





# **REVEGETATION TRENDS AND LESSONS – MONTANA COAL**



“The secret of managing is to keep the guys who hate you away from the guys who are undecided.”

Casey Stengel



“Can't anybody here  
play this game?”

Casey Stengel



# MONKEY SEE – MONKEY DO





SPRING CREEK AND  
DECKER COAL MINES  
TONGUE RIVER BASIN  
SOUTH-CENTRAL MT  
3500' ELEV. (1,070 m)  
10.8" (27 CM) ANNUAL PRECIP.  
~ CLAY LOAM  
3 SUBSTRATES: SPOIL,  
SCORIA, SALVAGED TOPSOIL

SCM HAS 9  
MAJOR SEED MIXES  
MAY USE SEVERAL IN ONE FIELD

E.G., 1 OR 2 UPLAND MIXES

ALLUVIAL MIX

SPECIAL SUBSTRATES

SHRUB MOSAICS



# MONTANA COAL DISTURBANCE

$$63 \text{ mi}^2 = 163 \text{ km}^2$$

0.2% OF CROPLAND

$$28,000 \text{ mi}^2 = 73,000 \text{ km}^2$$







# SMCRA 1977

REVEG. DIVERSE, EFFECTIVE, PERMANENT

NATIVE SPP. EXCEPT PASTURES

≥ PREMINE COVER AND PROD.

CONTROL EROSION



AFTER SMCRA

COAL BECAME THE  
CRUCIBLE FOR  
WESTERN REVEGETATION





**MT COAL AND URANIUM  
MINE RECLAMATION  
LAW WEAKENED 2003**

**STILL REQUIRES A  
MINIMUM 10 YEAR TO  
EVALUATE PHASE 3  
BOND RELEASE**



Table 10. Shrub survival as a function of field age, Sodic Overburden Test Plots.

AGE (YRS.)	4' Suitable Fill	8' Suitable Fill

---INDIV/HA (% SURVIVAL)---

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11	2,460	(29)	2,520	(14)





















2# T21  
p.5  
12

1000 days



Table 1. Premine (baseline) vegetational attributes, SCCM.

VEGETATION TYPE	PERENNIAL COVER %	PERENNIAL PSC KG/HA*	SHRUB DENSITY INDIV/HA**
Steppe Types (minor)	43	800	700
Sagebrush Types	48	625	8,400 (3,400/A)

\* Air-dried; excluding tree productivity. Multiply by 0.89 for pounds/acre.

\*\* For shrubs/acre divide by 2.47.

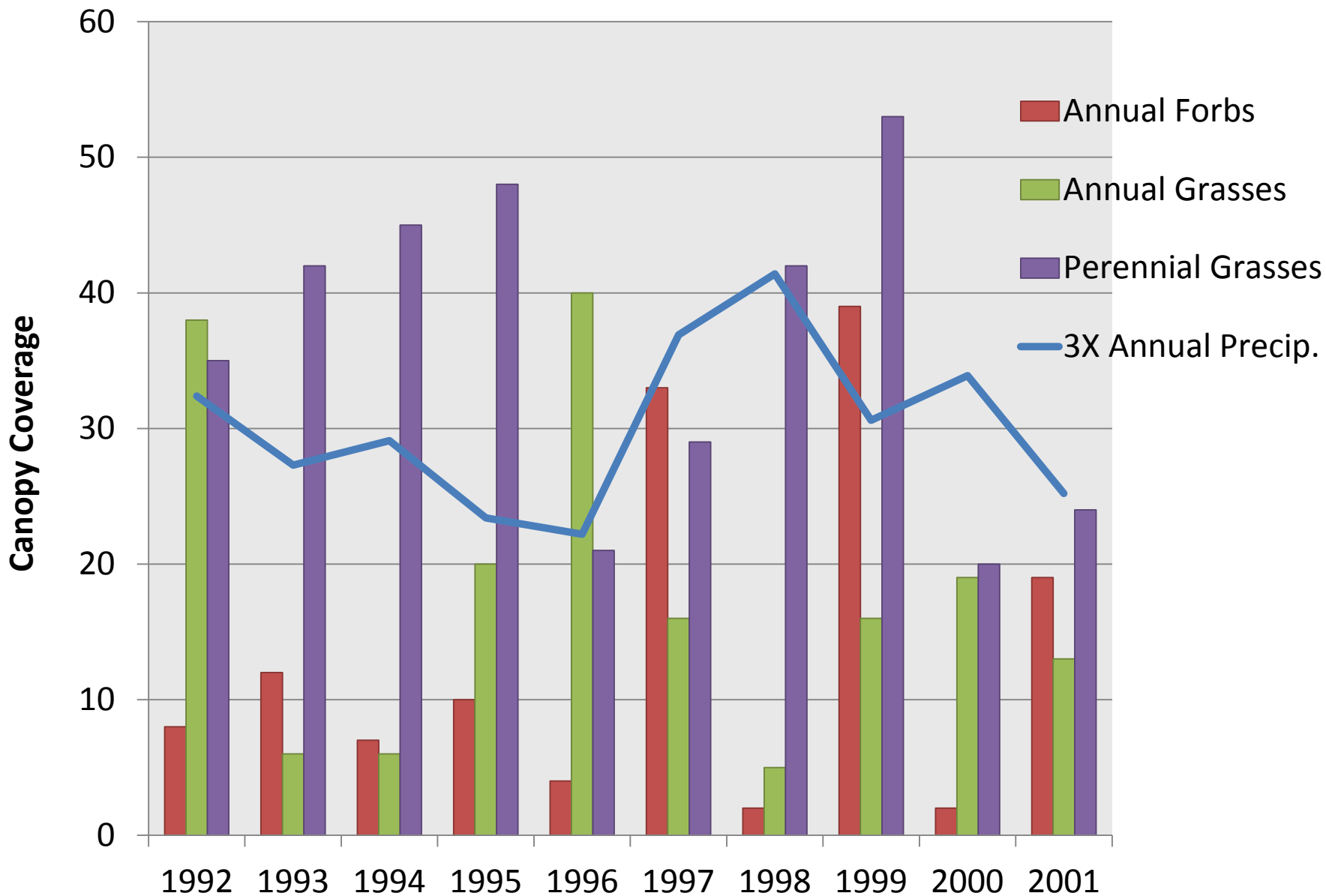
Table 2. Technical vegetation standards, SCCM. Revegetation must meet 90% of the standards with 0.1 Type 1 error.

PERFORMANCE PARAMETER	GRAZING LAND	WILDLIFE HABITAT
SHRUB DENSITY	1,110/HA	5,740/HA
PERENNIAL COVER	50%	46%
PEAK STANDING CROP	775 KG/HA	NA

TURNING TO TRENDS

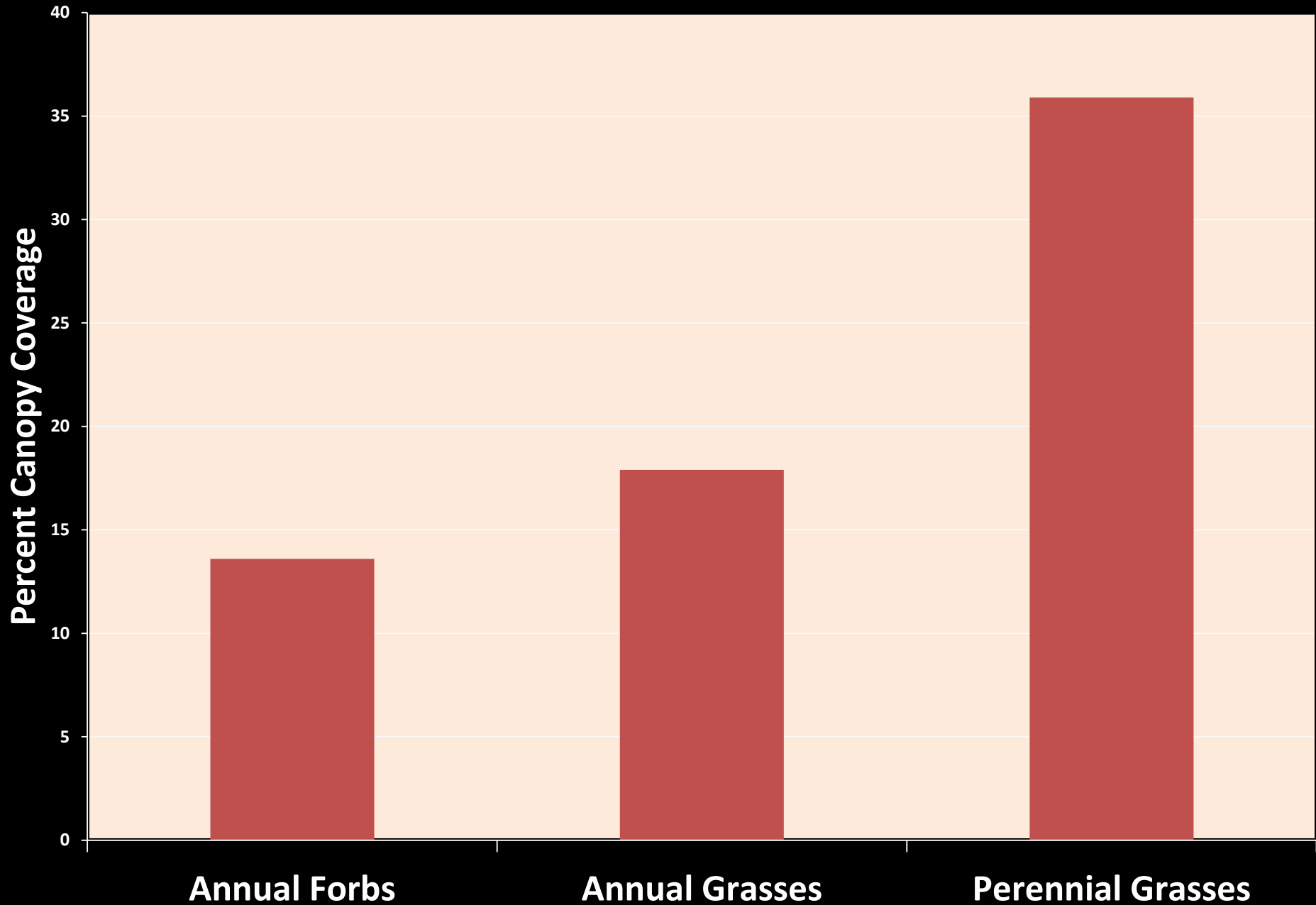
GENERALIZATIONS THAT  
MAKE THE COMPLICATED  
APPEAR SIMPLE  
USUALLY DIRECTIONAL





**Growth-Form Dynamic**  
**South Fork Spring Creek, Bighorn Co., MT**

# RELATIVE GROWTH-FORM ABUNDANCE



# 3 TRENDS PERTAIN TO BOND RELEASE

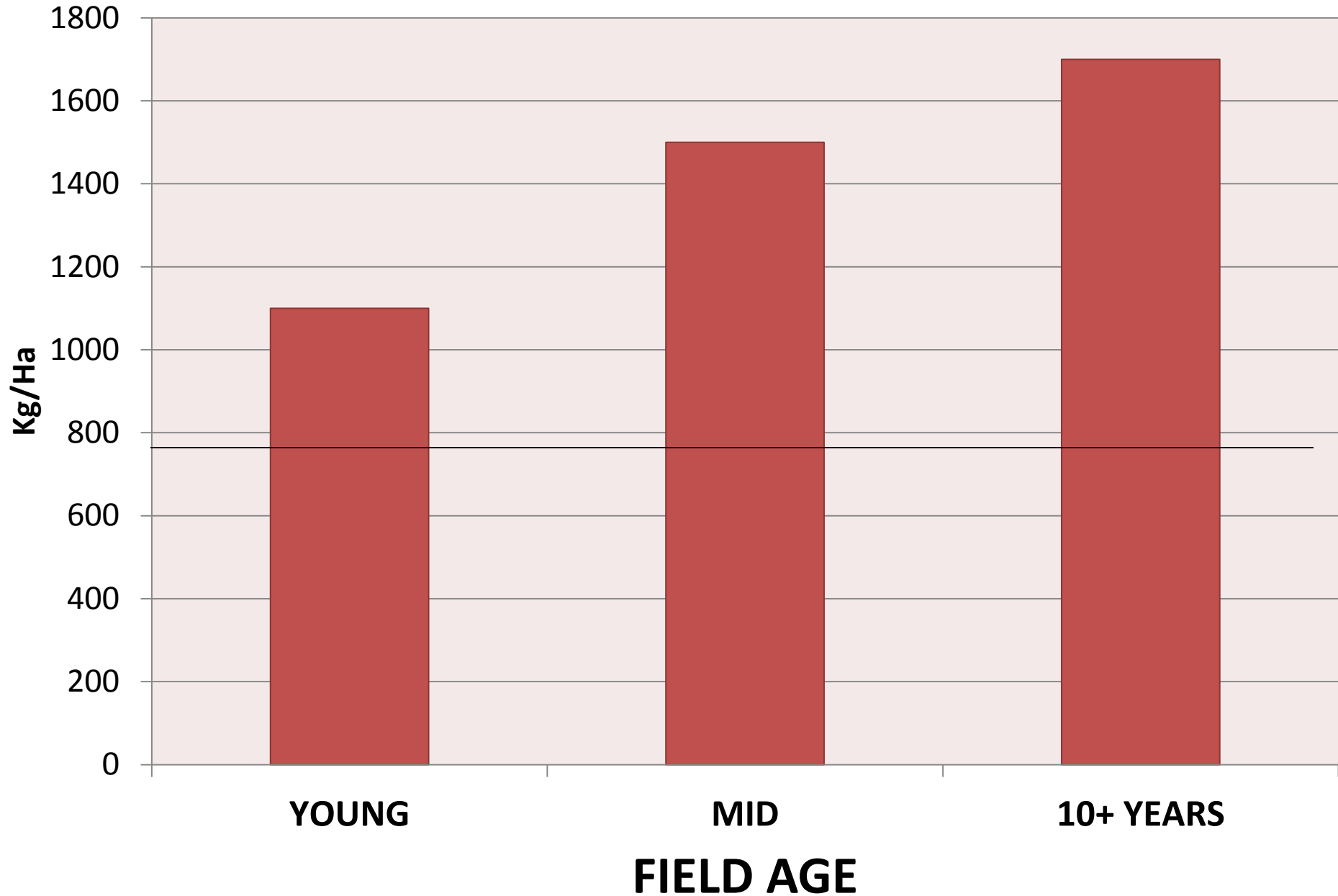
PERENNIAL COVER

PERENNIAL PRODUCTIVITY

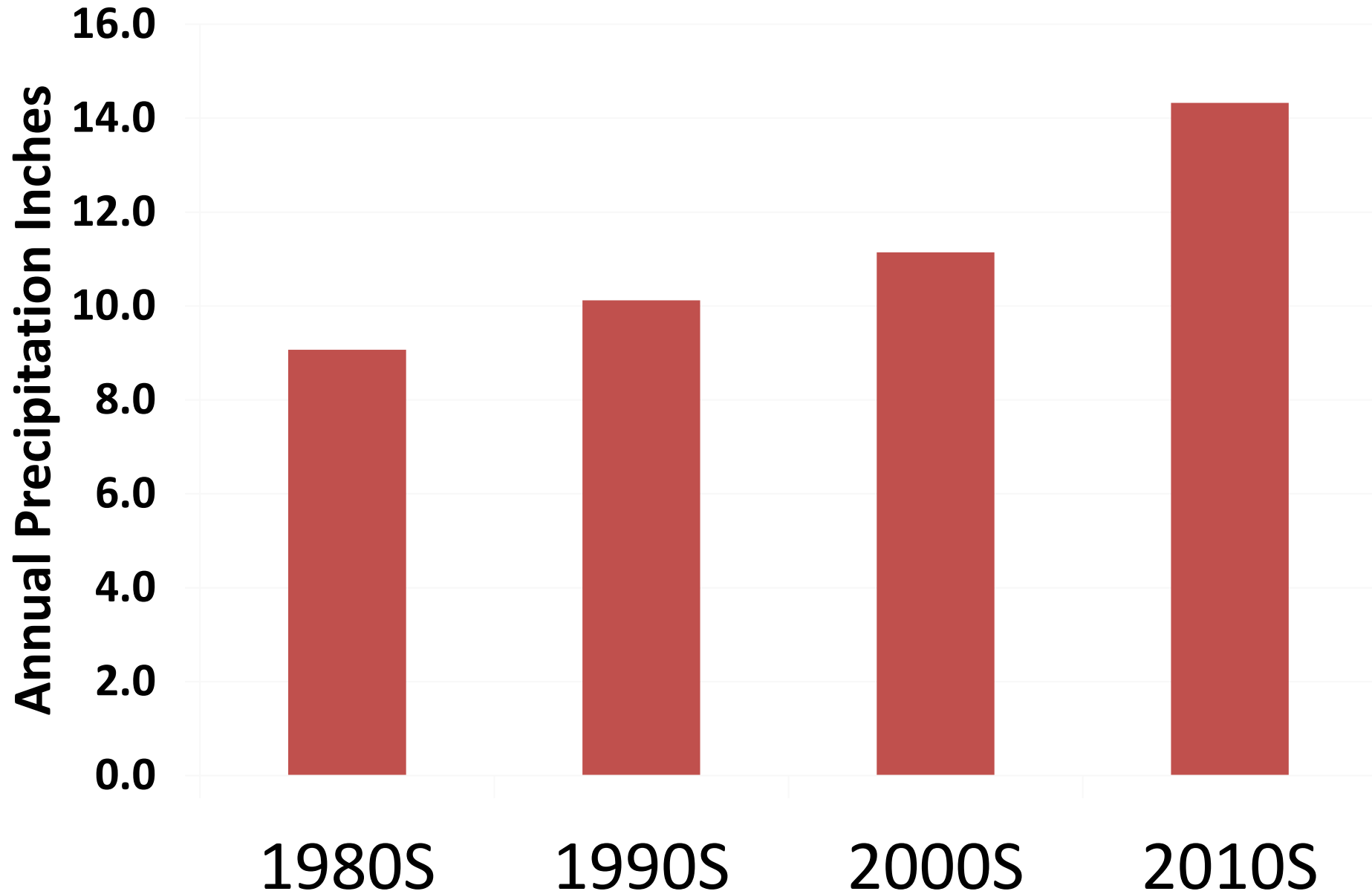
SHRUB DENSITY



# PERENNIAL PSC TREND IN REVEGETATION



# PRECIPITATION TRENDS SCM





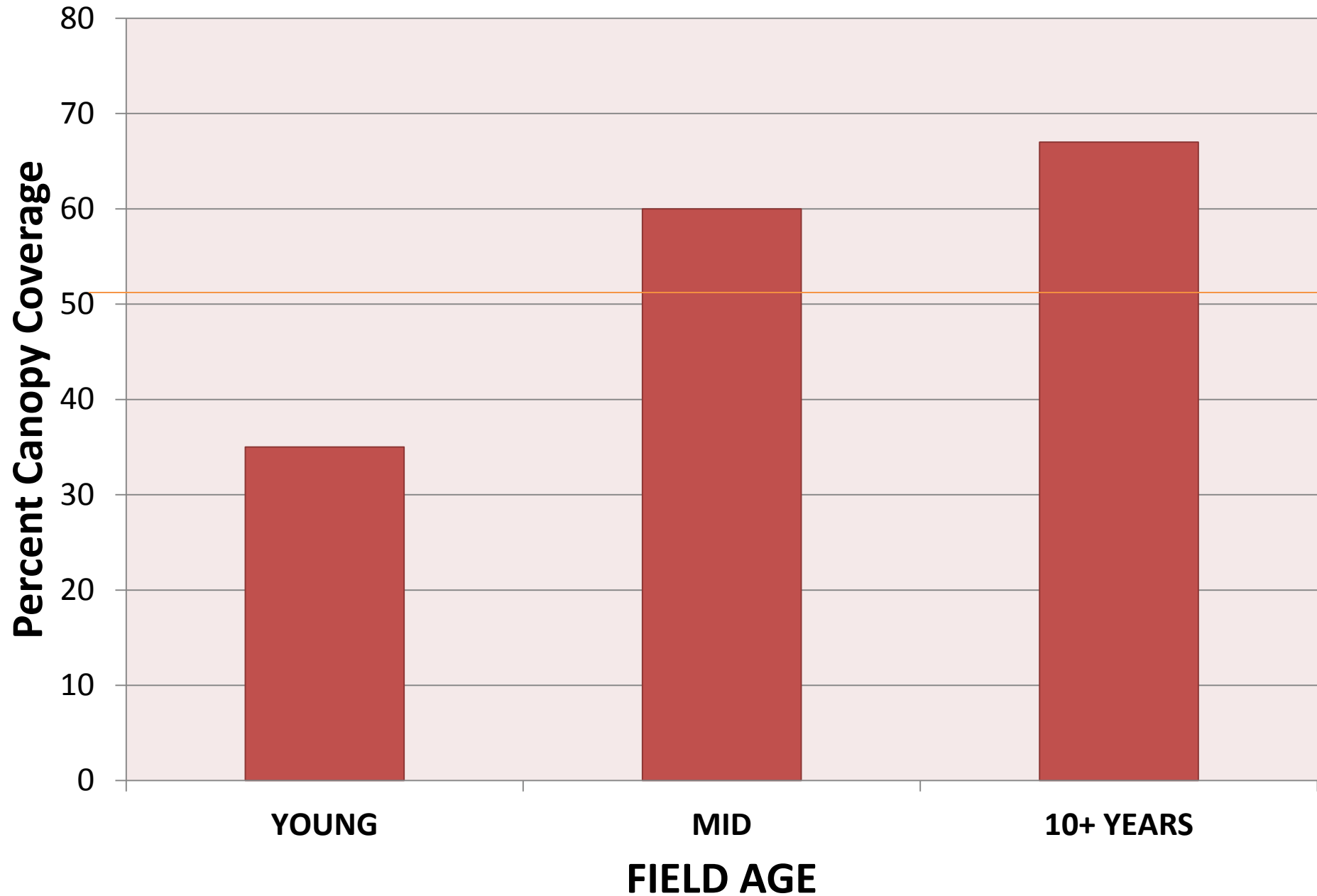








# PERENNIAL C-COVERAGE IN REVEGETATION









**TREND: SHRUB DENSITY DECLINES  
WITH TIME. 82% SURVIVAL AT  
THE CONCLUSION OF SAMPLING**





PAR 1 MI









MORE TRENDS  
QUICK LOOK AT 2  
PERENNIAL SPP.

WESTERN WHEATGRASS  
SHEEP FESCUE

# WESTERN WHEATGRASS

REVEG ALL-STAR

ORIGINATES LOCALLY

VIGOROUS RHIZ. SPREAD












A photograph of a vast, open field of tall, dry, golden-brown grass under a clear blue sky. In the background, a range of low, rocky hills or mountains is visible. In the foreground, a green metal post is stuck into the ground, with a piece of brown paper attached to it. The paper has the number '5' and the text 'T SOUTH' written in red. A white string is tied around the post and extends into the distance.

5  
T SOUTH

SEEDED 2003  
PHOTO 2007

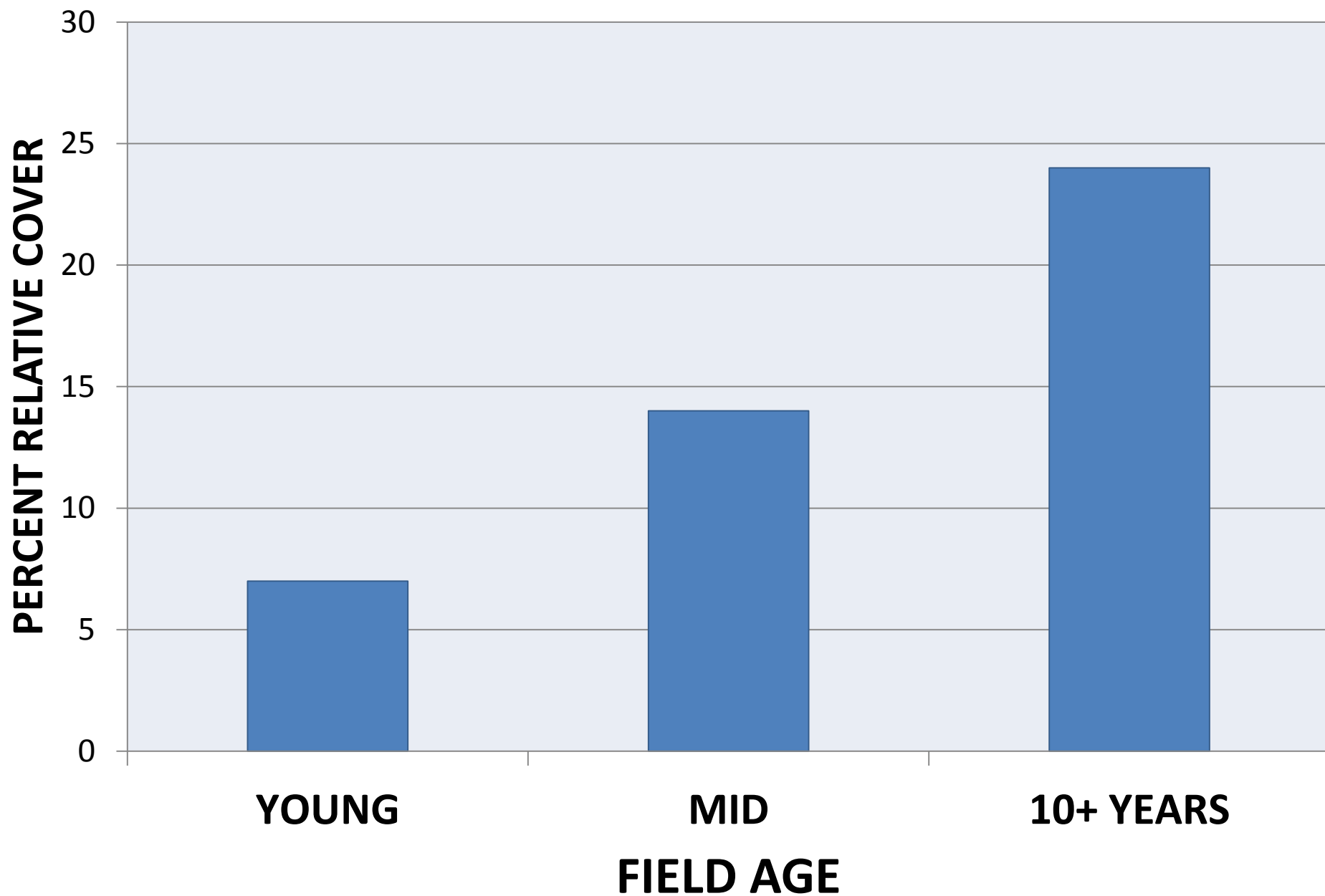




PAR 5 2015



# WESTERN WHEATGRASS C-COVER SCM



In the 2007 monitoring at  
DCM, 80% of perennial  
cover (relative cover)  
came from a single species:

**Western Wheatgrass.**



# **SHEEP FESCUE**

**REVEG ALL-STAR  
INTRODUCED TO U.S.**

**SMALL TUFTED BUNCHGRASS  
SPREADS BY COPIOUS  
SEED PRODUCTION**





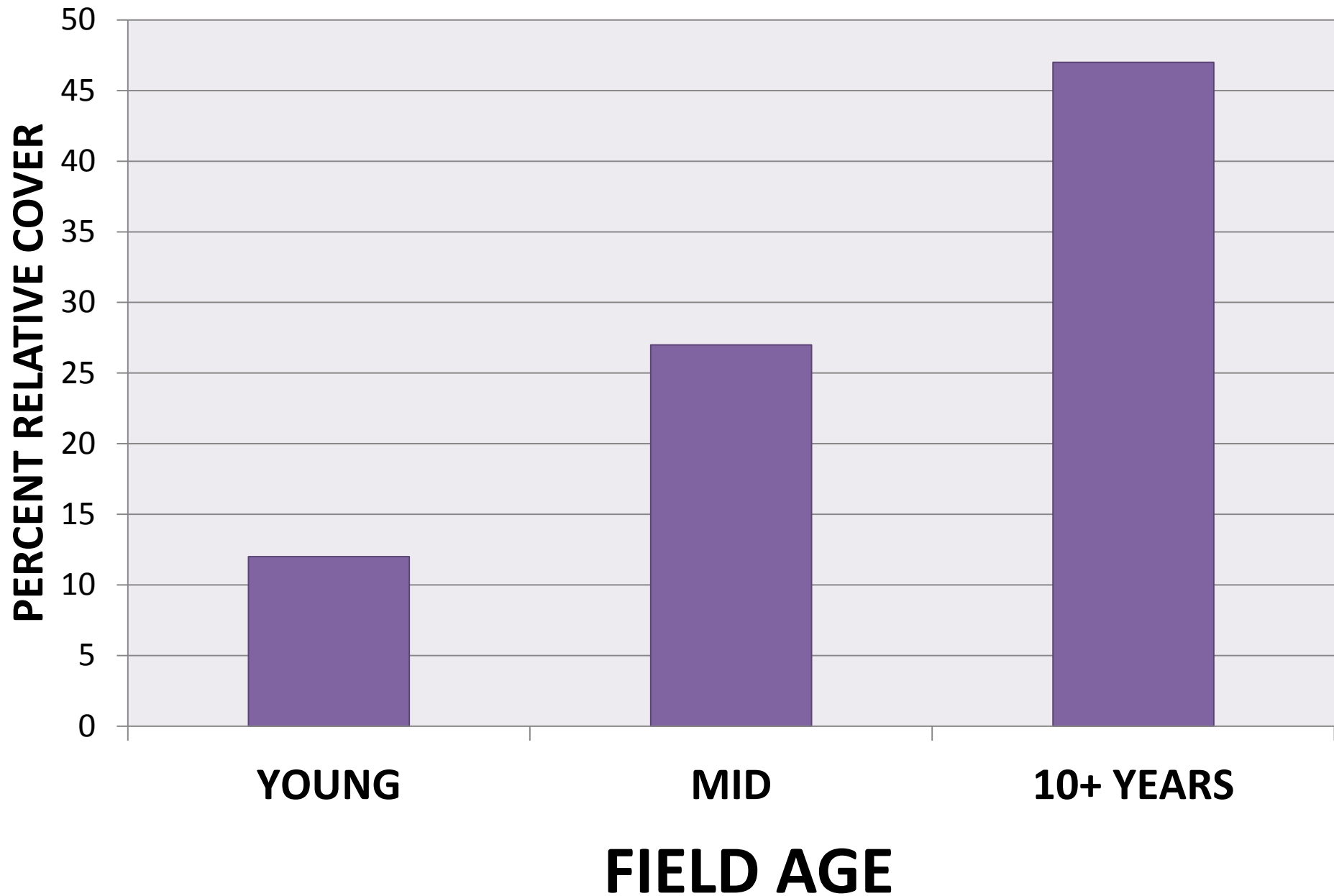
SEEDED 1990 PHOTO 2012





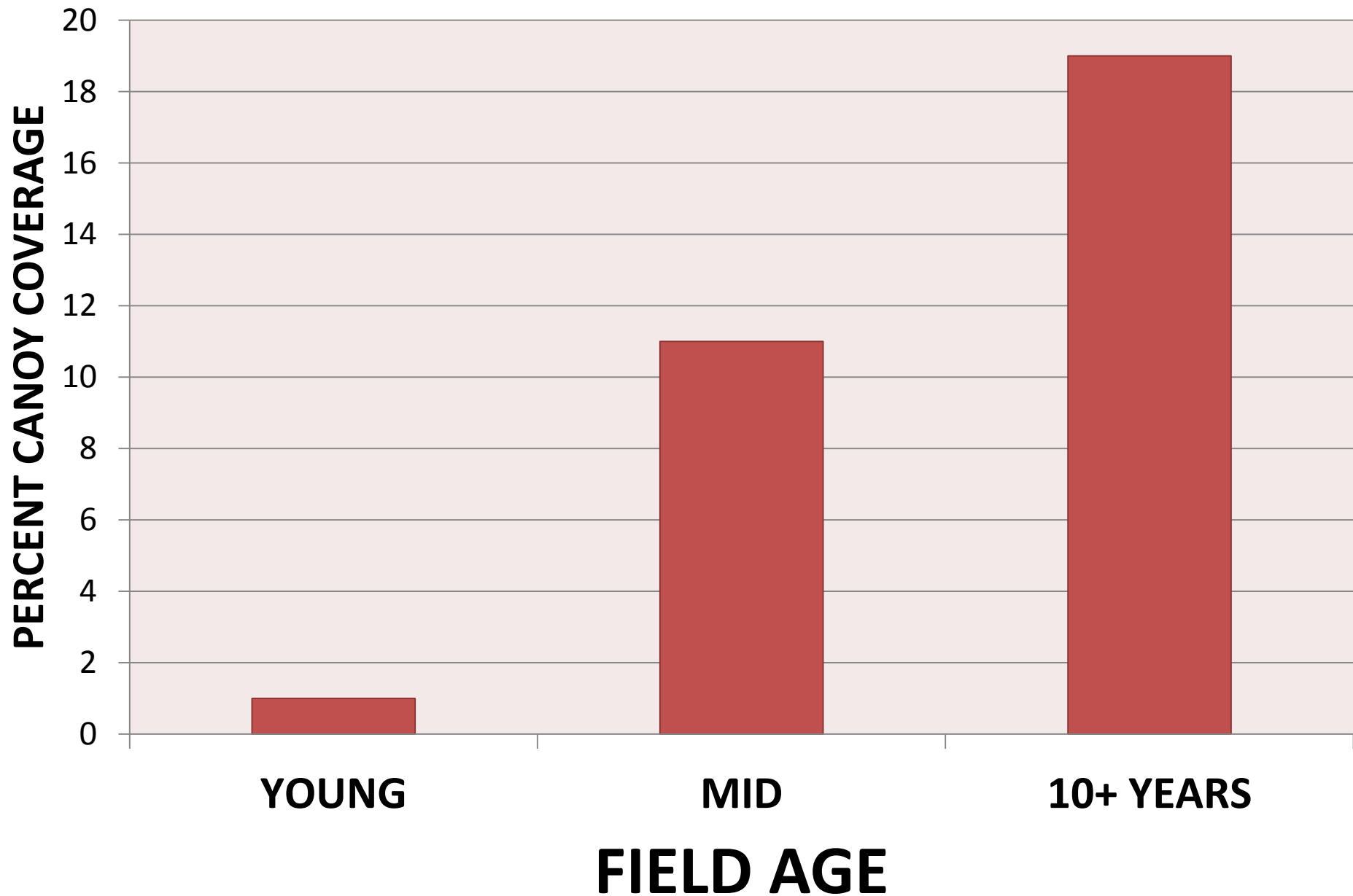


# SHEEP FESCUE COVER -- SEEDED





# SHEEP FESCUE COVER -- UNSEEDDED









# GROWING SHRUBS FROM SEED

NEXT 3 PHOTOS FROM  
A SINGLE FIELD,  
DIFFERENT SEEDINGS



A wide-angle photograph of a desert landscape. The foreground and middle ground are filled with dense, low-lying sagebrush with silvery-green foliage. Some taller, yellowish-brown shrubs are scattered throughout. In the background, there are rolling hills with patches of green grass and exposed sandy soil. The sky is clear and blue.

SAGEBRUSH

PAR 2F





GREASEWOOD





FOURWING SALTBUUSH



**3 MAIN SHRUB SPP.**

**FOURWING SALTBUH  
DRILL SEED (DE-WINGED)**





PARIC  
ETH



A wide-angle photograph of a field filled with dense, low-lying vegetation. The plants are a mix of green and yellowish-brown, suggesting some are dry or dormant. In the foreground, there's a dirt path or clearing with a few small yellow flowers. The background shows a flat expanse of similar vegetation leading to a dark, possibly rocky or eroded hillside under a clear sky.

DRILL THE HEAVY SEED

PAR 5



**BLACK GREASEWOOD**





EASTERN 4H





PAR 5B



**WYOMING BIG**

**SAGEBRUSH**





15 YEARS OLD





BROADCAST THE LIGHT SEED

PAR 4C SEEDED 11/99  
PHOTO 2012



# **2 LOCALLY IMPORTANT SHRUBS**

**WINTERFAT  
USUALLY A SUBSHRUB-  
A SHRUB IN REVEG**











RUBBER  
RABBITBRUSH



# RUBBER RABBITBRUSH







B6M



# GROWING SHRUBS IN REVEGETATION

START WITH  
SUBSTRATE



FOR SHRUBS: GOOD SPOIL

FOR DIVERSITY BUT LESS  
ASSURED SHRUBS: SCORIA

TOPSOIL IS PRODUCTIVE  
BUT WEEDY



# OBSERVATIONS

## EXAMPLE OF OB 2, DCM

SPOIL or OVERBURDEN  
STOCKPILE

UNSEEDDED BUT NOW  
POSSIBLY THE BEST CREATED  
WILDLIFE HABITAT ON THE MINE



A wide-angle photograph of a dry, hilly landscape. The terrain is covered with sparse, low-lying vegetation in shades of brown and tan. There are visible signs of soil erosion, with lighter-colored soil exposed in several areas, particularly along the slopes. In the background, there are more hills and some scattered trees. The overall scene suggests a semi-arid or desert environment.

**40+ YEARS**



EXAMPLE OF PAR 2C, SCM,  
SEEDED 11/99

OSM EXCELLENCE IN  
MINING AWARD



2C  
T10  
BACK



















STORY OF PAR 7E

SEEDED MAR-2013

ALL BUT DRAINAGES

SEEDED A SINGLE MIX





















TOPSOIL  
SEED MIX B

SPOIL  
SEED MIX B

PHOTO 2007

**SODIC OVERBURDEN TEST PLOTS**





TOPSOIL

SPOIL

2009





# EXAMPLE OF A FIELD EDGE LACKING TOPSOIL

PAR 6D 2015







ALL SPOIL IS NOT EQUAL

(SAME FOR SCORIA)





D8m2  
T1







# SCORIA CAN BE GOOD SHRUB HABITAT



**B7m2**







SCORIA CAN BE  
THE PREMIER DIVERSITY  
SUBSTRATE































**SEEDING SAGEBRUSH  
ON TOPSOIL**

**SEGREGATE THE SAGEBRUSH  
SEED SPATIALLY FROM  
THE HEAVY SEED**













# MANY SUCCESSES

**B7 m2**





PAR 4D



SUCCESSES  
NOTWITHSTANDING

CAN'T GET SAGEBRUSH  
ALL THE TIME OR EVEN  
MOST OF THE TIME



# REDUCE COMPETITION SHRUB MOSAICS

AREAS WITHIN A LARGER FIELD SEEDED  
WITH SAGEBRUSH AND OTHERS  
MINIMALLY COMPETITIVE  
e.g., all light seed



1C ~~TF~~ 0

~~TF~~  
T 9

SEEDED 10/97

PHOTO 2012



1CT10





ORDER SEED IN TWO  
SETS OF BAGS  
LIGHT AND HEAVY SEED

DRILL THE HEAVY  
BROADCAST THE LIGHT



NEXT, BLOCK SOME SEED DRILLS

SO THAT DRILL-ROW SPACING

IS 18" OR 24" BUT LIGHT SEED

IS BROADCAST EVERYWHERE





**PAR 6D**





SUNFLOWER

SUNFLOWER

9010 STUBBLE DRILL











OR SEED THE ENTIRE FIELD

WITH LIGHT SEED, THEN

DRILL SEED PART OF IT

RANDOMLY OR SYSTEMATICALLY





GRASSMOWER









PAR 5H 2013





PAR 5H 2014





2014



OR SEED SOME OTHER  
INNOVATIVE WAY













THERE ARE OTHER  
LESSONS FROM  
COAL COUNTRY







