Vegetation Community Monitoring Recommendations for the San Diego MSCP

Report for Tasks D,E of Local Assistance Grant #P0450009

Prepared by

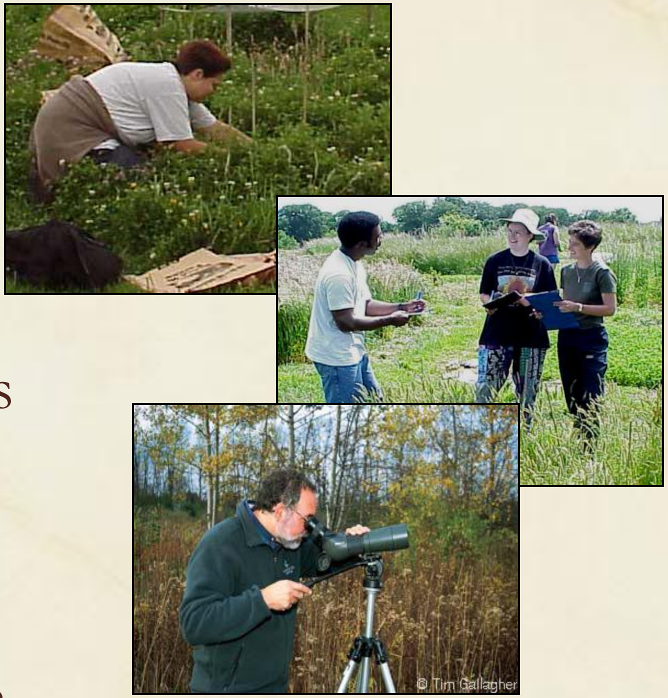
Dr. Douglas Deutschman, Lauren Hierl, Dr. Janet Franklin, and Dr. Helen Regan

January 30, 2007

Workshop Agenda

1. Presentation *(part 1)* . . . . . . 9:10-9:45 am
    - I. Introduction: The Challenge of Monitoring
    - II. Scope of Work
    - III. Monitoring: Theory and Application
2. Break . . . . 9:45-9:55 am
3. Presentation *(part 2)* . . . . . . 9:10-10:30 am
    - IV. Analysis of Existing Data
    - V. Recommendations
4. Break-out sessions . . . . . 10:40-11:10 am
5. Share results . . . . .11:20-12:00 pm

Outline of this Presentation



- **Introduction:**
  The Challenge of Monitoring
- Scope of Work:
  Deliverables, Atkinson et al. Steps
- Monitoring:
  Theory and Application
- Analysis of Existing Data
- Recommendations

Introduction: The Challenge

Legg and Nagy (2006). **Why most conservation monitoring is, but need not be, a waste of time.**
Journal of Environmental Management **8**:194-199.

Monitoring seems to be the automatic response to any change that is seen as a potential threat to the environment, *whether or not it is appropriate.*

Recommendations:

- Good Management of Conservation Programs
- Good Design and Field Methods for Monitoring

Introduction: The Challenge

Legg and Nagy (2006). Why most conservation monitoring is, but need not be, a waste of time. J. Env. Manage. **78**:194-199.

Good Management of Conservation Programs

- Flexible goals, refined objectives
- Locations, objectives and recording protocols detailed in establishment report
- Obtain peer review and statistical review of proposal
- Obtain periodic program evaluation and adjust sampling design and field protocols

Introduction: The Challenge

Legg and Nagy (2006). Why most conservation monitoring is, but need not be, a waste of time. J. Env. Manage. **78**:194-199.

Good Design and Field Methods for Monitoring

- Select methods appropriate to the objectives and habitat type
- Avoid bias in selection of long-term plots
- Ensure adequate spatial and temporal replication
- Integrate and synthesize theory and empirical work, experiments and observational studies, larger and smaller scale research

Introduction: The Challenge

Fuller (1999). Environmental surveys over time. J. Ag. Biol. And Env. Statistics **4**:331-335.

Surveys conducted over time are more difficult than a survey conducted only once.

Defining the data elements, implementing data collection in the field, the survey design, data processing, estimation and report preparation are all more difficult.

Introduction: The Challenge

Fuller (1999). Environmental surveys over time. JABES **4**:331-335.

Aphorisms

1. Every step in the process sounds easier than it is.
2. The "good" (*fill in the blank*) isn't all that good. Examples are the baseline data, protocols, data collection instrument, etc.
3. Over time. The definition of data elements, the data collection protocols, and the objectives of the survey will change.
4. The budget will always be insufficient. (Corollary: The time line is always unrealistic).

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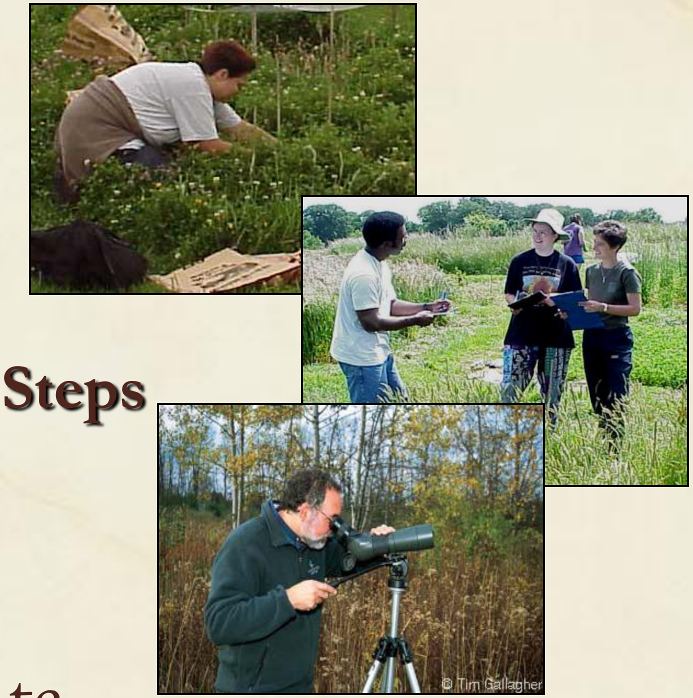
- Recommendations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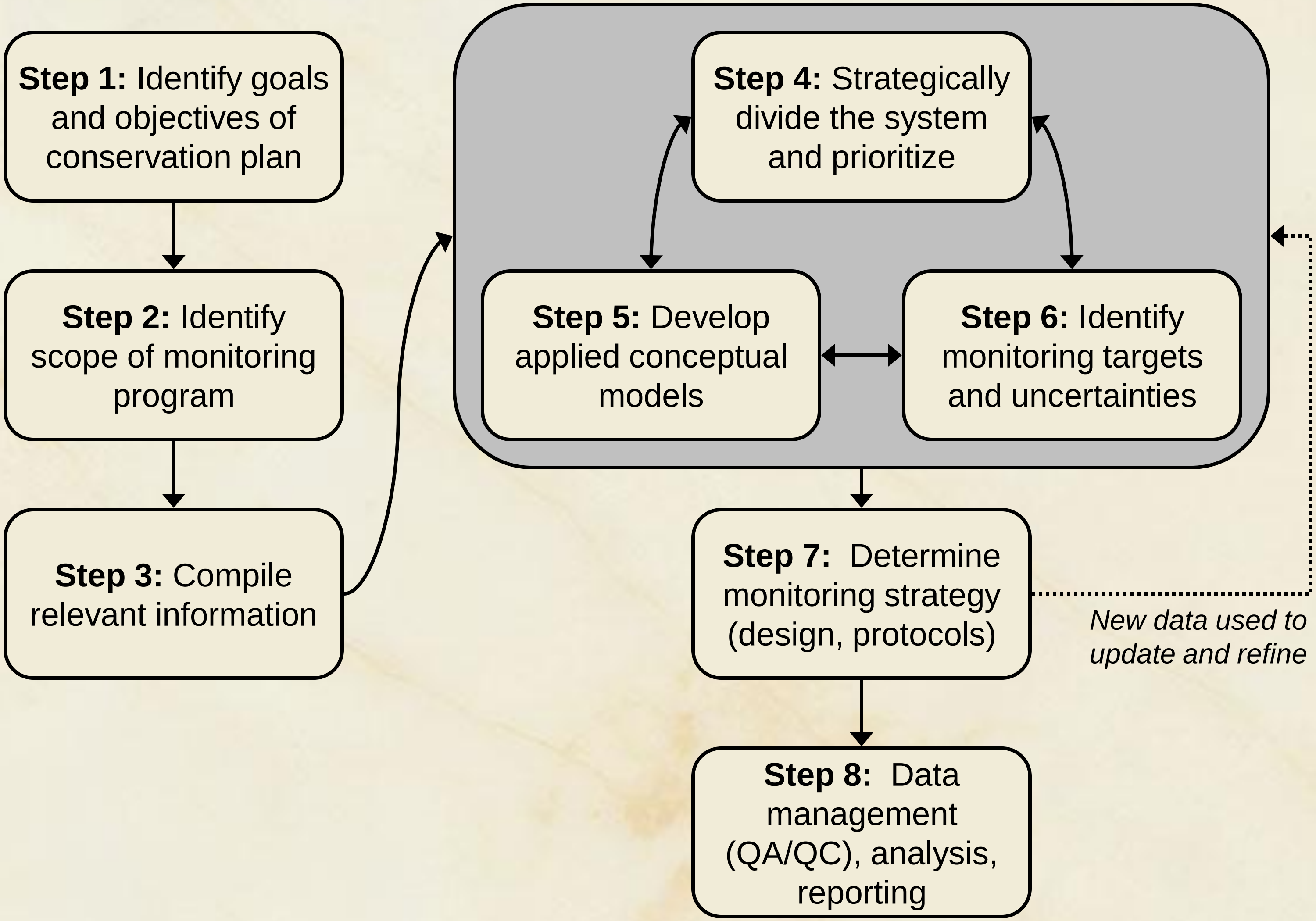
Atkinson et al. – Stepwise Approach



Step 1: Identify goals and objectives of conservation plan

Step 2: Identify scope of monitoring program

Step 3: Compile relevant information

Step 4: Strategically divide the system and prioritize

Step 5: Develop applied conceptual models

Step 6: Identify monitoring targets and uncertainties

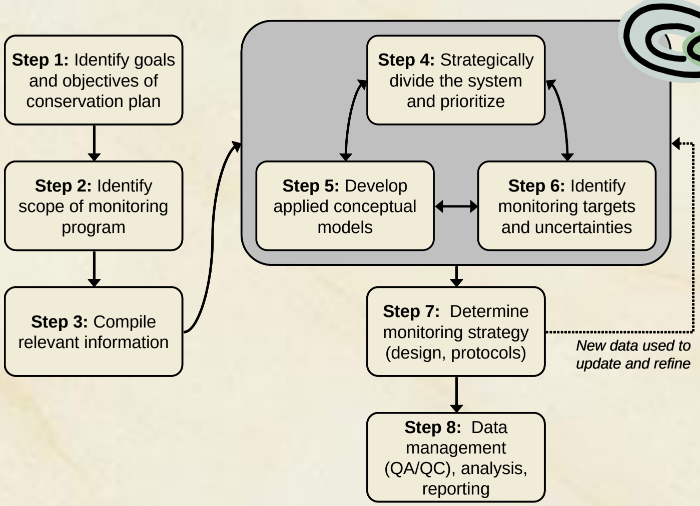
Step 7: Determine monitoring strategy (design, protocols)

New data used to update and refine

Step 8: Data management (QA/QC), analysis, reporting

Scope of Work (LAG - P0450009)

Atkinson et al.



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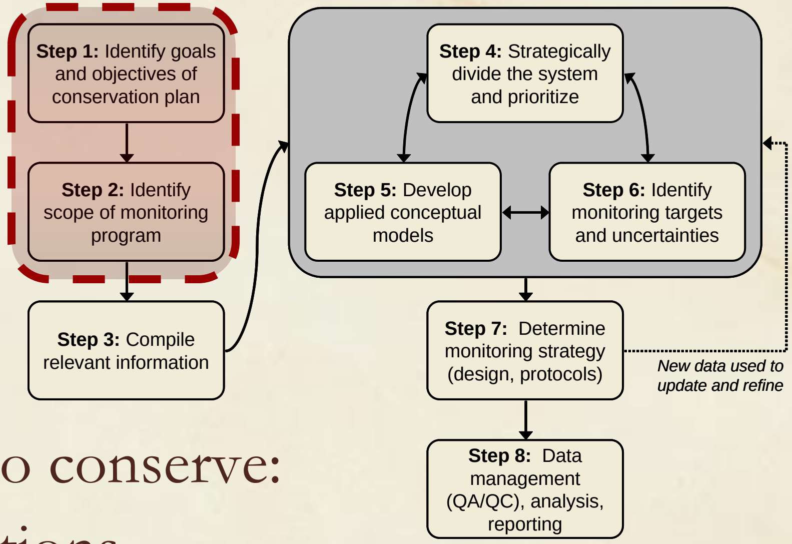
Tasks for This Project

Using the Atkinson et al. (2004) stepwise approach facilitates the development of a rigorous and transparent monitoring program. These steps were explicitly referenced in our Scope of Work.

Scope of Work (LAG - P0450009)

Atkinson et al.	Tasks for This Project
1. Identify goals of program. 2. Identify scope of monitoring. 3. Compile existing information.	**Task A.** (8/05) Assess the implementation of the MSCP monitoring program.
4. Strategically divide and prioritize species, communities and the system.	**Task B1.** (1/06) Risk-based prioritization of covered species. **Task B2.** (7/06) Spatial analysis of plant communities/landscape.
5. Develop management-oriented conceptual models.	**Task C.** (12/06) Framework for conceptual models of species, communities, and landscapes.
6. Identify monitoring recommendations and critical uncertainties. 7. Determine strategy for implementing monitoring.	**Task D.** (1/07) This presentation and the subsequent final report.

Goals and Objectives



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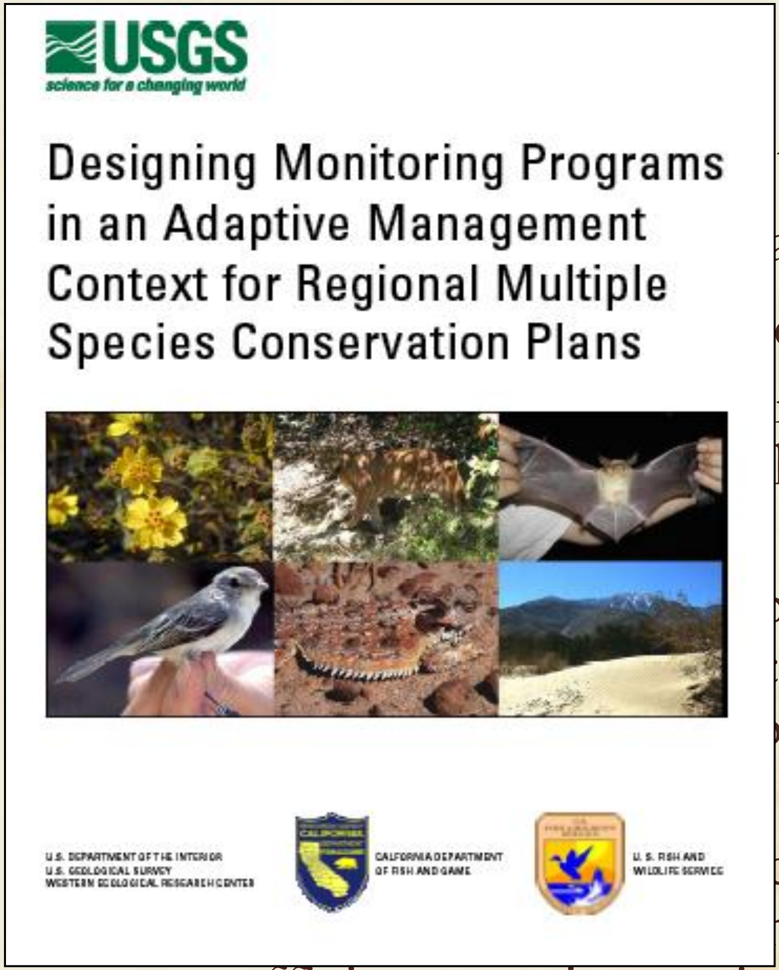

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Designing Monitoring Programs in an Adaptive Management Context for Regional Multiple Species Conservation Plans

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U.S. GEOLOGICAL SURVEY
WESTERN ECOLOGICAL RESEARCH CENTER

CALIFORNIA DEPARTMENT OF FISH AND GAME

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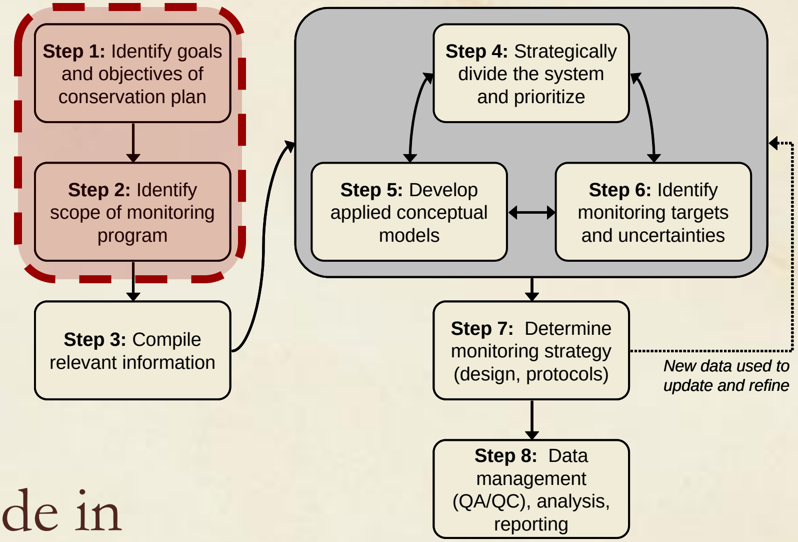
covered species with
ntegrity in an effective and
cost-efficient way is a major challenge.

Goals and Objectives



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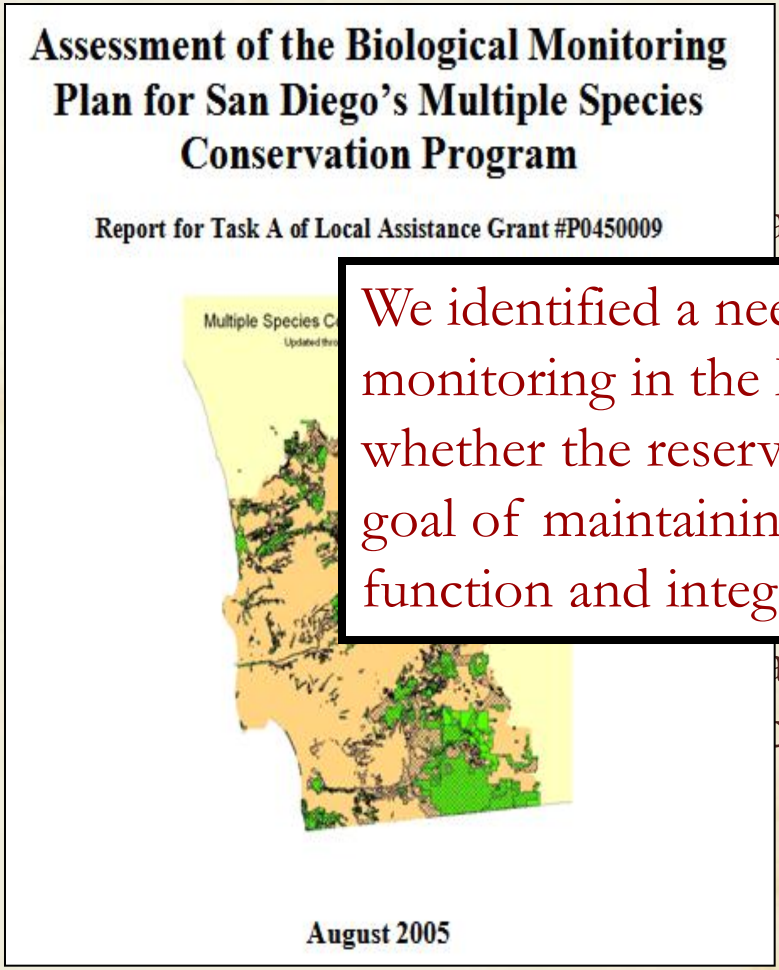

Assessment of the Biological Monitoring Plan for San Diego's Multiple Species Conservation Program

Report for Task A of Local Assistance Grant #P0450009

August 2005

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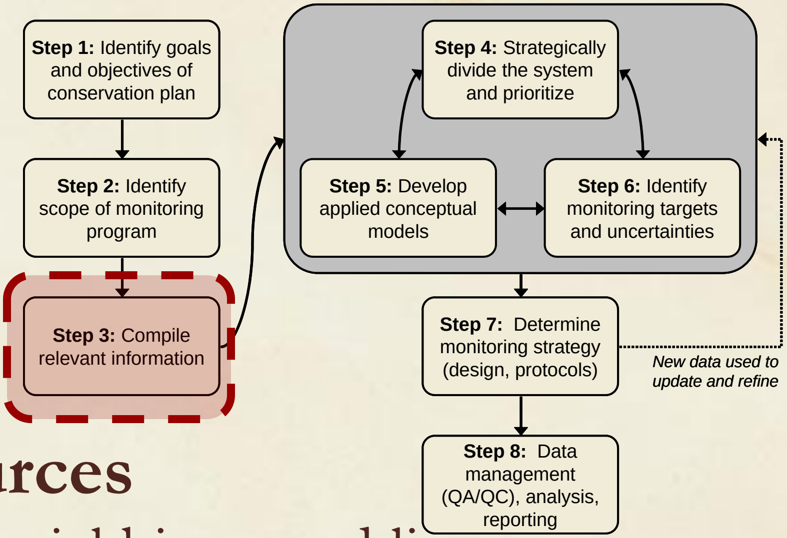
col development.

We identified a need for community monitoring in the MSCP to address whether the reserve is meeting its goal of maintaining ecosystem function and integrity.

Compile Relevant Information



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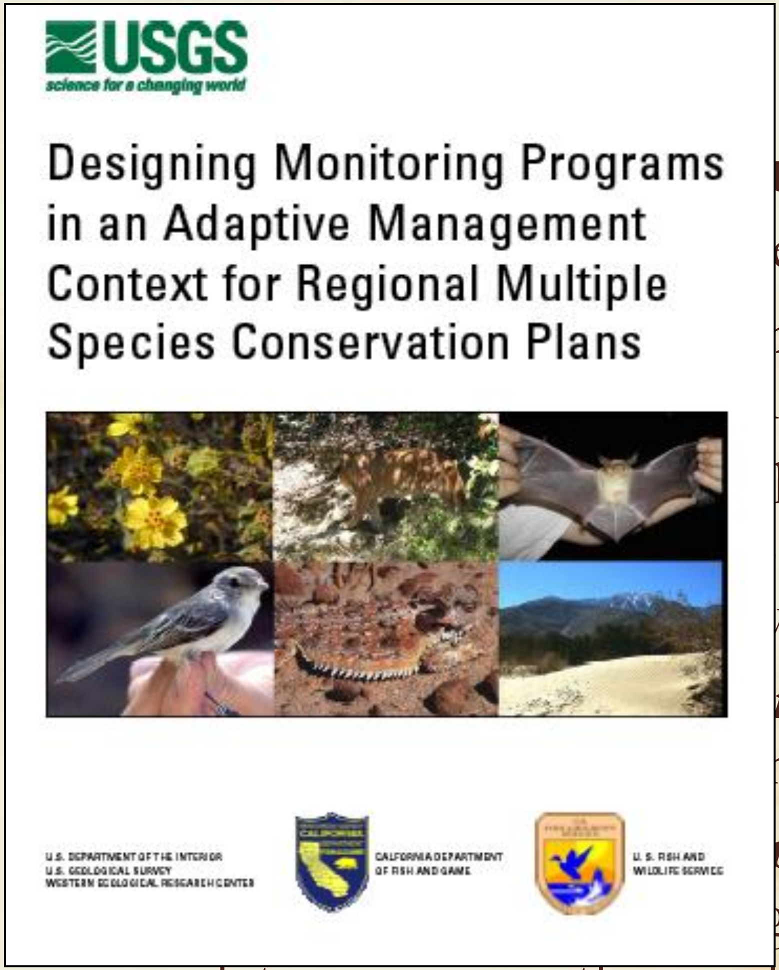

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ential biases and limitations.

ents: conservation plans,
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an boundaries, species ranges,
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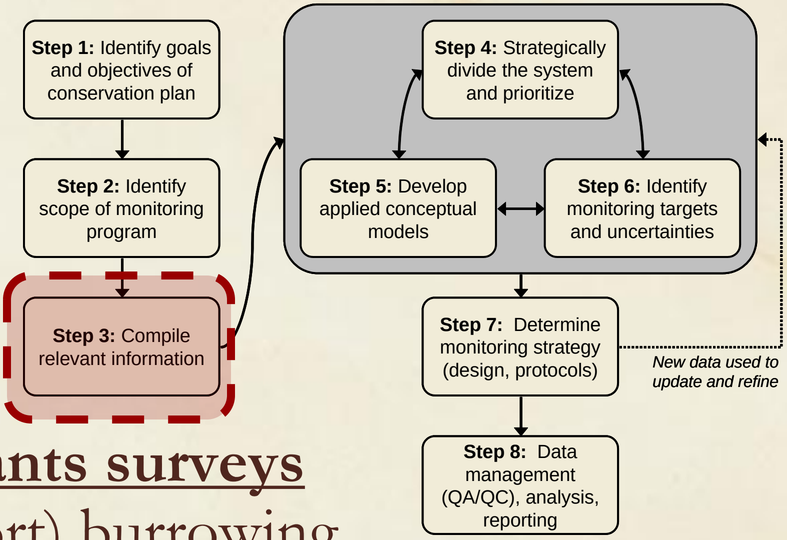
programs and data sources:
g monitoring programs and
data sources within and near the plan area.

Compile Relevant Information



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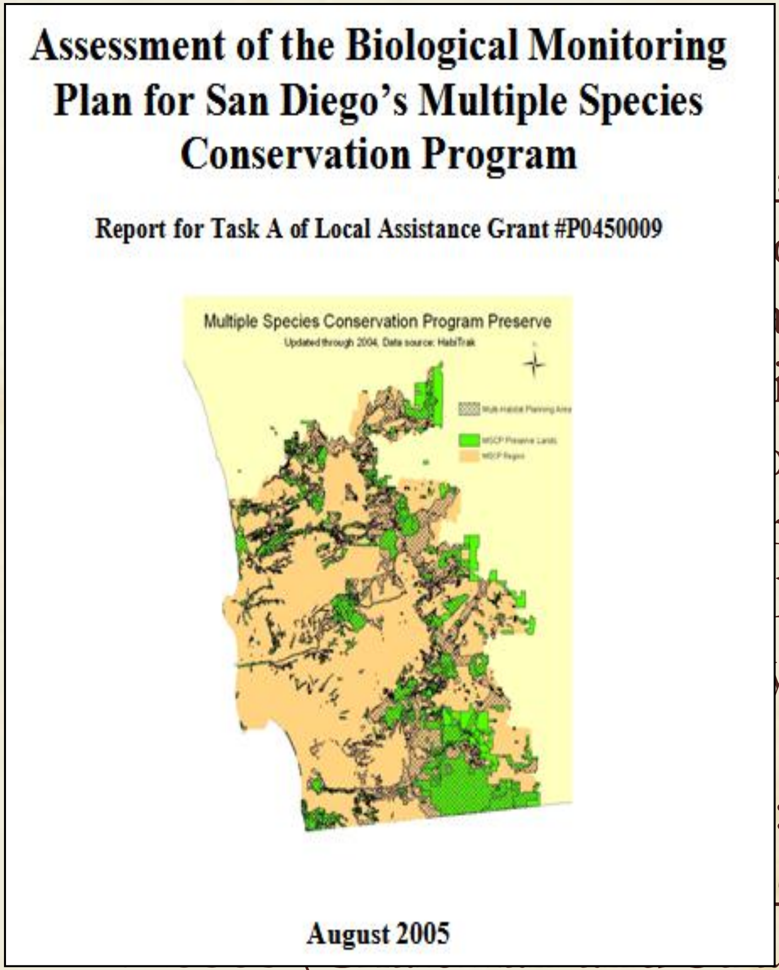

Assessment of the Biological Monitoring Plan for San Diego's Multiple Species Conservation Program

Report for Task A of Local Assistance Grant #P0450009

August 2005

ants surveys

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ing *and others*

yo toad, Quino checkerspot,

idors *and others*

ling design and monitoring,

yo toad, post-fire monitoring

: **Diffendorfer et al**. (LAG

et al, **Kelt et al**, **SDSU MS**

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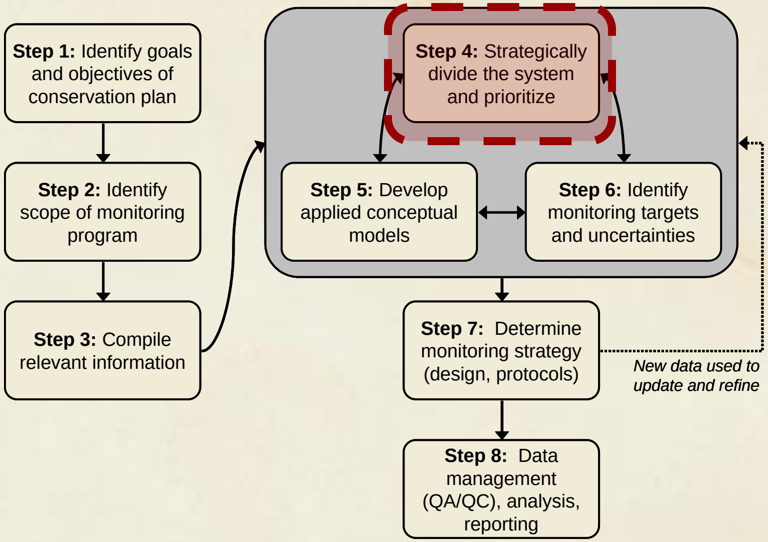
Prioritize Species and Communities



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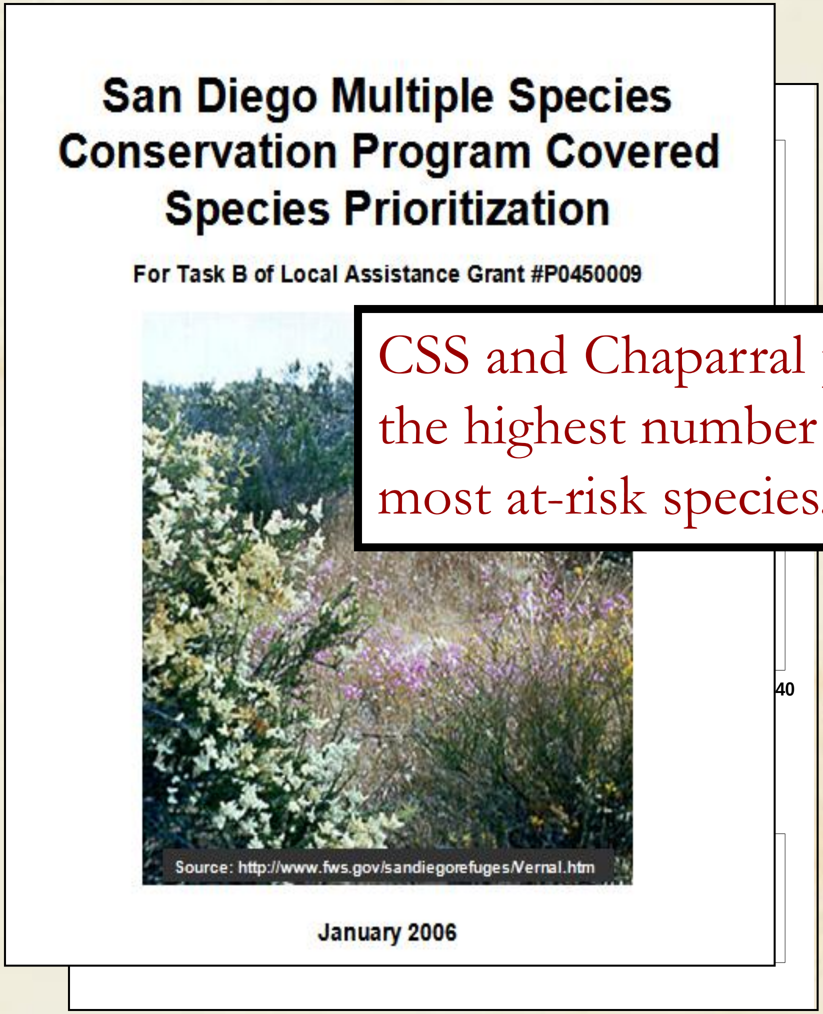


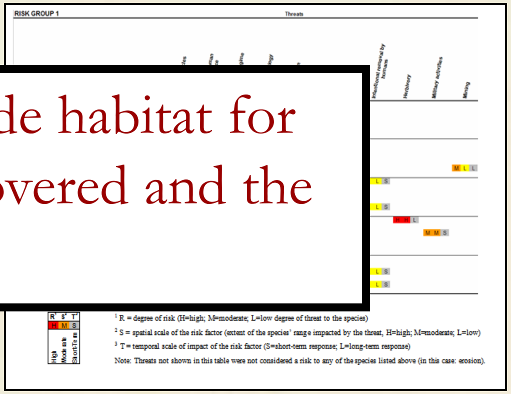
San Diego Multiple Species Conservation Program Covered Species Prioritization

For Task B of Local Assistance Grant #P0450009

Source: http://www.fws.gov/sandiegorefuges/Vernal.htm

January 2006

CSS and Chaparral provide habitat for the highest number of covered and the most at-risk species.



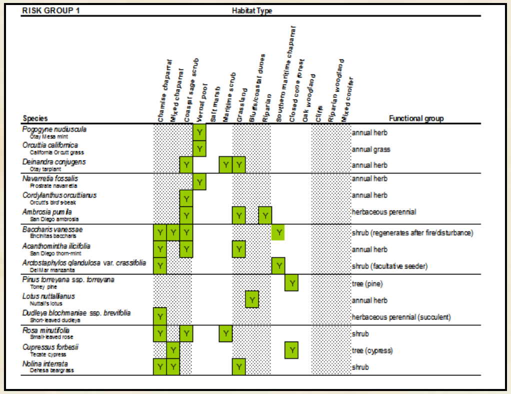
RISK GROUP 1 Threats

¹ R = degree of risk (H=high; M=moderate; L=low degree of threat to the species)

² S = spatial scale of the risk factor (extent of the species' range impacted by the threat, H=high; M=moderate; L=low)

³ T = temporal scale of impact of the risk factor (S=short-term response; L=long-term response)

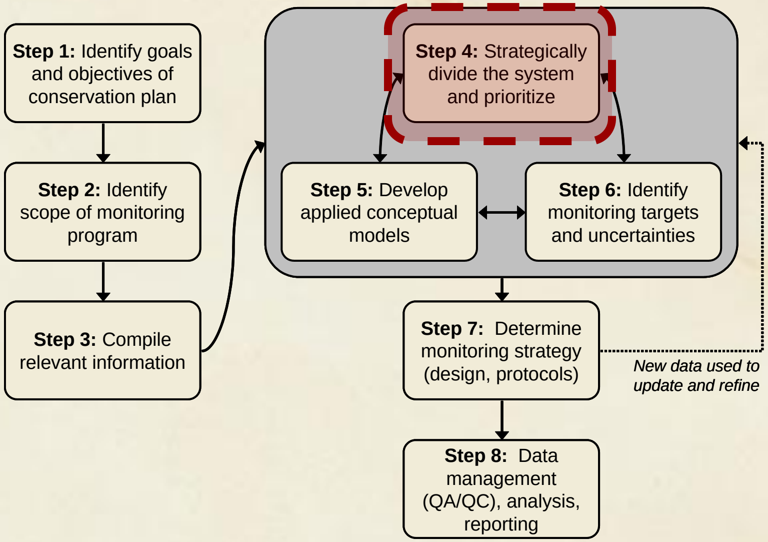
Note: Threats not shown in this table were not considered a risk to any of the species listed above (in this case: erosion).



RISK GROUP 1 Habitat Type

Species	Chamise chaparral	Mixed chaparral	Coastal sage scrub	Vernal pool	Salt marsh	Maritime scrub	Grassland	Bluffs/coastal dunes	Riparian	Southern maritime chaparral	Closed cone forest	Oak woodland	Cliffs	Riparian woodland	Mixed conifer	Functional group
Pogogyne nudiuscula Otay Mesa mint				Y												annual herb
Orcuttia californica California Orcutt grass				Y												annual grass
Deinandra conjugens Otay tarplant			Y			Y	Y									annual herb
Navarretia fossalis Prostrate navarretia				Y												annual herb
Cordylanthus orcuttianus Orcutt's bird's-beak			Y													annual herb
Ambrosia pumila San Diego ambrosia			Y				Y		Y							herbaceous perennial
Baccharis vanessae Encinitas baccharis	Y	Y	Y							Y						shrub (regenerates after fire/disturbance)
Acanthomintha ilicifolia San Diego thorn-mint	Y		Y				Y									annual herb
Arctostaphylos glandulosa var. *crassifolia* Del Mar manzanita	Y									Y						shrub (facultative seeder)
Pinus torreyana ssp. *torreyana* Torrey pine											Y					tree (pine)
Lotus nuttallianus Nuttall's lotus								Y								annual herb
Dudleya blochmaniae ssp. *brevifolia* Short-leaved dudleya	Y															herbaceous perennial (succulent)
Rosa minutifolia Small-leaved rose	Y		Y			Y										shrub
Cupressus forbesii Tecate cypress		Y									Y					tree (cypress)
Nolina interrata Dehesa beargrass	Y	Y					Y									shrub

Prioritize Species and Communities



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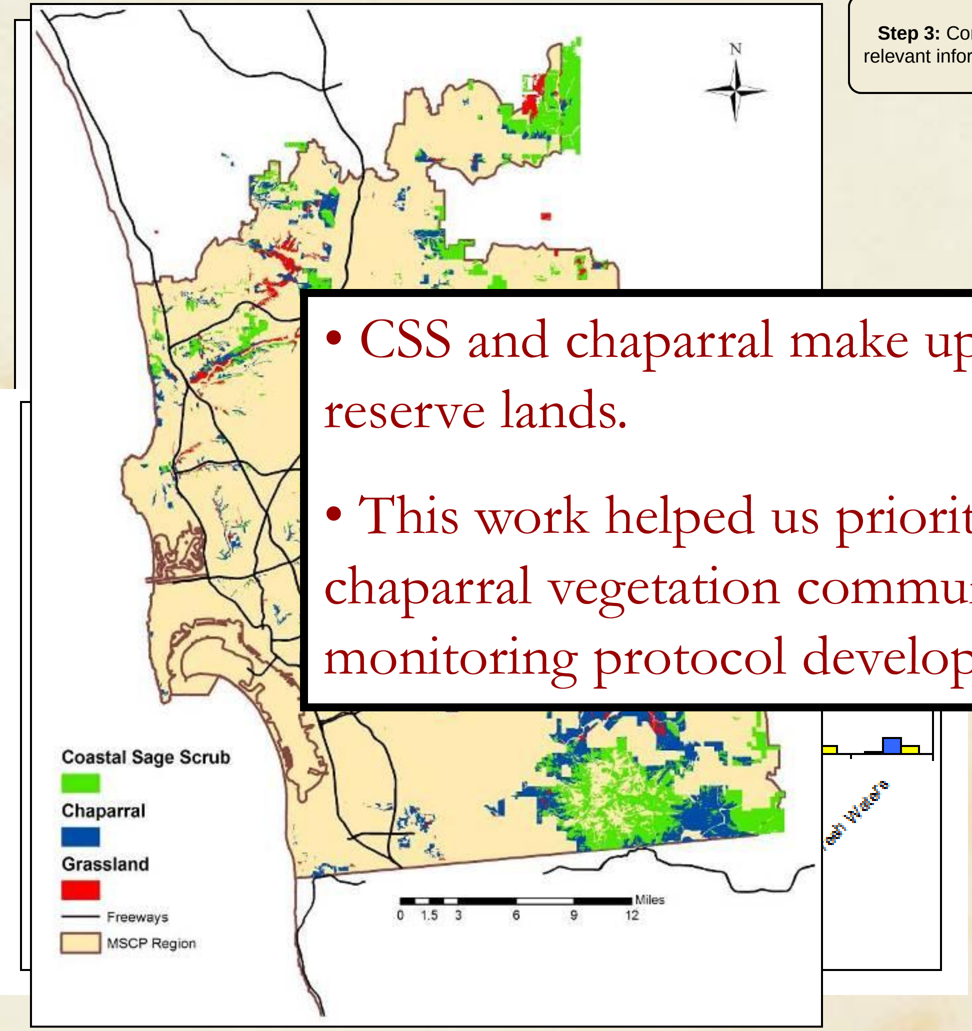
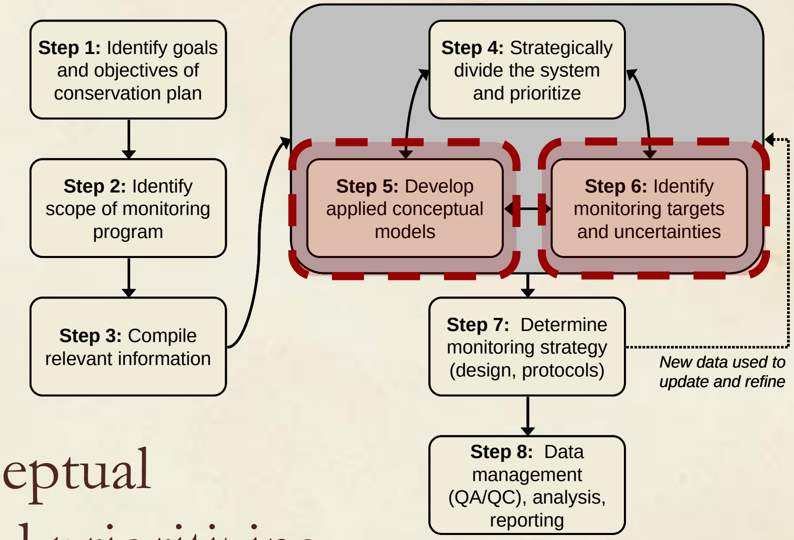


- CSS and chaparral make up ~76% of MSCP reserve lands.
- This work helped us prioritize CSS and chaparral vegetation communities to be our monitoring protocol development focus.

Conceptual Models



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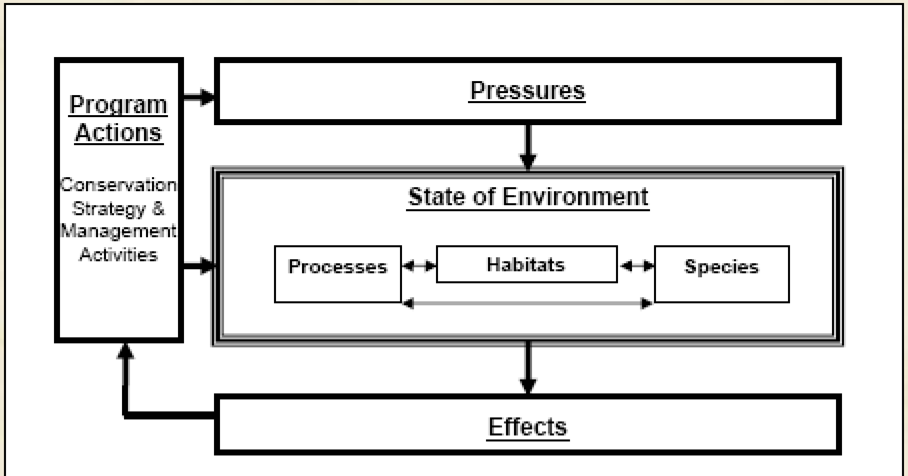
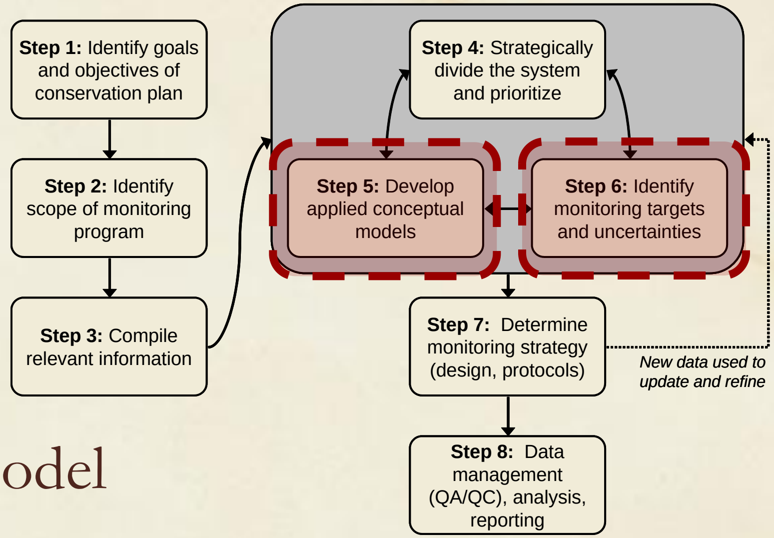
- Management-oriented conceptual models make identifying and prioritizing monitoring variables and critical uncertainties much easier (Step 6) and greatly assist sampling design (Step 7).



MANAGEMENT-ORIENTED CONCEPTUAL MODEL

Conceptual Models



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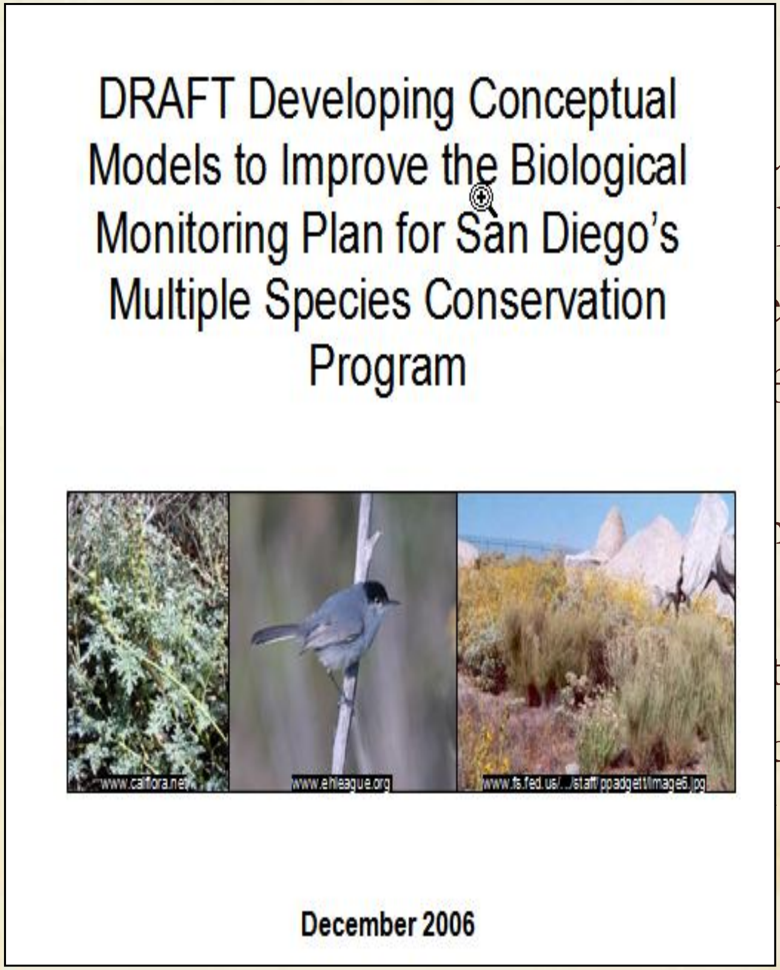

DRAFT Developing Conceptual Models to Improve the Biological Monitoring Plan for San Diego's Multiple Species Conservation Program

December 2006

l model

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monitored:

for the species, community, or landscape.

historical anthropogenic threats, natural

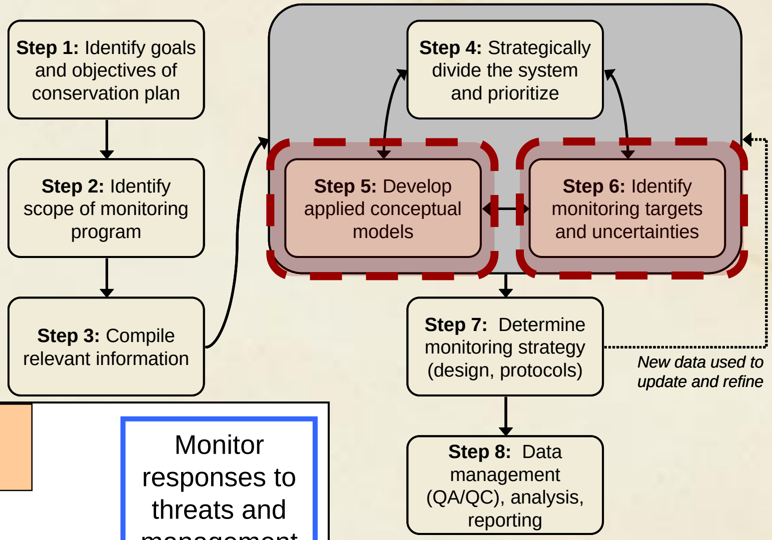
nmunity parameters that dictate current or

responses.

d on the main parameters that link the

to the monitoring goals.

Conceptual Models



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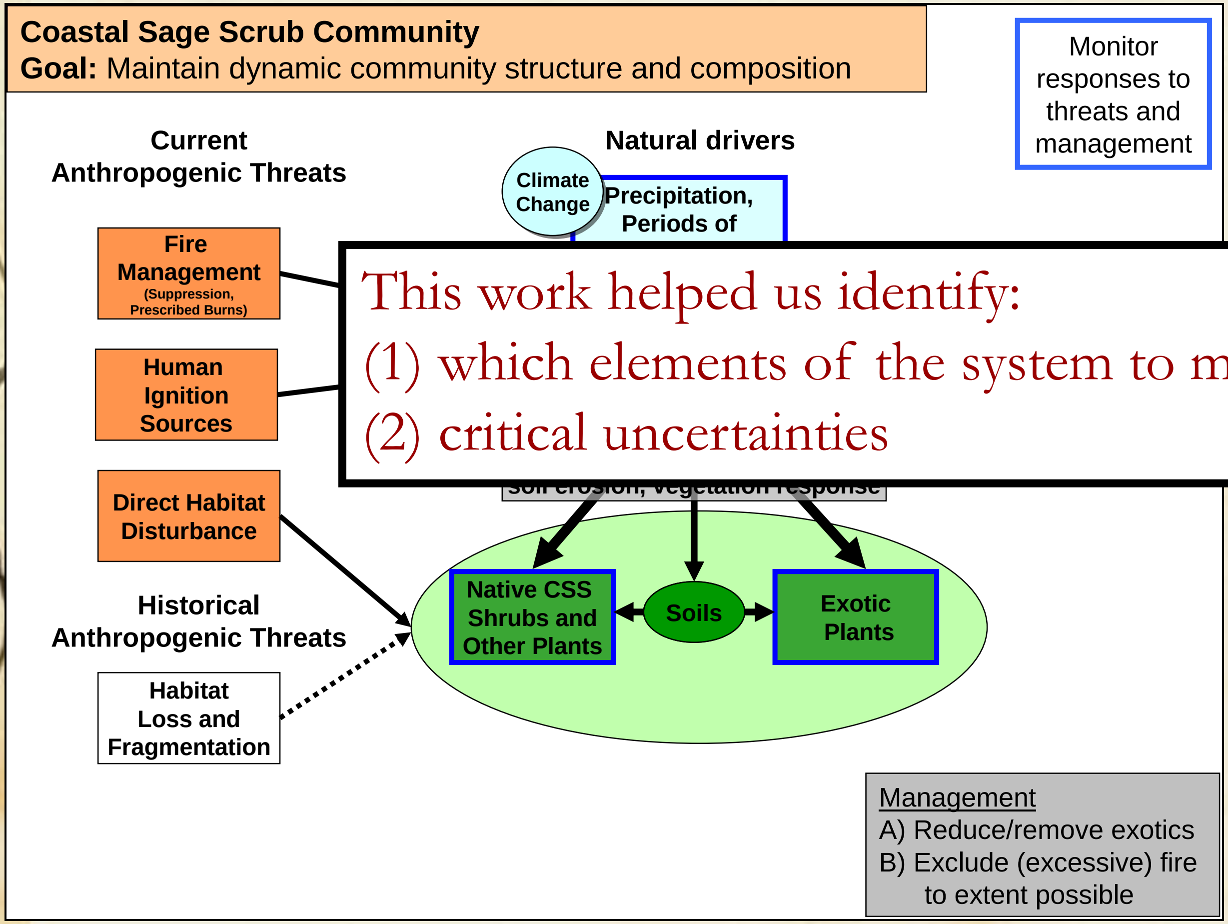


Coastal Sage Scrub Community
Goal: Maintain dynamic community structure and composition

Monitor responses to threats and management

Current Anthropogenic Threats

Fire Management (Suppression, Prescribed Burns)

Human Ignition Sources

Direct Habitat Disturbance

Historical Anthropogenic Threats

Habitat Loss and Fragmentation

Natural drivers

Climate Change

Precipitation, Periods of

soil erosion, vegetation response

Native CSS Shrubs and Other Plants

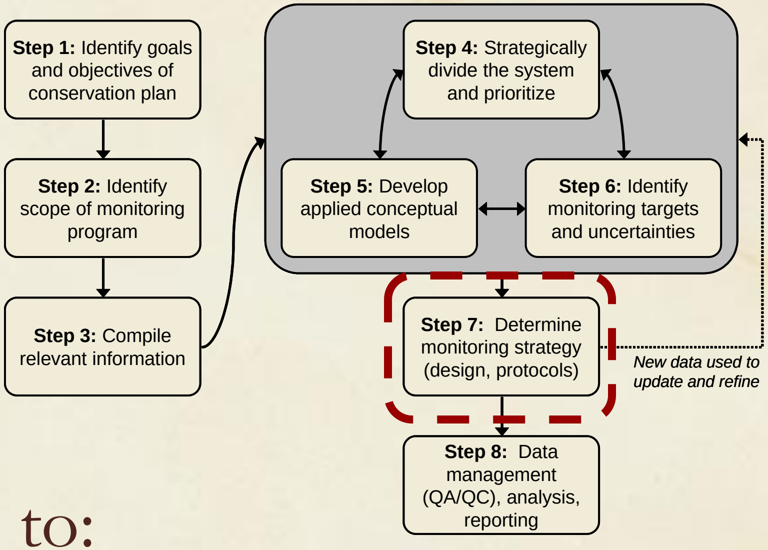
Soils

Exotic Plants

Management
A) Reduce/remove exotics
B) Exclude (excessive) fire to extent possible

This work helped us identify:
(1) which elements of the system to monitor
(2) critical uncertainties

Monitoring Recommendations



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New data used to update and refine

- Our previous work led us to:
  - focus on developing community monitoring recommendations
  - focus on the CSS and chaparral vegetation communities
  - identified monitoring targets and critical uncertainties
  - these are the focus of the remainder of this Presentation and subsequent Report

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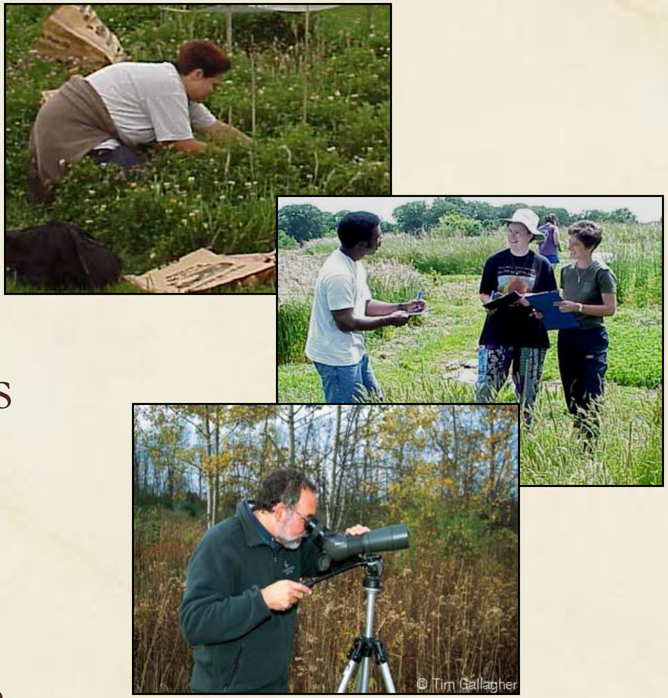
- Scope of Work:
  Deliverables, Atkinson et al. Steps
- **Monitoring:**
  Theory and Application
- Analysis of Existing Data
- Recommendations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Major Elements of Monitoring

- Sampling Design (Which, Where and When)
  - How many and which sites should be included in the initial sample?
  - Whether and how often sites should be revisited?
  - Should the Sampling Design be allowed to change as more data becomes available?
  - How should the samples at different times be related?
- Response Design (What and How)
  - The response design is often more closely linked to the specific questions being asked.
  - Common response designs for vegetation sampling include visual estimation, quadrats, transect or belt transect or line-intercept.
- Data Design (QA/QC, Database, and Analysis)

Sampling Design

Hypothetical Example:

- 9 sites that will be monitored for 9 years
- However, you can only allocate a total of 9 samples over the entire 9-year period.
- **How should you allocate your effort?**

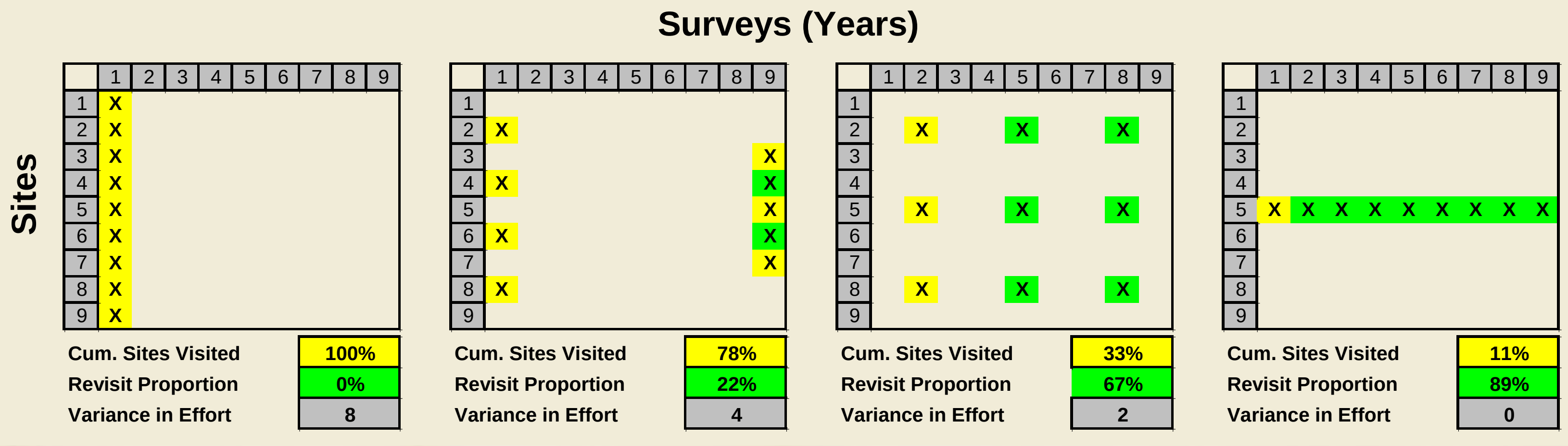
Years

Sites

	1	2	3	4	5	6	7	8	9
1	X								
2	X								
3	X								
4	X								
5	X	X	X	X	X	X	X	X	X
6	X								
7	X								
8	X								
9	X								

Cum. Sites Visited	**11%**
Revisit Proportion	**89%**
Variance in Effort	**0**

Sampling Design



Surveys (Years)

Sites

	1	2	3	4	5	6	7	8	9
1	X								
2	X								
3	X								
4	X								
5	X								
6	X								
7	X								
8	X								
9	X								

Cum. Sites Visited	100%
Revisit Proportion	0%
Variance in Effort	8

	1	2	3	4	5	6	7	8	9
1									
2	X								
3									X
4	X								X
5									X
6	X								X
7									X
8	X								
9									

Cum. Sites Visited	78%
Revisit Proportion	22%
Variance in Effort	4

	1	2	3	4	5	6	7	8	9
1									
2		X			X			X	
3									
4									
5		X			X			X	
6									
7									
8		X			X			X	
9									

Cum. Sites Visited	33%
Revisit Proportion	67%
Variance in Effort	2

	1	2	3	4	5	6	7	8	9
1									
2									
3									
4									
5	X	X	X	X	X	X	X	X	X
6									
7									
8									
9									

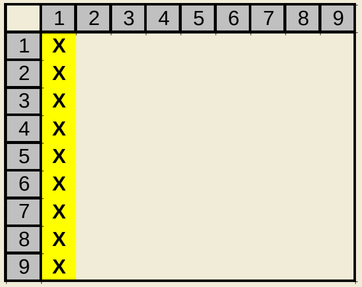
Cum. Sites Visited	11%
Revisit Proportion	89%
Variance in Effort	0

Effort

Sampling Design

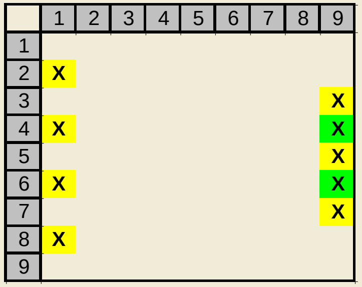
Surveys (Years)

Sites



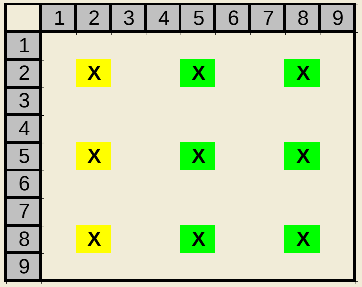
	1	2	3	4	5	6	7	8	9
1	X								
2	X								
3	X								
4	X								
5	X								
6	X								
7	X								
8	X								
9	X								

Cum. Sites Visited	100%
Revisit Proportion	0%
Variance in Effort	8



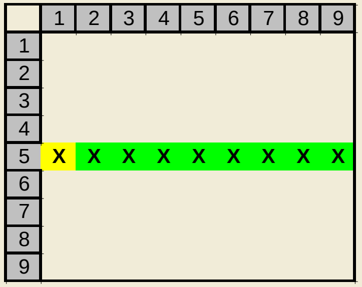
	1	2	3	4	5	6	7	8	9
1									
2	X								
3									X
4	X								X
5									X
6	X								X
7									X
8	X								
9									

Cum. Sites Visited	78%
Revisit Proportion	22%
Variance in Effort	4



	1	2	3	4	5	6	7	8	9
1									
2		X			X			X	
3									
4									
5		X			X			X	
6									
7									
8		X			X			X	
9									

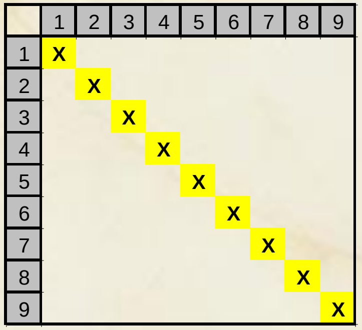
Cum. Sites Visited	33%
Revisit Proportion	67%
Variance in Effort	2



	1	2	3	4	5	6	7	8	9
1									
2									
3									
4									
5	X	X	X	X	X	X	X	X	X
6									
7									
8									
9									

Cum. Sites Visited	11%
Revisit Proportion	89%
Variance in Effort	0

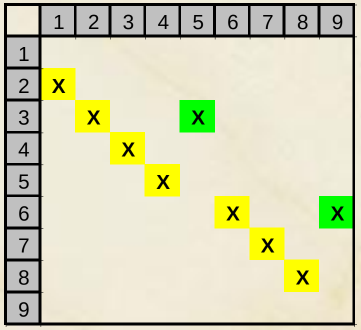
Sites



	1	2	3	4	5	6	7	8	9
1	X								
2		X							
3			X						
4				X					
5					X				
6						X			
7							X		
8								X	
9									X

Cum. Sites Visited	100%
Revisit Proportion	0%

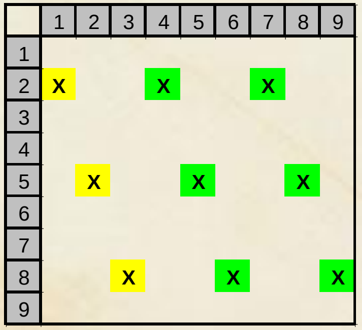
Constant Effort (1 per yr)



	1	2	3	4	5	6	7	8	9
1									
2	X								
3		X			X				
4			X						
5				X					
6						X			X
7							X		
8								X	
9									

Cum. Sites Visited	78%
Revisit Proportion	22%

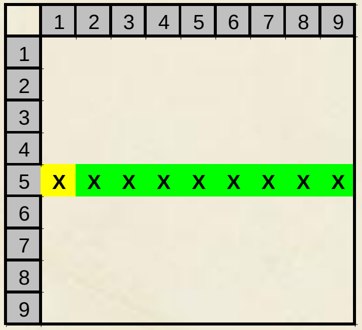
Constant Effort (1 per yr)



	1	2	3	4	5	6	7	8	9
1									
2	X			X			X		
3									
4									
5		X			X			X	
6									
7									
8			X			X			X
9									

Cum. Sites Visited	33%
Revisit Proportion	67%

Constant Effort (1 per yr)



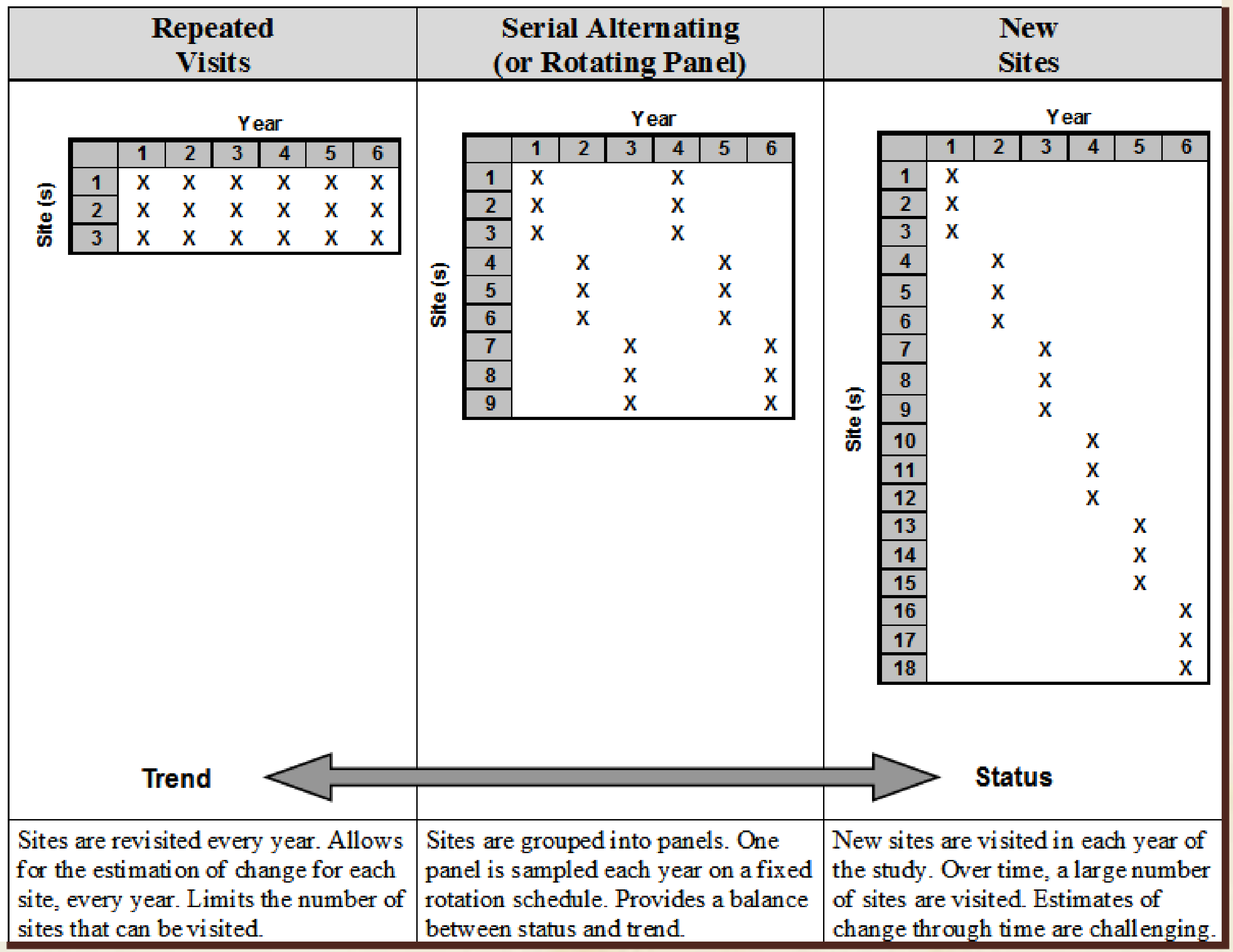
	1	2	3	4	5	6	7	8	9
1									
2									
3									
4									
5	X	X	X	X	X	X	X	X	X
6									
7									
8									
9									

Cum. Sites Visited	11%
Revisit Proportion	89%

Constant Effort (1 per yr)

But: space and time are now partially confounded

Sampling Design



Repeated Visits	Serial Alternating (or Rotating Panel)	New Sites
Sites are revisited every year. Allows for the estimation of change for each site, every year. Limits the number of sites that can be visited.	Sites are grouped into panels. One panel is sampled each year on a fixed rotation schedule. Provides a balance between status and trend.	New sites are visited in each year of the study. Over time, a large number of sites are visited. Estimates of change through time are challenging.

Repeated Visits

Year

Site (s)	1	2	3	4	5	6
1	X	X	X	X	X	X
2	X	X	X	X	X	X
3	X	X	X	X	X	X

Serial Alternating (or Rotating Panel)

Year

Site (s)	1	2	3	4	5	6
1	X			X		
2	X			X		
3	X			X		
4		X			X	
5		X			X	
6		X			X	
7			X			X
8			X			X
9			X			X

New Sites

Year

Site (s)	1	2	3	4	5	6
1	X					
2	X					
3	X					
4		X				
5		X				
6		X				
7			X			
8			X			
9			X			
10				X		
11				X		
12				X		
13					X	
14					X	
15					X	
16						X
17						X
18						X

Sampling Design

<table>
<tr><th>Sampling Method</th><th>Repeated Visits
+ Serial Alternating</th><th>Repeated Visits
+ Serial Alternating
+ New Sites</th><th>Serial Alternating
+ New Sites</th></tr>
<tr><td>Icon</td>
<td>Year
Site (s)
<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th></tr>
<tr><td>1</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
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<tr><td>3</td><td>X</td><td></td><td>X</td><td></td><td>X</td><td></td></tr>
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Site (s)
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<tr><td>3</td><td>X</td><td></td><td>X</td><td></td><td>X</td><td></td></tr>
<tr><td>4</td><td>X</td><td></td><td>X</td><td></td><td>X</td><td></td></tr>
<tr><td>5</td><td></td><td>X</td><td></td><td>X</td><td></td><td>X</td></tr>
<tr><td>6</td><td></td><td>X</td><td></td><td>X</td><td></td><td>X</td></tr>
<tr><td>7</td><td>X</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>8</td><td></td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>9</td><td></td><td></td><td>X</td><td></td><td></td><td></td></tr>
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Site (s)
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<tr><td>2</td><td>X</td><td></td><td>X</td><td></td><td>X</td><td></td></tr>
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<tr><td>7</td><td>X</td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>11</td><td></td><td></td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>12</td><td></td><td></td><td>X</td><td></td><td></td><td></td></tr>
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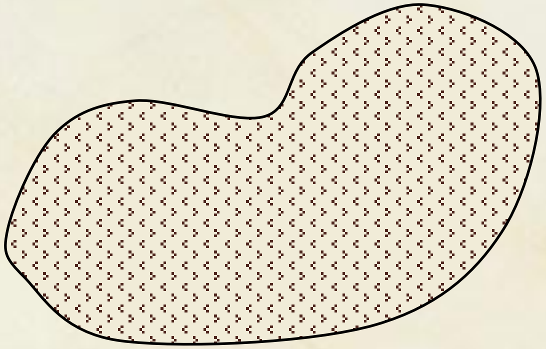
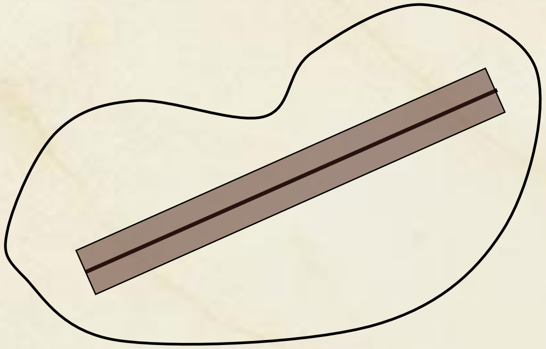
<tr><td>14</td><td></td><td></td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>15</td><td></td><td></td><td></td><td></td><td>X</td><td></td></tr>
<tr><td>16</td><td></td><td></td><td></td><td></td><td>X</td><td></td></tr>
<tr><td>17</td><td></td><td></td><td></td><td></td><td></td><td>X</td></tr>
<tr><td>18</td><td></td><td></td><td></td><td></td><td></td><td>X</td></tr>
</table>
</td></tr>
<tr><td>Intuition</td>
<td>Some sites (often called sentinel sites) are revisited every year. Some sites are on a two-year rotation. Emphasizes trend.</td>
<td>Includes sentinel sites, sites that are grouped into panels. Allocates some effort to new sites each year. Balances trend and status.</td>
<td>A group of sites are visited on a rotation but new sites are visited in each year of the study. Emphasizes status.</td></tr>
</table>

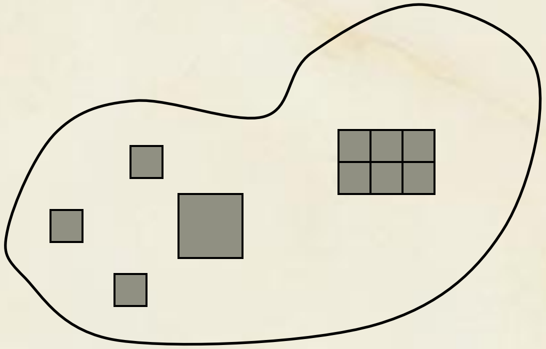
Response Design



Visual Estimate of Cover
(Releve or Cover classes)

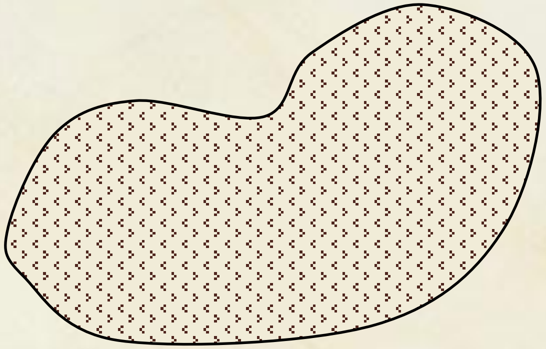


Transects
(Line Intercept or Belt)

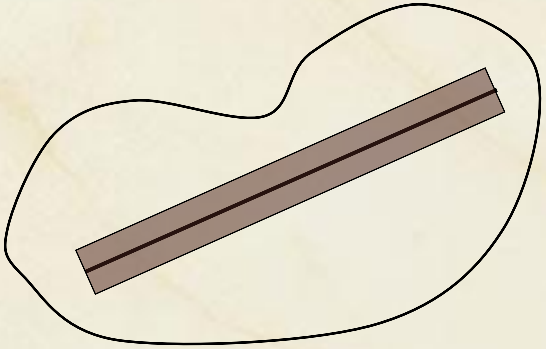


Quadrats
(random, systematic, multiscale)

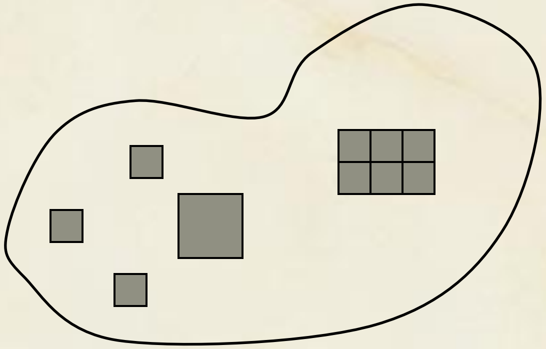
Transition



Visual Estimate of Cover
(Releve or Cover classes)



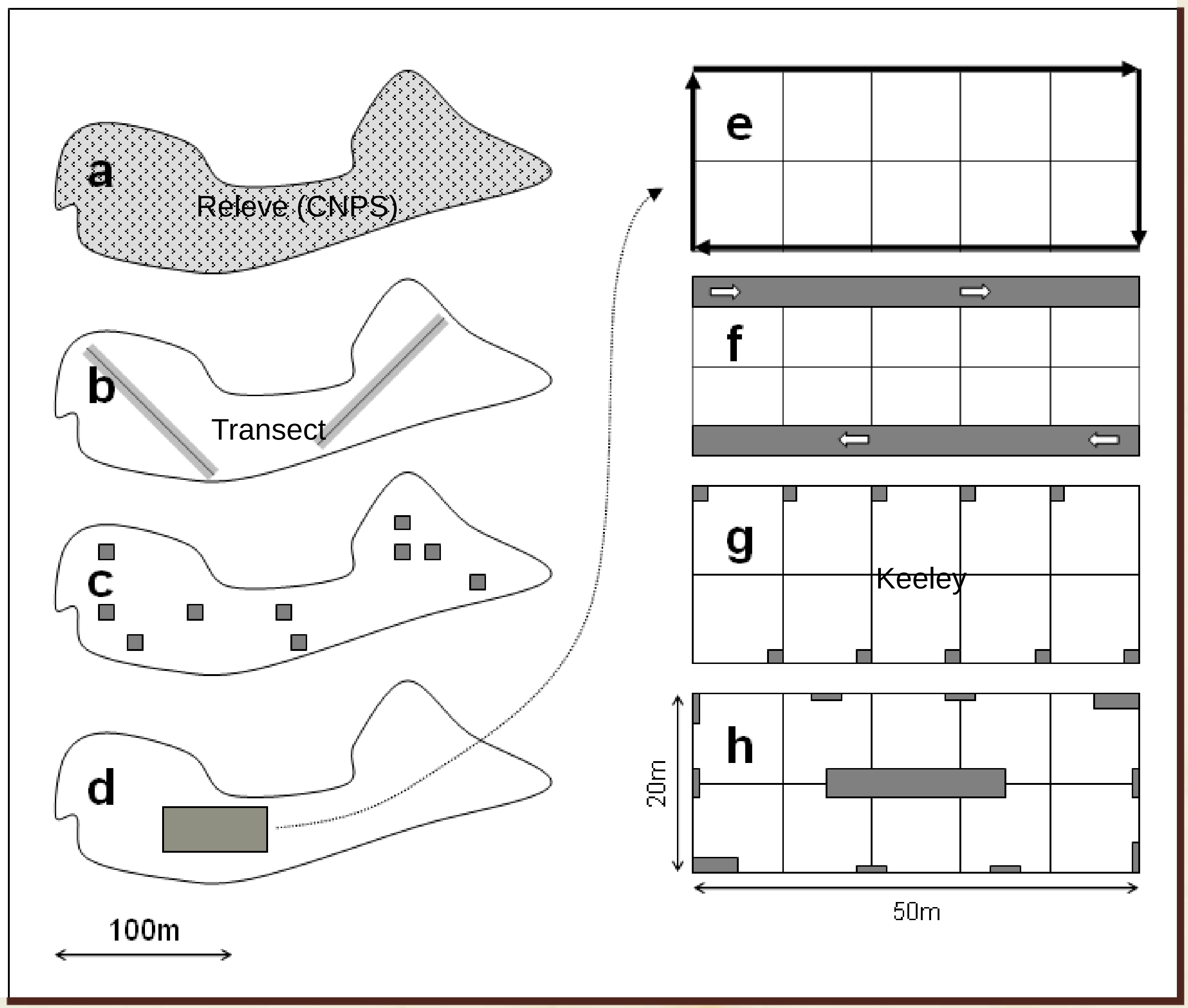
Transects
(Line Intercept or Belt)



Quadrats
(random, systematic, multiscale)

Response Design

Plot



Data Design

Beard et al. (1999). The value of consistent methodology in long term environmental monitoring. Env. Monitoring and Assessment 54:239-258.

- Sources of inconsistency: changes of instrument, personnel, measurement techniques, and analytical methods
- When methods change, the old and the new methods should overlap (allow calibration)
- Correction is more difficult than prevention. In extreme cases no correction is possible.

Vos et al. (2000). A framework for the design of ecological monitoring programs as a tool for environmental and nature management. Env. Monitoring and Assessment 61:317-344.

- The organizational aspects of the monitoring program – responsibility for the data collection, data handling and maintenance – must be considered during the design process.

Data Design

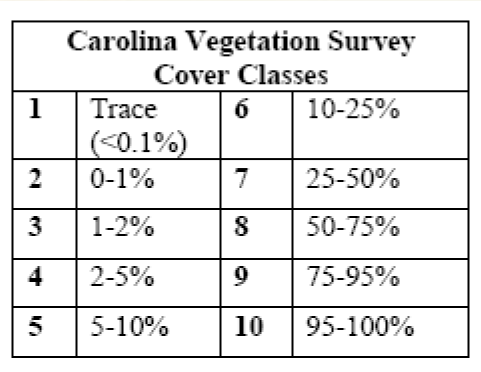
Atkinson et al. (2004) – Appendix J “Quality Assurance Plan”

1. Develop good data recording techniques that minimize errors and forgotten fields.
2. Have field observers double-check their data, preferably the same day.
3. Have a supervisor or data manager check the data regularly for obvious errors
4. Maintain information on who collected the data, entered the data in the database, etc (chain of custody).

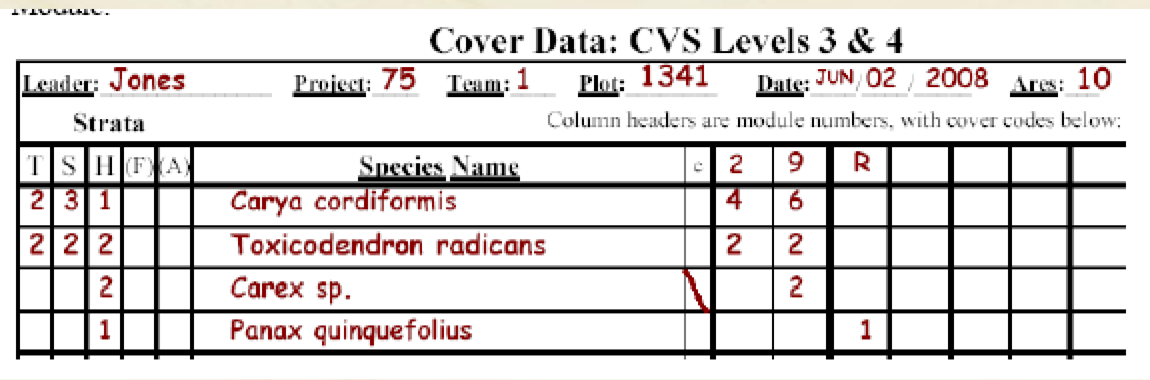
Data Design

Peet, R.K. 2006. The Carolina Vegetation Survey (Website). The University of North Carolina at Chapel Hill, Department of Biology, Chapel Hill, North Carolina, USA. http://cvs.bio.unc.edu.

- The Carolina Vegetation Survey - data entry tool within Microsoft Access
  - allows data entry in computer forms that mimic the datasheets
  - Quality-control checks are automatically performed



Carolina Vegetation Survey Cover Classes			
1	Trace (<0.1%)	**6**	10-25%
2	0-1%	**7**	25-50%
3	1-2%	**8**	50-75%
4	2-5%	**9**	75-95%
5	5-10%	**10**	95-100%



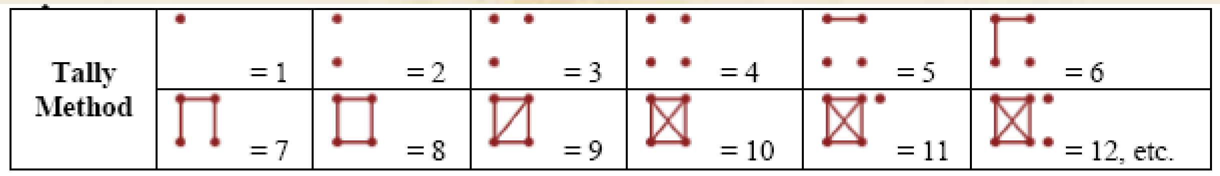
Cover Data: CVS Levels 3 & 4

Leader: Jones **Project:** 75 **Team:** 1 **Plot:** 1341 **Date:** JUN / 02 / 2008 **Area:** 10

Strata

Column headers are module numbers, with cover codes below:

T	S	H	(F)	(A)	Species Name	c	2	9	R				
2	3	1			Carya cordiformis		4	6					
2	2	2			Toxicodendron radicans		2	2					
		2			Carex sp.	\		2					
		1			Panax quinquefolius				1				



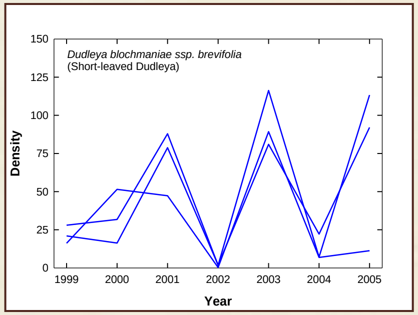
Tally Method	= 1	= 2	= 3	= 4	= 5	= 6
	= 7	= 8	= 9	= 10	= 11	= 12, etc.

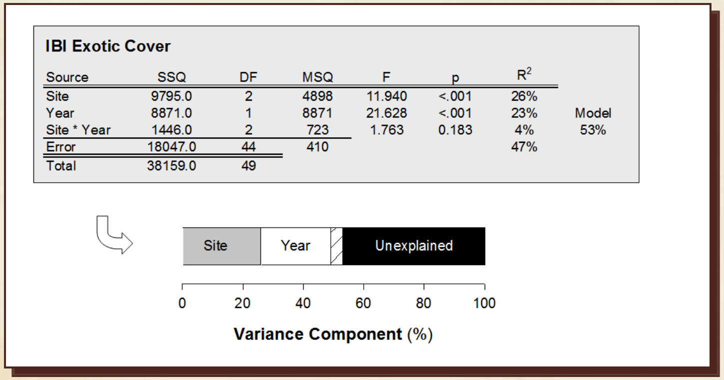
Outline of this Presentation

- Introduction:
  The Challenge of Monitoring
- Scope of Work:
  Deliverables, Atkinson et al. Steps
- Monitoring:
  Theory and Application
- **Analysis of Existing Data**
- Recommendations

General Approach

- Analyze existing data using a variance components approach (ANOVA).
- Calculate partial R2 as a metric describing the relative size of spatial and temporal variation.
- Compare and contrast across species and studies using a stacked bar chart.





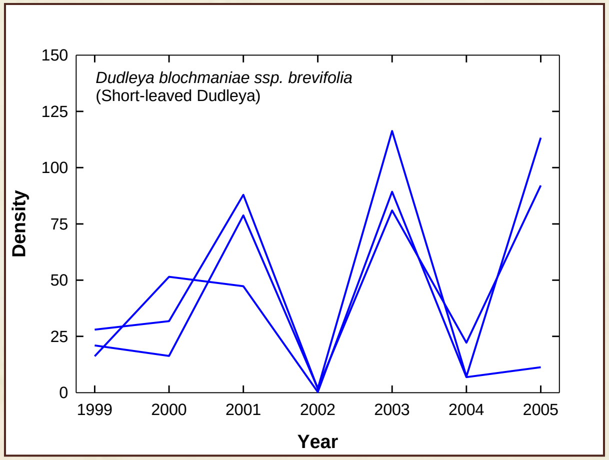
IBI Exotic Cover

Source	SSQ	DF	MSQ	F	p	R^2	
Site	9795.0	2	4898	11.940	<.001	26%	
Year	8871.0	1	8871	21.628	<.001	23%	Model
Site * Year	1446.0	2	723	1.763	0.183	4%	53%
Error	18047.0	44	410			47%	
Total	38159.0	49					

McEachern (Rare Plants LAG)

Dudleya brevifolia (Short-leaved Dudleya)

sometimes written as D. blochmaniae ssp. brevifolia



- 3 sites (Carmel Mtn 1, 2 and 3) over a 7-yr period
- Individuals counted on multiple quadrats arranged along multiple transects at each site.

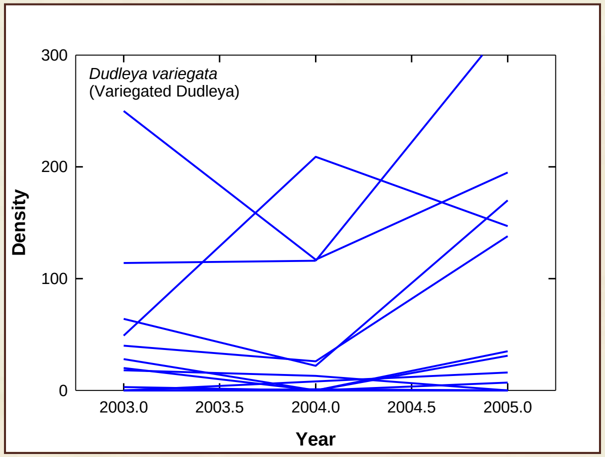
Source	SSQ	df	MSQ	F	P	R^2
Site	1916	2	958	1.820	0.204	6.1%
Year	22,950	6	3825	7.268	0.002	73.6%
Error	6315	12	526.25			20.3%

Temporal (Interannual)

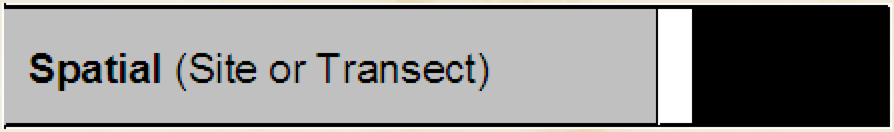
McEachern (Rare Plants LAG)

Dudleya variegata
(Variegated Dudleya)

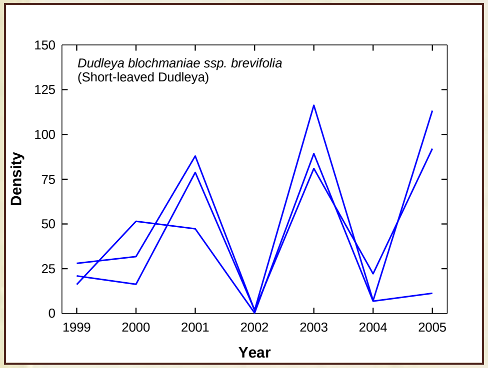
- 16 transects (all at Otay Lakes) over a 3-yr period
- Individuals counted on 1m belt transects averaging 300m in length.

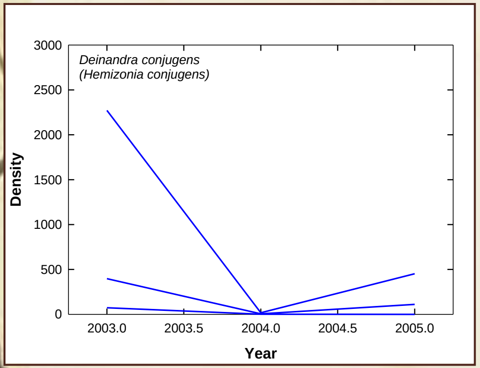


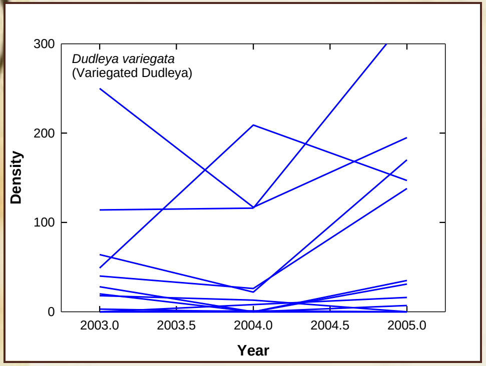
Source	SSQ	DF	MSQ	F	p	R^2
Transect	204.1	15	14	6.599	<.001	74%
Year	11.4	2	6	2.752	0.079	4%
Error	61.9	30	2			22%
Total	277.3	47				

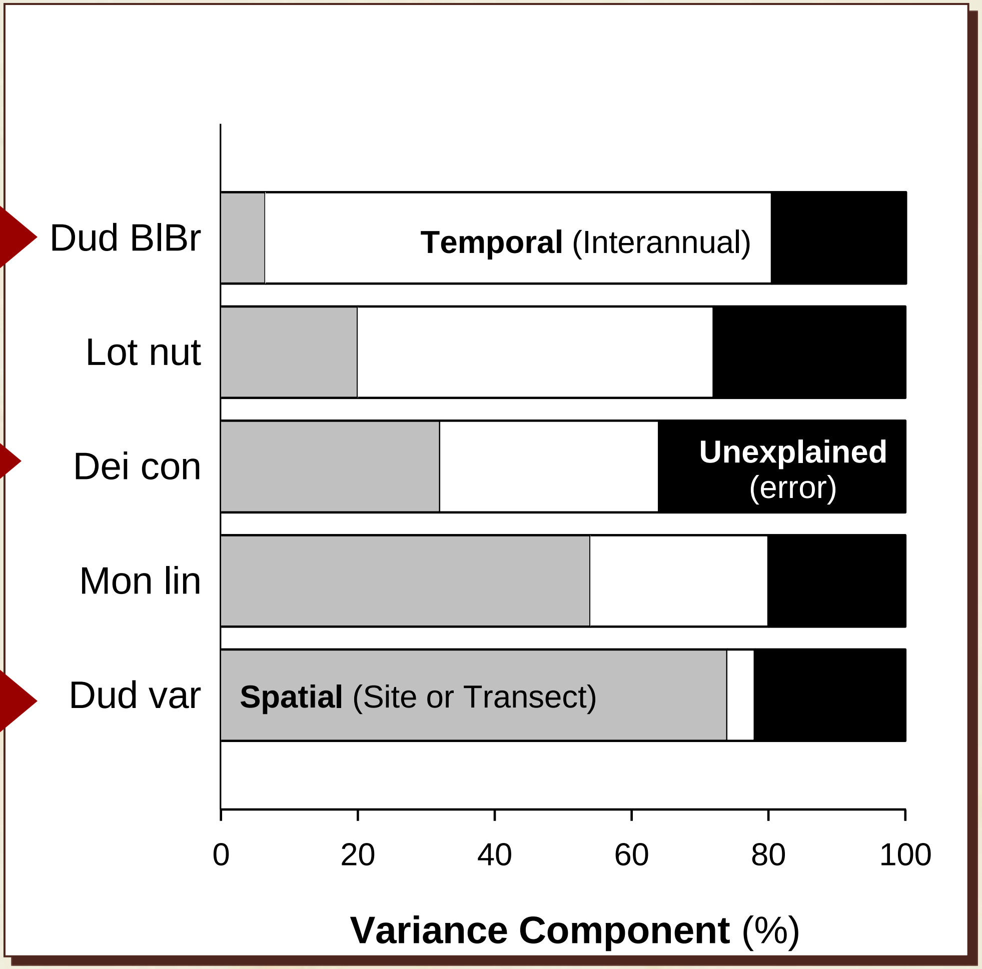


McEachern (Rare Plants LAG)

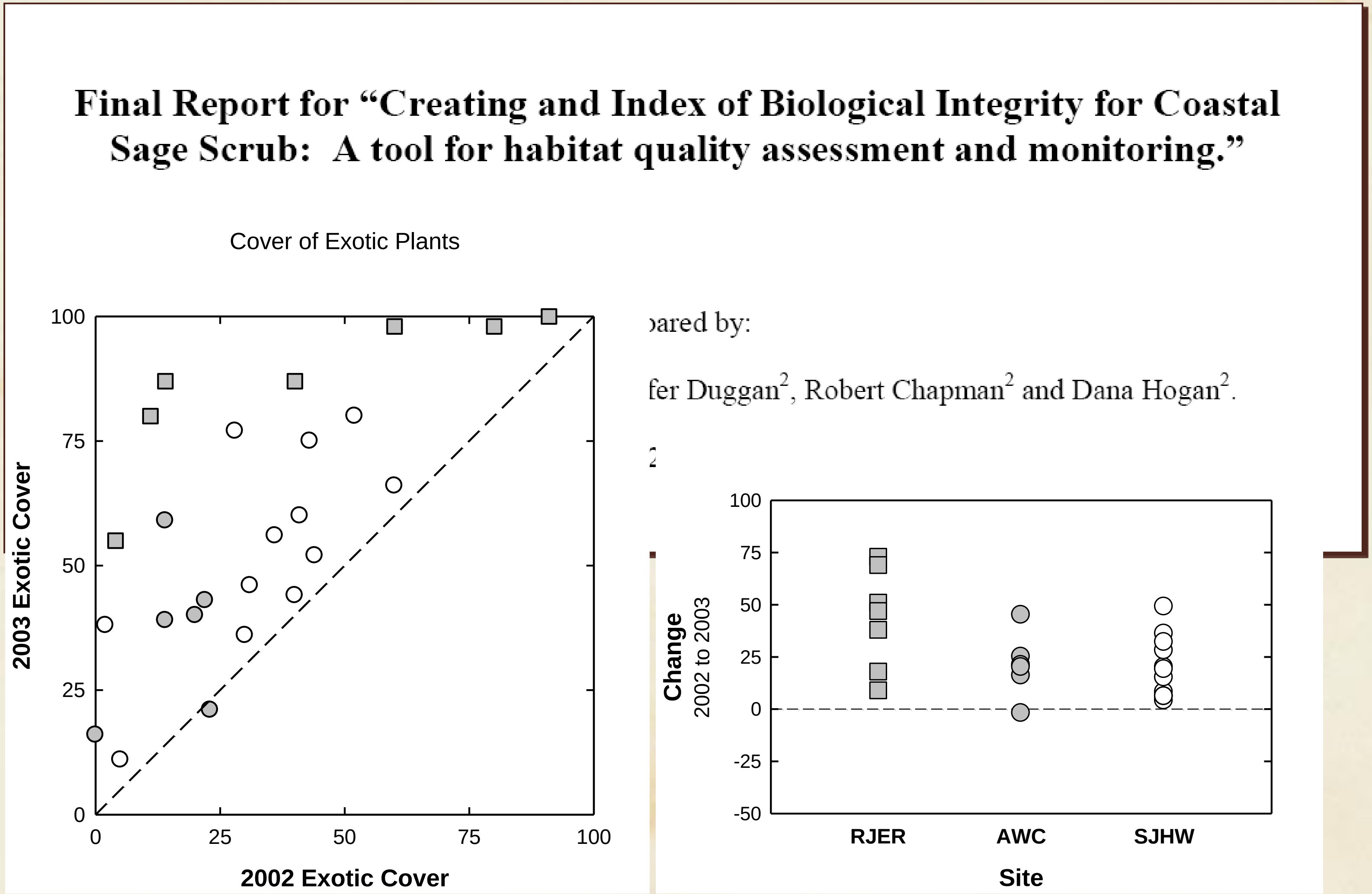








Diffendorfer et al. (2004)



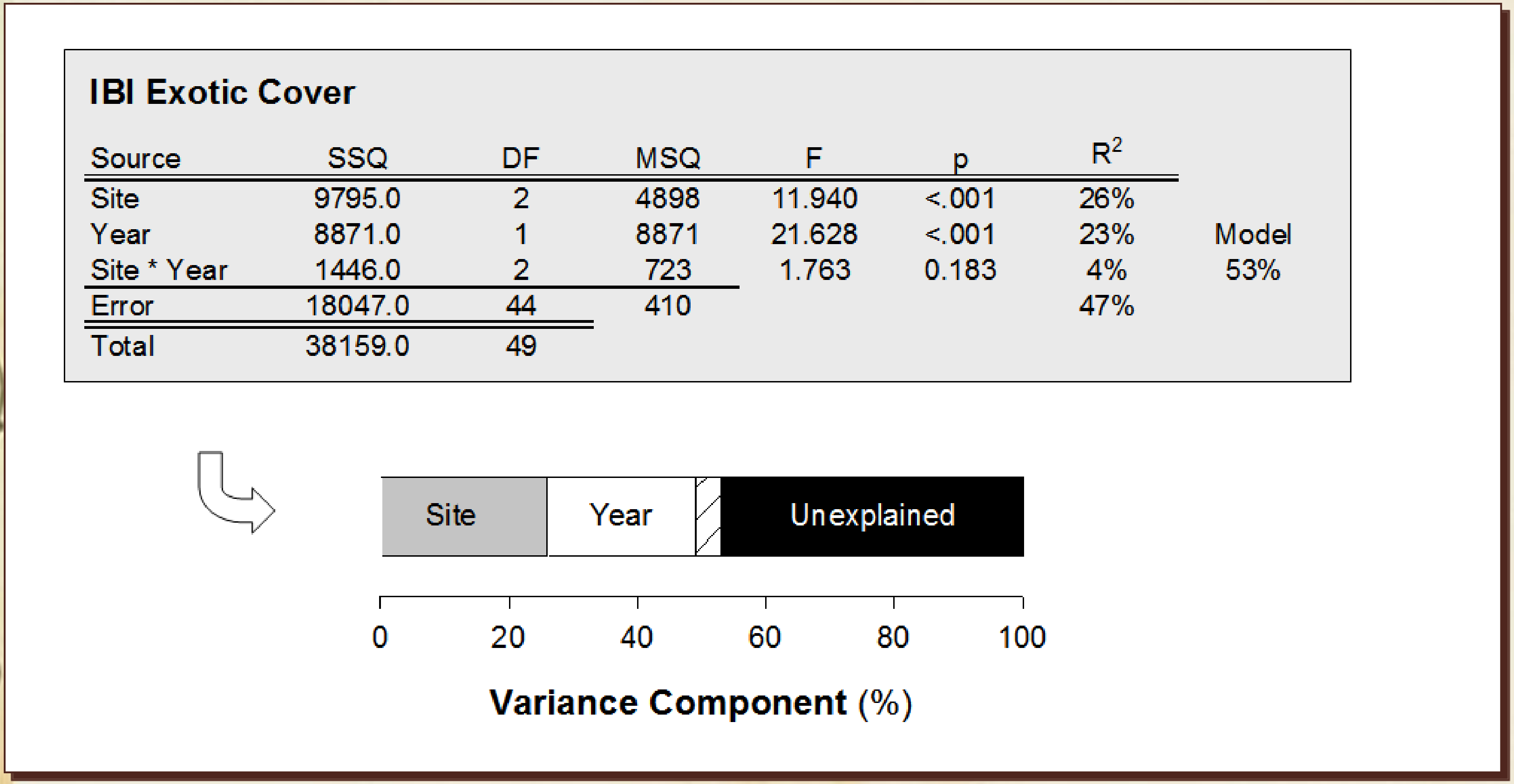
Final Report for "Creating and Index of Biological Integrity for Coastal Sage Scrub: A tool for habitat quality assessment and monitoring."

pared by:

fer Duggan[2], Robert Chapman[2] and Dana Hogan[2].

2

Diffendorfer et al. (2004)



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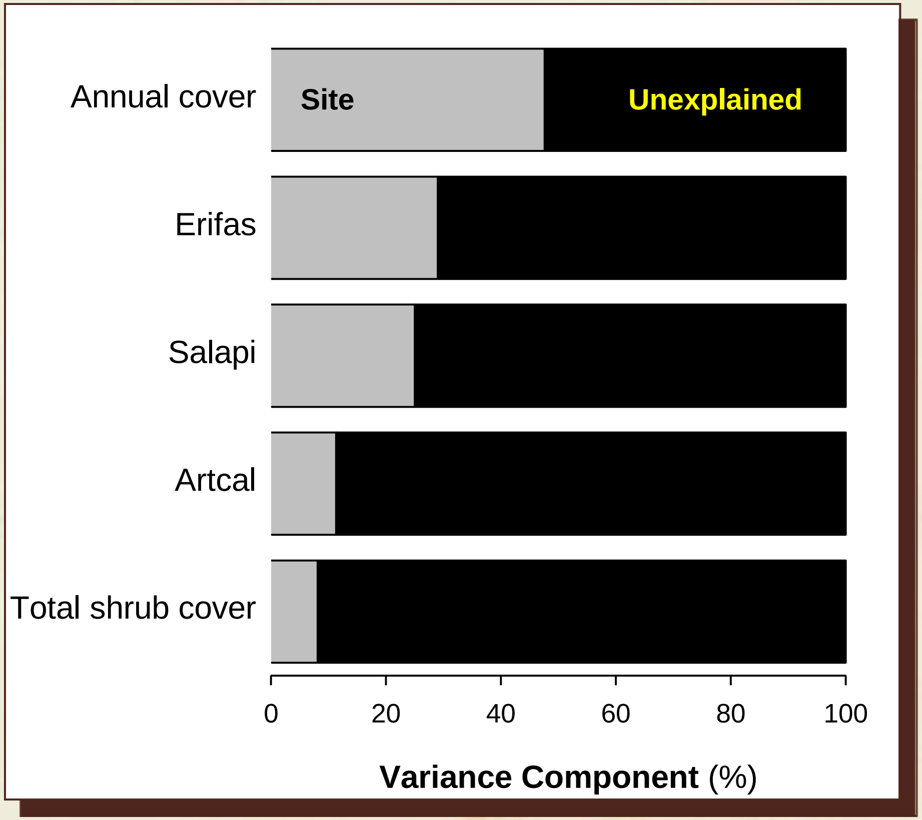
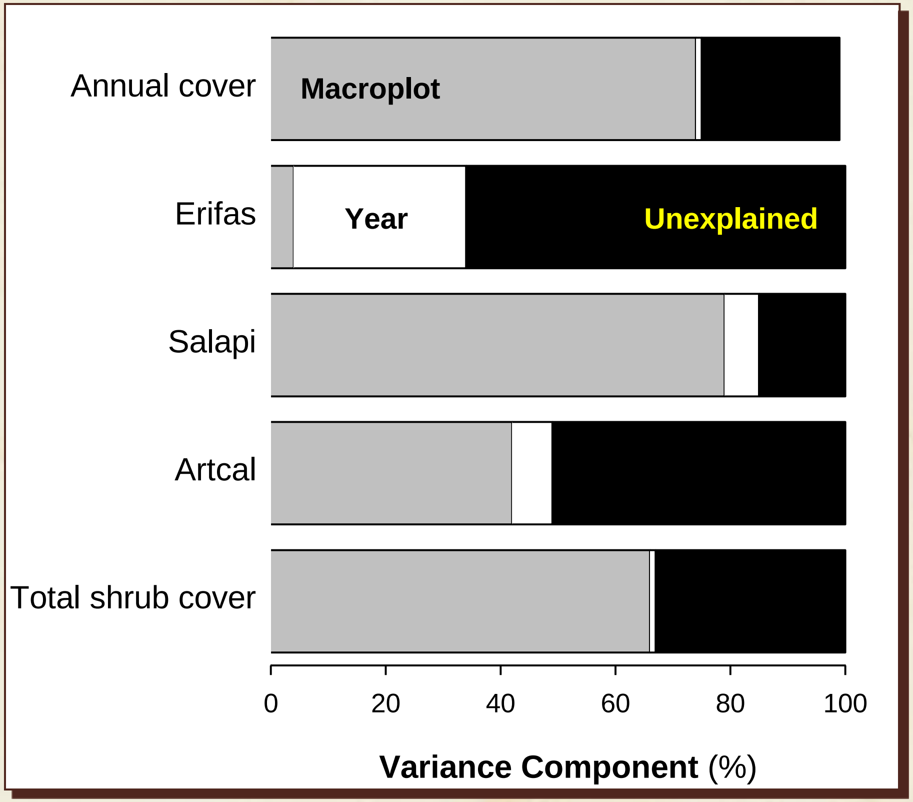
Chalekian and Strahm

Shipley and RJER (2003)

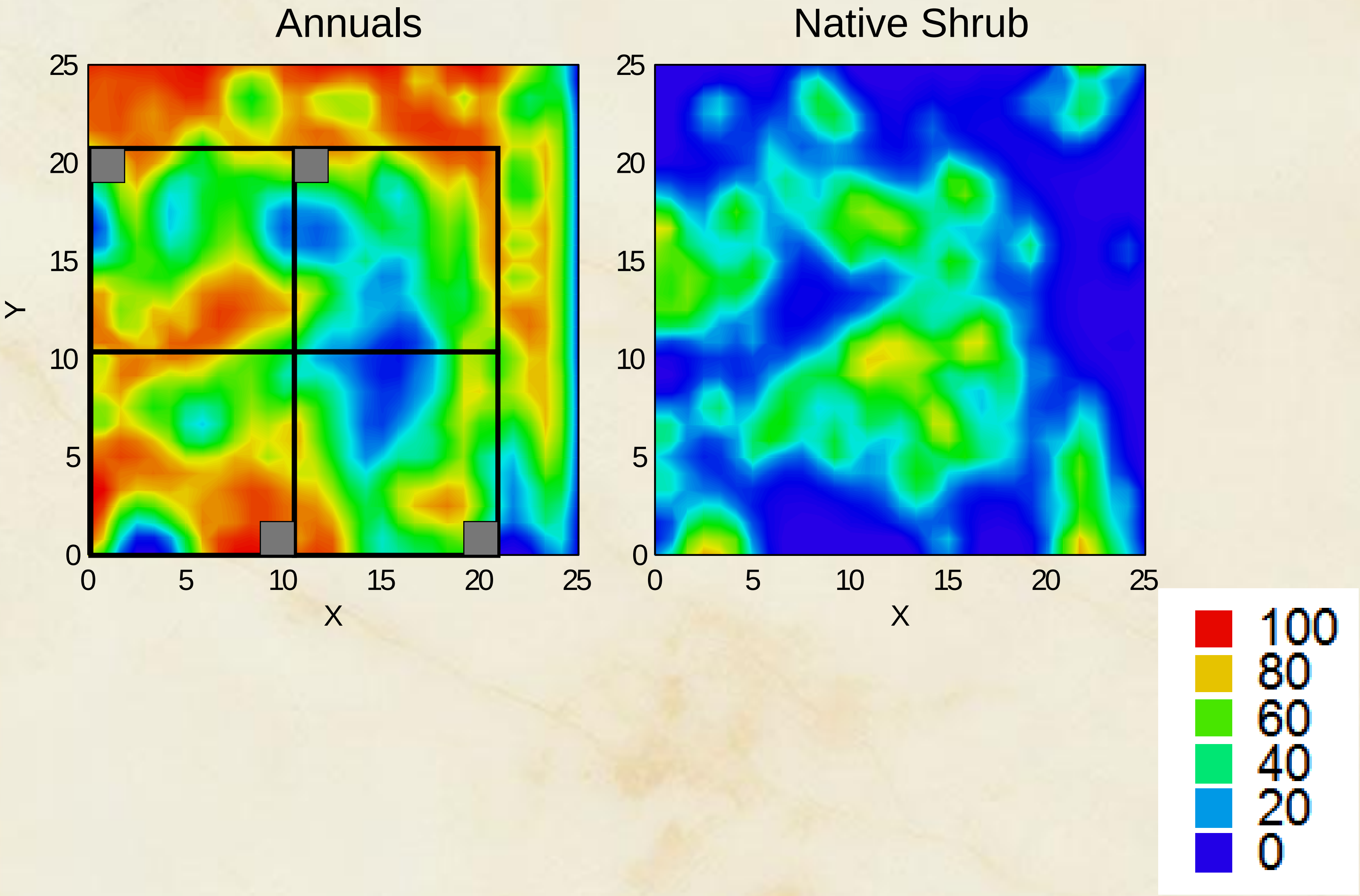


Chalekian and Strahm

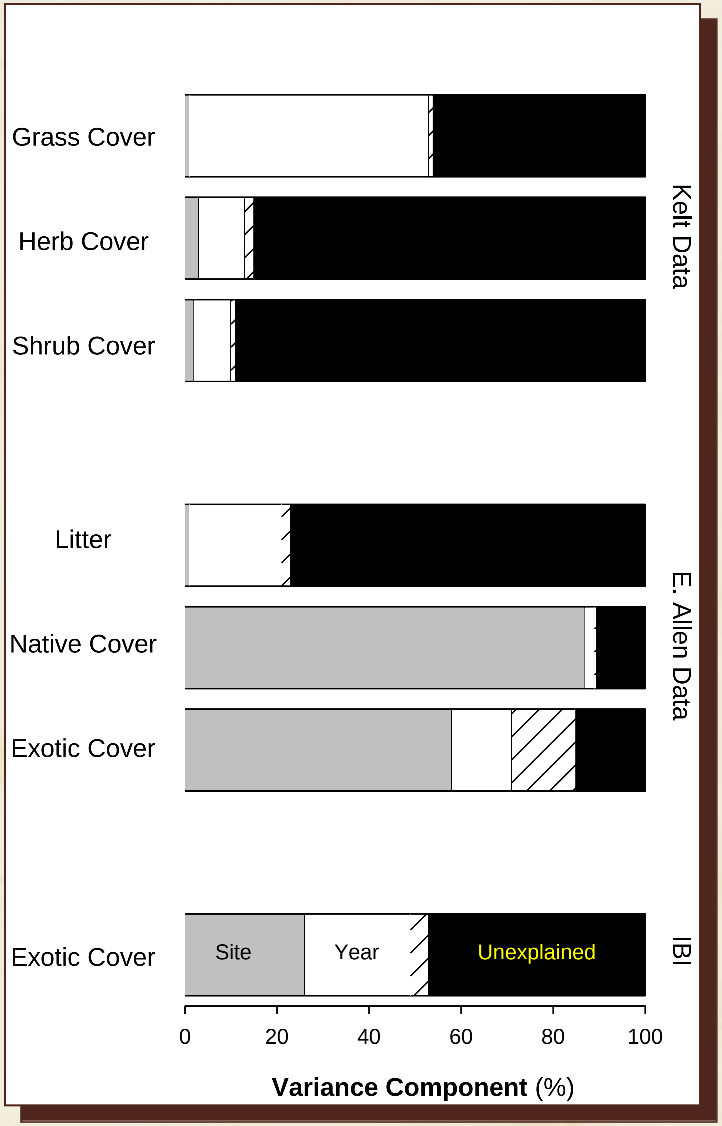
Shipley (1999 and 2003, by Macroplot)



Chalekian and Strahm

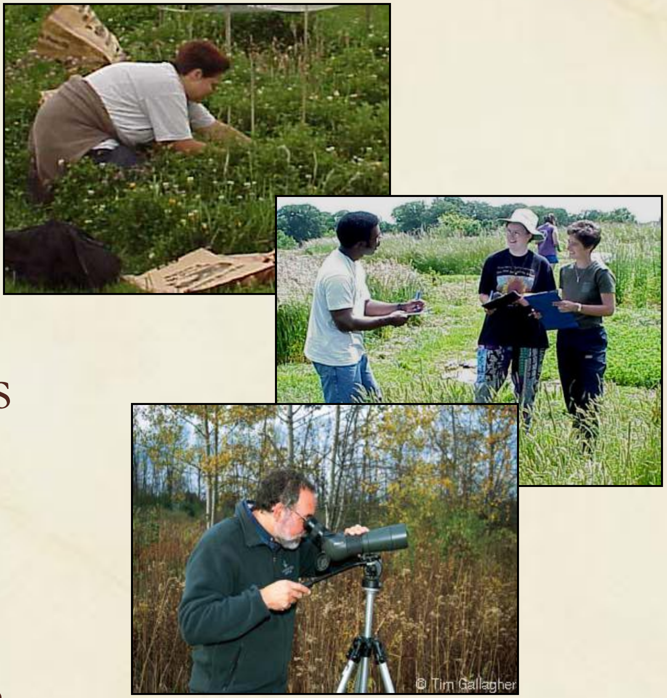


Other CSS Vegetation Data

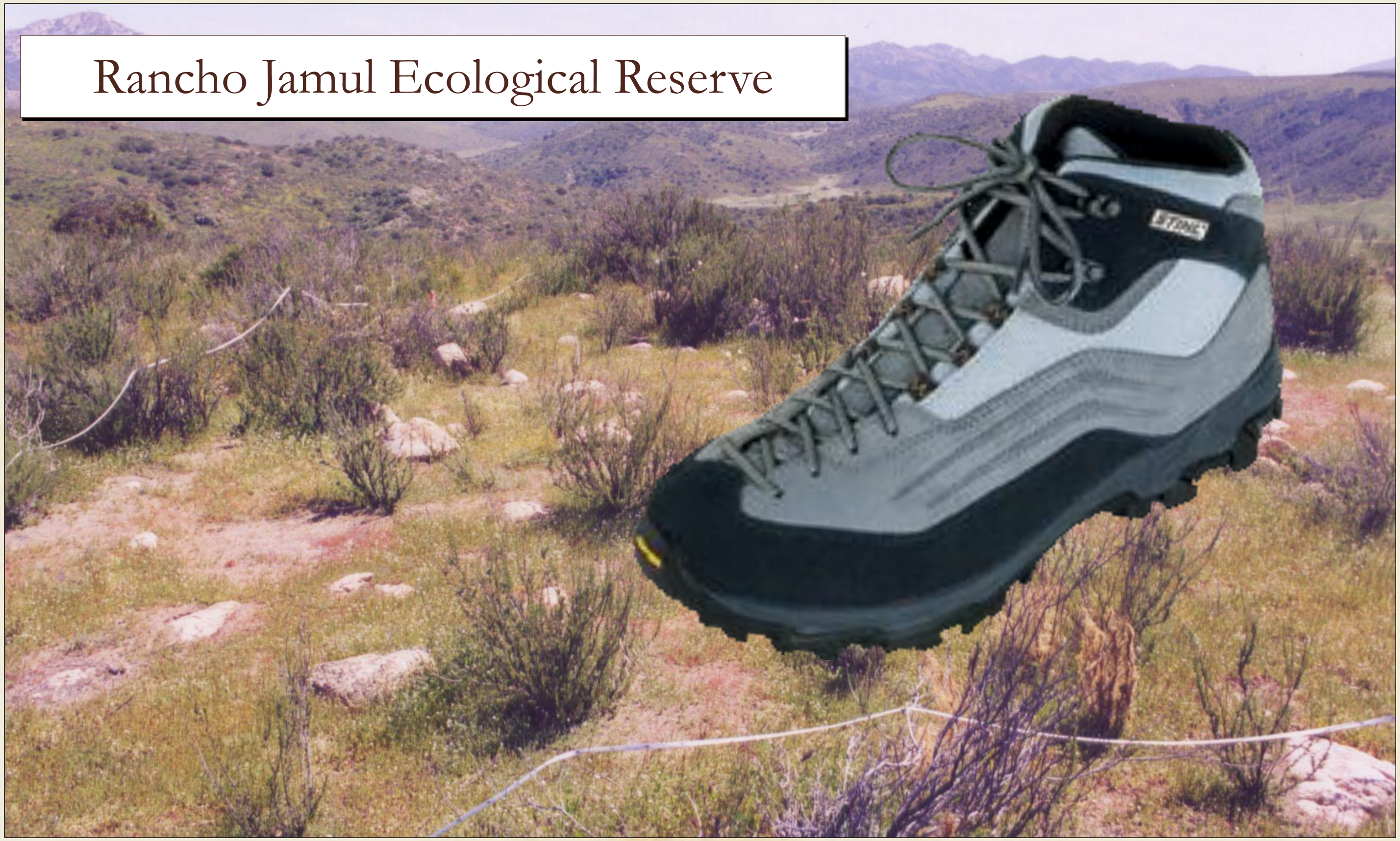


Outline of this Presentation

- Introduction:
  The Challenge of Monitoring
- Scope of Work:
  Deliverables, Atkinson et al. Steps
- Monitoring:
  Theory and Application
- Analysis of Existing Data
- **Recommendations**



Recommendations

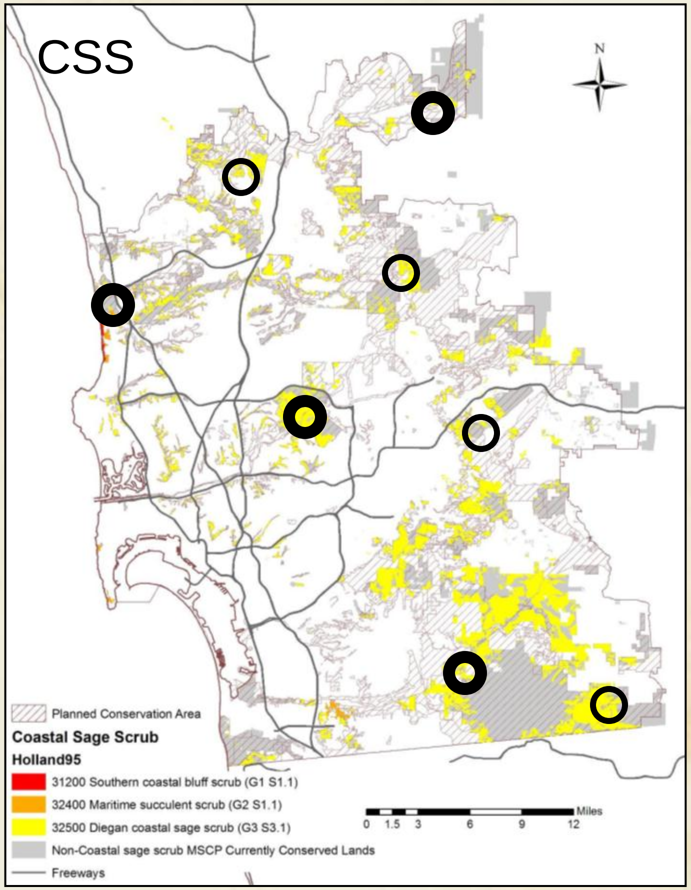

Rancho Jamul Ecological Reserve

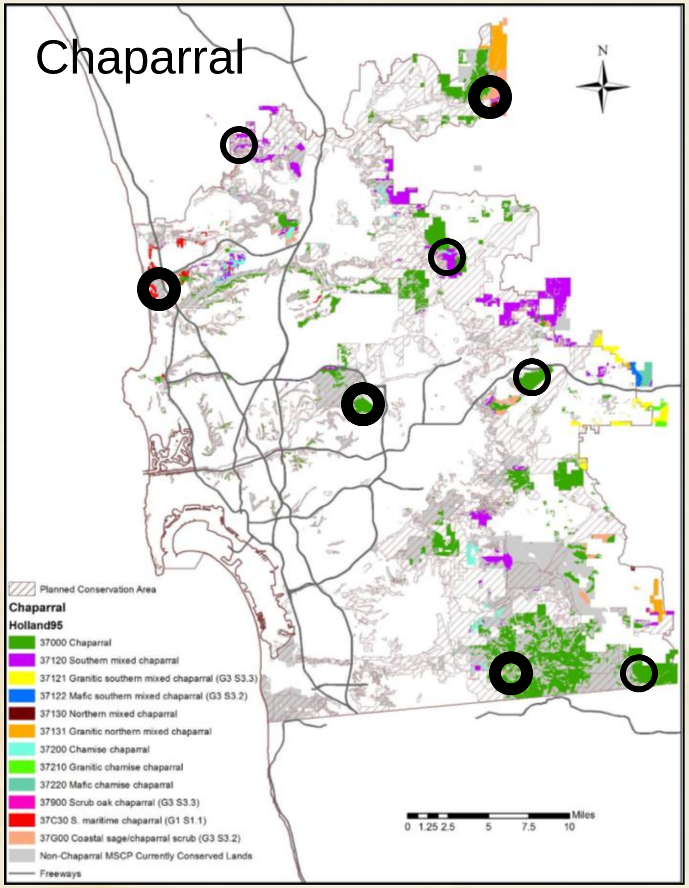
Recommendations

- Much of current data is restricted in coverage (reserve, years, species sampled, and methods).
- Existing data is not comprehensive enough to evaluate alternative designs (calculate power, evaluate bias etc)
- We propose that a broad-scale sampling program be implemented to collect and analyze data that will provide concrete guidance on design, cost and power.

Recommendations

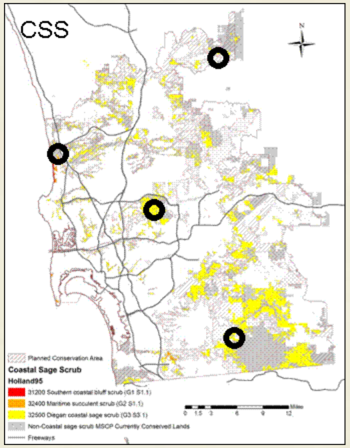
- Initially, a multi-scale, hierarchical design is needed since there is significant variation at several scales (intra- and inter-reserve, inter-annual)

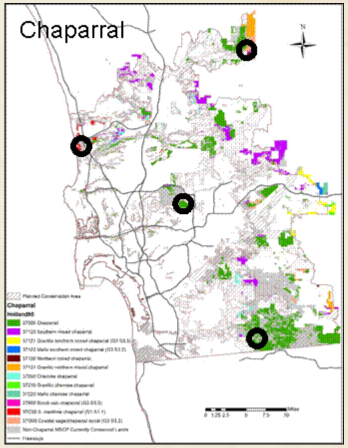




Recommendations

- Initially, all of the major sites would be visited annually.





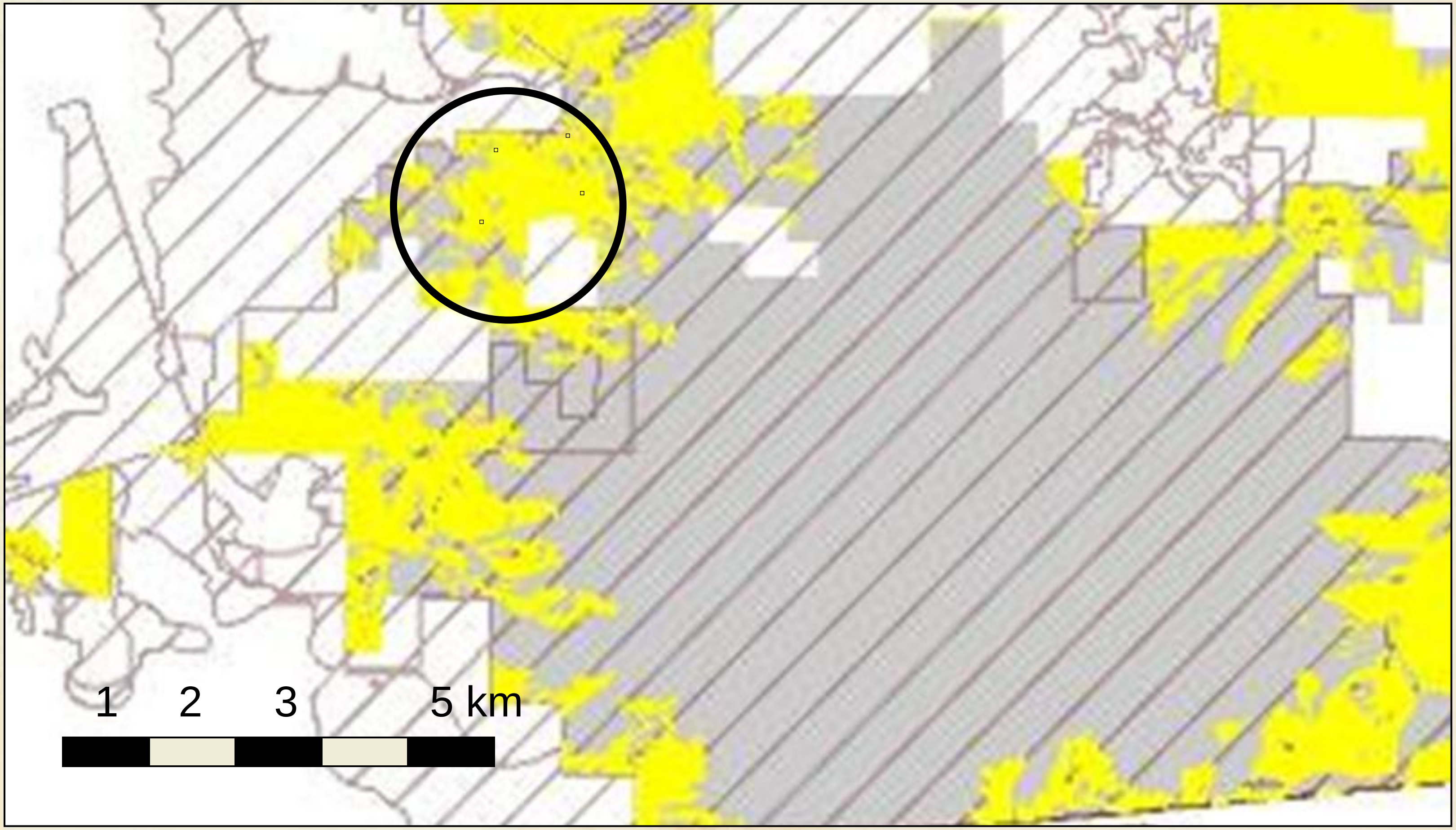
Sage Scrub

	Year		
Sites	**1**	**2**	**3**
CSS$_1$	**x**	**x**	x
CSS$_2$	**x**	**x**	x
CSS$_3$	**x**	**x**	x
CSS$_4$	**x**	**x**	x
CSS$_5$			
CSS$_6$			
CSS$_7$			
CSS$_8$			
CSS$_9$			
CSS$_{10}$			
CSS$_{11}$			
CSS$_{12}$			

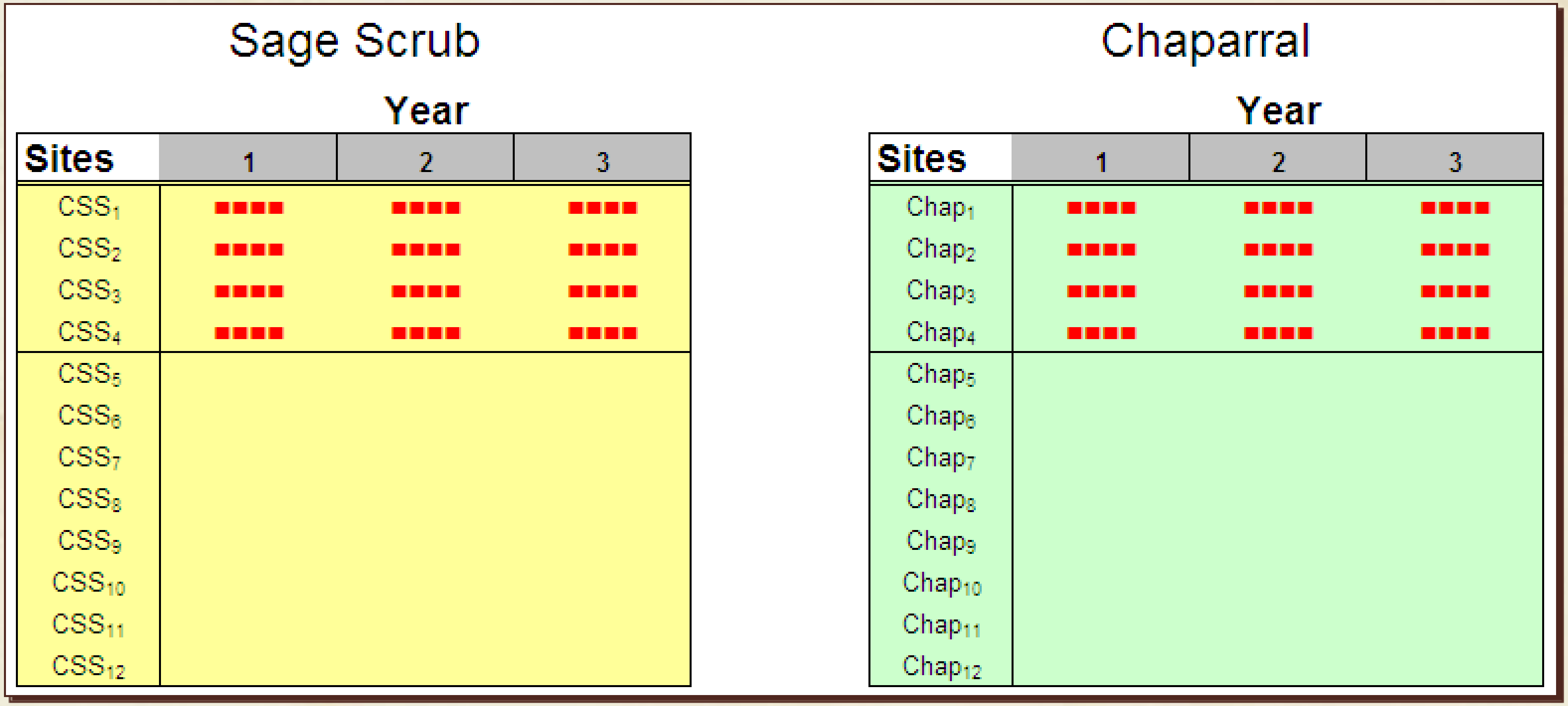
Chaparral

	Year		
Sites	**1**	**2**	**3**
Chap$_1$	**x**	**x**	x
Chap$_2$	**x**	**x**	x
Chap$_3$	**x**	**x**	x
Chap$_4$	**x**	**x**	x
Chap$_5$			
Chap$_6$			
Chap$_7$			
Chap$_8$			
Chap$_9$			
Chap$_{10}$			
Chap$_{11}$			
Chap$_{12}$			

Recommendations



Recommendations



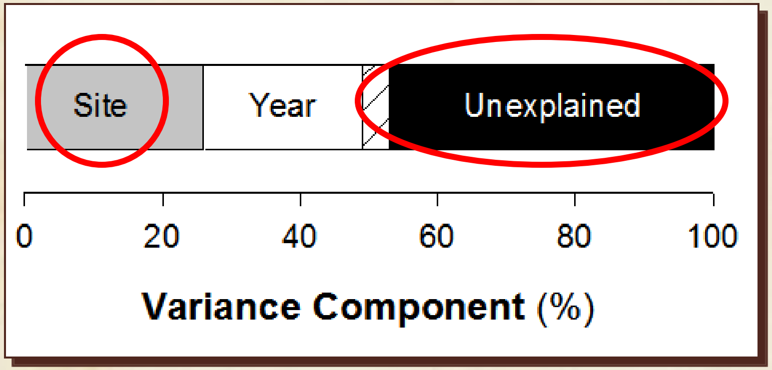
Sage Scrub

	Year		
Sites	1	2	3
CSS$_{1}$	■■■■	■■■■	■■■■
CSS$_{2}$	■■■■	■■■■	■■■■
CSS$_{3}$	■■■■	■■■■	■■■■
CSS$_{4}$	■■■■	■■■■	■■■■
CSS$_{5}$			
CSS$_{6}$			
CSS$_{7}$			
CSS$_{8}$			
CSS$_{9}$			
CSS$_{10}$			
CSS$_{11}$			
CSS$_{12}$			

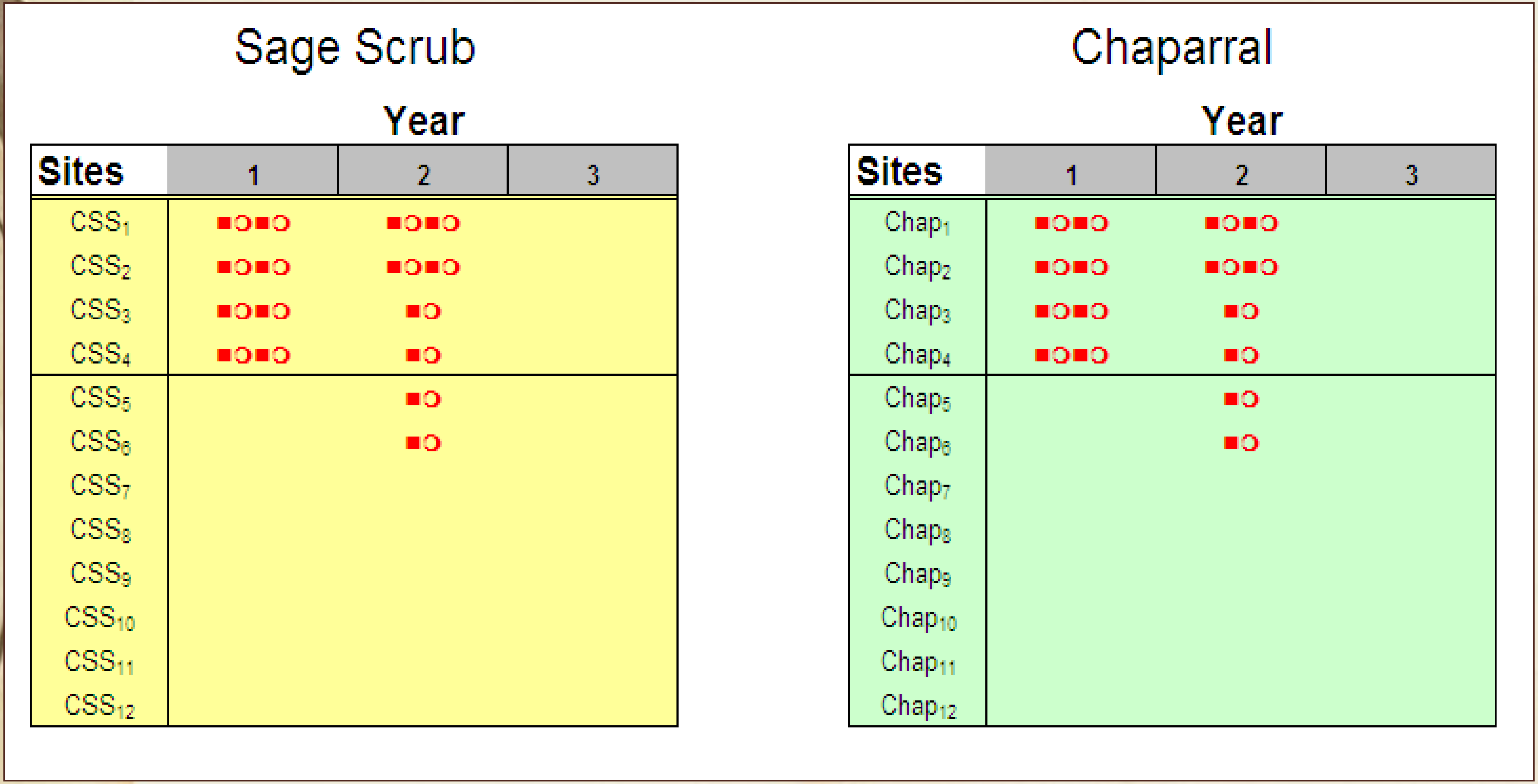
Chaparral

	Year		
Sites	1	2	3
Chap$_{1}$	■■■■	■■■■	■■■■
Chap$_{2}$	■■■■	■■■■	■■■■
Chap$_{3}$	■■■■	■■■■	■■■■
Chap$_{4}$	■■■■	■■■■	■■■■
Chap$_{5}$			
Chap$_{6}$			
Chap$_{7}$			
Chap$_{8}$			
Chap$_{9}$			
Chap$_{10}$			
Chap$_{11}$			
Chap$_{12}$			

This nested design will allow us to estimate spatial variance components.



Recommendations



Sage Scrub

	Year		
Sites	1	2	3
CSS$_{1}$	■○■○	■○■○	
CSS$_{2}$	■○■○	■○■○	
CSS$_{3}$	■○■○	■○	
CSS$_{4}$	■○■○	■○	
CSS$_{5}$		■○	
CSS$_{6}$		■○	
CSS$_{7}$			
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CSS$_{9}$			
CSS$_{10}$			
CSS$_{11}$			
CSS$_{12}$			

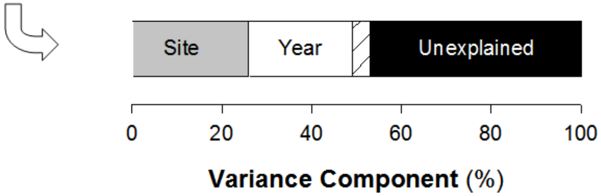
Chaparral

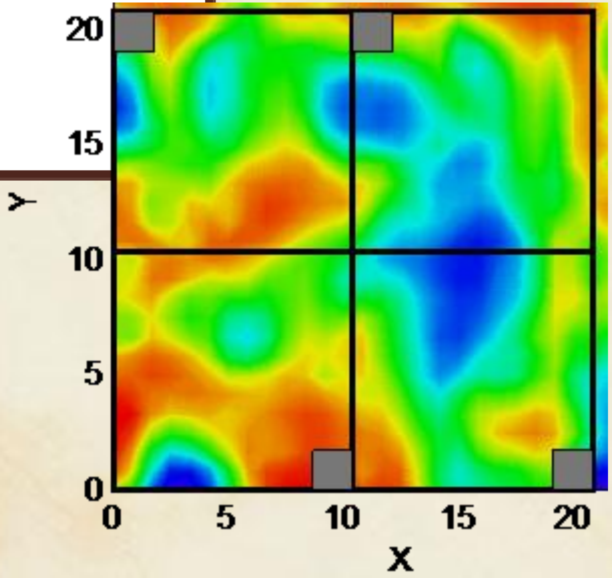
	Year		
Sites	1	2	3
Chap$_{1}$	■○■○	■○■○	
Chap$_{2}$	■○■○	■○■○	
Chap$_{3}$	■○■○	■○	
Chap$_{4}$	■○■○	■○	
Chap$_{5}$		■○	
Chap$_{6}$		■○	
Chap$_{7}$			
Chap$_{8}$			
Chap$_{9}$			
Chap$_{10}$			
Chap$_{11}$			
Chap$_{12}$			

Recommendations

IBI Exotic Cover

Source	SSQ	DF	MSQ	F	p	R^2	
Site	9795.0	2	4898	11.940	<.001	26%	
Year	8871.0	1	8871	21.628	<.001	23%	Model
Site * Year	1446.0	2	723	1.763	0.183	4%	53%
Error	18047.0	44	410			47%	
Total	38159.0	49					





Nested subsamples will be drawn from the large plots in order to estimate (bootstrap) the relationship between effort and precision.

Recommendations

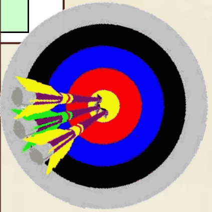
Sage Scrub

Sites	Year		
	1	2	3
CSS_1	■○■○ ■○■○	■○■○ ■○■○	
CSS_2	■○■○ ■○■○	■○■○ ■○■○	
CSS_8			
CSS_9			
CSS_{10}			
CSS_{11}			
CSS_{12}			

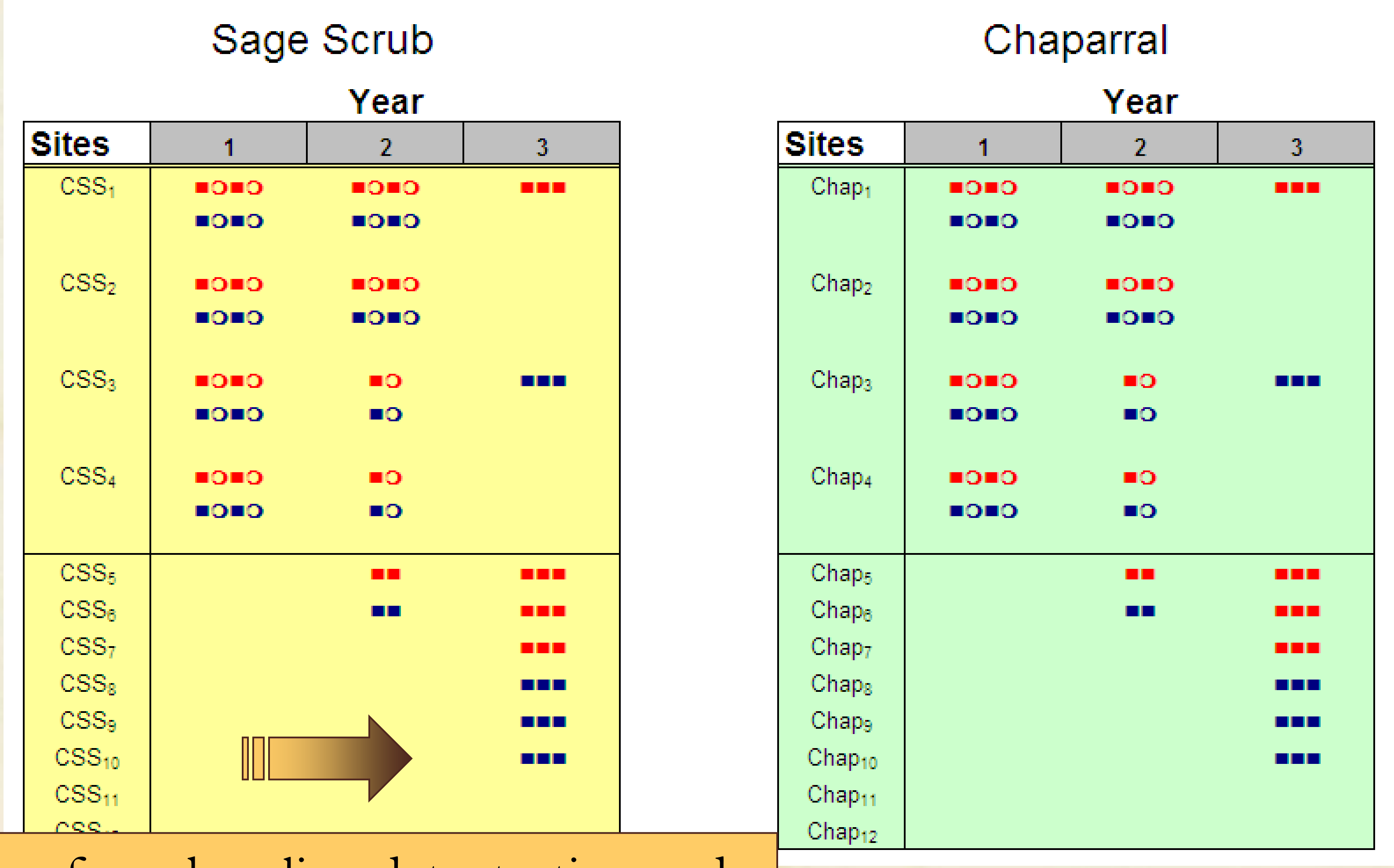
Chaparral

Sites	Year		
	1	2	3
$Chap_1$	■○■○ ■○■○	■○■○ ■○■○	
$Chap_2$	■○■○ ■○■○	■○■○ ■○■○	

Sites will be surveyed by multiple teams. This will allow us to estimate observer bias and variability (across protocols).



Recommendations



Sage Scrub

Year

Sites	1	2	3
CSS$_1$	🟥○🟥○ 🟦○🟦○	🟥○🟥○ 🟦○🟦○	🟥🟥🟥
CSS$_2$	🟥○🟥○ 🟦○🟦○	🟥○🟥○ 🟦○🟦○	
CSS$_3$	🟥○🟥○ 🟦○🟦○	🟥○ 🟦○	🟦🟦🟦
CSS$_4$	🟥○🟥○ 🟦○🟦○	🟥○ 🟦○	
CSS$_5$		🟥🟥	🟥🟥🟥
CSS$_6$		🟦🟦	🟥🟥🟥
CSS$_7$			🟥🟥🟥
CSS$_8$			🟦🟦🟦
CSS$_9$			🟦🟦🟦
CSS$_{10}$			🟦🟦🟦
CSS$_{11}$			
CSS			

Chaparral

Year

Sites	1	2	3
Chap$_1$	🟥○🟥○ 🟦○🟦○	🟥○🟥○ 🟦○🟦○	🟥🟥🟥
Chap$_2$	🟥○🟥○ 🟦○🟦○	🟥○🟥○ 🟦○🟦○	
Chap$_3$	🟥○🟥○ 🟦○🟦○	🟥○ 🟦○	🟦🟦🟦
Chap$_4$	🟥○🟥○ 🟦○🟦○	🟥○ 🟦○	
Chap$_5$		🟥🟥	🟥🟥🟥
Chap$_6$		🟦🟦	🟥🟥🟥
Chap$_7$			🟥🟥🟥
Chap$_8$			🟦🟦🟦
Chap$_9$			🟦🟦🟦
Chap$_{10}$			🟦🟦🟦
Chap$_{11}$			
Chap$_{12}$			

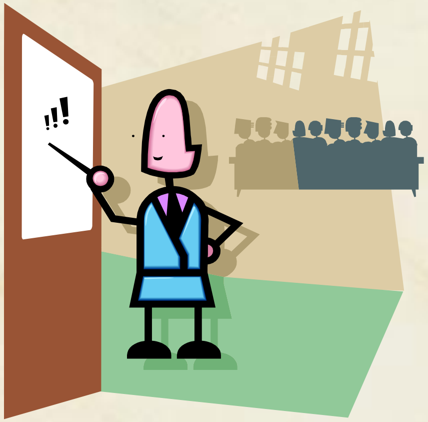
Transition from baseline data, testing and power calculations to established (sustainable) long-term monitoring

Workshop Agenda

1. Presentation *(part 1)* . . . . . . 9:10-9:45 am
    - I. Introduction: The Challenge of Monitoring
    - II. Scope of Work
    - III. Monitoring: Theory and Application
2. Break . . . . 9:45-9:55 am
3. Presentation *(part 2)* . . . . . . 9:10-10:30 am
    - IV. Analysis of Existing Data
    - V. Recommendations
4. Break-out sessions . . . . . 10:40-11:10 am
5. Share results . . . . .11:20-12:00 pm

Break Out Activity

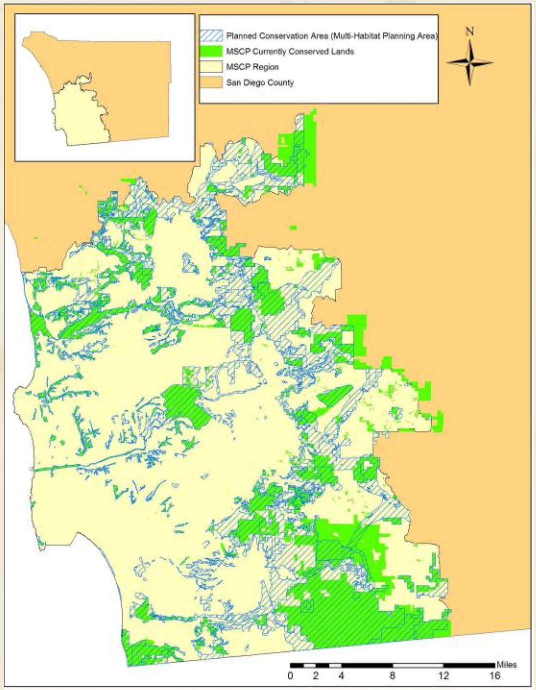
Activity



Us

You

Activity



COSTS (hr)		Your Estimate
Travel		
Travel to Sites	2	
Travel among plots	0.5	
Plot Establishment		
Locating (all)	2	
Setup - Transects	1	
Setup - Releve	2	
Setup - Keeley	3	
Plot Sampling (major taxonomic groups)		
Transects	3	
Releve	1	
Keeley	4	
Species Inventory		
Transects	2	
Releve	2	
Keeley	2	
Data Entry, Qa/Qc		
Transects	2	
Releve	1	
Keeley	2	

Missing Steps

if any

Task	Time

Activity

Major Sites	Year					
	1	2	3	4	5	6
CSS_1	6	6	6	6	6	6
CSS_2	6	6	6	6	6	6
CSS_3	3			3		
CSS_4	3			3		
CSS_5		3			3	
CSS_6		3			3	
CSS_7			3			3
CSS_8			3			3
CSS_9						
CSS_{10}						
CSS_{11}						
CSS_{12}						
CSS_{other}						
CSS_{other}						
CSS_{other}						
CSS_{other}						
CSS_{other}						
CSS_{other}						
CSS_{other}						
CSS_{other}						
CSS_{other}						

Major Sites	Year					
	1	2	3	4	5	6
$Chap_1$	6	6	6	6	6	6
$Chap_2$	6	6	6	6	6	6
$Chap_3$	3			3		
$Chap_4$	3			3		
$Chap_5$		3			3	
$Chap_6$		3			3	
$Chap_7$			3			3
$Chap_8$			3			3
$Chap_9$						
$Chap_{10}$						
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