Unpacking the term “Transboundary Dryland Border Region”

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What is meant by the term?

What areas and populations are included in the definition?

Why is it important to consider the region as a whole?
What is meant by the term?
What are Drylands (over 300 definitions)?

Accounting for the World’s Rangelands
By H. Gyde Lund

How much rangeland do we have? Globally, no one knows. We can’t hope to manage or conserve it without knowing. One way to determine the extent and condition of drylands is to identify critical functions and services that they provide. These services include the following:

1. Water: Rangelands are important sources of fresh water, both for human and animal consumption.
2. Food: Rangelands provide a variety of food resources, including grains, seeds, and other edible plants.
3. Fuel: Rangelands provide wood and other energy sources.
4. Recreation: Rangelands provide opportunities for outdoor activities such as hiking, hunting, and camping.
5. Wildlife habitat: Rangelands support a variety of wildlife species, including game animals and many other species.

Why Are Rangelands Important?
Rangelands are found in many parts of the world, from the deserts of Africa to the grasslands of South America. They cover more than 40% of the Earth’s land surface and provide important resources for human and animal survival. Rangelands are also important for their biodiversity, providing habitat for a wide variety of plant and animal species.

March 2007

Lund, H.G. 2007. Accounting for the World’s rangelands. Rangeland 3-
A part of this uncertainty relates to the Definition of Drylands

10 – 80% Degraded

Hungry Goats Atop a Tree, Doing Their Bit for Epicures

Land Use? Grazing of Forests
Land Cover? Grazing of Forests

Hungry Goats Atop a Tree, Doing Their Bit for Epicures
Watersheds

EPA Omernick

Level III Ecoregions of Texas

Ecoregions

Division = \( F(\text{CL (P &T)}, R, \text{time}) \)

Biogeographic Provinces

geographic distributions of related species, genera, & families
The Vegetation Subcommittee of the Federal Geographic Data Committee has endorsed the *National Vegetation Classification System* (NVCS) which produces uniform vegetation resource data at the national level. The NVCS uses a systematic approach to classifying a continuum of natural, existing vegetation. The combined physiognomic-floristic hierarchy uses both qualitative and quantitative data appropriate for conservation and mapping at various scales. Physiognomic characteristics include the more general and less precise levels of taxonomy, whereas the floristic characteristics are found in the more specific levels of taxonomy.

• Drylands are areas where \( \text{MAP}/\text{MAPET} \leq 0.65 \)

• Drylands Cover 41% of the Terrestrial Land Surface (MEA 2005)
• Provide ~ $1 trillion in Ecosystem Goods (e.g., 31 kg of beef consumed per year in US) & Services (e.g., carbon cycling: net primary productivity) to 36% of the World’s Population (Constanza et al. 1997, MEA 2005)
What are Drylands (over 300 definitions)?

~ 45% of the USA is Drylands (UNCCD definition)

and in México, drylands make up 65% of the territory, or 1,280,494 km² (Verbist et al., 2010)

DISTRIBUTION OF DRYLANDS: CLIMATE PERSPECTIVE

Types of drylands:
- Arid
- Semiarid
- Dry subhumid
- Other climates

- 101.5 million hectares, just over half of the national territory.
- Of this surface, arid zones represent 15.7%, semi-arid zones 58% and the remaining 26.3% correspond to dry sub-humid zones.
Six Main Uses of Drylands

• Plant products
  • forage, energy, timber

• Livestock production
  • meat, hides, fiber, milk, energy (manure), construction (adobe)

• Wildlife habitat management
  • meat, hides, recreation

• Water catchments
  • water supplies

• Open space for recreation
  • camping, hunting, fishing, photography, wind farming

• Lumber and mineral production
<table>
<thead>
<tr>
<th>Zone</th>
<th>Precipitation</th>
<th>Land Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry sub-humid</td>
<td>600 - 1200 mm</td>
<td>Cropping</td>
</tr>
<tr>
<td>Semi-arid</td>
<td>250 - 600 mm</td>
<td>Dryland Farming/Rangeland</td>
</tr>
<tr>
<td>Arid</td>
<td>100 - 250 mm</td>
<td>Rangeland (livestock grazing)</td>
</tr>
<tr>
<td>Hyper-arid</td>
<td>60 - 100 mm</td>
<td>Marginal livestock</td>
</tr>
</tbody>
</table>

- 88% of Dryland is used for Rangelands
- 3% is used for irrigated croplands
- 9% for rainfed agriculture
Complex System Dynamics
Contribution of Semi-Arid Forests to the Climate System

Eyal Rotenberg and Dan Yakir*

Forests both take up CO₂ and enhance absorption of solar radiation, with contrasting effects on global temperature. Based on a 9-year study in the forests' dry timberline, we show that substantial carbon sequestration (cooling effect) is maintained in the large dry transition zone (precipitation from 200 to 600 millimeters) by shifts in peak photosynthetic activities from summer to early spring, and this is counteracted by longwave radiation (L) suppression (warming effect), doubling the forestation shortwave (S) albedo effect. Several decades of carbon accumulation are required to balance the twofold S + L effect. Desertification over the past several decades, however, contributed negative forcing at Earth’s surface equivalent to ~20% of the global anthropogenic CO₂ effect over the same period, moderating warming trends.

Table 1. Indicators of carbon use efficiency in pine forests: GPP, Rₑ, and NEE of carbon for the 12 European pine forest sites [62 data years (36)], for the entire global Fluxnet network (43), and for semi-arid forest [Yatir (44)].

<table>
<thead>
<tr>
<th>Pine forest</th>
<th>GPP</th>
<th>Rₑ</th>
<th>NEE</th>
<th>NEE/GPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>European (Carboeurope)</td>
<td>1142</td>
<td>944</td>
<td>200</td>
<td>0.17</td>
</tr>
<tr>
<td>Global (FluxNet)</td>
<td>1540</td>
<td>1280</td>
<td>260</td>
<td>0.17</td>
</tr>
<tr>
<td>Semi-arid (Yatir)</td>
<td>820</td>
<td>600</td>
<td>220</td>
<td>0.27</td>
</tr>
</tbody>
</table>

57% of Carbon in Australia

Poulter et al. (2014). Nature DOI: 10.1038/nature13376
Global Greening Trend

Drylands are Regions with Unstable Plant Growth intra-annually and interannually

North American Vegetation Changes

Climate Change is Projected to Expand North American Drylands

Is Dryland climate changing?
Figure 2] The velocity of temperature change globally. 

a, Temporal gradients calculated from 2000 through 2100 across three emissions scenarios.

b, Temporal gradients calculated from 2000 – 2050 and 2050 – 2100 across three emissions scenarios.

Trends plotted here are the average of the global land surface.

c, A global map of climate velocity calculated using the 2050 – 2100 SRES A1B emissions scenario temporal gradient.

Figure 3: The velocity of temperature change by biome. A map of biomes and histograms of the speed of temperature change within each biome. Histograms are ordered by increasing velocity according to their geometric means.

Jun/Jul/Aug
Departures from average
1895-2011

Tree mortality from an exceptional drought spanning mesic to semiarid ecoregions

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Abstract. Significant areas of the southern USA periodically experience intense drought that can lead to episodic tree mortality events. Because drought tolerance varies among species and size of trees, such events can alter the structure and function of terrestrial ecosystem in ways that are difficult to detect with local data sets or solely with remote-sensing platforms. We investigated a widespread tree mortality event that resulted from the worst 1-year drought on record for the state of Texas, USA. The drought affected ecoregions spanning mesic to semiarid climate zones and provided a unique opportunity to test hypotheses related to how trees of varying genus and size were affected. The study was based on an extensive set of 599 distributed plots, each 0.16 ha, surveyed in the summer following the drought. In each plot, dead trees larger than 12.7 cm in diameter were counted, sized, and identified to the genus level. Estimates of total mortality were obtained for each of 10 regions using a combination of design-based estimators and calibrated remote sensing using MODIS 1-yr change in normalized difference vegetation index products developed by the U.S. Forest Service. As compared with most of the publicized extreme die-off events, this study documents relatively low rates of mortality occurring over a very large area. However, statewide, regional tree mortality was massive, with an estimated 6.2% of the live trees perishing, nearly nine times greater than normal annual mortality. Dead tree diameters averaged larger than the live trees for most ecoregions, and this trend was most pronounced in the wetter climate zones, suggesting a potential re-ordering of species dominance and downward trend in tree size that was specific to climatic regions. The net effect on carbon storage was estimated to be a redistribution of 24–30 Tg C from the live tree to dead tree carbon pool. The dead tree survey documented drought mortality in more than 29 genera across all regions, and surprisingly, drought resistant and sensitive species fared similarly in some regions. Both angiosperms and gymnosperms were affected. These results highlight that drought-driven mortality alters forest structure differently across climatic regions and genera.

Key words: acute drought impact; Central North America; dead carbon pool; forest structure; Texas, USA; tree death.
What areas and populations are included in the definition?

A Question of Space & Time Scale Perspectives
Grain is the raster equivalent of the term scale and refers to the resolution of a particular raster based database.

This application of “scale” often confuses people.
**Extent:** J Harlen Bretz 1923 Hypothesis: The channeled scablands had been formed catastrophically by a single gigantic flood of glacial meltwater.
Confirmed in the 1970’s

Alternative Definitions of the “Great Plains”
using different bases

Vegetation

Landform

Culture

Range of definitions by theme

Within all definitions of that theme
Though the Extent of Drylands is not Clear, The Administrative Border is more clearly defined
The Present Fence/Wall

Source: Center for Investigative Reporting and OpenStreetMap
BORDER STATES

USA
States:
New Mexico
Arizona
California
Texas

Mexico
States:
Baja California, Sonora, Chihuahua,
Coahuila, Nuevo León y Tamaulipas.
Of Borders & Boundaries

Native American Lands: The light areas are the tribes original territory. The dark areas are their current reservations.

Affected Peoples:
- Yuma
- Yaqui
- Pima
- Apache
- Kickapoo

https://indigenouspeoplesandtheborder.wikispaces.com/Information+about+the+Native+American+tribes+that+historically+lived+on+the+US-Mexico+Border
Of Borders & Boundaries: Tohono O’odham

Of Borders & Boundaries: Tohono O’odham

National surface: 196,437,500 Ha.

Social property: 99,714,952.45 Ha. (51% of National territory)

- Communal: 6.5%
- Ejidal: 93.5%

Source: SEDATU-RAN, 2017
Why is it important to consider the region as a whole?
**Key elements:**

i. conservation core areas;

ii. corridors and linkages;

iii. buffer zones and sustainable use of non-conservation lands; and

iv. the inclusion of human cultural and socioeconomic factors.

Currently, in the border region there are **25 ANPs in the US** and **13 ANPs of a federal character in Mexico** (EPA, 2010, CONANP, 2017).

**DRYLANDS** are particularly vulnerable to the effects of climate change (WWF, 2010, Bachelet, 2016).
There are 24 priority terrestrial regions, as well as 13 priority hydrological regions, which are the basis for implementing conservation efforts. In addition to 15 Areas of Importance for the Conservation of Birds, 10 RAMSAR sites and 581 Epicontinental aquatic priority sites (CONABIO, 2008).

The ecosystems present in the border region have an enormous natural value, among which the Sonoran Desert and Chihuahuan Desert, the Bravo / Grande River, the wetlands of the Colorado River Delta and Laguna Madre stand out.
~35 BIODIVERSITY HOTSPOTS IN THE WORLD

http://www.cepf.net/resources/hotspots/Pages/default.aspx
US protected lands mismatch biodiversity priorities

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Because habitat loss is the main cause of extinction, where and how much society chooses to protect is vital for saving species. The United States is well positioned economically and politically to pursue habitat conservation should it be a societal goal. We assessed the US protected area portfolio with respect to biodiversity in the country. New synthesis maps for terrestrial vertebrates, freshwater fish, and trees permit comparison with protected areas to identify priorities for future conservation investment. Although the total area protected is substantial, its geographic configuration is nearly the opposite of patterns of endemicity within the country. Most protected lands are in the West, whereas the vulnerable species are largely in the Southeast. Private land protections are significant, but they are not concentrated where the priorities are. To adequately protect the nation’s unique biodiversity, we recommend specific areas deserving additional protection, some of them including public lands, but many others requiring private investment.

of species richness (19), but they are generally not the species in need of conservation efforts.

In identifying conservation priorities, one must consider both existing protected areas and the intrinsic vulnerability of species. Vulnerable species tend to be in two groups: those with small geographic ranges, which is often correlated with local rarity, and large-bodied species that are sparsely distributed across large ranges. The latter species, which are relatively few but include predators like panthers and wolves, were largely extirpated from the east and still face persecution across large extents of the west.

Most imperiled species are of the first group: small range size is the best predictor of extinction risk and, thus, the first metric for conservation priority (20–22). We focus on small-ranged species defined in several ways. First, we consider endemics—those with their entire range in the United States (Methods). Amphibians (70%) and freshwater fish (68%) show the highest levels of endemism, followed by reptiles (30%), trees (29%), mammals (28%), and birds (<3%). Patterns of endemism for all taxa are consistently centered in the Southeast, although the west also has significant
Areas That are Not Protected

Fig. 4. Summed priority scores across all taxa and recommended priority areas to expand conservation: 1, Middle to southern Blue Ridge Mountains; 2, Sierra Nevada Mountains, particularly the southern section; 3, California Coast Ranges; 4, Tennessee, Alabama, and northern Georgia watersheds; 5, Florida panhandle; 6, Florida Keys; 7, Klamath Mountains, primarily along the border of Oregon and California; 8 South-Central Texas around Austin and San Antonio; 9, Channel Islands of California.

GIS Results available at BiodiversityMapping.org
The drylands provide habitats for 80% of North America’s mammal, bird and amphibian species.

Drylands provide important habitats for many unique species that are of global conservation concern.

Drivers of dryland biodiversity loss:
- habitat conversion, climate change, over-harvesting, grazing pressures, introduced species, and inappropriate soil management

CONSERVING DRYLAND BIODIVERSITY

Strategies for dryland biodiversity conservation:

1. Innovation, knowledge and science
2. Incentives and investment
3. Governance and empowerment
4. Mainstreaming dryland biodiversity

Native communities are major players in border politics, indigenous communities and indigenous nations address border policy in the context of their historical and contemporary relationship with the land, based on their spiritual and cultural practices, traditional subsistence and interaction with plants and animals, and a continuous responsibility for caring for their land.

- The indigenous people who live along the border depend on the natural environment for their sustenance and survival, as well as for ritual purposes.
- Marginalized communities are more vulnerable to extreme events, caused by climate change.

COMMON PROBLEMS: AIR POLLUTION

- The international report of Greenhouse Effect Gases (GHG) under the Kyoto Protocol are: Carbon Dioxide (CO₂), Methane (CH₄), Nitrous Oxide (N₂O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulfur Hexafluoride (SF₆).

- The most common and harmful air pollutants in the border area include suspended particles (PM10 and PM2.5) and tropospheric ozone.

- Mexico has been implementing various actions to support the Mexican border states to develop a State Climate Action Plan (PEAC); one of the most important inputs for the PEAC is the inventory of GHGs.
Pressure by various sectors due to the use of resources, including fishing, tourism, industrial (oil / mining) and urban.

The impacts of climate change are reflected in the environmental quality of the coastal line.

Overexploitation of coastal resources and pressures on species of commercial importance, including species at risk.

Gulf of Mexico, increased load of organic material that comes from the Mississippi River water basin

Gulf of California, tourism, fishing, wastewater discharges. Upper Gulf

Laguna Madre Region, diverse habitats and communities such as rivers, coastal lagoons, estuaries, reef systems, seagrasses and mangroves.

COMMON PROBLEMS: COASTS AND SEAS

Photo: ©Krista Schlyer
OTHER COMMON PROBLEMS

• Poverty
• Climate change
• Land degradation
• Droughts
• Water quality and availability
• Pollution and waste management

Photo: ©Krista Schlyer
STRATEGIC AXES

• Environmental health;
• Public health;
• Sustainability and development;
• Territorial and urban planning;
• Education and environmental culture;
• Mitigation and adaptation programs to climate change;
• Conservation programs for wild species (migratory, species at risk and vulnerable to climate change); and
• Attention to marginalized and indigenous communities.
• Identify the territorial, ecological, social and economic processes of the region and their behavior in the face of different perspectives to base the implementation of actions and public policies.