COMPOSITION LEVEL: LANDSCAPE

Identity, distribution, richness, and proportions of patch (habitat) types and multipatch landscape types; collective patterns of species distribution (richness, endemism)

A. FOCUS OF METRICS:

1. N/A

B. METRIC(S) EMPLOYED:

1. N/A

C. SCIENTIFIC JUSTIFICATION:

1. N/A

COMPOSITION LEVEL: COMMUNITY/ ECOSYSTEM

Identity, relative abundance, frequency, richness, evenness, and diversity of species and guilds; proportions of endemic, exotic, threatened, and endangered species, dominance-diversity curves; life form proportions; C3-C4 plant ratios

A. FOCUS OF METRICS:

1. Plant species richness: high richness of both grass and forb species, has been identified as an indicator of habitat quality for Utah Prairie dogs. However, this element of biodiversity is not discussed in the recovery plan.

B. METRIC(S) EMPLOYED:

1. Plant species richness: assess native plant species richness (grasses and forbs). Areas with greater than 10 species (at least 3 grass and 3 forb) are rated higher than those with fewer. No explicit survey method described for acquiring this information.

C. SCIENTIFIC JUSTIFICATION:

1. Plant species richness is associated with increased weight gain, higher juvenile to adult ratios, and higher animal densities of prairie dogs (Crocker-Bedford and Spillett 1981; Ritchie and Chang 2001)

COMPOSITION LEVEL: SPECIES

Absolute or relative abundance; frequency; importance or cover value; biomass; density

A. FOCUS OF METRICS:

1. The continuance of Utah prairie dog, as a species, is the primary goal of the mitigation practices.
2. Low overall population density is a secondary species-level composition element identified as reducing risk of plague-related extirpations.

B. METRIC(S) EMPLOYED:

1. Utah prairie dog abundance: annual population surveys are required both for impact and offset locations. Methods include: visual observation, auditory detection, and physical sign of prairie dogs (i.e., fecal pellets, tracks, fresh digging/ burrows).
2. Population density is NOT directly assessed as part of metrics, and is not part of credit calculation. However, overall size of the colony is a metric employed, so density could be calculated.

C. SCIENTIFIC JUSTIFICATION:

1. Although the Utah Prairie Dog Final revised recovery plan (1991) defines survey methodology, it provides no scientific justification for any methods as being appropriate for survey of this species.
2. High prairie dog density is linked to outbreaks of sylvatic plague (Barnes 1993).

COMPOSITION LEVEL: GENETIC

Allelic diversity; presence of particular rare alleles, deleterious recessives, or karyotypic variants

A. FOCUS OF METRICS:

1. Utah prairie dogs have notably low genetic variation as a species. Managing colonies for genetic diversity and minimum population size is critical to population survival as well as long-term fitness of the species

B. METRIC(S) EMPLOYED:

1. Population size surveys are required and higher conservation value is placed upon larger colony populations. This metric is used as a proxy for genetic diversity. No study supports minimum population size for maintaining genetic variability in this species. Here, population size below 30 are not considered to have adequate genetic variability. No direct measure of genetic variability is conducted.

C. SCIENTIFIC JUSTIFICATION:

1. Inbreeding among prairie dog populations of various species in the *Cynomys* genus is well-documented (Hoogland, 1992, Travis et.al., 1995, Johnson and Collinge, 2004). Frequent plague-induced population crashes are exacerbating inbreeding and genetic diversity issues for this species, which may lead to high risk of extirpation (Travis et al., 1997). This is particularly of note among Utah prairie dogs which experienced a bottleneck event in the 1920's. Given the high risk of inbreeding depression and loss of genetic diversity due to plague and habitat fragmentation which, in turn may lead to long-term non-viability for the species, assessing gene flow in and around impacted areas is likely critical to viability.

STRUCTURE LEVEL: LANDSCAPE

Heterogeneity; connectivity; spatial linkage; patchiness; porosity; contrast; grain size; fragmentation; configuration; juxtaposition; patch size; frequency distribution; perimeter-area ratio; pattern of habitat layer distribution

A. FOCUS OF METRICS:

1. Connectivity for areas of suitable habitat within the greater ecosystem. Connectivity promotes recolonization and genetic diversity of the species

B. METRIC(S) EMPLOYED:

1. Assess sides of a prairie dog colony that are “barred from dispersal.” If zero to two sides are barred from dispersal within 2km, colony receives a strong positive value in scoring. If three sides are barred, colony receives a small positive value. Barred on all four sides receives no positive value in scoring.

C. SCIENTIFIC JUSTIFICATION:

1. Connectivity is linked to genetic diversity (C1) metric through Recovery Plan, but not through literature. Genetic diversity’s value to prairie dogs identified in: Chauser, 1984 and Ritchie and Brown 2005,

STRUCTURE LEVEL: COMMUNITY/ ECOSYSTEM

Substrate and soil variables; slope and aspect; vegetation biomass and physiognomy; foliage density and layering; horizontal patchiness canopy opens and gap proportions; abundance, density, and distribution of key physical features (e.g., cliffs, outcrops, sinks) and structural elements (snags, down logs); water and resource (e.g., mast) availability; snow cover

A. FOCUS OF METRICS:

1. Shrub canopy cover: prairie dogs avoid areas where brushy species dominate
2. Percent ground cover: no defined explanation of value of this metric given

B. METRIC(S) EMPLOYED:

1. Average shrub canopy cover: Percent shrub canopy is assessed into three categories (above 20%, between 11 and 20%, and below 10%). These are considered low, medium, and high quality (respectively) value as prairie dog habitat.
2. Percent ground cover: Percent ground cover of plants is assessed into three categories (20% or less, 20-60%, and above 60%). These are considered low, medium, and high quality (respectively) value as prairie dog habitat).

C. SCIENTIFIC JUSTIFICATION:

1. High density of shrubs are avoided by prairie dogs (Collier 1875, Player and Urness 1982).
2. No justification given

STRUCTURE LEVEL: SPECIES

Dispersion (microdistribution); range (macrodistribution); population structure (sex ratio, age ratio); habitat variables (see Community/Ecosystem Structure description); within-individual morphological variability

A. FOCUS OF METRICS:

1. Well drained soils: to a depth of at least 1m are necessary to provide adequate substrate for burrows that protect prairie dogs from predators and freeze

B. METRIC(S) EMPLOYED:

1. No metrics are utilized to address this stated necessary element of biodiversity through the habitat exchange program

C. SCIENTIFIC JUSTIFICATION:

1. Population survival depends upon ability for prairie dogs to build good burrow systems. This requires well-drained soils to a depth of at least 1m (Collier 1975; Player and Urness 1982).

STRUCTURE LEVEL: GENETIC

Census and effective population size; heterozygosity; chromosomal or phenotypic polymorphism; generation overlap; heritability

A. FOCUS OF METRICS:

1. N/A

B. METRIC(S) EMPLOYED:

1. N/A

C. SCIENTIFIC JUSTIFICATION:

1. N/A

FUNCTION LEVEL: LANDSCAPE

Disturbance processes (areal extent, frequency or return interval, rotation period, predictability, intensity, severity, seasonality); nutrient cycling rates; energy flow; patch persistence and turnover rates; rates of erosion and geomorphic and hydrologic processes; human land-use trends.

A. FOCUS OF METRICS:

1. N/A

B. METRIC(S) EMPLOYED:

1. N/A

C. SCIENTIFIC JUSTIFICATION:

1. N/A

FUNCTION

LEVEL: COMMUNITY/ ECOSYSTEM

Biomass and resource productivity; herbivory, parasitism, and predation rates; colonization and local extinction rates; patch dynamics (fine-scale disturbance processes), nutrient cycling rates; human intrusion rates and intensities.

A. FOCUS OF METRICS:

1. N/A

B. METRIC(S) EMPLOYED:

1. N/A

C. SCIENTIFIC JUSTIFICATION:

1. N/A

FUNCTION

LEVEL: SPECIES

Demographic processes (fertility, recruitment rate, survivorship, mortality); metapopulation dynamical population genetics; population fluctuations; physiology; life history; phenology; acclimation adaptation

A. FOCUS OF METRICS:

1. Long-term persistence of the species in multiple locations is a stated priority 1 goal of the Recovery plan

B. METRIC(S) EMPLOYED:

1. Persistence of colony over a duration of years is evaluated. Colonies known to be consistently populated for more than 10 years are given the highest value in calculation of credits. Those of intermediate age (between 6 and 10 years) are given an intermediate credit value, and those of unknown age or with occupancy less than 6 of the last 10 years receive no additional value in credit calculations.

C. SCIENTIFIC JUSTIFICATION:

1. While

Lomolino, M.V., G.A. Smith, and V. Vidal. 2003.

2.

FUNCTION

LEVEL: GENETIC

Inbreeding depression; outbreeding rate; rate of genetic drift; gene flow; mutation rate; selection intensity

A. FOCUS OF METRICS:

1. Utah prairie dogs have notably low genetic variation as a species. Managing colonies for genetic diversity and minimum population size is critical to population survival as well as long-term fitness of the species

B. METRIC(S) EMPLOYED:

1. Population size surveys are required and higher conservation value is placed upon larger colony populations. This metric is used as a proxy for genetic diversity. No study supports minimum population size for maintaining genetic variability in this species. Here, population size below 30 are not considered to have adequate genetic variability
2. No direct measure of genetic diversity is conducted

C. SCIENTIFIC JUSTIFICATION:

1. Inbreeding among prairie dog populations of various species in the *Cynomys* genus is well-documented (Hoogland, 1992, Travis et.al., 1995, Johnson and Collinge, 2004). Frequent plague-induced population crashes are exacerbating inbreeding and genetic diversity issues for this species, which may lead to high risk of extirpation (Travis et al., 1997). This is particularly of note among Utah prairie dogs which experienced a bottleneck event in the 1920's. Given the high risk of inbreeding depression and loss of genetic diversity due to plague and habitat fragmentation which, in turn may lead to long-term non-viability for the species, assessing gene flow in and around impacted areas is likely critical to viability.