Characteristics and Dynamics of California Coastal Grasslands

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California Coastal Grasslands

Characteristic Grass Species of the Grasslands of Coastal California

Coastal Grasslands	Hill and Valleys Grasslands
Pacific reedgrass	Purple needlegrass
Calamagrostis nutkaensis	*Nassella pulchra*
Pacific hairgrass	Idaho fescue
Deschampsia holciformis	*Festuca idahoensis*
California Bentgrass	Pine bluegrass
Agrostis californica	*Poa scabrella*
California oatgrass	Nodding Stipa
Danthonia californica	*Nassella cernua*

Coastal Grasslands

Pacific reedgrass - *Calamagrostis nutkaensis*

Hills and Valley Grasslands

Purple needlegrass - *Nasella pulchra*

Pacific hairgrass - *Deschampsia holciformis*

Idaho fescue - *Festuca idahoensis*

"This place is one of very level land, well covered with pasturage, but it is lacking in firewood, for there is no other timber than the growth along the river, which is of cottonwoods, sycamores, ash, and laurels; and in all that region not a single stone."

Pedro Font, 1776
(near the mouth of the Guadalupe River)

From: Bolton, P. E. (Trans. & Ed.) 1930. Font: Anza's California Expeditions. 4 vols. Berkeley: University of California Press, 1930. 4:349-369.

Cattle

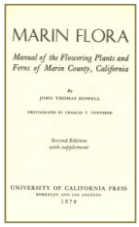
California Perennials → European Annuals

Nassella pulchra

Avena fatua

Parks in the San Francisco Bay Area

"Discovery/Reappearance" of Grass Species



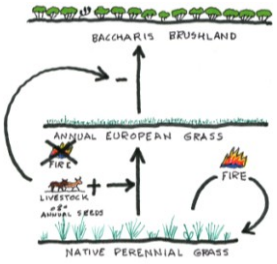
	1949 Edition*	1970 Edition*
Species of Gramineae		
native	86	93
non-native	65	91
total	151	184
Tamalpais Species		
All Species	73	-
native grasses	-	7
non-native grasses	-	1

* J.T.Howell - *Marin Flora*

Dynamics

Baccharis – *Baccharis pilularis* DC
(Coyote brush; Chaparral broom)

Baccharis/Grassland Dynamics



From: McBride, J. R. 1969. Plant Succession in the Berkeley Hills. Ph.D. Dissertation (Botany). University of California, Berkeley.

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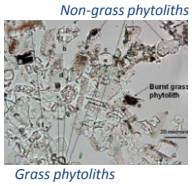
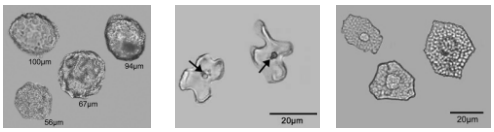
Phytolith Analysis

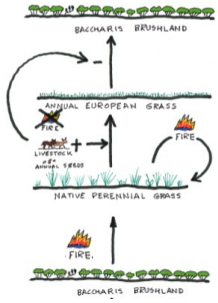




Squash *Maize* *Sedge*

From: Hopkinson, P. and L. Huntsinger. 2005. Are East Bay hills grasslands a historical artifact? Phytolith evidence and a potential candidate for the true East Bay vegetation type. *Grasslands* 15 (1):7-9.

Baccharis/Grassland Dynamics



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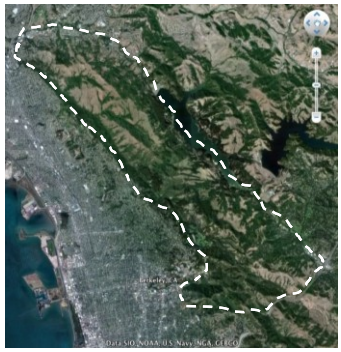
Case Studies

1. Berkeley Hills
2. Mt. Tamalpais State Park
3. The Sea Ranch

Berkeley Hills



Invasion of Berkeley Hills Grasslands by Baccharis

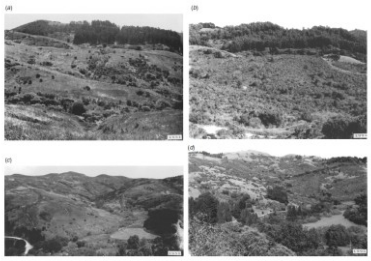
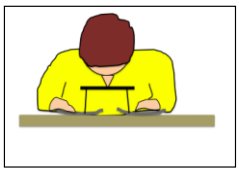


Fig. 3. Changes in the vegetation mosaic in the East Bay foothills during the latter half of the 20th century. (a) View south-east to part of San Pablo Ridge just west of Inspiration Point in 1951, (b) approximately the same view as panel (a) in 1994, (c) view east to Niantic Way north of Inspiration Point in 1951, and (d) the same view as panel (c) in 1994 (photographs by Oliver Pearson, courtesy of Anita Pearson).

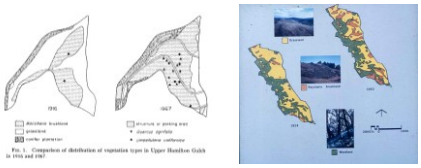
From: Keeley, J.E. 2005. Fire history of the San Francisco East Bay region and implications for landscape patterns. International Journal of Wildland Fire 14:285-296.

Berkeley Hills: Methods



1. Compare baccharis cover in regional parks on aerial photographs taken prior to park establishment and at later dates
2. Re-measure extent of baccharis along baccharis to grassland transects established by Heady

Baccharis Invasion of Grasslands in the Berkeley Hills



From: McBride, J. R. 1974. Plant succession in the Berkeley Hills. Madrono 22(7):317-329

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Acreage of Baccharis in three East Bay Regional Parks

Park	Prior*	1963	Increase Acres	%
Tilden	130	647	571	397
Redwood	132	480	348	263
Grass Valley	269	745	476	177

*Tilden – 1927; Redwood – 1932; Grass Valley – 1942

From: McBride, J. R. and H.F. Heady. 1968. Invasion of grasslands by *Baccharis pilularis* DC. J. Range Managem. 21:106-108

Vegetation type changes in Tilden Park 1939-1997

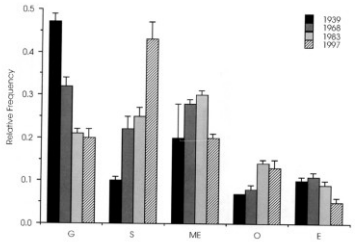

Fig. 4. Relative frequency of five vegetation types, (G: grass, S: shrub, ME: mixed evergreen, O: oak woodlands and savannas, eucalyptus.), in Tilden Regional Park. Error bars indicate 1 S.E.

From: Russell, W. H. and J. R. McBride. 2003. Landscape scale vegetation-type conversion and fire hazard in the San Francisco bay area open spaces. Landscape and Urban Planning. 64:201-208.

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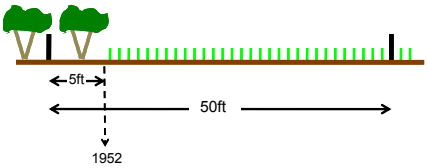
Re-survey of Heady Transects

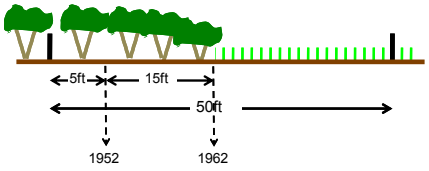
1952



From: McBride, J. R. and H.F. Heady. 1968. Invasion of grasslands by *Baccharis pilularis* DC. J. Range Managem. 21:106-108

Re-survey of Heady Transects

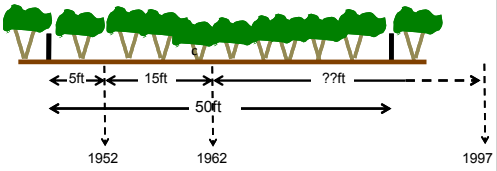
1962



From: McBride, J. R. and H.F. Heady. 1968. Invasion of grasslands by *Baccharis pilularis* DC. J. Range Managem. 21:106-108

"Re-survey" of Heady Transects

1997



Baccharis Invasion of Grasslands at Mt. Tamalpais State Park

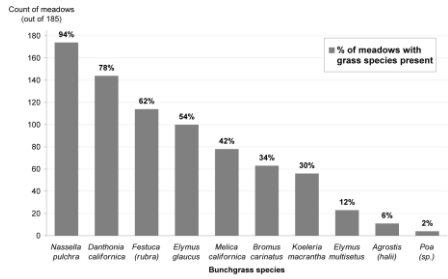
Baccharis in Grassland

Mt. Tamalpais: Methods

1. Delineation of grasslands on aerial photos
2. Analysis of aerial photographs to determine baccharis
3. Field surveys to determine species composition and percent cover of perennial grasses

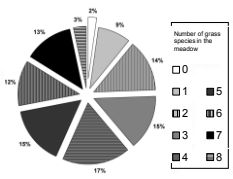
Delineation of Grassland Units along upper Ocean View Trail

Bunchgrass Species

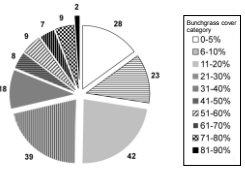


From: McBride, J. R., I. Lacan, and A. Green. 2010. Invasion of grassland in Mt. Tamalpais State Park by baccharis and Douglas-fir. Report to the California Department of Parks and Recreation. Sacramento, CA. 65p.

Number and Percent Cover of Bunchgrass Species



Proportion of the 185 surveyed grasslands By number of bunchgrass species



Count of grasslands by bunchgrass-cover category (no grasslands in "90 – 100%)

From: McBride, J. R., I. Lacan, and A. Green. 2010. Invasion of grassland in Mt. Tamalpais State Park by baccharis and Douglas-fir. Report to the California Department of Parks and Recreation. Sacramento, CA. 65p.

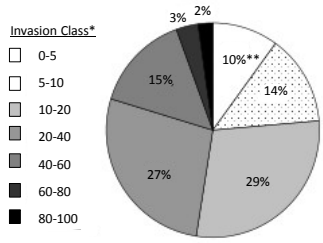
Mt. Tamalpais Grasslands

Grassland Unit Dominated by Native Perennial Bunchgrasses

Grassland Unit Dominated by European Annual Grasses

Appearance of Baccharis on Aerial Photographs

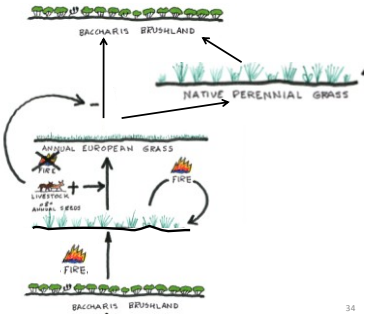
Baccharis Invasion



*% baccharis cover in a grassland unit
** % of grassland units in study (185 units)

From: McBride, J. R., I. Lacan, and A. Green. 2010. Invasion of grassland in Mt. Tamalpais State Park by baccharis and Douglas-fir. Report to the California Department of Parks and Recreation. Sacramento, CA. 65p.

Baccharis/Grassland Dynamics



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The Sea Ranch

Coastal Terrace Grasslands

Grassland Invasion at the Sea Ranch

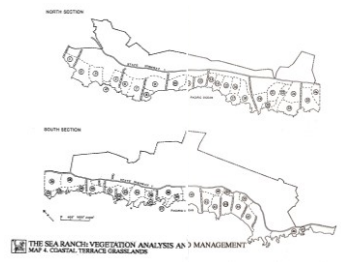
Bush Lupine – *Lupinus albifrons*

Baccharis – *Baccharis pilularis*

The Sea Ranch: Methods

1. Step-point survey of grasslands
2. Comparison of aerial photos: 1991 – 2011

Grassland Units



Coastal Terrace Grassland: Shrub Cover

(1991 & 2011)

Percent Cover

Grassland	Lupine		Baccharis		Total	
	'91	'12	'91	'12	'91	'12
1	50	65	0	10	50	75
10	3	5	1	25	4	30
20	0	25	1	1	1	26
30	0	0	0	2	0	2
40	10	10	2	5	12	15
50	0	0	15	85	15	85
Average	10.5	17.5	3.2	20.5	13.7	38.8

From: McBride, J. R. 1991. Vegetation Analysis and Management: The Sea Ranch. McBride and Associates. Albany, CA; McBride, J. R. 2012. Re-assessment of the 1991 Sea Ranch Vegetation Analysis and Management Plan. McBride and Associates. Berkeley, CA

Prioritization of Treatment Areas for Baccharis Control at Mt. Tamalpais State Park

Mt. Tamalpais State Park

1. Establish priority classes
2. Identify of treatment areas

Prioritization of Grasslands Units

Grassland units were prioritized on the basis of bunchgrass and baccharis cover.

Priority Class	Percent of Surveyed Meadows
1*	18
2	46
3**	36

* Units with greatest bunchgrass cover and lowest coyote brush cover

** Units with lowest bunchgrass cover and greatest coyote brush cover

Prioritization of Grasslands Units

Ranking based on perennial grass cover (75%) and baccharis cover (25%)

Formula for ranking:

Score = (perennial cover % x 3) + (100- baccharis cover %)

Examples:

1. Grassland unit with 15% perennial grass cover and 20% baccharis cover

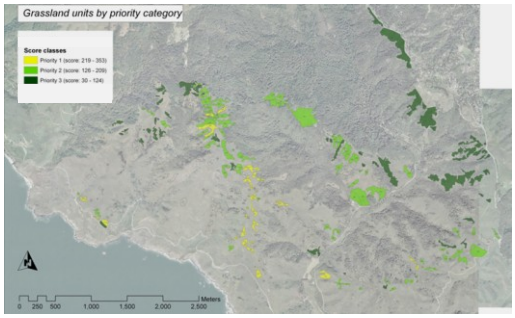
   Score = (15 x 3) + (100 – 23) = 45 + 80 = 125

2. Grassland unit with 7% perennial grass cover and 10% baccharis cover

   Score = (7x 3) + (100 – 10) = 21 + 90 = 111

The system was designed *to assign greater importance to the presence of native grasses than to the level of Baccharis invasion*, in order to maximize the potential for preserving the bunchgrass cover

Grassland Unit Priority



Identification of Treatment Areas

1. Priority class
2. Size of unit
3. Proximity to roads and trails
4. Spatial diversity of units

Treatment Areas

Treatment area 1A: 27 meadows adjacent to the lower half of the Ocean View Trail; excellent bunchgrass cover and low Baccharis cover; large total area (18 acres); high visibility to park users.

Treatment area 1B: 10 meadows at the north-west corner of the surveyed area; outstanding bunchgrass cover and low Baccharis cover; small total area (5.5 acres), but contributes to spatial diversity (away form the other treatment areas, and close to the ocean).

Treatment area 2A: 6 meadows surrounded by Douglas-fir forests; large total area (24 acres); these are the few large meadows that were found to have a moderate-to-good bunchgrass cover (other large meadows had low bunchgrass cover); high visibility to users.

Treatment area 2B: 12 meadows near the Diaz Ridge Trail; small total area (8 acres), but best bunchgrass cover on the eastern edge of the park; visible to park users; contributes to spatial diversity.

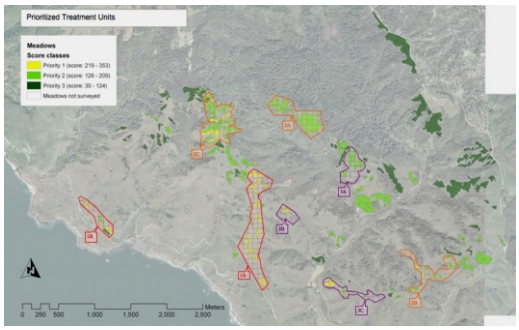
Treatment area 2C: 26 meadows adjacent to the top of the Ocean View trail; large total area (32 acres); very high use and visibility; low Baccharis cover but only moderate bunchgrass cover; excellent microhabitat variability.

Treatment area 3A: 9 moderate-size meadows covering 14 acres; contribute to spatial variability.

Treatment area 3B: 10 very small meadows (< 4 ac total); potential good bunchgrass cover.

Treatment area 3C: 6 meadows (7 ac total); excellent contribution to spatial variability, moderate- to good bunchgrass cover.

Treatment Areas: Mt. Tamalpais



Treatment Areas: Mt. Tamalpais

Management Zone	Meadow #	% Baccharis	Area (acres)	Management Zone	Meadow #	% Baccharis	Area (acres)	Management Zone	Meadow #	% Baccharis	Area (acres)
1A	21	40-60	0.7	2A	308	20-40	2.3	2C	196	10-20	0.4
1A	22	20-40	1.6	2A	309	5-10	0.2	2C	201	0-5	0.5
1A	23	0-5	0.0	2A	310	20-40	1.4	2C	202	0-5	0.9
1A	24	20-40	0.8	2A	311	60-80	0.8	2C	200	40-60	0.2
1A	25	0-5	0.4	2A	312	20-40	3.5	2C	203	5-10	0.5
1A	26	0-5	0.9	2A	307	20-40	15.4	2C	204	0-5	0.9
1A	28	10-20	0.4					2C	2041	0-5	0.9
1A	29	10-20	1.4	2B	67	20-40	1.2				
1A	87	40-60	0.6	2B	247	5-10	1.2	3A	292	20-40	1.4
1A	123	10-20	1.5	2B	249	0-5	1.0	3A	2921	20-40	2.4
1A	122	20-40	0.4	2B	250	0-5	0.2	3A	293	5-10	1.7
1A	125	40-60	1.4	2B	251	0-5	0.2	3A	294	5-10	1.7
1A	127	20-40	0.1	2B	260	20-40	1.2	3A	295	10-20	1.4
1A	126	5-10	0.3	2B	261	10-20	0.1	3A	297	5-10	2.0
1A	150	0-5	0.2	2B	262	10-20	0.1	3A	2971	0-5	1.5
1A	142	10-20	0.5	2B	263	10-20	0.6	3A	298	5-10	1.2
1A	143	5-10	0.7	2B	264	20-40	0.6	3A	2981	0-5	1.2
1A	148	5-10	0.1	2B	271	20-40	0.3				
1A	140	40-60	0.1	2B	272	20-40	0.8	3B	110	40-60	0.2
1A	146	5-10	0.4					3B	111	20-40	0.8
1A	147	20-40	0.2	2C	236	5-10	0.8	3B	112	10-20	0.7
1A	139	0-5	0.7	2C	237	5-10	1.3	3B	113	20-40	0.1
1A	145	40-60	0.2	2C	239	5-10	0.9	3B	115	0-5	0.8
1A	160	5-10	1.5	2C	240	10-20	2.3	3B	116	0-5	0.5
1A	161	5-10	0.8	2C	241	10-20	0.5	3B	114	5-10	0.1
1A	163	20-40	1.2	2C	242	20-40	0.1	3B	117	0-5	0.2
1A	162	10-20	1.6	2C	179	5-10	1.1	3B	118	10-20	0.2
				2C	186	10-20	1.0	3B	119	5-10	0.1
1B	4	0-5	0.3	2C	187	10-20	1.2				
1B	8	0-5	1.0	2C	188	10-20	4.1	3C	71	5-10	0.8
1B	9	10-20	0.2	2C	198	10-20	3.8	3C	72	5-10	1.5
1B	12	10-20	0.4	2C	189	10-20	3.4	3C	73	10-20	0.3
1B	13	10-20	0.9	2C	190	5-10	0.2	3C	78	10-20	1.2
1B	14	0-5	0.1	2C	192	5-10	1.6	3C	79	10-20	0.5
1B	15	5-10	0.2	2C	195	0-5	0.2	3C	83	20-40	2.7
1B	16	40-60	1.0	2C	193	5-10	1.2				
1B	17	10-20	1.3	2C	194	10-20	3.1				
1B	18	5-10	0.2	2C	199	10-20	0.3				
				2C	197	5-10	0.6				

Literature Cited

Bolton, P. E. (Trans. & Ed.) 1930. Font: Anza's California Expeditions. 4 vols. Berkeley: University of California Press, 1930. 4:349-369.

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The End

Native American Conversion of Coastal Scrub to Grassland

Table 1. Proposed time line of changes in vegetation and disturbance history for the East Bay expected from the patterns of natural and human fires on these landscapes

Period	Human impact	Expected or observed vegetation
Late Pleistocene to mid-Holocene	Limited Native American populations. Fire regime dominated by lightning with fire rotation intervals on the scale of centuries.	Woodland-dominated landscape with mosaic of shrublands, forests and patches of grassland.
Mid-Holocene to late 18th century	Increasing density of Native Americans and increasing dependence on plant products with frequent use of fire for landscape management. Expected fire rotation interval on the order of a decade or less.	Grassland-dominated landscape in a mosaic of shrublands and woodlands maintained by high fire frequency. Dominated by a combination of native perennial grasses and native annual forbs.
19th century	Euro-American settlement with heavy livestock grazing Fire frequency probably lower than earlier periods. Expected fire rotation interval perhaps several decades, maybe longer.	Grassland-dominated landscape maintained by replacing frequent fire with heavy grazing. Natives replaced by alien annual grasses and alien annual forbs.
20th century	Increasing protection, reduction of lifestock grazing. Increasing fire frequency due to population growth and urban sprawl coupled with increasing effectiveness of fire suppression. Fire rotation intervals very long on the order of a century or more.	Gradual recolonization of grasslands by native shrubs (baccharis) and trees, also invasion by alien shrubs (brooms).

From: Keeley, J.E. 2005. Fire history of the San Francisco East Bay region and implications for landscape patterns. International Journal of Wildland Fire 14:285-296.

Spanish Introduction of Livestock and European Annual Grasses to California

Vaqueros - Charles Christian Nahl, 1866