed new SAF curriculum standards also require student competency in the same four areas in the forestry curriculum as is required in the current accreditation standards (forest ecology/biology, measurement of forest resources, management of forest resources, forest resource policy and administration). However, the proposed new SAF curriculum requires coverage of a list of subjects and topics for each of the four general areas, instead of making general suggestions about the appropriate content and subjects as is contained in the current standards. In other words, the new accreditation standards proposed by the SAF task force are less flexible than the current standards, and this potential loss of flexibility may have implications on our future accreditation.

The recommendations of the SAF task force and proposed new accreditation standards, copied *verbatim* from the task force report, are listed below. In this section, our comments on the implications of these proposed new standards on accreditation of our revised curriculum are shown in **BOLD CAPS**. We address only those recommendations that are directly relevant to our curriculum. As you will read, our proposed revised curriculum is consistent with most, but perhaps not all, of these recommendations

#### **B. Summary of Findings and Recommendations of SAF Revised Accreditation Standards (May 2000)**

Recommendation #1—Professional forestry education accreditation must continue to be a critically important function of the Society of American Foresters.

Recommendation #2—The Task Force endorses a model for accreditation that consists of a core set of competencies that would apply to all accredited forestry programs. This is contrasted to a model in which a core PLUS specialized areas of forestry would be accredited, with each specialized area having its own accreditation standards.

**OUR REVISED CURRICULUM IS CONSISTENT WITH MUCH, BUT PERHAPS NOT ALL, OF THIS PROPOSED CORE SET OF COMPETENCIES (SEE BELOW UNDER *Proposed Standard II—Curriculum*). ALSO, THE TASK FORCE REPORT MENTIONS THAT WITH THE PREFERRED MODEL, SPECIALIZED AREAS OF FORESTRY MIGHT BE FORMALLY CERTIFIED BY SAF. OUR EMPHASIS AREAS CAN BE VIEWED AS SUCH SPECIALIZED AREAS, HOWEVER WE DOUBT THAT SAF WILL HAVE A CERTIFICATION**

**PROGRAM FOR MOST OF OUR EMPHASIS AREAS GIVEN THEIR UNIQUENESS.**

Recommendation #3—The appropriate unit for accreditation is the academic *program* leading to a professional forestry degree. Program is defined as the curriculum put forth by the institution for accreditation AND the institutional resources needed to support that specific program. SAF does not accredit universities, colleges, or departments. It accredits academic programs within these institutional structures. One or more programs may be accredited within a single department, school, or college. Similarly, a department, school, or college may contain both accredited and non-accredited academic programs.

Recommendation #4—It is recommended that programs leading to a professional forestry degree be clearly delineated and defined in order to be eligible for forestry accreditation. Institutions may seek accreditation for programs that lead to baccalaureate, masters, or perhaps even doctoral degrees. All programs, irrespective of the degree which is awarded, will be required to conform to all accreditation standards of the Society in order to obtain or retain professional forestry accreditation.

Recommendation #5—Both the Society of American Foresters and universities must be clear in specifying which programs are, and are not, accredited when communicating with students, employers, and the public. This "truth-in-advertising" principle is becoming increasingly important as forestry schools and departments develop programs related to general natural resource or environmental curricula in which the core competencies for professional foresters may not be offered.

Recommendation #6—The Task Force recommends that Accreditation Standards specified in the 1994 Accreditation Handbook be replaced with a new set of standards. By so doing, it fulfills its charge from Council to develop "a summary of minimum, entry-level forestry occupational competencies and curriculum topics" and to propose revisions to SAF accreditation standards if appropriate. It is recommended that the proposed standards, which define core competencies for entry-level foresters, be widely disseminated by Council for comment by various stakeholder groups and, based on such input, be adopted by the Society of American Foresters.

**OUR COMPETENCY BASED REVISIONS ARE CONSISTENT WITH THIS RECOMMENDATION. THE EXACT COMPETENCIES REQUIRED FOR FUTURE SAF ACCREDITATION ARE NOT CLEAR YET, ALTHOUGH THE TASK FORCE REPORT CONTAINS RECOMMENDATIONS (SEE BELOW). WE SHOULD BE PREPARED TO CHANGE OUR COMPETENCIES TO FOLLOW SAF'S NEW STANDARDS.**

Recommendation #7—It is recommended that curricular standards be stated in terms of desired competencies rather than simply as courses or topics. Each institution must demonstrate that it instills the core competencies that define a professional forester through a combination of: (1) listing courses, subjects, and topics, and (2) providing

results of educational outcomes assessments. The former traditional approach demonstrates that instruction is provided in the core competencies. The latter provides *ex ante* evidence that students from the program have actually acquired the core competencies. To help with this change, the Task Force recommends that the Society of American Foresters work with selected universities or contractors to prepare a handbook on educational outcomes assessment.

**OUR COMPETENCY BASED REVISIONS ARE CONSISTENT WITH THIS RECOMMENDATION. MOVEOVER, WE EASILY MEET CRITERION (1) FOR DEMONSTRATION OF STUDENT COMPETENCIES. WHEREAS FOR 421 AND FOR 422 MEETS SOME ASPECTS OF CRITERION (2), WE MIGHT HAVE TO DEVELOP ADDITIONAL EDUCATIONAL OUTCOME ASSESSMENTS TO FULLY MEET THIS CRITERION.**

Recommendation #8—It is recommended that the accreditation standards be strengthened by *requiring* that each standard be met, rather than indicating that some standards *should* be met as was the case with previous standards.

**AS NOTED ABOVE, THIS RECOMMENDATION MAY COMPLICATE ACCREDITATION OF OUR REVISED CURRICULUM. (SEE BELOW UNDER *Proposed Standard II—Curriculum* FOR SPECIFIC DETAILS).**

Recommendation #9—Accreditation standards and processes must be uniform for all forestry programs in the United States. It is not recommended that accreditation standards be modified to suit regional needs or conditions.

**THE IMPLICATION FOR OUR CURRICULUM IS THAT ACCREDITATION STANDARDS WILL BE LESS FLEXIBLE, AND REGIONALLY RELEVANT EDUCATIONAL CONTENT MIGHT BE LOST.**

Recommendation #10—It is clear that current staffing levels and organization of the SAF Office of the Director of Science and Education are not adequate to permit the full adoption of the recommendations of this Task Force. The Task Force strongly recommends that the staff and the Council of the Society of American Foresters assess the current resources allocated to the education, accreditation, and certification functions; assess the resource implications (both revenue opportunities and costs) of the Task Force recommendations; and allocate those resources needed to assure an exemplary accreditation and certification program.

Recommendation #11—As a necessary complement to both the proposed changes in the accreditation standards and the expanding scope of forestry, the Task Force recommends that SAF broaden its current efforts in professional forestry certification. Consideration should be given to developing certification standards and programs for specialized areas of expertise such as urban forestry, forest recreation, forest engineering, agro-forestry, watershed management, timber management, and others that reflect the

breadth of forestry as a profession and which are relevant to the professional activities and needs of the membership.

**AS MENTIONED ABOVE, WE QUESTION WHETHER SAF WOULD EVEN CONSIDER DEVELOPING CERTIFICATION STANDARDS FOR OUR EMPHASIS AREAS. HOWEVER, SAF CERTIFICATION OF A SPECIALTY AREA MAY NOT BE IMPORTANT IF THE CORE CURRICULUM IS ACCREDITED. ALSO, IT MIGHT BE POSSIBLE TO OBTAIN CERTIFICATION OF EMPHASIS AREAS BY OTHER PROFESSIONAL ORGANIZATIONS IF DESIRED.**

### **C. Proposed Standards II- Curriculum**

Subject matter described below may be incorporated differently by different programs. What may be a separate course in one program may be part of a more comprehensive course in another. Forestry education is built upon the fundamentals of written and oral communication; mathematics; biological, social, and physical sciences; and the humanities. These general education subject areas are usually incorporated in, but are not limited to, instruction delivered by arts and science units at the university. To the degree they are not, they must be provided in the forestry curriculum.

**OUR REVISED CURRICULUM ADEQUATELY ADDRESSES THESE FUNDAMENTALS.**

The professional education areas of study must provide in-depth coverage of forest ecology and biology; measurement; management; and policy and administration. The forestry curriculum must be presented in a manner that fosters analytical and critical reasoning skills, including systematic problem solving and decision-making. Awareness of historical and current issues and policies affecting resource management and conservation must be established.

**OUR REVISED CURRICULUM GENERALLY ADDRESSES THESE SUBJECT AREAS AND SKILLS.**

The forestry curriculum must provide a variety of educational experiences including lectures, discussion, simulations, computer applications, and individual and group projects in laboratories and field experiences. The purpose of these experiences is to enable students to apply scientific methodologies necessary to attain an array of desired forest conditions and benefits.

**OUR REVISED CURRICULUM INCLUDES THESE EXPERIENCES ADEQUATELY.**

I. General Education:

D. Communications: Programs must demonstrate how oral and written communication

skills are reinforced throughout the *entire* curriculum.

1. Oral: Competencies must be demonstrated in:
  - a. ability in preparing, organizing, and delivering effective oral presentations.
2. Written: Competencies must be demonstrated in:
  - a. proficiency in English composition, technical/business writing, and writing for non-professional audiences,
  - b. ability to read with comprehension a variety of documents, and critically evaluate opposing viewpoints.

**OUR REVISED CURRICULUM ADEQUATELY ADDRESSES THESE COMMUNICATION COMPETENCIES, EXCEPT PERHAPS FOR “WRITING FOR NON-PROFESSIONAL AUDIENCES.”**

D. Science and Mathematics: Biological and physical sciences and mathematics must be included.

3. Biological sciences: Competencies must be demonstrated as:
  - a. An understanding of the components, patterns, and processes of biological and ecological systems across spatial and temporal scales,
  - b. an understanding of molecular biology, cells, organisms, populations, species, communities and ecosystems.
4. Physical sciences: Competencies must be demonstrated as an understanding of physical and chemical properties, measurements, structure, and states of matter.
5. Mathematics: Competencies must be demonstrated as the ability to understand and use the basic approaches and applications of algebra, trigonometry, and statistics for analysis and problem solving.

**OUR REVISED CURRICULUM ADEQUATELY ADDRESSES THESE COMPETENCIES.**

- C. Social Sciences and Humanities: Competencies must be demonstrated as:
1. an understanding of, and ability to deal with, moral and ethical questions and use critical reasoning skills,

2. an understanding of human behavior and social and economic structures, processes, and institutions of importance across a broad range of societies,
3. an understanding of various dimensions of the human experience.

**OUR REVISED CURRICULUM ADEQUATELY ADDRESSES THESE COMPETENCIES.**

- D. Computer literacy: Competencies must be demonstrated as an ability to use Computers and other contemporary electronic technologies in professional life.

**OUR REVISED CURRICULUM ADEQUATELY ADDRESSES THESE COMPETENCIES.**

II. Professional Education

The forestry program must demonstrate depth, breadth, and balance among the four major subject matter categories shown below. In each category, adequate instruction in basic principles, typical applications, and current practices must be provided. Each forestry program must offer adequate field instruction and practice to ensure that graduates have the opportunity to be competent to practice forestry as professionals in the forests—rural or urban—or in research laboratories.

**OUR REVISED CURRICULUM INCLUDES AN APPROPRIATE BALANCE OF CLASSROOM, FIELD, AND LAB EXPERIENCES, AS WELL AS BASIC PRINCIPLES AND APPLICATIONS.**

A. Ecology and Biology:

Competencies must be demonstrated in:

1. understanding of taxonomy and ability to identify forest and other tree species, their distribution, and associated vegetation and wildlife,
2. understanding of soil properties and processes, hydrology, water quality, and watershed management,
3. understanding of ecological concepts and principles including the structure and function of ecosystems, plant and animal communities, competition, diversity, population dynamics, succession, disturbance, and nutrient cycling,
4. ability to make ecosystem, forest, and stand assessments,
5. understanding of tree physiology and the effects of climate, fire, pollutants, moisture, nutrients, genetics, insects and diseases on tree and forest health and productivity,

6. ability to make silvicultural prescriptions and understand their consequences, including methods of establishing and influencing the composition, growth and quality of forests.

**OUR REVISED CURRICULUM ADEQUATELY ADDRESSES THESE COMPETENCIES, EXCEPT PERHAPS FOR AN UNDERSTANDING OF TREE PHYSIOLOGY, AND EFFECTS OF POLLUTANTS ON TREE AND FOREST HEALTH AND PRODUCTIVITY.**

**B. Measurements of Forest Resources:**

Competencies must be demonstrated in:

1. ability to identify and measure land areas and conduct spatial analysis,
2. ability to design and implement a comprehensive forest inventory that meets specific objectives using appropriate sampling methods and units of measurement,
3. ability to analyze inventory data and project future forest conditions.

**OUR REVISED CURRICULUM ADEQUATELY ADDRESSES THESE COMPETENCIES, EXCEPT FOR ABILITY TO CONDUCT SOME TYPES OF SPATIAL ANALYSIS.**

**C. Management of Forest Resources:**

Competencies must be demonstrated in:

1. ability to analyze the economic, environmental, and social consequences of resource management strategies and decisions,
2. ability to develop a management plan with specific multiple objectives and constraints,
3. an understanding of harvesting methods, wood properties, forest products manufacturing processes, utilization, markets, and valuation,
4. understanding the role of direct human use of forests and the importance of non-wood forest uses and influences,
5. understanding the administration, ownership, and organization of forest management enterprises.

**OUR REVISED CURRICULUM ADEQUATELY ADDRESSES THESE COMPETENCIES, EXCEPT PERHAPS FOR ALL ITEMS UNDER 3.**

**D. Forest Resource Policy and Administration:**

Competencies must be demonstrated in:

1. an understanding of forest policy and the processes by which it is developed,
2. an understanding of how federal, state, and local laws and regulations govern the practice of forestry,
3. an understanding of professional ethics, including the SAF Code of Ethics, and recognition of the ethical responsibility to adhere to those ethical standards in forestry decision making on behalf of clients and the public,
4. an ability to understand the integration of technical, financial, human resources, and legal aspects of public and private enterprises.

**OUR REVISED CURRICULUM ADEQUATELY ADDRESSES THESE COMPETENCIES**

**D. Research**

We also predict that the curricular changes described earlier will affect the NAU School of Forestry's national stature in research:

- Increased faculty collaboration in teaching and administration of emphasis areas will lead to an increase in interdisciplinary, collaborative research.
- Increased involvement of undergraduate students in interdisciplinary research projects associated with emphasis areas will provide graduate students with increased mentoring opportunities that will enhance their career development and employment opportunities, and may enhance overall research productivity if such students address important questions with adequate support and guidance.
- Emphasis areas may increase funding or other support of research because of increased interdisciplinary research interests among faculty and students as well as national recognition of emphasis areas.
- Increased faculty and staff time spent on the development and implementation of emphasis areas and distance-education courses, as well as increased faculty time used for advising students of emphasis areas, will limit time available for faculty research and other scholarship.

**E. Service**

We predict relatively small impacts of our proposed revised curriculum on our national stature in service. These impacts include:

- The successful development of distance-learning may provide continuing education opportunities for national clients.
- The increased emphasis on ‘transferable’ and interpersonal skills in our revised curriculum will be an overall service to the profession of forestry nationally because our students will be better public servants.
- Increased faculty and staff time spent on the development and implementation of emphasis areas and distance-education courses, as well as increased faculty time used for advising students of emphasis areas, will limit time available for national service.

## **XIV. Transition to the New Structure**

As with any curriculum change, several issues are raised by this new structure and how to transition smoothly into it:

1. Students can begin using the Emphasis Area structure as soon as the 2001-2 catalog is published. Some existing students may elect the new catalog depending on their depth into the program (credits taken vs. needed) and their interest in having an emphasis area experience.
2. Emphasis Areas will be difficult to fit into 120 credits for cohorts of students prior to FOR 313-316 2002 students, but it would be feasible for transfer students on >4 year plans.
3. Two cohorts of students (2000 and 2001) will have old FOR 311/312 (32 credits) and new FOR 413-416 (12 credits). These students will only need to take four elective credits to total 120. We could require that those four credits come from the Emphasis Area list.
4. We need to quickly develop and offer the new Soils course (i.e., beginning Spring 2002) to prepare students for the new FOR 313-316 in Fall 2002 (which will assume soils knowledge).
5. Many students have completed GLG101/103 or have it currently scheduled. If they do not have room in their future schedules for the new soils course, then they may elect to stay in the old catalog and their soils knowledge and performance in the new FOR 313-316 may suffer.
6. Many students have completed ECO285, which will no longer be required. If they don’t want that to serve as an ‘elective’ in the new catalog, then they may elect to stay in the old catalog.
7. Students coming Fall 2001 will be strictly in the new catalog. Most Fall 2000 incoming students will have the new FOR 313-316, 323-326 and FOR 413-416 and, therefore, will likely elect the new catalog and emphasis areas. The Fall 1999 cohort and before will be the difficult decisions.
8. Careful advising and comparison of old and new catalog will be required for each individual student, as with the recent Liberal Studies change.

## **XV. Program Assessment and Future Revisions**

Revisions in the undergraduate curriculum proposed in this report should be re-evaluated after the final SAF accreditation standards are finalized. Also this committee should be reconvened in 5 years following the implementation of any changes. The impact of changes in the curriculum are recruitment, retention, ease of transfer to NAU from other programs, and employment success should be evaluated. Likewise faculty satisfaction with the revised curriculum should be assessed.