Delineation of Ecosystem Regions

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ABSTRACT / As a means of developing reliable estimates of ecosystem productivity, ecosystem classification needs to be placed within a geographical framework of regions or zones. This paper explains the basis for the regions delineated on the 1976 map *Ecoregions of the United States*. Four ecological levels are discussed—domain, division, province, and section—based on climatic and vegetational criteria. Statistical tests are needed to verify and refine map units.

Ecoregions are large ecosystems of regional extent that contain a number of smaller ecosystems. They are geographical zones that represent geographical groups or associations of similarly functioning ecosystems. Regional boundaries may be delineated on the basis of detailed information about ecosystems at the site level, or by analysis of the environmental factors that most probably acted as selective forces in creating variation in ecosystems.

Using the latter approach, Bailey (1976) constructed a 1:7,500,000-scale map of the United States' ecoregions, with a brief narrative text that described the approach and development of the map. Bailey's map was developed as an inland counterpart to the regionalization of marine and estuarine systems proposed by Cowardin and others (1979). An accompanying manual (Bailey 1980) describes and illustrates the regions shown on the map. However, a detailed explanation of the basis for the delineation of these regions was not included. This topic is addressed here.

The regionalization system described here is based on published information. This paper does not report on a data-supported study; but is, instead, an exposition of a rationale for data synthesis using existing small-scale maps. It presents one system for recognizing and displaying ecosystems with respect to geographical distribution. This system and others are undergoing rigorous evaluation to determine the most appropriate procedure for delineating ecosystem associations (Driscoll and others 1981).

Why Ecoregions Are a Necessary Classification

The purpose of ecological land classification is to divide the landscape into variously sized ecosystem units that have significance both for development of resources and for conservation of environment. More specifically, such units are the base for estimating ecosystem productivity and the probable responses to management practices. To make such estimates, relationships between the needed production information and ecosystem classes must be developed. These relationships are called rules (Davis 1980). Rules take many forms, ranging from simple experienced-based judgments to multivariate regression models to complex mathematical simulations. Application of these rules is firmly based upon concepts of transfer by analogy. Thus, the rules necessary for estimation of productivity are extrapolated from experimental sites or from management experience to analogous areas defined by classification.

Such methods do not require any prior knowledge of functional relationships between site parameters and the specific form of biological production, although such criteria may be incorporated. The land as a holistic ecosystem or separate major component (for example, soil) is classified on the basis of a number of observed and measurable characteristics.

Subsequent evaluation is based on the hypothesis that all replications of a physically defined and characterized ecosystem or component class will respond in a similar way to management for any specified level of use. This hypothesis has been questioned by a number of research workers on the grounds that correlations between ecosystem and component classes and production are generally low.

One of the ways to establish reliable site-production relationships is to identify homogeneous geographical strata where similar ecosystems have developed on materials having similar properties (Rowe 1962). For example, similar sites (those having the same landform, slope, parent material, and drainage characteristics) may be found in several climatic regions. Within a region, these sites will support the same vegetation communities, but in other regions vegetation on the sites will be different. Thus, beach ridges in the tundra region support low-growing shrubs and forbs, whereas beaches in the subarctic region usually have dense growth of black spruce or jack pine. Soils display similar trends, as the kind and development of soil properties vary from region to region on similar sites. The depth of the thawed layer and the form and kind of surface expression of permafrost on similar sites also vary between regions but remain relatively constant on comparable sites within a region. Ecoregions, therefore, define broad areas where one can expect to find the same kinds of vegetation and soil associations on similar sites.

KEY WORDS: Ecoregions; Ecosystems; Ecological land classification; Mapping; Site production

Ecoregions have at least two important functions for management. First, a map of such regions suggests over what area the productivity relationships (rules) derived from experiments and experience can be applied without too much adjustment. Second, they provide a geographical framework in which similar responses may be expected within similarly defined sites. Methods of site classification involving such a geographical framework have been employed with success for over 50 years in Europe. The Baden-Württemberg system of southwestern Germany as described by Spurr and Barnes (1980) is perhaps the best example. Similar methods have proliferated widely in Canada.

Criteria Used in Delineating Ecoregions

Because information about variation among ecosystems throughout the country is limited, a national zoning system must be based primarily on criteria that reflect causal environmental factors. For broad-scale subdivision of a continent into a small number of large units, the large ecological climate-zones present an obvious means of approach. Because the formation of soils and vegetation types and, to a lesser degree, of fauna is determined primarily by the climate. The macroclimate is the best reflection of zonality. Surface configuration, which is partly the result of internal forces, is less influenced by the climate than either vegetation or soil; but the influence is great enough for the minor features to reflect the climate of the area where they are found.

For further subclassification beyond climate, the macrofeatures of the vegetation appear to be the appropriate criteria for defining secondary divisions (Damman 1969, Küchler 1973). Although only a result, vegetation is important as a criterion in the delineation of geographical zones because it affords a very delicate index of climate. The predominance of vegetation in the landscape also ensures its consideration in any scheme of zoning. Usually, the boundaries of vegetationally defined regions coincide with those of major relief units; this strengthens the primary division. However, the surface features are more useful at lower levels, that is, for subdividing the biotically circumscribed areas.

The concept of climate as expressed by vegetation has been used frequently as the basis for delineating broad-scale ecological regions. Of immense significance for the development of the concept was the work of Dokuchaev (1899). This author pointed out that natural conditions are characterized by many common features within the limits of extensive areas (zones) and that these features change markedly in passing from one zone to another. In subsequent studies, Grigor'yev and Budyko (Grigor'yev 1961) established that the boundaries of geographical zones are determined to a considerable extent by climatic factors. Every feature with a distribution that broadly conforms to climate is termed *zonal.* The term *azonal* describes processes or features that occur in several zones. For example, wetlands are not associated with a particular climatic zone.

Efforts to divide the world into ecological regions have been based primarily on the distribution of climate-vegetation zones (for example, Herbertson 1905, James 1951, Biasutti 1962, Udvardy 1975). Recently, Walter (1977, Walter and Box 1976) presented a scheme for classifying the world into a hierarchy of ecosystems from a climatic viewpoint. In Russia, Berg (Isachenko 1973) detailed landscape zones based on climate, while similar work was developed by Passarge (Troll 1971) in Germany, and Galoux (Delvaux and Galoux 1962) in Belgium. Some systems for the classification of climates (Köppen 1931, Thornthwaite 1931, 1948) seek to define climatic units that will correspond to major vegetation units. A number of authors (for example, Merriam 1898, Hopkins 1938) have sought to define life zones primarily on the basis of climate; the system of Holdridge (1947, Tosi 1964) employs a complex classification of zones by both temperature and moisture conditions.

In Canada, the concept of forest ecosystem regions (there called *site regions*) was developed by Hills (1960) based on macroclimate. Simliar work has been done in other parts of Canada (Crowley 1967, Burger 1976). Krajina (1965) has delineated the biogeoclimatic zones of British Columbia. Climatic regionalization is used in biophysical or ecological land classification throughout Canada (Wiken and Ironside 1977).

Of the variety of classifications available, the one devised by Crowley (1967) has been adopted as most suitable for the current purpose. A hierarchical order is established by defining successively smaller ecosystems within larger ecosystems (Figure 1). First, subcontinental areas, termed *domains,* are identified on the basis of broad climatic similarity, such as having dry climates. Climate is emphasized at the broadest level because of its overriding effect on the composition and productivity of ecosystems from region to region. The domains are quite heterogeneous and are further subdivided, again on the basis of climatic criteria, into *divisons.* The divisions correspond to areas having definite vegetational affinities (prairie or forest) and falling within the same regional climate, generally at the level of the basic climatic types of Köppen (1931) or of Thornthwaite (1931, 1948); usually the zonal soils are also related. Dry climates, for example, are separated into semiarid steppe and arid desert. A major exception to this is that the dry western side of the humid continental and subtropical climates, which is very extensive in central North America, is distinguished as subhumid prairie (Borchert 1950).

Within a division, one or several climatic gradients may affect the potential distribution of the dominant vegetation strata. Within the arid zone, for example, deserts that receive only winter rain (Sonoran Desert) can be distinguished from

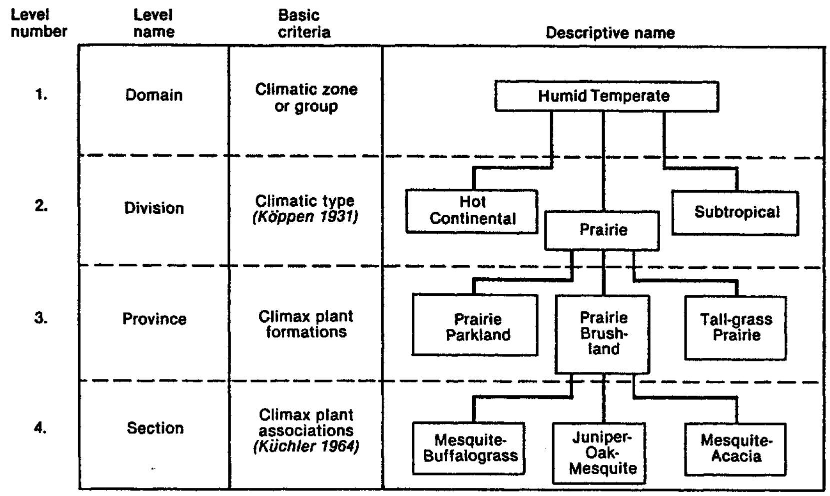

Figure 1. A hierarchy to the fourth level for ecosystem regions within the Humid Temperate Domain.

those that receive only summer rain (Chihuahuan Desert). Within the steppe zone, a semiarid steppe (short-grass prairie) climate that has a dry summer season and occasional drought can be distinguished from an arid semidesert (sagebrush) climate that has a very pronounced drought season plus a short humid season. A southern (coniferous forest) climate and northern (forest-tundra) climate can be distinguished within the Subarctic Division of the Polar Domain.

These climatic subzones are evident as areas covered by the same dominant vegetation on sites supporting climax vegetation (Weaver and Clements 1938). Such sites are uplands, with well-drained surface, moderate surface slope, and well-developed soils. The climax vegetation corresponds to the major plant formation (for example, deciduous forest) characterized by uniformity both in physiognomy and in the structure of the climax type. Each climatic subzone comprises both the climax formation and all the successional stages within its geographical area.

Divisions are subdivided into *provinces* on the basis of the climax plant formation that geographically dominates the upland area of the province. Boundaries drawn on the basis of this broad criterion are often coincident with the major soil zones which, therefore, serve as supplemental criteria for delimiting provinces. Provinces are further subdivided into *sections* on the basis of differences in the composition of the climax vegetation type. Thus, the summer green deciduous forest of eastern North America is fairly homogeneous in its main structural features from east to west and north to south; but, five discrete climax associations can be recognized on the basis of floristic composition: oak-hickory, beech-maple, Appalachian oak, mixed mesophytic, and maple-basswood. The sections correspond generally to the potential natural vegetation types of Küchler (1964).

The vertical arrangement of the ecological systems in mountainous areas, with their various altitudinal belts, poses a problem. Such systems do not have the same climate as the adjacent lowlands, but they do have the same climatic regime (cycle of weather phenomena). These systems do not belong to the zones; rather, each mountain range forms a certain ecological unit in itself, which depends on the relations within the zone(s) in which it is located. This results in a certain zonal relationship, which also affects the vertical climate-vegetation-soil zonation within the mountain range. The earlier view that the upward sequence of altitudinal belts in the mountains represents a short repetition of the zonal arrangement from south to north (in the Northern Hemisphere) rests only on very superficial comparisons. The climate of an altitudinal belt in the mountains is always different from the climates of a northerly climate zone. The latitude is different, as are the day length, the solar declination, the length of the season, and the precipitation pattern, the level of which generally increases upward in the mountains as a result of the ascending rain.

Between the individual altitudinal belts, there is a lively exchange of materials: water and the products of erosion move down the mountains; updrafts and downdrafts carry dust and pieces of organic matter; animals can move easily from one belt into the next; seeds are easily scattered by the wind or propagated by birds. The vertical belts, as a result, are not always as sharply separated from each other as are the climatic zones. The geographical area over which a sequence of belts extends is considered to be a large ecological unit, designated by the term *highland province*. In this system, the montane forest belt is not treated as a separate zone. The montane belt is only one member of the total sequence of altitudinal belts. Montane belts in mountainous areas of different climatic zones are just as distinct from one another as the montane belt is from other altitudinal belts in the same zone. For example, the montane coniferous belt appears in the subarctic zone as spruce-fir forest, while in the steppe it is represented by a fir and pine forest.

The structure of the stratification (that is, the number and sequence of strata or belts) within a single zone is usually quite uniform. The variant types of vertical stratification are distinguished, in the main, not by the number of belts in the sequence but by the existence of certain plant species in individual belts. Thus, all mountain systems that lie within the steppe zone have a uniform system of belts, yet they reveal certain partial differences in character. In the forest of the northern Rocky Mountains, the montane belt consists of grand fir-Douglas-fir forest; within the central region, only of Douglas-fir; and in the south, of ponderosa pine-Douglas-fir forest. The term *highland section* is applied to these different areas (forest types).

Highlands are distinguished where, because of the influence of altitude, the climatic regime differs substantially from that in adjacent lowlands so that there is complex vertical climate-vegetation-soil zonation. As a result, the levels appear as follows:

1. Domain
2. Division
3. Lowland Province — 3. Highland Province
4. Lowland Section — 4. Highland Section

All levels are needed to denote a particular area within the complete hierarchical system. For example, the Colorado Piedmont is part of the Grama-Buffalograss Section of the Great Plains Short-grass Prairie Province within the Steppe Division of the Dry Domain. The Cascade Range represents the Silver Fir-Douglas-fir Forest Section of the Pacific Forest Province, which belongs to the Marine Regime Highlands Division of the Humid Temperate Domain.

The ecoregions of the United States listed in Table 1 are shown in Figure 2, which also shows the distribution of ten marine and estuarine provinces proposed by Cowardin and others (1979).

Mapping Procedures

When considering ecoregion differences, one should realize that regional boundaries indicate where significant ecological changes are taking place, often over a transitional zone. Therefore, the definitions of the limits will always be somewhat subjective. A boundary is placed where changes in the climate-vegetation-soil conditions appear to be most pronounced or significant compared with adjacent areas. A line drawn in this way is only an approximation showing where most of the changes take place; many local variations become obvious when smaller areas are mapped in more detail. For this reason, a particular soil name or vegetation type may be applied to two adjacent ecoregions when site conditions are similar in these two regions. This situation usually exists only within a limited area on either side of a regional boundary line; as the distance from the boundary line increases, climatic change is sufficient to produce major, significant differences in similar site conditions.

Because vegetation serves an an indicator of climate, its geographical distribution serves as a primary recognition criterion for regional boundaries. It is important to note again that usually variation in vegetation is essentially continuous, and degrees of difference form a full spectrum from insignificant to complete. Consequently, the placement of the boundaries is inherently subjective.

The vegetation of the United States is described and mapped in "Potential Natural Vegetation of the Conterminous United States" (Küchler 1964) at a scale of 1:3,168,000. Küchler's map was used in conjunction with maps of climatic regions as the base map for delineating ecoregions. As a first step in regionalizing Küchler's map, all lands were divided into lowlands and highlands. The pattern of montane vegetation as exhibited on the map was sufficient to identify these areas as a first approximation. These areas were further refined by reference to Hammond's (1964) land-surface form map (scale 1:5,000,000). Hammond's high mountains (less than 50% of area gently sloping with local relief over 900 m) correlate well with the patterns of montane vegetation shown on Küchler's map. However, the vegetation boundaries and the orographic boundaries do not always coincide in detail. For example, the vegetation of the basal plain commonly does not stop at the foot of the mountain but extends up the lower slopes. In this case, the orographic boundary is the one that stands out most clearly and is, therefore, treated as the ecoregion boundary, even though this choice is essentially arbitrary.

For the purpose of the ecoregion map (Bailey 1976), the working definition of highlands that was adopted was an area in which the relief must be high enough to bring about a differentiation of the vegetal cover with elevation. In addition, this differentiation must be great enough to cause a change in life form, for example, from desert shrub to forest. The basic idea was to identify regions based not on orography alone, but on vegetation as the result and index of orography and climate. Such a definition would include high mountains such as the Colorado Rocky Mountains but would exclude the lower relief Appalachians. Although the widely spaced ranges of the southwest exhibit such zonation, the region as a whole is occupied largely by gently sloping plains. Thus, at the level of

Table 1. Scheme for a fourth-order ecosystem regionalization of the United States.

- 1000 Polar Domain
  - 1200 Tundra Division
    - 1210 Arctic Tundra Province
    - 1220 Bering Tundra Province
  - Highlands[1]
    - M1210 Brooks Range Province
  - 1300 Subarctic Division
    - 1310 Yukon Parkland Province
    - 1320 Yukon Forest Province
  - Highlands[1]
    - M1310 Alaska Range Province
- 2000 Humid Temperate Domain
  - 2100 Warm Continental Division
    - 2110 Laurentian Mixed Forest Province
      - 2111 Spruce-fir Forest Section
      - 2112 Northern Hardwoods-Fir Forest Section
      - 2113 Northern Hardwoods Forest Section
      - 2114 Northern Hardwoods-Spruce Forest Section
  - Highlands[1]
    - M2110 Columbia Forest Province
      - M2111 Douglas-fir Forest Section
      - M2112 Cedar-Hemlock-Douglas-fir Forest Section
  - 2200 Hot Continental Division
    - 2210 Eastern Deciduous Forest Province
      - 2211 Mixed Mesophytic Forest Section
      - 2212 Beech-Maple Forest Section
      - 2213 Maple-Basswood Forest + Oak Savanna Section
      - 2214 Appalachian Oak Forest Section
      - 2215 Oak-Hickory Forest Section
  - 2300 Subtropical Division
    - 2310 Outer Coastal Plain Forest Province
      - 2311 Beech-Sweetgum-Magnolia-Pine-Oak Forest Section
      - 2312 Southern Floodplain Forest Section
    - 2320 Southern Mixed Forest Province
  - 2400 Marine Division
    - 2410 Willamette-Puget Forest Province
  - Highlands[1]
    - M2410 Pacific Forest Province
      - M2411 Sitka Spruce-Cedar-Hemlock Forest Section
      - M2412 Redwood Forest Section
      - M2413 Cedar-Hemlock-Douglas-fir Forest Section
      - M2414 California Mixed Evergreen Forest Section
      - M2415 Silver Fir-Douglas-fir Forest Section
  - 2500 Prairie Division
    - 2510 Prairie Parkland Province
      - 2511 Oak-History-Bluestem Parkland Section
      - 2512 Oak + Bluestem Parkland Section
    - 2520 Prairie Brushland Province
      - 2521 Mesquite-Buffalograss Section
      - 2522 Juniper-Oak-Mesquite Section
      - 2523 Mesquite-Acacia Section
    - 2530 Tall-grass Prairie Province
      - 2531 Bluestem Prairie Section
      - 2532 Wheatgrass-Bluestem-Needlegrass Section
      - 2533 Bluestem-Grama Prairie Section
  - 2600 Mediterranean Division
    - 2610 California Grassland Province
  - Highlands[1]
    - M2610 Sierran Forest Province
    - M2620 California Chaparral Province
- 3000 Dry Domain
  - 3100 Steppe Division
    - 3110 Great Plains Short-grass Prairie Province
      - 3111 Grama-Needlegrass-Wheatgrass Section
      - 3112 Wheatgrass-Needlegrass Section
      - 3113 Grama-Buffalograss Section
    - 3120 Palouse Grassland Province
    - 3130 Intermountain Sagebrush Province
      - 3131 Sagebrush-Wheatgrass Section
      - 3132 Lahontan Saltbush-Greasewood Section
      - 3133 Great Basin Sagebrush Section
      - 3134 Bonneville Saltbush-Greasewood Section
      - 3135 Ponderosa Shrub Forest Section
    - 3140 Mexican Highlands Shrub Steppe Province
  - Highlands[1]
    - M3110 Rocky Mountain Forest Province
      - M3111 Grand Fir-Douglas-fir Forest Section
      - M3112 Douglas-fir Forest Section
      - M3113 Ponderosa Pine-Douglas-fir Forest Section
    - M3120 Upper Gila Mountains Forest Province
    - P 3130 Colorado Plateau Province
      - P 3131 Juniper-Pinyon Woodland + Sagebrush-Saltbush Mosaic Section
      - P 3132 Grama-Galleta Steppe + Juniper-Pinyon Woodland Section
    - A3140 Wyoming Basin Province
      - A3141 Wheatgrass-Needlegrass-Sagebrush Section
      - A3142 Sagebrush-Wheatgrass Section
  - 3200 Desert Division
    - 3210 Chihuahuan Desert Province
      - 3211 Grama-Tobosa Section
      - 3212 Tarbush-Creosote Bush Section
    - 3220 American Desert (Mojave-Colorado-Sonoran) Province
      - 3221 Creosote Bush Section
      - 3222 Creosote Bush-Bur Sage Section
- 4000 Humid Tropical Domain
  - 4100 Tropical Savanna Division
    - 4110 Everglades Province
  - 4200 Rainforest Division
  - Highlands[1]
    - M4210 Hawaiian Islands Province

[1]Key to letter symbols: M-Mountain, P-Plateau, A-Altiplano.

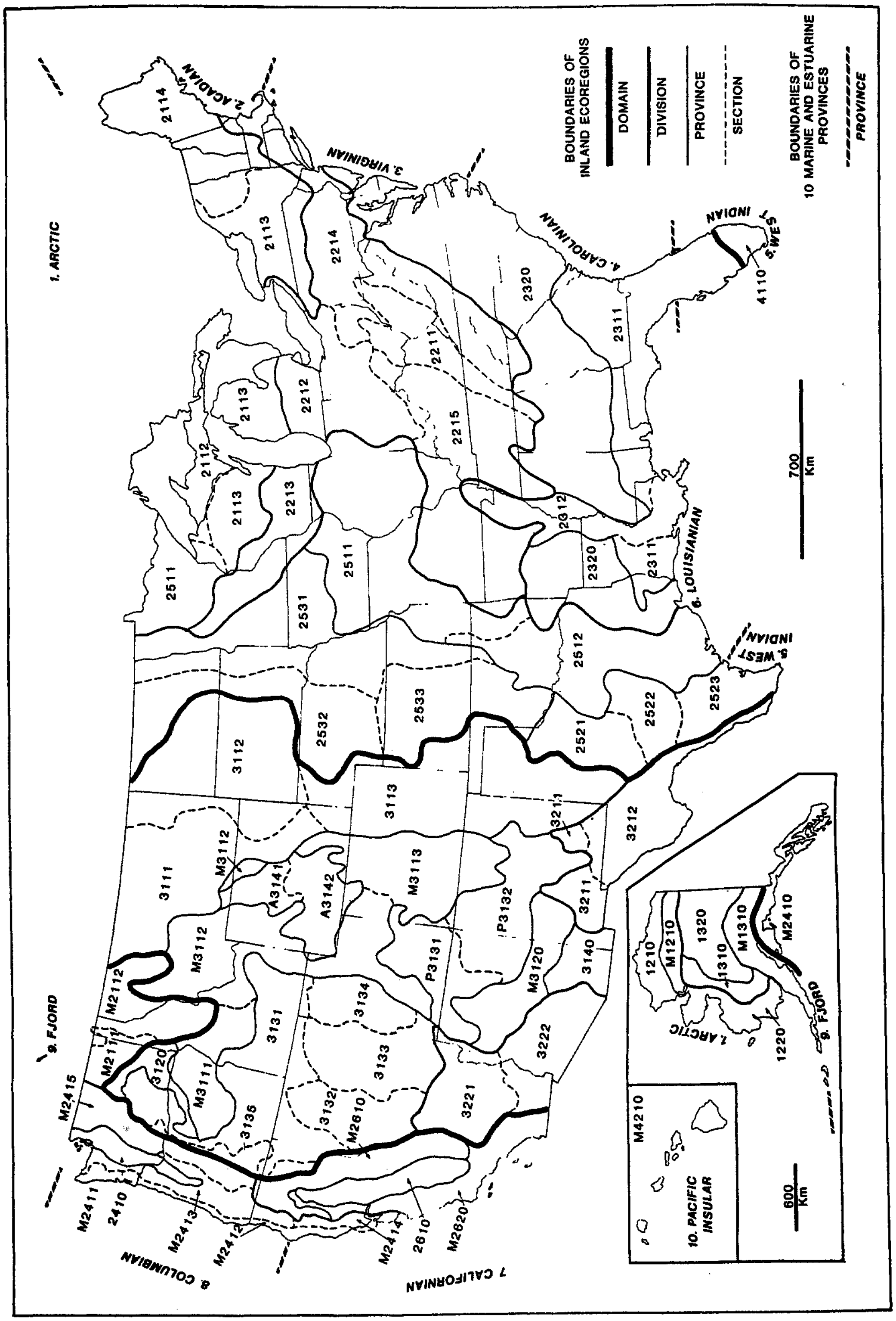

Figure 2. Ecoregions of the United States. See Table 1 for explanation.

generalization of the map, they are considered lowland regions.

In addition to mountain systems, the extreme high-altitude phases of plains (altiplano) and plateaus should be distinguished so that the distinctive position of such plains as the Wyoming Basin and the Colorado Plateau may be appreciated.

Within the lowland series, section and province boundaries were established by using the diagnostic criteria of Crowley (1967) to generalize Küchler's map. The generalization was of two types. First, boundaries were simplified by elimating enclaves and peninsulas that were deemed to small to show on the finished small-scale map. (The smallest region shown on the map is about 11,100 km^2 (4300 sq mi).) Second, there was a reduction in the number of Küchler types. Some of Küchler's mapping units show the presence of large areas of azonal soils such as sand plains and peat deposits. These units were combined with surrounding zonal types in delineating sections and provinces; this relegated edaphically controlled ecosystems to a lower level of classification and to more detailed maps.

Lowlands and highlands were then grouped into larger climatic regions (domains and divisions) following the Köppen (1931) system. Köppen's system is simple, is based on quantitative criteria, and correlates well with the distribution of many natural phenomena, such as vegetation and soils. In the Köppen system, summarized in Tables 2 and 3, each climate is defined according to assigned values of temperature and precipitation, computed in terms of annual and monthly values. It has become the most widely used climatic classification for geographical purposes. Particularly useful in delineating climatic regions were the climatic map of the world, modified from the Köppen system (Trewartha 1943) at a scale of 1:75,000,000, and the climatic map of North America (Thornthwaite 1931) at a scale of 1:20,000,000. Boundaries of the climatic regions were altered in some cases to make them conform to vegetation boundaries.

Testing and Validation

As Rowe and Sheard (1981) point out, maps are hypotheses to be tested and improved. The unit areas delineated are hypotheses that arise from a knowledge of what is ecologically important. The regionalization of the United States, as just described, is the product of an ecological concept. A key hypothesis is that the large divisions, bounded by changes in climatic regime, are functionally different in important ways. Furthermore, it is hypothesized that similar sites within map units should respond in a similar way to management.

Some land management agencies are currently using the ecoregion concept without formal validation, much as others have used Küchler's (1964) map of potential natural vegeta-

Table 2. Regional climates, based on the Köppen system of classification (1931), as modified by Trewartha (1943).

Köppen groups and types	Ecoregion equivalents
A—*Tropical humid climates*	*Humid tropical domain*
Tropical rainforest (Af)	Rainforest division
Tropical savanna (Aw)	Savanna division
B—*Dry climates*	*Dry domain*
Steppe (BSk)	Steppe division
Desert (BWh, BWk)	Desert division
C—*Subtropical climates*	*Humid temperate domain*
Mediterranean (Csa)	Mediterranean division
Humid subtropical (Cfa)	Subtropical division Prairie division[1]
Marine west coast (Cfb)	Marine division
D—*Temperate climates*	
Humid continental, warm summer (Dfa)	Hot continental division Prairie division[1]
Humid continental, cool summer (Dfb)	Warm continental division Prairie division[1]
	Polar domain
Subarctic (Dfc, Dfd)	Subarctic division
E—*Polar climates*	
Tundra (ET)	Tundra division
Ice cap (EF)	

[1]Köppen did not recognize the prairie as a distinct climatic type. The ecoregion classification system represents it at the dry sides of the Cfa, Dfa, and Dfb types.

Table 3. Definitions and boundaries of Köppen system.

- A Tropical forest climates; without frost. Coolest month warmer than 18°C (65°F).
- B Dry climates; evaporation exceeds precipitation.
  - BS—Steppe or semiarid climate.
  - BW—Desert or arid climate.
- C Subtropical climates; 8 months or more warmer than 10°C (50°F); coolest month warmer than 0°C (32°F) but colder than 18°C (65°F).
- D Temperate forest climates; 4–8 months warmer than 10°C (50°F); coldest month cooler than 0°C (32°F).
- E Polar climates, warmest month colder than 10°C (50°F).
  - ET—Tundra climate; warmest month colder than 10°C (50°F) but warmer than 0°C (32°F).
  - EF—Perpetual frost; all months colder than 0°C (32°F).

a—average temperature of warmest month warmer than 22°C (72°F).
b—average temperature of warmest month colder than 22°C (72°F).
c—fewer than 4 months warmer than 10°C (50°F).
d—same as c, but coldest month cooler than −38°C (−36°F).
f—no dry season; rainfall throughout the year.
h—hot and dry; all months warmer than 0°C (32°F).
k—cold and dry; at least one month colder than 0°C (32°F).
s—dry season in summer.
w—dry season in winter.

tion, on the assumption that nothing better is available. Thus, while on the surface it may appear that the ecoregion concept is definitive, in fact the concept and map must be tested and validated before long-range analysis and planning are undertaken.

If adequate data on productivity are collected from the regions and assembled, the hypothesis underlying the regionalization can be evaluated statistically, and the validity of the regional structure (map) objectively evaluated. A program of research to statistically test the ecoregion construct by using data to verify and refine the boundaries of ecoregions, the internal homogeneity of the regions and their subdivisions, and the general applicability of the ecoregion concept to nationwide resource assessment and planning is being developed.

Summary

The map of the ecoregions of the United States depicts ecosystems of regional extent according to the Crowley classification, with climate and vegetation as indicators of the extent of each unit. Four ecological levels are shown. The broadest, domains, are based on observable differences that have developed largely because of prevailing climatic conditions. Then, on the basis of further climatic criteria, domains are broken down into categories called divisions which, on the basis of the climax plant formation that geographically dominates the area of the province, are subdivided into provinces. Provinces are subdivided into sections which differ in the floristic composition of the climax plant formation. Highland provinces and sections are distinguished where, as a result of the influence of altitude, the climatic regime differs substantially from adjacent lowlands to cause complex vertical climate-vegetation-soil zonation.

Acknowledgments

I wish to thank J. F. Franklin, A. W. Küchler, and J. S. Rowe for reviewing the manuscript and for making several valuable suggestions, which I have incorporated into the text.

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