

ECOREGIONS

Ecoregion development by EPA

- purpose, definitions, methods, applications, and interagency activities

Perspectives on the nature of ecoregions and their definition

- ecoregions do not nest
- why there is disagreement over how to define ecoregions

The process of refining and subdividing ecoregions

General purpose and special purpose regions

Distinguishing between ecoregions, watersheds, and hydrologic units (HUCs)

ECOREGIONS

Areas of similarity regarding patterns in the mosaic of biotic, abiotic, aquatic, and terrestrial ecosystem components, with humans being considered as part of the biota

General Purpose

A spatial framework to allow resource mgmt. agencies and programs with different responsibilities for the same geographic areas to integrate their research, assessment, and management activities regarding environmental resources.

Ecoregions were not designed to serve a single purpose or to correspond specifically to patterns of specific components such as fish, macroinvertebrates, soils, or vegetation.

Ecoregions are intended to serve as a geographic organizational tool for ecosystem management.

-The quality and quantity of water at any point reflects the aggregate of characteristics upgradient from that point.

-Water quality and quantity will tend to be similar within areas where this “aggregate” is similar.

-**Therefore**, for effective water resource research, assessment, and management we must 1) define these regions with similar characteristics and 2) identify sets of “reference” watersheds/areas within each region.

-These regions of similarity (ecoregions) can be used to set expectations, standards, management practices, etc.

-Basins and watersheds may then be identified to address contributions to particular points. The regional reference data will be used to determine the contributions.

“Ecological land classification is a process of delineating and classifying ecologically distinctive areas of the earth’s surface. Each area can be viewed as discrete system which has resulted from the mesh and interplay of the geologic, landform, soil, vegetative, climatic, wildlife, water, and human factors which may be present. The dominance of any one or a number of these factors varies with the given ecological land unit. This holistic approach to land classification can be applied incrementally on a scale-related basis from very site-specific ecosystems to very broad ecosystems.”

Wiken '86

GAO

United States General Accounting Office
Report to Congressional Requesters

August 1994

ECOSYSTEM MANAGEMENT

Additional Actions Needed to Adequately Test a Promising Approach



MEMORANDUM OF UNDERSTANDING
AMONG THE
U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
FOREST SERVICE
AGRICULTURAL RESEARCH SERVICE

AND THE

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
U.S. GEOLOGICAL SURVEY
FISH AND WILDLIFE SERVICE
NATIONAL BIOLOGICAL SERVICE
NATIONAL PARK SERVICE

AND THE

U.S. ENVIRONMENTAL PROTECTION AGENCY

RELATIVE TO

**DEVELOPING A SPATIAL FRAMEWORK OF ECOLOGICAL UNITS OF THE
UNITED STATES**

This Memorandum of Understanding (MOU) is entered into by the Department of Agriculture, Natural Resources Conservation Service (NRCS), Forest Service (FS), and Agricultural Research Service (ARS); the U.S. Department of the Interior, Bureau of Land Management (BLM), U.S. Geological Survey (USGS), Fish and Wildlife Service (FWS), National Biological Service (NBS), and National Park Service (NPS); and the U.S. Environmental Protection Agency (EPA)).

I. PURPOSE

This MOU documents and defines the responsibilities of the cooperating agencies to develop a common spatial framework for defining ecological units of the United States. It also provides a vehicle for other Federal agencies with natural resource management responsibilities to become part of the cooperative effort nationwide.

II. BACKGROUND AND BENEFITS

Examples of "Ecoregion Frameworks"

U.S. NRCS major land resource regions

USEPA ecoregions

U.S. Forest Service

- Bailey ecoregions
- ECOMAP terrestrial ecological units (Keys et al.)
- aquatic ecological units (Maxwell et al.)

World Wildlife Fund

- terrestrial ecoregions
- freshwater ecoregions

Commission for Environmental Cooperation ecological regions

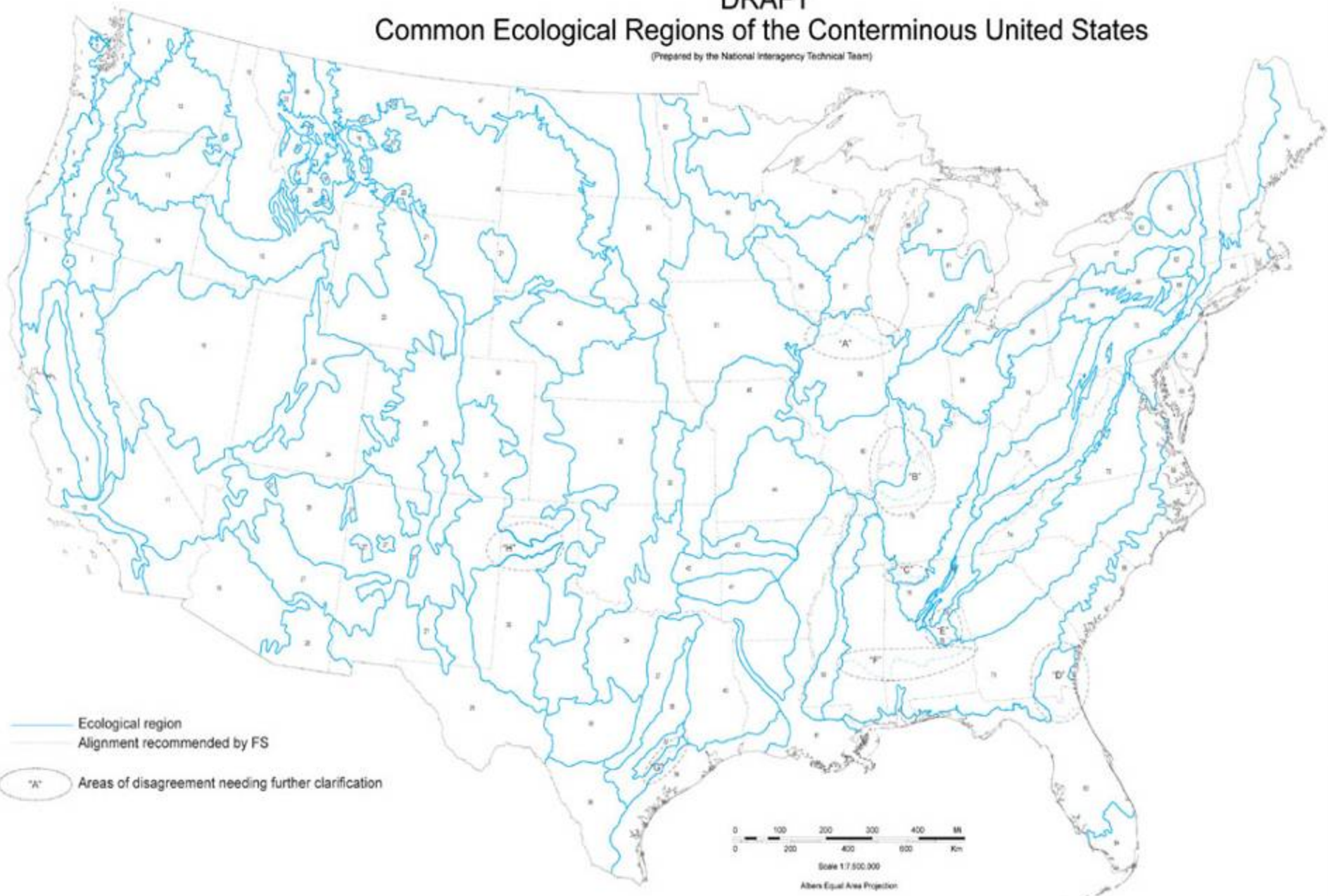
NITT common ecological regions

Quantitatively developed ecoregions (e.g. Hargrove and Hoffman)

McMahon and others. 2001. Developing a Spatial Framework of Common Ecological Regions for the Conterminous United States. *Environmental Management* 28(3):293-316

DRAFT Common Ecological Regions of the Conterminous United States

(Prepared by the National Interagency Technical Team)



Level III Ecoregions of the Continental United States

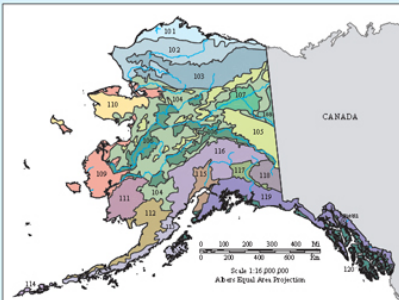
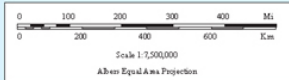
(Revised April 2013)

National Health and Environmental Effects Research Laboratory
U.S. Environmental Protection Agency

- 1. Coast Range
- 2. Puget Lowland
- 3. Willamette Valley
- 4. Cascades
- 5. Sierra Nevada
- 6. Central California Foothills and Coastal Mountains
- 7. Central California Valley
- 8. Southern California Mountains
- 9. Eastern Cascades Slopes and Foothills
- 10. Columbia Plateau
- 11. Blue Mountains
- 12. Snake River Plain
- 13. Central Basin and Range
- 14. Mojave Basin and Range
- 15. Northern Rockies
- 16. Idaho Batholith
- 17. Middle Rockies
- 18. Wyoming Basin
- 19. Washach and Uinta Mountains
- 20. Colorado Plateau
- 21. Southern Rockies
- 22. Arizona-New Mexico Plateau
- 23. Arizona-New Mexico Mountains
- 24. Chihuahuan Deserts
- 25. High Plains
- 26. Southwestern Tidallands
- 27. Central Great Plains
- 28. Plains Hills
- 29. Cross Timbers
- 30. Edwards Plateau
- 31. Southern Texas Plains
- 32. Texas Blackland Prairies
- 33. East Central Texas Plains
- 34. Western Gulf Coastal Plain
- 35. South Central Plains
- 36. Ouachita Mountains
- 37. Arkansas Valley
- 38. Boston Mountains
- 39. Ozark Highlands
- 40. Central Irregular Plains
- 41. Canadian Rockies
- 42. Northwestern Glaciated Plains
- 43. Northwestern Great Plains
- 44. Nebraska Sand Hills
- 45. Piedmont
- 46. Northern Glaciated Plains
- 47. Western Corn Belt Plains
- 48. Lake Agassiz Plain
- 49. Northern Minnesota Wetlands
- 50. Northern Lakes and Forests
- 51. North Central Hardwood Forests
- 52. Driftless Area
- 53. Southeastern Wisconsin Till Plains
- 54. Central Corn Belt Plains
- 55. Eastern Corn Belt Plains
- 56. Southern Michigan/Northern Indiana Drift Plains



- 57. Huron/Erie Lake Plains
- 58. Northeastern Highlands
- 59. Northeast Coastal Zone
- 60. Northern Allegheny Plateau
- 61. Erie Drift Plain
- 62. North Central Appalachians
- 63. Middle Atlantic Coastal Plain
- 64. Northern Piedmont
- 65. Southeast Plains
- 66. Blue Ridge
- 67. Ridge and Valley
- 68. Southwest Appalachians
- 69. Central Appalachians
- 70. Western Allegheny Plateau
- 71. Interior Plateau
- 72. Interior River Valleys and Hills
- 73. Mississippi Alluvial Plain
- 74. Mississippi Valley Lower Plains
- 75. Southern Coastal Plain
- 76. Southern Florida Coastal Plain
- 77. North Cascades
- 78. Klamath Mountains/California High North Coast Range
- 79. Madras Archipelago
- 80. Northern Basin and Range
- 81. Sonoran Basin and Range
- 82. Acanthian Plains and Hills
- 83. Eastern Great Lakes Lowlands
- 84. Atlantic Coastal Pine Barrens
- 85. Southern California/Northern Baja Coast



- 101. Arctic Coastal Plain
- 102. Arctic Foothills
- 103. Brooks Range
- 104. Interior Forested Lowlands and Uplands
- 105. Interior Highlands
- 106. Interior Boreal and Dry
- 107. Yukon Flats
- 108. Cobble Mountains
- 109. Subarctic Coastal Plains
- 110. Stewart Plateau
- 111. Alibon and Killbuck Mountains
- 112. Bristol Bay/Chukchi Lowlands
- 113. Alaska Peninsula Mountains
- 114. Aleutian Islands (Western portion not shown)
- 115. Cook Inlet
- 116. Alekha Range
- 117. Copper Plateaus
- 118. Wrangell Mountains
- 119. Pacific Coastal Mountains
- 120. Coastal Western Hemlock-Sitka Spruce Forests

The ecoregions shown here have been derived from Omernik (1987) and from refinements of the U.S. EPA ecoregion framework made in numerous three-level projects. These projects, conducted in collaboration with the U.S. EPA regional offices, state resource management agencies, and with other federal agencies, typically involved defining ecoregions, defining subregions, and loading sets of stream indicators. Designed to serve as a spatial framework for environmental resource management, ecoregion designates areas within which ecosystems (and the type, quality and quantity of environmental resources) are generally similar. The ecoregions have been used to develop regional biological criteria and water quality standards and to set management goals for important sources pollution, among other applications.

The approach used to compile this map is based on the premise that ecological regions can be identified through the analysis of the pattern and the composition of biotic and abiotic phenomena that reflect or reflect differences in ecosystem quality and integrity (Omernik 1987, 1997). These phenomena include geology, physiography, topography, climate, soils, and land use, wildlife, and hydrology. The relative importance of each characteristic varies from one ecological region to another depending on the hierarchical level. A Roman numeral classification scheme has been adopted for different levels of ecological region. Level I is the coarsest level, dividing North America into 15 ecological regions, whereas at Level III the continent is subdivided into 10 classes (CEC 1997, 2000). Level II is the hierarchical level between the first and the 100 ecoregions in the continental U.S. For the continental United States, the ecoregions have been further subdivided to 860 Level IV ecoregions. Details about the ecoregions or their applications are explained in reports and publications from the state and regional projects (e.g., Boyer et al., 1998, 2003; Chapman et al., 2001, 2006; Galloway et al., 1989, 1995; Orthoff et al., 2002, 2004, 2009; McInnes et al., 2002; Omernik et al., 2000, 2004; Thomson et al., 2003; Wilcox et al., 2011; and Wilcox et al., 1998, 2002, 2004). For additional information, contact James M. Omernik, 10155 Old U.S. EPA, 200 SW 30th Street, Corvallis, OR 97331, phone (541) 754-4465, email omernik@epa.gov.

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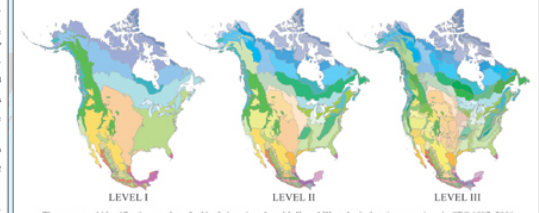
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ECOLOGICAL REGIONS OF NORTH AMERICA



The names and identification numbers for North American Level I, II, and III ecological regions are given in CEC 1997, 2006.

CITING THIS MAP: U.S. Environmental Protection Agency. 2013. Level III ecoregions of the continental United States. Corvallis, Oregon, U.S. EPA National Health and Environmental Effects Research Laboratory, map scale 1:7,500,000. http://www.epa.gov/eeo/regions/eng/regions_1_10_000_000.pdf

REASONS FOR DISAGREEMENT OVER HOW TO DELINEATE ECOREGIONS

- 1. Disagreement on the definition of *ecosystems***
- 2. The complexity of the nature of ecoregions and ecoregion boundaries**
- 3. Bias toward particular characteristics**
- 4. Inability or reluctance to embrace a holistic ecosystem concept and preoccupation with specific objectives and reductive methods**
- 5. Disagreement on whether to use quantitative (rule-based) or qualitative (weight of evidence) approaches**
- 6. Disagreement over whether watersheds comprise ecoregions**
- 7. Investment in existing frameworks and reluctance to change.**

A major problem:

A common belief that ecoregion boundaries must be based on a single characteristic

Ecoregion Boundaries

- Places where the mosaic of geographic phenomena that characterize one ecoregion meet those of an adjacent ecoregion.

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Quote from an ecologist/botanist on his state map of ecoregions:

"My ideas have not changed since the first time I started putting these notes together some 7+ years ago; this is not because I am getting old and conservative, it is because I am right and I know it(!).

I have emphasized vegetation and plant distributions, which I think is useful, and gives my map an edge over the others that claim to be biogeographic, but do not really take details into consideration.

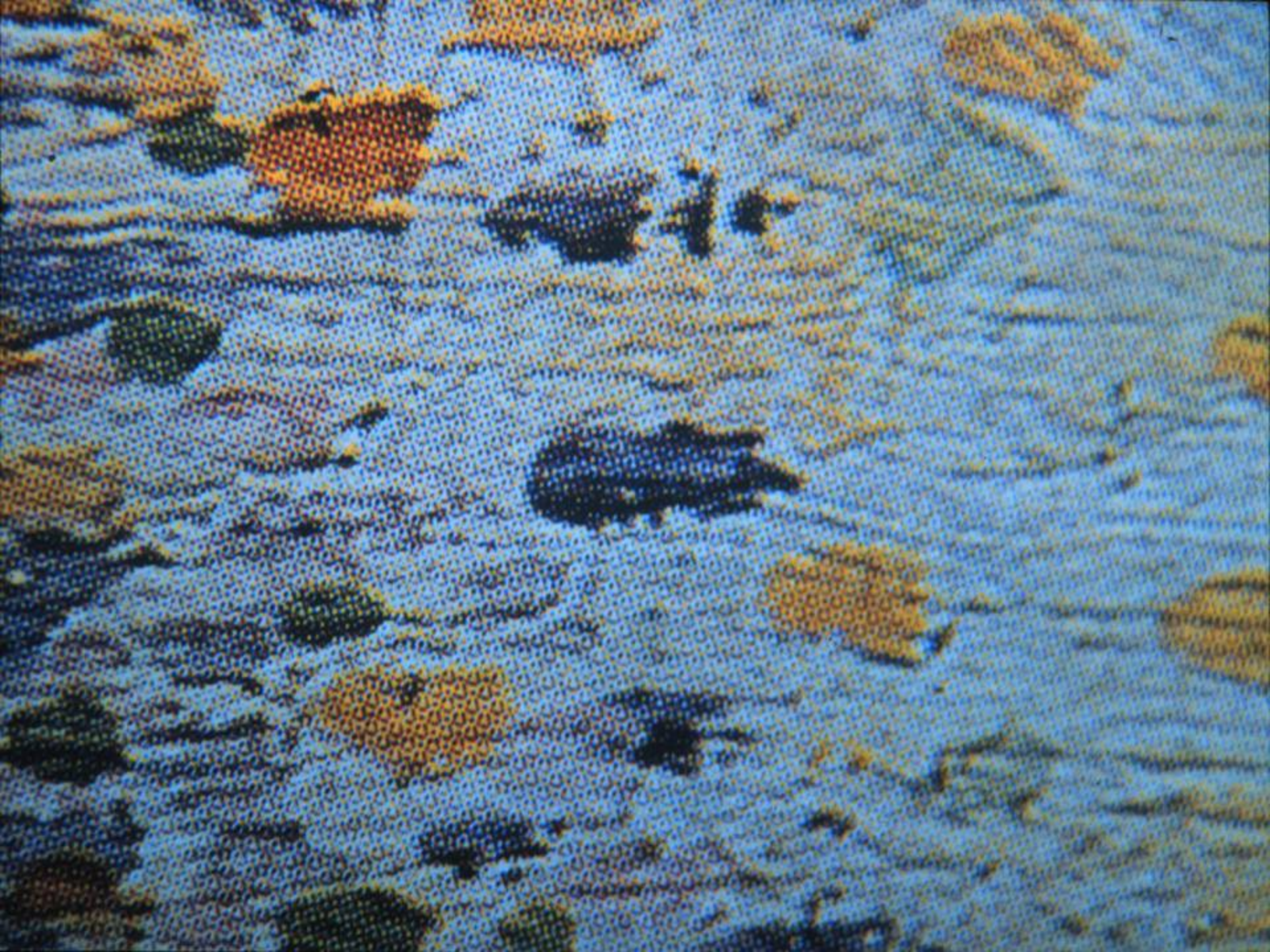
ACTUALLY, my main conclusion is that there is no perfect eco/regional map – there are too many viewpoints, applications, and biases to allow a perfect map."

General purpose ecological regions

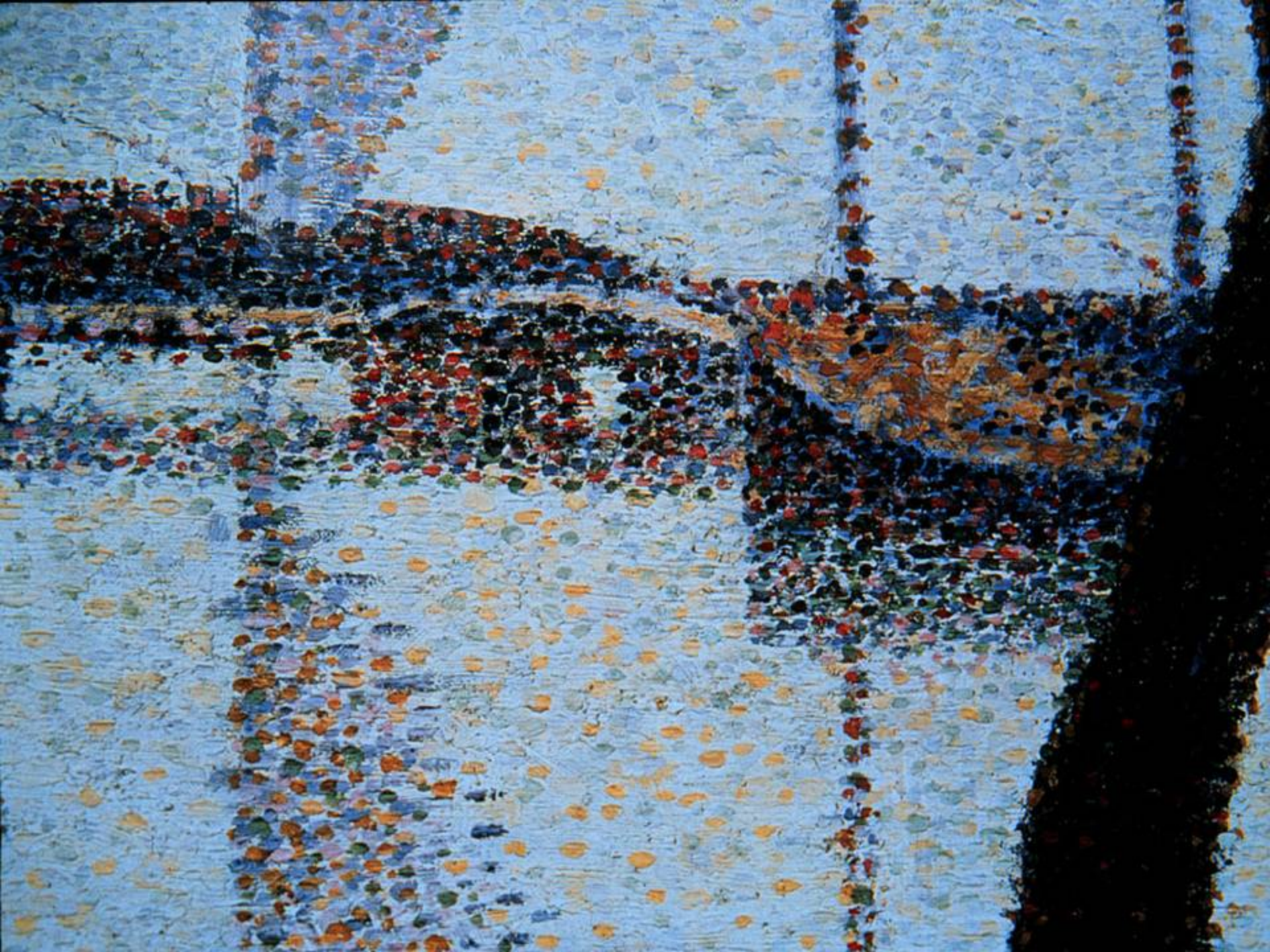
Based on spatial coincidence of numerous geographic phenomena affecting or reflecting ecosystem characteristics

Specific purpose regions (e.g. alkalinity, soils, or geology regions)

Based on patterns of one characteristic and spatial associations with causal or reflective geographical phenomena









Level I

Nivel I

Niveau I

- 1.0 ARCTIC CORDILLERA
CORDILLERA ÁRTICA
CORDILLÈRE ARCTIQUE
- 2.0 TUNDRA
TUNDRA
TOUNDRRA
- 3.0 TAIGA
TAÏGA
TAÏGA
- 4.0 HUDSON PLAIN
PLANICIE DE HUDSON
PLAINE D' HUDSON
- 5.0 NORTHERN FORESTS
BOSQUES SEPTENTRIONALES
FORÊTS SEPTENTRIONALES
- 6.0 NORTHWESTERN FORESTED MOUNTAINS
MONTAÑAS BOSCOSAS NOROCCIDENTALES
MONTAGNES FORESTÉES DU NORD-OUEST
- 7.0 MARINE WEST COAST FOREST
BOSQUE COSTERO OCCIDENTAL
FORÊT MARITIME DE LA CÔTE OCCIDENTALE
- 8.0 EASTERN TEMPERATE FORESTS
BOSQUES TEMPLADOS DEL ESTE
FORÊTS TEMPÉRÉES DE L'EST
- 9.0 GREAT PLAINS
GRANDES PLANICIES
GRANDES PLAINES
- 10.0 NORTH AMERICAN DESERTS
DESIERTOS DE NORTEAMÉRICA
DESERTS DE L'AMÉRIQUE DU NORD
- 11.0 MEDITERRANEAN CALIFORNIA
CALIFORNIA MEDITERRANEA
CALIFORNIE MÉDITERRANÉENNE
- 12.0 SOUTHERN SEMI-ARID HIGHLANDS
ELEVACIONES SEMIÁRIDAS MERIDIONALES
HAUTES TERRES SEMI-ARIDES MÉRIDIIONALES
- 13.0 TEMPERATE SIERRAS
SIERRAS TEMPLADAS
SIERRAS TEMPÉRÉES
- 14.0 TROPICAL DRY FORESTS
SELVAS CALIDO-SECAS
FORÊTS TROPICALES SÈCHES
- 15.0 TROPICAL WET FORESTS
SELVAS CALIDO-HUMEDAS
FORÊTS TROPICALES HUMIDES



Region boundary Level I
Limite de regiones Nivel I
Limite de régions Niveau I

International boundary
Limite internacional
Limite internationale

Échelle Escala Scale

0 200 400 600 800 1000 Km

0 400 800 1200 Mi

Projection Azimutal de Equi-área de Lambert
Proyección Azimutal de Equi-área de Lambert
Lambert Azimuthal Equal Area Projection

- 1. Arctic region (Level I)
- 2. Subarctic region (Level I)
- 3. Boreal region (Level I)
- 4. Temperate region (Level I)
- 5. Subtropical region (Level I)
- 6. Mediterranean region (Level I)
- 7. Desert region (Level I)
- 8. Steppe region (Level I)
- 9. Grassland region (Level I)
- 10. Savanna region (Level I)
- 11. Tundra region (Level I)
- 12. Alpine region (Level I)
- 13. Mountain region (Level I)
- 14. Coastal region (Level I)
- 15. Inland region (Level I)
- 16. ... (many more detailed entries with descriptions of climate, vegetation, and fauna)

ECOLOGICAL REGIONS OF NORTH AMERICA

RÉGIONS ÉCOLOGIQUES DE L'AMÉRIQUE DU NORD

RÉGIONES ECOLÓGICAS DE AMÉRICA DEL NORTE

 Level I II III

Prepared in partnership with:



Scale: 1:100,000,000

 0 200 400 600 800 km

Latin American Equivalency Project

 Proyección América de Equivalencia de Latitudes

 Proyección América de Equivalencia de Latitudes

The map shows four levels of ecological regions in North America. The first level is a broad division into six major regions based on climate and vegetation. The second level is a more detailed division into 11 major regions. The third level is a further division into 33 sub-regions. The fourth level is a final division into 111 sub-sub-regions.

The map was prepared in partnership with Environment Canada, the Canadian Council of Ministers of the Environment, and the Instituto Nacional de Estadística y Geografía (INEGI) of Mexico.

The map is a product of the North American Equivalency Project, which is a joint effort of the three countries to develop a common framework for environmental assessment and monitoring.

The map is based on a synthesis of scientific knowledge and is intended to provide a common framework for environmental assessment and monitoring.

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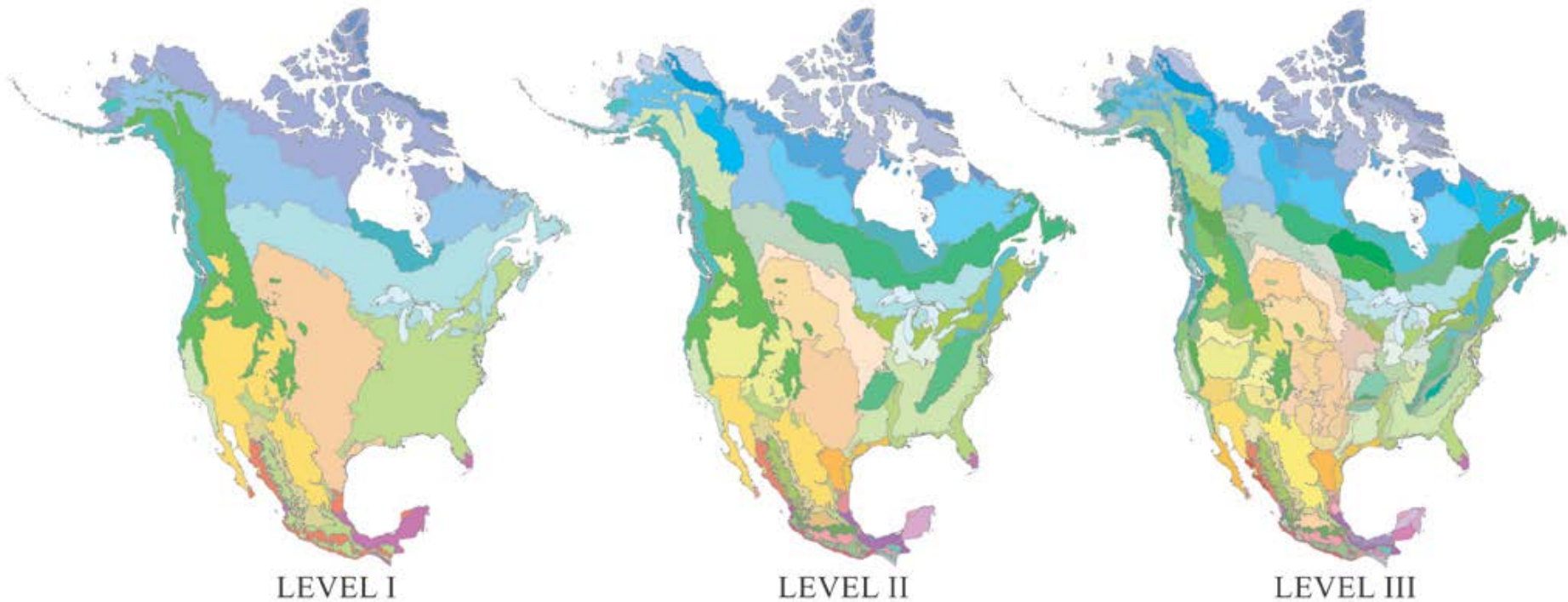
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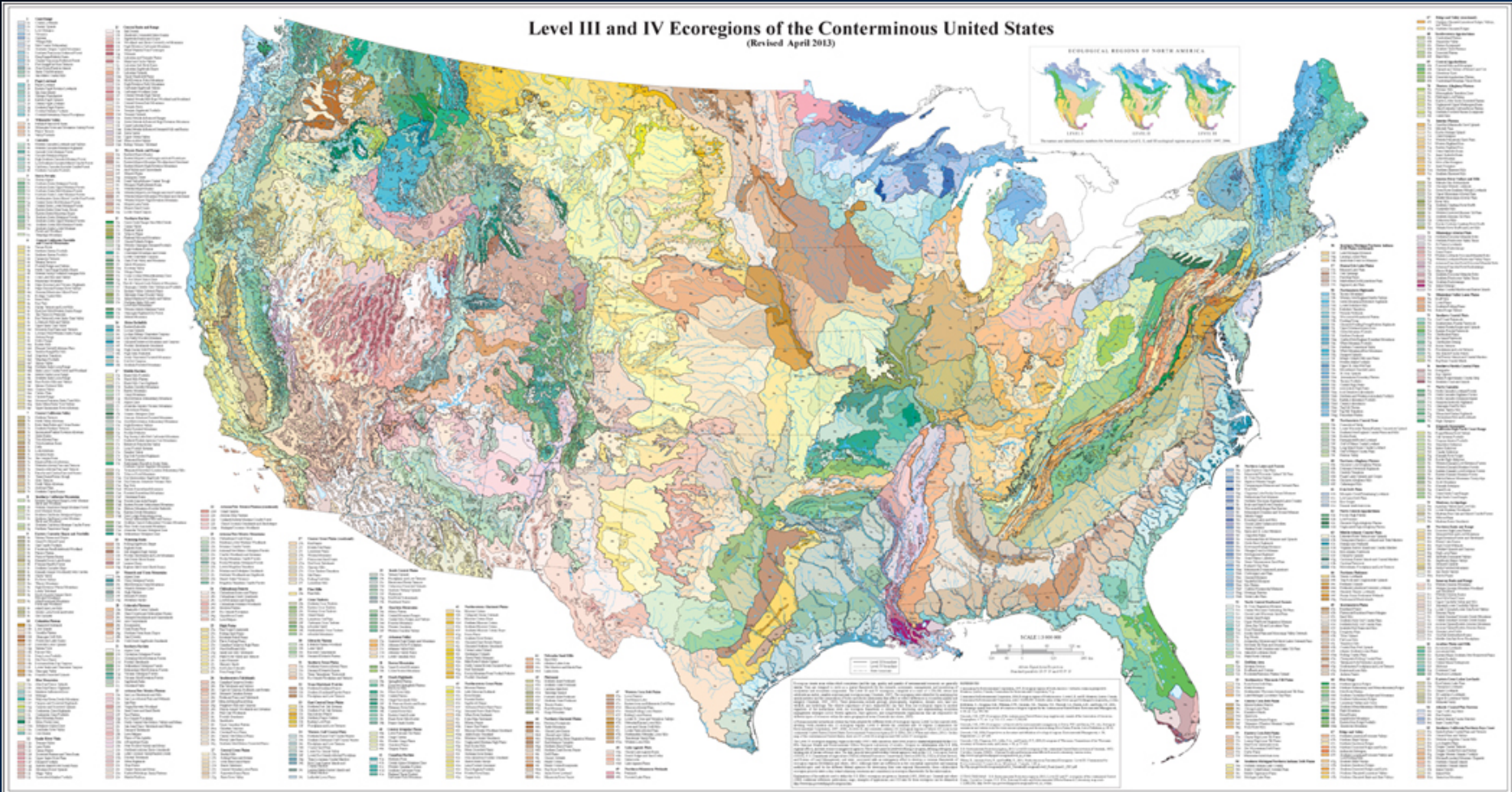
North American Ecoregions (CEC) Levels I, II, & III

ECOLOGICAL REGIONS OF NORTH AMERICA



The names and identification numbers for North American Level I, II, and III ecological regions are given in CEC 1997, 2006.

Level III and IV Ecoregions of the Conterminous U.S.
Revised April 2013
85 Level III, 967 Level IV ecoregions



ECOREGION DEVELOPMENT

Collaborative projects with states, EPA Regions, other federal agencies, and NHEERL-WED to refine and subdivide ecoregions and locate reference cites.

Provides a framework for:

- ecosystem management
- developing biological criteria
- setting water quality standards
- establishing lake management goals
- assessment and management of nonpoint source pollution
- TMDL allocations and NPDES evaluations
- extrapolation from "watershed" studies

DEVELOPING LEVEL III AND IV ECOREGIONS

- Projects are collaborative and always driven by needs
- EPA/USGS geographers facilitate work to decrease spatial inconsistency

Process:

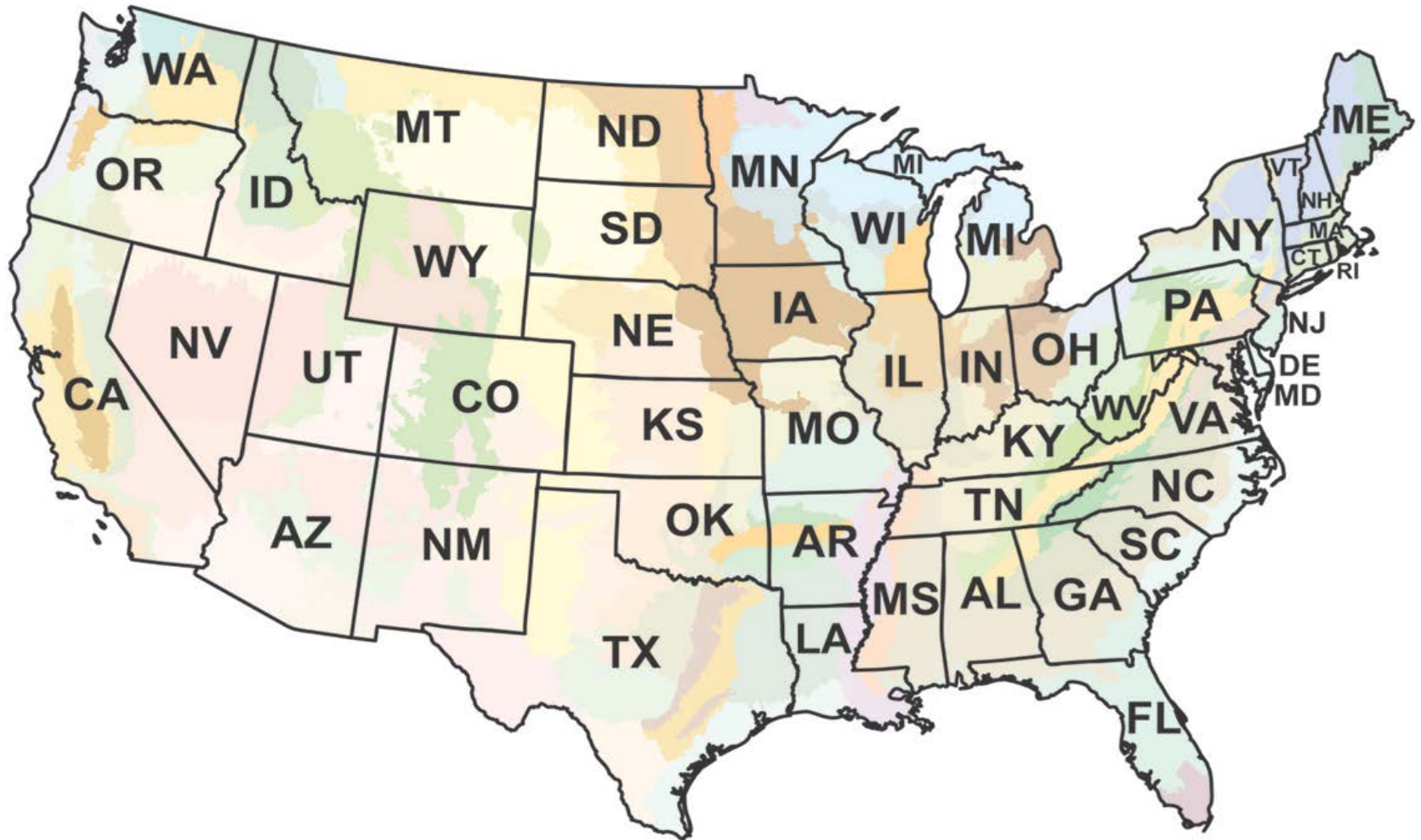
1. Initial meeting to gather information and ideas, determine participants, and discuss purpose, approaches, and timelines
2. Research subject region (gather maps , books, ideas etc. on the geography, ecology, and resources of the region)
3. Develop level III and IV scenarios
4. Draft map and descriptions sent out for review
5. Review meeting
6. Revise map and descriptions
7. Second review meeting and field verification

Process (continued):

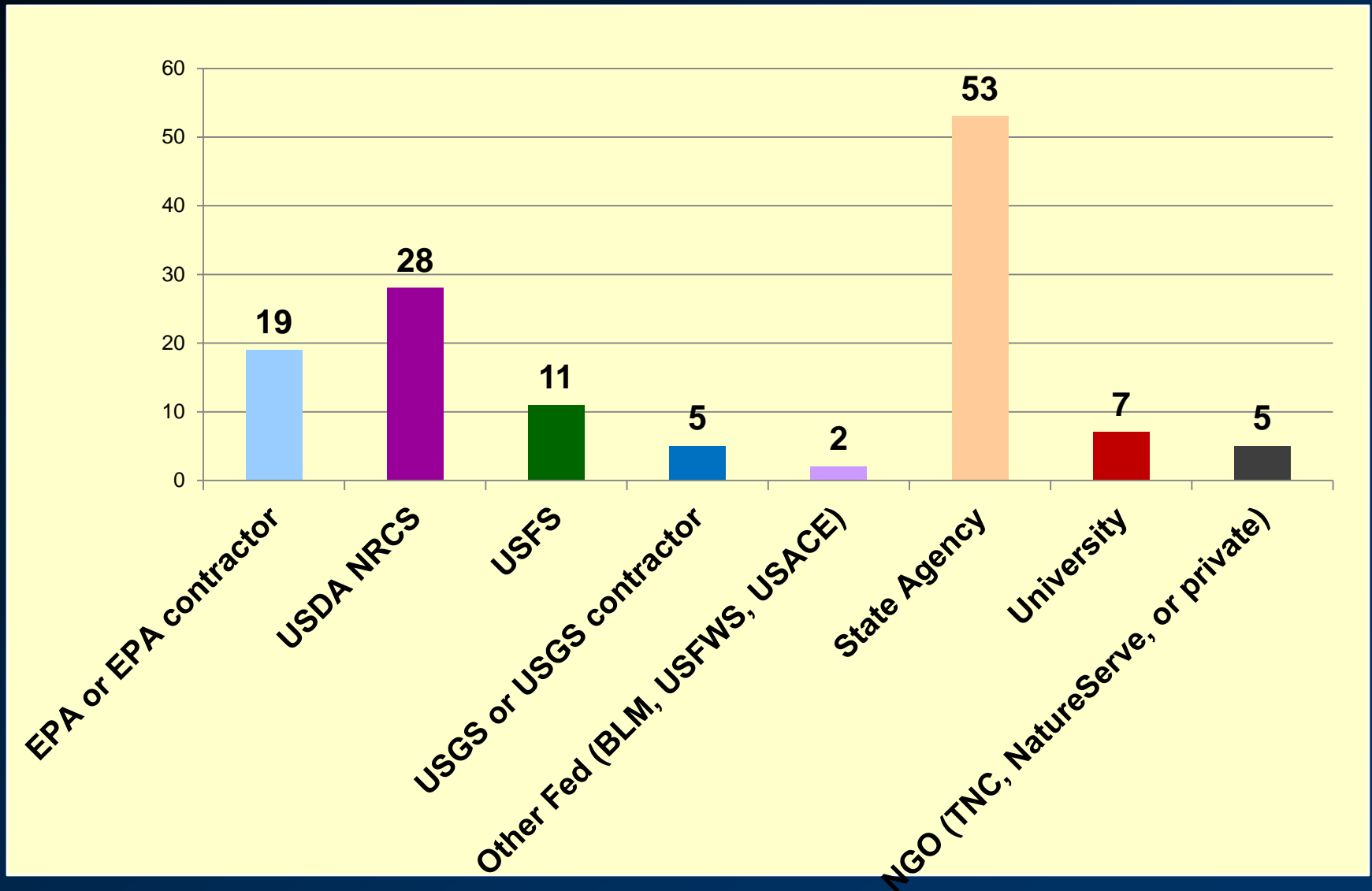
8. Revise level III and IV ecoregions and descriptions
9. Peer review
10. Produce co-authored and co-endorsed maps/posters

http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm

CLICKABLE MAP FOR STATE ECOREGION FILES

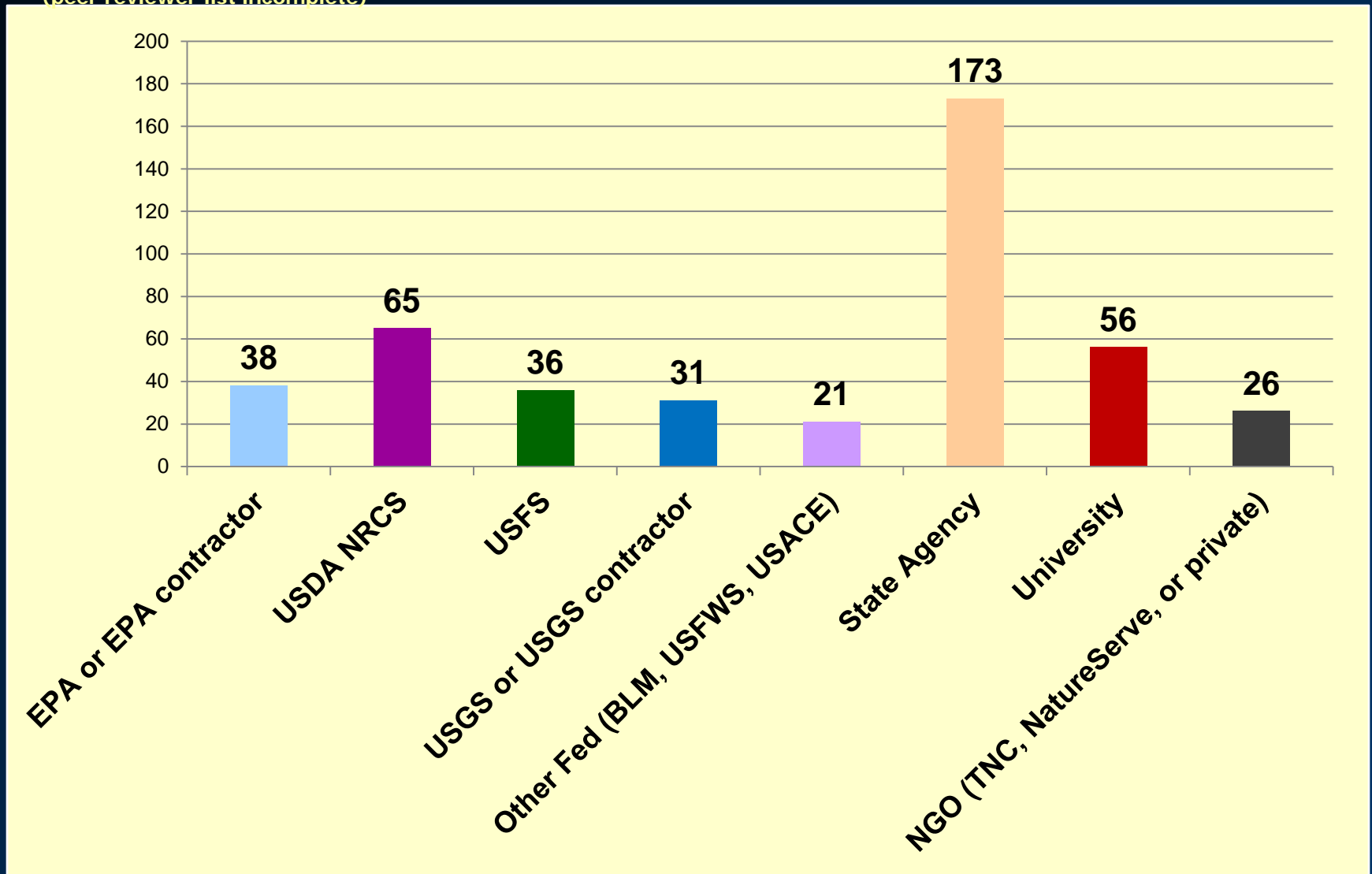


**Number of individuals listed as principal authors on Level IV
Ecoregion mapping publications, 1994-2011, and their affiliations.
(Total number of individuals = 130)**



Number of individuals listed as coauthor, collaborator, contributor, or peer reviewer* on Level IV Ecoregion mapping publications, 1994-2011, and their affiliations. (Total number of individuals = 446)

* (peer reviewer list incomplete)



California: 13 Level III and 177 Level IV Ecoregions

publication status: USGS Open-File Report, in peer review



Descriptions of the Level IV Ecoregions of California

1. Coast Range

2. Cascades

3. Sierra Nevada

4. Central California Foothills and Central Mountains (continued)

5. Central California Valley

6. Northern California Mountains

7. Southern California Mountains

8. Eastern Cascades Slopes and Foothills

9. Central Basin and Range

10. Mojave Basin and Range

11. Northern Basin and Range

12. Southern California Northern Basin Coast

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14. Mojave Basin and Range

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The big help in California....

David W. Smith (NRCS State Soil Scientist)

Terry D. Cook (NRCS-retired)

Ed Tallyn (NRCS)

Kendra Moseley (NRCS)

John Rogers (NRCS-retired)

Thor Thorson (NRCS)

Dick McCleery (NRCS)

James Weigand (BLM)

Ben Sleeter (USGS)

James Calzia (USGS)

Hazel Gordon (USFS)

Hugh Safford (USFS)

Joseph Furnish (USFS)

Robert K. Hall (USEPA)

Todd Keeler-Wolf (DFG)

Julie Evens (CNPS)

Greg Suba (CNPS)

Earl B. Alexander (Soils & Geocology)

James M. Harrington (DFG)

Peter Ode (DFG)

Randy Southard (UC-Davis)

Toby O'Geen (UC-Davis)

Colleen B. Johnson (Raytheon/SRA)

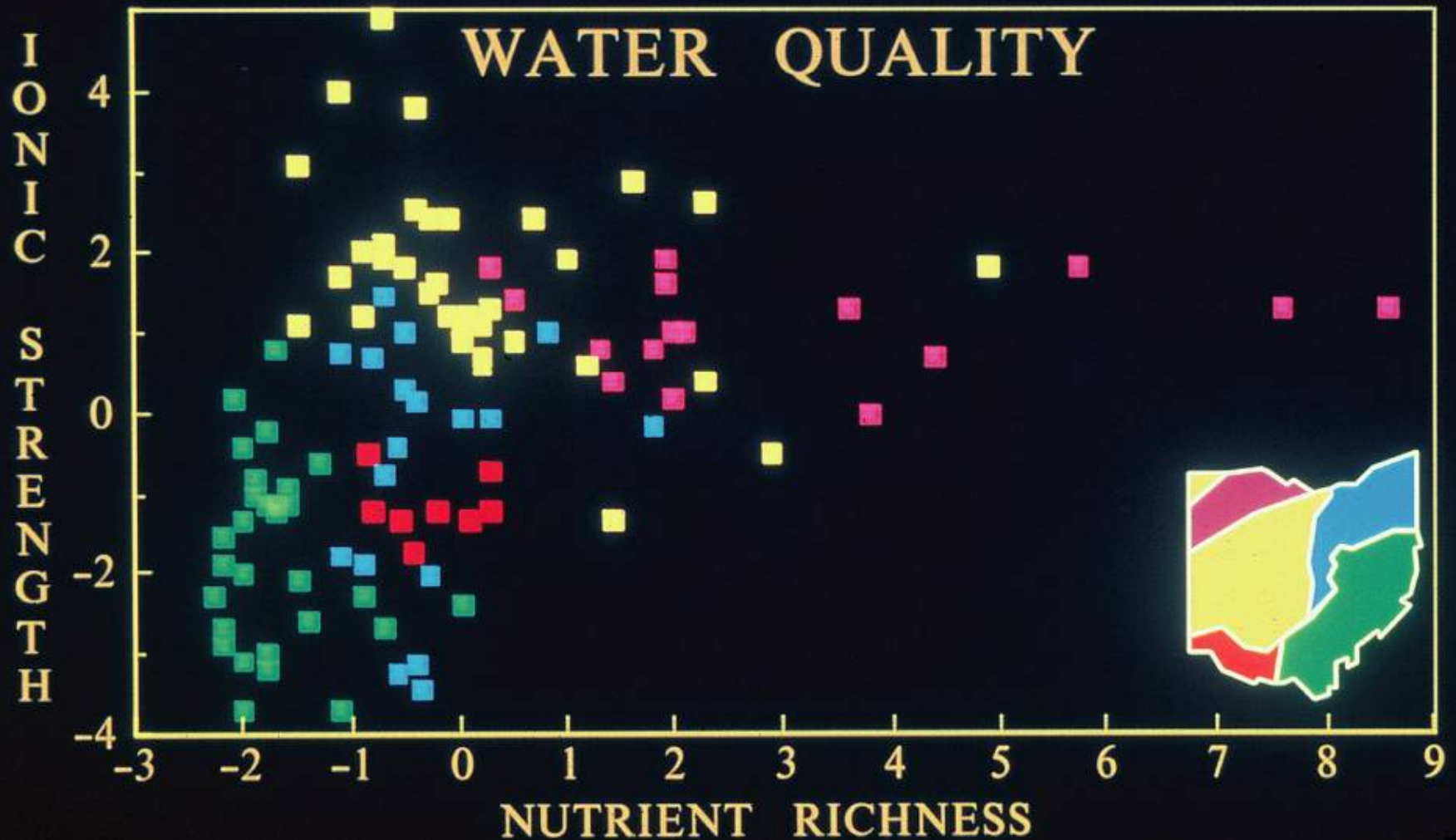
Sandra A. Bryce (Dynamac

Corporation) Alan J. Woods (Oregon State University)

Applications

- Ecosystem management
- Developing biological criteria
- Setting water quality standards
- Establishing lake management goals
- Assessment and management of nonpoint source pollution
- TMDL allocations and NPDES evaluations
- Extrapolation from "watershed" studies
- Post stratification of EMAP data
- Evaluating land cover change

Principal components analysis showing Ohio ecoregional patterns in least-disturbed reference watersheds



Applications: State Water Quality

J. N. Am. Benthol. Soc., 2000, 19(3):442-461
© 2000 by The North American Benthological Society

Correspondence between stream macroinvertebrate assemblages and 4 ecoregions of the southeastern USA

JACK W. FEMINELLA¹

Department of Biological Sciences, 331 Funchess Hall, Auburn University, Auburn,
Alabama 36849-5407 USA

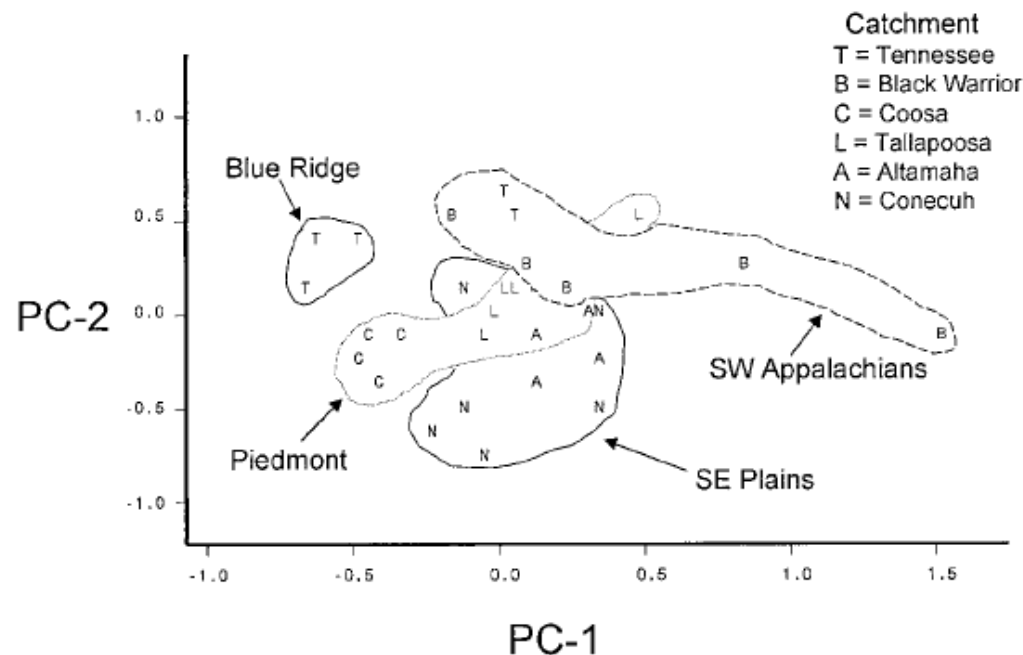


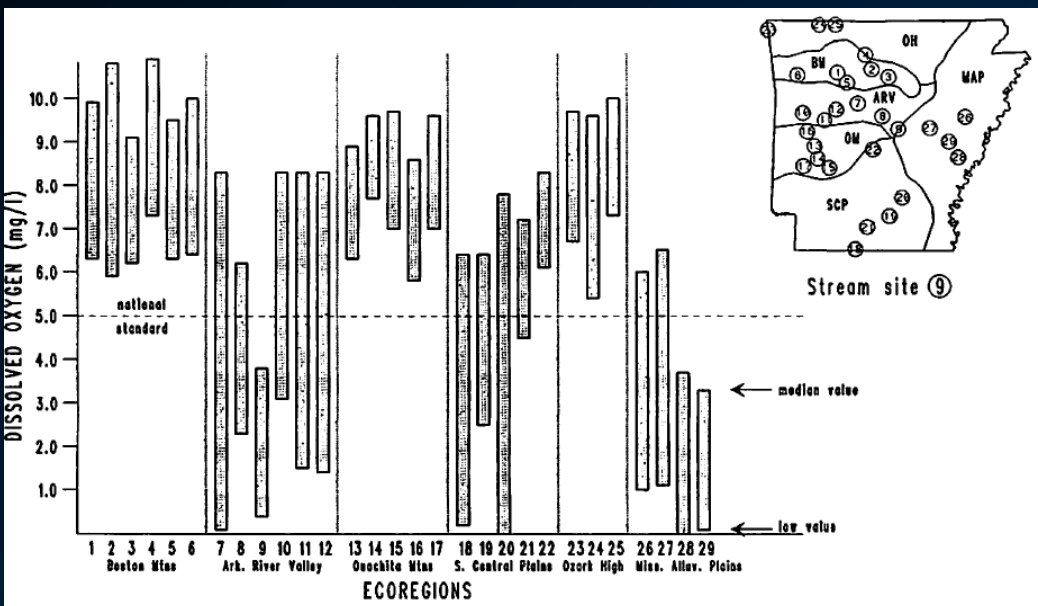
FIG. 2. Principal components analysis (PCA) ordination of physico-chemical variables measured from the 30 southeastern streams used in this study. PC-1 was largely associated with water chemical variables (conductivity, hardness, alkalinity, pH), whereas PC-2 was largely associated with % dissolved oxygen saturation at baseflow and several physical variables (median substrate size, current velocity, discharge, stream order, % of sand in substrate). PC-1 and PC-2 together accounted for 51% of the total variation. SW = Southwestern, SE = Southeastern.

“My study showed that the 4 southeastern ecoregions examined could be delineated on the basis of the stream invertebrate assemblages they contain. This finding supports the hypothesis that ecoregions represent a useful framework with which to characterize natural variation in aquatic biota”

Applications: State Water Quality Assessments, Regional Reference Conditions, WQ Standards

Arkansas

Tennessee



DEVELOPMENT OF REGIONALLY-BASED NUMERIC INTERPRETATIONS OF TENNESSEE'S NARRATIVE BIOLOGICAL INTEGRITY CRITERION



Figure 5. Median and low values for dissolved oxygen in regionally representative Arkansas streams by ecoregion. (Data from USGS, Water Years 1983-1988).

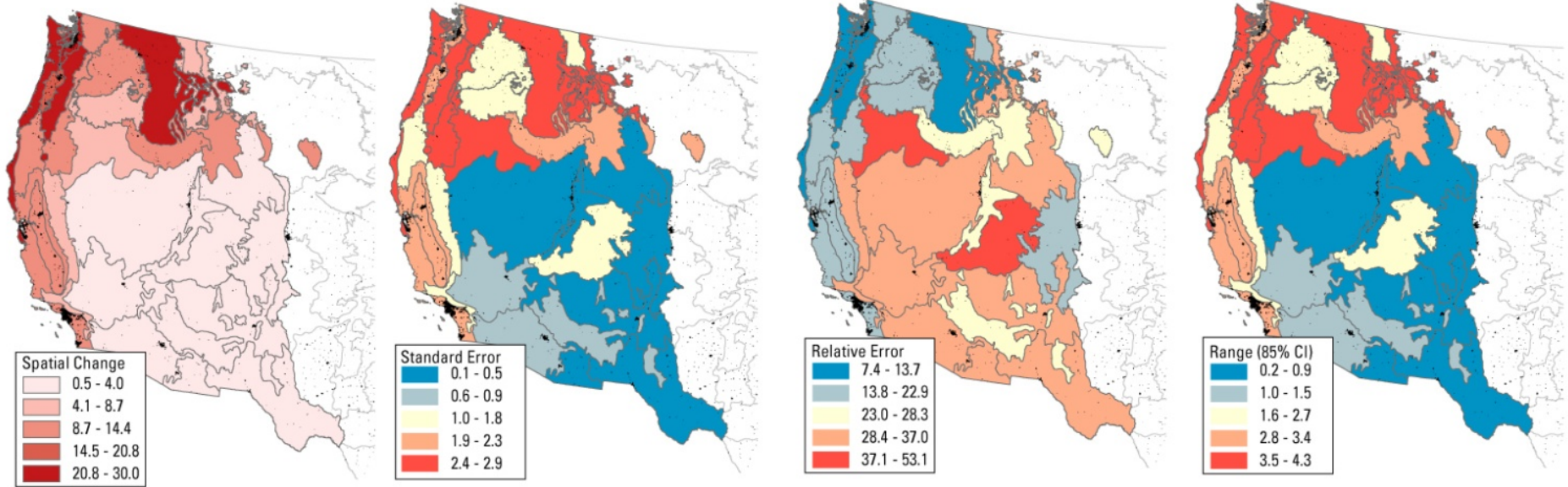
Tennessee Department of Environment and Conservation
 Division of Water Pollution Control
 7th Floor L & C Annex
 401 Church Street
 Nashville, TN 37243-1534

Applications: USGS Land Cover Trends



Land Cover with
Ecoregions

Overall spatial change from 1973 to 2000 for all Western U.S. ecoregions *(Sleeter et al., 2011)*



<http://landcover Trends.usgs.gov/>

USGS
science for a changing world

Land Cover Trends Project

USGS Home | Contact USGS | Search USGS

Home | About Trends | Results | Publications | Download Data | Contact Us

Ecoregion Summaries

West	Great Plains	Midwest	East
1. Coast Range	25. Western High Plains	34. Western Gulf Coastal Plain	45. Piedmont
2. Puget Lowland	26. Southwestern Tablelands	35. South Central Plains	58. Northeastern Highlands
3. Willamette Valley	27. Central Great Plains	36. Ouachita Mountains	59. Northeastern Coastal Zone
4. Cascades	28. Flint Hills	37. Arkansas Valley	60. Northern Appalachian Plateau and Uplands
5. Sierra Nevada	29. Central Oklahoma/Texas Plains	38. Boston Mountains	61. North Central Appalachians
6. California Chaparral and Oak Woodlands	30. Edwards Plateau	39. Ozark Highlands	62. Middle Atlantic Coastal Plain
7. Central California Valley	31. Southern Texas Plains	40. Northern Minnesota Wetlands	63. Northern Piedmont
8. Southern California Mountains	32. Texas Blackland Prairies	50. Northern Lakes and Forests	64. Southeastern Plains
9. Eastern Cascade Slopes and Foothills	33. East Central Texas Plains	51. North Central Hardwood Forests	65. Blue Ridge Mountains
10. Columbia Plateau	40. Central Irregular Plains	52. Driftless Area	67. Ridge and Valley
11. Blue Mountains	42. Northwestern Glaciated Plains	53. Southeastern Wisconsin Till Plains	68. Southwestern Appalachians
12. Snake River Basin	43. Northwestern Great Plains	54. Central Corn Belt Plains	69. Central Appalachians
13. Central Basin and Range	44. Nebraska Sandhills	55. Eastern Corn Belt Plains	70. Western Allegheny Plateau
14. Mojave Basin and Range	46. Northern Glaciated Plains	56. Southern Michigan/Northern Indiana Drift Plains	71. Interior Plateau
15. Northern Rockies	47. Western Corn Belt Plains	57. Huron/Erie Lake Plain	72. Mississippi Valley Loess Plains
16. Montana Valley and Foothill Prairies	48. Lake Agassiz Plain	61. Erie Drift Plains	73. Southern Coastal Plain
17. Middle Rockies		72. Interior River Lowland	74. Southern Coastal Plain
18. Wyoming Basin		73. Mississippi Alluvial Plain	75. Southern Coastal Plain
19. Wasatch and Uinta Mountains			76. Southern Florida Coastal Plain
20. Colorado Plateaus			77. Southern Florida Coastal Plain
21. Southern Rockies			78. Southern Florida Coastal Plain
22. Arizona/New Mexico Plateau			79. Southern Florida Coastal Plain
23. Arizona/New Mexico Mountains			80. Laurentian Plains and Hills
24. Chihuahuan Deserts			81. Eastern Great Lakes and Hudson Lowlands
41. Canadian Rockies			84. Atlantic Coastal Pine Barrens
77. North Cascades			
78. Klamath Mountains			
79. Madrean Archipelago			
80. Northern Basin and Range			
81. Sonoran Basin and Range			

Applications: BLM Rapid Ecoregional Assessments

in 7 Level III Ecoregions started in 2010

- Partners: BLM, states, NatureServe, other contractors
- Objectives: 'wall-to-all' assessment of **key resources** and **change agents** – including climate change - in preparation for resource management planning (under NEPA)



Rapid Ecoregional Assessments

(REAs)

REAs synthesize the best available information about resource conditions and trends within an ecoregion. Tie to future projections.

Ecoregional Direction

Ecoregional direction will use the results of the REAs to identify key management priorities for the public lands within an ecoregion.

Field Implementation

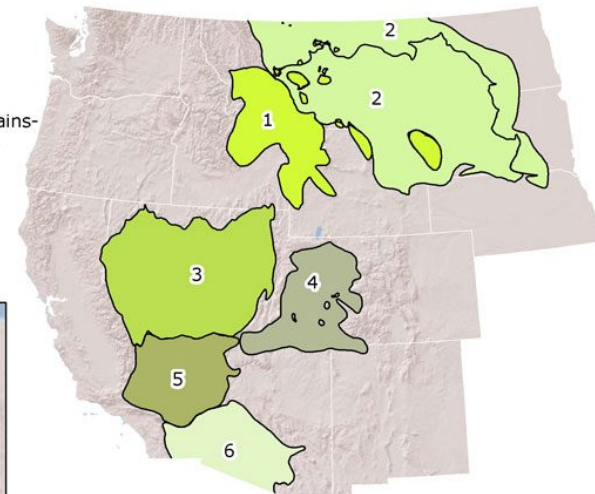
Management priorities and strategies identified in ecoregional direction put into practice on-the-ground.

Rapid Ecoregional Assessments



The BLM launched seven REAs in 2010. This map shows the general outlines of the ecoregions being assessed.

1. Middle Rockies
2. Northwestern Glaciated Plains-Northwestern Great Plains
3. Central Basin and Range
4. Colorado Plateau
5. Mojave Basin and Range
6. Sonoran Desert
7. Seward Peninsula-Nulato Hills-Kotzebue Lowlands



Applications: State Wildlife Action Plans

e.g., <http://www.wildlifearkansas.com/strategy.html>

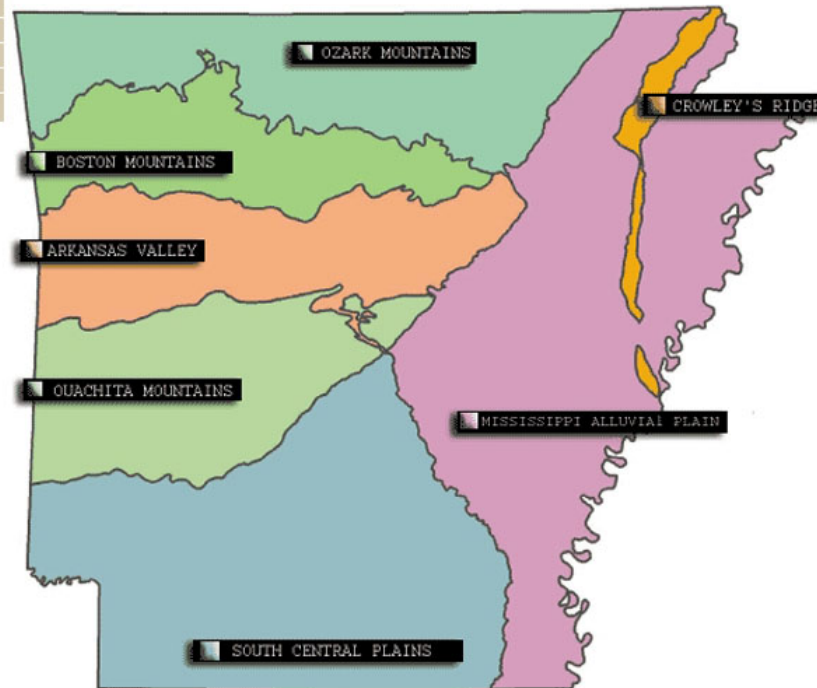


Arkansas Wildlife Action Plan

- [Announcements](#)
- [AWAP in the News](#)
- [Executive Summary](#)
- [Wildlife Action Plan](#)
- [Database](#)
- [Ecoregions](#)
- [Grants](#)
- [Project Reports](#)
- [Legislative History](#)
- [Links](#)
- [Partners](#)
- [Home](#)

ECOREGIONS

Explore Arkansas's Ecoregions by clicking on the ecoregion area you are interested in. Each ecoregion has a list of species and habitats. Or, use the [hyperlinks](#) below to download a PDF version of the ecoregion map for each area.



AR Ecoregions

Download a PDF version of the ecoregion map for each area.

- [Mississippi Alluvial Plain](#)
- [South Central Plain](#)
- [Boston Mountains](#)

Applications: Bird Conservation Regions

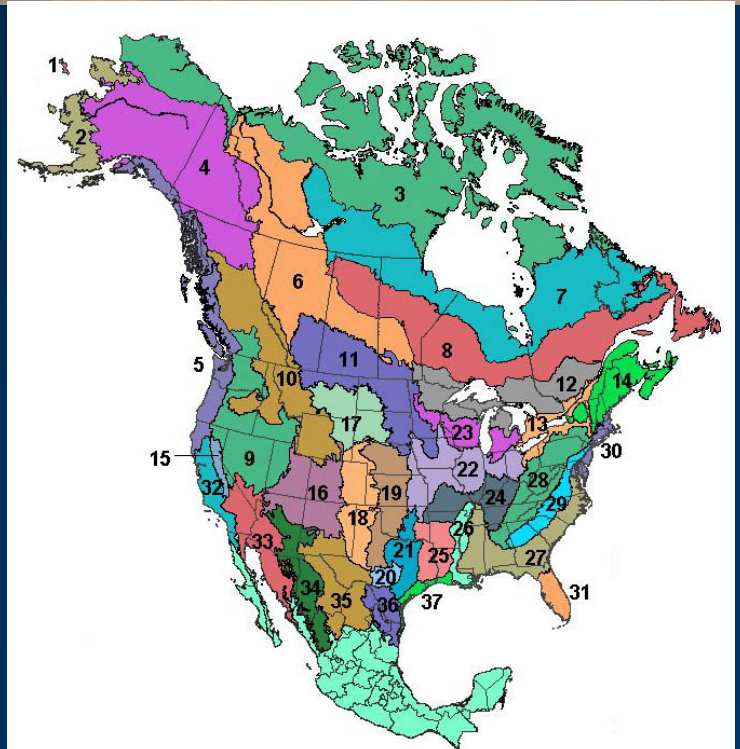
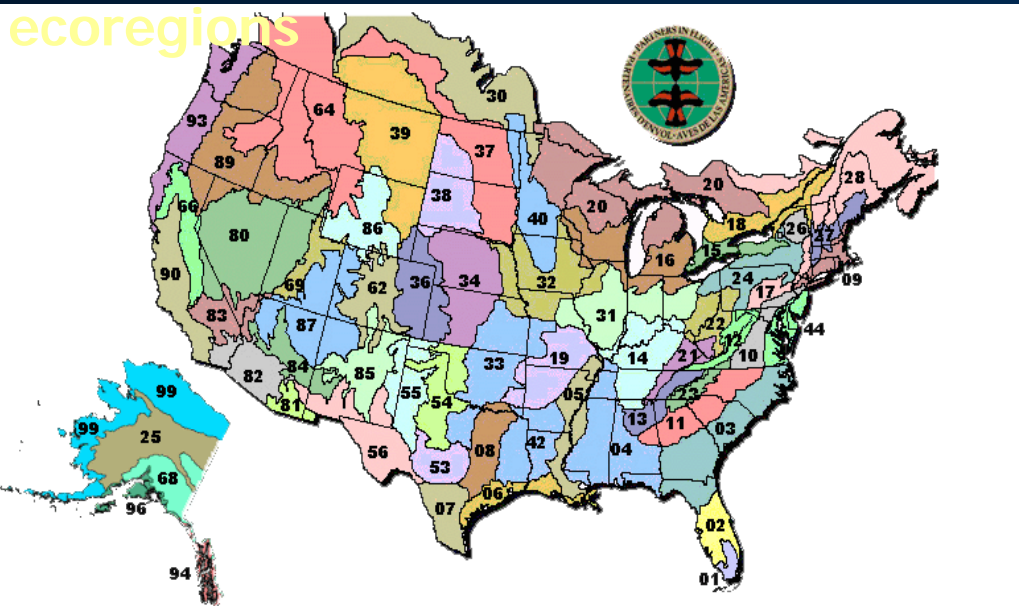
North American Bird Conservation Initiative

Bird Conservation Regions (BCRs) created by aggregating CEC level II, III, and IV ecoregions in combinations that reflect bird species distribution and life history requirements.

North American Bird Conservation Initiative - United States
A map of the United States showing the boundaries of Bird Conservation Regions (BCRs) created by aggregating CEC level II, III, and IV ecoregions.

Partners In Flight

"Physiographic Areas"
Based in part on Level III ecoregions



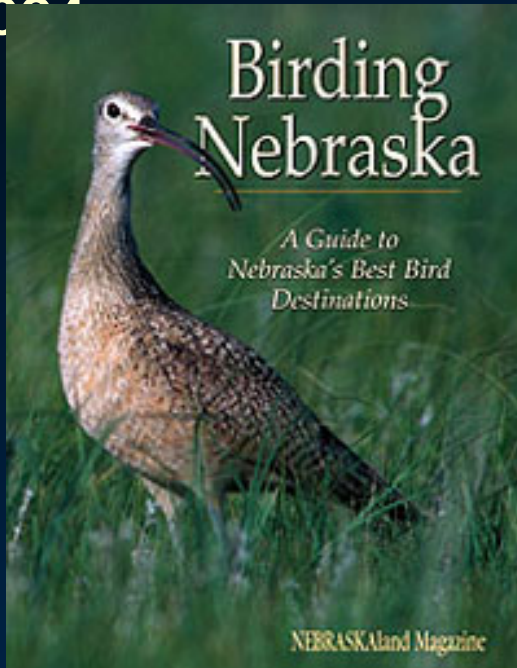
Applications: Bird Conservation Regions and Bird Atlases

Birding Nebraska

NebraskaLand Magazine

Vol. 82, No 1, Jan/Feb

2004



Author: Jon Farrar

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INTRODUCTION

EARLY BIRD STUDY

A CENTURY OF BIRD STUDY

ECOREGIONS AND DESTINATIONS

WESTERN CORN BELT PLAINS

Missouri River Corridor

Indian Cave State Park

Fontenelle Forest

Neale Woods

DeSoto National Wildlife Refuge

Tallgrass Prairie

Audubon Spring Creek Prairie

Pawnee Prairie Wildlife Management Area

Burchard Lake Wildlife Management Area

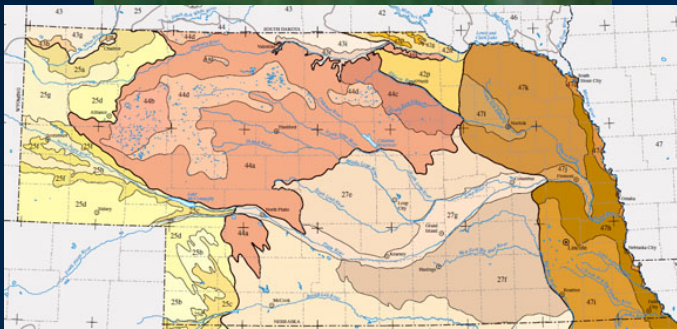
CENTRAL GREAT PLAINS

Loess Hills and Plains

Cather Prairie

Myrtle Hall Wildlife Management Area

.....



Applications: Forest Disturbance Assessments



Contents lists available at SciVerse ScienceDirect

Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse



Table 3

Decision-tree modeling of species' mean % vulnerability in 34 ecoregions. The 1st and 2nd most vulnerable species in each ecoregion are listed if they were modeled to occur in >5% of the forested area and were judged >50% vulnerable.

Ecoregion	EPA code	1st species	2nd species	Mean % Vulnerability
Clear Hills and Western Alberta Upland	5.4.2	ENG	DF	36
Watson Highlands	6.1.5	ENG	WP	68
Yukon-Stikine Highlands/Boreal Mountains and Plateaus	6.1.6	ENG	WP	40
Skeena-Omineca-Central Canadian Rocky Mountains	6.2.1	WP	ENG	34
Chilcotin Ranges and Fraser Plateau	6.2.2	WL	-	23
Columbia Mountains/Northern Rockies	6.2.3	LPP	-	17
Canadian Rockies	6.2.4	-	-	20
North Cascades	6.2.5	YC	-	15
Cascades	6.2.7	LPP	-	13
Eastern Cascades Slopes and Foothills	6.2.8	LPP	MH	26
Blue Mountains	6.2.9	LPP	WH	27
Middle Rockies	6.2.10	WL	MH	38
Klamath Mountains	6.2.11	WH	-	26
Sierra Nevada	6.2.12	WH	MH	46
Wasatch and Uinta Mountains	6.2.13	MH	WRC	47
Southern Rockies	6.2.14	SAF	-	35
Idaho Batholith	6.2.15	WH	-	20
Pacific Coastal Mountains	7.1.4	ENG	WP	26
Coastal Western Hemlock-Sitka Spruce Forests	7.1.5	WP	-	19
Pacific and Nass Ranges	7.1.6	ENG	LPP	17
Strait of Georgia/Puget Lowland	7.1.7	PP	-	29
Coast Range	7.1.8	YC	PP	21
Willamette Valley	7.1.9	PP	-	32
Thompson-Okanogan Plateau	10.1.1	LPP	-	24
Columbia Plateau	10.1.2	LPP	WH	49
Northern Basin and Range	10.1.3	WRC	PSF	52
Wyoming Basin	10.1.4	PSF	GF	69
Central Basin and Range	10.1.5	MH	LPP	60
Colorado Plateaus	10.1.6	LPP	WL	49
Snake River Plain	10.1.8	LPP	-	34
Mojave Basin and Range	10.2.1	PP	DF	80
California Coastal Sage, Chaparral, and Oak Woodlands	11.1.1	WP	MH	58
Central California Valley	11.1.2	DF	-	52
Southern and Baja California Pine-Oak Mountains	11.1.3	PP	DF	59

DF = Douglas-fir, ENG = Engelmann spruce, GF = grand fir, LPP = lodgepole pine, MH = mountain hemlock, PP = ponderosa pine, PSF = Pacific silver fir, SAF = subalpine fir, SS = Sitka spruce, WH = western hemlock, WL = western larch, WP = white pine, WRC = western red cedar, YC = yellow cedar.

Predicting satellite-derived patterns of large-scale disturbances in forests of the Pacific Northwest Region in response to recent climatic variation

Richard H. Waring ^{a,*}, Nicholas C. Coops ^b, Steven W. Running ^c

^a College of Forestry, Oregon State University, Corvallis, OR 97331, United States

^b Department of Forest Resource Management, 2424 Main Mall, University of British Columbia, Vancouver, Canada V6T 1Z4

^c College of Forestry & Conservation, University of Montana, Missoula, MT 59812, United States

Volume 115, Issue 12, December 2011

Modeling conifer species vulnerability to climate change within 34 Level III ecoregions and comparing to MODIS imagery disturbance

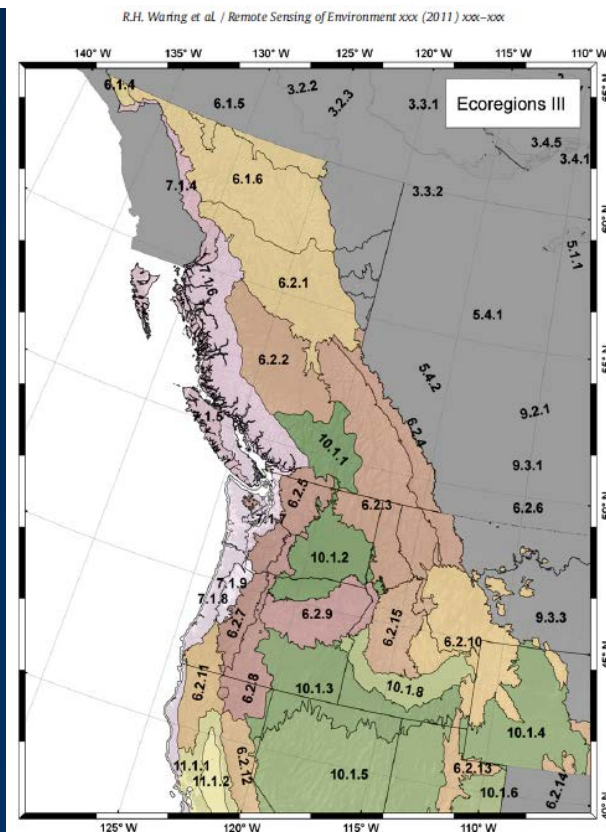


Fig. 1. Defined boundaries of the Environmental Protection Agency's 34 level III ecoregions.

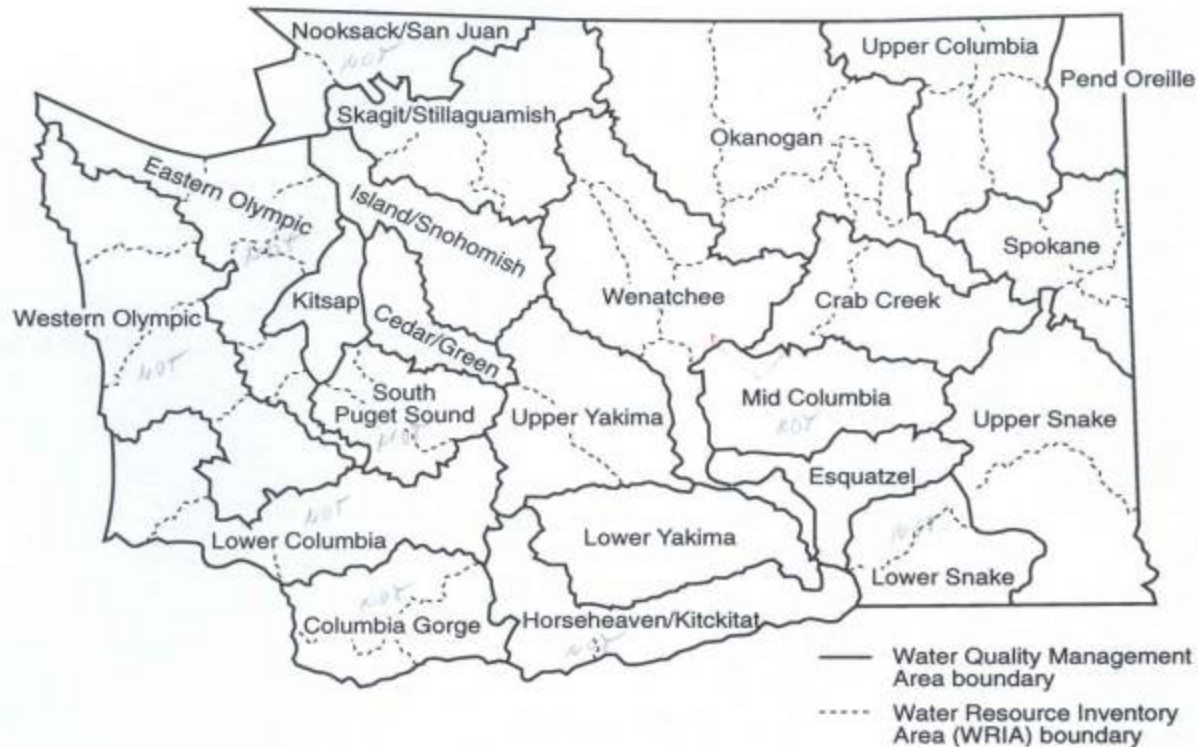
**Distinguishing between
ecoregions, watersheds, and
hydrologic units (HUCs)**



Watershed Approach Framework



Watershed Protection: A Statewide Approach



WATERSHEDS

Areas within which apparent surface water drains to a particular point.

ECOREGIONS

Regions of relative homogeneity in ecological systems and/or relationships among organisms and their environments

BASINS

Large watersheds

HYDROLOGIC UNITS

**Watersheds and segments of watersheds
and basins, often with adjacent
intersticies**

WATERSHEDS

Useful for assessing the relative contribution of natural and anthropogenic characteristics to the quality and quantity of water at specific points on streams and on particular water bodies.

ECOREGIONS

Provide a spatial framework for the research, assessment, inventory, monitoring, and management of ecosystems and ecosystem components.

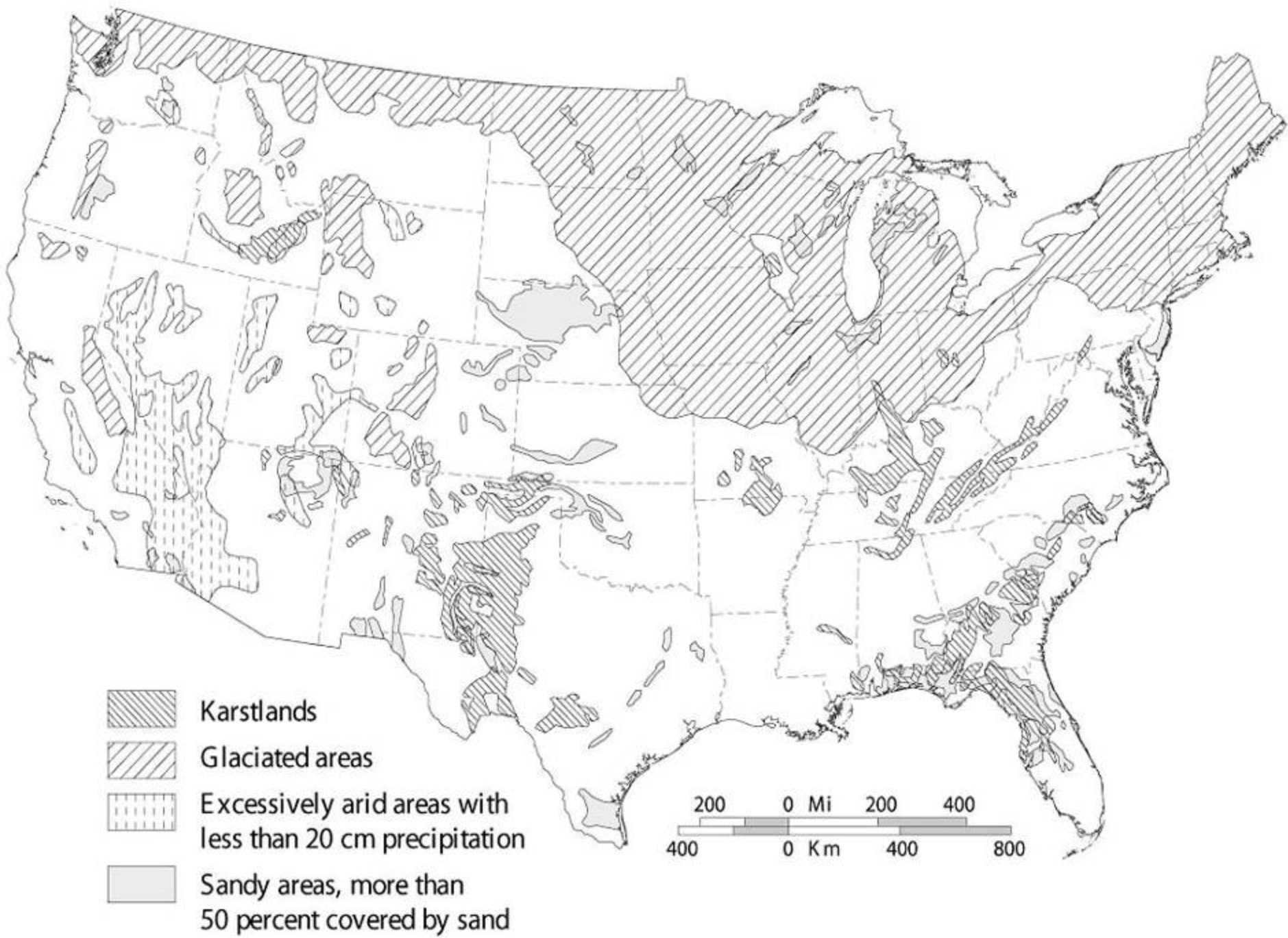
-The quality and quantity of water at any point reflects the aggregate of characteristics upgradient from that point.

-Water quality and quantity will tend to be similar within areas where this "aggregate" is similar.

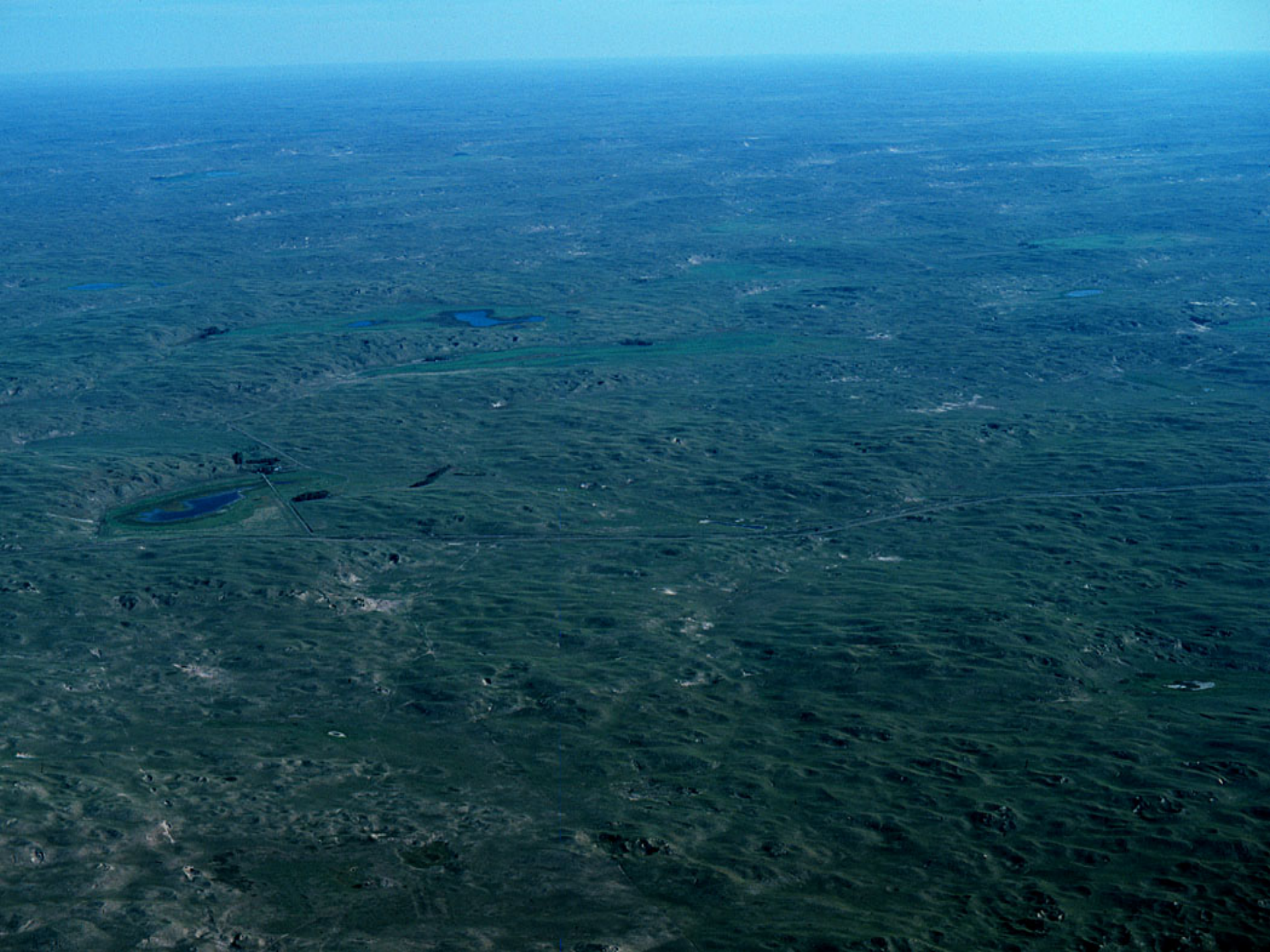
-**Therefore**, for effective water resource research, assessment, and management we must 1) define these regions with similar characteristics and 2) identify sets of "reference" watersheds/areas within each region.

-These regions of similarity (ecoregions) can be used to set expectations, standards, management practices, etc.

-Basins and watersheds may then be identified to address contributions to particular points. The regional reference data will be used to determine the contributions.









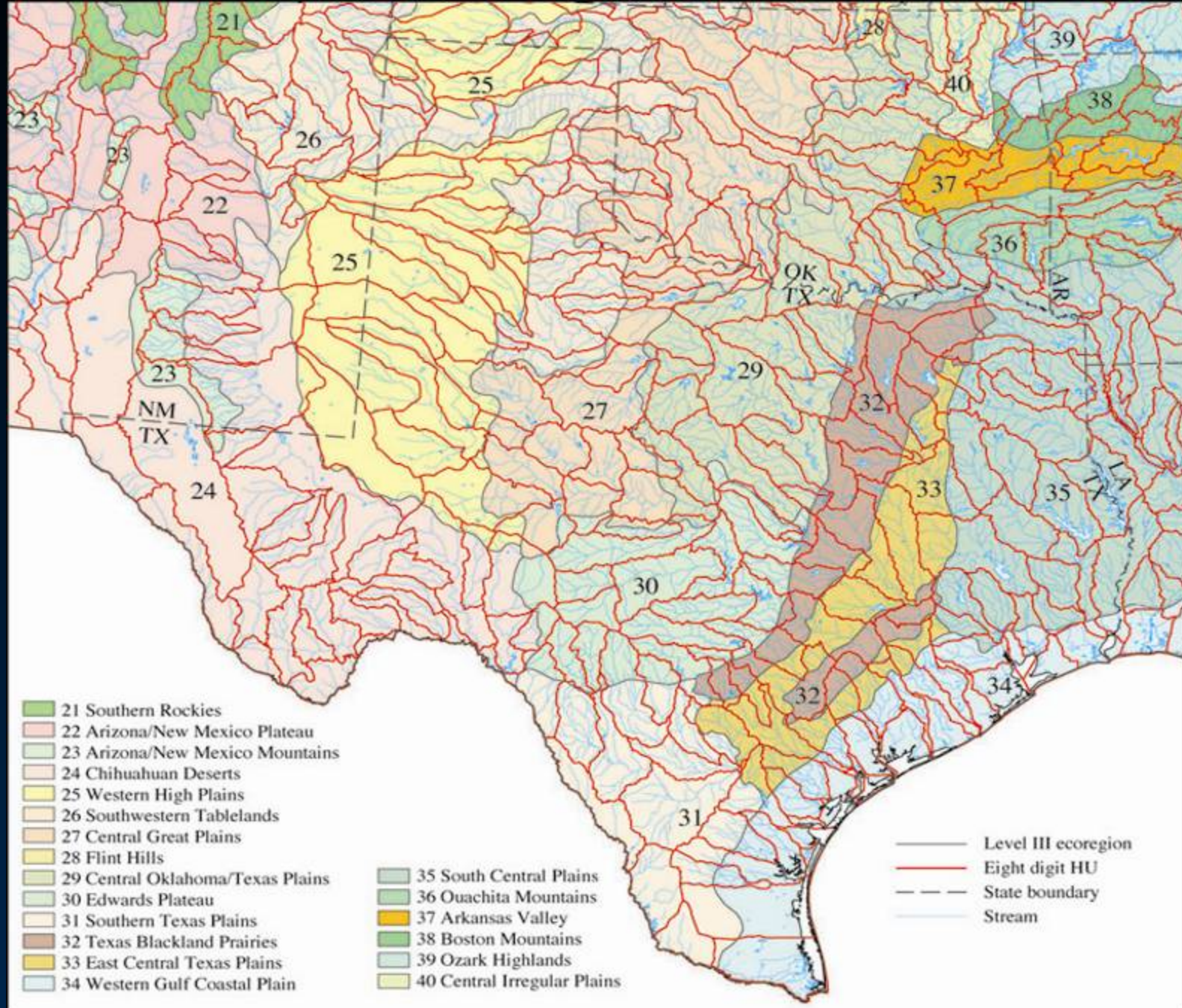


Figure 1. Level III ecoregions and eight digit HUs in Texas and parts of adjacent states.

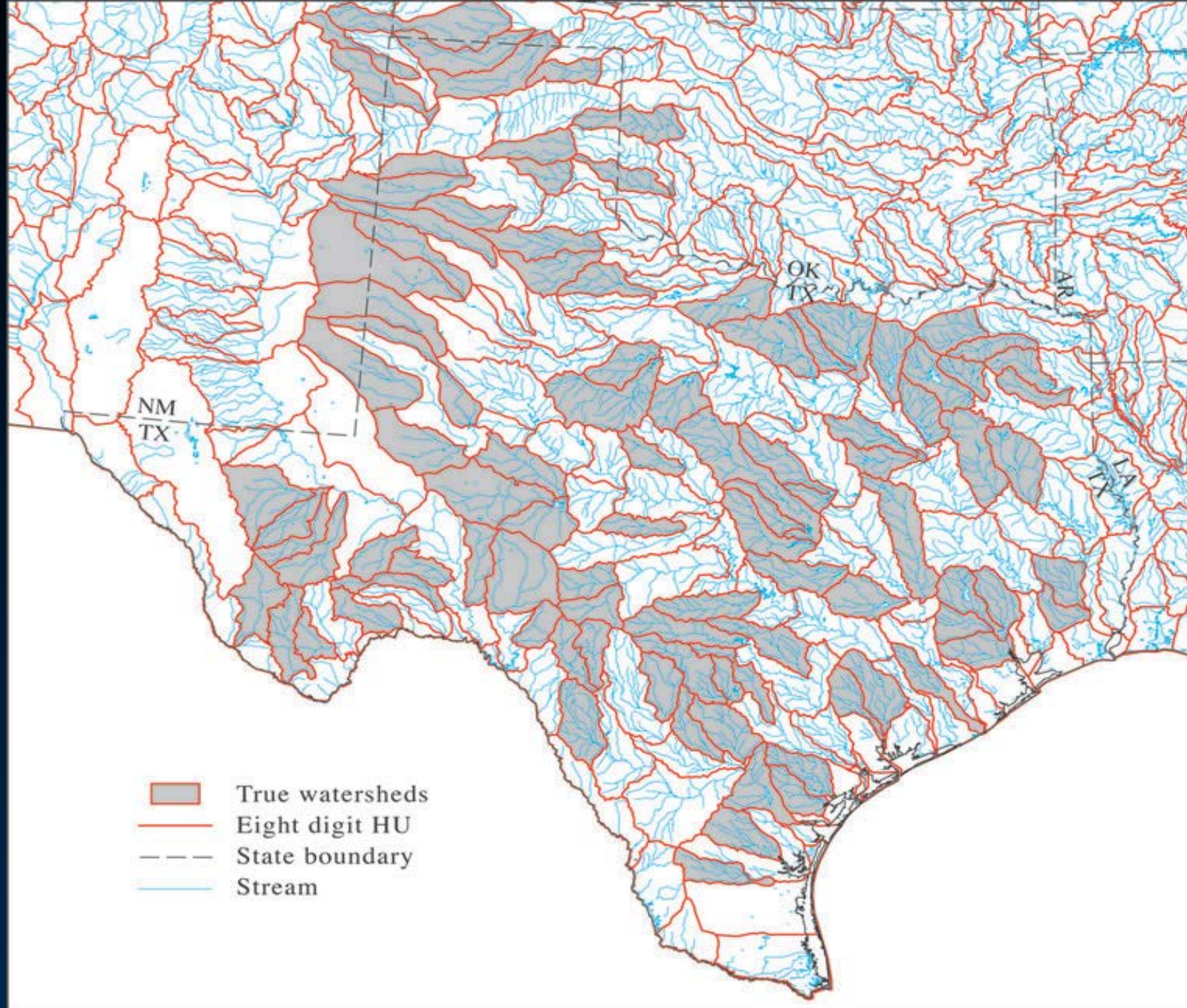


Figure 2. Eight digit HUs that are true watersheds and are completely or partially in Texas.

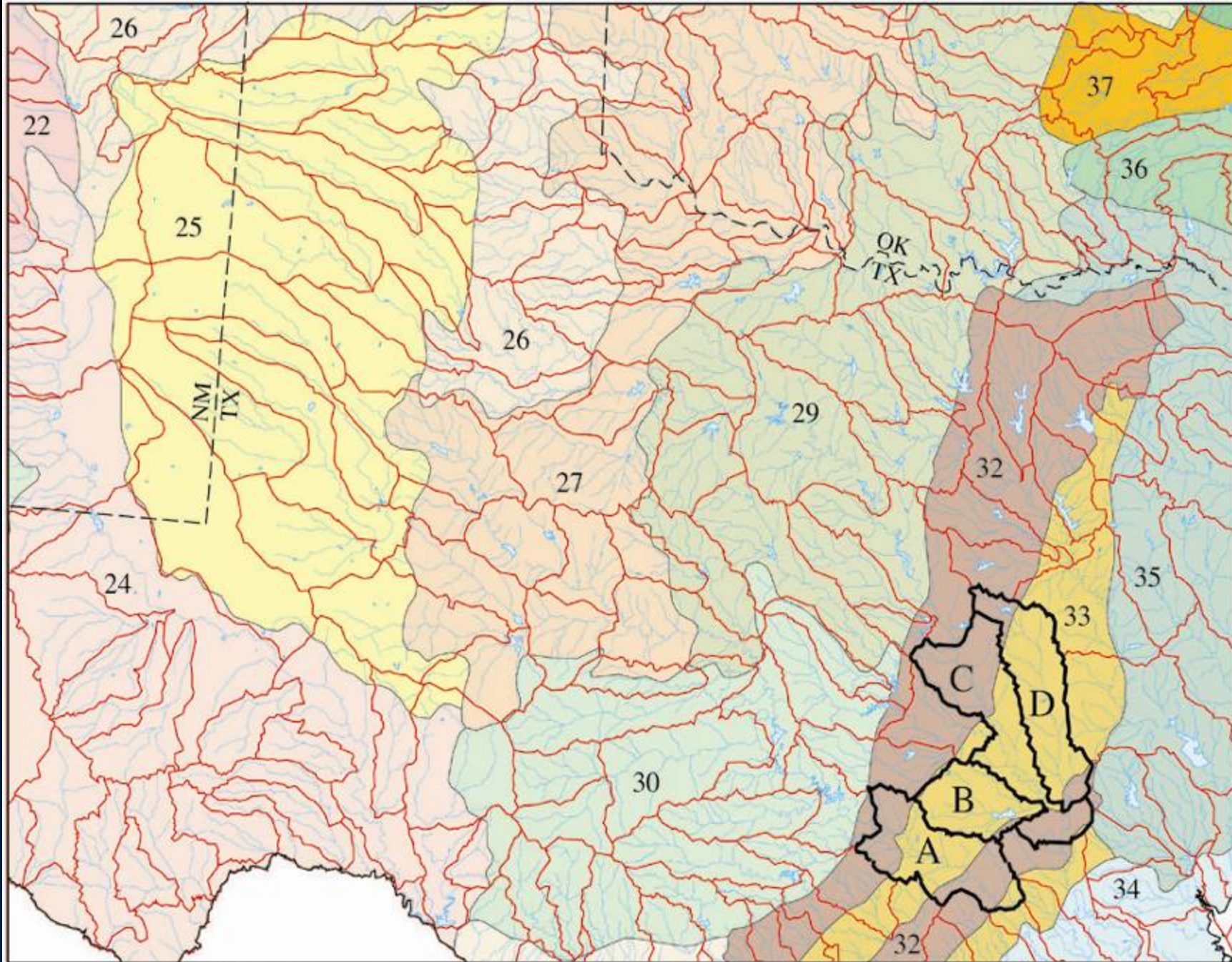


Figure 3. Four eight digit HUs covering ecoregions 32 (the Texas Blackland Prairie) and 33 (the East Central Texas Plain). The hydrologic unit codes for A, B, C, and D are 12090301, 12070102, 12080101, and 12070103 respectively.

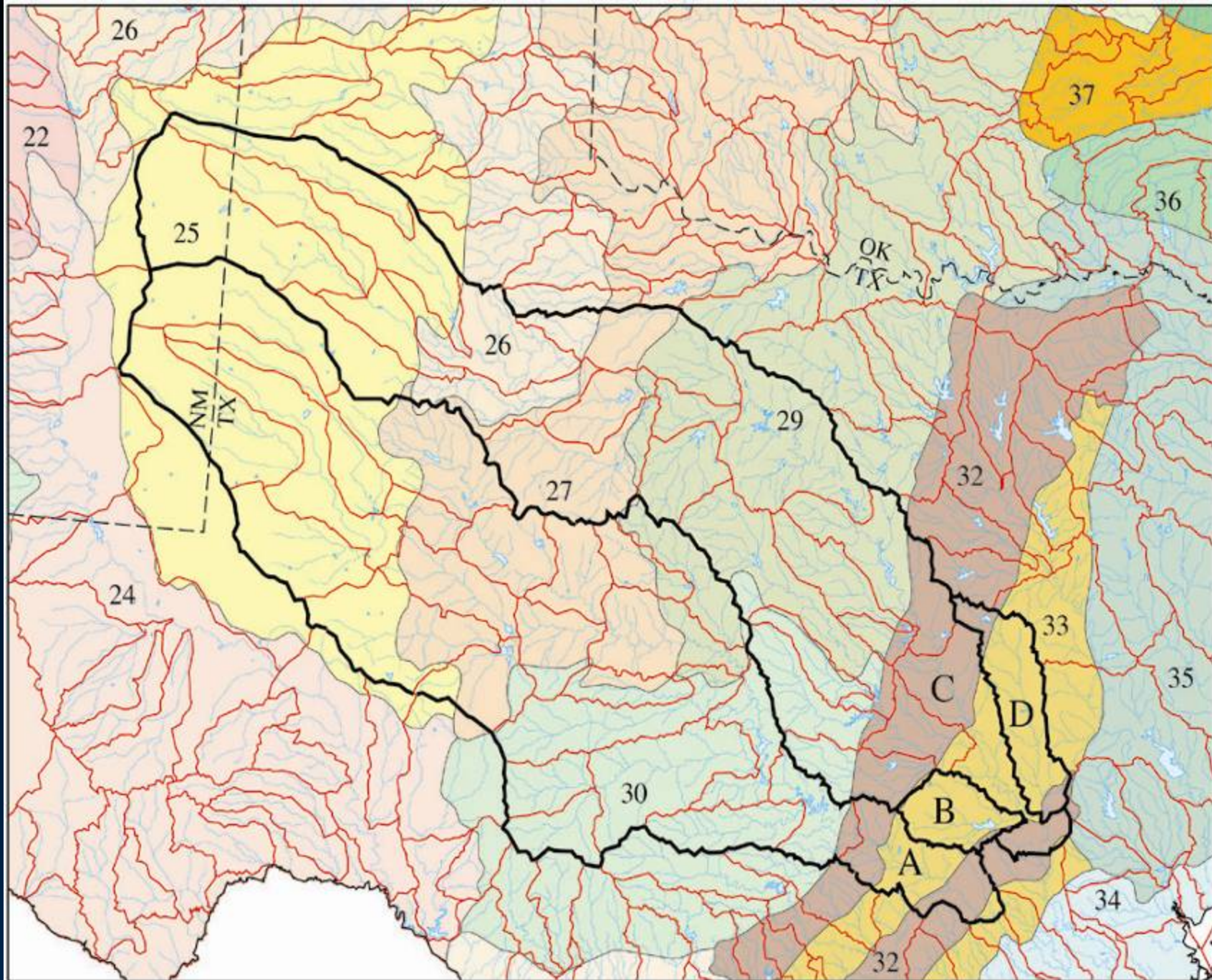


Figure 4. True watersheds associated with downstream points in HUs A, B, C, and D.

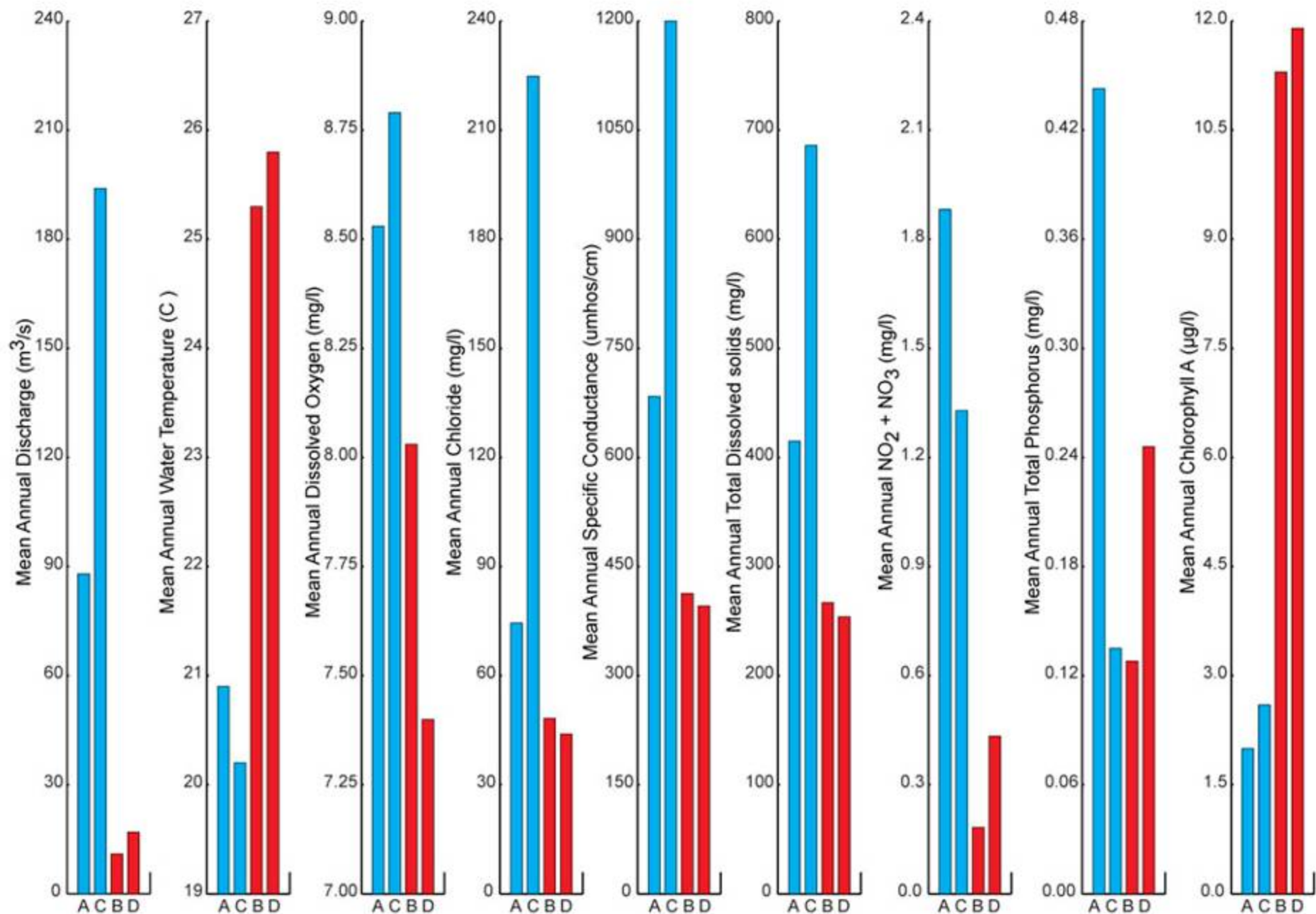


Figure 5. Discharge and water quality characteristics for HUs A, C, B, and D. Sources: Gandara et al. 1995; Gandara et al. 2001a; Gandara et al. 2001b; Texas Natural Resources Commission, 1996.

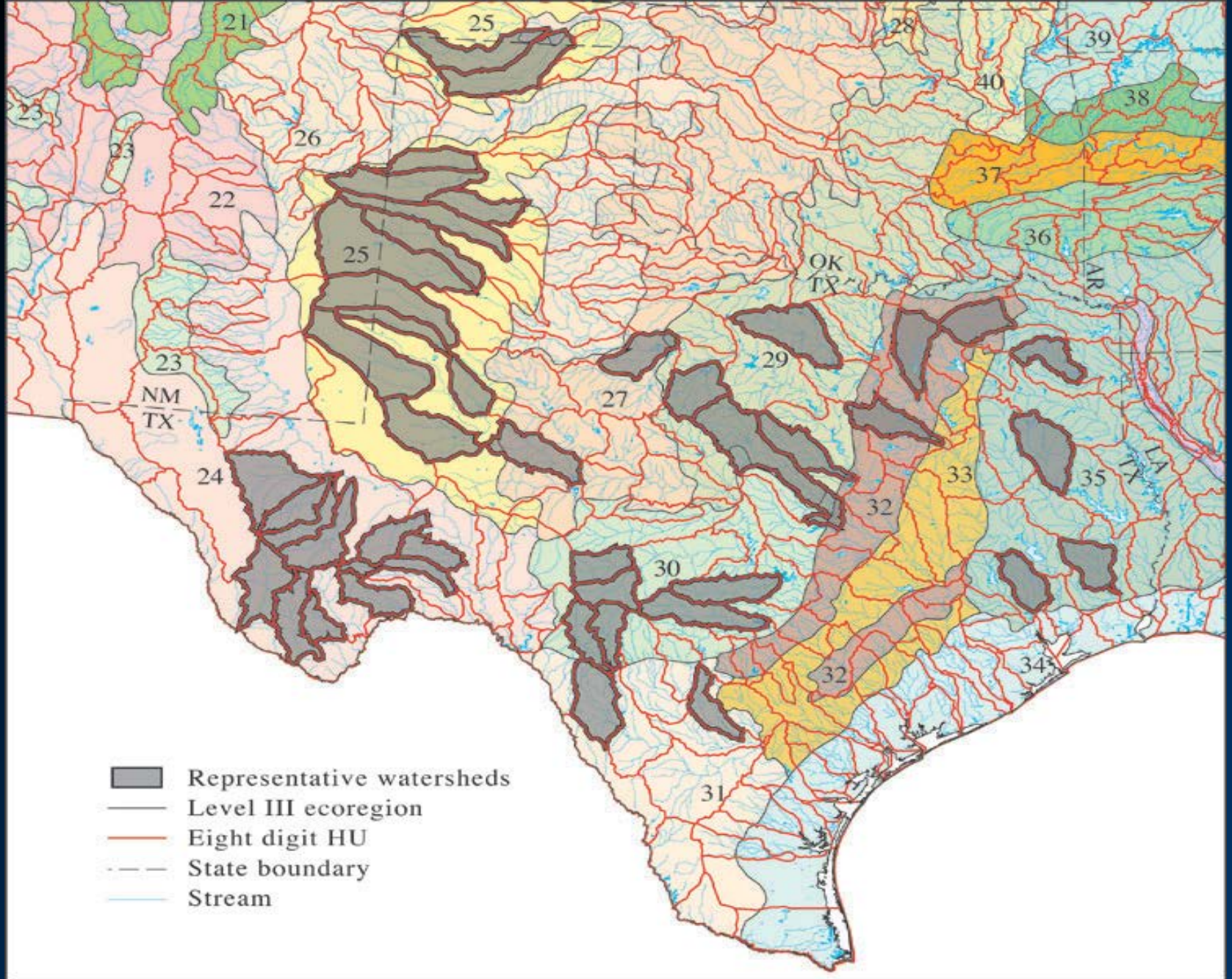
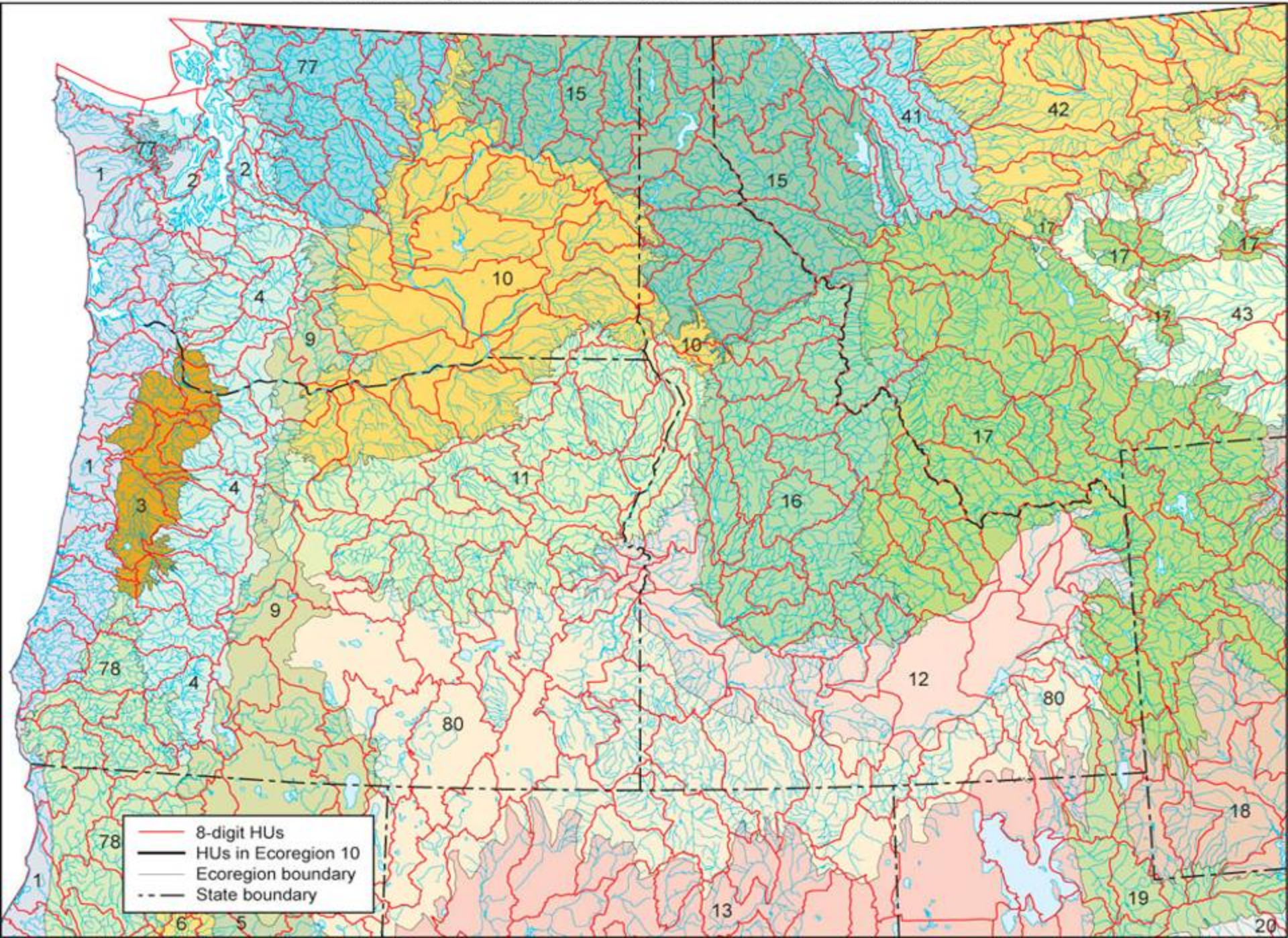
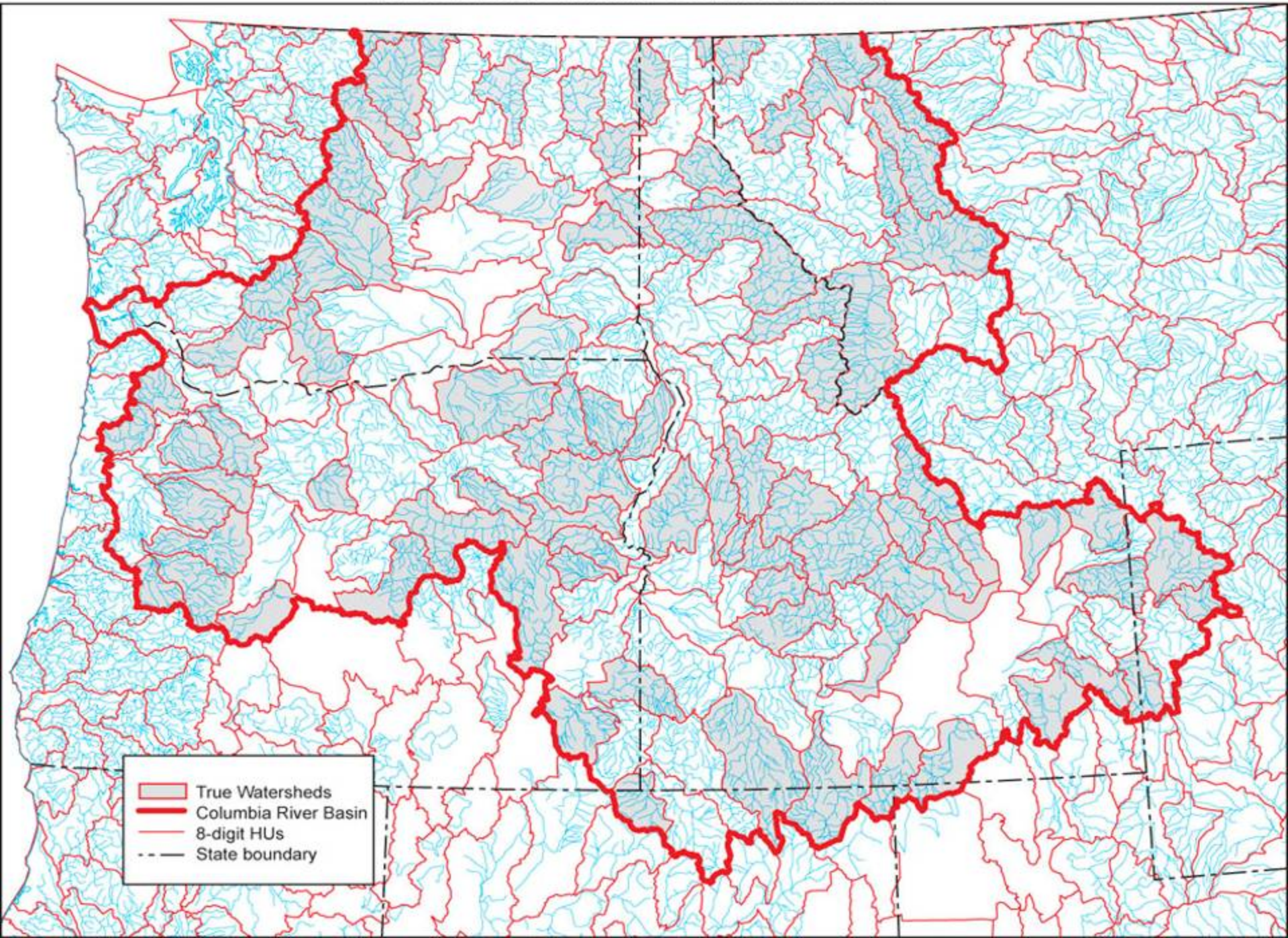


Figure 6. Representative watersheds within level III ecoregions that are completely or partially in Texas.

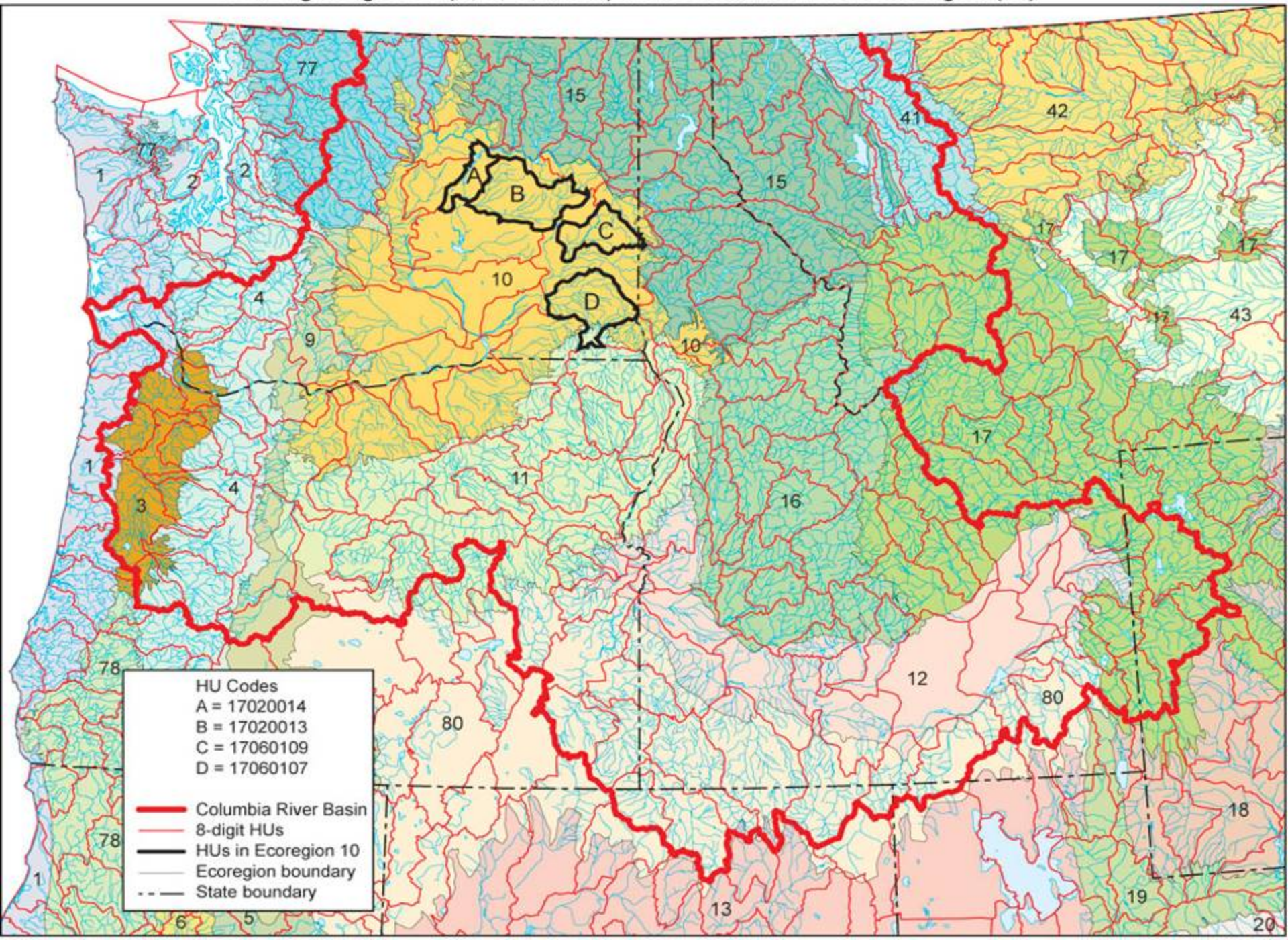
Level III Ecoregions and Eight Digit HUs in the Pacific Northwest



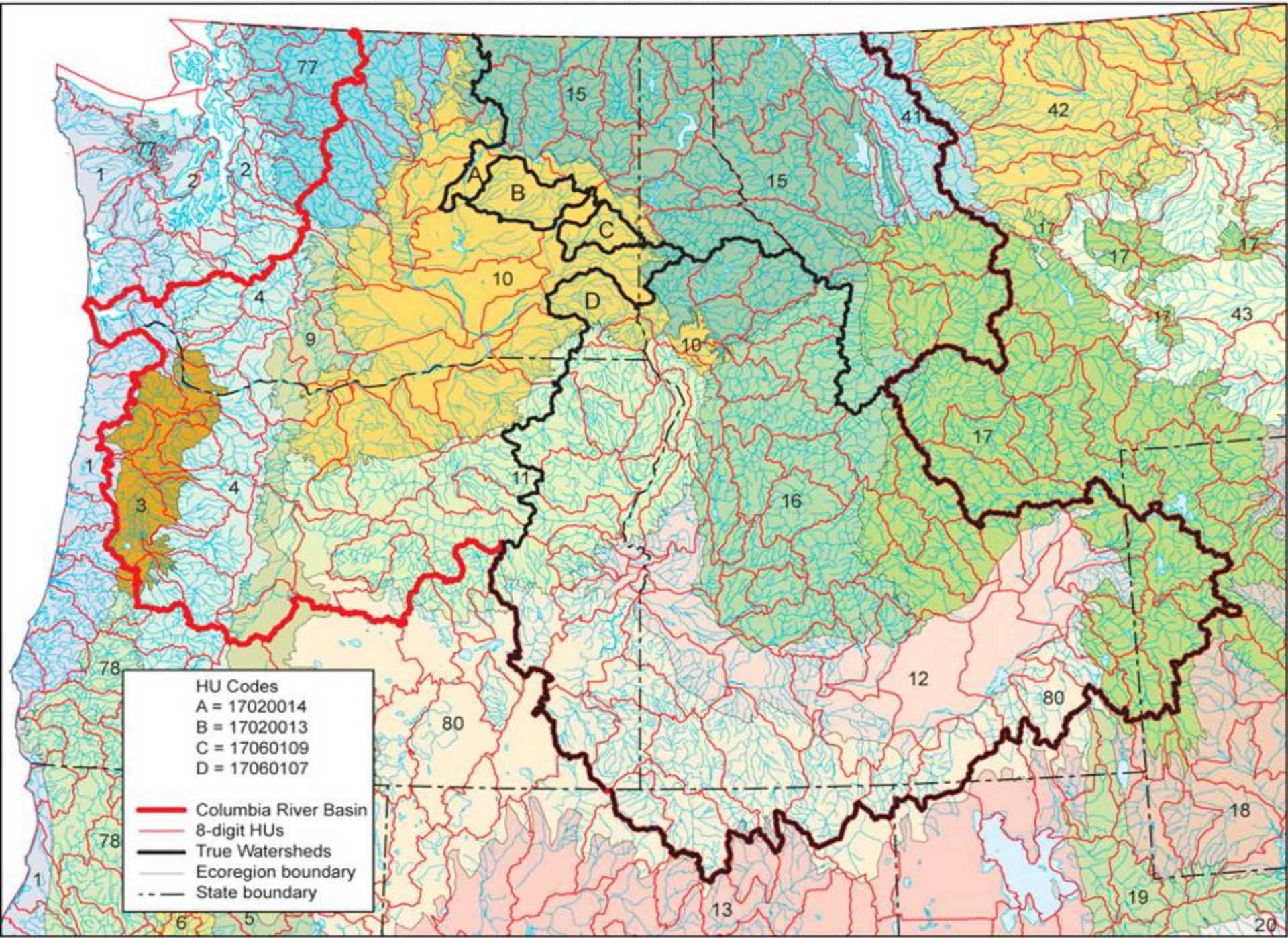
True Watersheds within the Columbia River Basin



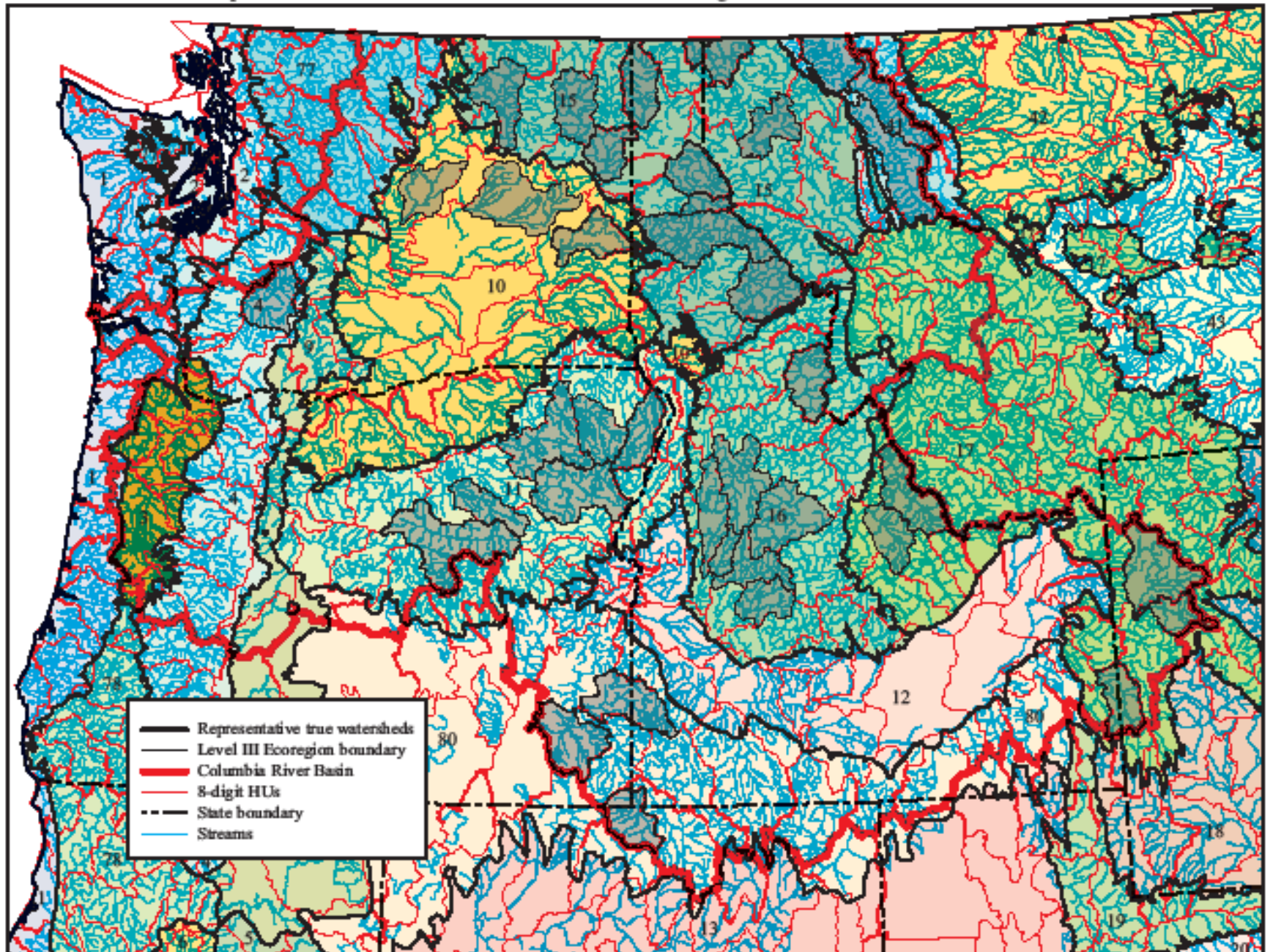
Four Eight Digit HUs (A, B, C, and D) in the Columbia Plateau Ecoregion (10)

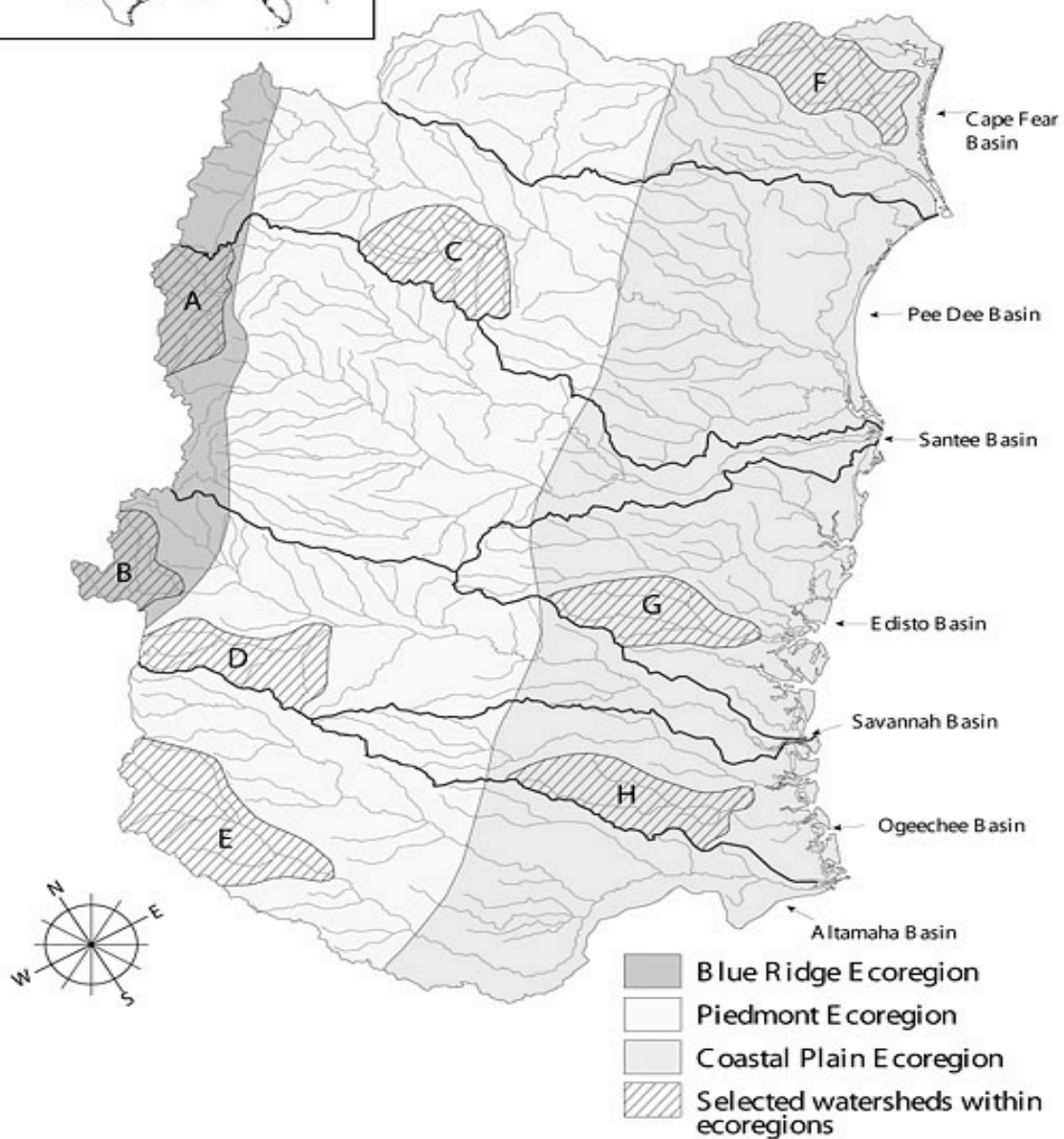


True Watersheds Associated with Downstream Points in HUs A, B, C, and D



Representative True Watersheds within Level III Ecoregions in the Columbia River Basin





KEY POINTS

- Watersheds are imperative for understanding the associations between human and non-human characteristics and water quality and quantity.
- Watersheds rarely correspond to areas within which there is similarity in characteristics affecting water quality and quantity.
- Most hydrologic units (HUCs) are not watersheds.
- In many areas (approx. 30%) watersheds are difficult to impossible to define or are irrelevant.
- Watersheds and ecoregions are complementary frameworks.

NEEDED:

**A set of national maps of true
watersheds of each size
(cataloging unit?) category**

“People often ask, ‘What is the single most important environmental/population problem facing the world today?’ A flip answer would be, ‘the single most important problem is our misguided focus on identifying the single most important problem!’ That flip answer is essentially correct, because any of the dozen problems if unsolved would do us grave harm, and because they all interact with each other”

**Jared Diamond, 2006. *COLLAPSE:
How Societies Choose to Fail or
Succeed.***

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“Two streams of science – one reductive and certain, and one integrative and uncertain. The first provides the bricks for the edifice, but not the architectural design”

C.S. Holling '95