U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

NUCLEAR WASTE TECHNICAL REVIEW BOARD ENVIRONMENT AND PUBLIC HEALTH PANEL MEETING

SUBJECT: YMP RECLAMATION PROGRAM

PRESENTER: CATHY WILLS

PRESENTER'S TITLE AND ORGANIZATION: RECLAMATION PROGRAM MANAGER
EG&G ENERGY MEASUREMENTS

PRESENTER'S TELEPHONE NUMBER: (702) 794-7477

LAS VEGAS, NEVADA
NOVEMBER 22, 1993

YMP RECLAMATION PROGRAM

PURPOSE:

To return sites disturbed by site characterization activities to a stable ecological state with similar form and productivity

LEGISLATION, REGULATORY REQUIREMENTS, DOE COMMITMENTS:

- **Nuclear Waste Policy Act**
- **National Environmental Policy Act**
- **Federal Land Policy and Management Act (ROW Agreement)**
- **Endangered Species Act (Biological Opinion)**
- **DOE Order 5400.1, "General Environmental Protection Program"**
- **DOE Order 6430.1, "General Design Criteria"**
- **DOE Mission Plan**
- **Yucca Mountain Environmental Assessment**
- **Site Characterization Plan**
- **Environmental Monitoring and Mitigation Plan**
- **Reclamation Program Documents**

RECLAMATION PROGRAM DOCUMENTS

Reclamation Program Plan (RPP)

- Defines DOE reclamation policy for Yucca Mountain
- Provides overview of reclamation program

Reclamation Implementation Plan (RIP)

- Describes steps to be taken in implementing reclamation policy

Reclamation Feasibility Plan (RFP)

- Describes methods to investigate the success of various restoration/reclamation techniques which will be incorporated into site-specific implementation plans

RECLAMATION PROGRAM COMPONENTS

- Reclamation Feasibility Studies
  - Disturbed habitat studies
  - Reclamation trials
  - Stockpiled soil viability studies
  - Mined spoils revegetation studies

- Interim Reclamation Activities
  - Reclamation inventories
  - Site-specific reclamation stipulations
  - Site stabilization

- Final Reclamation Activities
  - Site inventory (post-activity survey)
  - Final reclamation plans
  - Recontouring and revegetation

- Post-Reclamation Activities
  - Revegetation monitoring
  - Wildlife use monitoring
  - Additional reclamation activities as needed

RECLAMATION FEASIBILITY STUDIES

DISTURBED HABITAT STUDIES

Site Inventory

Objective: To identify past disturbances at Yucca Mountain to be reclaimed and those to be used for natural succession studies and revegetation field trials

Components:

- Site history
- GIS base map
- Inventory database

RECLAMATION FEASIBILITY STUDIES

DISTURBED HABITAT STUDIES

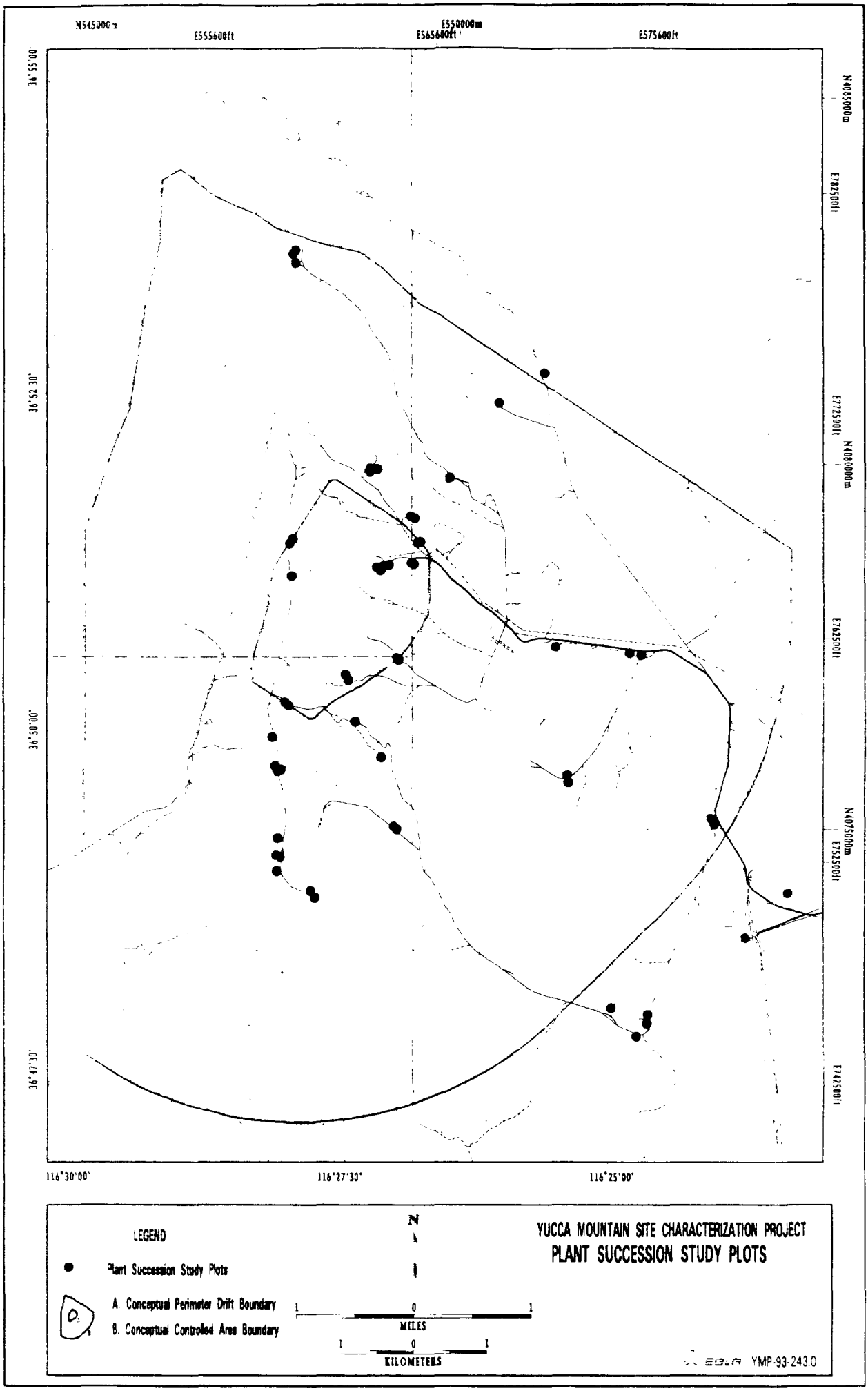
Succession Study

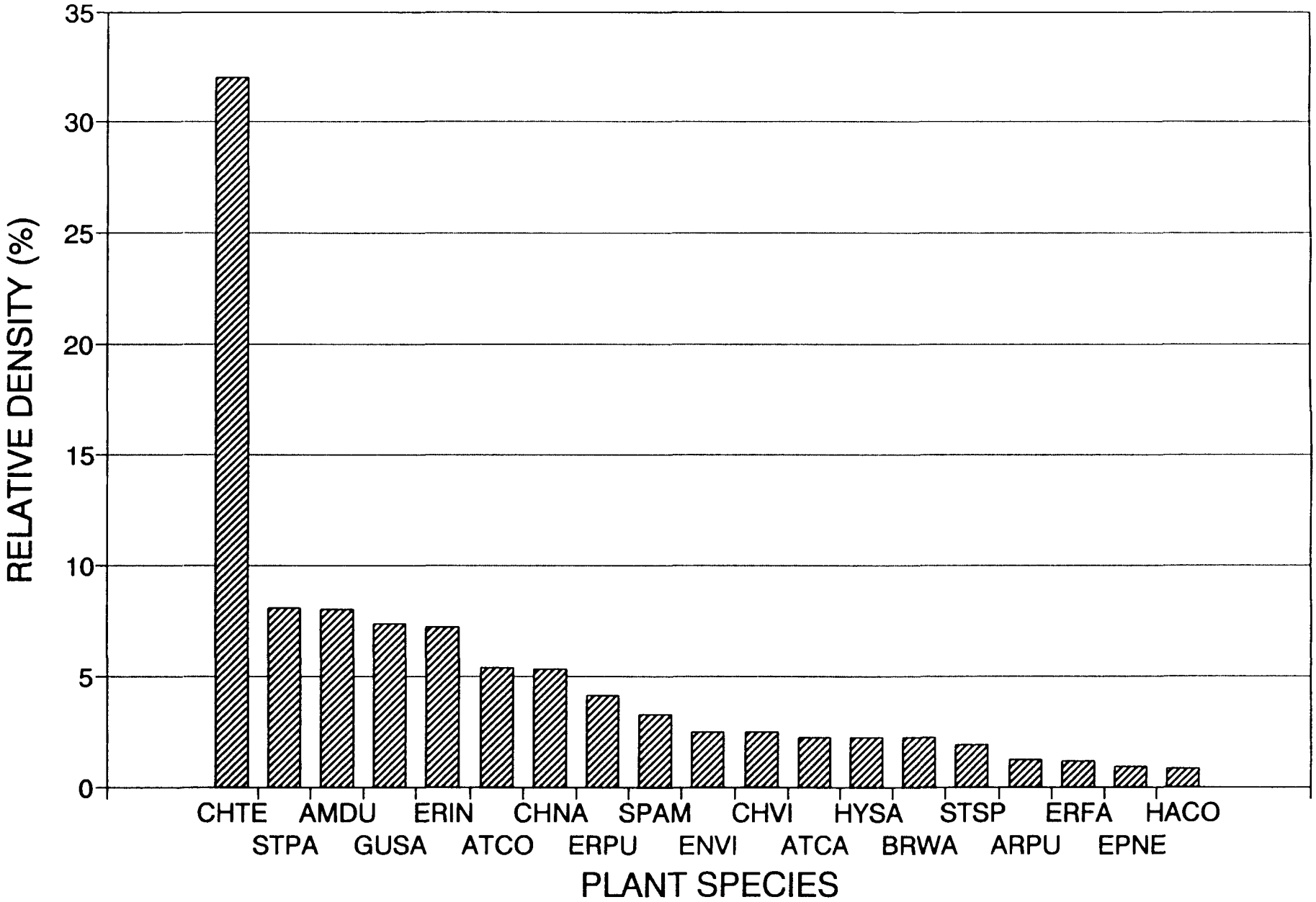
Objectives:

- Describe the native vegetation growing on disturbed sites
- Identify early successional or pioneer species specific to particular vegetation associations for use in interim/final site reclamation
- Identify species to be included in reclamation field trials to examine planting techniques that may enhance their establishment

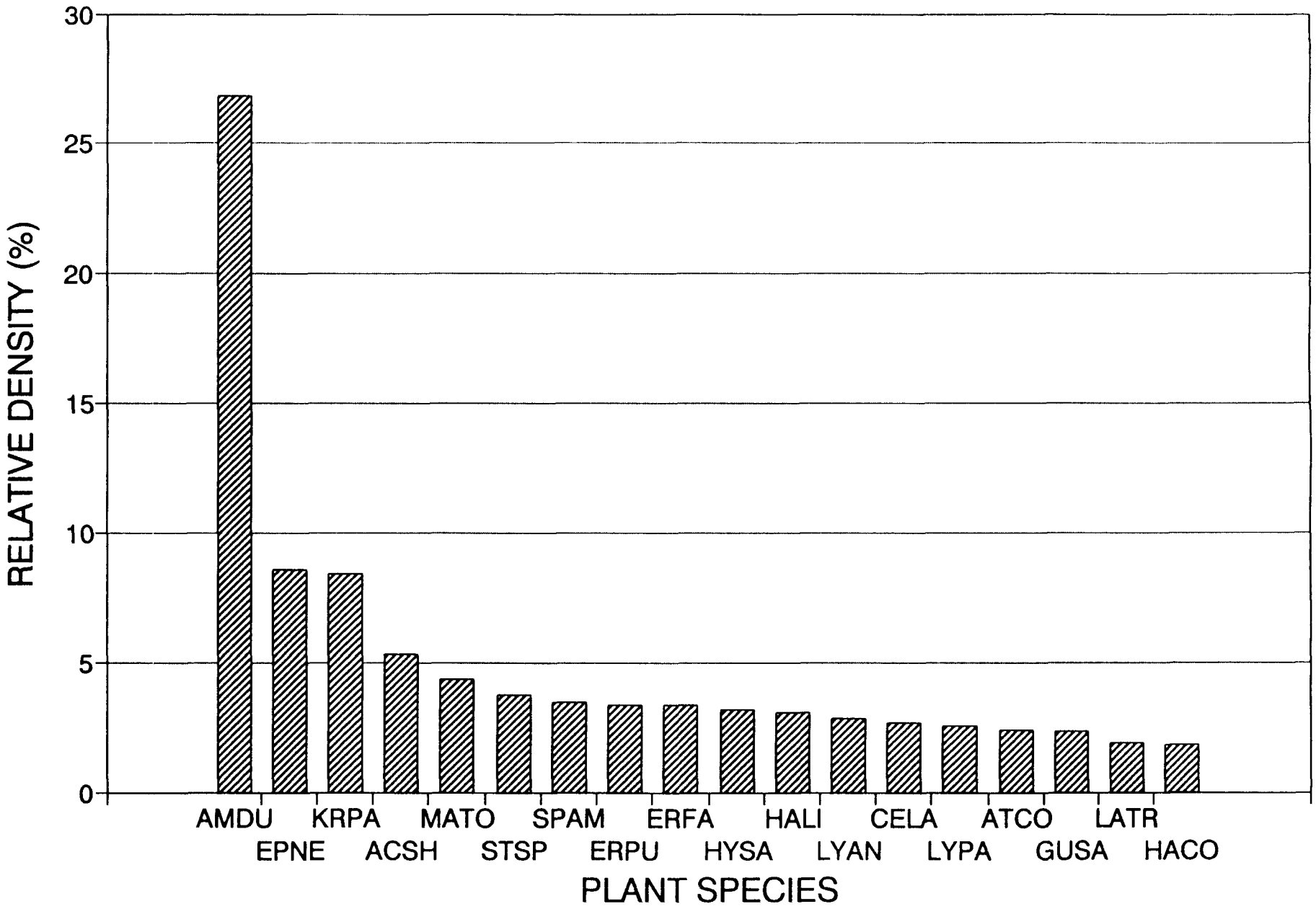
Methods:

- 57 disturbed sites examined
- Sites described by vegetation association, disturbance age, and disturbance severity
- Parameters measured include vegetative cover, density, and species composition
- Vegetation parameters compared with those of 48 undisturbed sites


E555600ft
E565600ft
E575600ft
36°55'00"
36°52'30"
36°50'00"
36°47'30"
N4085000m
E372500ft
E377500ft
N4080000m
E382500ft
N4075000m
E387500ft
E392500ft
116°30'00"
116°27'30"
116°25'00"
LEGEND
Plant Succession Study Plots
A. Conceptual Perimeter Drift Boundary
B. Conceptual Controlled Area Boundary
N
1 0 1
MILES
1 0 1
KILOMETERS
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
PLANT SUCCESSION STUDY PLOTS
EDAR YMP-93-243.0



The relative density of the 19 most common species in 57 disturbed sites, at Yucca Mountain, Nevada.



The relative density of the 18 most common species in 48 undisturbed study plots at Yucca Mountain, Nevada.

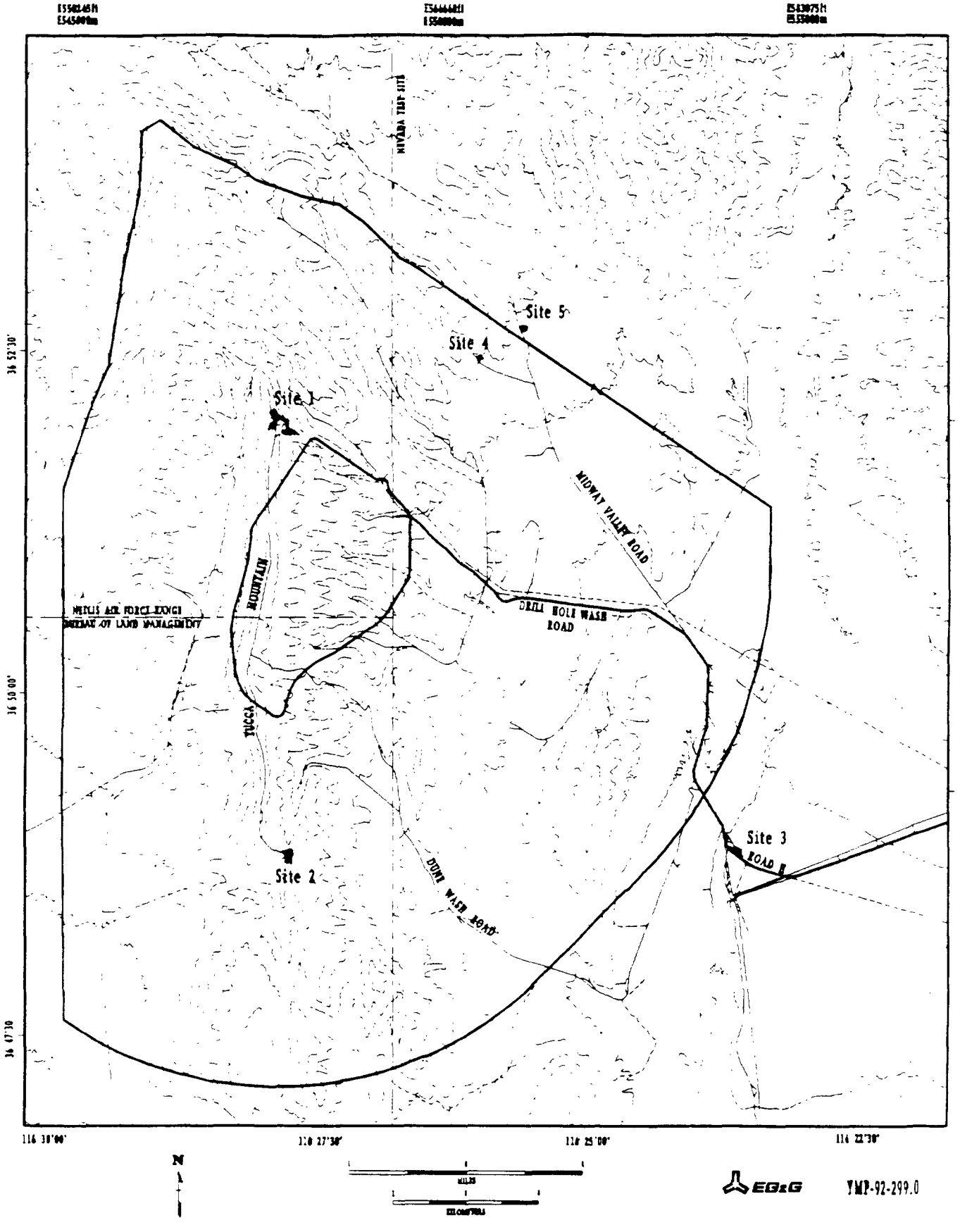
RECLAMATION FEASIBILITY STUDIES

RECLAMATION TRIALS

Objective: To refine and improve the reclamation quidelines in the Reclamation Implementation Plan

Methods:

- Five pre-site characterization disturbance sites chosen
- Techniques/materials examined:
  - soil amendments
  - plant materials
  - planting methods
  - water harvesting methods
  - irrigation rates
  - herbivory protection methods
- Parameters measured:
  - species composition
  - density by species



EG&G YMP-92-299.0

RECLAMATION TRIAL SITE #1

Objective: To examine the effects of soil quality and soil depth on seedling emergence and survival

Treatments:

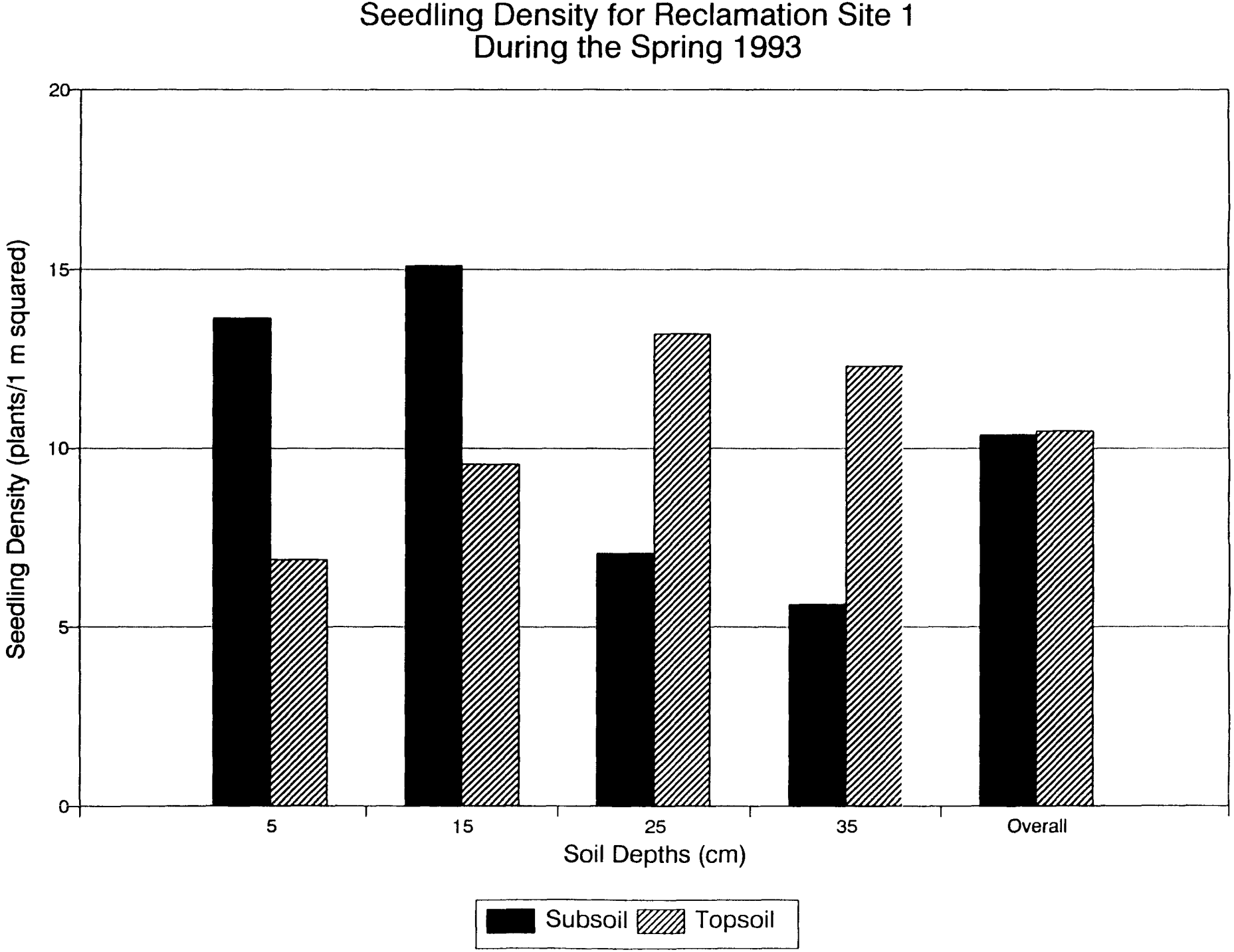
- Soil quality (topsoil vs subsoil)
- Soil depth (5, 15, 25, and 35 cm)

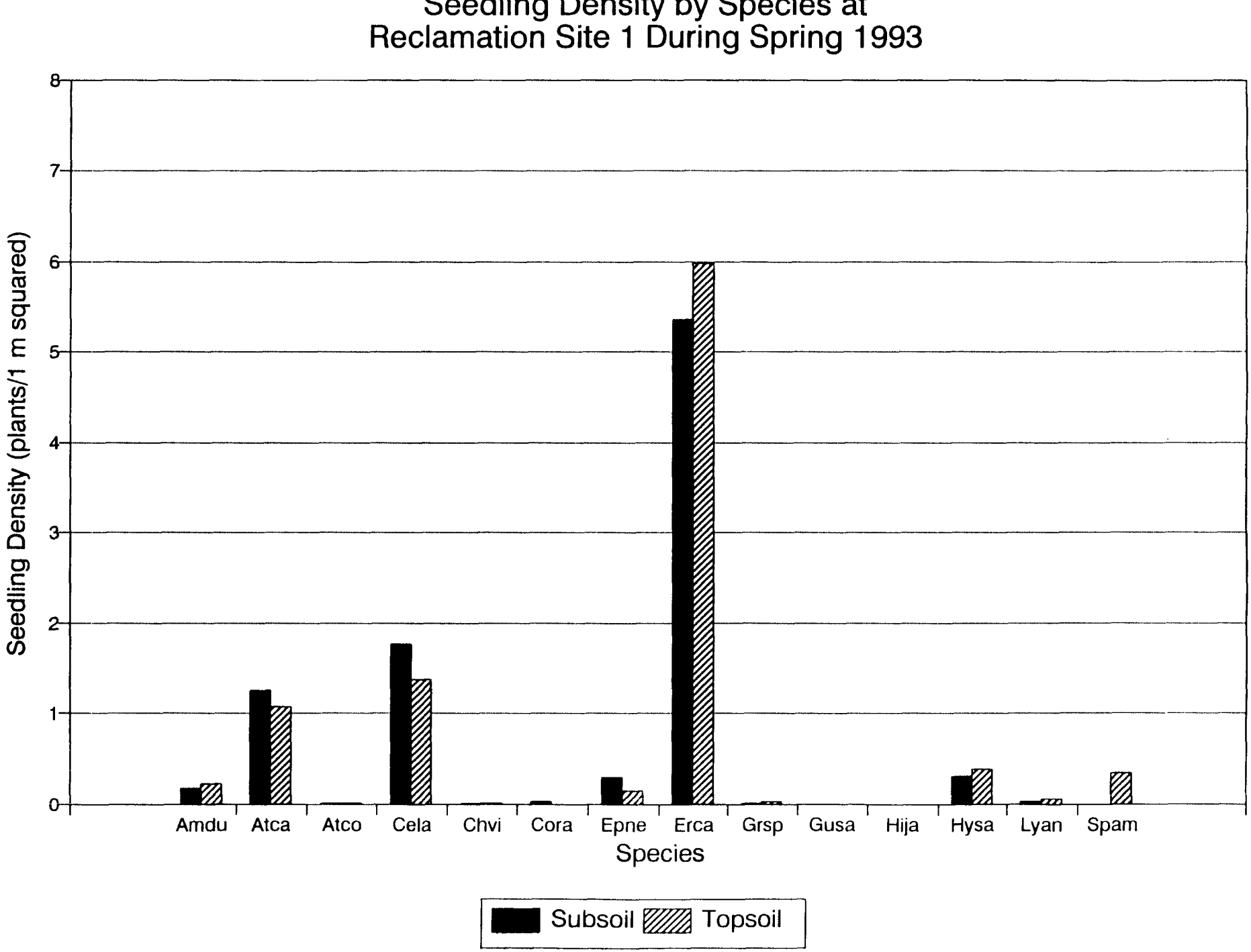
Methods:

- 7 replicates per treatment
- Mix of 14 native species drill seeded at 18.4 PLS kg/ha
- Straw mulch applied and tackified
- 10 1-m^2 quadrats sampled per replicate for density of seeded and unseeded species

Status:

- Initiated in FY93
- Ongoing multi-year study
- Density data collected June and October 1993
- Soil amendment study to be initiated at site November 1993


Seedling Density for Reclamation Site 1
During the Spring 1993
Seedling Density (plants/1 m squared)
20
15
10
5
0
5
15
25
35
Overall
Soil Depths (cm)
Subsoil
Topsoil


Seedling Density by Species at
Reclamation Site 1 During Spring 1993
Seedling Density (plants/1 m squared)
0
1
2
3
4
5
6
7
8
Amdu
Atca
Atco
Cela
Chvi
Cora
Epne
Erca
Grsp
Gusa
Hija
Hysa
Lyan
Spam
Species
Subsoil
Topsoil

RECLAMATION TRIAL SITE #4

Objective: To examine the effects of soil depth and of mixing topsoil with subsoil during seedbed preparation on seedling emergence and survival

Treatments:

- Soil depth (5, 10, 15, and 20 cm)
- Soil mixing (complete mixing of topsoil versus no mixing)

Methods:

- 5 replicates per treatment
- Drill-seeded mix of 16 species at 18.6 PLS kg/ha
- Straw mulch crimped
- 16 quadrats sampled per replicate for density of seeded and unseeded species

Status:

- Initiated in FY93
- Ongoing multi-year study
- Density data collected June and October 1993

RECLAMATION TRIAL SITE #5

Objective: To examine the effects of two water conservation treatments and two topsoil redistribution treatments on seedling emergence and survival

Treatments:

- Water conservation (imprinting and pitting)
- Topsoil redistribution (prior to imprinting/pitting versus after)

Methods:

- 7 replicates per treatment
- Drill-seeded mix of 16 species at 18.6 PLS kg/ha
- No mulch
- 16 quadrats sampled per replicate for density of seeded and unseeded species

Status:

- Initiated in FY93
- Density data collected June and October 1993
- To be re-implemented in winter 1993/94 due to low seedling emergence and survival

RECLAMATION SITE #3 - DEMONSTRATION PLOT

Objective: To demonstrate a wide variety of revegetation methods and materials that can be used at Yucca Mountain and to describe the effects of them on seedling emergence and survival

Treatments:

- Water conservation (none, imprinting, pitting, desert strips)
- Amendments (none, fertilizer, topsoil, polyacrylamide gel)
- Revegetation method (drill seed, broadcast, transplant)
- Mulch (straw/crimp, straw/tackify, straw/net, gravel)
- Irrigation (none, 0.6 cm, 1.3 cm)

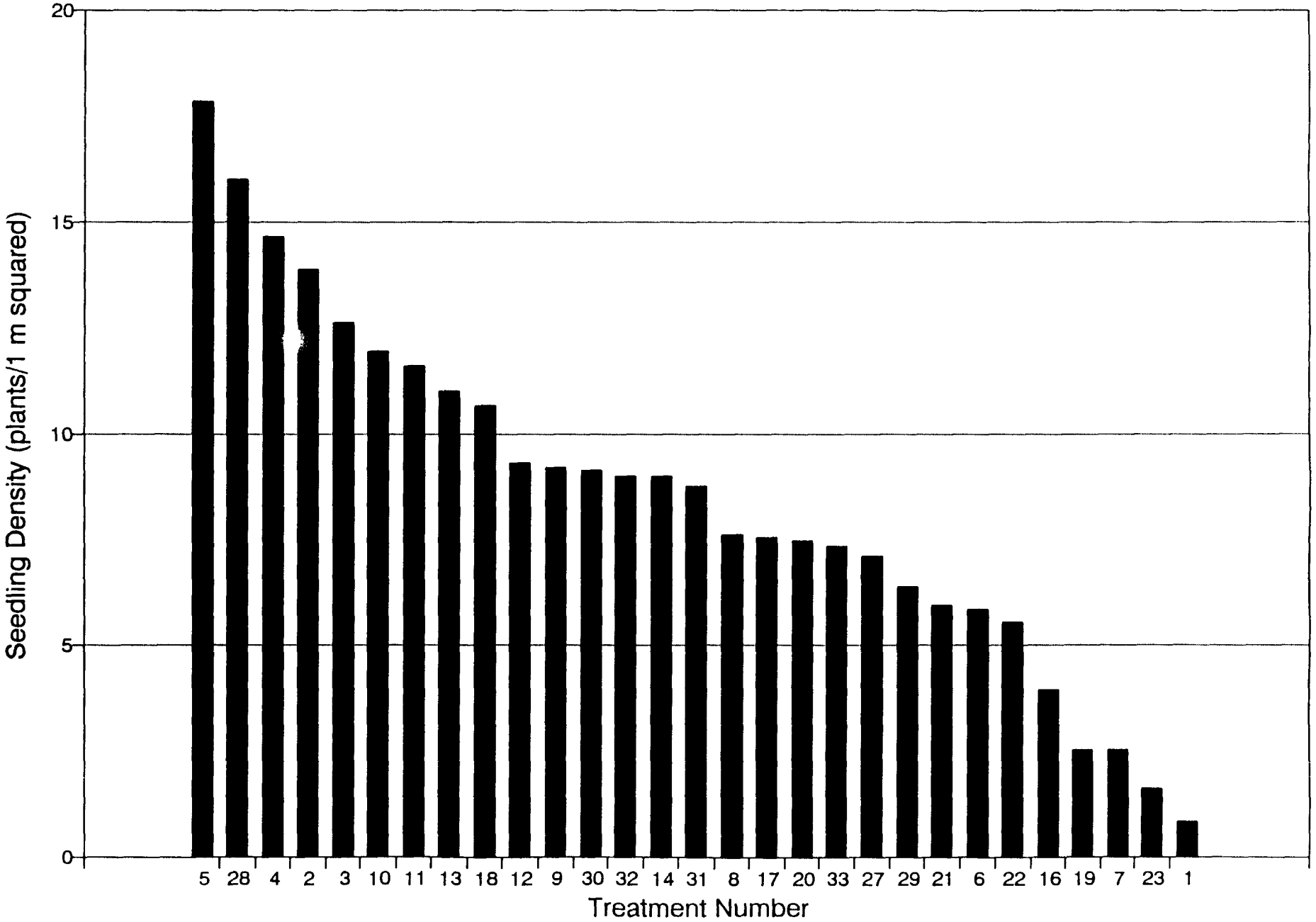
Methods:

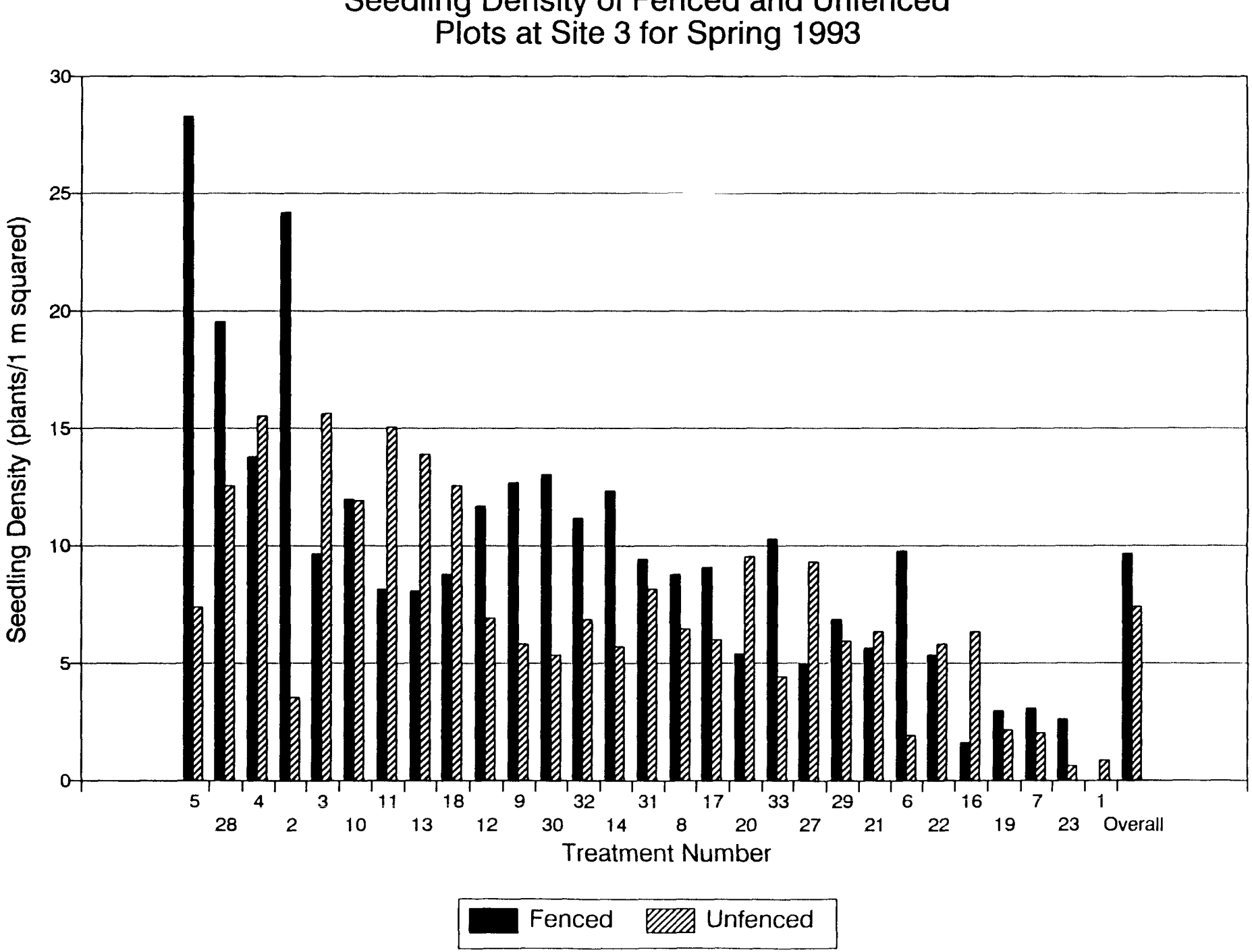
- 2 replicates per treatment
- All plots ripped and harrowed
- 13 quadrats sampled per replicate for density of seeded and unseeded species

Status:

- Initiated in FY92
- Ongoing multi-year study
- Density data collected Spring and Fall 1992 and Spring 1993

Seedling Density at Reclamation Site 3 During Spring 1993




Seedling Density of Fenced and Unfenced Plots at Site 3 for Spring 1993
Seedling Density (plants/1 m squared)
30
25
20
15
10
5
0
5 4 3 11 18 9 32 31 17 33 29 6 16 7 1
28 2 10 13 12 30 14 8 20 27 21 22 19 23 Overall
Treatment Number
Fenced
Unfenced

RECLAMATION FEASIBILITY STUDIES

TOPSOIL STOCKPILE STUDIES

Objectives:

- To determine the effects of short-term (< 6 months) and long-term topsoil stockpiling on microbial activity and biomass

- To determine the effects of topsoil stockpile depth on microbial activity and biomass

- To determine how different species planted on stockpiles influence soil microbial activity and biomass

Methods:

- Three long-term topsoil stockpiles chosen (Area 25 Borrow Pit, Borehole NRG-6, Drillhole UZ-16)

- Treatments to be examined:
  - stockpile age
  - stockpile depth
  - plant species composition on seeded stockpile

RECLAMATION FEASIBILITY STUDIES

TOPSOIL STOCKPILE STUDIES - AREA 25 BORROW PIT

Objective: To examine the effects of species composition, soil depth, and time on soil microbial populations in a long-term topsoil stockpile

Treatments:

- Species composition (native seed mix, shallow-rooted native seed mix, deep-rooted native seed mix, shallow-rooted legumes)
- Soil depth (0-20, 50-70, 100-120, 160-180, 210-230 cm)
- Time (soil samples collected once every six months, then every six months

Methods:

- 4 trenches for soil sampling are excavated each month for first six months (1 per seed mix treatment)
- 1 soil sample per soil depth range is collected for analysis of bacteria, fungi, nematodes, VAM spores, and CO_2 respiration

Status:

- Seeded in April 1993
- First soil samples collected May 1993

INTERIM RECLAMATION ACTIVITIES

Reclamation Inventories — **Conducted 54 inventories**

- Component of preactivity survey
- Undisturbed vegetation is described
- Soil samples are collected/horizons identified
- Site-specific erosion/reclamation potential evaluated

Site-Specific Reclamation Stipulations — **Provided stipulations for 192 sites**

- Depth of topsoil salvage
- Construction criteria for topsoil stockpile
- Stockpile stabilization actions
- Site configuration changes to lessen disturbance/reclamation efforts
- Erosion controls

Site Stabilization — **Stabilized 110 sites**

- Chemical stabilizer for short-term stockpiles
- Seeding for long-term stockpiles

FINAL RECLAMATION ACTIVITIES

Site Inventories (Post-Activity Surveys) — **Conducted at 53 sites**

- Document extent of areal disturbance
- Document compliance with site-specific reclamation stipulations
- Soil samples collected if needed

Final Reclamation Plans — **Prepared for 14 sites**

- Recontouring specifications
- Revegetation plans

Recontouring and Revegetation — **Conducted at 4 sites**

- Site recontouring
- Topsoil redistribution
- Seedbed preparation
- Revegetation
- Mulching

POST-RECLAMATION ACTIVITIES

Revegetation Monitoring

- Bi-annual qualitative assessments
- Quantitative beginning the third spring following reclamation
- Photography
- Cover
- Productivity
- Species diversity

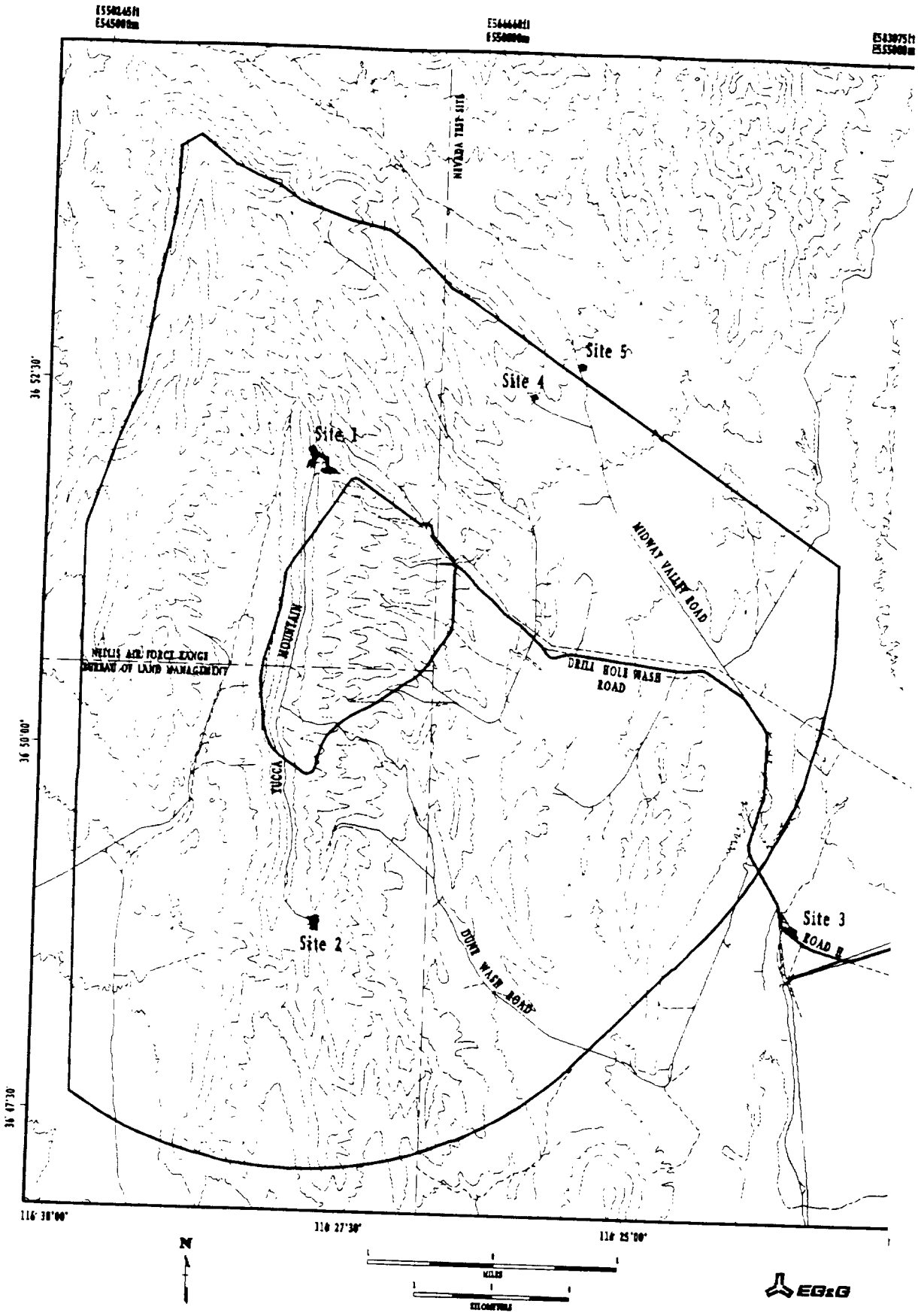
Wildlife Use Monitoring

- Conducted during quantitative vegetation monitoring
- Animal burrow density
- Extent of grazing
- Reptile density
- Ant mound density
- Wildlife scat density

Additional Reclamation Stipulations/Activities (as needed)

YMP RECLAMATION PROGRAM

- Mitigates loss of wildlife habitat
- Refines reclamation guidelines and implementation procedures
- Promotes reclamation as a standard good-engineering practice
- Creates potential for technology transfers among other DOE arid-land facilities, other federal agencies, academia, and private business sector


NEVADA TEST SITE
Site 1
Site 2
Site 3
Site 4
Site 5
MIDWAY VALLEY ROAD
DRILL HOLE WASH ROAD
DUNE WASH ROAD
ROAD B
TUCCA MOUNTAIN
NELLIS AIR FORCE RANGE
BUREAU OF LAND MANAGEMENT
36° 52'30"
36° 50'00"
36° 47'30"
116° 30'00"
116° 27'30"
116° 25'00"
N
MILES
KILOMETERS
EG&G

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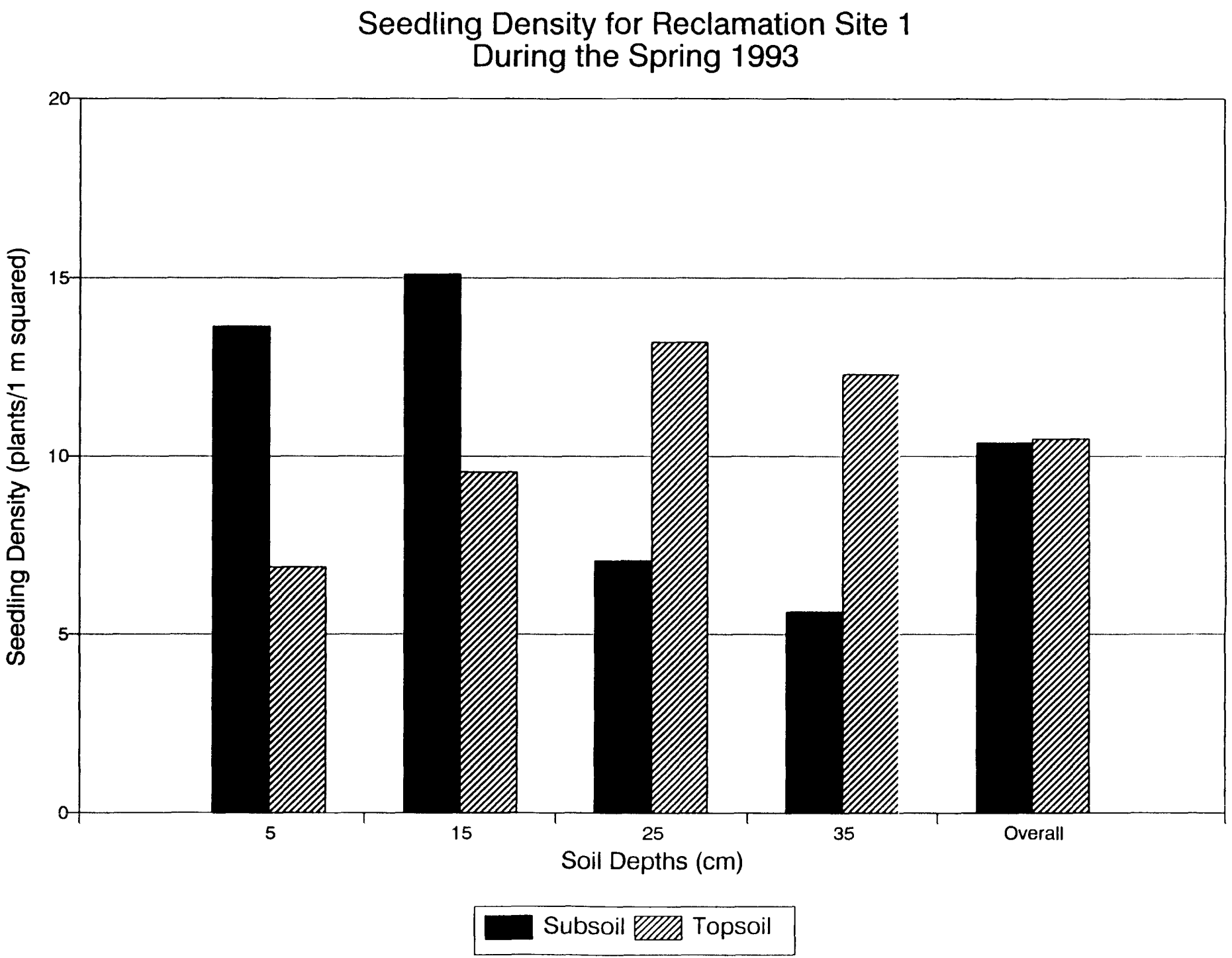
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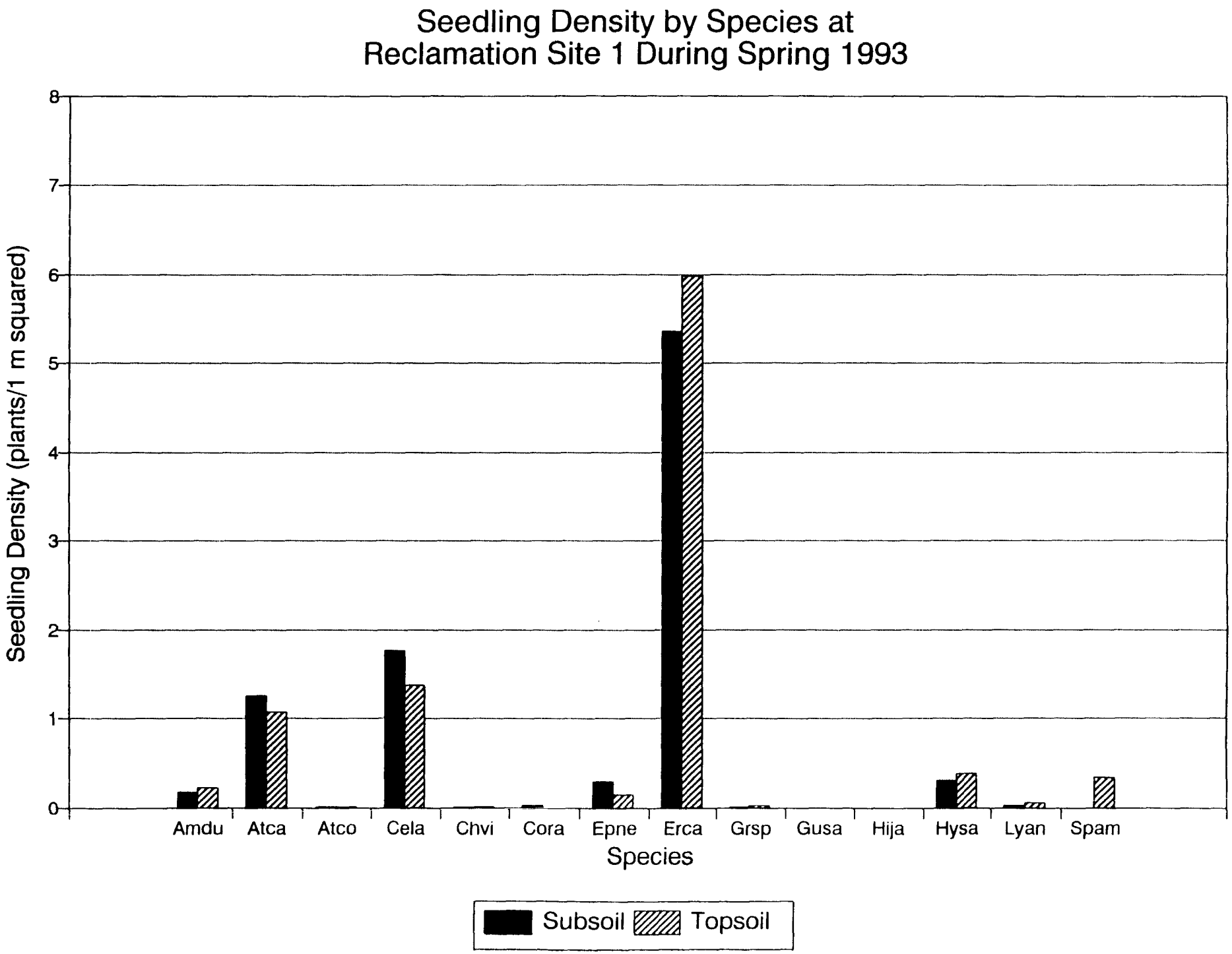
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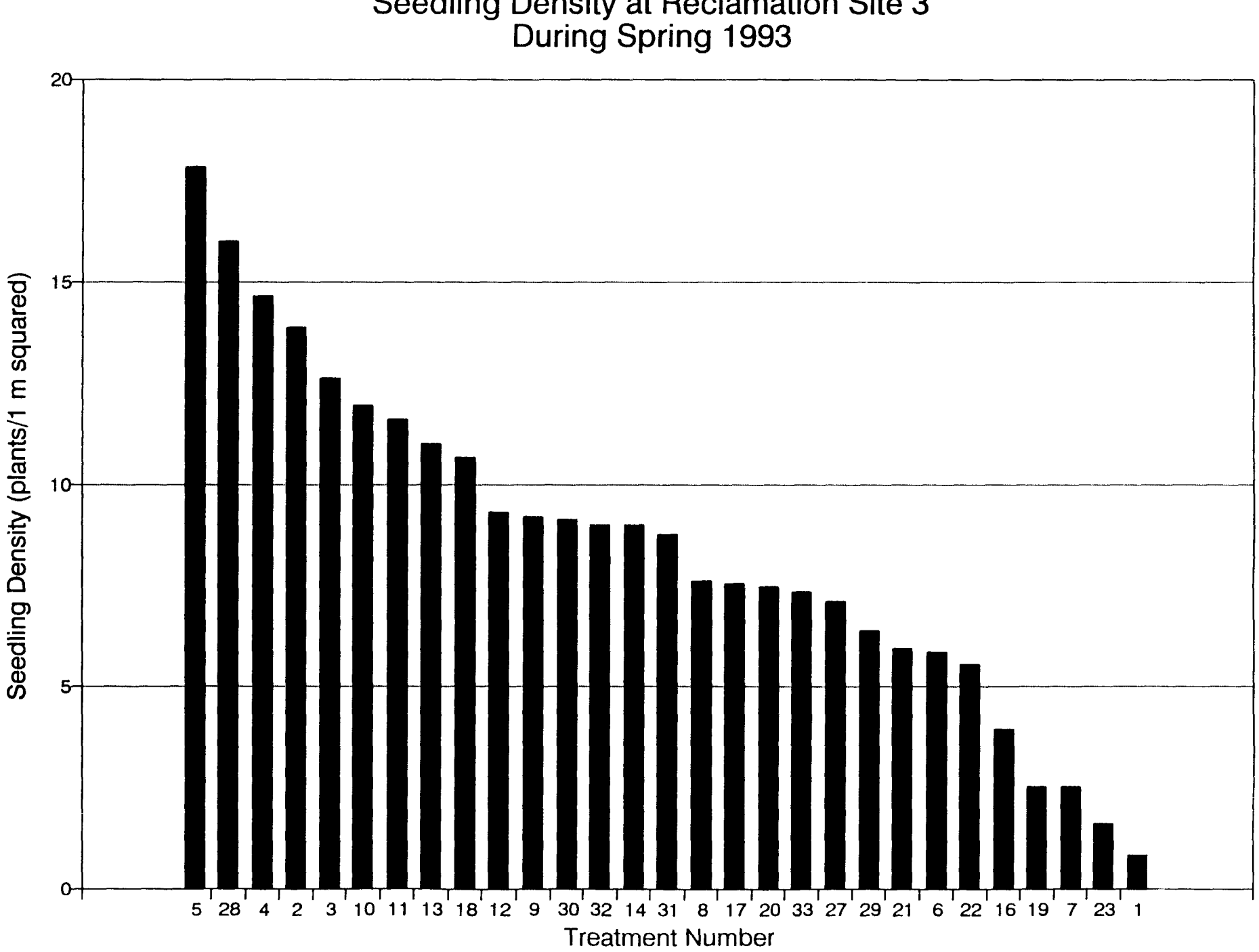
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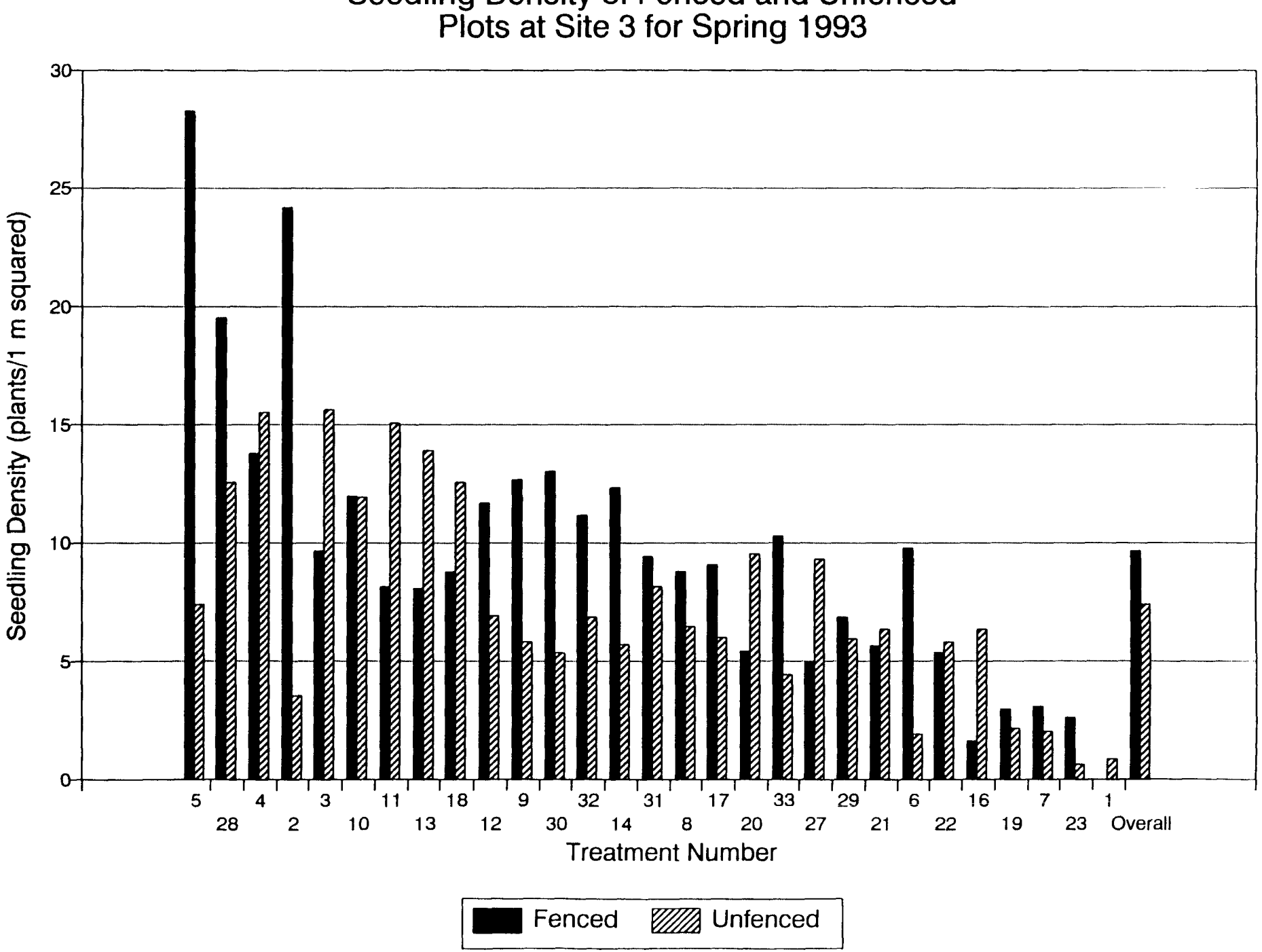
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