



- I. INTRODUCTION**
- II. HISTORICAL DEVELOPMENT**
- III. DESIGN OF MONITORING PROGRAM**
- IV. MONITORING RESULTS**
- V. PROGRAM CHANGES**

## **Nuclear Waste Policy Act**

- **Site Characterization Activities will be conducted in a manner that minimizes effects on the environment**

## **Environmental Monitoring and Mitigation Plan**

- **Biological resources will be monitored to ensure no unexpected impacts occur**

**Objective: Monitor and Document Potential Effects of Site Characterization Activities on Biological Resources at Yucca Mountain**

## **II. HISTORICAL DEVELOPMENT**

**Purpose: Provide Overview of Decisions and the Decision Process in Developing the Monitoring Program**

- **Location of Site Characterization Activities**
- **Description of Activities**
- **Types of Disturbances**
- **Potential Sources Impacts**

NELLIS  
AIR FORCE  
RANGE

NEVADA  
TEST  
SITE

YUCCA WASH

DRILLHOLE  
WASH

SOLITARIO CANYON  
HORIZONTAL BOREHOLE  
SITE LOCATION →

ALICE  
HILL

EXILE  
HILL

FRAN  
RIDGE

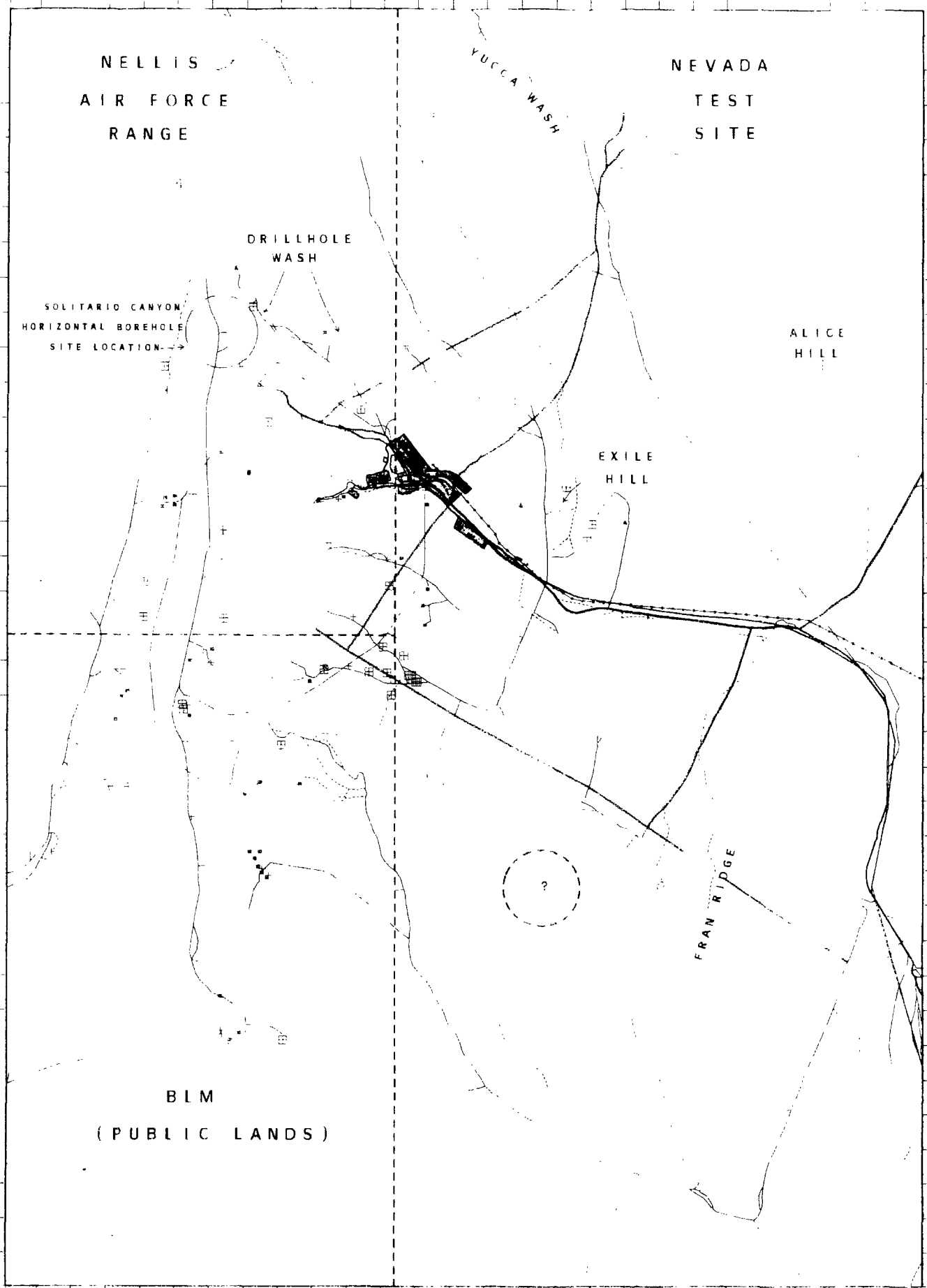
BLM  
(PUBLIC LANDS)

N 770,000

N 750,000

E 560 000

E 570 000



# DESCRIPTION OF ACTIVITIES

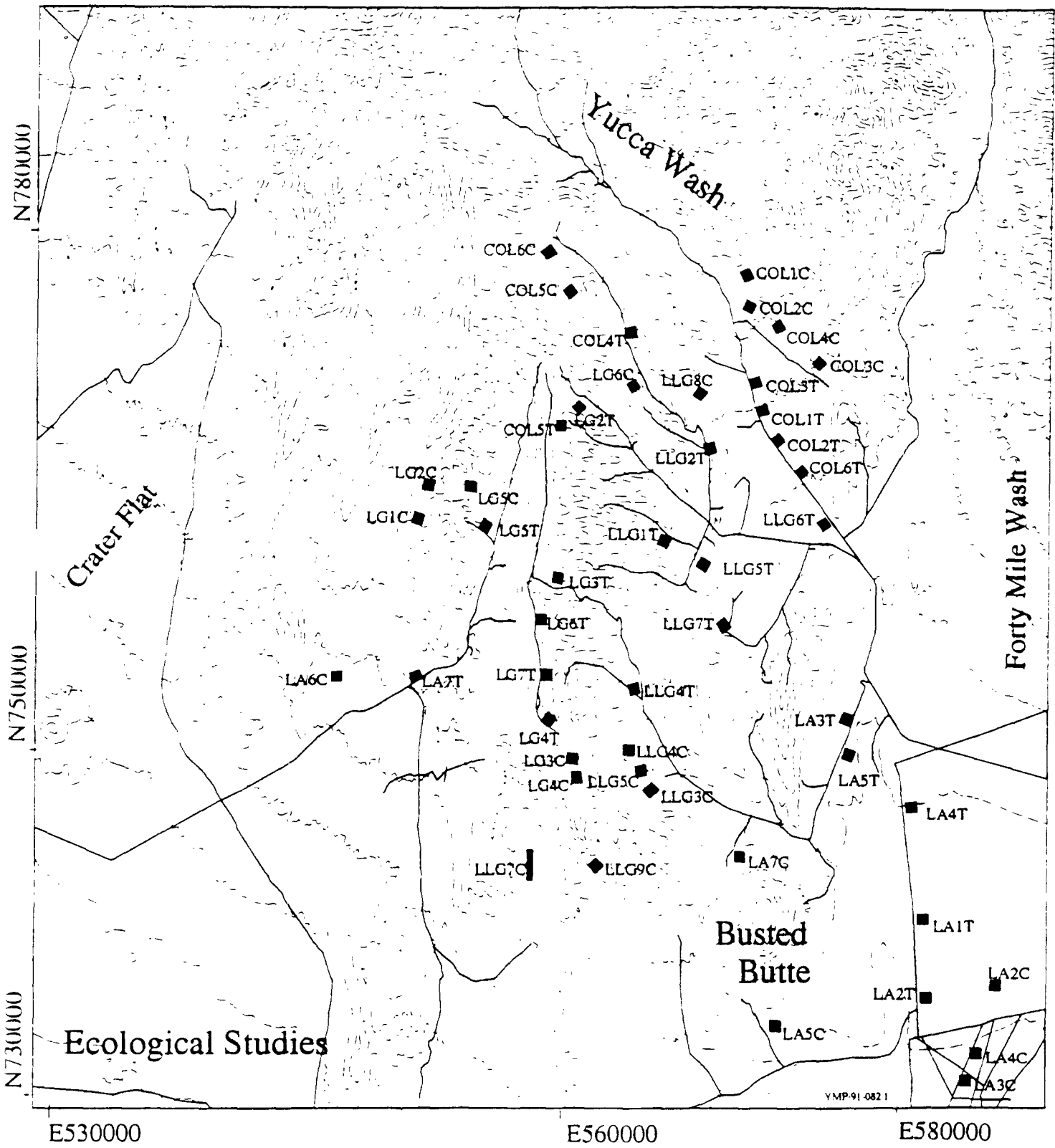
- **Trenches**
- **Drill pads**
- **Top soil stock piles**
- **Muck storage areas**
- **Equipment storage pads**
- **Road construction**
- **Pavement and ponding studies**

# POTENTIAL TYPES OF DISTURBANCE

- **Land Clearing (removal or covering of vegetation)**
- **Human disturbance**
- **Increased dust deposition**
- **Habitat fragmentation**
- **Release of water**

## TYPE OF IMPACT

- **Direct (Loss of Habitat)**
- **Indirect (Change in Habitat Quality)**



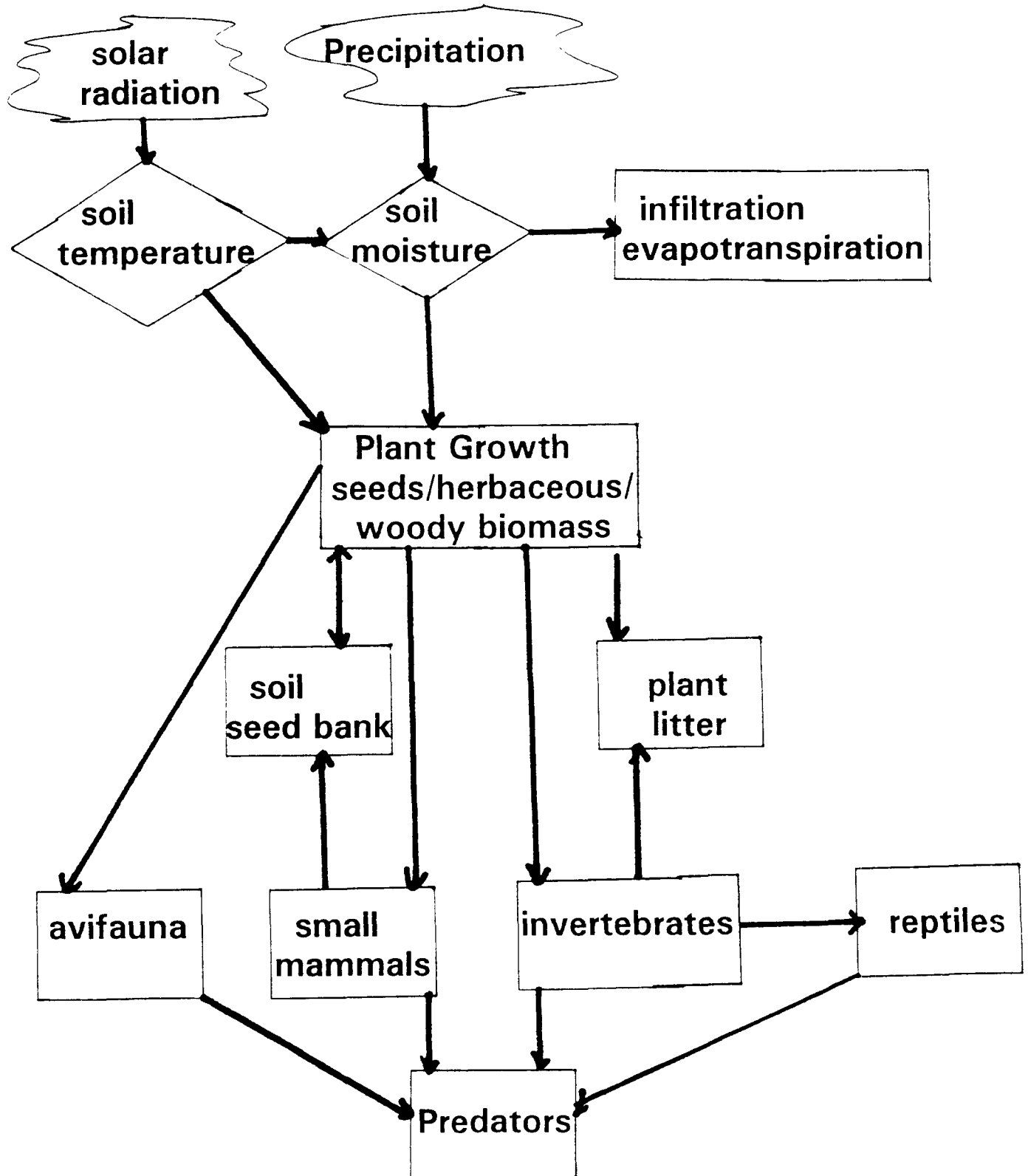


# **III. DESIGN OF MONITORING STUDIES**

- **Statistical Design**
- **Parameter Selection**
- **Integration of Studies**

Location	TIME (t)---->	Pre-Site Characterization			SCA Starts			Post-Site Characterization
	Veg. Association	$t_{1-n}$	...	$t_{i-1}$	$t_i$	$t_{i+1}$	...	$t_{i+n}$
Treatment	Coleogyne	$v_1$ . $v_j$						
	Larrea-Ambrosia	$v_1$ . $v_j$						
	Larrea-Lycium-Grayia	$v_1$ . $v_j$						
	Lycium-Grayia	$v_1$ . $v_j$						
Control	Coleogyne	$v_1$ . $v_j$						
	Larrea-Ambrosia	$v_1$ . $v_j$						
	Larrea-Lycium-Grayia	$v_1$ . $v_j$						
	Lycium-Grayia	$v_1$ . $v_j$						

# RELATIONSHIPS BETWEEN ABIOTIC and BIOTIC COMPONENTS of the ECOSYSTEM



# PARAMETER SELECTION

## ABIOTIC VARIABLES

- **Soil Temperature - 15, 30, and 45 cm depth**
- **Soil Moisture - 15, 30, and 45 cm depth**
- **Precipitation**
- **Max-Min Air Temperature**
- **Soil Properties**

# BIOTIC VARIABLES

- **Vegetation Communities**

- 1) **Cover - by annual and perennial life-forms; soil, rock, and litter**
- 2) **Density - perennials, width and height**
- 3) **Production - annuals, perennial forbs, perennial shrubs, and perennial grasses**

# BIOTIC VARIABLES

- **Animal Communities**
  - 1) **Small Mammals - abundance  
survival rate  
recruitment  
species composition**
  - 2) **Reptiles - abundance  
survival rate  
species composition**
  - 3) **Avifauna - species richness  
breeding bird list**
  - 4) **Invertebrates - relative abundance**
  - 5) **Predators - presence/absence**
  - 6) **Lagomorphs - relative abundance**

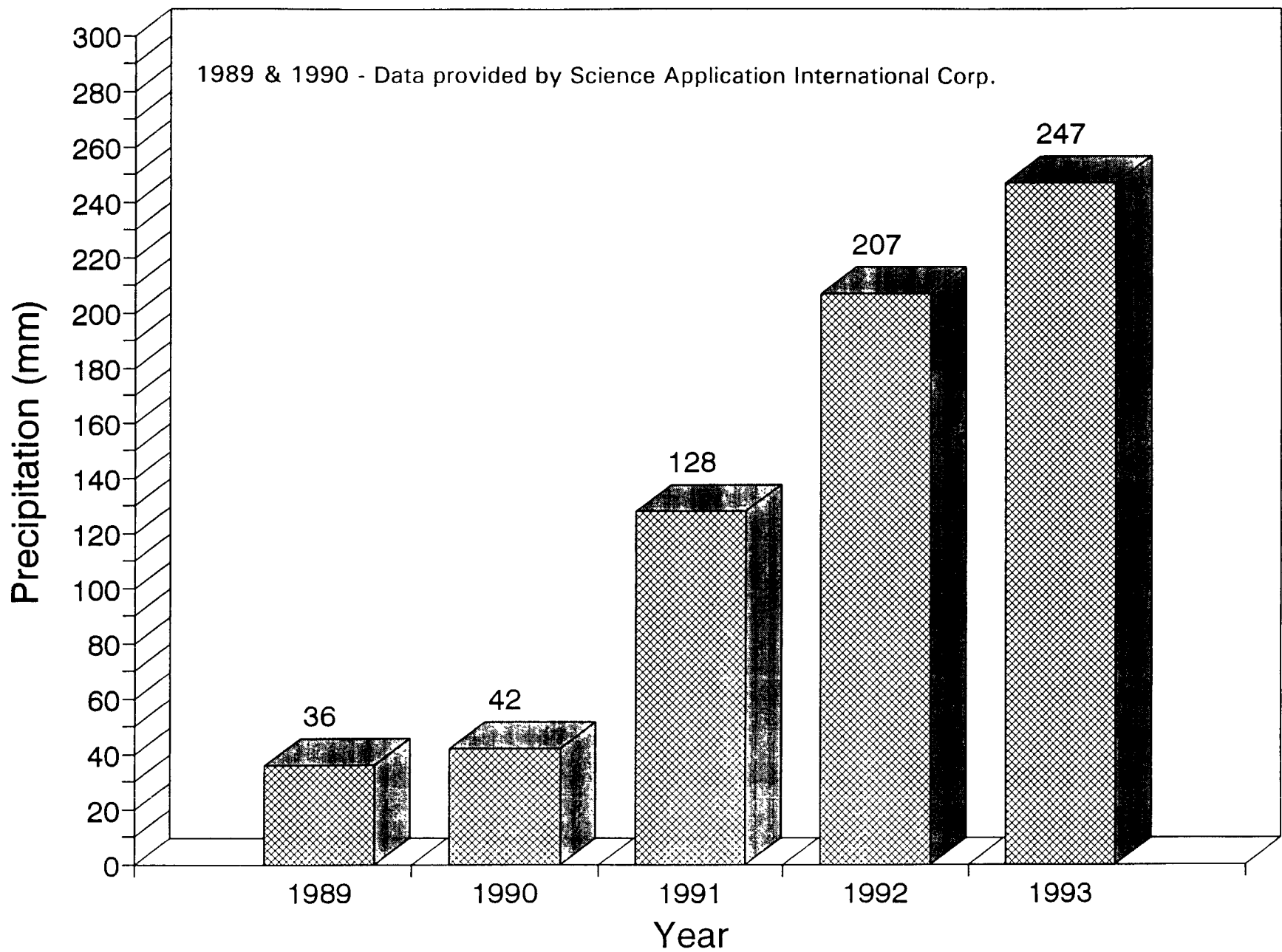
## **IV. MONITORING RESULTS**

- **Precipitation**
- **Vegetation**
- **Small Mammals**

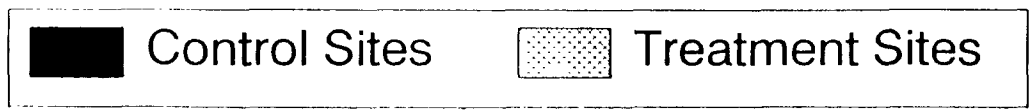
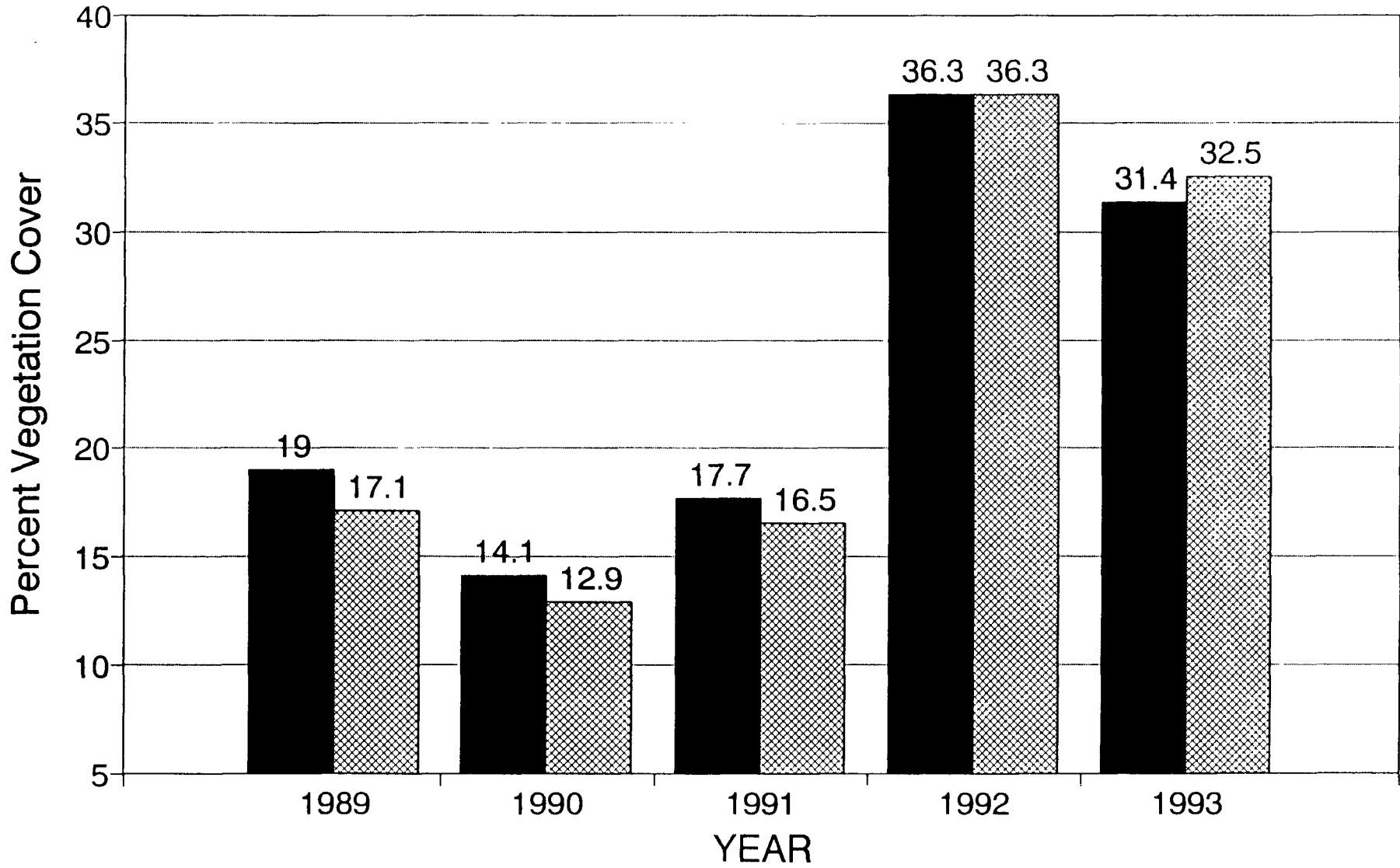
<b>Parameters Measured</b>	<b>1989</b>	<b>1990</b>	<b>1991</b>	<b>1992</b>	<b>1993</b>
<b>Abiotic Variables</b>					
<b>Soil Moisture</b>			X	X	X
<b>Soil Temperature</b>			X	X	X
<b>Precipitation</b>			X	X	X
<b>Air Temperature</b>			X	X	X
<b>Soil Properties</b>					X
<b>Vegetation Communities</b>					
<b>Cover</b>	X	X	X	X	X
<b>Density</b>	X	X	X	X	X
<b>Biomass Production</b>	X	X	X	X	X
<b>Small Mammals</b>					
<b>Abundance</b>	X	X	X	X	X
<b>Survival Rates</b>	X	X	X	X	X
<b>Recruitment</b>			X	X	X
<b>Community Composition</b>	X	X	X	X	X
<b>Reptiles</b>					
<b>Abundance</b>			X	X	X
<b>Survival</b>					X
<b>Community Composition</b>			X	X	X
<b>Spotted Bat (presence)</b>			X	X	
<b>Invertebrates (relative abundance)</b>			X	X	
<b>Avifauna (presence)</b>			X	X	
<b>Predators (presence)</b>		X	X	X	X
<b>Lagomorphs (relative abundance)</b>		X	X	X	X



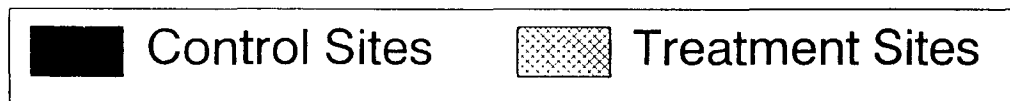
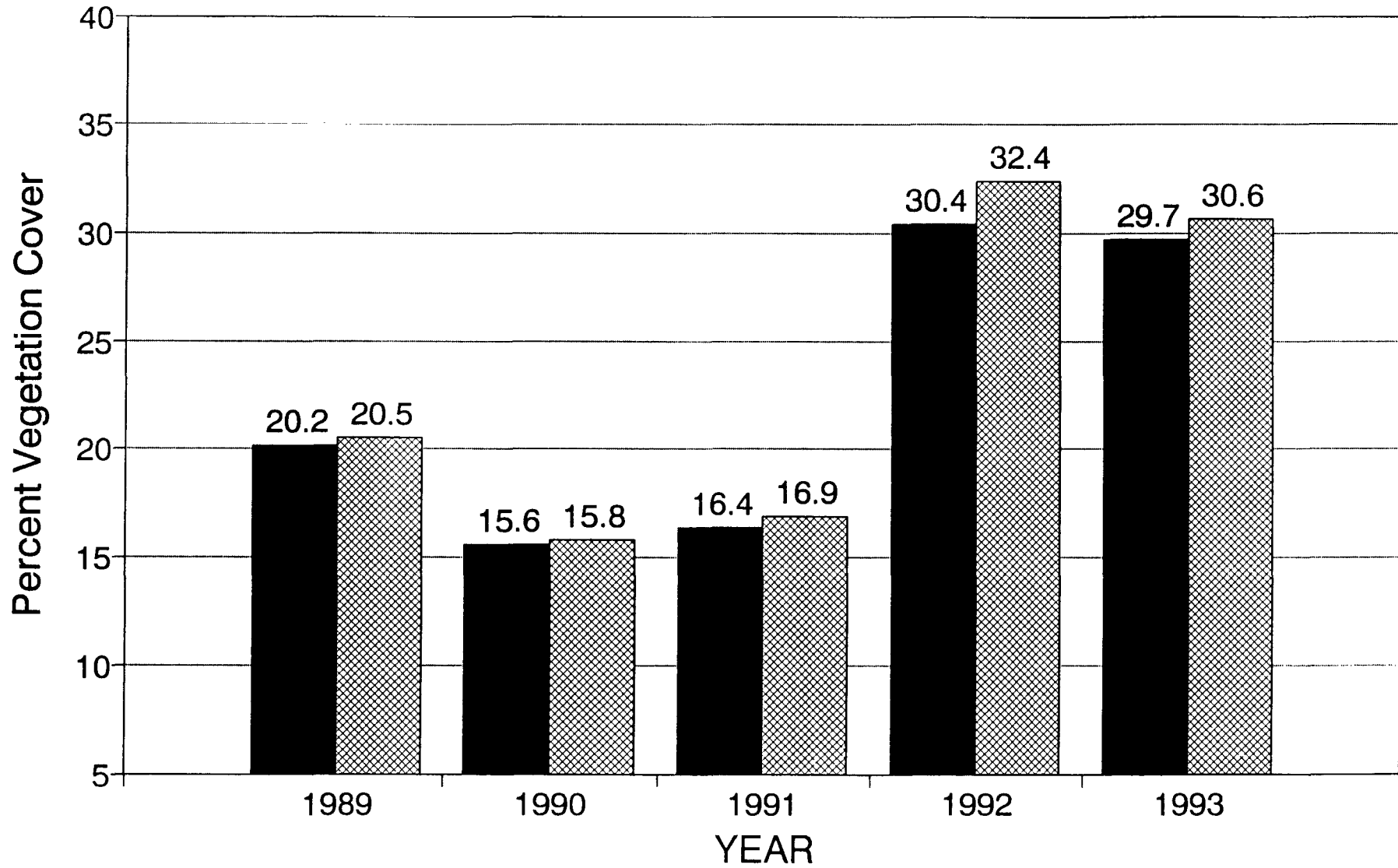
# Precipitation at Yucca Mountain



# Vegetation Cover Estimates *Larrea-Lycium-Grayia*



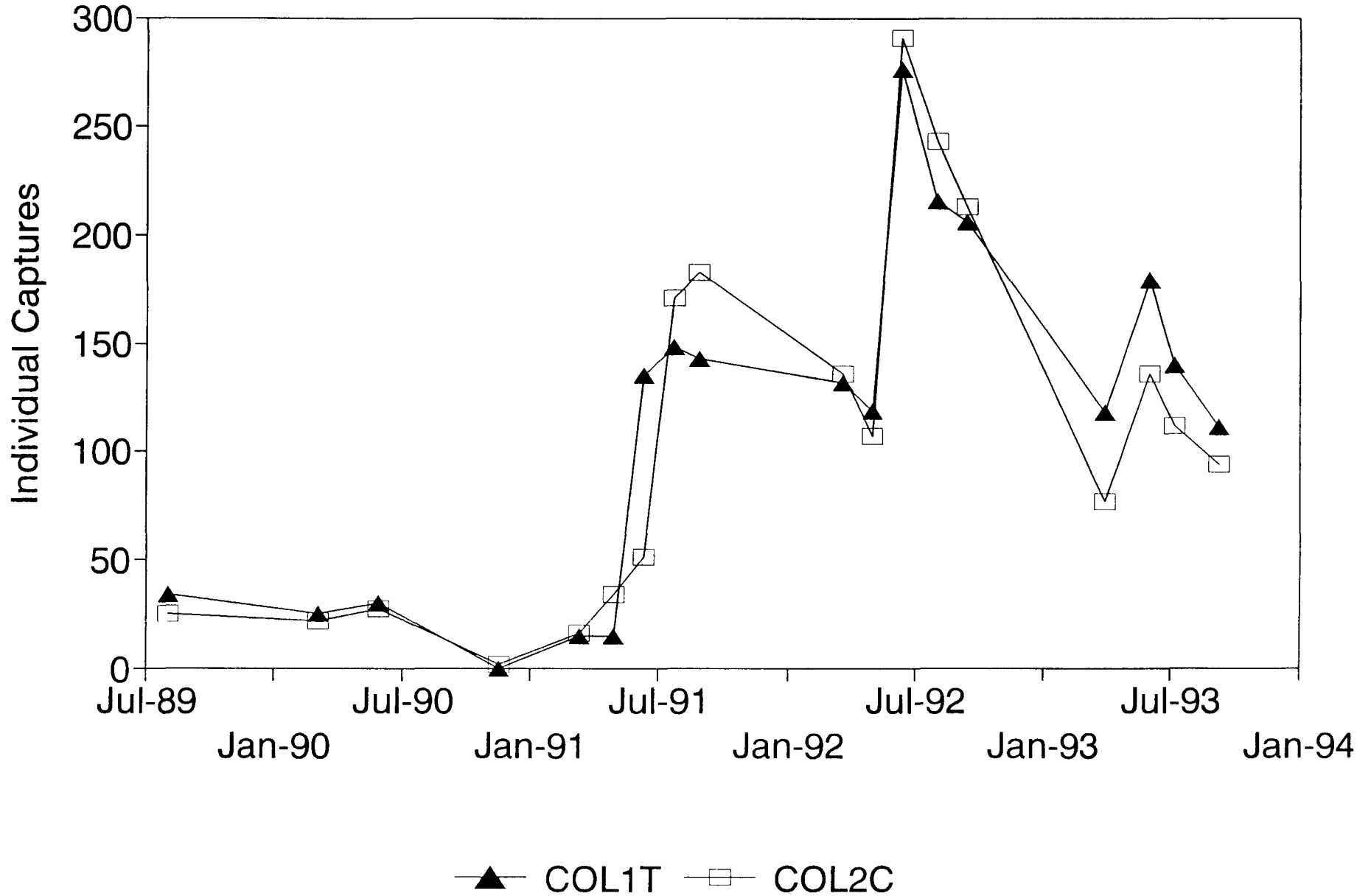
# Vegetation Cover Estimates *Lycium-Grayia*



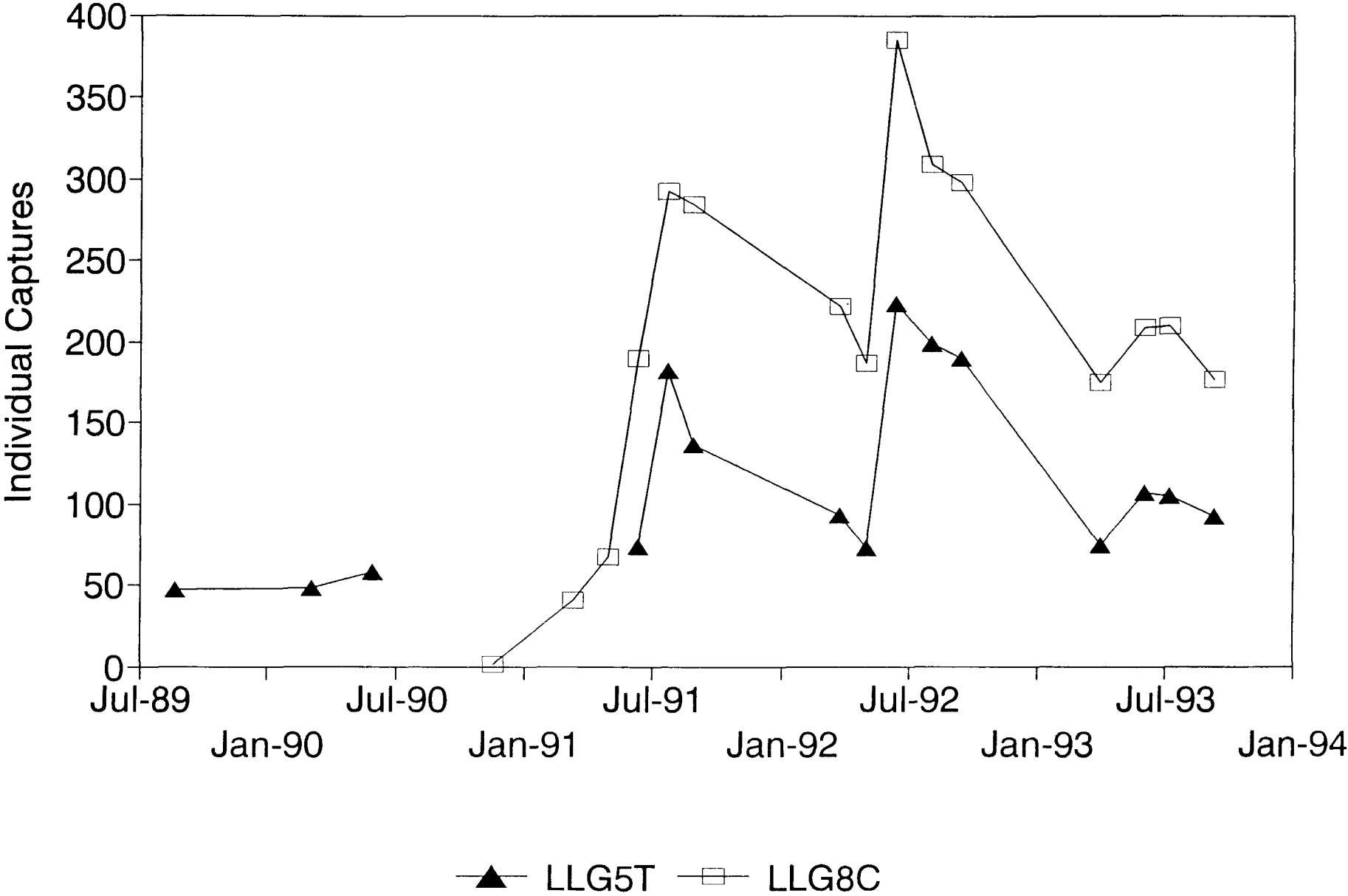
**SAMPLE SIZE REQUIRED TO DETECT 20% CHANGE IN TOTAL VEGETATION COVER**

	<i>Larrea-Lycium-Grayia</i> Association		<i>Lycium-Grayia</i> Association	
<b>Year</b>	<b>Control</b>	<b>Treatment</b>	<b>Control</b>	<b>Treatment</b>
<b>1989</b>	<b>4</b>	<b>4</b>	<b>2</b>	<b>2</b>
<b>1990</b>	<b>3</b>	<b>4</b>	<b>1</b>	<b>1</b>
<b>1991</b>	<b>1</b>	<b>1</b>	<b>4</b>	<b>4</b>
<b>1992</b>	<b>6</b>	<b>6</b>	<b>9</b>	<b>8</b>
<b>1993</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>

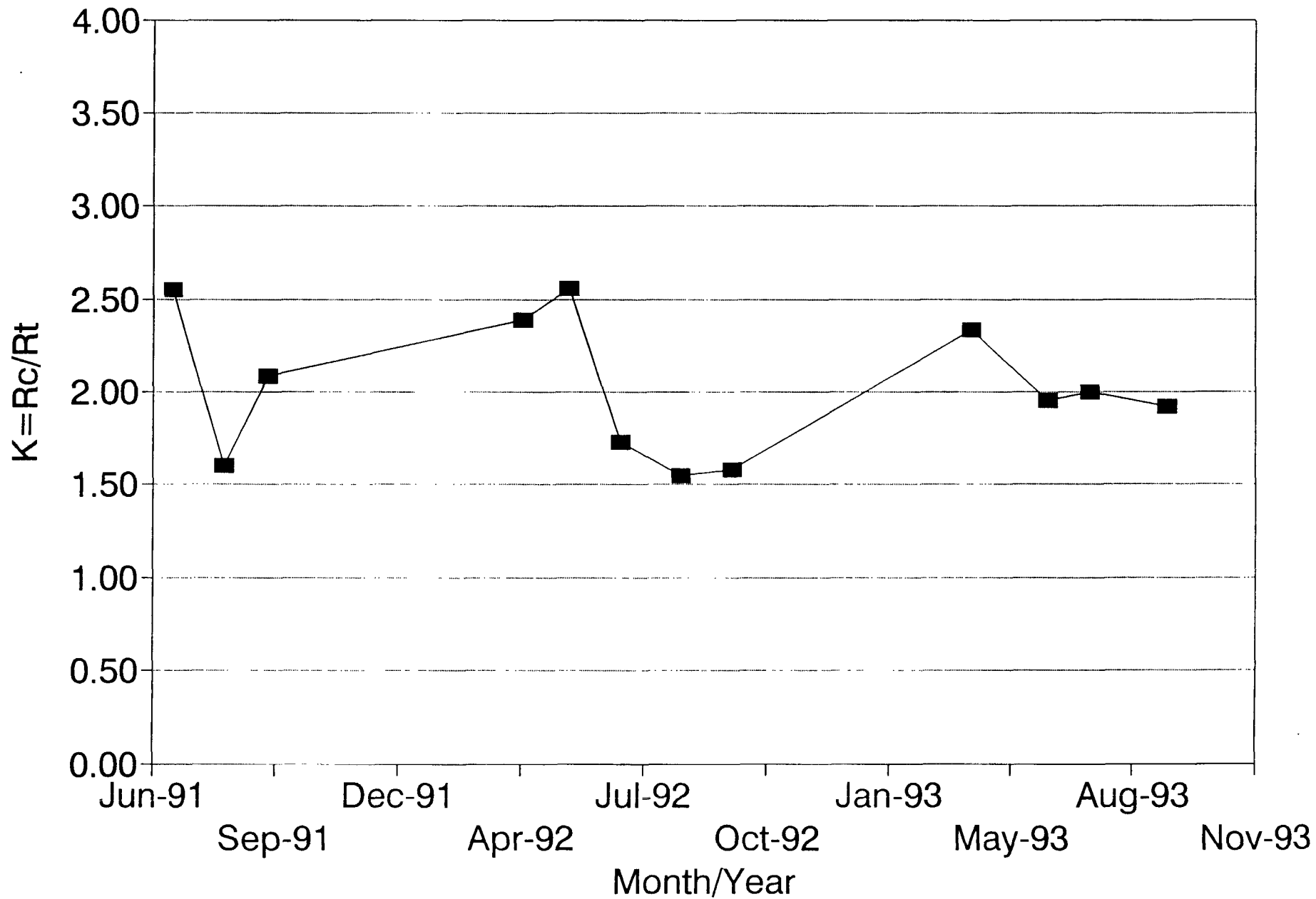
*Coleogyne*  
Long-tailed Pocket Mouse



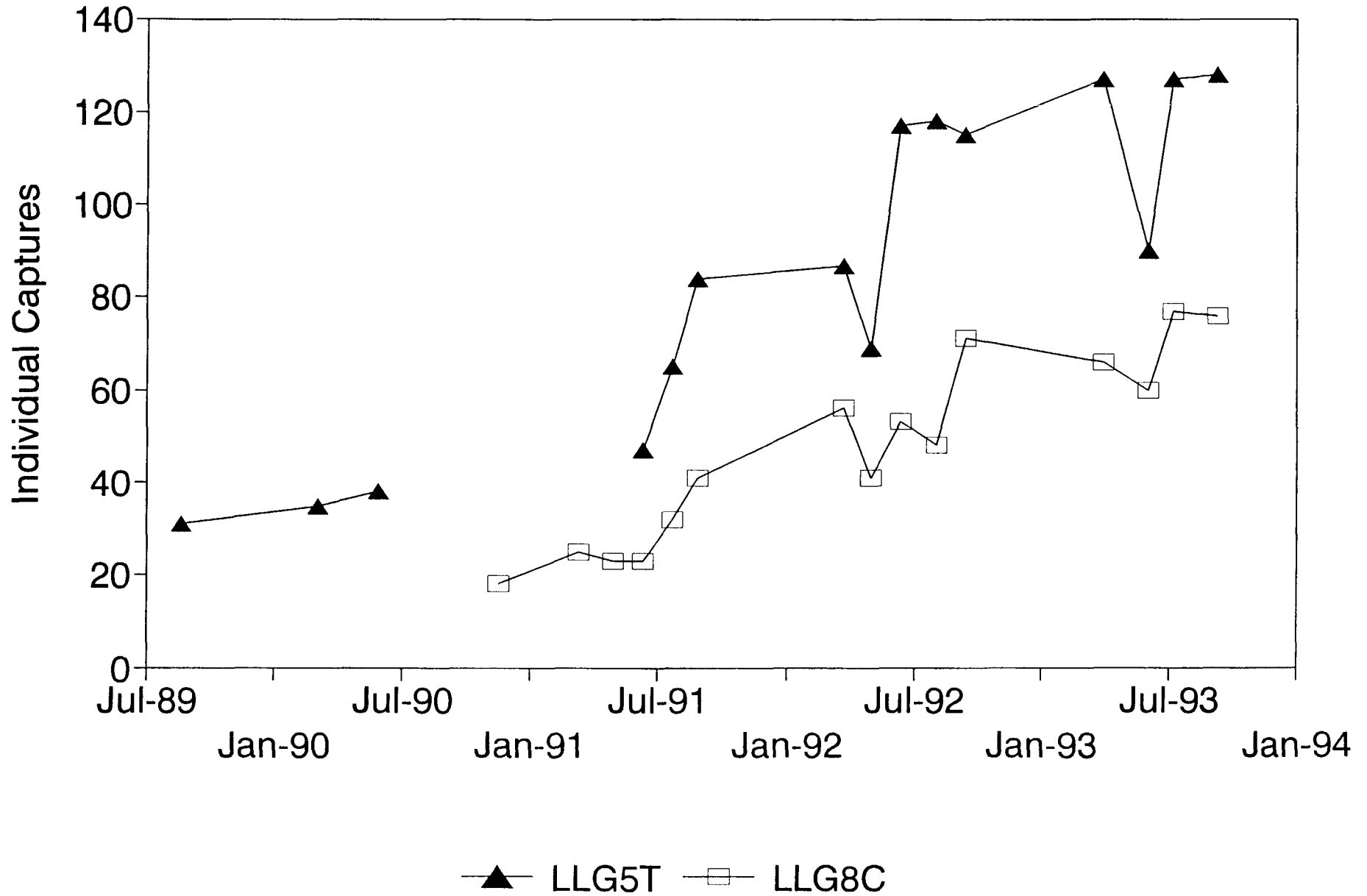
*Larrea-Lycium-Grayia*  
Long-tailed Pocket Mouse



K - Proportional Abundance  
Long-tailed Pocket Mouse (LLG)

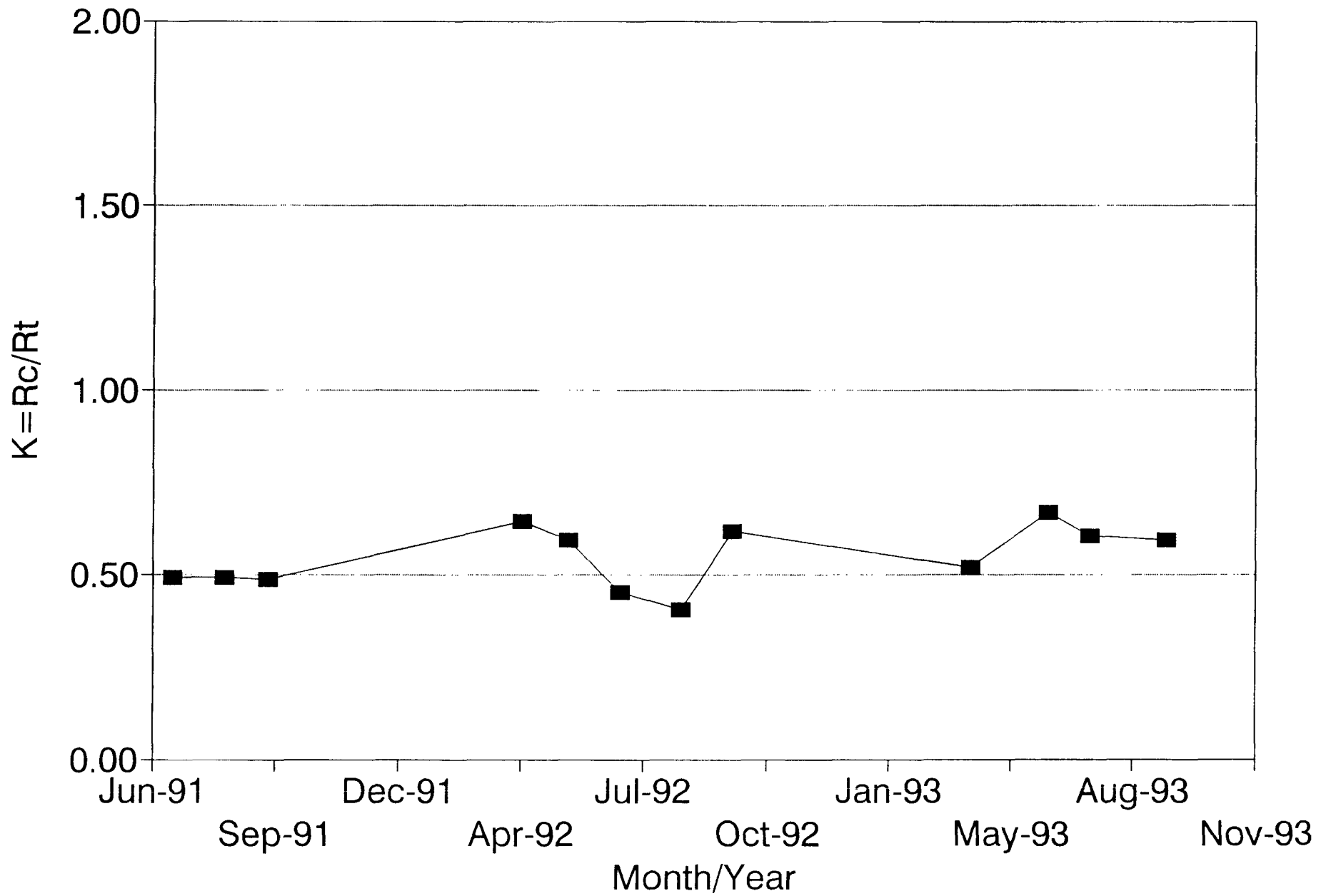


*Larrea-Lycium-Grayia*  
*Merriam's Kangaroo Rat*





K - Proportional Abundance  
*Dipodomys merriami-Larrea-Lycium-Grayia*



## V. PROGRAM CHANGES

- **The location of Exploratory Studies Facilities has changed based on recommendations from the Technical Review Board.**
- **Because the location of specific activities are now better known, new monitoring plots will be located near sites of expected future disturbance. Additional far-field control plots also will be established.**
- **These sites occur primarily in the *Larrea-Lycium-Grayia* vegetation association. Little disturbance is expected to occur in the *Larrea-Ambrosia* or *Coleogyne* associations.**

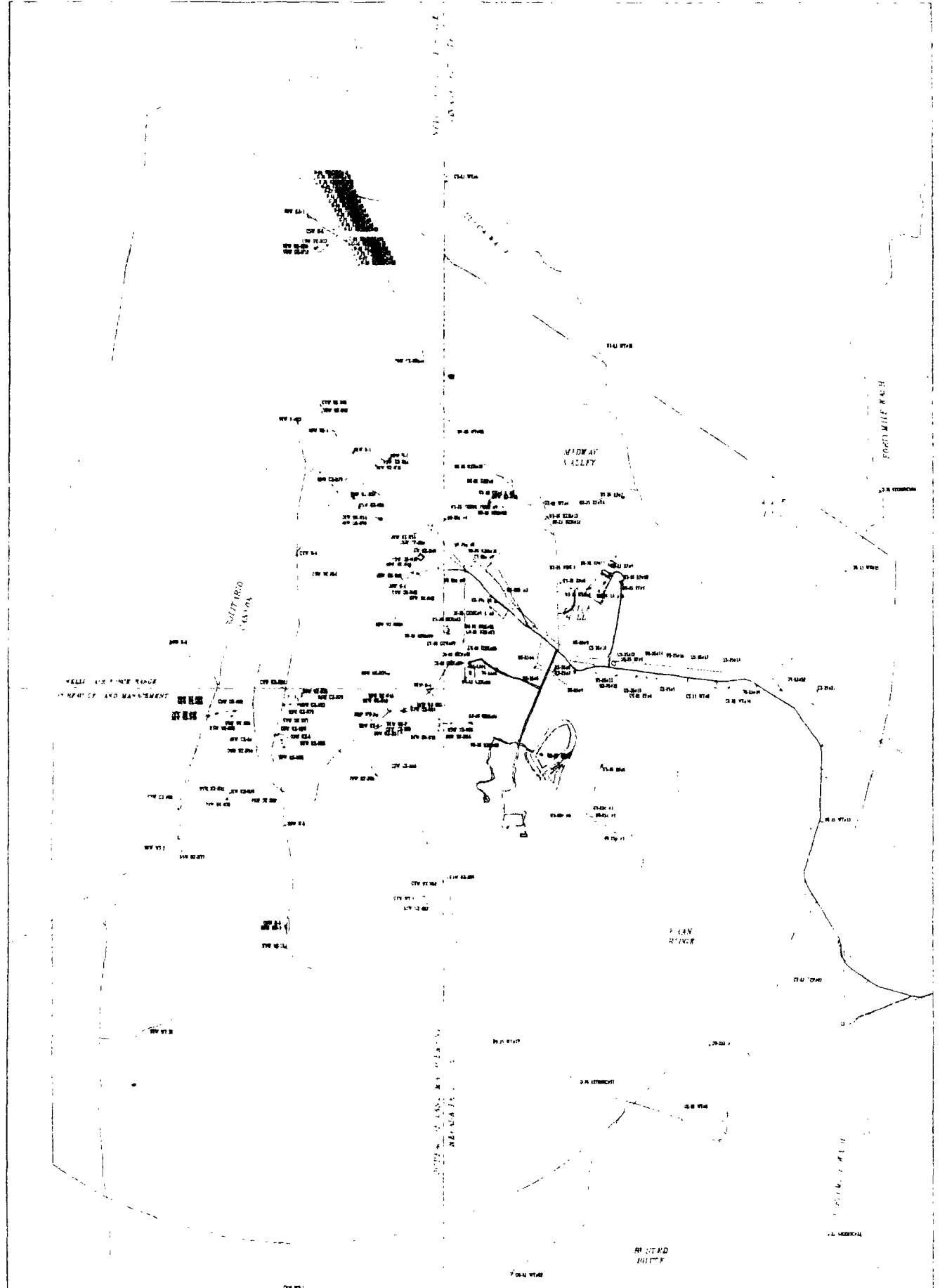
E550245ft  
E545000m

E566660ft  
E550000m

36°52'30"

36°50'00"

36°47'30"



116°30'00"

116°27'30"

116°25'00"

N4080000m

N4075000m