MCC Peri-Urban Rangeland Monitoring Project: Rangeland Monitoring Activity

May 2012

Choibalsan Peri-Urban Area
Kharkhorin Peri-Urban Area

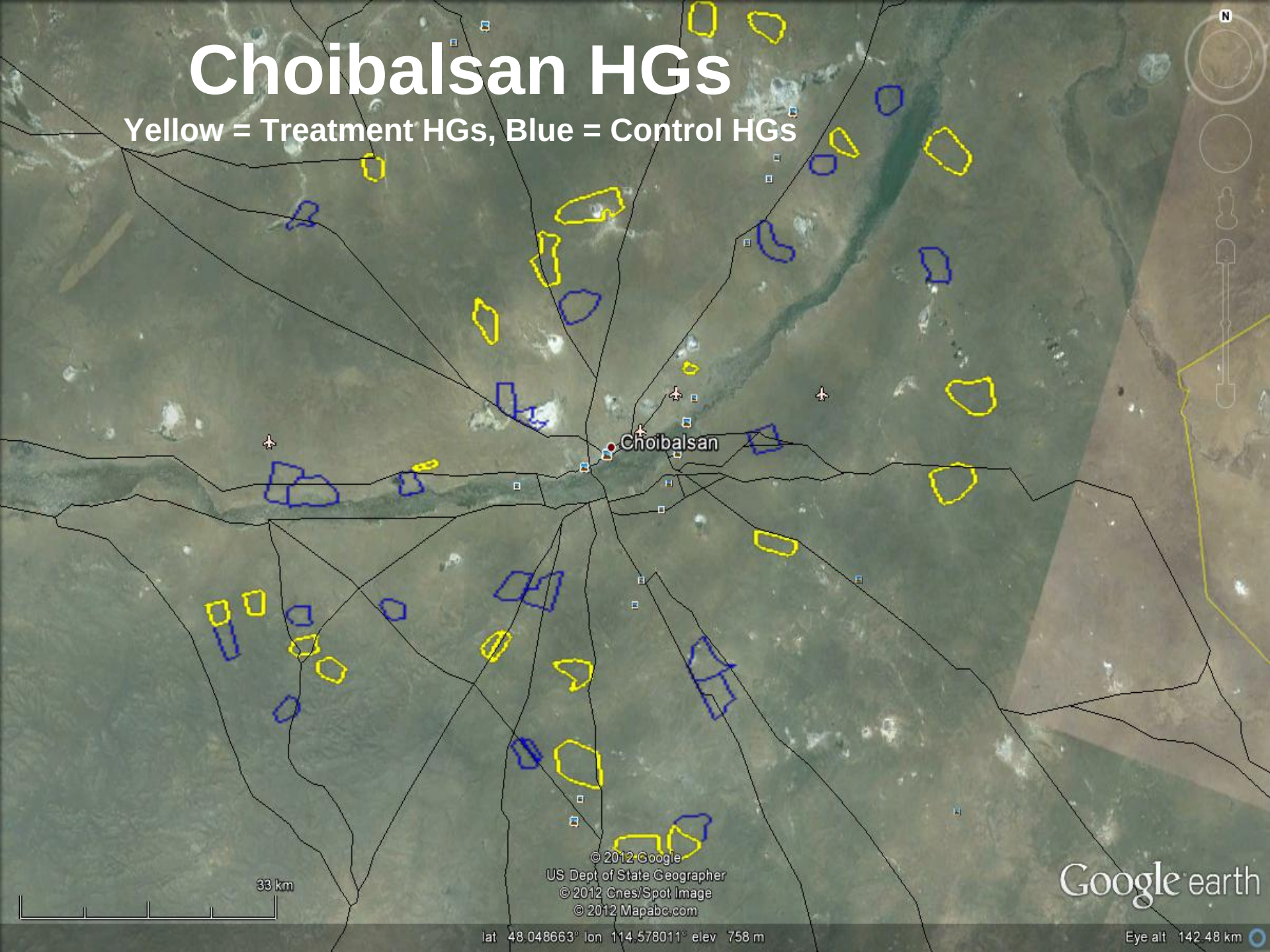
- Preparation (pre-field work)
- Field work completed
- Future work at sites
- Indicators and information generated from field measurements

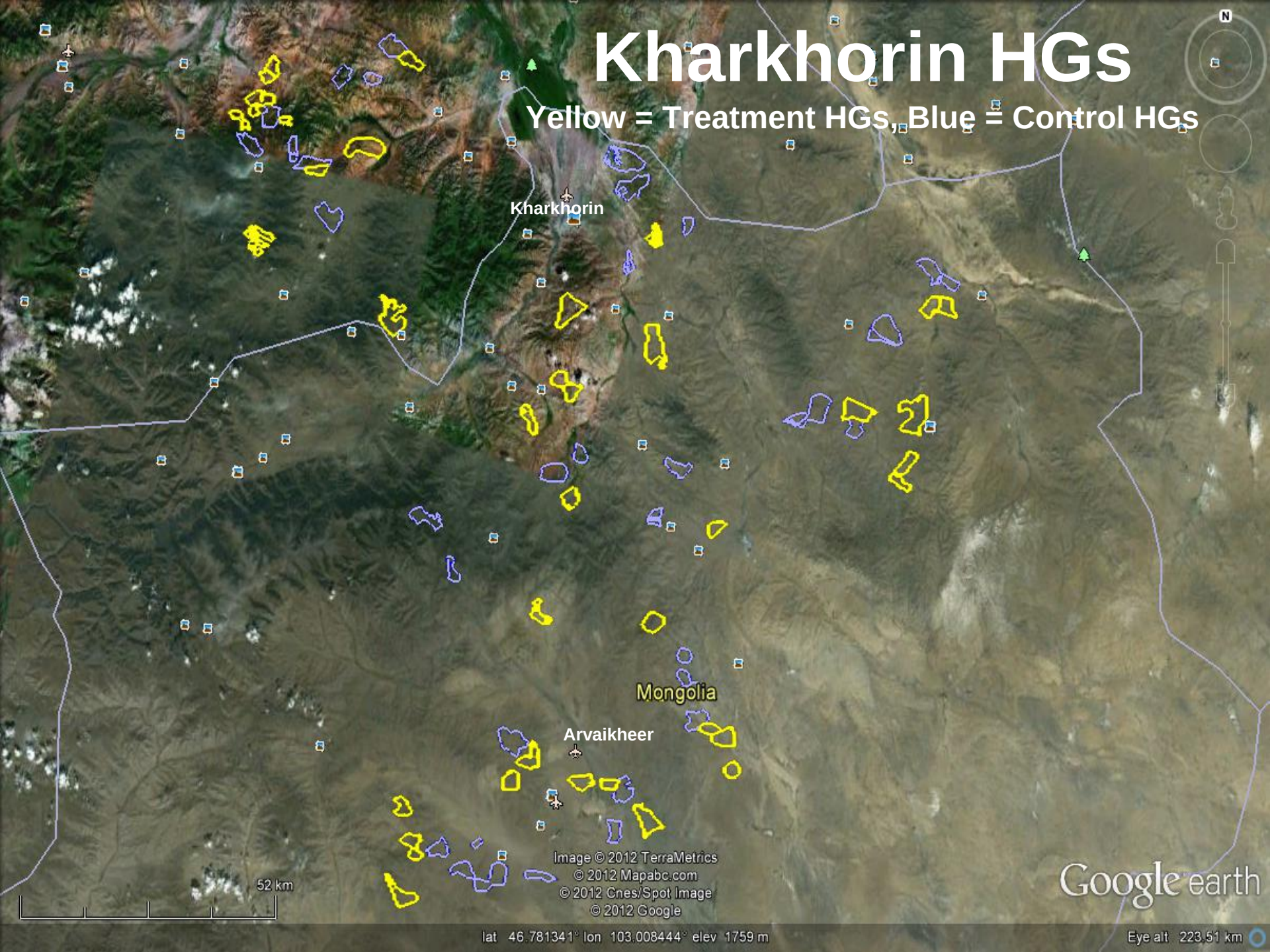
USDA-ARS-Jornada received Phase 2 Herder Group (HG) polygons from IPA (5 April 2012)

- A total of 100 HGs would be sampled.
- Kharkhorin Peri-Urban Area (Övörkhangai and Arkhangai Aimags): 31 Treatments & 31 Controls (plus 3 extra Treatment & Control HG pairs in case of rejections).
- Choibalsan Peri-Urban Area (Dornod Aimag): 19 Treatments & 19 Controls (plus 3 extra Treatment & Control HG pairs in case of rejections).
- Treatment and Control HGs were paired within each study area (Kharkhorin and Choibalsan). Pairing criteria were soum and HG size (ha).
  - Distance between Treatment and Control HGs varied. Some pairs were ~1-km and some were more than 100-km from each other.
- HGs were NOT paired by ecological criteria (i.e., ecological zone, soil type, vegetation community, slopes, aspects, elevation, etc.).
- USDA Jornada Experimental Range overlaid polygons on best generalized map (Google Earth).

Choibalsan HGs

Yellow = Treatment HGs, Blue = Control HGs




Kharkhorin HGs
Yellow = Treatment HGs, Blue = Control HGs
Kharkhorin
Mongolia
Arvaikheer
52 km
Image © 2012 TerraMetrics
© 2012 Mapabc.com
© 2012 Cnes/Spot Image
© 2012 Google
Google earth
lat 46.781341° lon 103.008444° elev 1759 m
Eye alt 223.51 km

Using ArcGIS, the Jornada randomly placed 15 potential sample points within each HG

- Placed points within a 250-meter buffer distance from edge of HG polygon.
- Avoided open water, obvious large roads, steep bare rocky slopes and visible agricultural fields and haymaking areas.
- All points were at least 100-meters from each other.

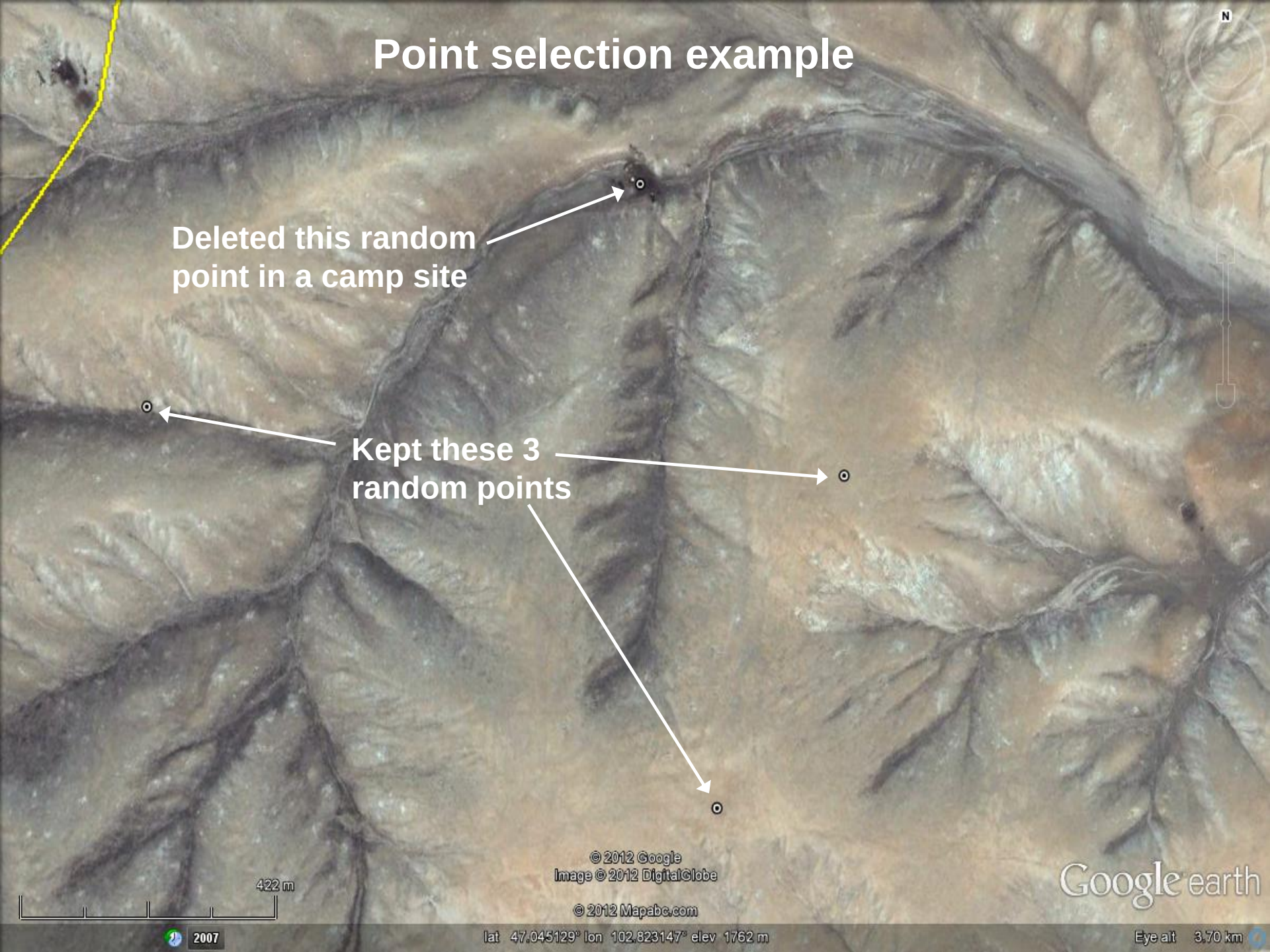
Ulziit Gol HG in Kharkhorin area (example HG) - 15 random points applied

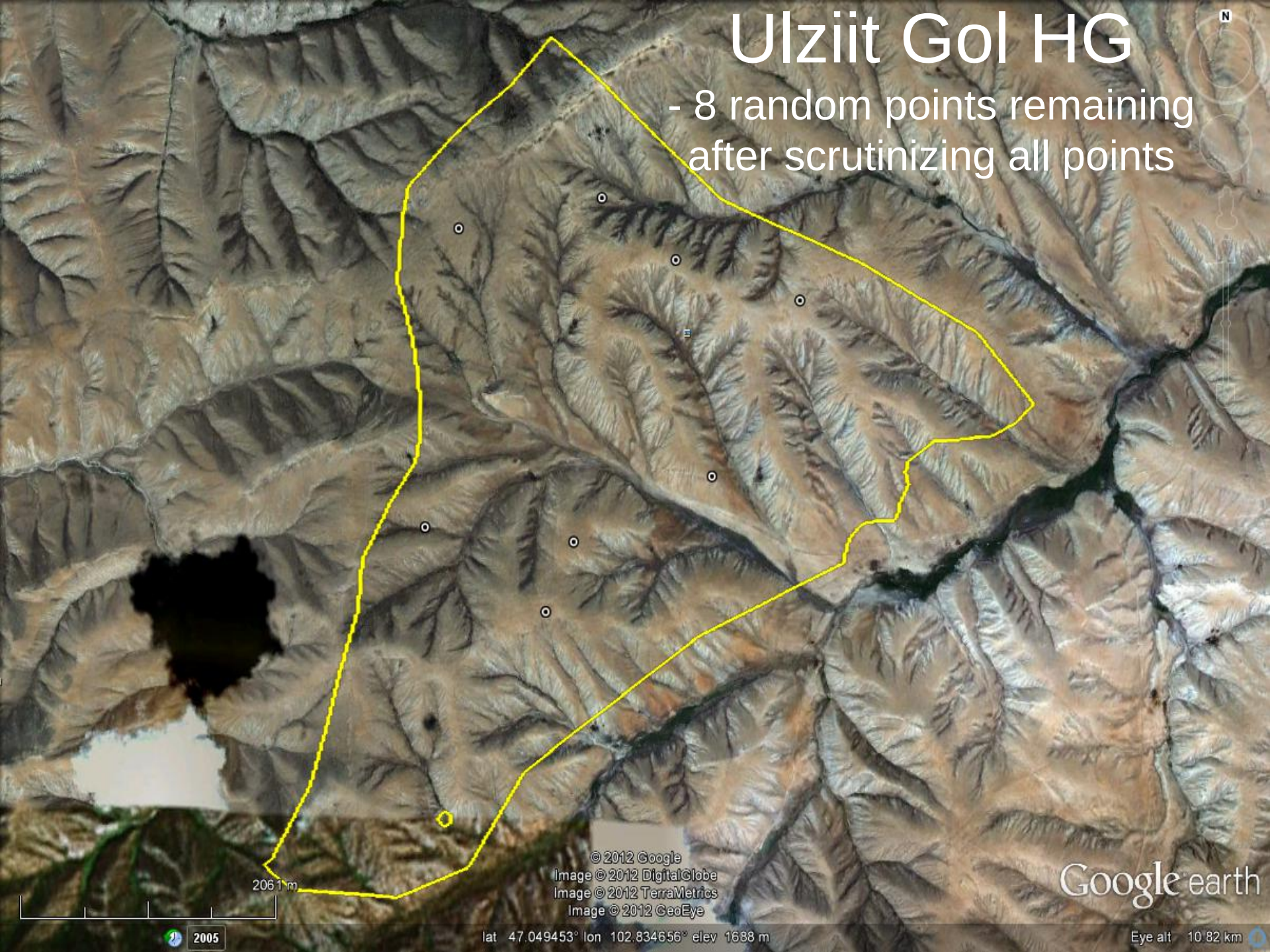
In Google Earth, the Jornada zoomed into every sample point, scrutinized them, and deleted points if they were < 100-meters from:

- A visible road
- A camp site (dark colored dung marks on soil)
- Open water
- A building or other structure
- An agriculture field or haymaking area

If > 8 points remained after this procedure, points were randomly eliminated until 8 remained.

Final number of potential sample points that remained in both Phase 2 study areas = 885.


Point selection example
Deleted this random point in a camp site
Kept these 3 random points
© 2012 Google
Image © 2012 DigitalGlobe
© 2012 Mapabc.com
422 m
Google earth
2007
lat 47.045129° lon 102.823147° elev 1762 m
Eye alt 3.70 km


Ulziit Gol HG
- 8 random points remaining
after scrutinizing all points
2061 m
© 2012 Google
Image © 2012 DigitalGlobe
Image © 2012 TerraMetrics
Image © 2012 GeoEye
Google earth
2005
lat 47.049453° lon 102.834656° elev 1688 m
Eye alt 10.82 km

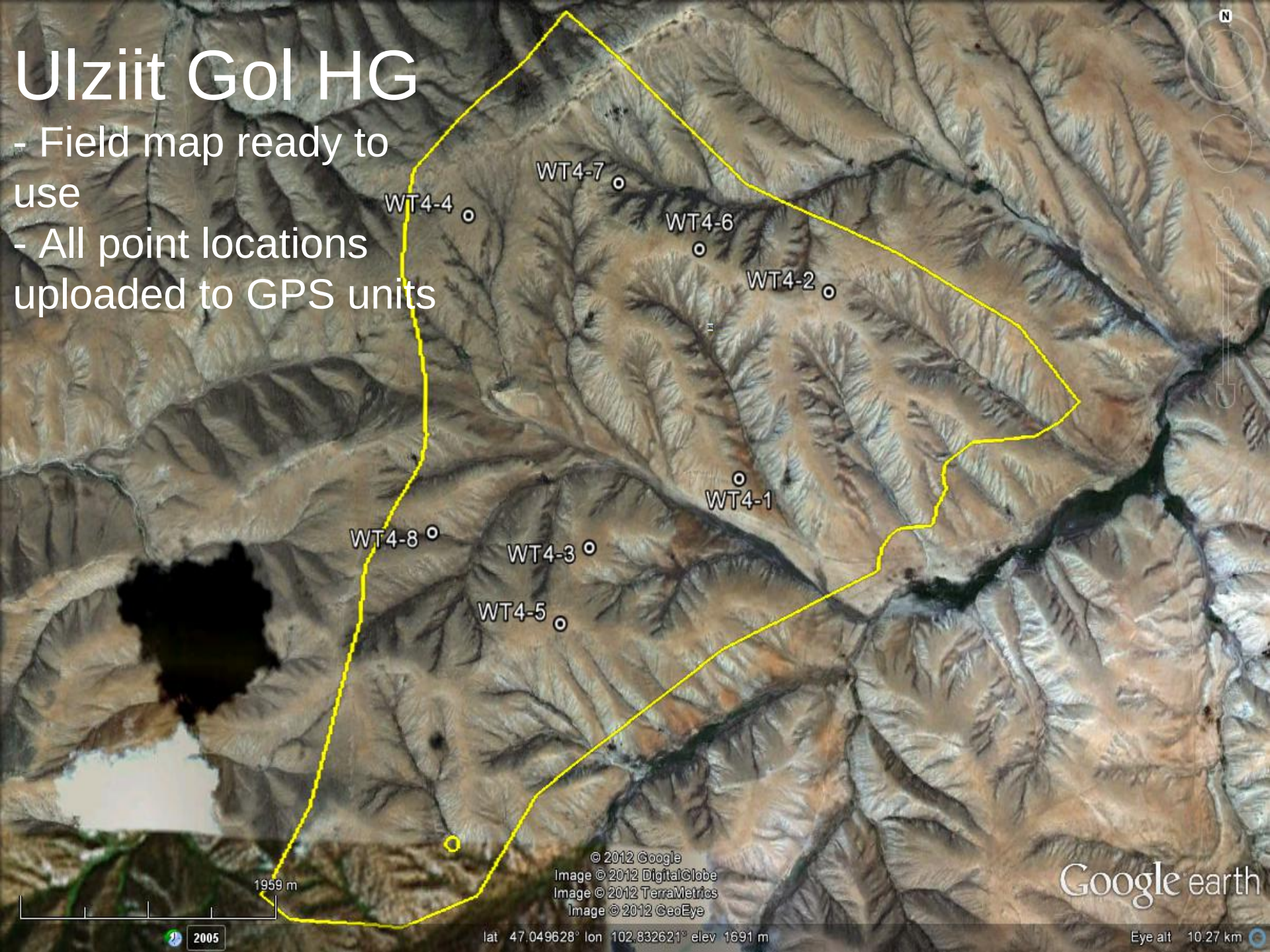
Each of the remaining 885 potential sample points was uniquely labeled in random spatial order.

Field maps were printed of every HG polygon to help site characterization crews navigate to points.

Waypoints of all potential sample points were uploaded to GPS units.

Ulziit Gol HG

- Field map ready to use
- All point locations uploaded to GPS units



Field work prior to May 2012 (Phase 2)

- April 22-May 2: MSRM installed the new fences at 18 Treatment sites from Phase 1.
- Six sites each in Erdenet, Darkhan and Ulaanbaatar peri-urban areas.
- Sites fenced were the 6 best-matched Treatment-Control pairs from each of the 3 peri-urban areas in 2011.
- Sites were chosen by Jornada Experimental Range.


Phase 1 sites from 2011 chosen for re-fencing
Selenge
DN 9-4
DT 9-6
DN 3-2
DT 2-6
DT 3-6
DN 2-5
Darkhan-Uul
DT 1-3
DT 12-4
DN 1-6
DN 12-6
ET 20-3
EN 15-1
EN 20-1
Bulgan
ET 9-2
EN 5-6
ET 5-5
EN 9-3
DT 10-1
EN 3-4
EN 2-2
ET 3-3
DN 10-1
ET 2-6
Hentiyn Mountains
UN 10-1
UT 2-6
UT 10-1
UN 2-6
UN 8-2
Ulaanbaatar
UT 8-3
Ulaanbaatar
UT 20-6
UN 20-3
Kher
UT 17-1
UN 12-1
UN 17-3
UT 12-4
© 2012 Google
US Dept of State Geographer
© 2012 GIS Innovatsia
Image © 2012 TerraMetrics
111 km
Google earth
lat 48.647515° lon 106.358498° elev 1011 m
Eye alt 469.58 km

Phase 2 work begins…

- May 3, 2012: Brief field orientation for site selection/characterization teams, MCA, IPA and fencing teams at site south of Ulaanbaatar.

- May 4, 2012: One team led by Justin Van Zee (USDA-ARS-Jornada) left for Kharkhorin area. Other team led by Pat Shaver (USDA-NRCS) left for Choibalsan area. MSRM personnel assisted both teams.

- Fencing teams followed site selection teams.

Site selection team navigated to 1st random potential sample point on the list within each HG

- Point was accepted if it was:
  - >100-m from a medium to high-use road (defined as such if no vegetation was growing in tire tracks.
  - >100-m from a wall or dung pile of camp
  - >100-m from a building or structure
  - >100-m from a permanent body of water
  - >100-m from an agricultural field or haymaking area
  - On a slope of < 50%
  - Not limited by accessibility (i.e., located in a bog or marsh)
- If point did not meet above criteria, it was rejected and the crew navigated to the 2nd randomly labeled point (not the nearest point), and so on until a point met the criteria above.

Soil pit dug at exact waypoint

- All pits dug to a minimum depth of 70-cm, or until a root restrictive horizon was encountered, if present (i.e., bedrock, petrocalcic, etc.).

Photos were taken of the fresh, undisturbed face of every soil pit

Soil pit diversity: a few examples from the Kharkhorin area

Calcic sandy loam

Shallow sandy loam, in alluvial floodplain

Very gravelly shallow sandy loam

Mountain meadow, loamy w/ frozen soil

Deep sand

Silty floodplain

Cobbly sandy loam

Calcic clay loam

Soil horizons were defined and the depth of each horizon was measured in every pit

- Soil horizons are defined by:
  - Soil structure
  - Color
  - Texture (sand, silt, clay %)
  - Gravel content
  - Calcium carbonate ($CaCO_3$) content

Defining soil horizons

A representative soil sample was collected from each horizon.

Samples were field sieved to 2-mm (standard particle size cutoff between soil and rock).

Volumetric gravel % and cobble % was measured in each horizon, if present. Relates to how much soil volume is available to plants.

Calcium carbonate ($CaCO_3$) content was estimated for each horizon with a field effervescence test.

- 1M HCl is dropped onto a soil subsample and quantity and speed of bubbles that form is observed and rated on a scale.
- Carbonates affect available soil water, soil fertility and nutrient transfer to plants.

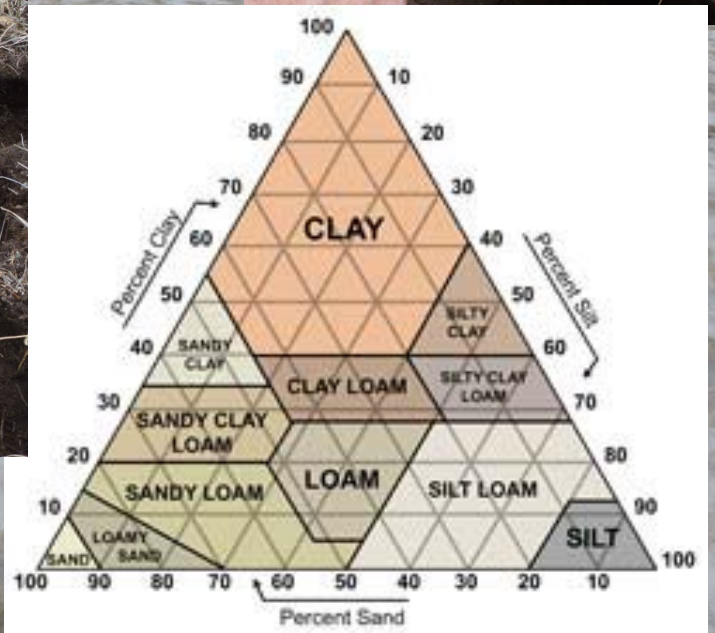
Air-dried soil color was measured for each horizon using the standard Munsell color system

- Soil color helps interpret mineral composition, organic matter content and soil environment (e.g., anaerobic vs. aerobic).

•Soil texture (sand/silt/clay proportions) was estimated for each horizon using a standard field hand texture method.

•Clay content (%) was also estimated for each horizon.

•Indicates what type of plant community could exist at a site, water holding capacity, and how much erosion potential there might be, in addition to many other properties.

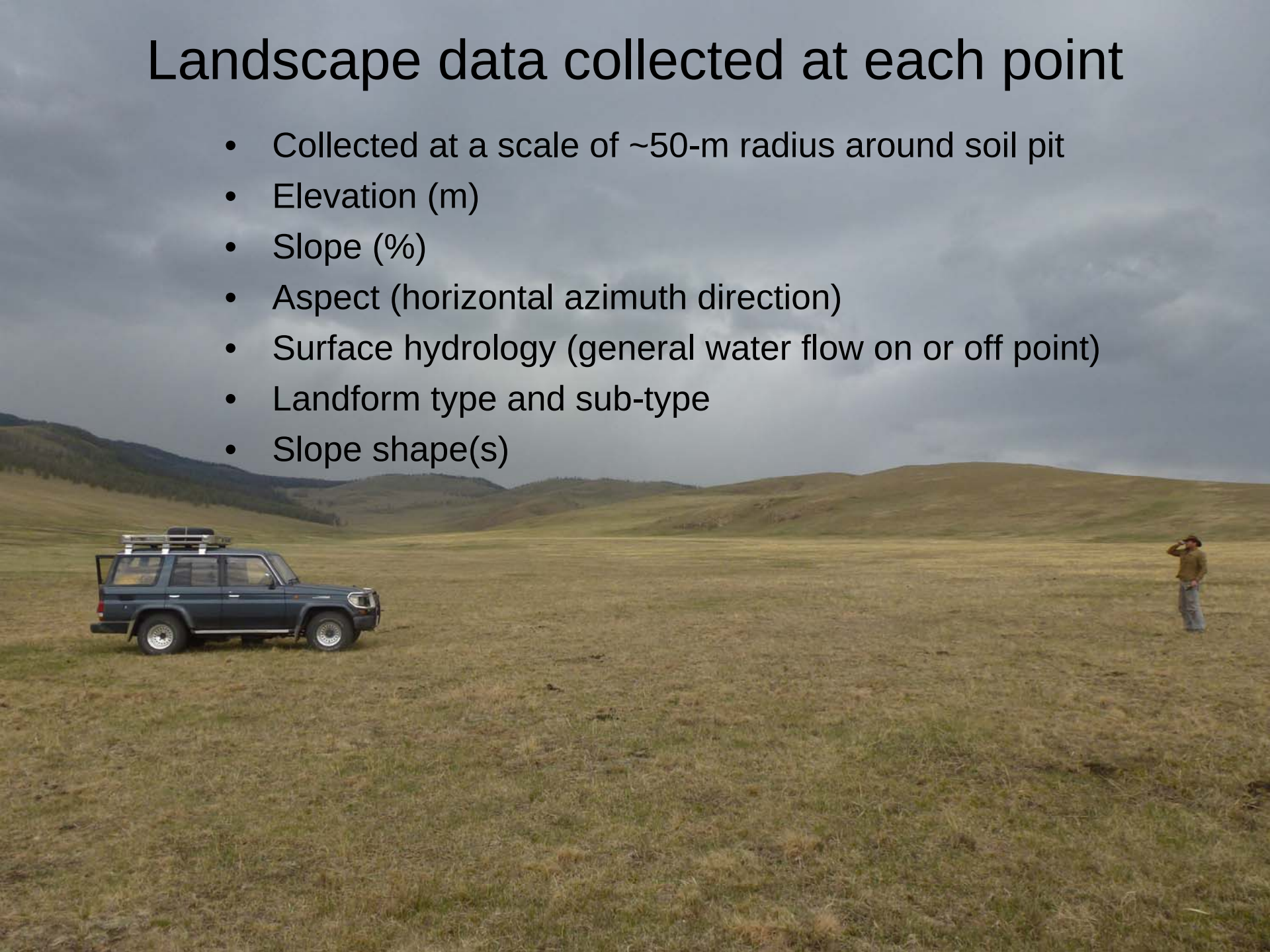


Photos were taken of the fine earth portion of all horizons to record progression of colors within horizons of the pit.

- Relates to soil organic matter, soil development, and carbonate presence.

Landscape data collected at each point

- Collected at a scale of ~50-m radius around soil pit
- Elevation (m)
- Slope (%)
- Aspect (horizontal azimuth direction)
- Surface hydrology (general water flow on or off point)
- Landform type and sub-type
- Slope shape(s)



Four general site photos taken while standing over soil pit, 90-degrees from each other

- Helps put site into landscape perspective; shows general plant community, surface morphology, and geological or anthropogenic features that might affect site.

Upslope

90° clockwise from upslope

180° from upslope

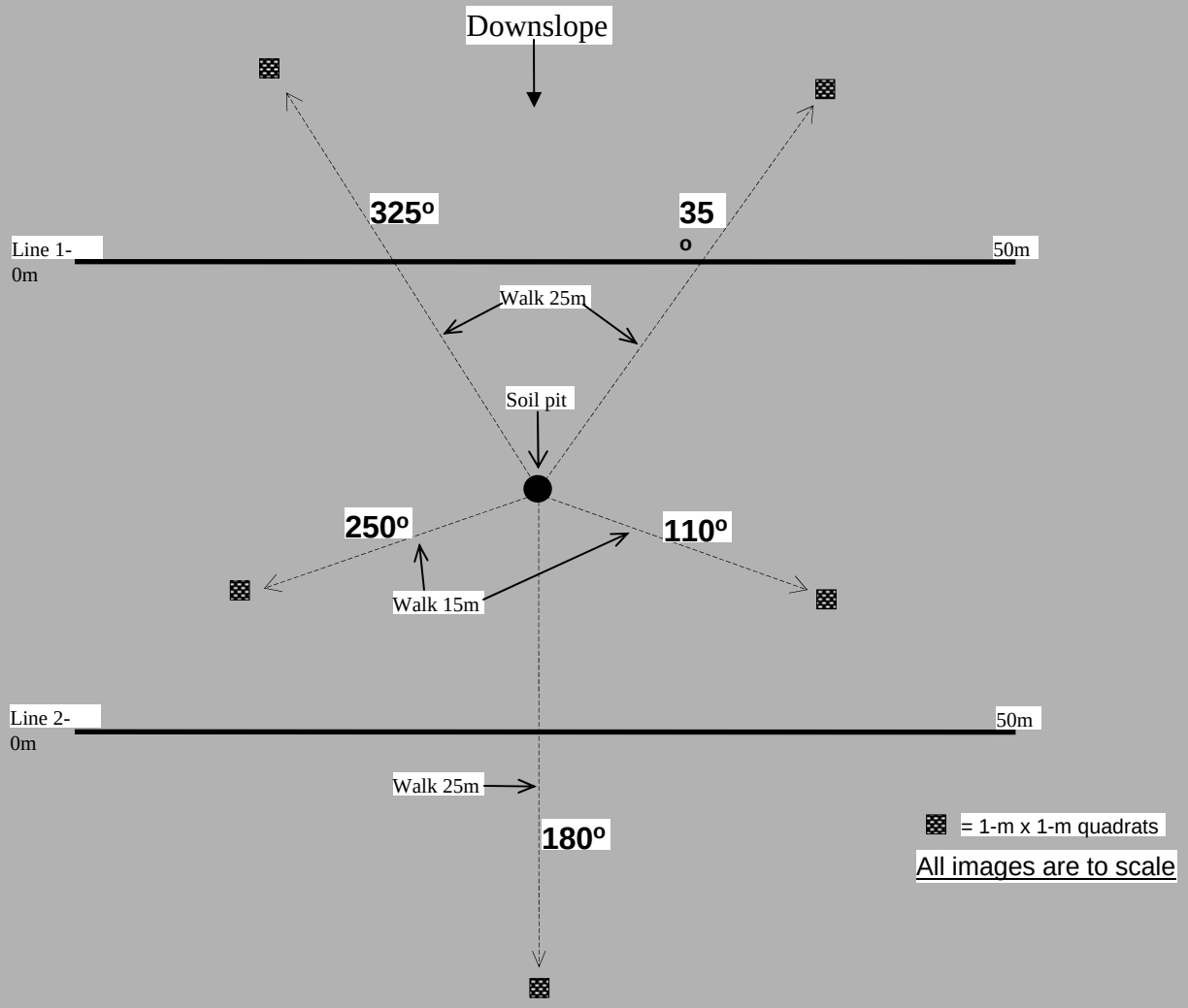
270° clockwise from upslope

If plot was a Control…

- Site Characterization team marked corners of five 1-m X 1-m quadrats in defined directions (relative to aspect at each site) and distances from the soil pit.
- GPS waypoints were collected for all 5 of these quadrats.
- Vegetation in each half of every quadrat will be clipped in Fall 2012, and the other half will be clipped in Spring 2013.

Quadrat and line location diagram for Control plots

Example shown is of a plot with an aspect of 180˚



1-m X 1-m quadrats were placed at 5 points around soil pit

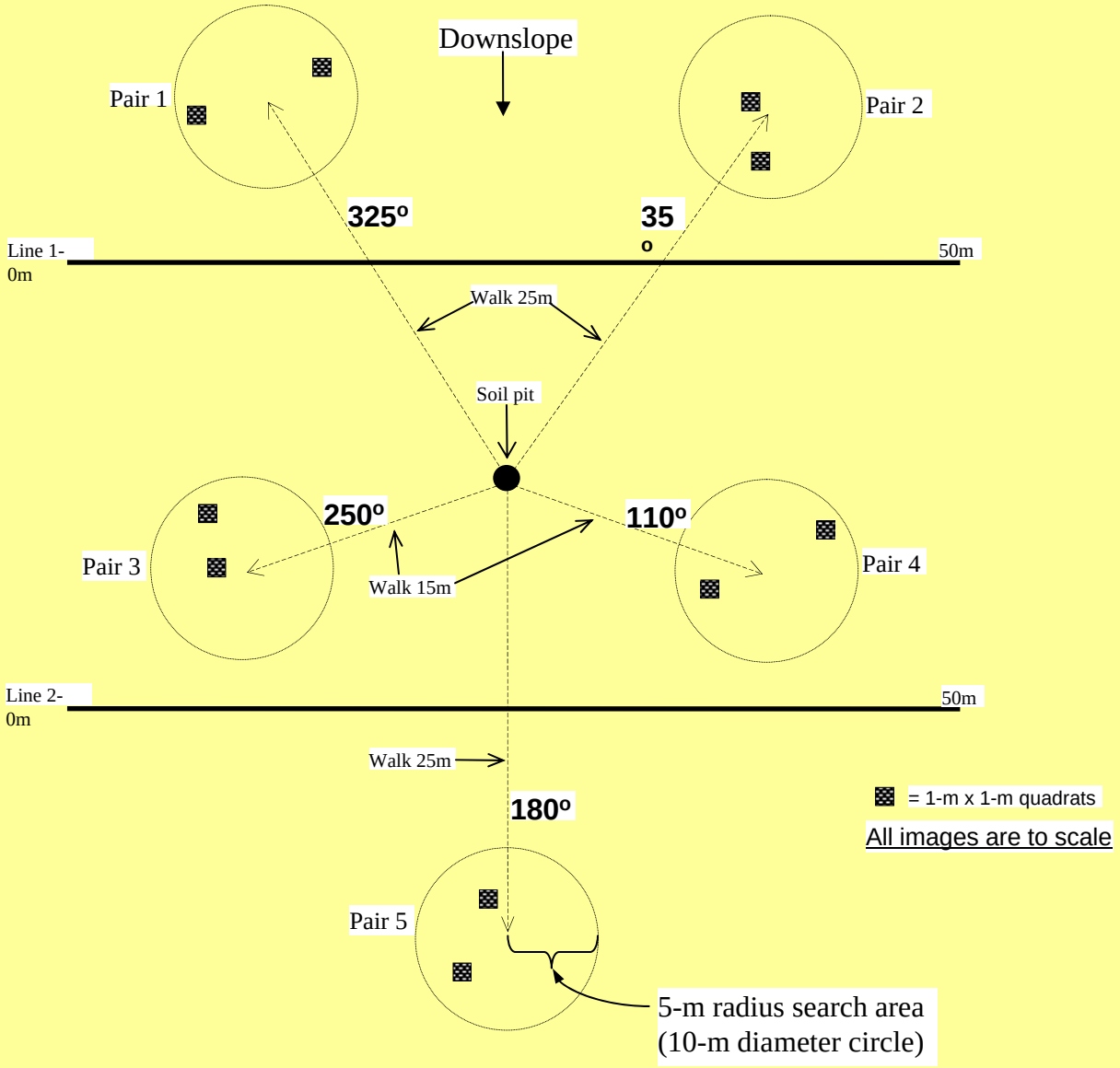
- Corners marked with small square aluminum tags, attached flush to soil with 10-cm nails.
- GPS waypoints were taken of every quadrat.

If plot was a Treatment…

- The site characterization team reported the Site ID, soil pit location and Aspect to the fencing team.
- Fencing team arrived later and installed 5 fences and their paired unfenced control quads.
- Fenced/unfenced quads were installed in the same relative locations at the site as Control plots.
  - Two 1-m X 1-m quadrats were chosen within each 10-m diameter circle, and were matched as closely as possible by percent perennial plant basal cover.
  - Which of the two quadrats would be fenced was then chosen randomly.

Quadrat and line location diagram for Treatment plots

Example shown is of a plot with an aspect of 180˚



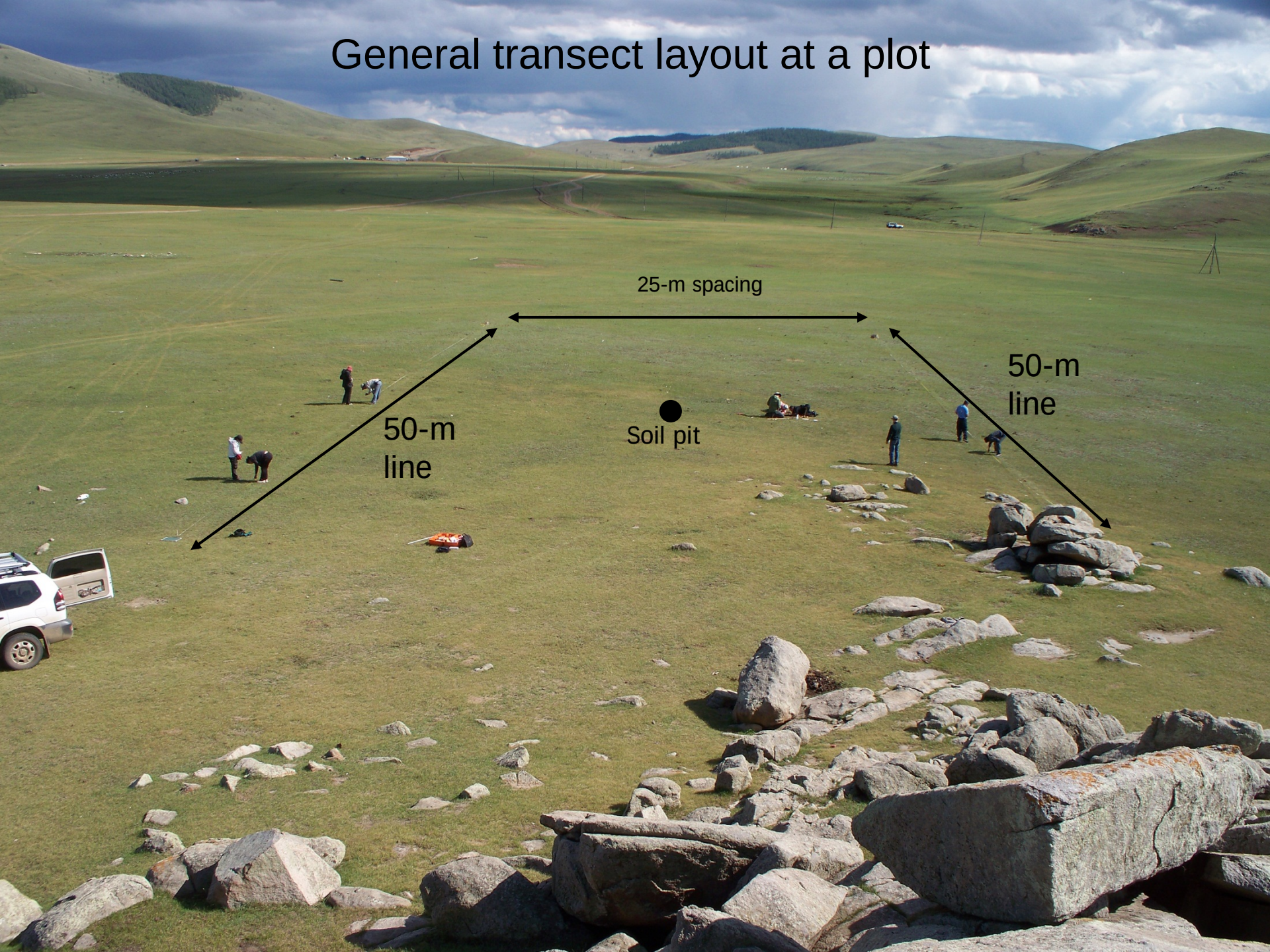
- Five 2-m X 2-m fences (cages) were installed at Treatment plots.
- Each fence protects a 1-m X 1-m quadrat from livestock grazing.
- GPS waypoints were collected for all quadrats.

Future work on project

- Soil and site characterization data will be entered into the Database for Inventory, Monitoring and Assessment (DIMA) and error checked.
- Starting in August 2012 (end of growing season) all 100 plots in Phase 2 and 36 plots in Phase 1 will be re-visited….

- At Phase 2 sites, two 50-m, parallel transects will be installed and many vegetation characteristics will be measured.
  - A common, robust field method used in the U.S. and many other countries to describe vegetation, soils, and site characteristics.
  - Same design has been used for several years at hundreds of sites around Mongolia.
  - Transects are centered around soil pit, are 25-m apart, and are oriented across the dominant slope at each site.

General transect layout at a plot



Measurements in Fall 2012 (August into September)

-Photo points will be taken of each 50-m transect, plus general site photos (Phase 2 plots only).

-Data collected from the two 50-m transects (Phase 2 plots only):

- -Line Point Intercept (LPI)
- -Gap Intercept

-Half of every 1-m X 1-m quadrat will be clipped and plants will be air-dried and weighed (Phase 1 and Phase 2 plots).

- -A photo of every quadrat will be taken before clipping.
- -Basal area of all perennial plants within the 50-cm X 100-cm area will be measured with a point-frame method before clipping.
- -Plants in each quadrat will be clipped and composited by “functional groups” (grasses, sedges, forbs, shrubs, etc.) that are important to livestock in Mongolia.

Measurements in Spring 2013 (late April into early May)

-The remaining half of every 1-m X 1-m quadrat will be clipped and plants will be air-dried and weighed (Phase 1 and Phase 2 plots).

-A photo of every quadrat will be taken before clipping.

-Basal area of all perennial plants within the 50-cm X 100-cm area will be measured before clipping.

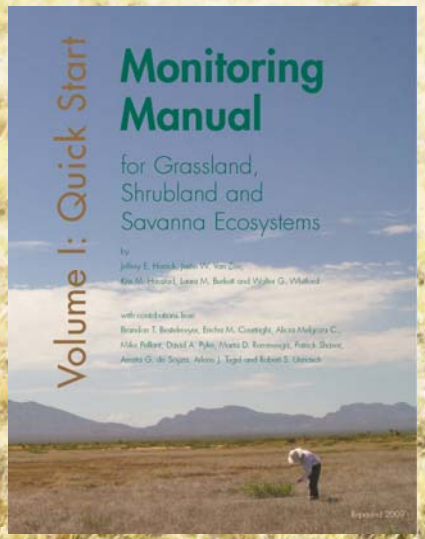
-Plants in each quadrat will be clipped and composited by “functional groups” (grasses, sedges, forbs, shrubs, etc.) that are important to livestock in Mongolia.

Data collected in Fall 2012 and Spring 2013

- Will be entered into DIMA and error checked after each field season.

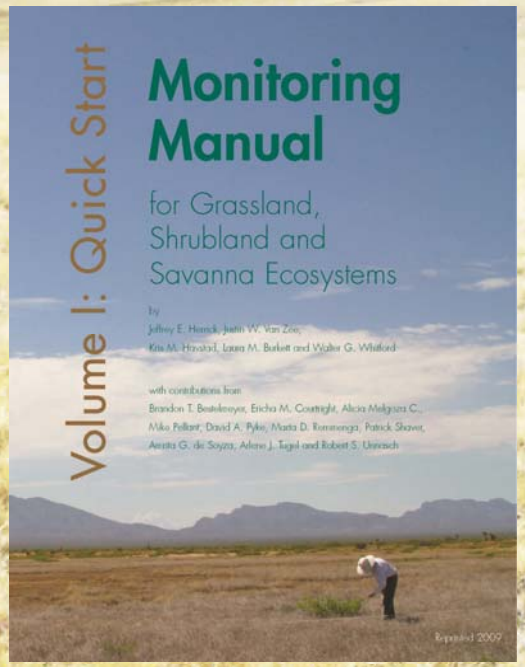
What will these measurements tell us?

- Line Point Intercept (LPI)
  - Percent foliar cover (by species or life form)
  - Percent basal plant cover (by species or life form)
  - Basic plant species richness at a site
  - Percent ground cover (soil covered by herbaceous litter, woody litter, dung, lichens or soil crusts, rocks ≥ 5-mm diameter)
  - Percent bare soil (exposed, uncovered, mineral soil)



What will these measurements tell us?

- <u>Gap Intercept</u>
  -Percent open space between perennial plant bases, with the ability to partition these spaces into categories (25-50-cm, 50-100-cm, 100-200-cm, >200-cm) that relate to site erosion potential.



What will these measurements tell us?

- Soil and site characterization (completed May 2012), in addition to transect-based vegetation and soil measurements (Fall 2012), give us information to begin to classify a site in a functional way and put it into an ecological site perspective.

What will these measurements tell us?

- <u>Plant clipping – Treatment sites</u>
  - Livestock utilization by plant functional group within Treatment sites (fenced quads vs. unfenced quads (kg/ha), or how much forage was consumed by livestock within a site compared to how much was available that season at a site).
    - Growing season (May-August) and Dormant season (Sept-April) estimates.
  - Post-season forage available by plant functional group at Treatment sites (unfenced biomass estimates (kg/ha), or how much forage remains after a growing season, and how much will be available for the upcoming season).
    - Growing season (May-August) and Dormant season (Sept-April) estimates.

What will these measurements tell us?

- <u>Plant clipping – Treatments vs. Controls</u>
  - Forage available by plant functional group between Treatment and Control sites (Treatment unfenced quads vs. Control unfenced quads (kg/ha), or how much forage remains available to livestock at the end of the season at Treatment sites vs. Control sites).
    - Will need to post-stratify and compare sites based on ecological site type (the combination of vegetation, soil, landform and climate characteristics).
    - Growing season (May-August) and Dormant season (Sept-April) estimates.
    - Cannot assess how much utilization occurred within Control sites because fences were not erected in those areas.
  - Forage available by plant functional group at Control sites (unfenced biomass estimates (kg/ha), or how much forage remains after a growing season, and how much will be available for the upcoming season).
    - Growing season (May-August) and Dormant season (Sept-April) estimates.

Agencies involved

- USDA-ARS-Jornada Experimental Range
- Green Gold Pastureland Ecosystem Management Program
- Mongolian Society for Range Management
- USDA-NRCS