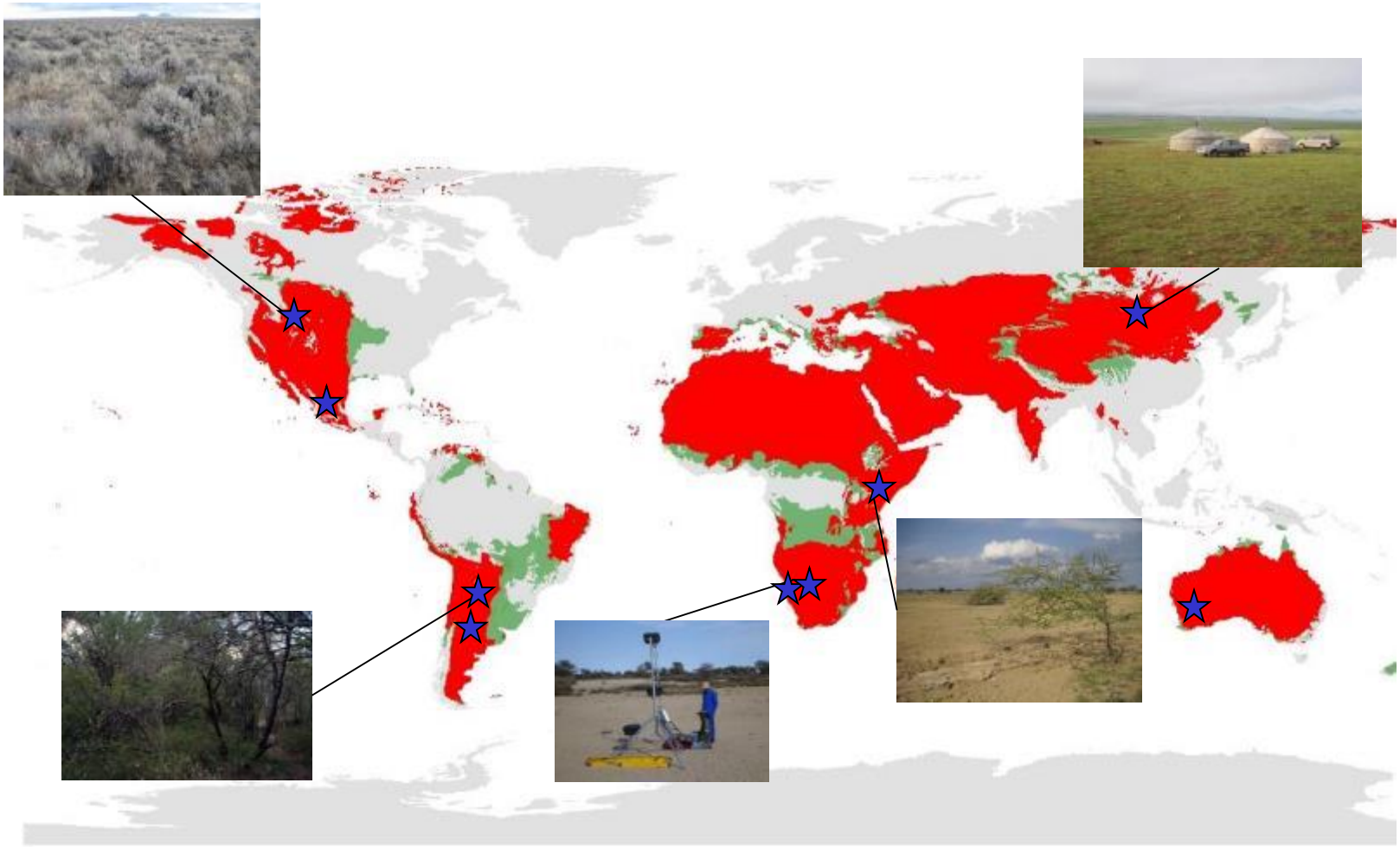
International collaborations

Brandon Bestelmeyer

Drylands—41% land area and 35% of population



★ Active field or synthesis collaborations by LTER Pis

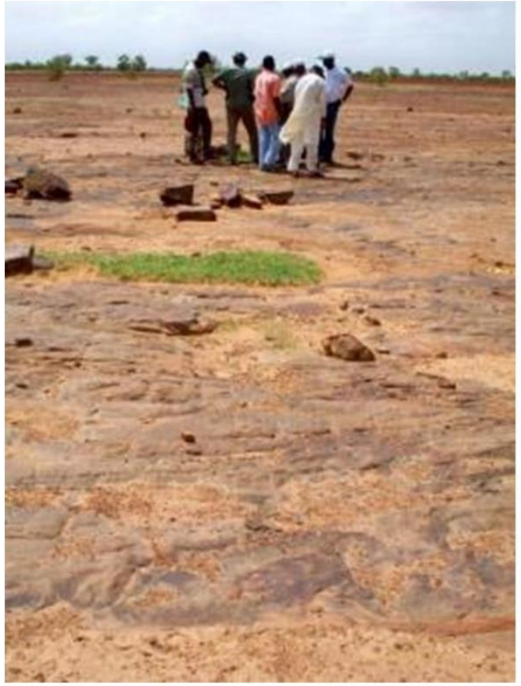
Red--CGIAR-CSI Global Aridity Index (Drylands = 0-0.65)
Green—humid grasslands, savannas
Red+ green =“rangelands”

Desertification

"the loss of the ability of a landscape to provide ecosystem services that are important to sustain life[1]"

1. D'Odorico et al., 2013, Advances in Water Resources 51: 326–344

Syndromes



Soil loss

Shrub encroachment/annualization

Thicketization

Soil fertility loss

Globally, what institutional factors circumvent responses?

a) Knowledge about effective management/restoration

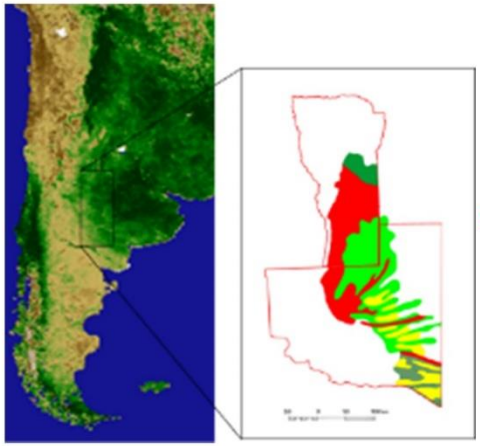
b) Availability of existing knowledge to users

c) Ability or willingness to act on knowledge

Translate concepts and methods used at JRN to tools that can be applied globally

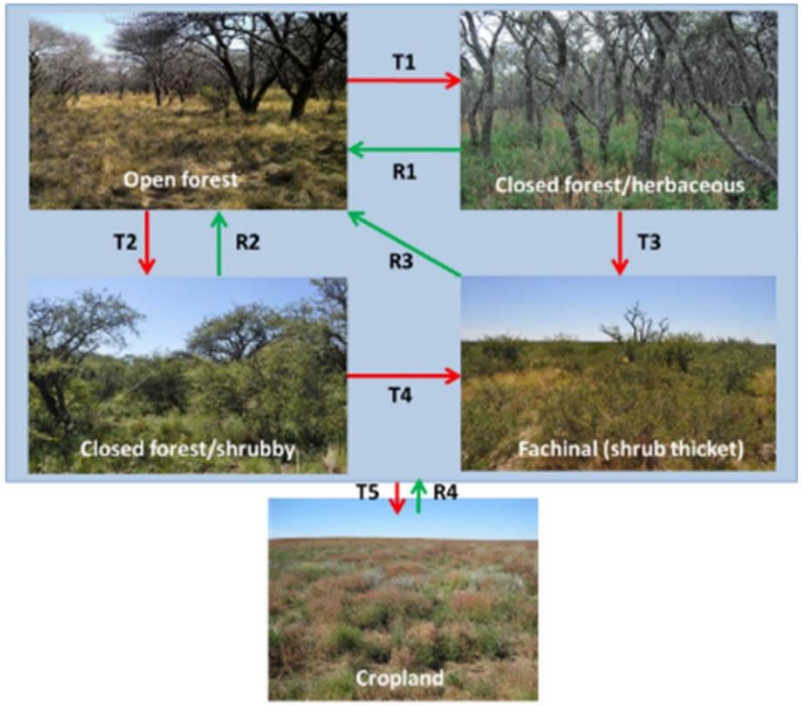
State-and-transition models

Geographic domain/
landscape setting



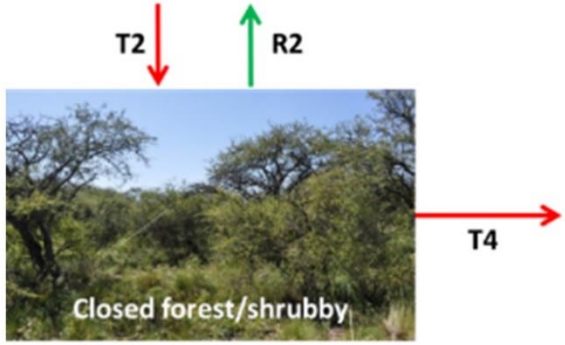
Caldenal subregion,
central Argentina

State-and-transition model



Management/
land-use decision

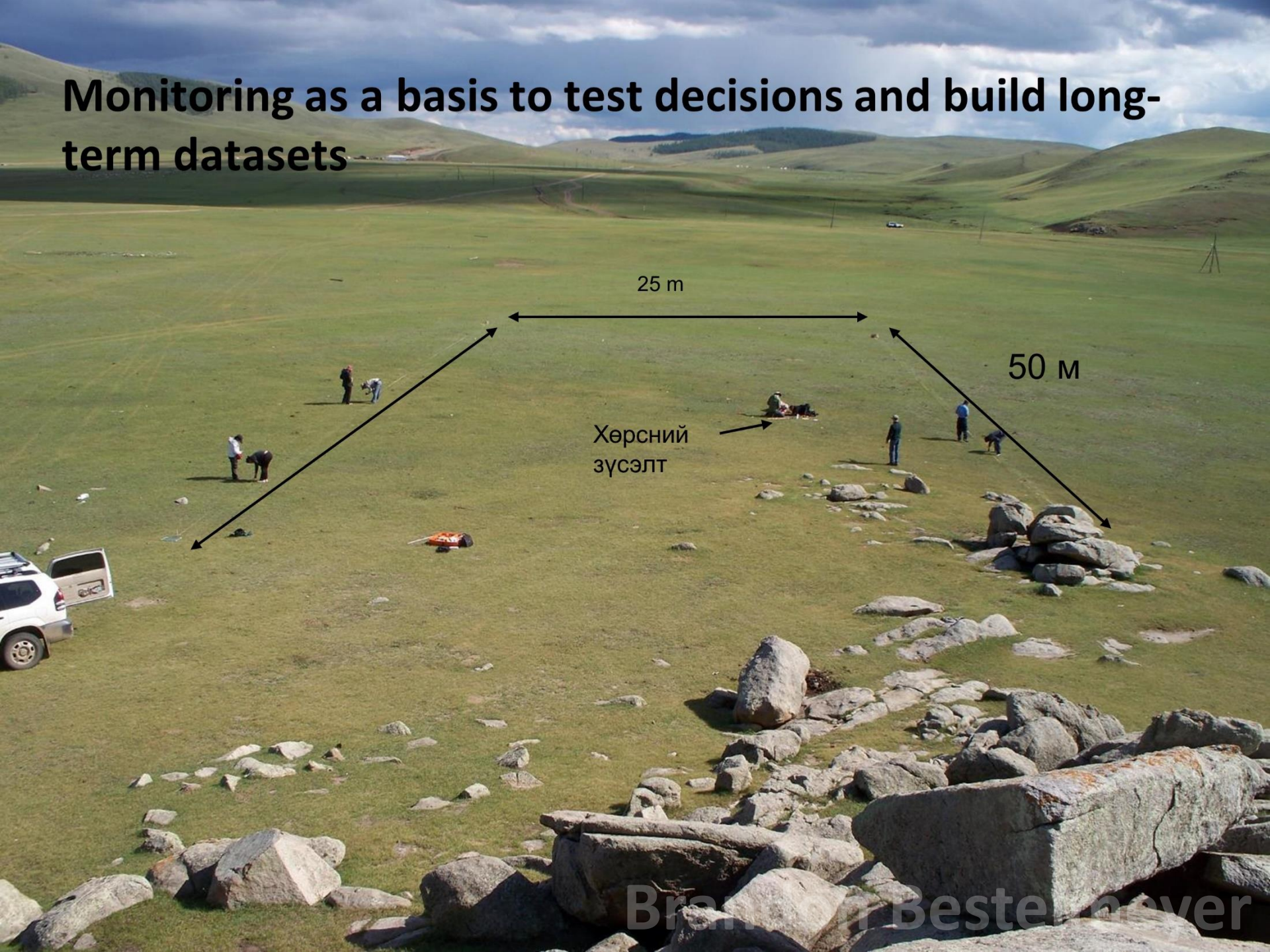
State-and-transition models



Information for each state

- Characteristics/ecosystem services of state
- Management to promote/weaken resilience of state
- Mechanisms of transition to other states
- Constraints to recovery of former state
- Restoration strategies, likelihood of success

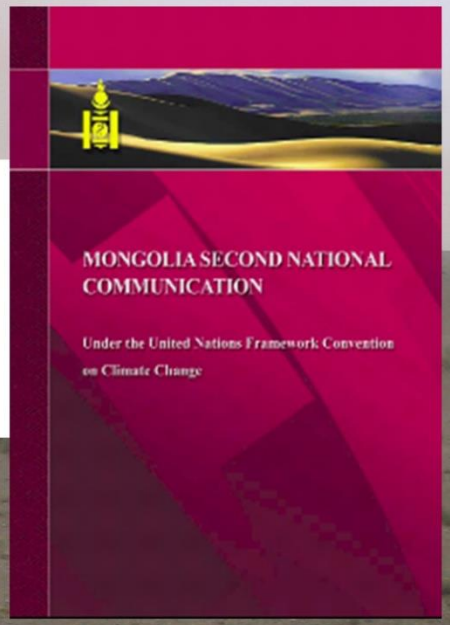
Monitoring as a basis to test decisions and build long-term datasets



Example: widespread reports that rangelands in Mongolia are undergoing desertification

"Some studies indicate that 70 percent of Mongolia's grasslands are degraded."

New York Times, 22 September 2014

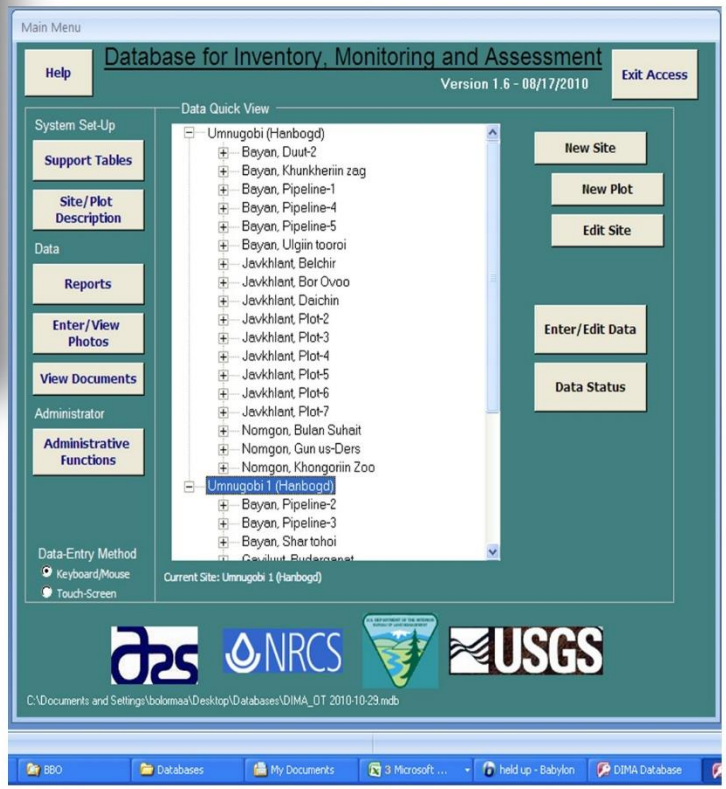


Not clear:

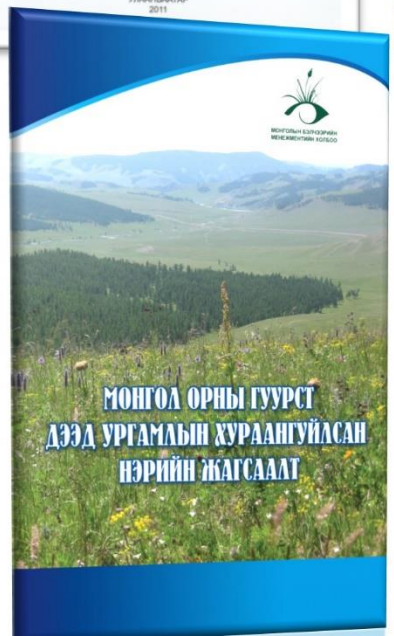
1) **What degradation actually is**
2) **Where is degraded**
3) **Whether it is reversible and how to manage it**

Standardization of national rangeland monitoring methodology

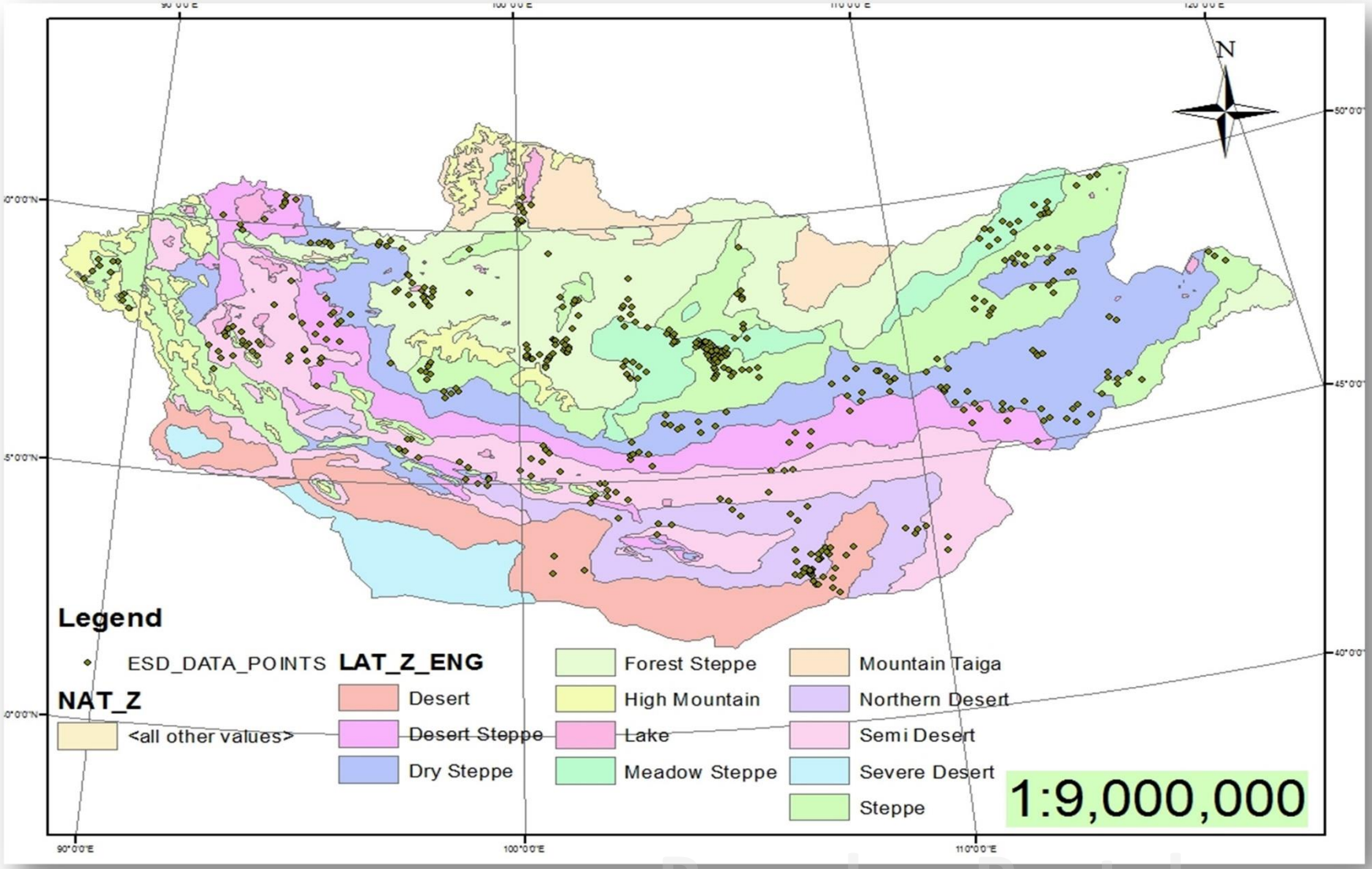
More than 400 meteorology staff and 150 researchers trained



Guides translated for use by government/universities

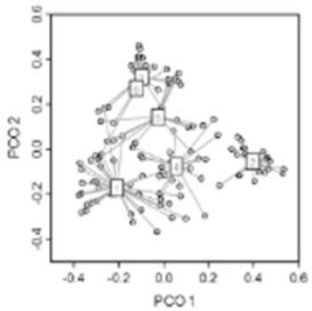


Field inventory and interviews from 2008-2014



Analysis

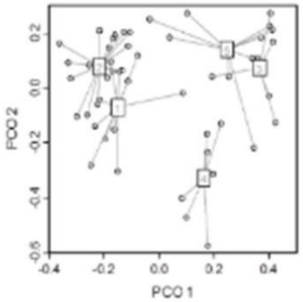
Oit heeriin bus (Forest steppes)



Species frequency and mean cover by cluster

Plant species	Plant species (Mongolian)	1 (n=26)	2 (n=22)	3 (n=15)	4 (n=25)	5 (n=15)	6 (n=5)
Agropyron cristatum	Saman erhug	91(4.7)	59(4.1)	73(3.7)	90(4.0)	53(9.6)	50(2.8)
Allium bidentatum	Shudlig songino	31(3.7)	14(0.5)	33(1.2)	60(2.4)	13(0.5)	0(NaN)
Arenaria capillaris	Hyalgasan dewhergen tsagaan	63(2.9)	45(2.3)	67(6.2)	65(4.0)	20(1.7)	0(NaN)
Artemisia commutata	Hurgan sharlj	14(0.8)	18(2.2)	60(6.7)	30(3.3)	0(NaN)	17(5.0)
Ameblia fimbriata	Tsatsagt bereemeg	14(2.8)	32(2.8)	0(NaN)	55(6.6)	0(NaN)	17(13.2)
Artemisia frigida	Agi	60(5.7)	36(10.0)	67(8.9)	35(3.4)	33(5.2)	0(NaN)
Aster alpinus	Tagin gol geser	29(2.0)	9(2.6)	53(1.9)	15(1.2)	7(0.5)	33(2.4)
Carex duriuscula	Shireg ulalj	91(11.5)	100(44.6)	33(4.6)	100(17.9)	47(7.5)	33(0.6)
Carex korshinskyi	Korjnskin ulalj	14(3.6)	5(1.5)	67(17.7)	5(0.2)	13(0.9)	0(NaN)
Carex pediformis	Zogdor ulalj	6(3.1)	5(0.2)	7(4.0)	15(8.3)	7(4.5)	100(41.5)
Daisphore fruticosa	Suugun borolzgono	0(NaN)	18(4.3)	13(1.1)	5(1.2)	13(7.2)	67(10.4)
Festuca lenensis	Lenin botuuli	31(4.2)	18(0.9)	67(3.0)	35(1.6)	33(8.1)	33(5.0)
Galium verum	Jinhene urumtuul	17(1.5)	18(0.5)	33(2.8)	40(0.9)	20(0.9)	67(5.5)
Koeleria macrantha	Tom tsetsegt daagan suul	83(4.1)	68(1.9)	100(9.0)	90(4.8)	20(5.5)	67(6.2)
Poa attenuata	Suniagar bieleg	37(2.3)	36(1.8)	60(3.6)	55(1.9)	33(1.8)	67(2.1)
Potentilla acaulis	Ishgui gichgene	57(7.3)	32(3.4)	33(8.5)	60(4.1)	13(0.3)	33(10.5)
Potentilla bifurca	Imt gichgene	43(0.8)	77(1.1)	40(1.9)	45(0.7)	33(2.1)	50(1.7)
Pulsatilla turczaninovii	Turchaninovin yargui	34(2.8)	23(1.4)	60(4.7)	65(2.4)	13(0.4)	17(0.8)
Stipa krylovii	Krylovin hyalgana	100(34.5)	41(2.6)	73(5.2)	100(10.9)	60(7.0)	67(18.8)

Nugat heer (Meadow steppe)



Species frequency and mean cover by cluster

Plant species	Plant species (Mongolian)	1 (n=11)	2 (n=18)	3 (n=9)	4 (n=7)	5 (n=5)
Agropyron cristatum	Saman erhug	64(1.6)	83(3.4)	50(2.2)	71(3.0)	80(15.9)
Allium bidentatum	Shudlig songino	45(2.6)	39(2.0)	33(1.2)	57(1.1)	33(0.5)
Artemisia adamsii	Adamsin sharlj	0(NaN)	28(9.2)	33(11.4)	14(1.8)	67(11.9)
Ameblia fimbriata	Tsatsagt bereemeg	0(NaN)	6(2.4)	17(12.0)	0(NaN)	67(6.8)
Artemisia frigida	Agi	55(19.1)	56(6.9)	33(8.0)	86(9.7)	11(12.0)
Caragana microphylla	Byalshan navchit hargana	45(3.8)	28(2.3)	33(11.5)	57(5.4)	44(8.8)
Caragana stenophylla	Narin navchit hargana	27(2.0)	33(1.1)	33(0.4)	43(1.2)	56(1.8)
Chenopodium album	Tsagaan luuli	9(44.0)	6(4.0)	67(4.1)	57(1.3)	33(1.5)
Cleistogenes squarrosa	Cerveen hazaar	55(18.9)	72(11.3)	50(2.8)	71(15.1)	78(1.5)
Carex duriuscula	Shireg ulalj	18(2.0)	33(4.6)	83(8.0)	29(0.8)	100(19.5)
Cymbaria dahurica	Daguur hatnii tsetseg	55(1.4)	17(0.6)	17(1.0)	14(1.0)	22(0.2)
Elymus chinensis	Nangiad tsagaan suli	100(4.4)	78(13.1)	100(22.0)	43(9.2)	78(6.2)
Potentilla bifurca	Imt gichgene	27(0.6)	17(0.3)	50(1.4)	14(0.5)	56(1.0)
Salsola collina	Tolgodiin budargana	9(2.0)	6(1.0)	33(8.9)	71(9.4)	0(NaN)
Serratula centauroides	Hongor zulig hongorzalaa	18(3.1)	11(0.2)	17(0.8)	57(3.0)	0(NaN)
Stipa krylovii	Krylovin hyalgana	100(29.0)	100(50.7)	67(5.2)	86(6.8)	100(16.1)
Thymus gobicus	Govin ganga	0(NaN)	0(NaN)	0(NaN)	57(1.7)	11(9.0)

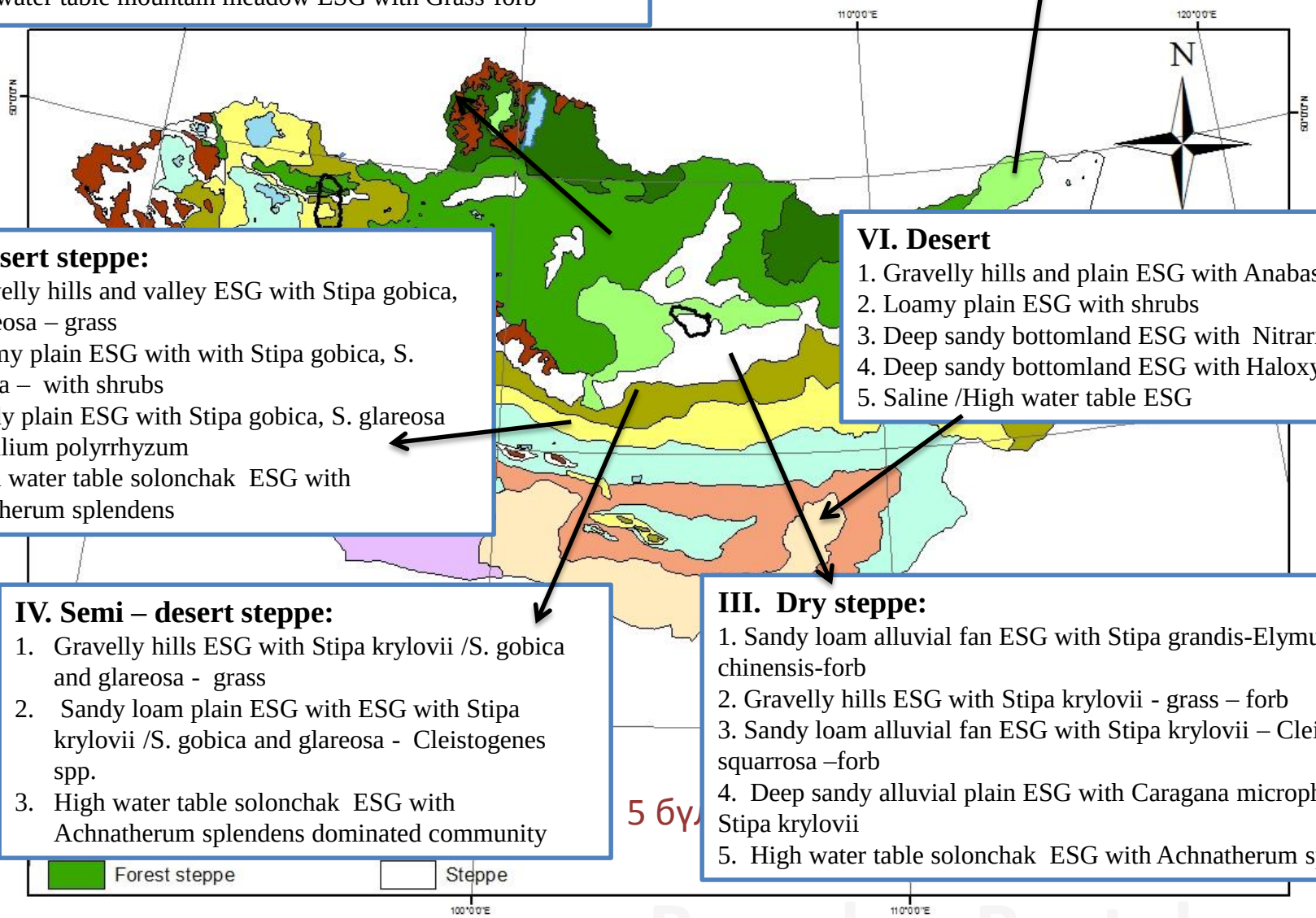
- Used multivariate approaches to test and refine plot assignments to ecoregions
- Subdivide data by ecoregion and test for meaningful differences among putative ecological site classes and states

I. Forest steppe:

1. Gravelly hills ESG with Small bunch grass- forb-artemisia frigida
2. Loamy fan and mountain valley ESG with Small bunch grass-forb
3. High water table river meadow ESG with Carex-forb
4. High water table mountain meadow ESG with Grass-forb

II. Meadow steppe:

1. Loamy fan and mountain valley ESG with Stipa baicalensis- forb



V. Desert steppe:

1. Gravelly hills and valley ESG with Stipa gobica, S. glareosa – grass
2. Loamy plain ESG with with Stipa gobica, S. glareosa – with shrubs
3. Sandy plain ESG with Stipa gobica, S. glareosa with Allium polyrrhyzum
4. High water table solonchak ESG with Achnatherum splendens

VI. Desert

1. Gravelly hills and plain ESG with Anabasis
2. Loamy plain ESG with shrubs
3. Deep sandy bottomland ESG with Nitraria
4. Deep sandy bottomland ESG with Haloxylon
5. Saline /High water table ESG

IV. Semi – desert steppe:

1. Gravelly hills ESG with Stipa krylovii /S. gobica and glareosa - grass
2. Sandy loam plain ESG with ESG with Stipa krylovii /S. gobica and glareosa - Cleistogenes spp.
3. High water table solonchak ESG with Achnatherum splendens dominated community

III. Dry steppe:

1. Sandy loam alluvial fan ESG with Stipa grandis-Elymus chinensis-forb
2. Gravelly hills ESG with Stipa krylovii - grass – forb
3. Sandy loam alluvial fan ESG with Stipa krylovii – Cleistogenes squarrosa –forb
4. Deep sandy alluvial plain ESG with Caragana microphylla – Stipa krylovii
5. High water table solonchak ESG with Achnatherum splendens

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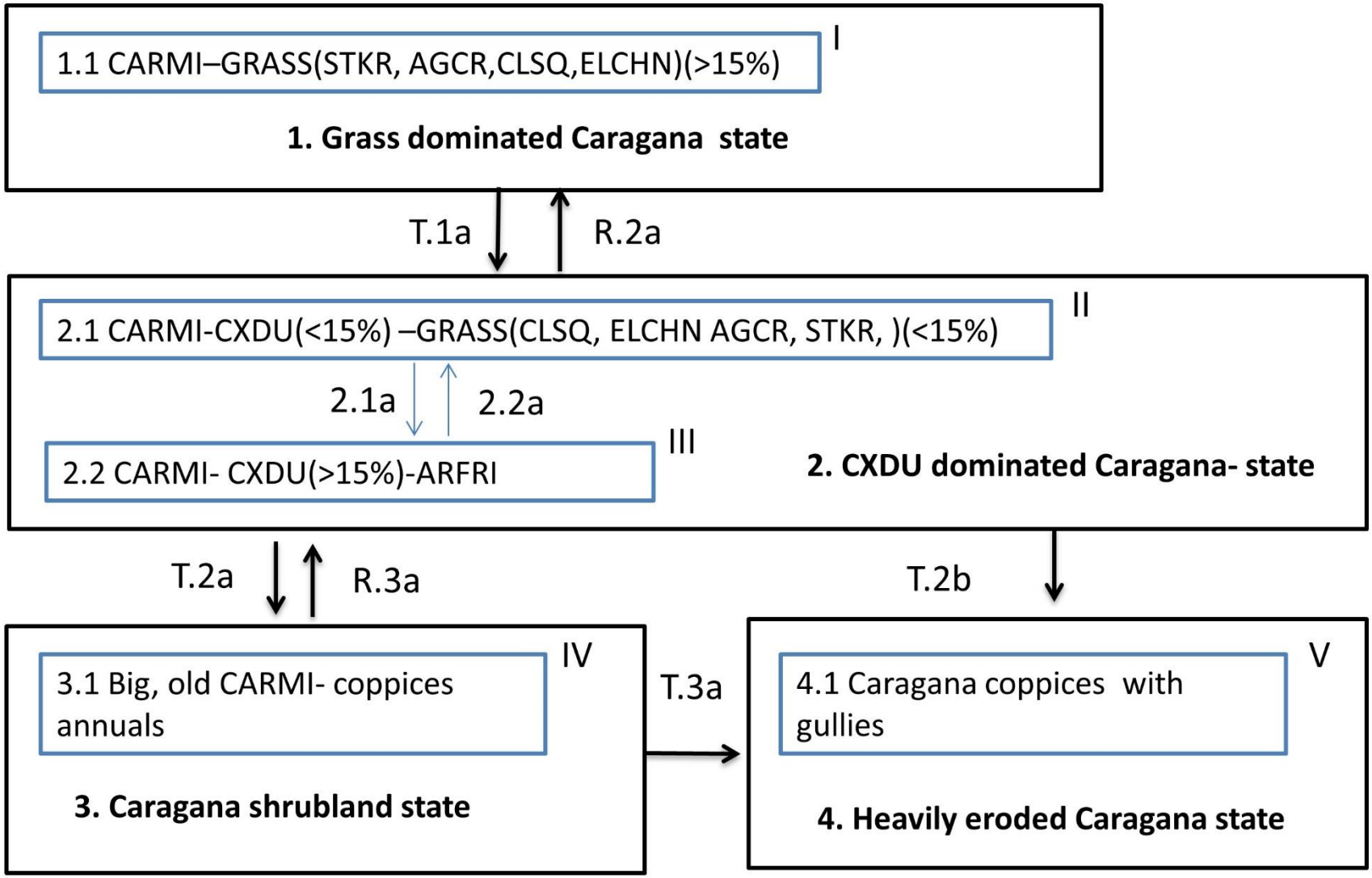
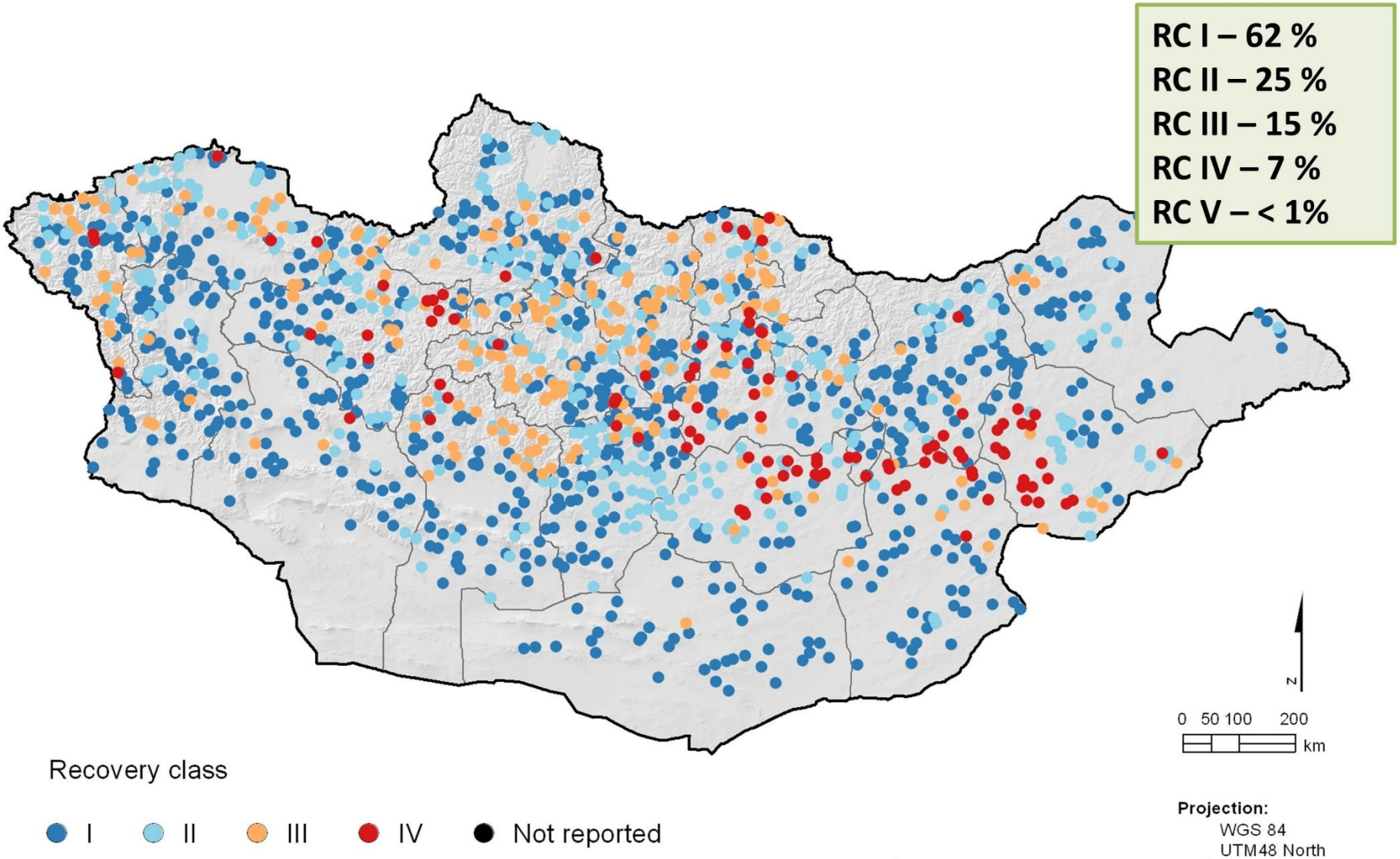
Caragana-grass rangeland in Deep sandy alluvial plain, Steppe



The more than 90 % of altered rangelands can be recovered in 10 years



http://jornada.nmsu.edu/esd/international/mongolia/recovery-classes-interactive-map

Future plans

Similar approach underway in woodlands of Argentina

Monitoring of brush management responses in Namibia

LPKS applications in Kenya, Namibia, and elsewhere