LONG-TERM CHANGES IN PERENNIAL VEGETATION IN PERMANENT PLOTS OF THE NORTHERN MOJAVE DESERT

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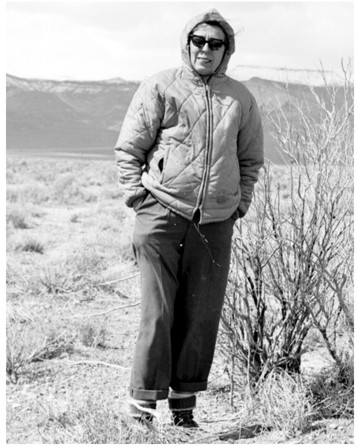
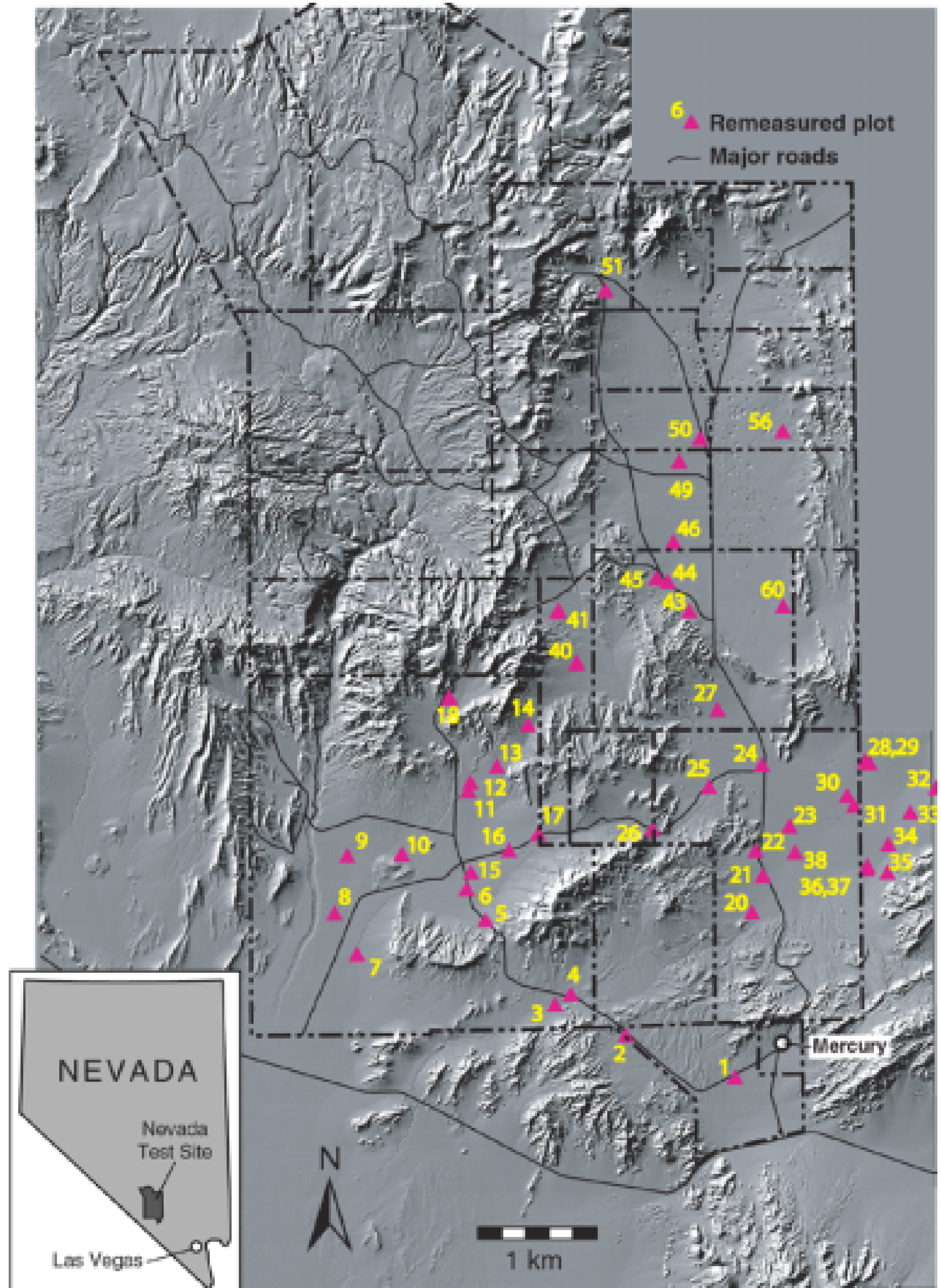
DYNAMICS OF UNDISTURBED VEGETATION IN THE MOJAVE DESERT

- “The [Mojave] desert is easily scarred, slowly healed.”
- Before our study, most ecologists viewed Mojave Desert vegetation as static and unchanging
- Some ecologists retain the community view of ecosystem processes; others consider species response to be individualistic

NEVADA TEST SITE PLOTS



J.C. Beatley established 68 permanent plots on the Nevada Test Site in 1963. She remeasured them in 1975; we remeasured 66 of them in 2000-2002. A total of 51 of Beatley's plots are in Mojave or Transition Great Basin Desert plant assemblages.



NEVADA TEST SITE

- Vegetation is representative of northern Mojave Desert and Great Basin Desert transition
- Cattle grazing over most of NTS was minimal
- One mining town (Wahmonie) was briefly established
- Land was withdrawn for testing in 1951
- Besides operational needs, land use is highly controlled
- Wild horses currently use northern ranges; occasional trespass cattle come in the southwestern corner

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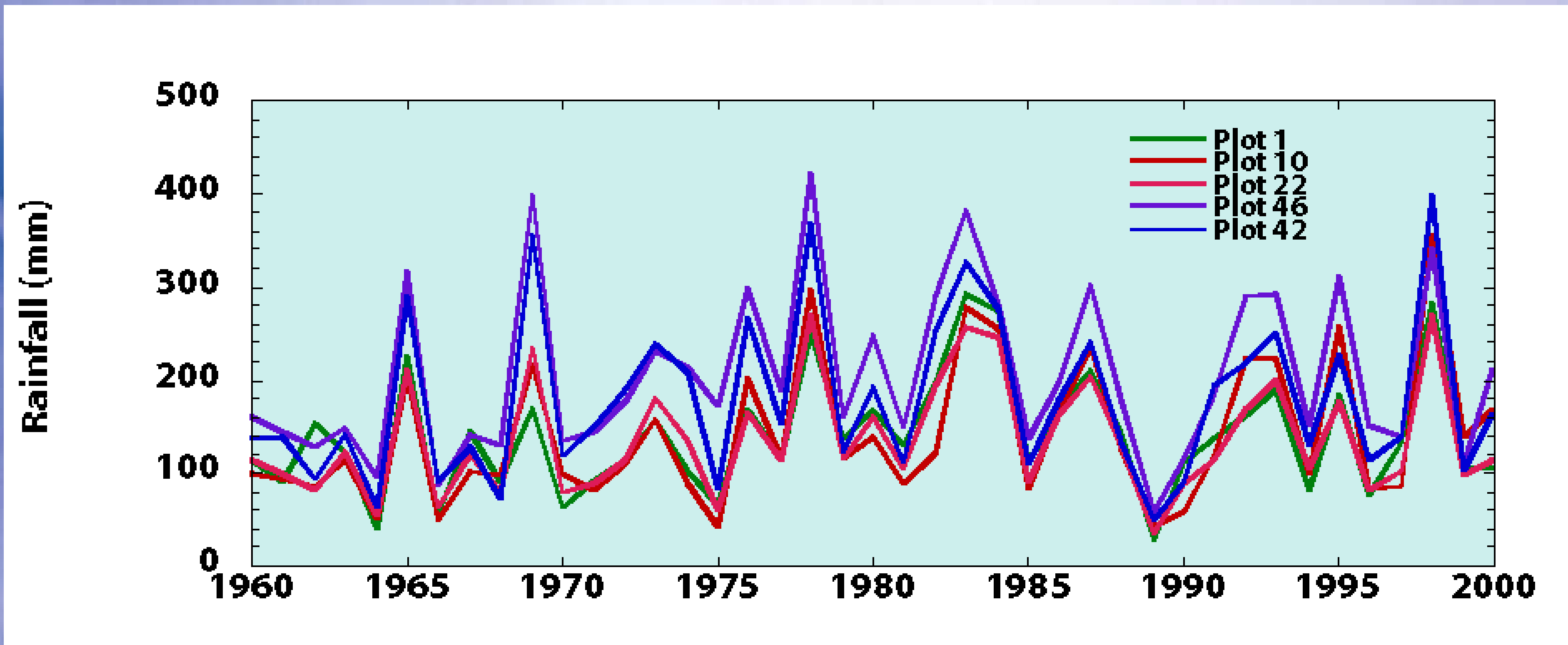
NTS CLIMATE, 1960-2000



Four high wet periods, two major droughts, increased growing season.

QUESTIONS

- Do Mojave Desert plants respond to climatic fluctuations as a community (in unison) or as individuals?
- Can species be classified into functional groups on the basis of their net response to climatic fluctuations?

POSITIVE RESPONSE OF INDIVIDUALS

Larrea tridentata

(n = 31 plots)

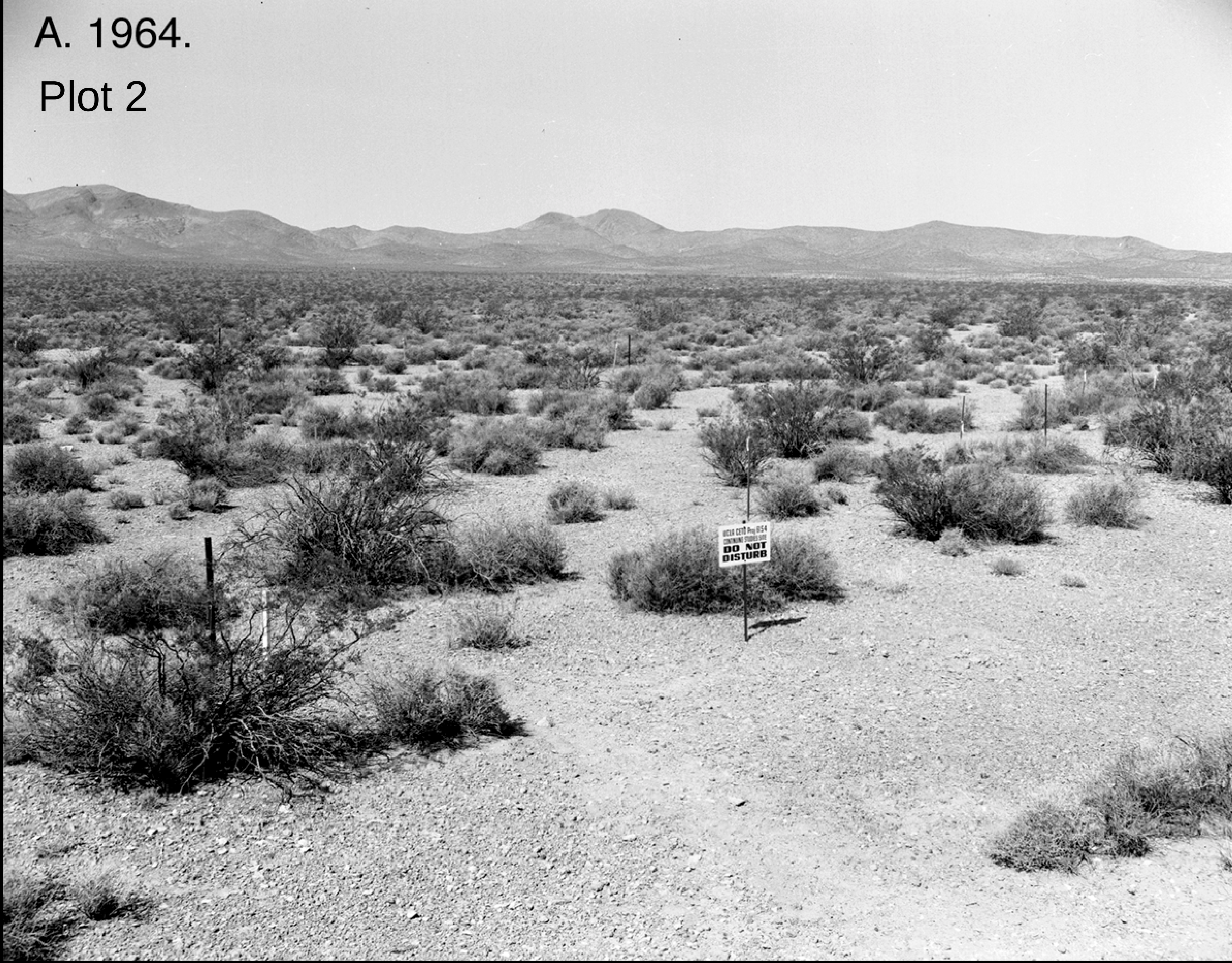
	Percent Change		
	1963-1975	1975-2002	1963-2002
Cover	54	32	97
Biomass	65	66	163

Ephedra nevadensis

(n = 27 plots)

	Percent Change		
	1963-1975	1975-2002	1963-2002
Cover	49	52	132
Biomass	93	65	222

Creosote bush and Mormon tea increased dramatically between 1963 and 2002 with little mortality or recruitment. Few individuals of either species died in 1989. Most existing individuals increased in size.



A. 1964.

Plot 2


B. 2000.
Plot 2

LARGE ESTABLISHMENT AND MORTALITY

Ambrosia dumosa
(n = 23 plots)

	Percent Change		
	1963-1975	1975-2002	1963-2002
Cover	37	133	246
Biomass	48	129	357

Acamptopappus shockleyi
(n = 13 plots)

	Percent Change		
	1963-1975	1975-2002	1963-2002
Cover	23	-21	11
Biomass	35	-9	51

These species increased during wet periods but had high mortality during the 1989 drought. The result is a net increase in density, 1963-2002.

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LARGE, FLUCTUATING RESPONSE

Achnatherum speciosum
(n = 10 plots)

	Percent Change		
	1963-1975	1975-2002	1963-2002
Cover	518	-9	195
Biomass	662	39	331

Achnatherum hymenoides
(n = 23 plots)

	Percent Change		
	1963-1975	1975-2002	1963-2002
Cover	667	7	363
Biomass	913	12	440

Perennial grasses increased in the wet years of the 1970s-80s, only to die off during the 1989 drought. Few grass clumps persisted 1963-2002.

HIGH DROUGHT-RELATED MORTALITY

Grayia spinosa

(n = 29 plots)

	Percent Change		
	1963-1975	1975-2002	1963-2002
Cover	60	-71	-65
Biomass	78	-75	-67

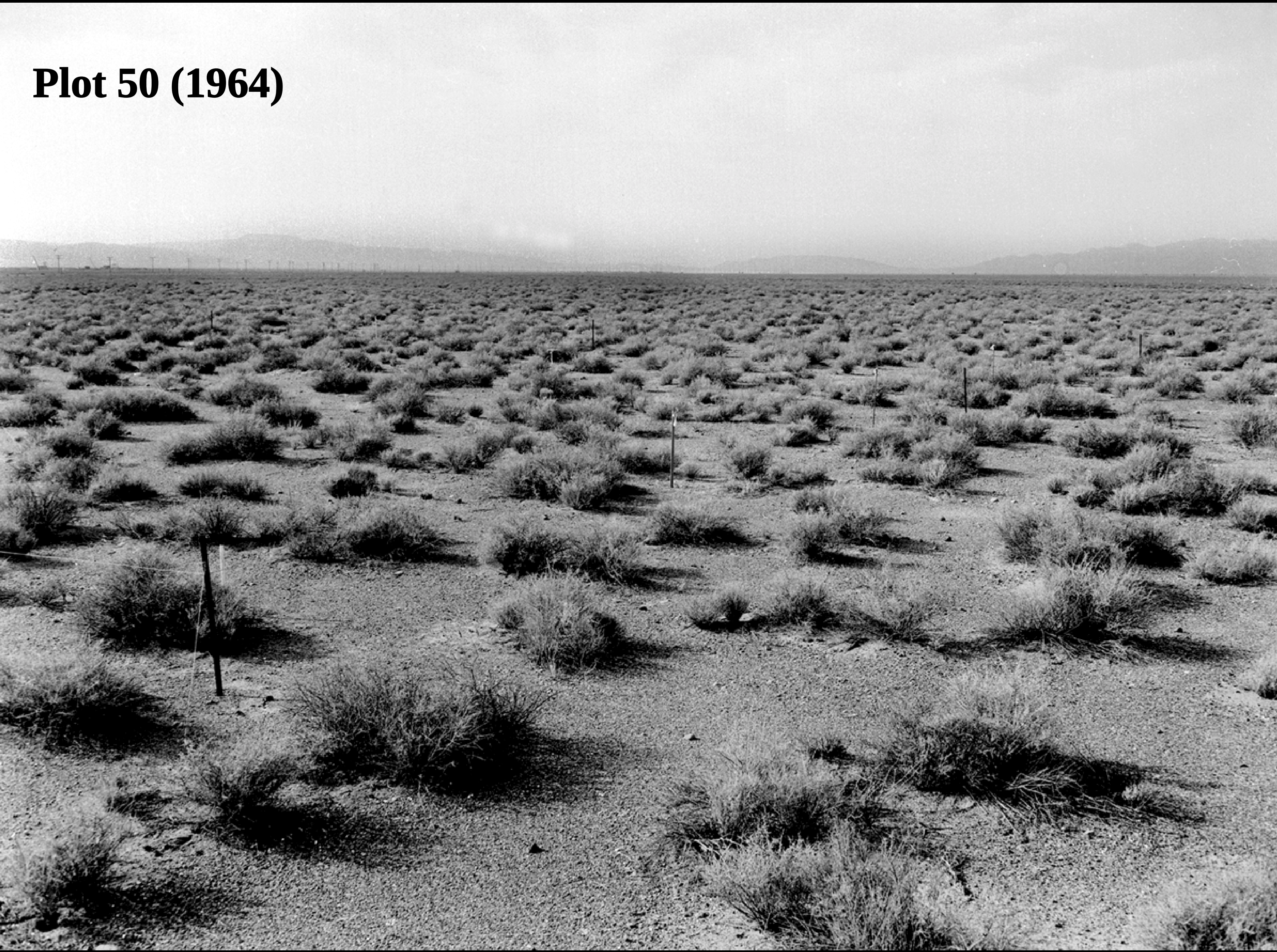
Atriplex confertifolia

(n = 9 plots)

	Percent Change		
	1963-1975	1975-2002	1963-2002
Cover	39	-47	-32
Biomass	98	-56	-23

Spiny hopsage increased from 1963-1975 then decreased on every plot that it was present in 1963 and 1975. Shadscale is less common but also decreased. Previous studies reported mortality of Chenopods during the 1989 drought.

Plot 50 (1964)




Plot 50 (2001)

CO-DEPENDENCY AND DROUGHT

Lycium andersonii
(n = 28 plots)

	Percent Change		
	1963-1975	1975-2002	1963-2002
Cover	23	-37	-25
Biomass	27	-42	-31

Grayia spinosa
(n = 29 plots)

	Percent Change		
	1963-1975	1975-2002	1963-2002
Cover	60	-71	-65
Biomass	78	-75	-67

Wolfberry and spiny hopsage commonly occur together. Spiny hopsage changed more, illustrating differential response.

HEMI-ROOT PARASITE

Krameria parvifolia
(n = 16 plots)

	Percent Change		
	1963-1975	1975-2002	1963-2002
Cover	17	32	65
Biomass	28	61	116

Range ratany has increased consistently in cover and biomass. It appears to be more related to creosote bush than spiny hopsage and has responded similarly to former species.

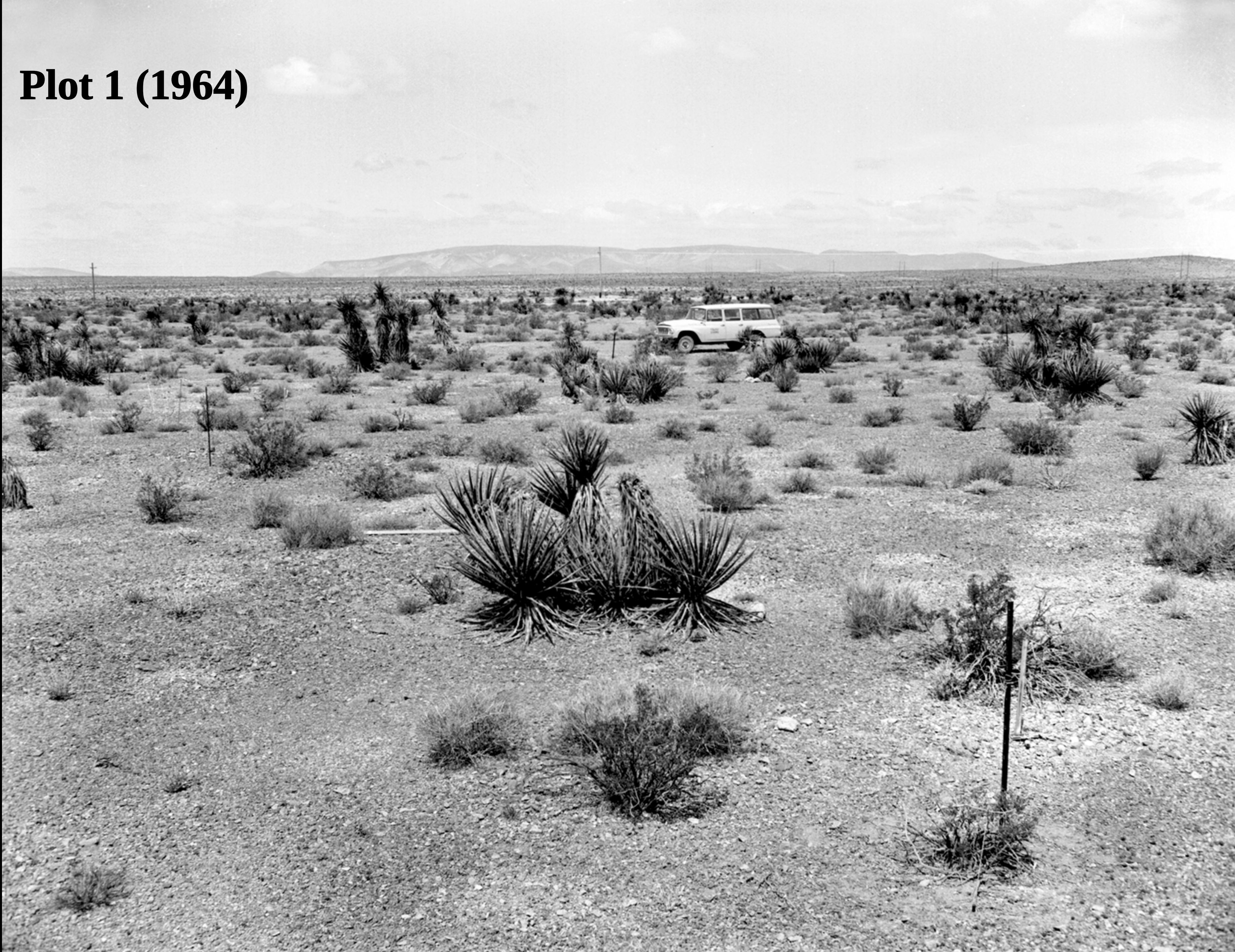
CHARISMATIC SPECIES

Yucca populations are highly visible but low-density elements of the Mojave landscape.

Mojave Yucca (*Yucca schidigera*) appears on only one plot (Plot 1). It appears to be very long-lived with a stable population.

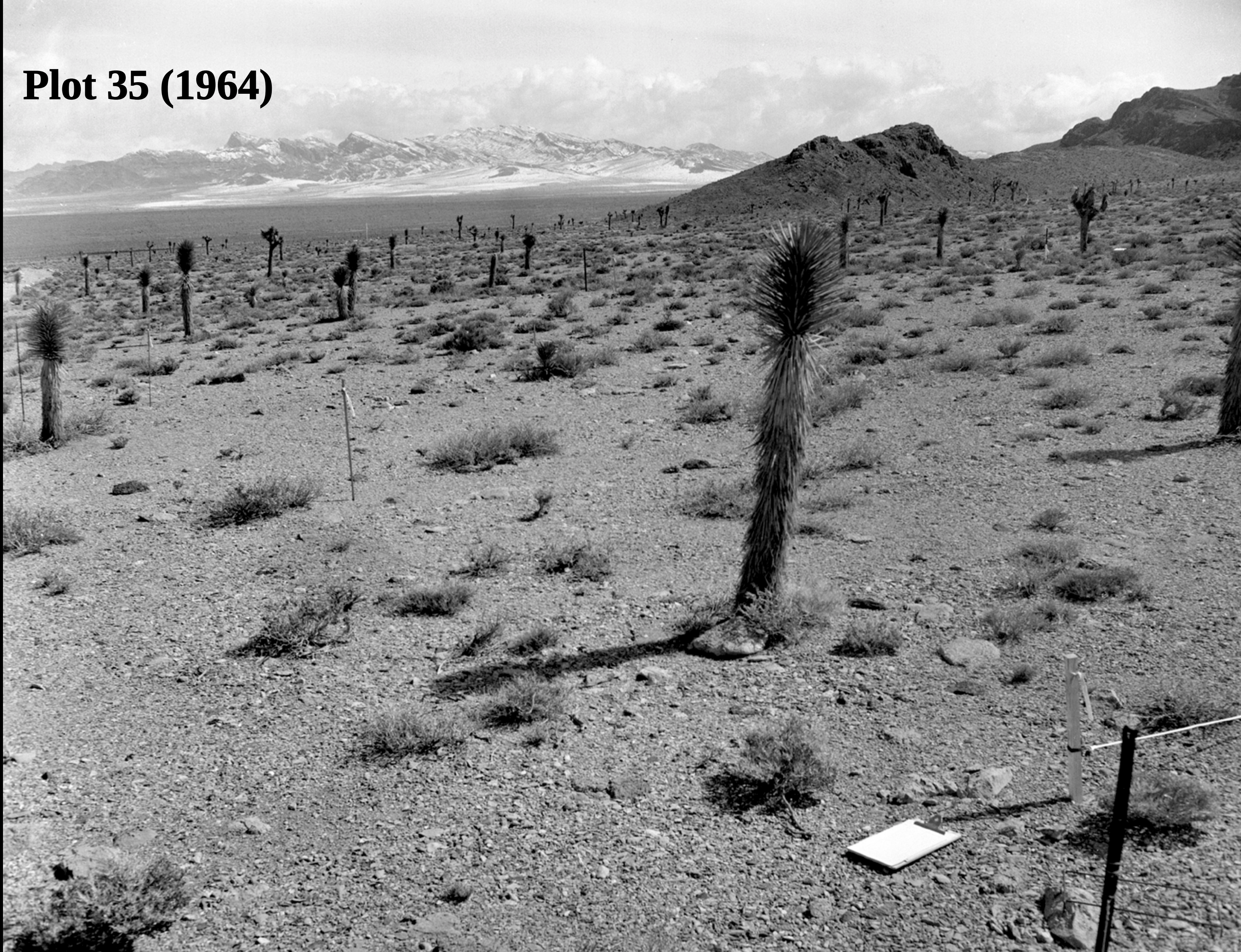
Joshua trees (*Yucca brevifolia*) appears on many plots. Most observations indicate significant increases in size and density of Joshua trees

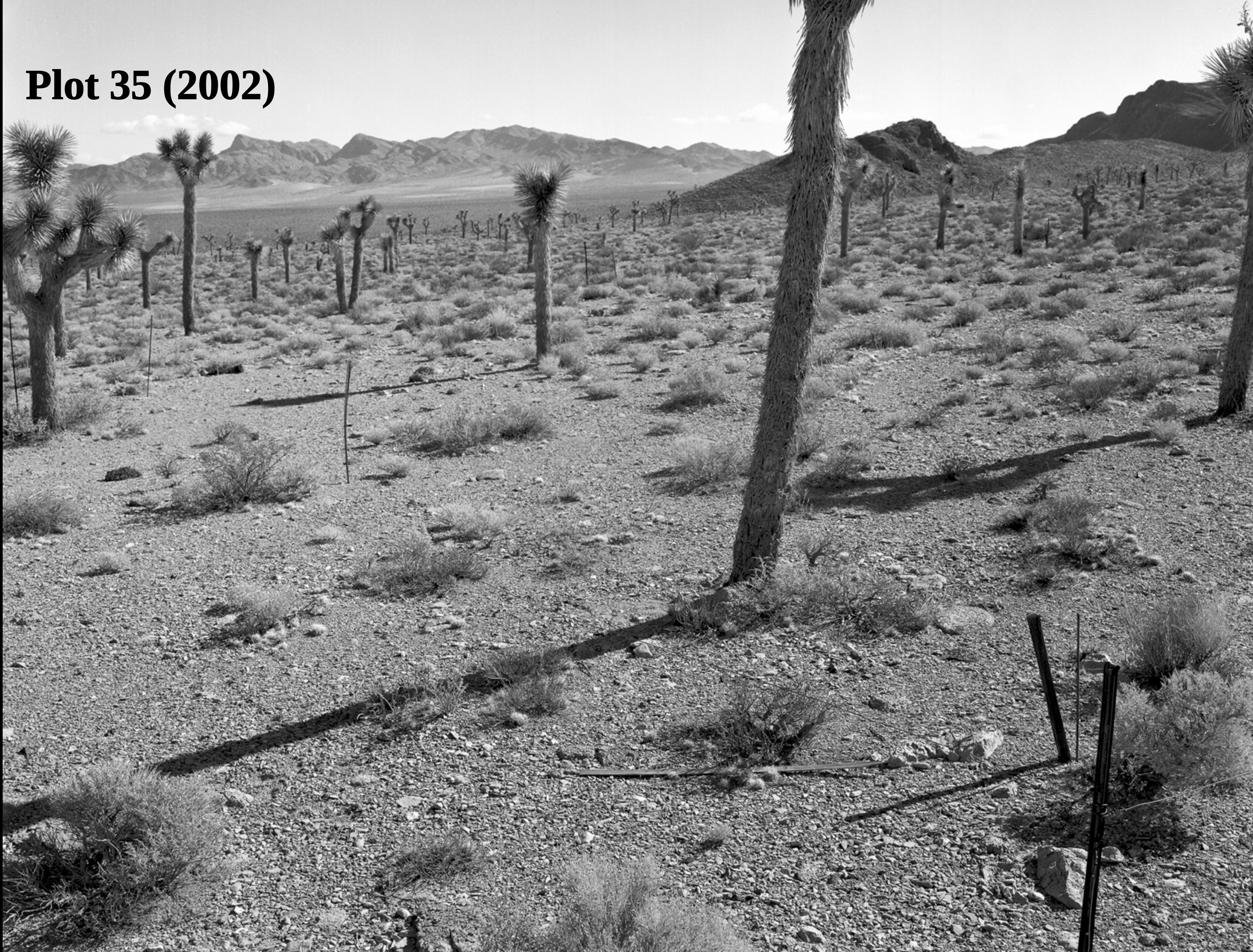
Banana yucca (*Yucca baccata*) appears on several plots and has increases in density.



Plot 1 (1964)

Plot 1 (2000)


Plot 35 (1964)



Plot 35 (2002)

CLIMATICALLY-INSENSITIVE SPECIES

Coleogyne ramosissima
(n = 12 plots)

	Percent Change		
	1963-1975	1975-2002	1963-2002
Cover	3	5	8
Biomass	-1	23	23

Blackbrush has remained at about the same level as it was in 1963. Cover increased, then decreased by drought pruning during 1989 drought. Increases in biomass are mainly the result of increases in plant height.

Plot 51 (1964)

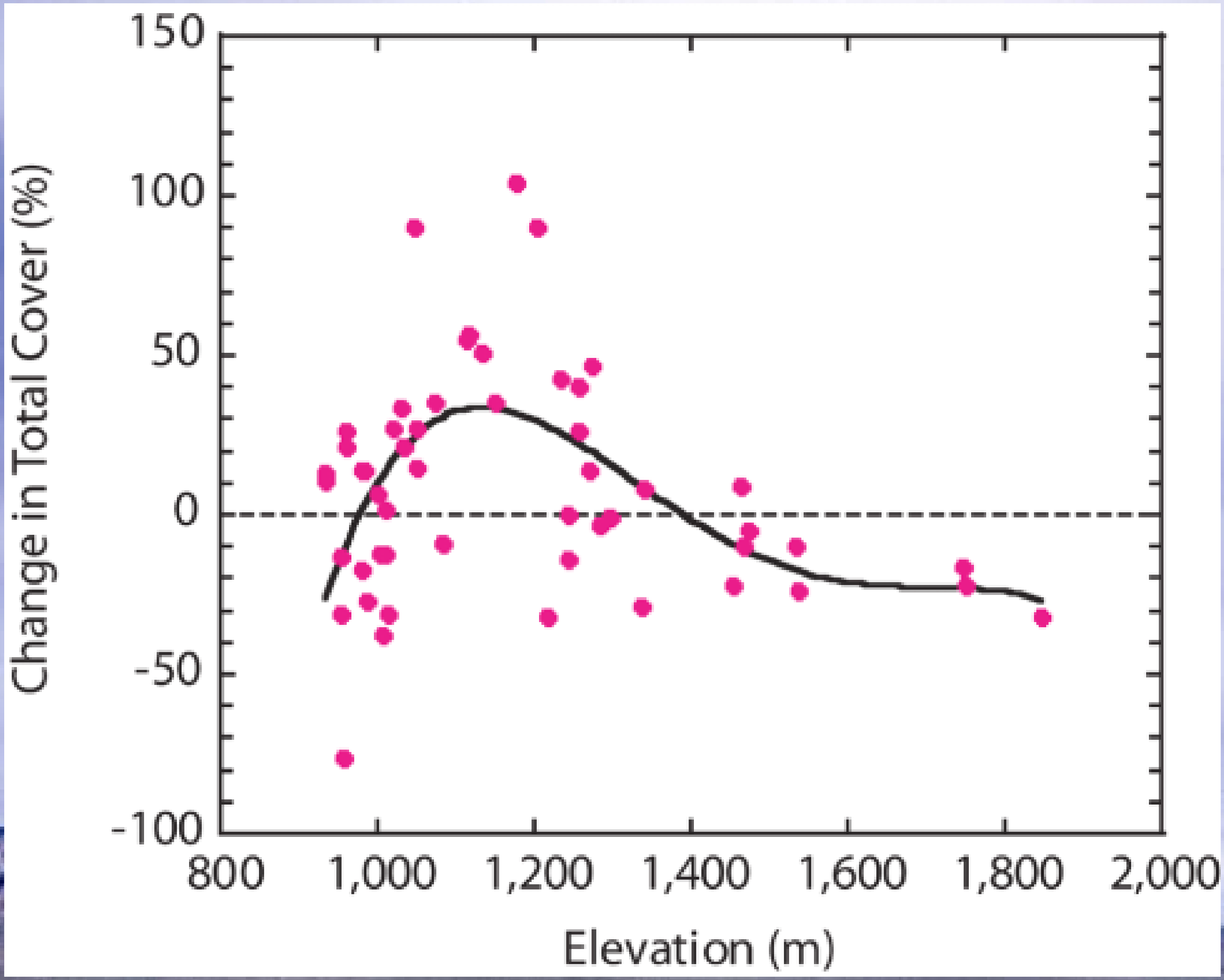

Plot 51 (2002)
DO NOT
DISTURB

CHANGES IN TOTAL COVER AND BIOMASS INDEX (n = 52 plots)

	Percent Change		
	1963-1975	1975-2002	1963-2002
Cover	33	-15	12
Biomass	47	-1	40

As Beatley (1979) noted, shrub cover increased 1963-1975, largely as a result of high precipitation in 1966 and 1972. Between 1975 and 2002, extreme wet and dry periods caused a mixed signal, resulting in only small changes in cover and biomass.

LONG-TERM (1963-2002) CHANGE IN UNDISTURBED PERENNIAL VEGETATION



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LONG-TERM STABILITY OF VEGETATION ASSOCIATIONS?

- In 1979, Beatley used her data to define 16 vegetation associations in the Mojave and Transition Deserts. Of those, 8 named spiny hopsage (*Grayia spinosa)* as a dominant.
- In 2000, Ostler *et al*. defined 10 vegetation associations for Mojave and Transition Deserts. One lists *Grayia* as dominant.
- In 1999-2002, *Grayia* doesn't dominate any of Beatley's plots, and only 3 of 28 plots had enough *Grayia* to justify calling them associations.

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COMMUNITIES OR ASSEMBLAGES?

- Clearly, Mojave Desert plant communities are sensitive to climatic fluctuations.
- Mojave Desert plant associations are aggregations of individuals, not communities responding as a group.
- Climatic events induce differential species responses – some species (*Larrea tridentata*, *Ambrosia dumosa*) gain; others (Chenopods such as *Grayia spinosa*) lose; others (grasses) have large fluctuations in population.
- Some species (*Coleogyne ramosissima*) are relatively insensitive to climate.

IMPLICATIONS FOR MANAGEMENT

- Directional fluctuations in Mojave Desert shrub
Desert shrub populations occur irrespective of land
irrespective of land use
- Monitoring should identify and follow the backbone
follow the backbone of the ecosystem (*e.g.*, creosote
ecosystem (*e.g.*, creosote bush, Mormon tea,
Mormon tea, blackbrush) as the canaries in the mine
canaries in the mine shaft
- High mortality during drought years should be
should be expected – it doesn't necessarily take the
necessarily take the bazillion-year drought to kill
drought to kill Mojave Desert shrubs, nor is that
shrubs, nor is that necessarily a "bad thing"
"bad thing"