

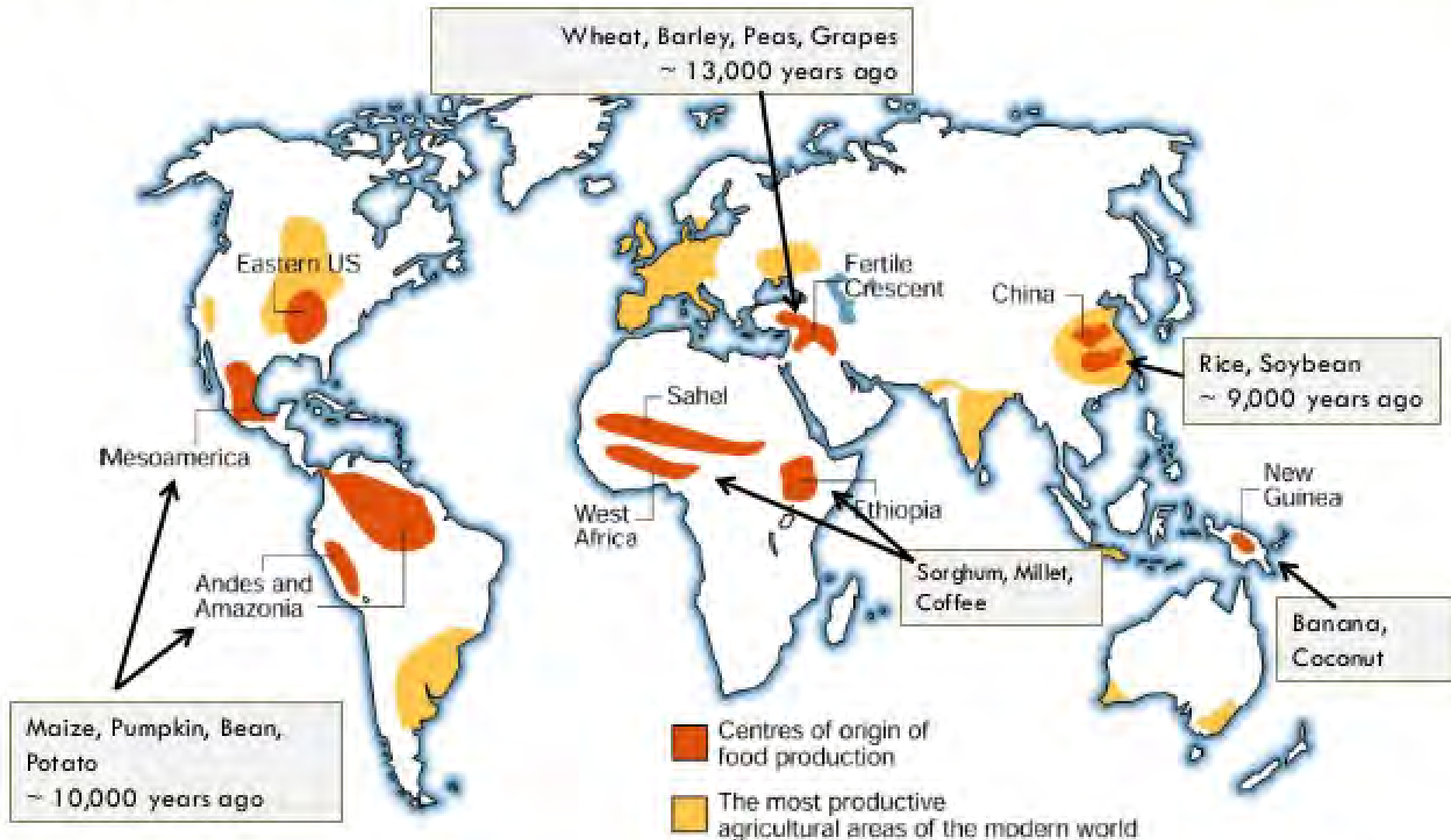
A photograph of a white plate set against a green background. The plate contains several pieces of raw, red meat. The meat is arranged to form the outline of the United States. To the left of the plate is a silver fork with a dark handle. To the right is a large, serrated knife with a dark handle. The text "Biodiversity & Nutrition" is overlaid in the center of the image.

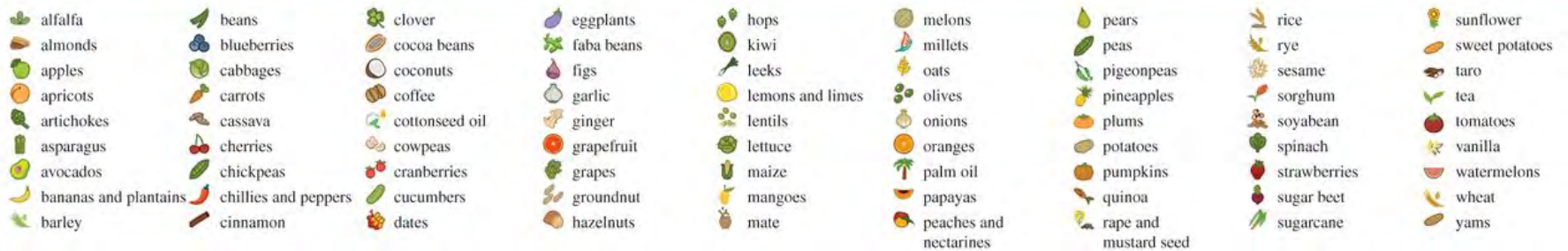
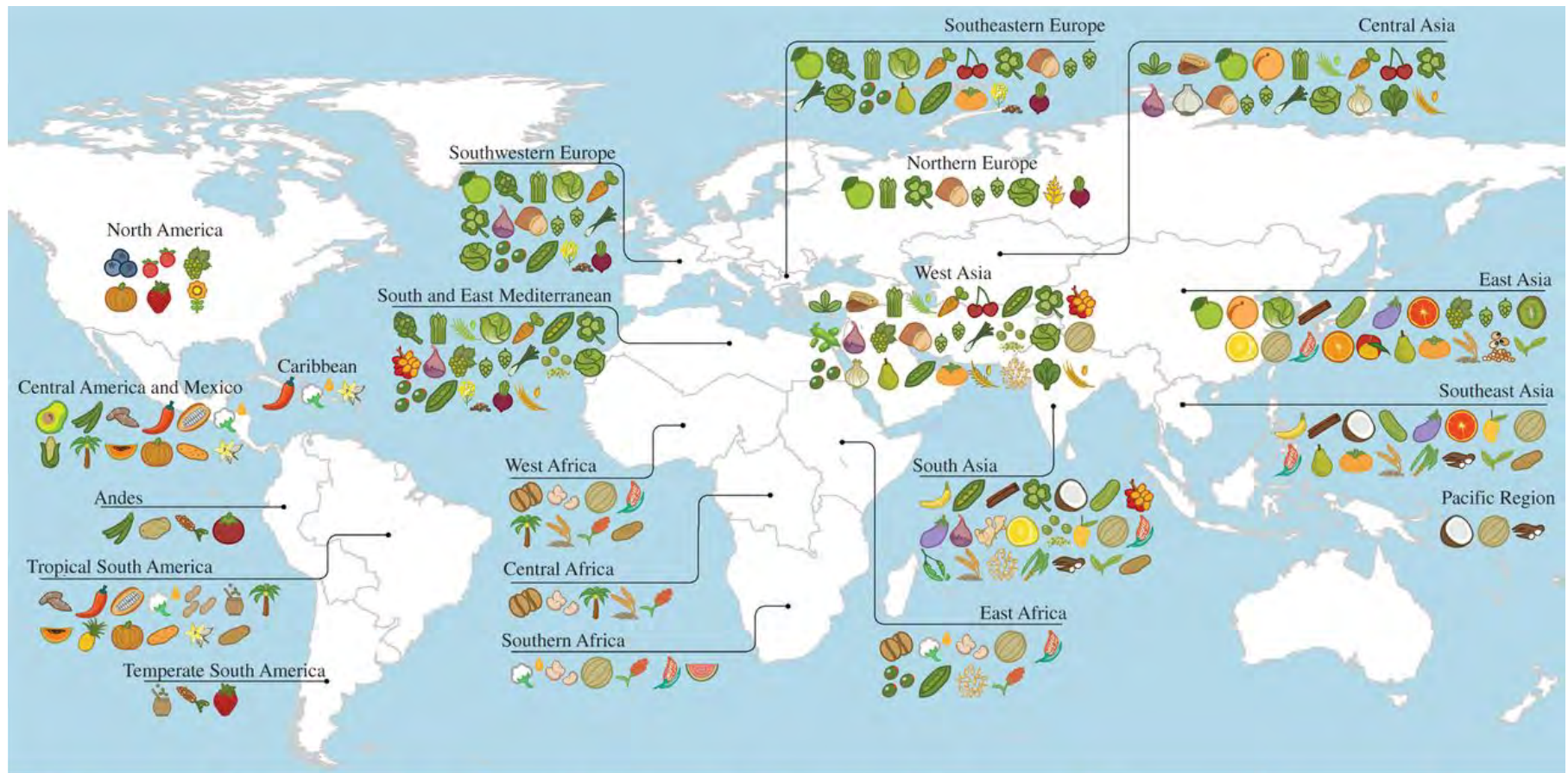
Biodiversity & Nutrition

Steven Bond-Hikatubbi
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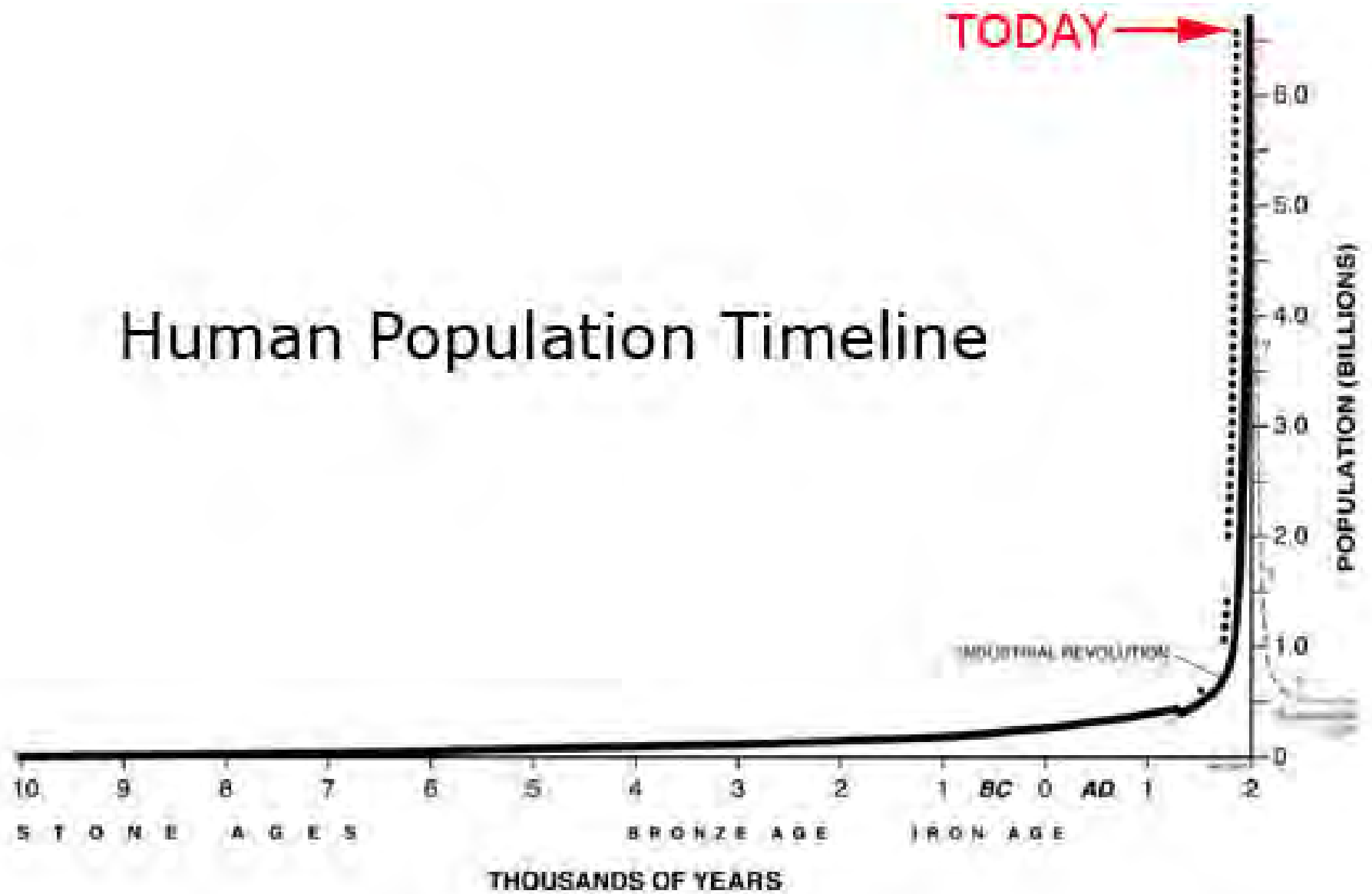


Agricultural centers of origin developed independently in different parts of the world





Human Population Timeline





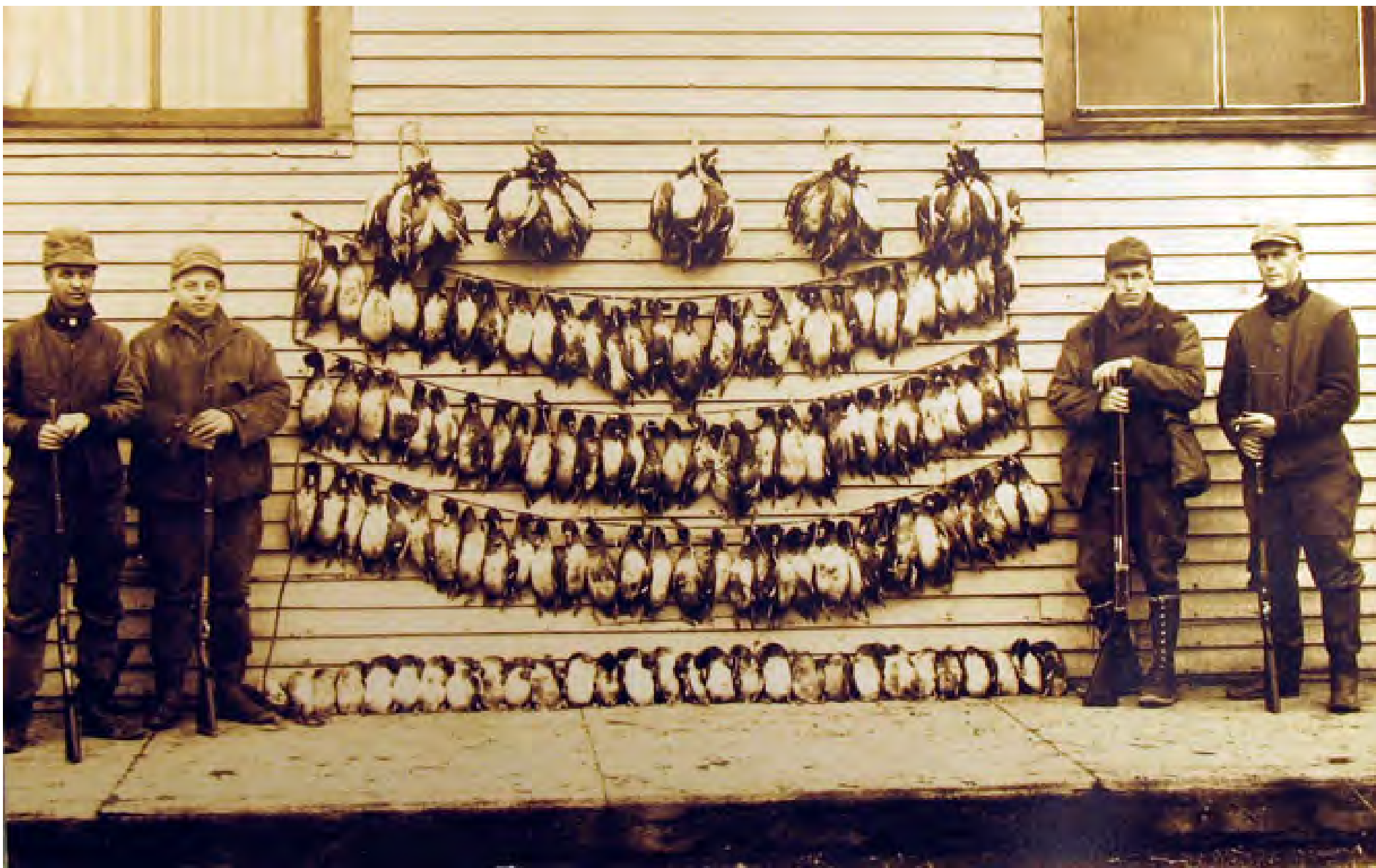




Drawn from Nature by A. Wilson.

1. Passenger Pigeon. 2. Blue-mountain Warbler. 3. Hemlock W.

Engraved by W. B. Lewis.





Collection of
Roger Tory Peterson



4/1/57

Passenger Pigeon
Oct. 1860
Pittsfield, Mass.
1500 Sprague
Hatched Nov. 1860
Collected by J. A. Sprague
Cat. No. 87
No. 1500





North American Species believed extinct since 1960s

Last Seen	Common Name	Scientific Name	Former Range	Type
2007	Columbia Basin Pygmy Rabbit	<i>Brachylagus idahoensis</i> pop. 2	Douglas, Grant, Lincoln, Adams and Benton counties of Washington state	mammal
1994	Hadley Lake Limnetic Stickleback	<i>Gasterosteus</i> sp. 12	Hadley Lake on Lasqueti Island, British Columbia	fish
1994	Hadley Lake Benthic Stickleback	<i>Gasterosteus</i> sp. 13	Hadley Lake on Lasqueti Island, British Columbia	fish
1994	Pearson's Hawthorn	<i>Crataegus pearsonii</i>	Mississippi, Louisiana and Texas	plant
1992	Vancouver Island Wolverine	<i>Gulo gulo vancouverensis</i>	Vancouver Island, British Columbia	mammal
1988	Fish Lake Pyrg	<i>Pyrgulopsis ruinosa</i>	One spring in Esmeralda County, Nevada	mollusc
1988	Maryland Darter	<i>Etheostoma sellare</i>	Streams near the head of Chesapeake Bay in Maryland	fish
1988	Bachman's Warbler	<i>Vermivora bachmanii</i>	Nested in Missouri, Arkansas, Kentucky, Alabama, South Carolina, and Louisiana; wintered in Cuba and Isle of Pines	bird
1987	Dusky Seaside Sparrow	<i>Ammodramus maritimus nigrescens</i>	East coast of Florida	bird

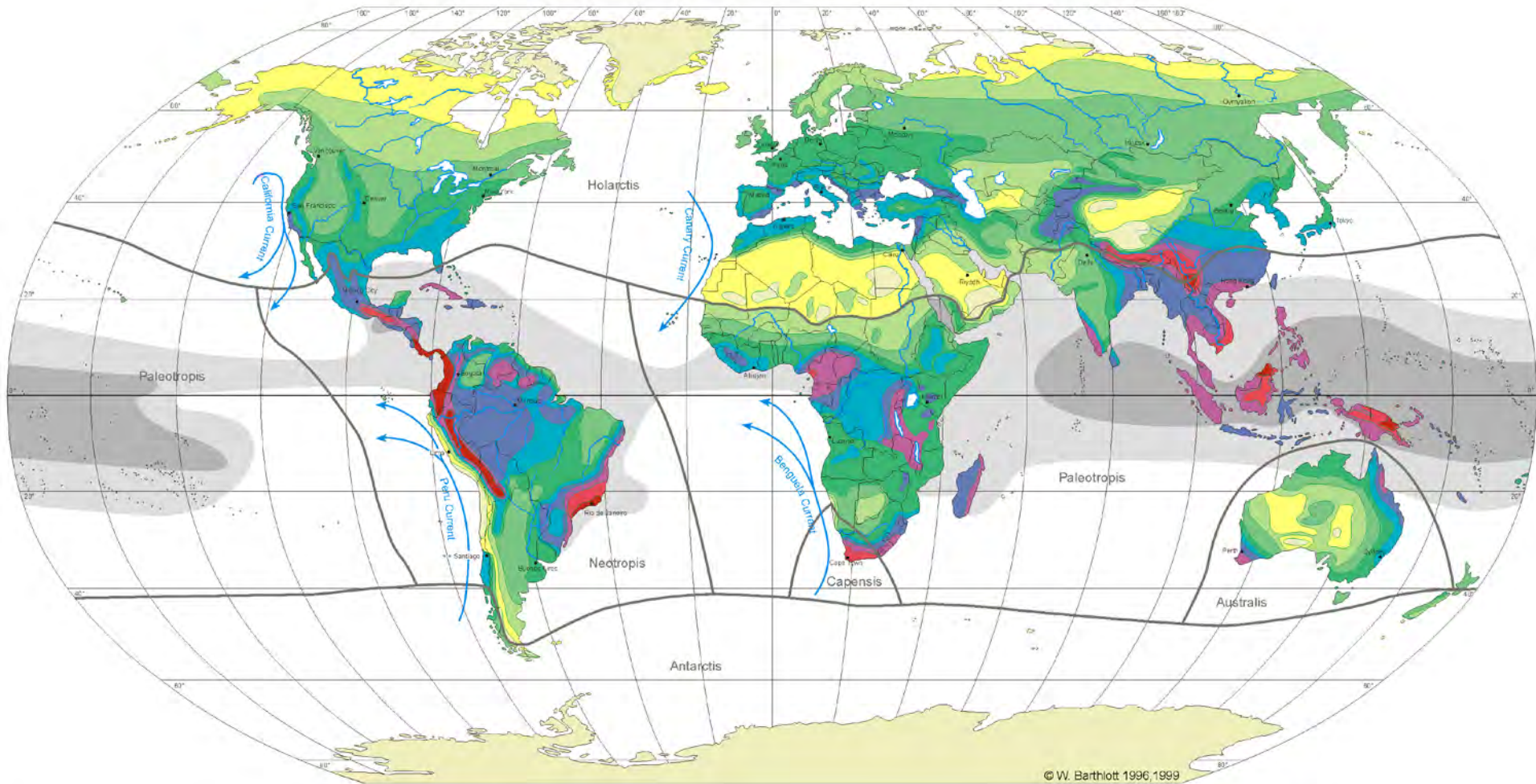
1986	Banff Longnose Dace	<i>Rhinichthys cataractae smithi</i>	A marsh fed by hot springs near Banff, Alberta	fish
1985	Shortnose Cisco	<i>Coregonus reighardi</i>	Lakes Huron, Michigan and Ontario	fish
1984	Green Blossom	<i>Epioblasma torulosa gubernaculum</i>	Tennessee and Virginia	mollusc
1983	San Marcos Gambusia	<i>Gambusia georgei</i>	San Marcos River, Texas	fish
1978	Kingman's Prickly-pear	<i>Opuntia superbospina</i>	Mojave Desert, Arizona	plant
late 1970s	Amistad Gambusia	<i>Gambusia amistadensis</i>	Goodenough Spring, Texas	fish
1975	Phantom Shiner	<i>Notropis orca</i>	Rio Grande River in New Mexico and Texas	fish
mid 1970s	Lewis's Woodpecker, Georgia Depression Population	<i>Melanerpes lewis</i> pop. 1	Southwestern British Columbia and western Washington state	bird
1974	Tacoma Pocket Gopher	<i>Thomomys mazama tacomensis</i>	Pierce County, Washington state	mammal
1973	Carinate Duckwater Pyrg	<i>Pyrgulopsis carinata</i>	Spring in Duckwater Valley, Nye County, Nevada	mollusc
1971	Santa Cruz Pupfish	<i>Cyprinodon arcuatus</i>	Monkey Spring in Arizona	fish
1971	Zion Jimmyweed	<i>Isocoma humilis</i>	Washington County, Utah	plant

1971	Blue Walleye	<i>Sander vitreus glaucus</i>	Lake Erie, Lake Ontario, lower Niagara River and Lake Huron	fish
1970s	Acornshell	<i>Epioblasma haysiana</i>	Cumberland and Tennessee River systems in Alabama, Virginia, Tennessee and Kentucky	mollusc
1970	Clear Lake Splittail	<i>Pogonichthys ciscoides</i>	Clear Lake, California	fish
1969	Blackfin Cisco	<i>Coregonus nigripinnis</i>	Lake Huron and Lake Michigan	fish
1969	Tubercled Blossom	<i>Epioblasma torulosa torulosa</i>	Alabama, Illinois, Indiana, Kentucky, Ohio, Tennessee and West Virginia	mollusc
1968	Striped Bass, St. Lawrence Estuary population	<i>Morone saxatilis</i> sp. 3	Quebec	fish
1967	Angled Riffleshell	<i>Epioblasma biemarginata</i>	Alabama, Kentucky and Tennessee	mollusc
1967	Narrow Catspaw	<i>Epioblasma lenior</i>	Tennessee River system in Virginia, Tennessee and Alabama	mollusc
1967	Lined Pocketbook	<i>Lampsilis binominata</i>	Upper Chattahoochee and Flint River systems in Alabama and Georgia	mollusc
mid 1960s	Turgid Blossom	<i>Epioblasma turgidula</i>	Alabama, Arkansas and Tennessee	mollusc
1964	Bluntnose Shiner	<i>Notropis simus simus</i>	Rio Grande River in New Mexico and Texas	fish
1964	Lake Ontario Kiyi	<i>Coregonus kiyi orientalis</i>	Ontario	fish
1964	Bay Springs Salamander	<i>Plethodon ainsworthi</i>	Jasper County, Mississippi	amphibian
1963	Eskimo Curlew	<i>Numenius borealis</i>	Nested in Northwest Territories, wintered in Argentina	bird

Biodiversity Hotspots?

- Two qualifying criteria
- Region must have 1500 endemic vascular plant species
- Region must have 30% or less of native vegetation
- Globally, 35 areas qualify as hotspots
- 2.3% of Earth's land surface
- support more than half of the world's plant species as endemics
- 43% of bird, mammal, reptile and amphibian species as endemics

GLOBAL BIODIVERSITY: SPECIES NUMBERS OF VASCULAR PLANTS

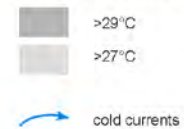


Robinson Projection
Standard Parallels 38°N und 38°S

Diversity Zones (DZ): Number of species per 10 000km²



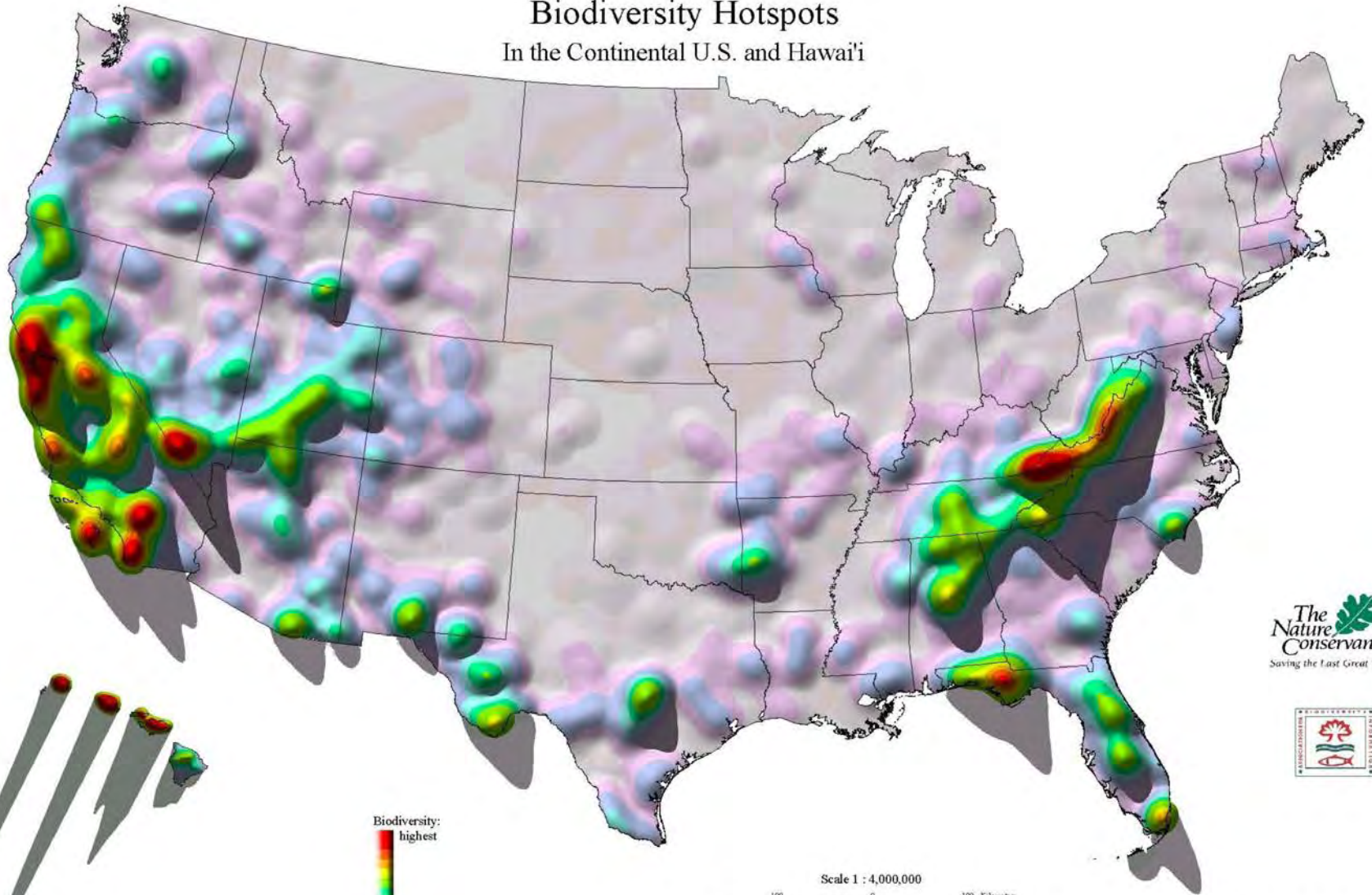
sea surface temperature



W Barthlott, N. Biedinger, G. Braun, F. Feig, G. Kier,
W. Lauer & J. Mutke 1999
modified after
W. Barthlott, W. Lauer & A. Placke 1996
Department of Botany and Geography
University of Bonn
German Aerospace Research Establishment, Cologne
Cartography: M. Gref
Department of Geography University of Bonn

Biodiversity Hotspots

In the Continental U.S. and Hawai'i



Biodiversity:
highest
lowest

Scale 1 : 4,000,000

100 0 100 Kilometers
100 0 100 Miles

The
Nature
Conservancy®
Saving the Last Great Places



Map adapted from *Encyclopaedia Britannica: The States of Biodiversity in the United States*.
Data from State Natural Heritage Programs and their cooperation.
Map produced by The Nature Conservancy Science GIS, 5/19/00.
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Ecoregions of North America

- 15 Level I Ecoregions
- 50 Level II Ecoregions
- 182 Level III Ecoregions

Level III Ecosystems

- **COAST RANGE**
-
- **PUGET LOWLANDS**
-
- **WILLAMETTE VALLEY**
-
- **CASCADES**
-
- **SIERRA NEVADA**
-
- **CENTRAL CALIFORNIA FOOTHILLS AND COASTAL MOUNTAINS**
-
- **CENTRAL CALIFORNIA VALLEY**
-
- **SOUTHERN CALIFORNIA MOUNTAINS**
-
- **EASTERN CASCADE SLOPES AND FOOTHILLS**
-
- **COLUMBIA PLATEAU**
-
- **BLUE MOUNTAINS**
-
- **SNAKE RIVER PLAIN**
-
- **CENTRAL BASIN AND RANGE**
-
- **MOJAVE BASIN AND RANGE**
-
- **NORTHERN ROCKIES**
-
- **IDAHO BATHOLITH**
-
- **MIDDLE ROCKIES**
-
- **WYOMING BASIN**
-
- **WASATCH AND UINTA MOUNTAINS**
-
- **COLORADO PLATEAUS**
-
- **SOUTHERN ROCKIES**
-
- **ARIZONA/NEW MEXICO PLATEAU**
-
- **ARIZONA/NEW MEXICO MOUNTAINS**
-
- **CHIHUAHUAN DESERTS**

Level III Ecosystems (cont.)

- HIGH PLAINS
-
- SOUTHWESTERN TABLELANDS
-
- CENTRAL GREAT PLAINS
-
- FLINT HILLS
-
- CROSS TIMBERS
-
- EDWARDS PLATEAU
-
- SOUTHERN TEXAS PLAINS
-
- TEXAS BLACKLAND PRAIRIES
-
- EAST CENTRAL TEXAS PLAINS
-
- WESTERN GULF COASTAL PLAIN
-
- SOUTH CENTRAL PLAINS
-
- OUACHITA MOUNTAINS
-
- ARKANSAS VALLEY
-
- BOSTON MOUNTAINS
-
- OZARK HIGHLANDS
-
- CENTRAL IRREGULAR PLAINS
-
- CANADIAN ROCKIES
-
- NORTHWESTERN GLACIATED PLAINS
-
- NORTHWESTERN GREAT PLAINS
-
- NEBRASKA SANDHILLS
-
- PIEDMONT
-
- NORTHERN GLACIATED PLAINS
-
- WESTERN CORN BELT PLAINS
-
- LAKE AGASSIZ PLAIN
-
- NORTHERN MINNESOTA WETLANDS
-
- NORTHERN LAKES AND FORESTS
-
- NORTH CENTRAL HARDWOOD FORESTS
-
- DRIFTLESS AREA

Level III Ecosystems (cont.)

- SOUTHEASTERN WISCONSIN TILL PLAINS
- **CENTRAL CORN BELT PLAINS**
-
- **EASTERN CORN BELT PLAINS**
-
- SOUTHERN MICHIGAN/NORTHERN INDIANA DRIFT PLAINS
-
- HURON/ERIE LAKE PLAINS
-
- NORTHEASTERN HIGHLANDS
-
- NORTHEASTERN COASTAL ZONE
-
- NORTHERN ALLEGHENY PLATEAU
-
- ERIE DRIFT PLAIN
-
- NORTH CENTRAL APPALACHIANS
-
- MIDDLE ATLANTIC COASTAL PLAIN
-
- NORTHERN PIEDMONT
-
- SOUTHEASTERN PLAINS
-
- BLUE RIDGE
-
- RIDGE AND VALLEY
- SOUTHWESTERN APPALACHIANS
-
- CENTRAL APPALACHIANS
-
- WESTERN ALLEGHENY PLATEAU
-
- INTERIOR PLATEAU
-
- INTERIOR RIVER VALLEYS AND HILLS
-
- **MISSISSIPPI ALLUVIAL PLAIN**
-
- **MISSISSIPPI VALLEY LOESS PLAINS**
-
- **SOUTHERN COASTAL PLAIN**
-
- **SOUTHERN FLORIDA COASTAL PLAIN**
-
- NORTH CASCADES
-
- KLAMATH MOUNTAINS AND CALIFORNIA HIGH NORTH COAST RANGE
-
- MADREAN ARCHIPELAGO

Level III Ecosystems (cont.)

- NORTHERN BASIN AND RANGE
- **SONORAN BASIN AND RANGE**
-
- ACADIAN PLAINS AND HILLS
-
- EASTERN GREAT LAKES LOWLANDS
-
- ATLANTIC COASTAL PINE BARRENS
-
- SOUTHERN CALIFORNIA/NORTHERN BAJA COAST
-
- ARCTIC COASTAL PLAIN
-
- ARCTIC FOOTHILLS
-
- BROOKS RANGE
-
- INTERIOR FORESTED LOWLANDS AND UPLANDS
-
- INTERIOR HIGHLANDS
-
- INTERIOR BOTTOMLANDS
-
- YUKON FLATS
- OGILVIE MOUNTAINS
- SUBARCTIC COASTAL PLAINS
-
- SEWARD PENINSULA
-
- AHKLUN AND KILBUCK MOUNTAINS
-
- BRISTOL BAY-NUSHAGAK LOWLANDS
-
- ALASKA PENINSULA MOUNTAINS
-
- ALEUTIAN ISLANDS
-
- COOK INLET
-
- ALASKA RANGE
-
- COPPER PLATEAU
-
- WRANGELL MOUNTAINS
-
- PACIFIC COASTAL MOUNTAINS
-
- COASTAL WESTERN HEMLOCK-SITKA SPRUCE FORESTS



Level I Ecoregions (15)

- 1.0 ARCTIC CORDILLERA
CORDILLERA ÁRTICA
CORDILLÈRE ARCTIQUE
- 2.0 TUNDRA
TUNDRA
TOUNDRA
- 3.0 TAIGA
TAIGA
TAIGA
- 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 FORÊTÉES 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 NORTEAMERICA
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 MÉRIDIONALES
- 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-HÚMEDAS
FORÊTS TROPICALES HUMIDES





Canada

United States of America

Estados Unidos Mexicanos

Three countries working together to map our shared environment.
Tres países trabajando juntos para cartografiar nuestro medio ambiente.
Trois pays s'unissent pour cartographier notre environnement à tous.



ECOLOGICAL REGIONS OF NORTH AMERICA
REGIONES ECOLÓGICAS DE AMÉRICA DEL NORTE
RÉGIONS ÉCOLOGIQUES DE L'AMÉRIQUE DU NORD

Level I Nivel I Niveau I

North American Atlas
Atlas de América del Norte
Atlas nord-américain

Produced in partnership with:
Elaborado en colaboración con: Réalisé en partenariat avec:



Ecological regions are areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. They serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. They are effective for national and regional state of the environment reports, environmental resource inventories and assessments, setting regional resource management goals, determining carrying capacity, as well as developing biological criteria and water quality standards. The development of a clear understanding of regional and large continental ecosystems is critical for evaluating ecological risk, sustainability, and health.

- Ecological classification is based on hierarchy—ecosystems are nested within ecosystems as mapped, although in reality, they may not always nest.
- Such classification integrates knowledge; it is not an overlay process.
- It recognizes that ecosystems are interactive—characteristics of one ecosystem blend with those of another.
- Map lines depicting ecological classification boundaries generally coincide with the location of zones of transition.

The maps shown here represent a second attempt to holistically classify and map ecological regions across the North American continent (Commission for Environmental Cooperation Working Group, 1997). The mapping from 1997 and 2006 was built upon earlier efforts that had begun individually in all three countries (e.g., Wilken 1986, Omernik 1987). These approaches recognized the need to consider a full range of physical and biotic characteristics to explain ecosystem regions (Omernik, 2004). Equally, they recognized that the relative importance of each characteristic varies from one ecological region to another regardless of the hierarchical level. In describing reorganization in Canada, Wilken (1986) stated:

Ecological land classification is a process of delineating and classifying ecologically distinctive areas of the Earth's surface. Each area can be viewed as a discrete system which has resulted from the interplay of the geologic, landform, soil, vegetation, 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.

Determining ecological regions at a continental level is a challenging task. It is difficult, in part, because North America is ecologically diverse and because a nation's territorial boundaries can be a hindrance to seeing and appreciating the perspectives across the land-mass of three countries. Developing and refining a framework of North American ecological regions has been the product of research and consultation between federal, state, provincial and territorial agencies. These agencies were often government departments, but the initiative also involved nongovernmental groups, universities and institutes. The Commission for Environmental Cooperation (CEC) was instrumental in bringing these groups together. The CEC was established in 1994 by Canada, Mexico, and the United States to address environmental concerns common to the three countries. The CEC derives its formal mandate from the North American Agreement on Environmental Cooperation (NAAEC), the environmental side accord to the North American Free Trade Agreement (NAFTA).

These maps represent the working group's best consensus on the distribution and characteristics of major ecosystems on all three levels throughout the three North American countries. The methodology incorporated these points in mapping ecological regions.

- Ecological classification incorporates all major components of ecosystems: air, water, land, and biota, including humans.
- It is holistic ("the whole is greater than the sum of its parts").
- The number and relative importance of factors that are helpful in the delineation process vary from one area to another, regardless of the level of generalization.

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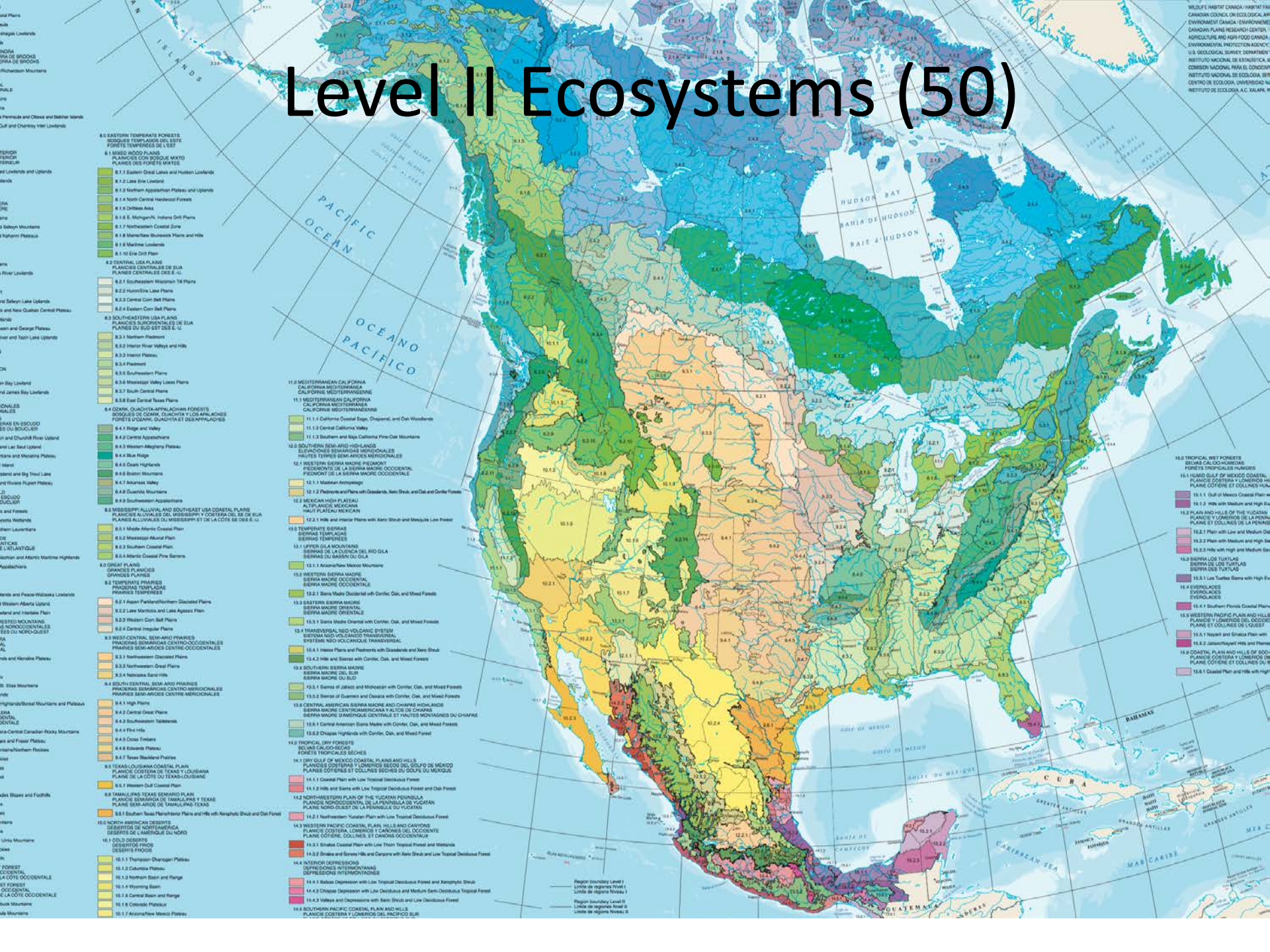
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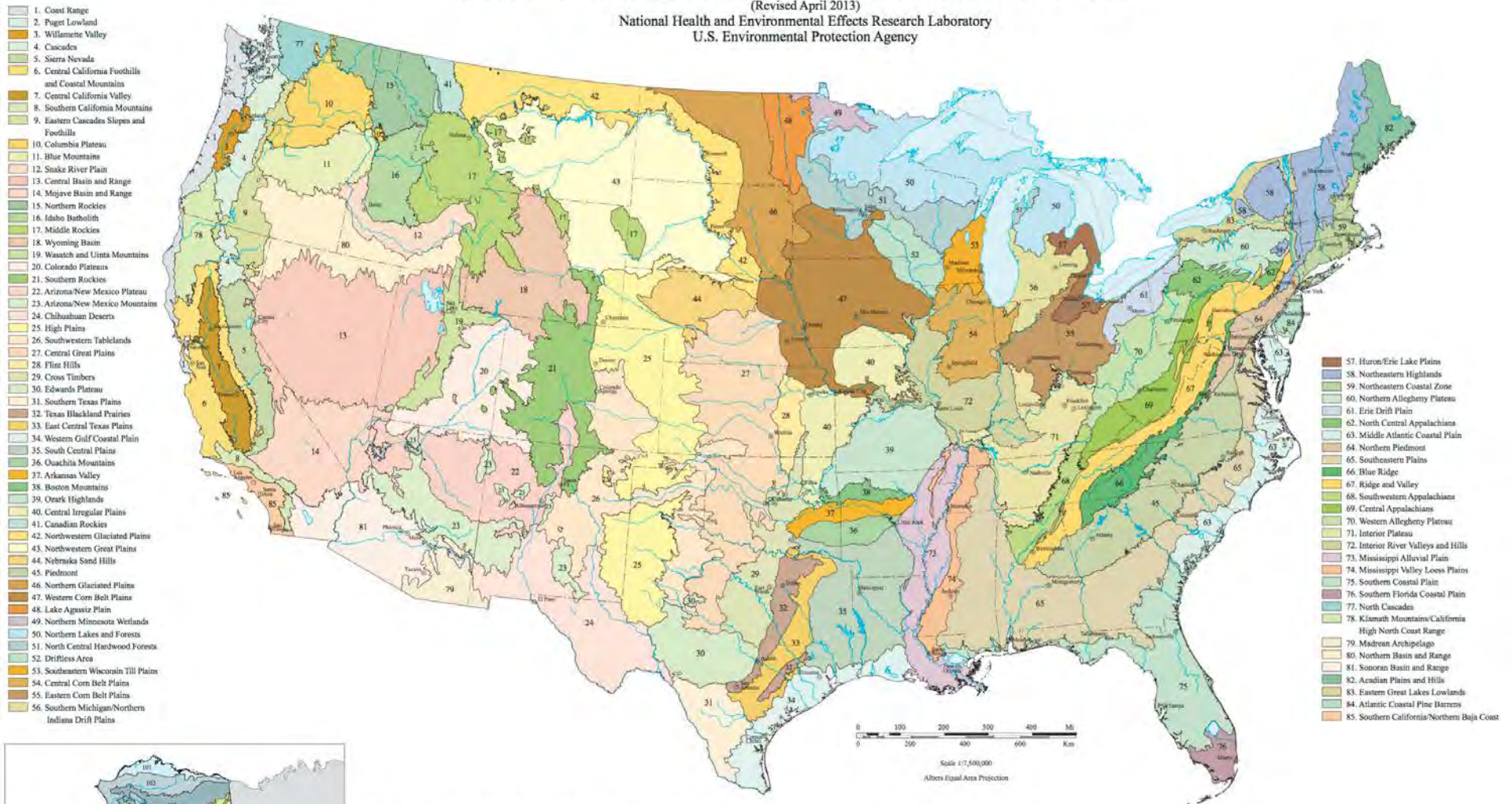
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Level II Ecosystems (50)



Level III Ecoregions of the Continental United States (182)

(Revised April 2013)
National Health and Environmental Effects Research Laboratory
U.S. Environmental Protection Agency



Ecoregions are areas where ecosystems (and the type, quality, and quantity of environmental resources) are generally similar. This ecoregion framework is derived from Omernik (1987) and from mapping done in collaboration with U.S. EPA regional offices, other federal agencies, state resource management agencies, and neighboring North American countries (Omernik and Griffith 2014). Designed to serve as a spatial framework for the research, assessment, and monitoring of ecosystems and ecosystem components, ecoregions denote areas of similarity in the mosaic of biotic, abiotic, terrestrial, and aquatic ecosystem components, with humans considered as part of the biota. These ecoregions have been used to develop regional biological criteria and water quality standards, set management goals for nonpoint source pollution, assess land cover trends, report on ecosystem carbon sequestration, and frame wildlife conservation research, among other applications.

Ecoregions can be identified by analyzing the patterns and composition of biotic and abiotic phenomena that affect or reflect differences in ecosystem quality and integrity (Omernik 1987, 1995). These phenomena include geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. The relative importance of each characteristic varies from one ecoregion to another regardless of the hierarchical level. A Russian natural classification scheme has been adopted for different levels of ecological regions. Level I is the coarsest level, dividing North America into 15 ecological regions; at Level II the contents is subdivided into 50 classes (CIC 1997, 2000). Level III, shown here, has 105 ecoregions in the continental U.S. For the conterminous United States, the ecoregions have been further subdivided to 867 Level IV ecoregions. Details about the ecoregions or their applications are explained in reports and publications from the state and regional reports (e.g., Bryer et al. 1998, 2005; Chapman et al. 2001, 2006; Griffith et al. 1989, 1995; Griffith et al. 2004, 2009, 2014; McGrath et al. 2002; Omernik 2006; Omernik et al. 2000; Thomson et al. 2003; Wilcox et al. 2011; and Woods et al. 1996, 2002, 2004). For additional information, contact James M. Omernik, USGS, c/o U.S. EPA, 200 SW 35th Street, Corvallis, OR 97331, phone (541) 754-4658, email jomernik@usgs.gov, or Glenn Griffith, USGS, c/o U.S. EPA, 200 SW 35th Street, Corvallis, OR 97331, phone (541) 754-4465, email griffith@usgs.gov.

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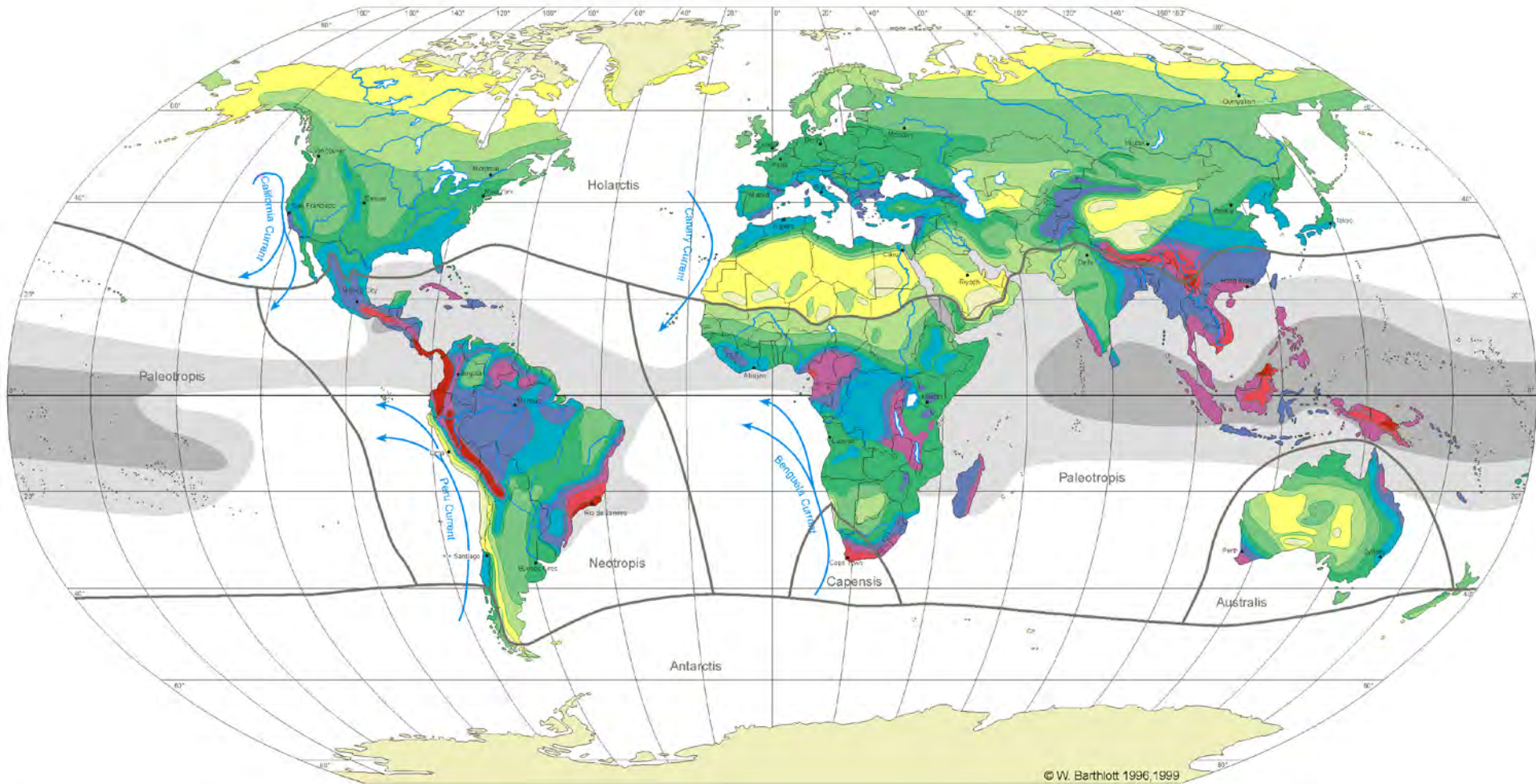
Omernik, J.M. and G.B. Griffith. 2014. Ecoregions of the conterminous United States: evolution of a hierarchical spatial framework. Environmental Management 54(5):1249-1266. <http://dx.doi.org/10.1007/s10626-014-0268-1>

Thomson, T.D., S.A. Bryer, A.J. Lammert, A.J. Woods, J.M. Omernik, J. Kagan, D.E. Pitts, and J.A. Connick. 2003. Ecoregions of Oregon (map poster). U.S. Geological Survey, Reston, VA. Scale 1:1,500,000.

ECOLOGICAL REGIONS OF NORTH AMERICA



GLOBAL BIODIVERSITY: SPECIES NUMBERS OF VASCULAR PLANTS



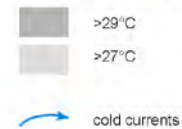
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Robinson Projection
Standard Parallels 38°N und 38°S

Diversity Zones (DZ): Number of species per 10 000km²

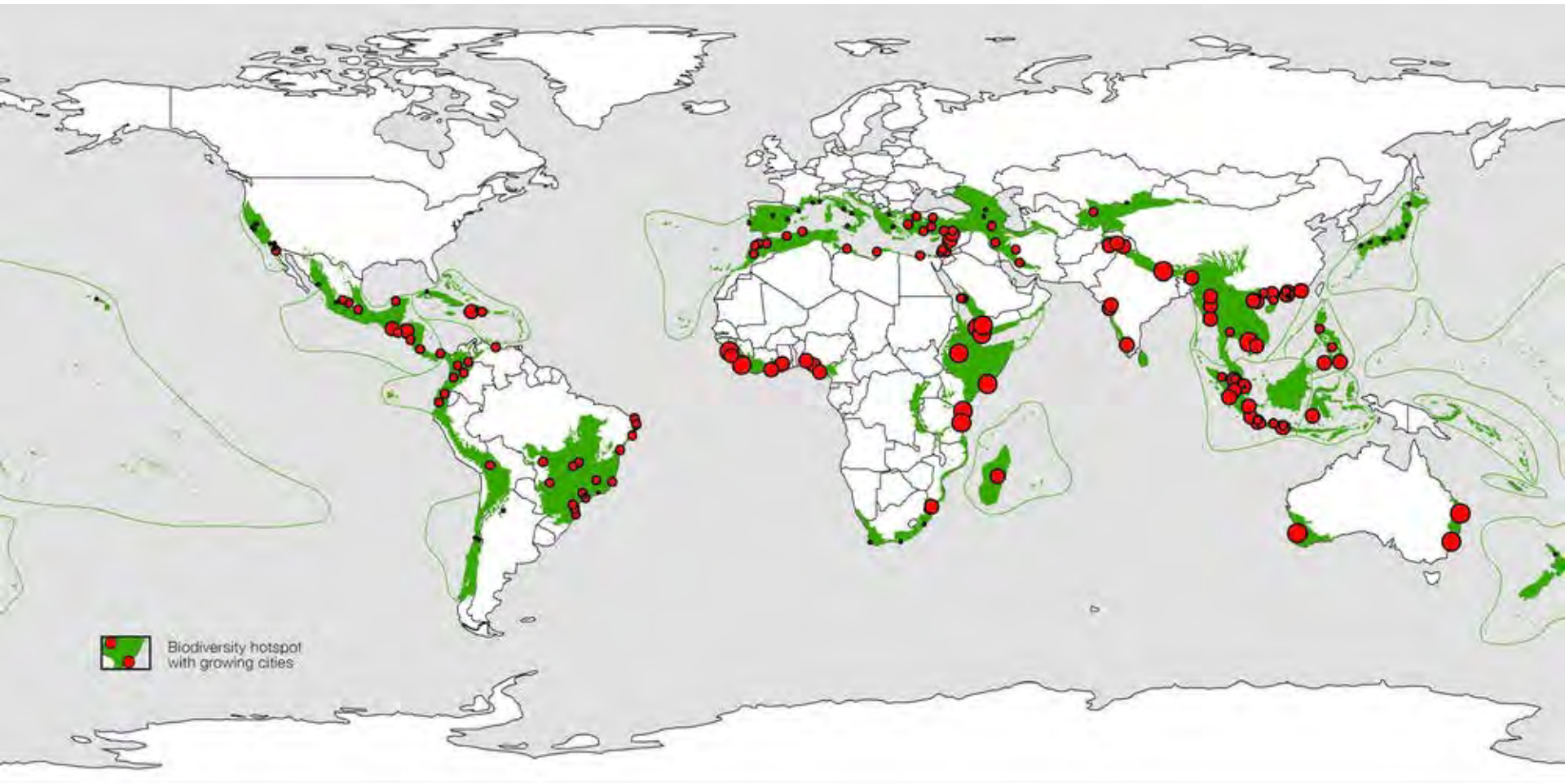


sea surface temperature

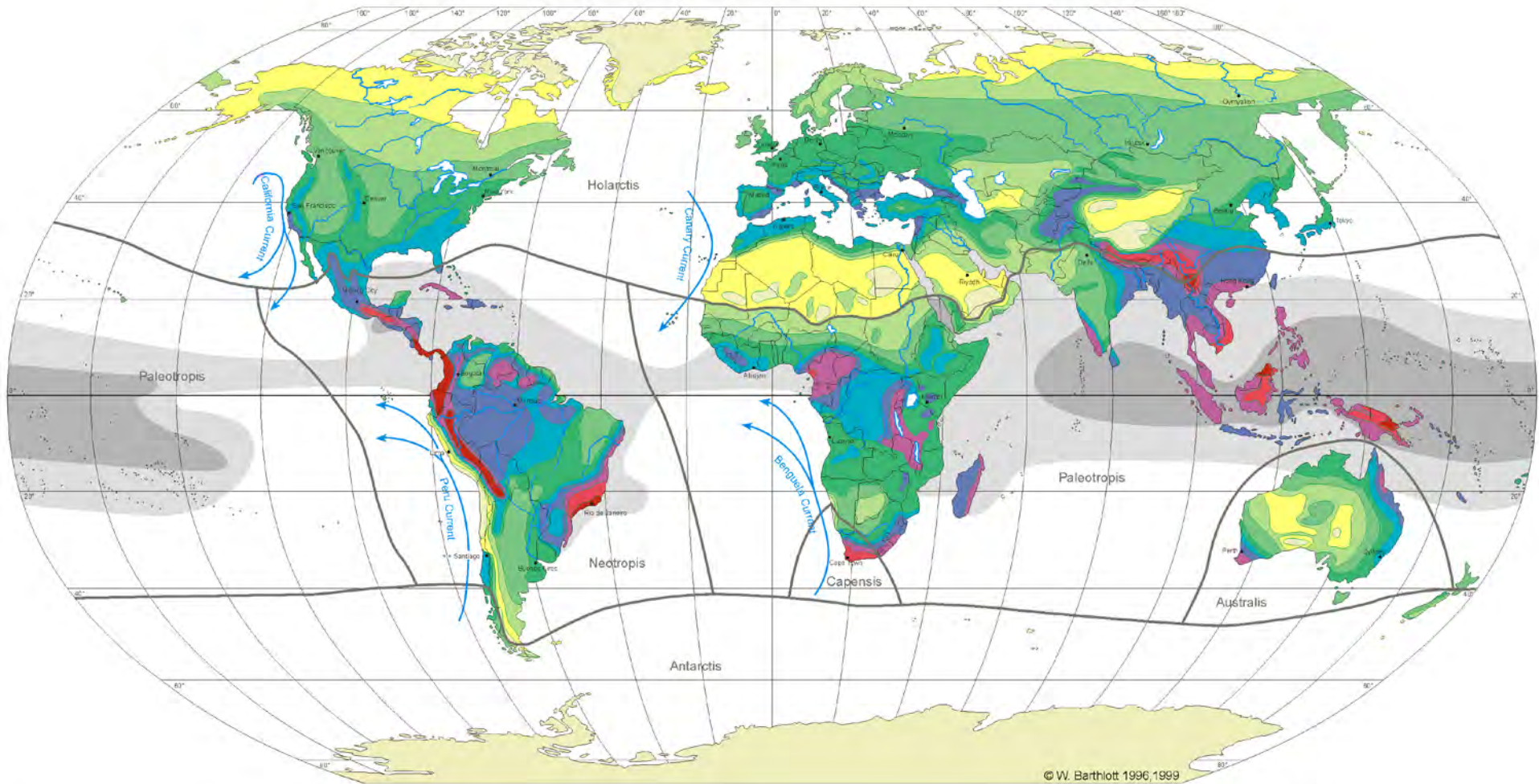


W Barthlott, N. Biedinger, G. Braun, F. Feig, G. Kier,
W. Lauer & J. Mutke 1999
modified after
W. Barthlott, W. Lauer & A. Placke 1996
Department of Botany and Geography
University of Bonn
German Aerospace Research Establishment, Cologne
Cartography: M. Gref
Department of Geography University of Bonn

Biodiversity Hotspots Overlaid Urban Development



GLOBAL BIODIVERSITY: SPECIES NUMBERS OF VASCULAR PLANTS

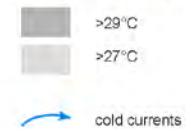


Robinson Projection
Standard Parallels 38°N und 38°S

Diversity Zones (DZ): Number of species per 10 000km²



sea surface temperature

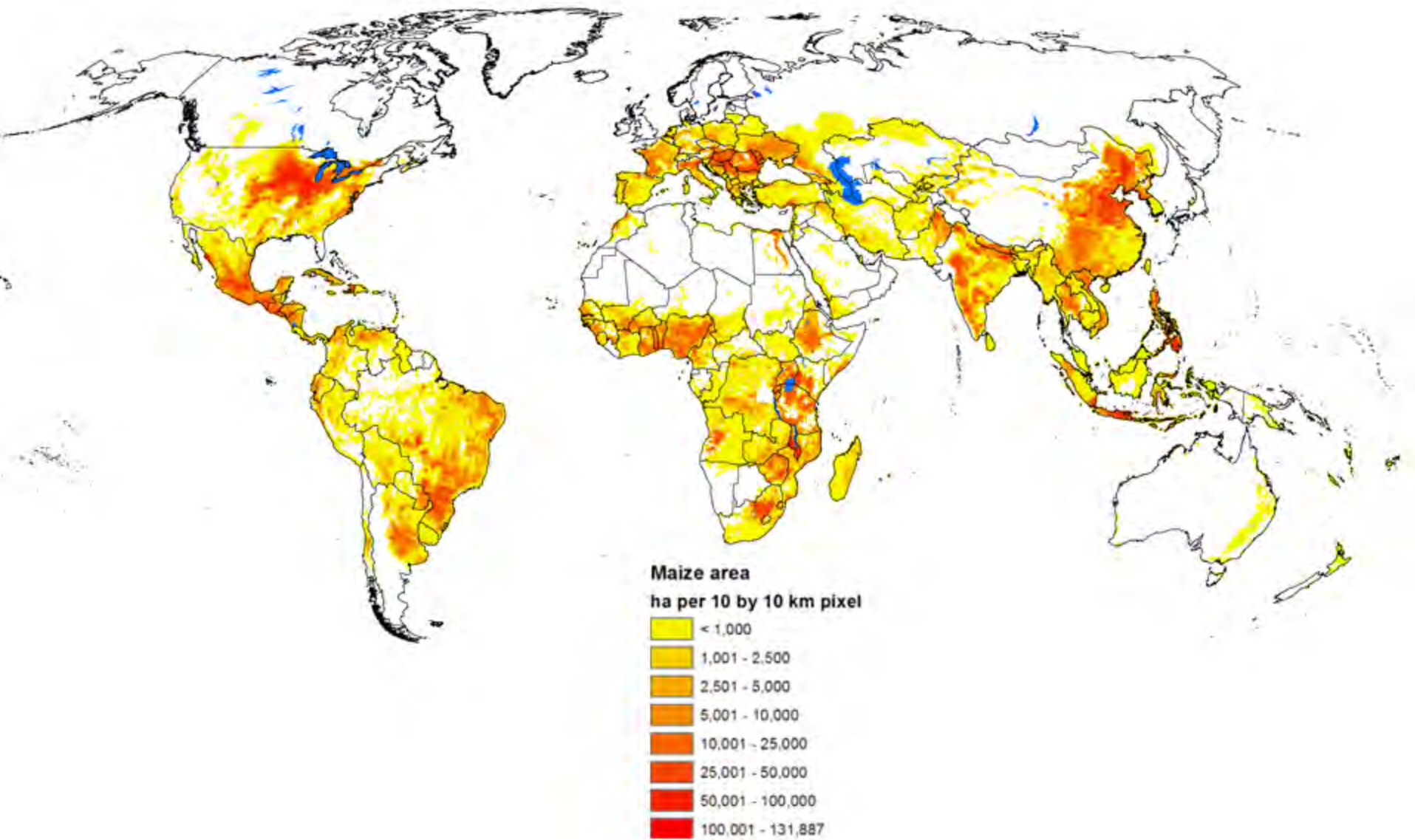


W Barthlott, N Biedinger, G. Braun, F. Feig, G Kier,
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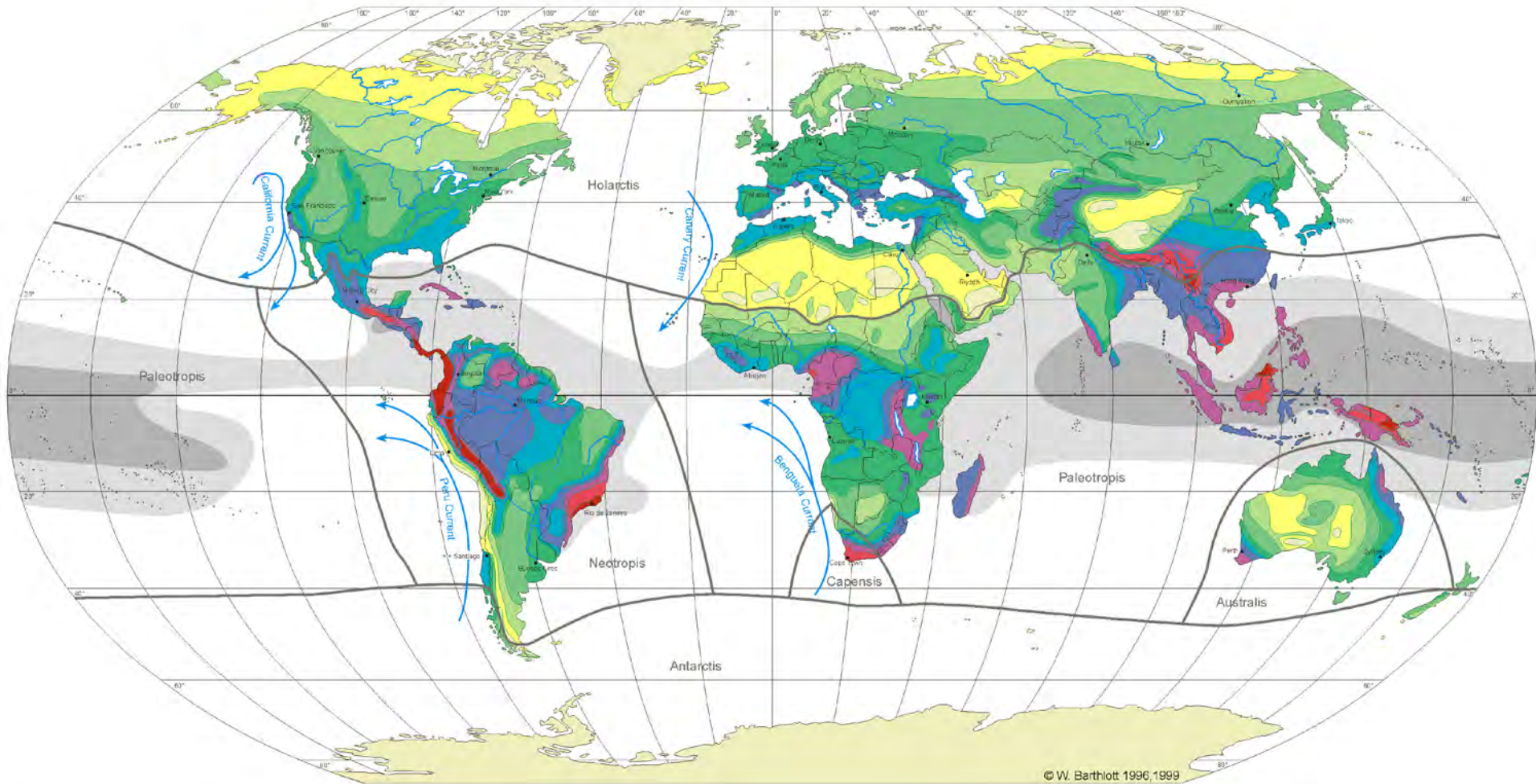
Global Cropland



Global Maize Area



GLOBAL BIODIVERSITY: SPECIES NUMBERS OF VASCULAR PLANTS



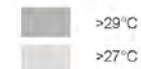
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Robinson Projection
Standard Parallels 38°N und 38°S

Diversity Zones (DZ): Number of species per 10 000km²



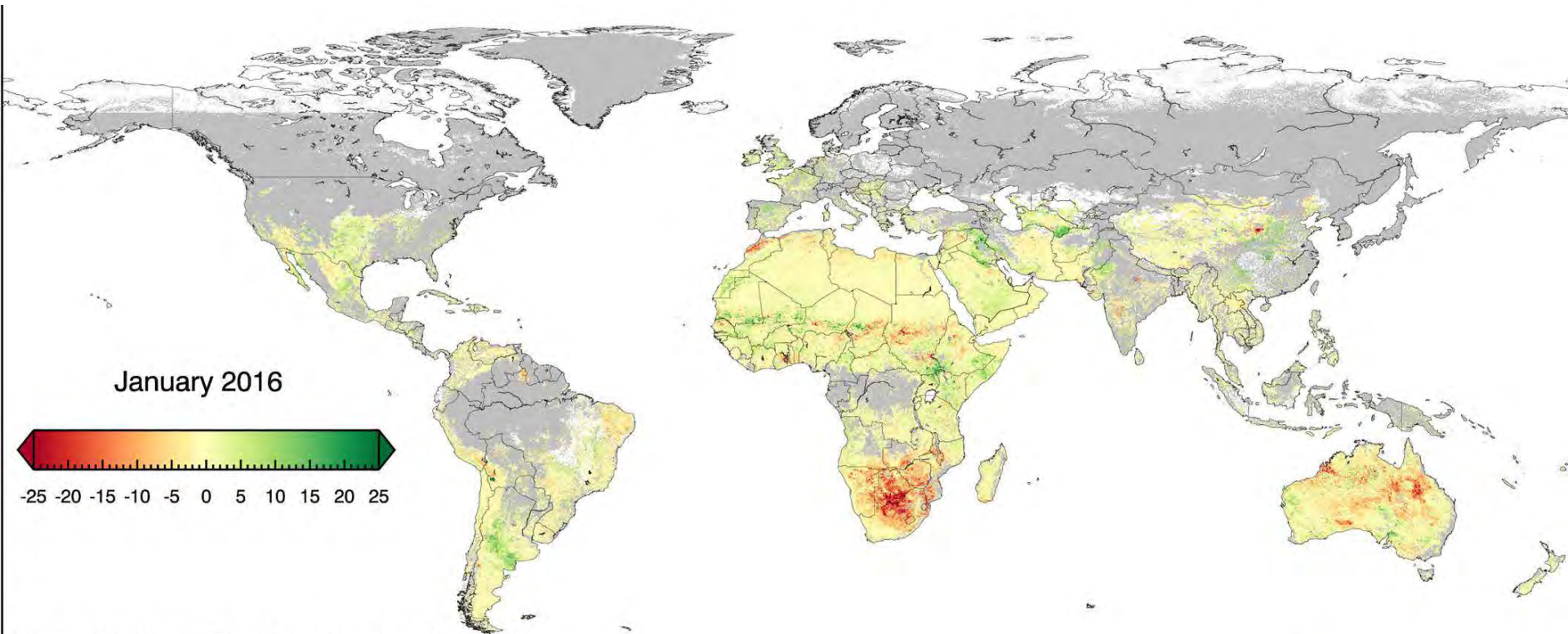
sea surface temperature



cold currents

W Barthlott, N Biedinger, G. Braun, F. Feig, G Kier,
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Global Rangeland & Pasture



Vegetation Cover Anomaly [%]

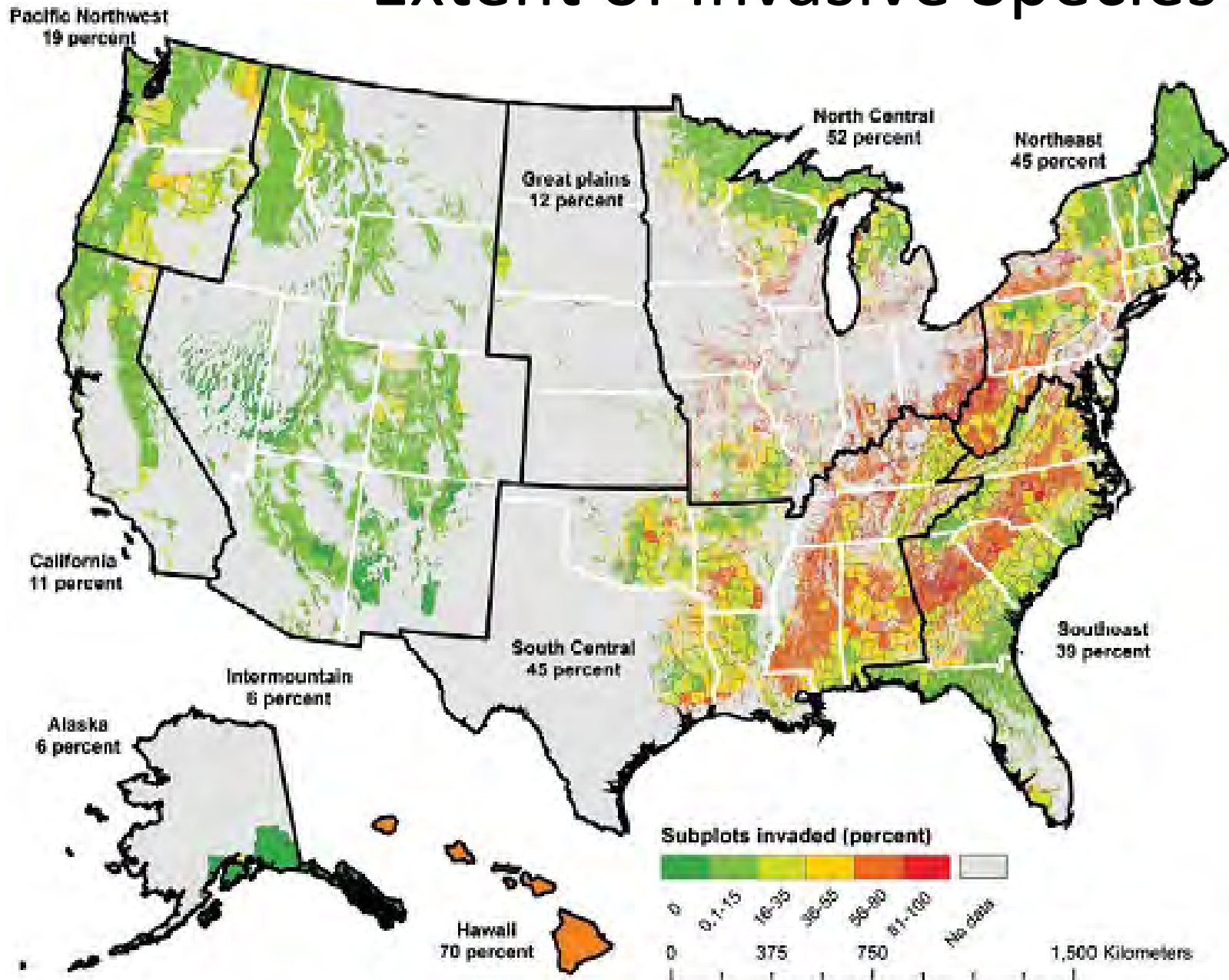
Difference between vegetation cover (*) in January 2016 and the mean vegetation cover for January in 2000-2015

* Vegetation cover includes the photosynthetic and non-photosynthetic fractions

gray areas are not rangeland/pastures or have no data

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Extent of Invasive Species





Kudzu (*Pueraria montana*)





