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## Separating the Cows From the Trees: Toward Development of National Definitions of Forest and Rangeland

H. Gyde Lund<sup>1</sup>

**Abstract.**—This paper introduces issues surrounding the need for national definitions of forest and rangeland, and it reviews types of definitions in use, reviews past agreements and their status, and finally gives recommendations as to what should be done next.

### The Need for National Definitions

The classification of lands as forest is one of the most important decisions that inventory specialists make in the course of their work. How lands are classified may influence how lands are to be managed and what Agencies are funded. Most of the time, classification is straightforward. Other times it may be difficult. For example, should figure 1 be classified as forest, rangeland, or both?

If lands are classed as forest, the management strategy and funding may be to maintain the lands in tree cover. The U.S.

Figure 1.—*Native juniper (Juniperus spp.) invading grass/shrubland in central Oregon.*



Department of Agriculture (USDA) Forest Service has the lead. If lands are classed as range, then the management strategy and funding may be to maintain grass and shrubs and to remove any trees. The U.S. Natural Resources Conservation Service (NRCS) has the lead on private lands.

The NRCS defines rangeland as “a land cover/use category on which the climax or potential plant cover is composed principally of native grasses, grasslike plants, forbs or shrubs suitable for grazing and browsing, and introduced forage species that are managed like rangeland. This would include areas where introduced hardy and persistent grasses, such as crested wheatgrass, are planted and such practices as deferred grazing, burning, chaining, and rotational grazing are used, with little or no chemicals or fertilizer being applied. Grasslands, savannas, many wetlands, some deserts, and tundra are considered to be rangeland. Certain communities of low forbs and shrubs, such as mesquite, chaparral, mountain shrub, and pinyon-juniper, are also included as rangeland.”

The USDA Forest Service defines forest as “land at least 10 percent stocked by forest trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10 percent stocked with forest trees and forested areas adjacent to urban or built-up lands. Also included are pinyon juniper and chaparral areas in the West and afforested areas. The minimum area for classification of forest is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width of at least 120 feet to qualify as forestland. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 120 feet wide.”

The USDA Forest Service Forest Inventory and Analysis (FIA)

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<sup>1</sup> U.S. Department of Agriculture, Forest Service (retired); Forestry Consultant, Forest Information Services, 6238 Settlers Trail Place, Gainesville, VA, 20155-1374. E-mail: gyde@comcast.net.

program classifies junipers as trees, while the NRCS National Resource Inventory (NRI) considers them shrubs. The FIA classifies oak and juniper woodlands as forests, while the NRI classifies them as rangeland. According to the Agency definitions, the land shown in figure 1 would be classified as forest by the USDA Forest Service and rangeland by the NRCS. In the United States, at least 50 million acres of such land are in question—roughly an area the size of Nebraska.

The difference between the USDA Forest Service and NRCS is but one example. Sixteen other Federal Agencies have at least one official definition of forest and rangeland, and eight have official definitions of tree.

Because of this overlap, the U.S. Roundtable on Sustainable Forests and the Sustainable Rangelands Roundtable are seeking national definitions for forest and rangelands for mutually exclusive criteria and indicators. To this end, the Federal Geographic Data Committee's (FGDC) Sustainable Forest Data Working Group's created the Forest/Rangeland Definitions Group (FRDG). The objective of the FRDG is to develop standard operational definitions of forests and rangelands, allowing consistent and credible estimates of these areas and of their components, conditions, and products. Ultimately, development of definitions will be done through the FGDC. Membership includes people from the Federal Government, professional societies, and environmental groups.

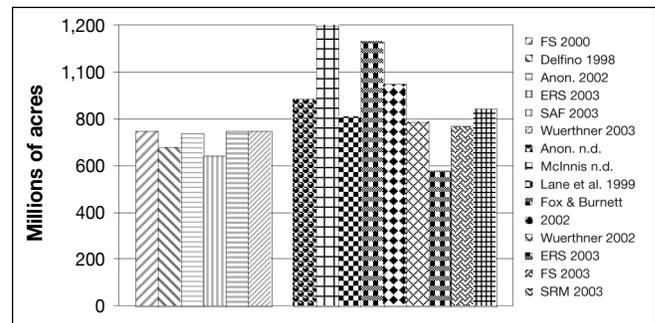
I served as a consultant to the group. This article is based on the final report that I submitted (Lund 2004).

## Findings

### Forest and Rangeland Estimates

Figure 2 shows recent published estimates of forest and rangeland area in the United States (Lund 2004). Note that the estimates for rangeland vary more widely than those for forest. The reasons for the differences are the sources and perceptions of what constitute forest and rangeland (i.e., the definitions). The estimates of forest are all based on FIA data. Those for rangeland come from a variety of sources using different definitions.

Figure 2.—Recent published estimates of forest (striped) and rangeland (checkered) area in the United States.



Source: Lund 2004.

### Existing Definitions of Forest, Rangeland, and Tree

In my quest, I found 786 published definitions of forest, 368 definitions of rangeland, and 199 definitions of tree (Lund 2005a, 2005b). Forest and rangeland definitions are grouped into four categories based on cover, use, ecological potential, or administration. Forest definitions are most frequently based on cover, while rangeland definitions are often based on potential or use.

My literature review led me to the following conclusions:

- Estimates of rangeland area vary more widely than those for forestland.
- There is only one party responsible for inventorying the Nation's forests.
- Responsibility for the inventory of rangelands falls to many parties.
- Generally, definitions of forest are more inventory friendly than those of rangeland. That is to say, the definitions are more precise.
- There are accepted national and international definitions of forest but not of rangeland.

### Past Attempts at National Standards and Direction

At least six attempts have been made in the past to develop and implement national standards for classification of lands for Federal Agencies. Three were recommendations for standards (Anderson *et al.* 1976, Driscoll *et al.* 1984, and Land Use and Land Cover Common Terminology Workgroup 1985) and three are actual agreements (Anon. 2001, FGDC 1997, and USDA SCS and Forest Service 1977, [National Land Cover Data—NLCD]).

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Anderson *et al.* (1976) classed forest as a cover type and rangeland as a land use, so the categories were not mutually exclusive. Driscoll *et al.* (1984) defined forest land but not rangeland. The Land Use and Land Cover Terminology Workgroup (5-WAY) focused on land cover such as treeland, grassland, shrubland, etc., but the recommendations were not implemented.

The USDA SCS Forest Service agreement (1977) combined definitions for a new definition of forest land: “Lands with at least 25 percent tree canopy cover or lands at least 16.7 (10 percent) stocked by forest trees of any size.” This definition assumed that a 25 percent tree cover equaled 10 percent stocking. A 16.7 percent stocking is more closely related to 5 percent rather than 10 percent canopy cover. Similarly, a 25 percent canopy cover is more closely related to 68 percent rather than 10 percent stocking (Lund *et al.* 1981).

The FGDC (1997) purposefully did not define forest or rangeland. Instead, it used a similar approach as the 5-WAY based on cover. The NLCD system is also based on cover.

A review of agency definitions in use after the agreements showed that very few agencies fully comply with the past agreements or recommendations. Reasons may include the following:

1. Classification did not meet need.
2. Difficult to break with tradition.
3. Change did not meet need.
4. No advantage.
5. Didn't know about.
6. Didn't have the authority.
7. Fear of being the only one to adopt.
8. Too much trouble.
9. Lack of incentives.
10. Lack of reprisals if direction not followed.

As part of my presentation at this symposium, I tested the audience's perception to see how they define forest and rangeland. The test was in two parts. First, participants wrote down their own definitions of forest and rangeland. Second,

I showed a series of images and asked the people to classify the photos according to the definitions they had written. The appendix to this paper contains the results. The bottom line is that none of the participants followed their own direction. Based on past experiences and the test, implementation of Nationwide standards may meet with the same results.

## **How Do I See the Situation?**

We only need standard or common definitions in the following circumstances:

- Comparing estimates from different lands owners.
- Comparing estimates over time.
- Aggregating estimates for upward reporting.

### **The Forest Situation**

- NRCS and FIA present conflicting estimates of forest area on private lands.
- Conflicts could occur between FIA estimates and those of any landowner who uses a different definition of forest.
- FIA has the responsibility for inventory, monitoring, and reporting on forest land at the national and international levels.
- Other agencies and organizations may have their own definitions, as long as their data are not used for national reporting. Therefore, there is no issue with the definition of forest.

### **The Rangeland Situation**

- No single agency is responsible for the inventory and monitoring of rangelands.
- USDA Economic Research Service reports on the Nation's rangelands, but data comes from a variety of sources.
- Many definitions are in use, none of which are inventory friendly.
- As a result, uncertainty exists as to what lands are considered rangelands.
- There appears to be a reporting requirement at the national and international levels.
- The definition of rangeland is an issue at the national level.

Change in area is an indicator of sustainable management for both forest and rangeland activities. We have a good handle on what is considered forest but not is what is considered rangeland. The main definitional issues are what constitute a tree and minimum tree cover.

## Where To Go From Here?

The FRDG work is currently on hold until it can do the following:

1. Determine what we really need to create, out of the following options:
  - National definitions that an agency or agencies would use for upward national (and international) reporting.
  - Common definitions that agencies and cooperators would use for comparison and/or upward reporting.
  - FDGC standard definitions that all agencies and cooperators would use regardless of purpose.
  - All of the above.
  - None of the above.
2. Identify national and international reporting requirements. Nationally, the USDA Forest Service periodically reports on forest and rangeland as the result of the Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974. Definitions may overlap. Both the Roundtable on Sustainable Forests and the Sustainable Rangelands Roundtable call for estimates but only for their particular area of interest. At the international level, the United Nations Economic Commission of Europe and the Food and Agriculture Organization periodically conduct the Global Forest Resource Assessment and

the Intergovernmental Panel on Climate Change (IPCC) monitors changes in greenhouse emissions (table 1). Of the two, the IPCC has the only reporting requirement for mutually exclusive estimates of forest and rangeland.

3. Identify who has to use definitions, and when and why. Federal agencies are just the tip of the iceberg. Cooperators such as States, counties, municipalities, etc., also must be considered.
4. Determine how adoption of new standards may affect public perceptions of changes.
5. Determine how standards may affect agency funding and programs.
6. Determine what resistance the standard may face and how to mitigate.
7. Identify who will be responsible for what.
8. Construct an inventory-friendly classification system. The system should do the following:
  - Be applicable over all lands.
  - Follow established scientific procedures where appropriate.
  - Be repeatable from place to place (spatial) and from time to time (temporal).
  - Be recognizable on the ground (generally based on cover and current condition).
  - Be unambiguous (i.e., inventory friendly).
  - Include minimum thresholds for area, strip width, vegetation type, height and cover, and any exclusions.

Table 1.—National and international reporting requirements for forest and rangeland statistics.

Requirement	Forest	Rangeland	Definition type
Forest and Rangeland Renewable RPA of 1974	Yes	Yes	Definitions may overlap
Roundtable on Sustainable Forests	Yes	No	—
Sustainable Rangelands Roundtable	No	Yes	—
UNECE/FAO's Global Forest Resource Assessment	Yes	No	—
IPCC	Yes	Yes (Grassland)	Mutually exclusive

FAO = Food and Agriculture Organization; IPCC = Intergovernmental Panel on Climate Change; RPA = Resource Planning Act; UNECE = United Nations Economic Commission of Europe.

9. Agree on the following:

- What we consider a tree.
- How much tree cover we require to be a forest.
- A minimum area including strip width.

The IPCC has six land classes including forest, cropland, grassland (including rangeland), wetland, settlement, and other. Each class is mutually exclusive and all lands are covered (Milne and Jallow 2003). The IPCC classes provide the best base on which to develop any national definitions of forest and rangeland. Box 1 contains a proposed key for classifying lands in the United States based on the IPCC classes.

Box 1.—*A proposed key for land classification based on IPCC classes.*

1.	Is the land area > <b>1 acre and strip width &gt; ___ feet?</b> Yes—Go to 2. No—Classify with surrounding area.
2.	Does the land have tree crown cover > <b>25 percent?</b> Yes—Go to 3. No—Go to 4.
3.	Are the trees > <b>6 feet in height?</b> Yes = <b>forest land.</b> No = <b>nonforest land</b> —Go to 4.
4.	Is the land used for growing crops? Yes = <b>cropland.</b> No—Go to 5.
5.	Is the land covered or saturated by water for all or part of the year? Yes = <b>wetland.</b> No—Go to 6.
6.	Is the land dominated by grasses, forbs, or shrubs? Yes = <b>rangeland.</b> No—Go to 7.
7.	Is the land developed for human activity? Yes = <b>settlement.</b> No = <b>other land.</b>

IPCC = Intergovernmental Panel on Climate Change.  
Source: Lund 2006.

10. Establish a program to encourage agencies to use standards. As indicated above, it is one thing to create standards and another to get people to use them. We need some mechanism to see if people are following direction and, if not, how we can correct the situation.

Following these recommendations, we should be able to separate the cows from the trees.

## Appendix

### Results of Lund's Great Land Classification Test

Several agencies of the U.S. Government are in the process of developing national definitions of forest and rangeland for upward reporting. Agency and people's perceptions of what is forest and rangeland vary. During my presentation at the 7<sup>th</sup> Annual Forest Inventory and Analysis (FIA) Symposium in Portland, ME, I tested the audience to see how a group of forest inventory specialists looked at the land. There were two parts to the test—an essay and a multiple-choice test. This article reports on the results. On the average, the FIA audience agreed less then when compared to the results of essentially the same test given to other groups.

#### Essay

For the first part, participants were asked to write down their mutually exclusive definition of rangeland and forest land. Thirty-one people participated in the test. Only 27, however, provided at least one definition. The results are shown in table A-1. Note that in a couple of instances I could not read parts of definitions. These I noted in the table with XXX.

#### Multiple Choice

Next, the participants were shown a series of 38 images and were asked to classify each image as to if it was forest, rangeland, or other using the definitions they had written. Not everyone answered all the questions. In addition some people provided two answers for some questions. The latter were not counted. The results are shown in table A-2.

#### Analysis

The participants agreed on classification on the average of 70.8 percent of the time. Even though the audience was fairly homogeneous in background (all inventory specialists and many FIA employees), a great deal of variety exists as to how they look at the land. This is surprising as the U.S. Department of Agriculture Forest Service has a very specific definition of forest land. It is even more surprising when compared to results for essentially the same test given to other groups over the past 2 years (table A-3).

Table A-1.—Results of Essay—Definitions.

Participant	In my opinion...		Lund's comment
	Rangeland is...	Forest land is...	
1	Use.	Cover.	Use for range, cover for forest
2	Less than 10 percent stocked.	More than 10 percent stocked.	Cover definition
3	Used for grazing.	FIA definition.	
4	< 10 percent stocked trees.	> 10 percent stocked trees.	Cover definition
5	Areas between/in forested lands that can be used for grazing.	Lands producing forest products.	Use definition
6	Covered by grazing or browsing species with few than five merchantable trees per acre.	Five or more merchantable size trees per acre and/or covered by regeneration with potential to become merchantable trees.	Cover for range, use for forest
8	This concept is not well known in Europe. My question is how rangeland is divided into forest land, other wooded land, and on the other into forest land and grassland on the basis of IPCC definitions.	I would follow Timber Boreal Forest Resources Assessment 2000 definition or Finnish National definition.	Land use for forest
9	None.	10 percent canopy cover of tree, w/ potential for tree establishment.	Potential or use
10	None.	Covered by a certain amount of trees (crown cover).	Cover class
11	Not forest, but has significant evidence of browsing by domesticated animals.	10 percent cover, has a forest understory or the potential to develop one (usually due to wild animals), not used for anything other than forestry, at least one acre or 120-foot strip.	Use class
12	Land, not defined as forest land, that has vegetation used for grazing XXX. Be good to use 'grassland' vs. rangeland so get away from use definition.	Land =/> 10 percent (5, 10, 25 percent?) stocked w/ trees at least 1 acre in size.	Use for range, cover for forest
13	Critters eat it and not enough trees.	Land with enough tree cover—let the user define 'enough.' I use the 10 percent.	Cover class
14	< 10 percent tree cover.	> 10 percent tree cover (need exception to handle certain situations such as clearcuts and recently planted stands).	Cover for range, use for forest
15	Agriculture area.	Depends on the source of the data. For us the definition is linked with XXX XXX (tree crown cover, XXX, width).	Use for range, cover for forest
16	Lands with primarily grass or shrubs and with plants defined as trees as < 25 percent of cover.	Lands with primarily trees, > 25 percent cover.	Cover class
17	An area dominated by grasslands and predominate used for gazing.	An area dominated by tree cover > 20 percent; trees > 2 m tall and > 1 ha in size.	Cover class
18	< 25 percent tree w/ domestic livestock.	25 percent tree cover potential/probable.	Use class
19	Land uses—a place which raises cows; land provides other functions as well but mainly for cow.	There are trees, crown cover of 10 percent on the 0.1-ha size area—management use for forest products.	Use class
20	Rangeland is land inhabited by people trying to eat cows.	Forest land is land inhabited by bears trying to eat people.	Use class (sort of)
21	Barren land that has natural vegetation by no trees.	Tree land.	Cover class

FIA = Forest Inventory and Analysis; IPCC = Intergovernmental Panel on Climate Change.

Table A-1.—Results of Essay—Definitions (continued).

Participant	In my opinion...		Lund's comment
	Rangeland is...	Forest land is...	
22	Produces at least a minimal amount of forage, nonagricultural, nonurban, and below a threshold of forest tree stocking.	Land that meets a minimum size and stocking of trees or the immediate potential to achieve stocking of trees.	Use class
24	Land not in below definition (see forest definition) that is grazed.	Wild land stocked more than 50 percent with trees, or more than 10 percent with shrubs.	Use for range, cover for forest
25	Land use or land cover? Land cover: grassland w/ < 10 percent tree. Land use: grazed. What is a tree?	Land cover =/> 10 forest cover. Land use: not grazed.	Both use and cover
26	Not forest, not developed.	"Undisturbed" understory.	Cover class
28	Not forested, having cover of grass or grazeable shrubs.	10 percent cover of trees, any plant with potential to produce a wood product.	Use class
29	A land use where livestock can be grazed.	> 10 percent canopy cover w/tree species; or the potential to achieve this w/o major change in land use.	Use class
30	I'll know it when I see it.	At least 1 acre, 120 feet wide...of trees...	Cover class

Table A-2.—Results of the classification test. Numbers are the percent of participants classifying the image as forest, range, or other.

No.	Image	Forest	Range	Other	High	Comment
1	"Jungle"	100	0	0	100	
2	Oasis	31	31	38	38	Issue is if participants considered palms as trees.
3	Tundra	15	37	48	48	Amount of tree cover is issue.
4	Alpine	68	13	19	68	No live trees—so class not based upon cover.
5	Golf course	0	9	91	91	Image shows elk grazing on course.
6	Mature black spruce stand	100	0	0	100	The trees are less than 1 m in height at maturity. By some definitions this should not have been classed as forest.
7	Desert	28	28	44	44	
8	Pinyon-Juniper (P-J)	84	13	3	84	
9	Mesquite	27	53	20	53	
10	Trees with grass	94	3	3	94	
11	Scattered trees with shrubs	12	61	27	61	
12	Scattered trees on peat bog	50	7	43	50	Amount of tree cover is the issue.
13	Trees and shrubs	57	37	6	57	
14	Open stand	69	21	10	69	
15	Coppice site	93	7	0	93	Those calling the area forest assume a land use, not cover. Note in table 1, most participants defined forest in terms of cover.
16	Canyon walls	56	9	36	56	
17	Degraded land	3	3	94	94	
18	Invading leafy spurge	27	60	13	60	Leafy spurge is not native.
19	Invading native juniper	62	31	7	62	
20	Invading houses	0	0	100	100	

Table A-2.—Results of the classification test. Numbers are the percent of participants classifying the image as forest, range, or other (continued).

No.	Image	Forest	Range	Other	High	Comment
21	Chained P-J area	29	61	10	61	Those calling the area rangeland assume a land use, not land cover.
22	Recent clearcuts	94	0	6	94	Those calling the area forest assume a land use, not land cover. Note in table one that most participants wrote a cover definition.
23	Older clearcut	91	9	0	91	
24	Pasture	0	70	30	70	Potential is forest
25	Las Vegas	0	0	100	100	
26	Change in water table	24	30	46	46	Trees are dead.
27	Wetland	3	13	84	84	
28	Riparian	52	25	23	52	Strip width is the issue.
29	Highway	0	3	97	97	Width of the highway is the issue.
30	Back road	3	39	58	58	Same.
31	Isolated stand	63	22	15	63	Size of the stand and distance from another stand is the issue.
32	Area between stands	17	53	30	53	
33	Bare area	0	19	81	81	
34	Plowed and sown area	23	16	61	61	Some people must have put down answers after the use of the land was revealed. This is an afforestation project but one could not tell from the image alone.
35	Seeded area	23	47	30	47	
36	Re-establishing native cedar	77	13	10	77	
37	Young plantation	90	0	10	90	
38	National forest	19	44	38	44	
<b>Total</b>		<b>1,584</b>	<b>887</b>	<b>1,331</b>	<b>2,691</b>	
Average		41.7	23.3	35.0	70.8	

Table A-3.—Comparison of FIA results with results from other groups (percent of participants classifying images as forest, range, or other).

Group	Number of participants	Forest	Range	Other	Average percent agreement
Board of Directors, Society for Range Management 2003	15	23.0	52.0	25.0	80.0
Forest Rangeland Definitions Group 2003	21	30.0	42.0	29.0	72.0
Mapping and Remote Sensing Specialists EROS Data Center 2004	24	28.5	42.9	26.6	75.5
FIA Seventh Annual Symposium 2005	31	41.7	23.3	35.0	70.8

FIA = Forest Inventory and Analysis.

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The Society for Range Management, Forest Rangeland Definitions Group, and EROS Data Center folks tended to classify more lands as range while the FIA tended to classify more lands as forest. As noted in table 3, however, on the average there was less agreement within the FIA classifications than there were with the other three groups tested.

As in the earlier tests, while many participants wrote their own definitions, most did not apply them when classifying images. Images 4, 16, 22, and 24 are good examples. These images contained no live trees, but many of the FIA participants who wrote a cover definition, classified the lands as forest anyway.

The bottom line is that it is easy to write a definition, but it is another thing to follow it. National definitions will meet with the same results.

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