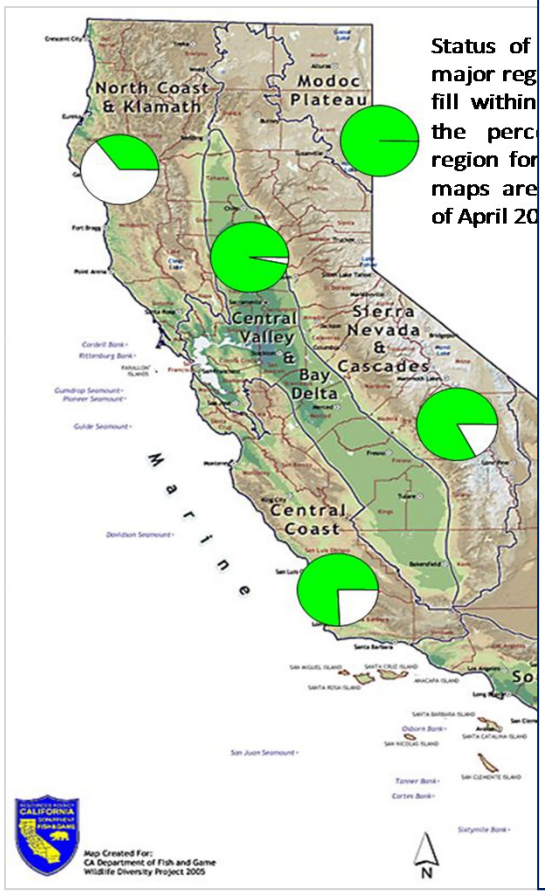
Development of a Wetland Status and Trends Program for California

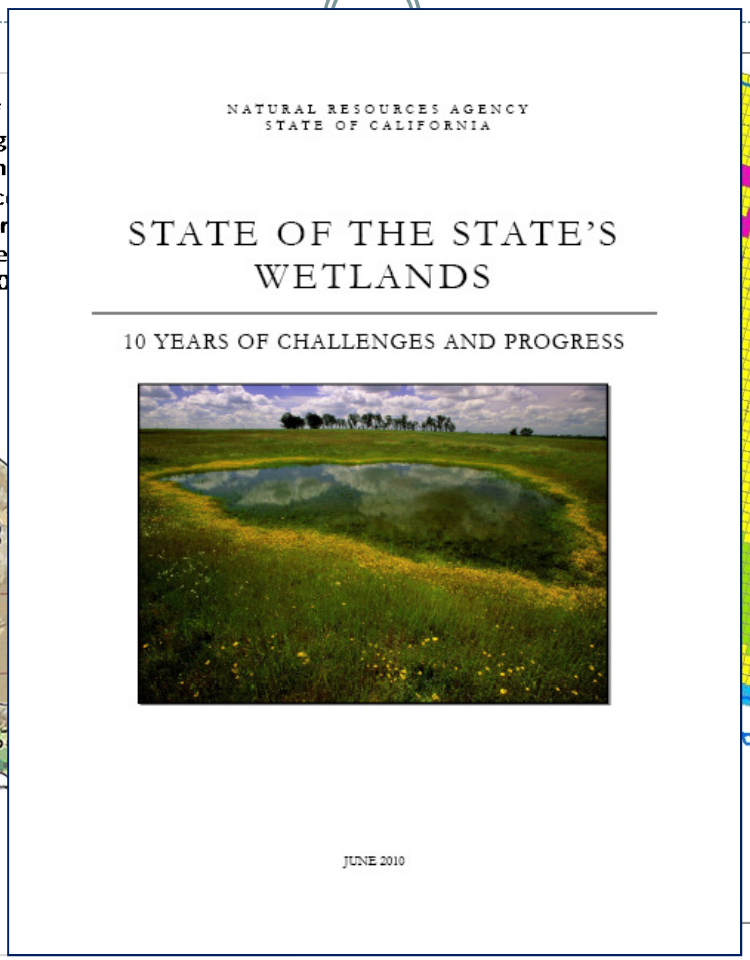
ERIC STEIN & LEILA LACKEY
S.CA COASTAL WATER RESEARCH PROJECT
BIOLOGY DEPARTMENT

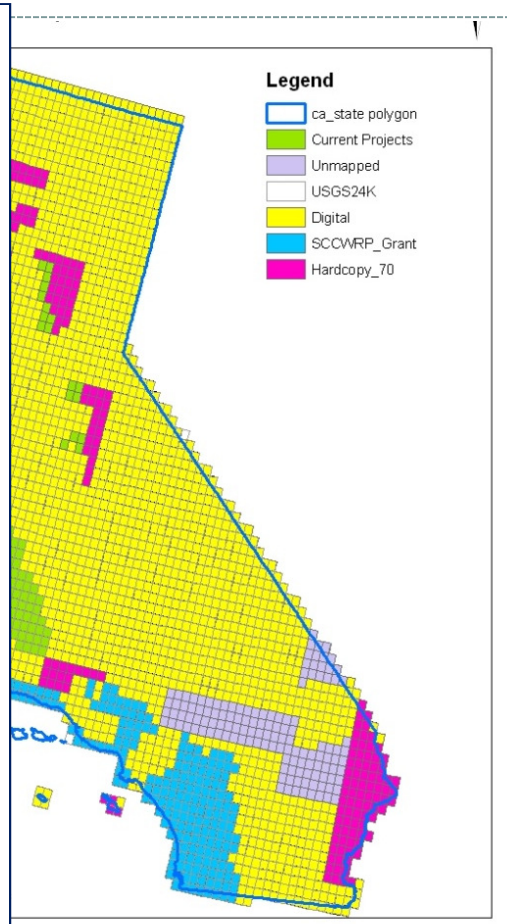
Project Partners

Funded by USEPA

How Much wetlands are in CA?





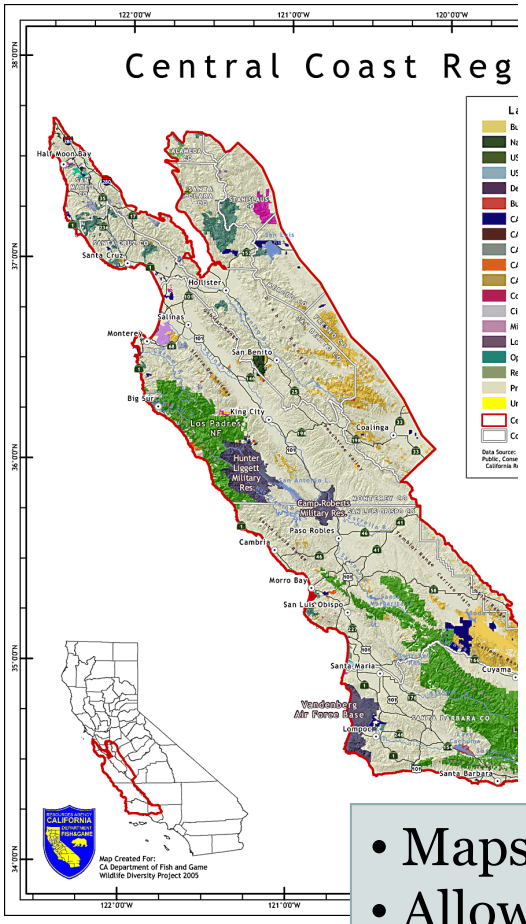


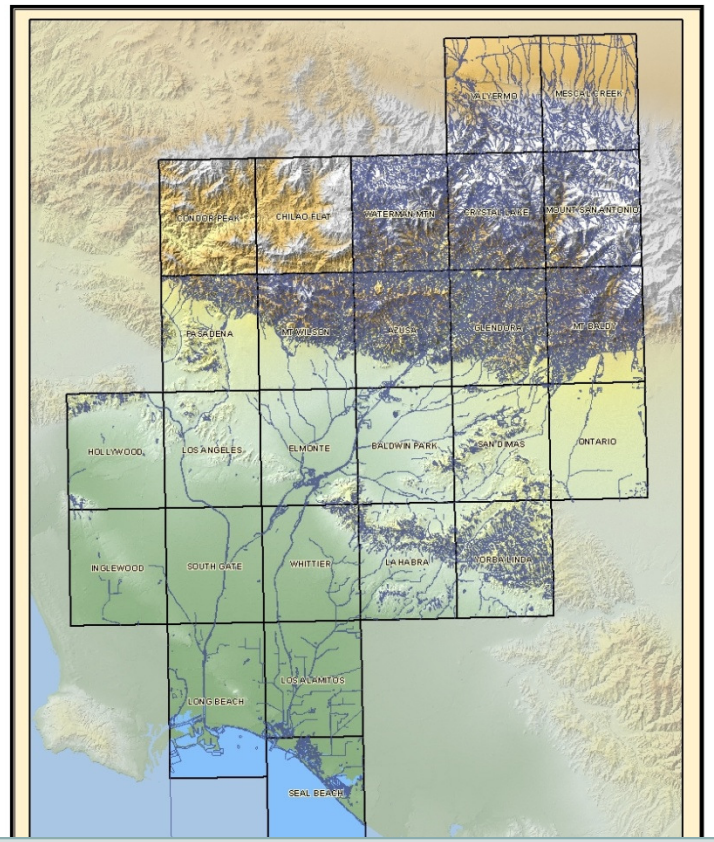
Wetland inventory covers approximately 80% of the State

Inventory is patchwork of base imagery dates (1980s or better) and resolution

Status and Trends assessment is difficult to accomplish statewide

Why Do We Care??





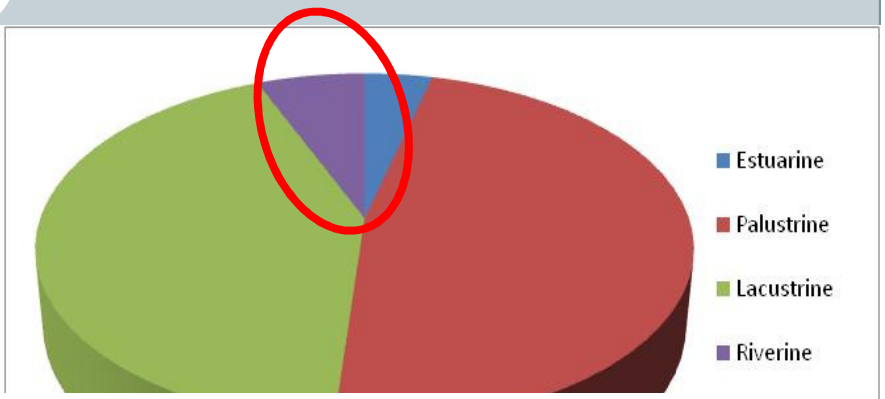
- Maps are the foundation of all monitoring
- Allow us to answer basic questions
- Sample frame for probabilistic sampling

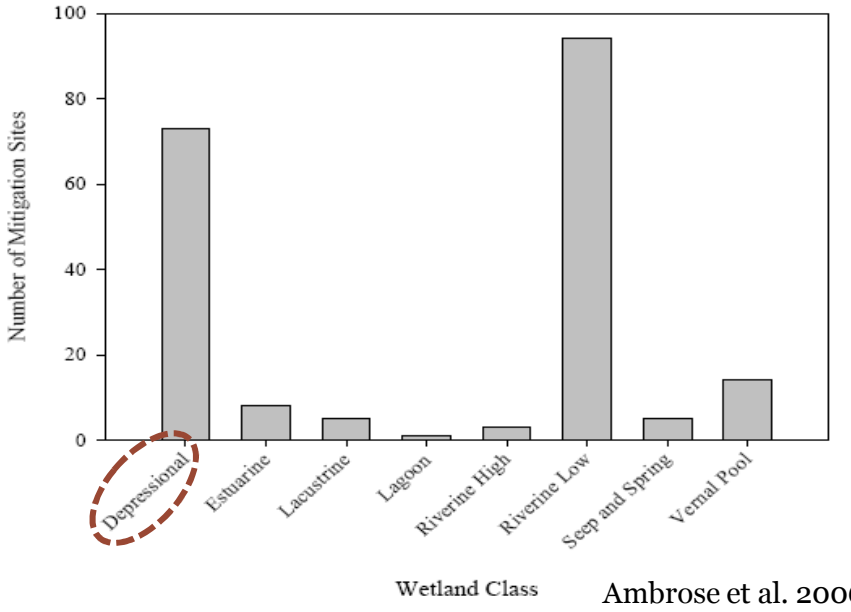
In a Perfect World . . .
We Would Map Everything

- *We do OK for streams….*
- *Not so good for other waterbodies*

- Just map it!!!!
  - Not enough time
  - Not enough money
  - Not agile enough to inform management

What is the alternative?





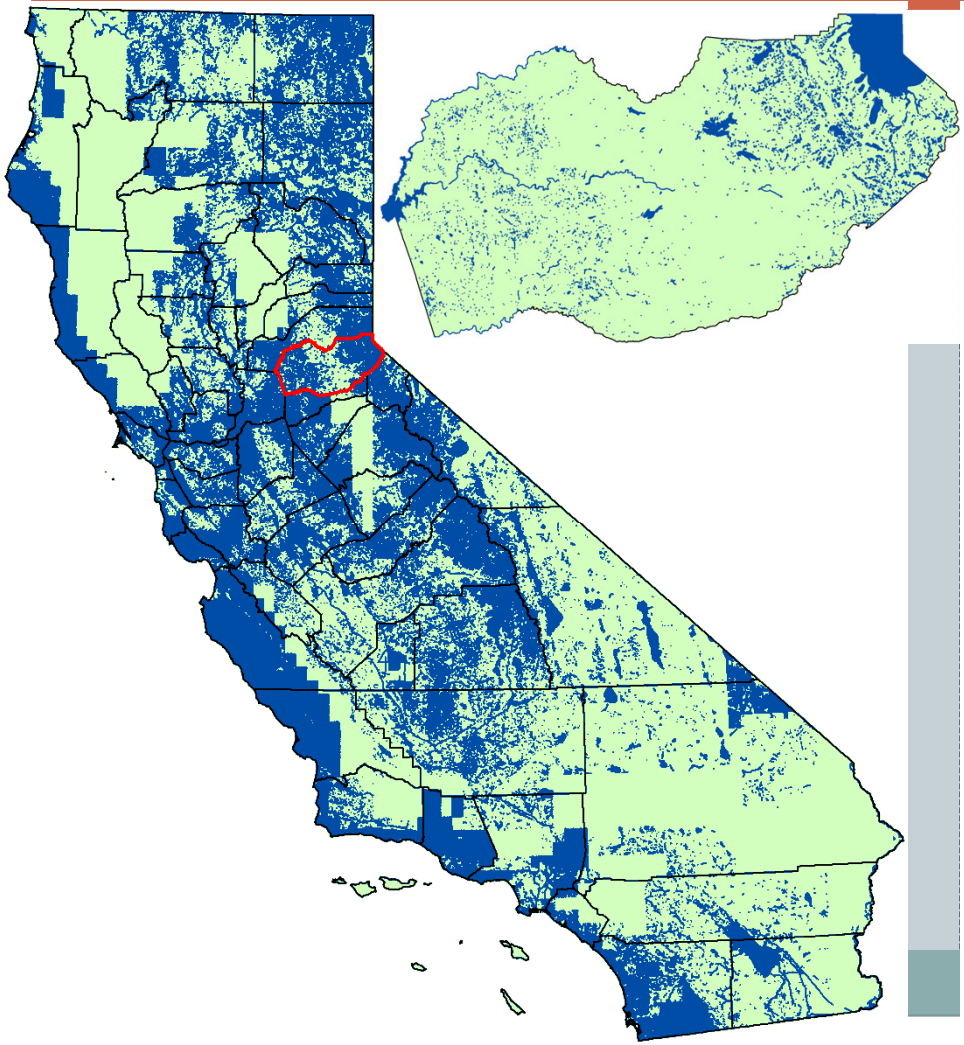
Ambrose et al. 2006

What are the alternatives?

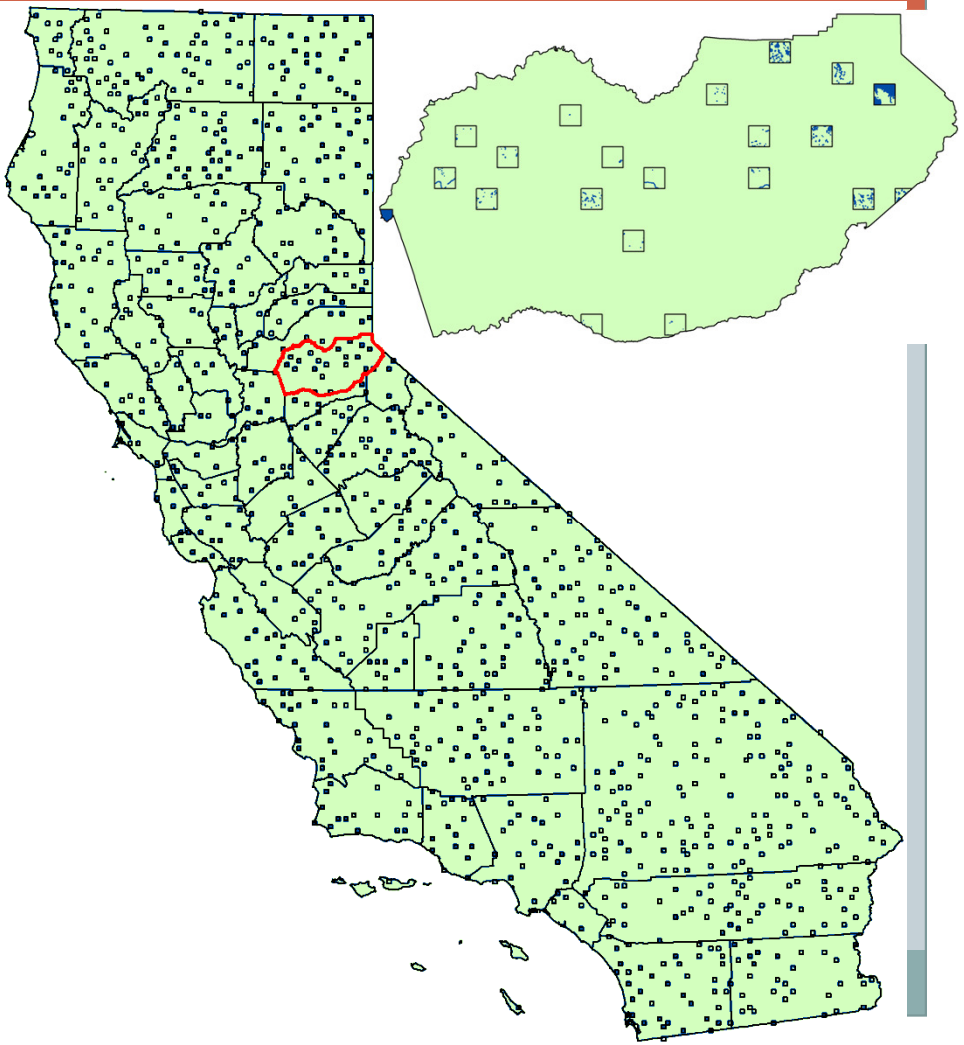
- Accounting of permits and restoration
  - Does not include natural changes, illegal or exempt activities, etc.
  - Requires remote or field validation
- Probability-based sampling
  - Capable of capturing all sources of change
  - Does not result in a comprehensive map
- Both options (and more) should be part of an overall strategy that includes state, regional, and local data

What does a probability-based approach look like?

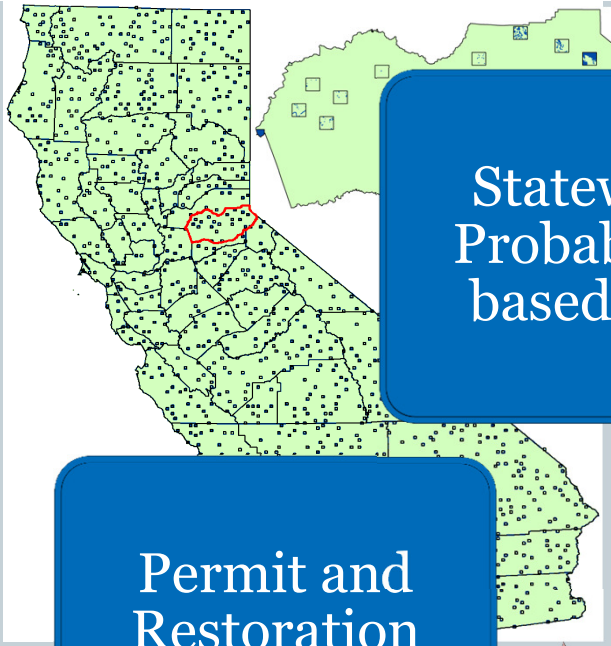
Comprehensive Approach



Probabilistic Approach

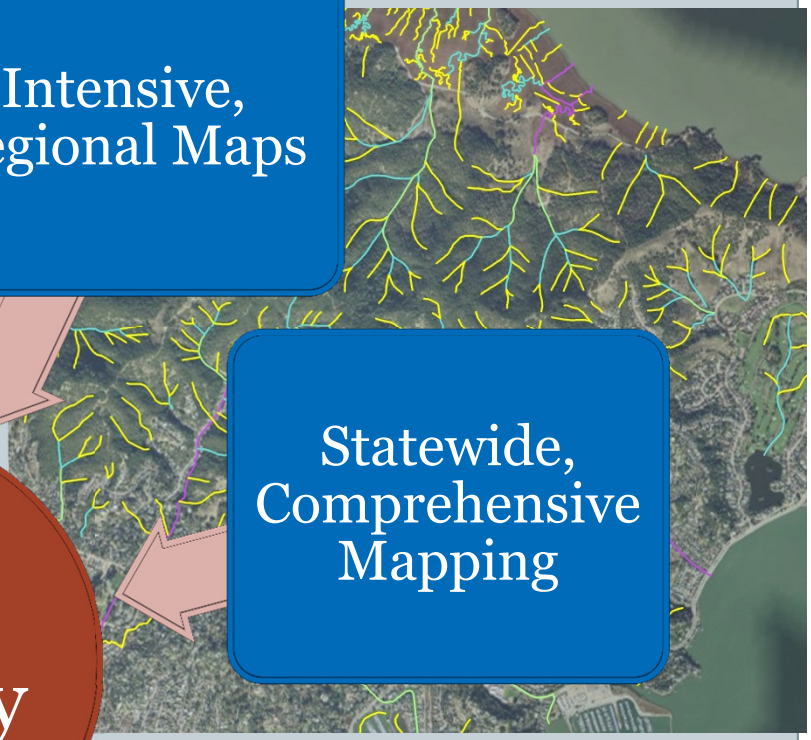


California's Complete Level 1 Strategy



Statewide, Probability-based S&T

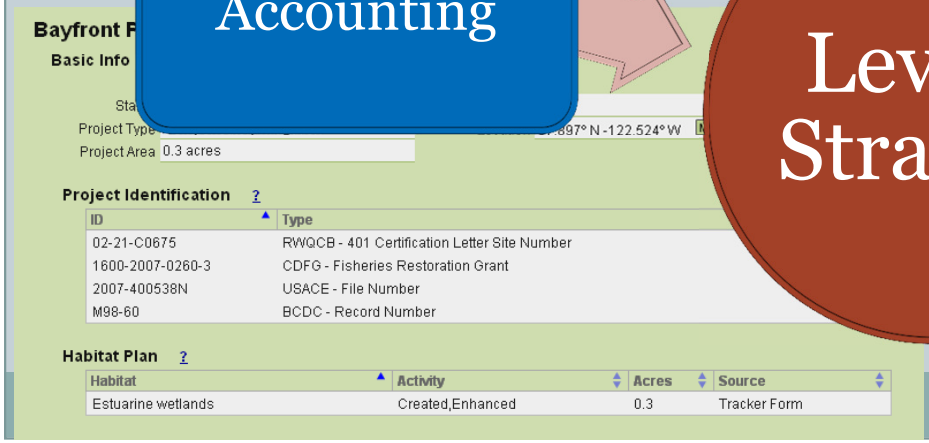
Intensive, Regional Maps



Permit and Restoration Accounting

Statewide, Comprehensive Mapping

Level 1 Strategy



Bayfront F

Basic Info

Project Type

Project Area 0.3 acres

Project Identification ?

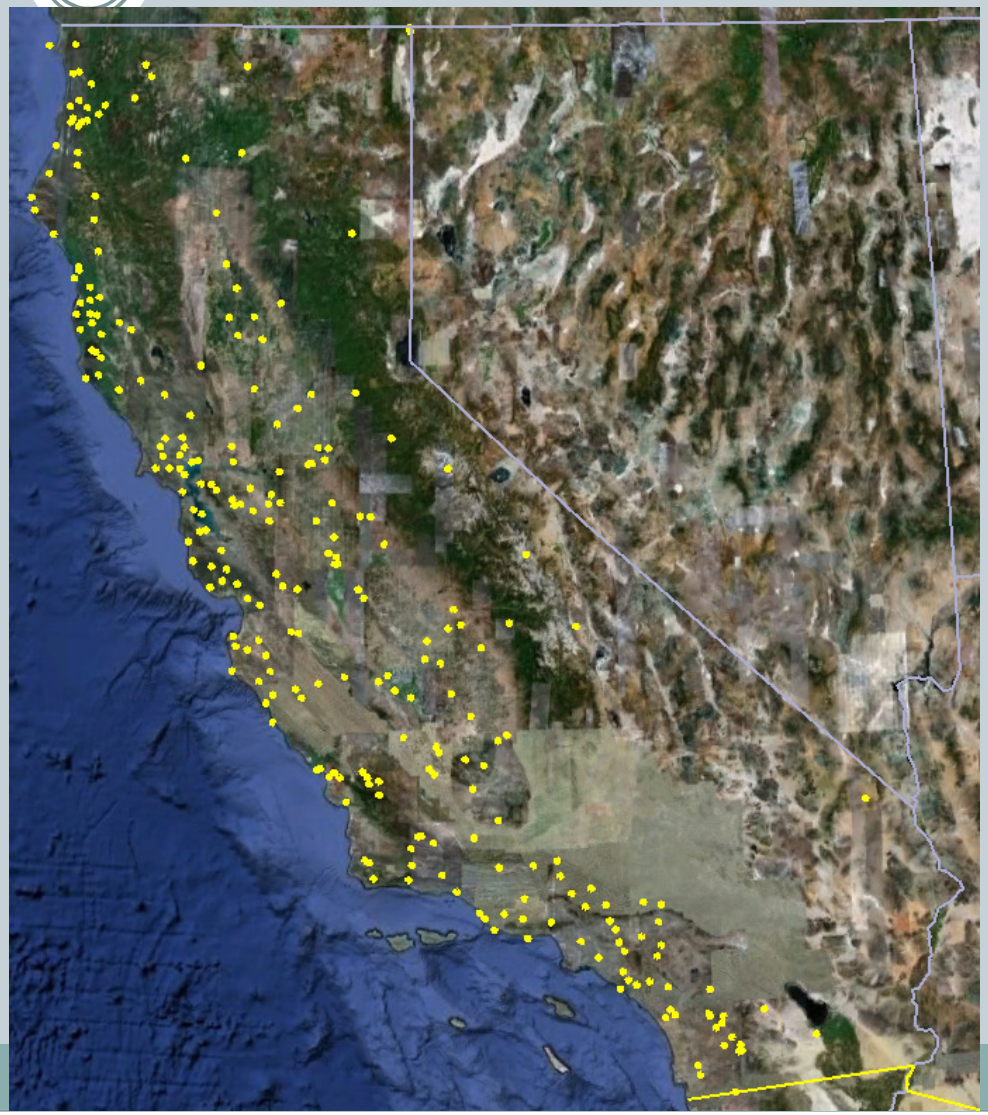
ID	Type
02-21-C0675	RWQCB - 401 Certification Letter Site Number
1600-2007-0260-3	CDFG - Fisheries Restoration Grant
2007-400538N	USACE - File Number
M98-60	BCDC - Record Number

Habitat Plan ?

Habitat	Activity	Acres	Source
Estuarine wetlands	Created,Enhanced	0.3	Tracker Form

NWI-S&T Design: Challenges in California

- National Wetland Inventory, Status and Trends Program
- Plot allocation based on a 1956 study of wetlands used by migratory birds
- Sample biased to coastal region
- Approximately 250 plots
- NEED more comprehensive and representative distribution

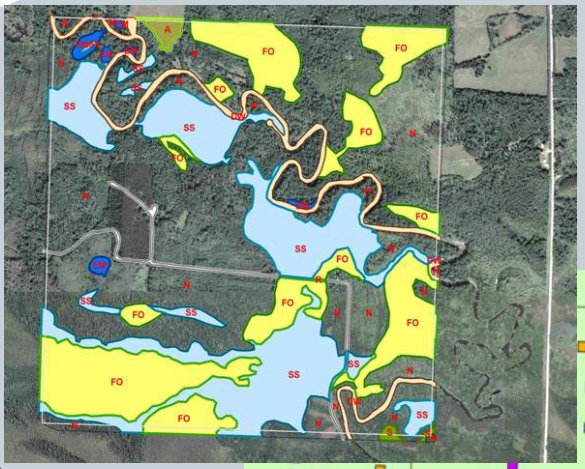


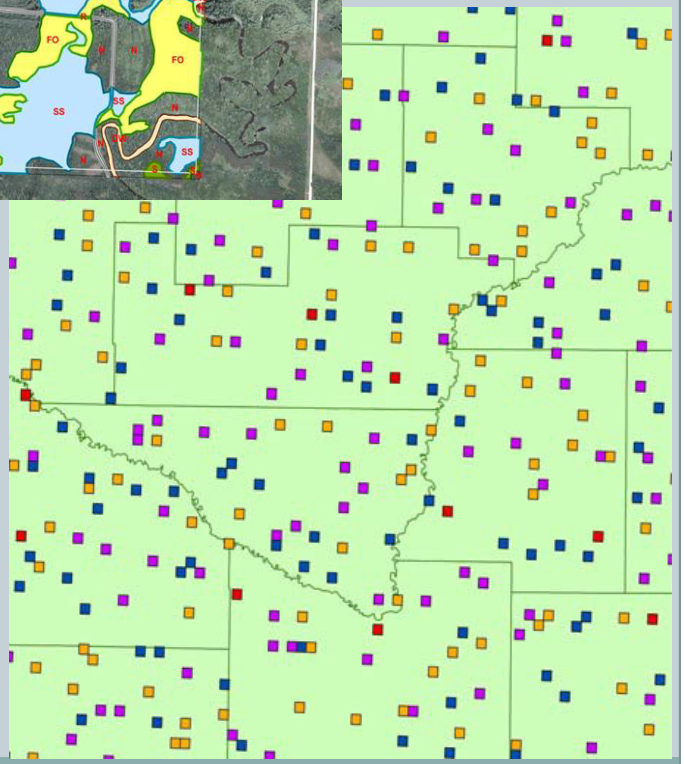
Overall Goals

- Report both status and trends
- Provide accurate information for all aquatic resources (e.g., wetlands, streams, and deepwater habitat)
- Target reporting for every five years, one year ahead of the National Condition Assessment
- Support regional or question-based intensification of sampling and coordination with other agency programs

Designing a Status and Trends Program

1. Review existing programs
2. Test various design options
3. Evaluate rigor vs. costs
4. Provide recommendation to CA Wetland Monitoring Workgroup
5. Test proposed design
6. Compare to traditional mapping
7. *Phase 2 (beginning Oct. 2012):*
   - *Implementation of S&T program*
   - *Developing change assessment methodology*





General Design Features

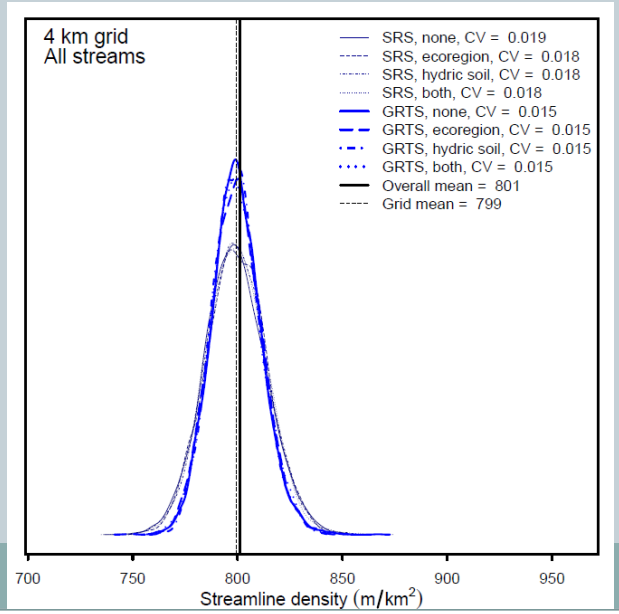
- Use the entire state as a sample frame, not just areas with known aquatic resources
  - Sample locations should be selected from a square grid, placed over the entire State.
- Select a master sample of locations for observation across all of California
  - Allows nesting for local intenstifications
- Map and classify all aquatic resources **and** upland areas within selected plots
  - Use new, "proposed" California wetland classification system
  - Include general upland classifications to support change assessment

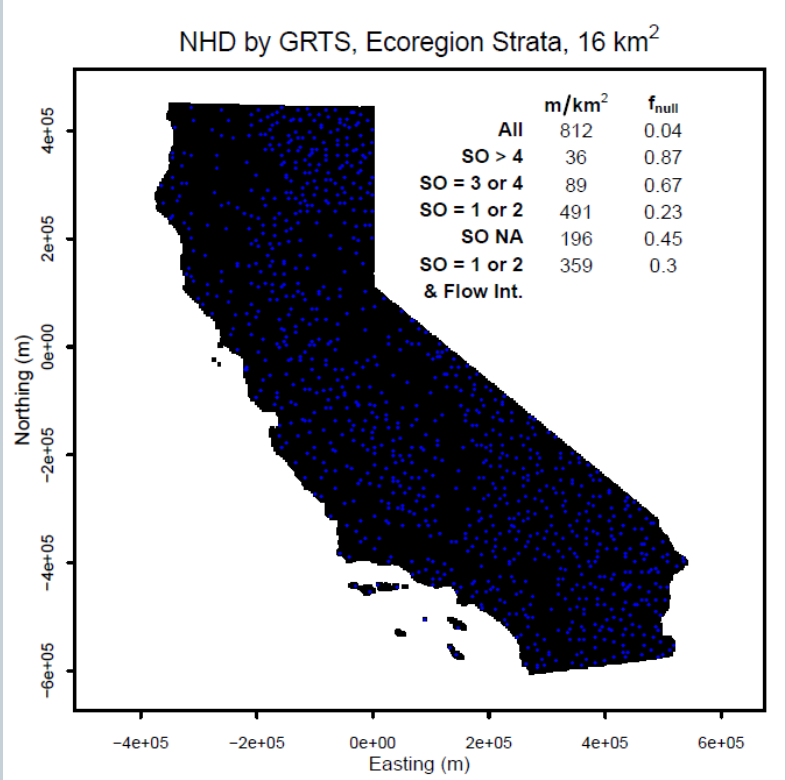
Design Options

- Which sampling method?
  - Simple Random Sampling vs. GRTS
- Whether to stratify?
  - Unstratified
  - Stratify by geography (e.g. Ecoregion)
  - Stratify by soil type
  - Stratify by soil + ecoregion
- What plot size?
  - 1 km^2, 4 km^2, 9 km^2, 16 km^2
- How many plots?
  - Cost analysis with plot size
- Panel design to balance status and trends assessment
  - Fixed plots
  - New plots each cycle
  - Hybrid design

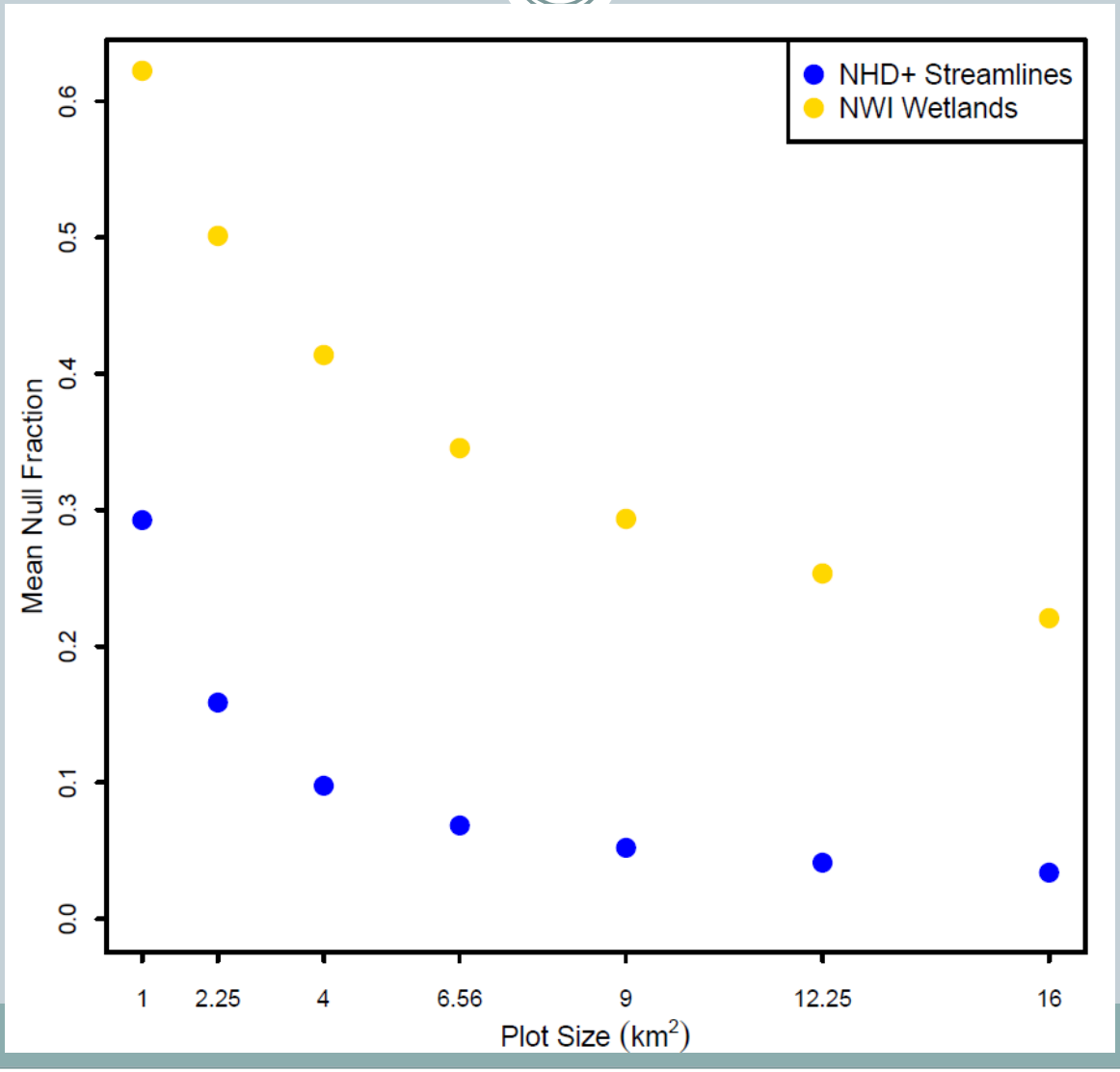
Methodology for Evaluating Design Options

- Source Data: NHD and NWI
- Modeling
  - 5,000 Stochastic Simulations
  - Compare distribution of results





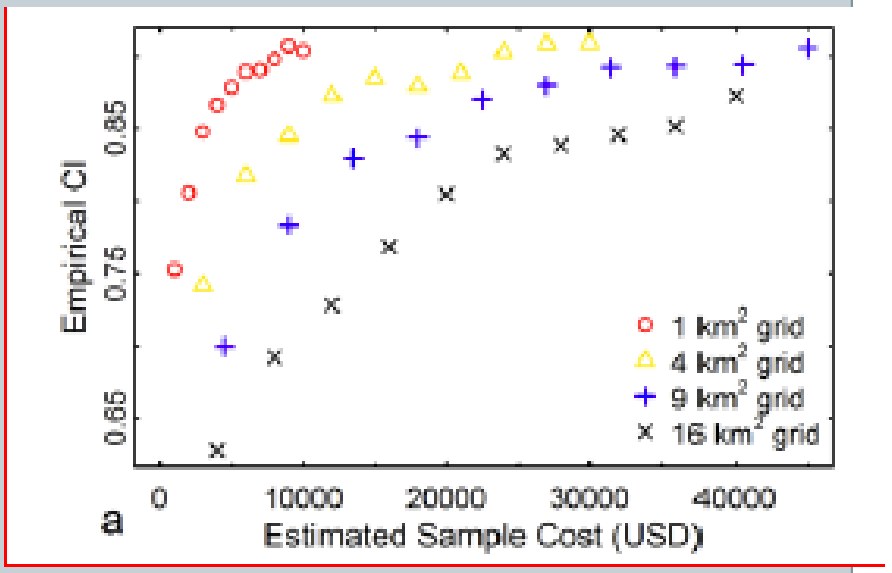
Which plot size?



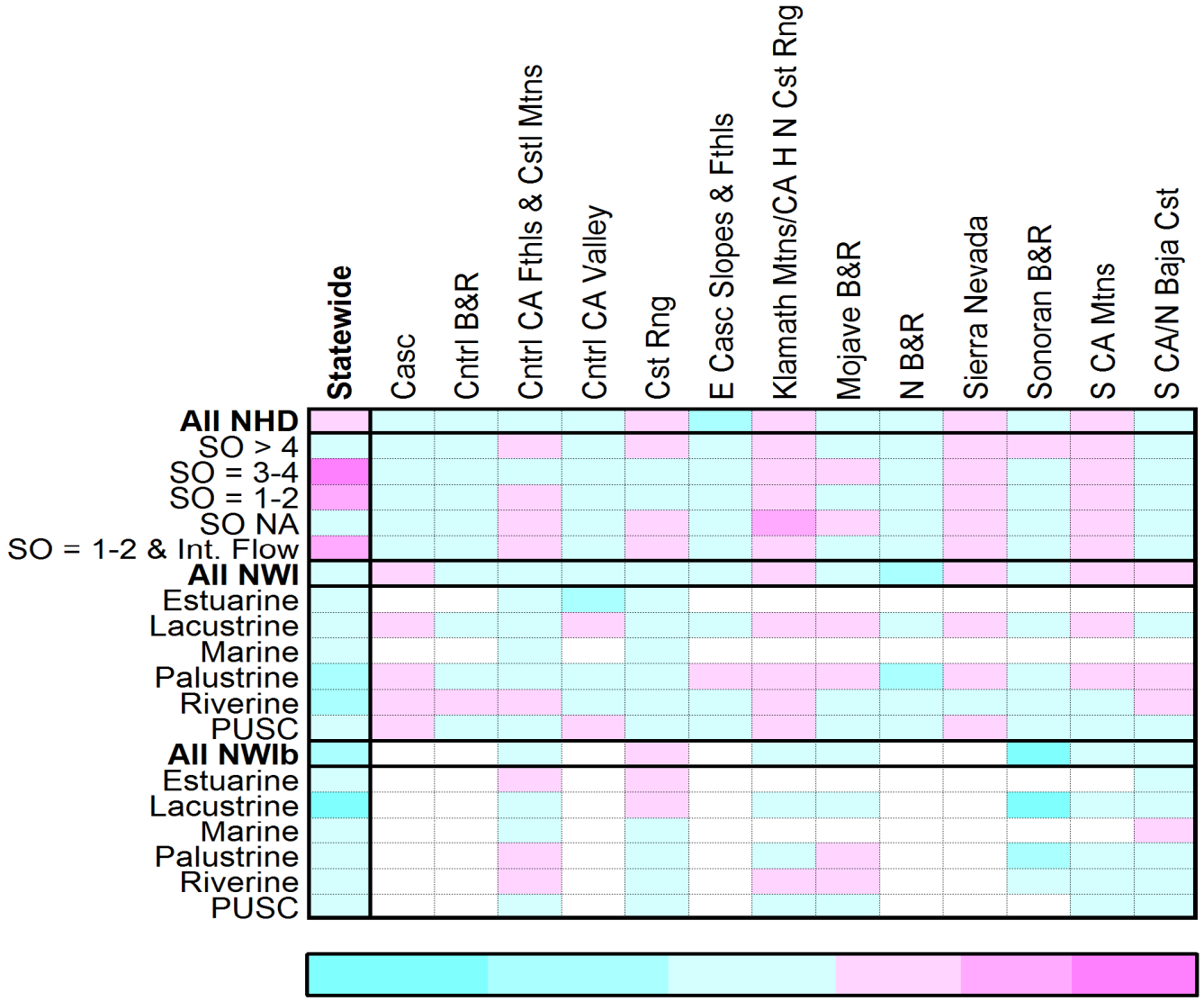
Tradeoffs of Plot Size

- Smaller plots are more cost effective
- Larger plots are more inclusive
- Riverine resources are present in almost every plot
- Other wetland types drop off substantially between 9 km² and 4 km² and even more at 1km²

Recommend 4 km² plot size



Effect of Stratification on Precision



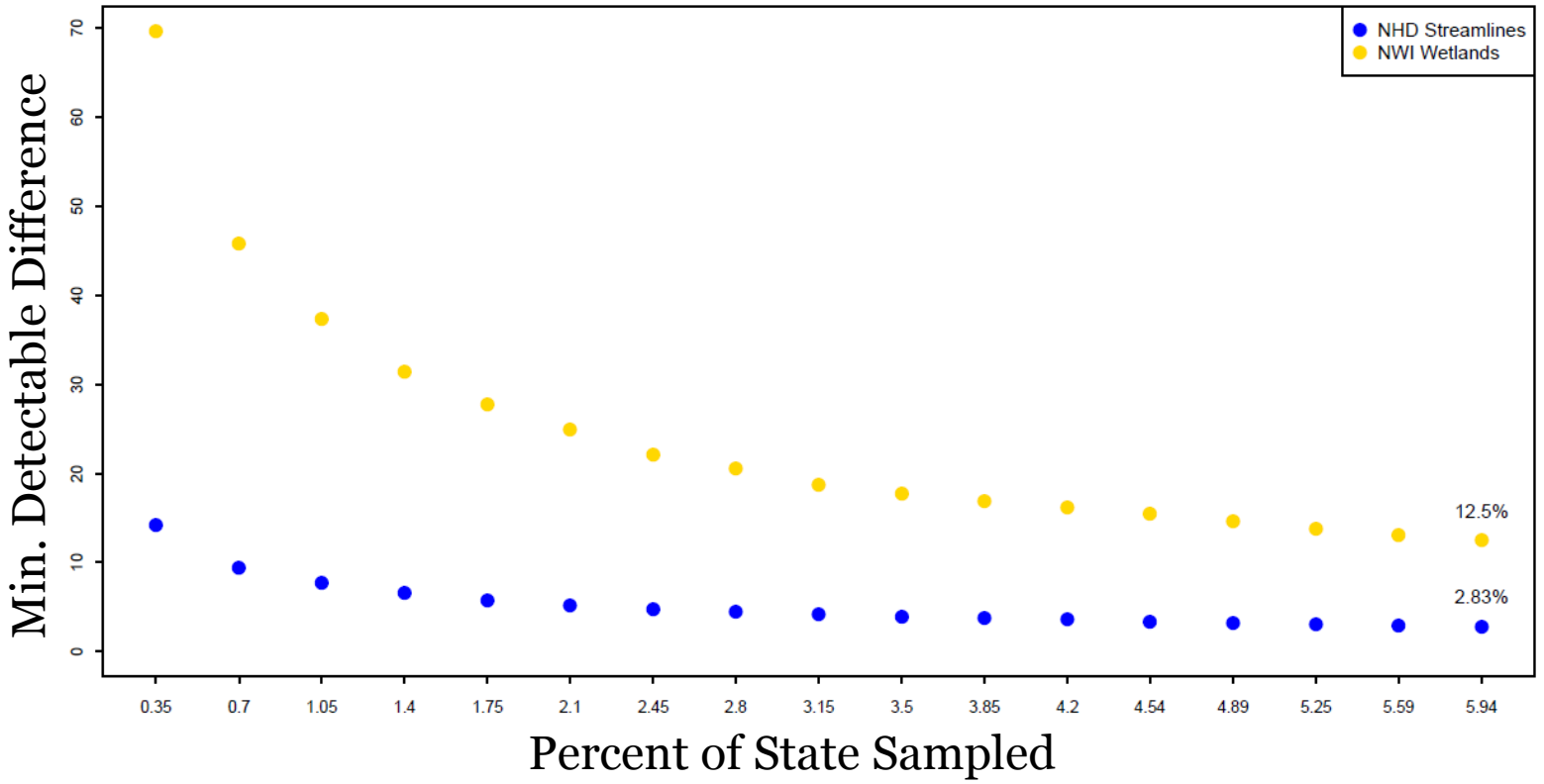
Increasing variance with stratification →

Decreasing precision with stratification →

Strata Tested

- Ecoregion
- Soil type
- Combination

How of Many Plots?

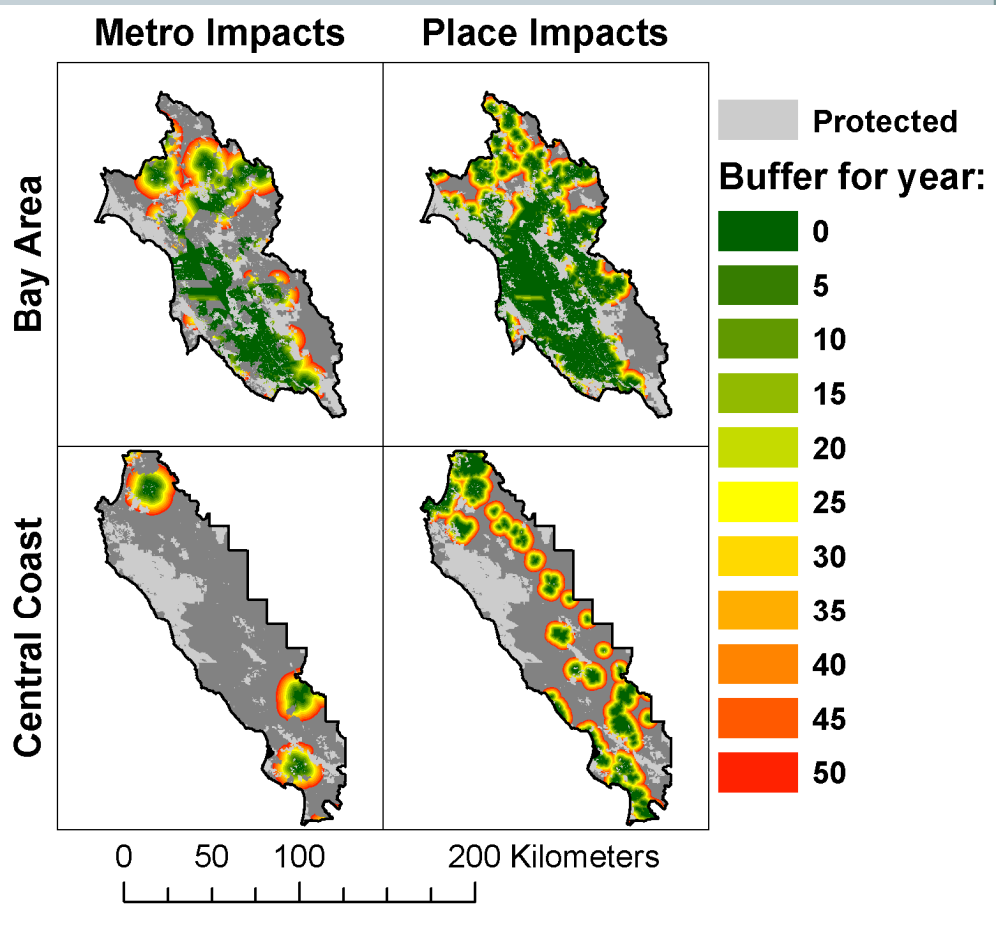


Questions Addressed & Answered

- Which sampling method?
  - GRTS
- Whether to stratify?
  - Unstratified sampling
- What plot size?
  - 4km^2
  - Cost analysis with sample size
- How many plots?
  - 1,000 – 3,000 depending on desired confidence levels

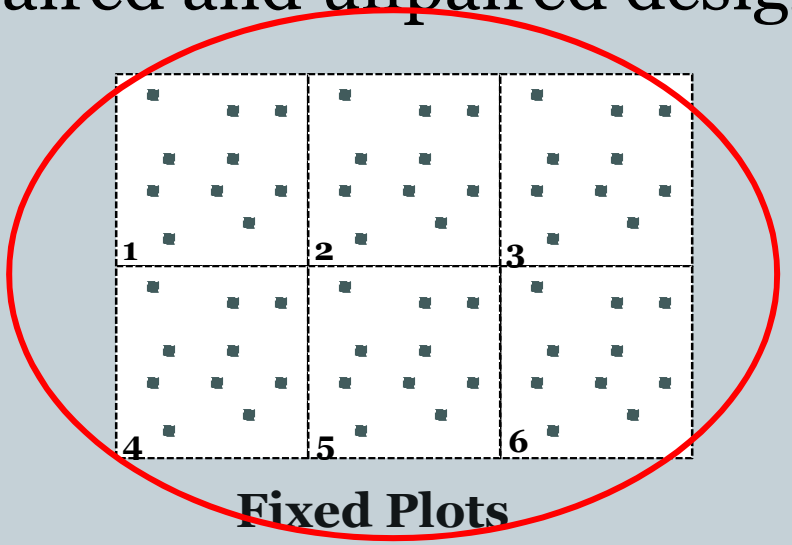
Simulated Wetland Impacts: Trends

- Two growth scenarios
- Two locations
- 50 years
  - 10 x 5 yr increments
- Avoid protected areas
- Assume 50% wetland loss per impact grid

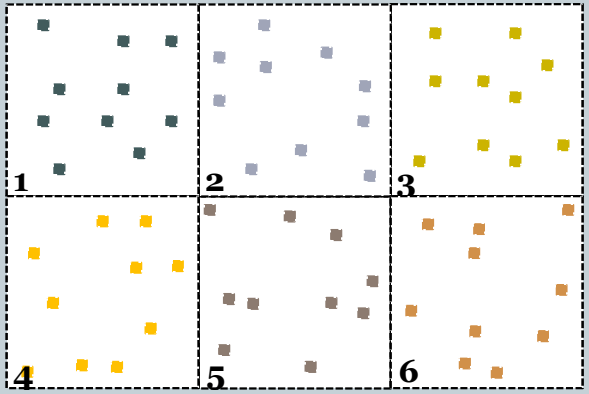


Temporal Observation Strategy

- Paired and unpaired designs

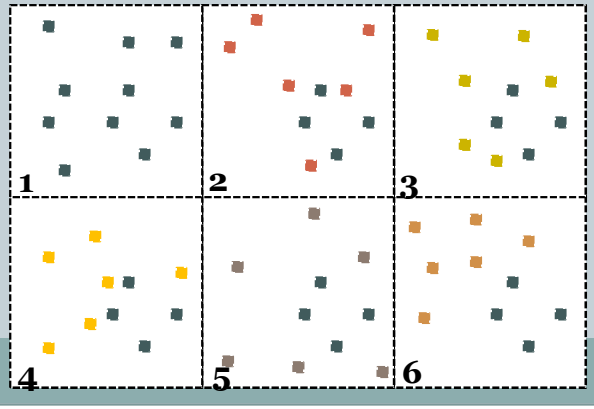


Fixed Plots



Moving Plots

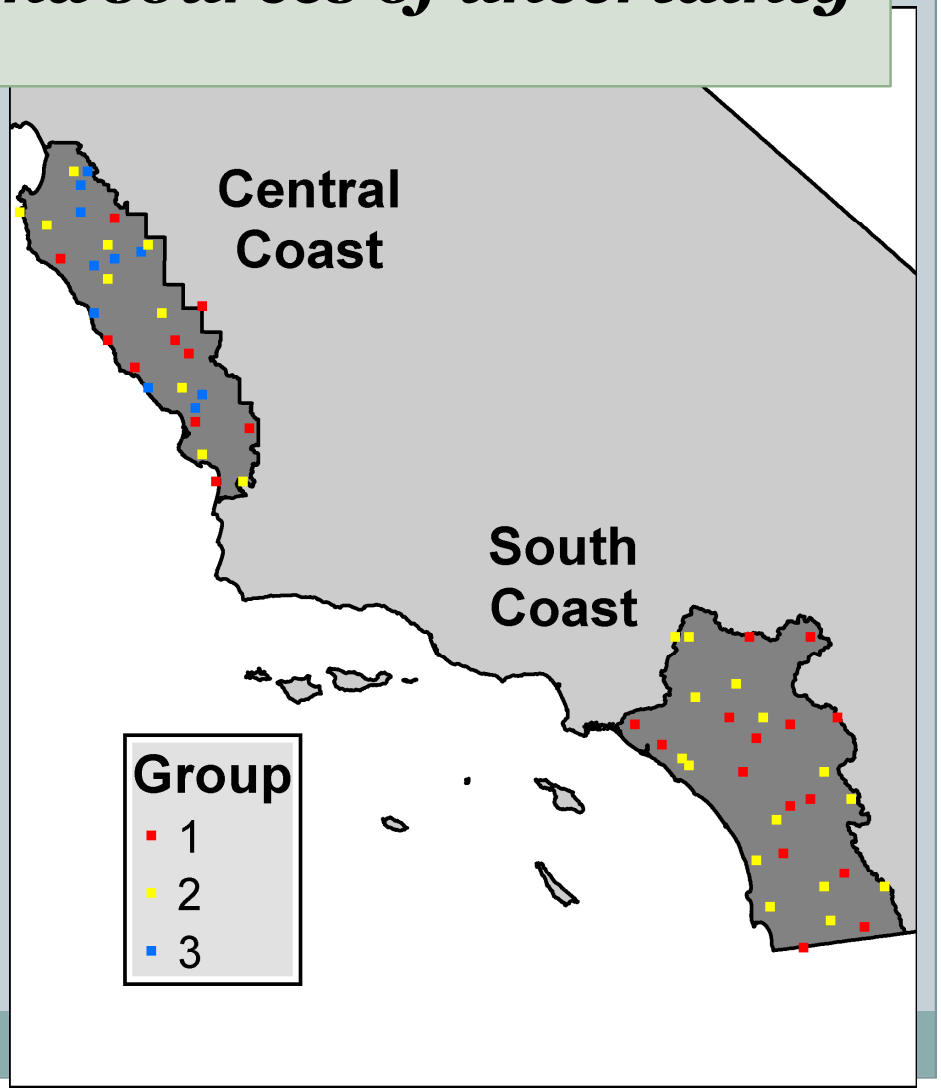
- Hybrid designs



Pilot Testing

Evaluate performance and sources of uncertainty

- Two regions
- GRTS selection
- 30 plots per region
- 16 km² plots (nesting for analysis)
- 2-3 mapping groups per region



Summary: Sources of Uncertainty

Source	Estimated Magnitude
Inter-mapper differences • Multiple groups with calibration	+/- 25%
Methodological differences • buffer rules • SOPs and QA measures can reduce this	+/- 40%
Model estimation •Use GRTS estimator • Increase number of plots used	+/- 30%
Classification •Does not influence total aquatic resource area • Standardize classification system	??

Advantages for California

- Ability to report on wetland, stream, and other water body extent, distribution, and trends
- Sample frame for probabilistic condition analysis for resources where comprehensive mapping is unavailable (e.g. things other than streams)
- Platform for identifying priority areas for intensified investigations of extent or condition

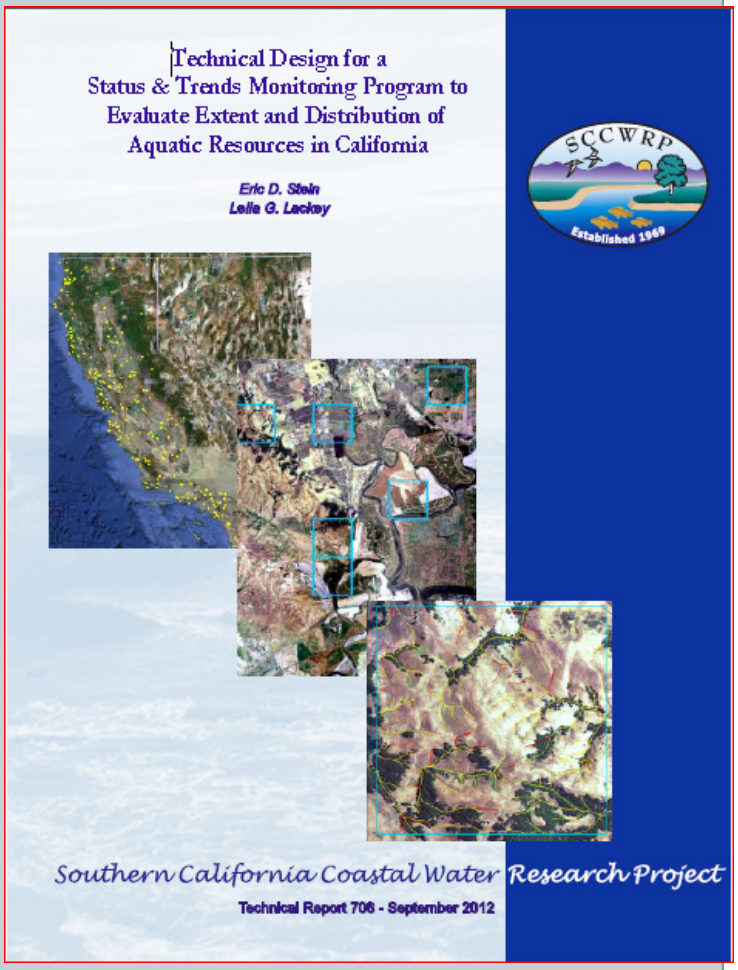
Depressional Wetland Condition Assessment

- **Indicators of condition**
  - CRAM
  - Aquatic invertebrates
  - Algae
- **Indicators of stress**
  - Chemistry and/or toxicity
  - Hydrology and hydroperiod
  - Landscape factors

Next Steps

- CNRA, CDFG, SWRCB to develop implementation recommendations
  - Agency stewardship
  - Funding
- Begin Phase 2 – October 2012
  - Refine change assessment methodology
  - Develop SOPs and data quality objectives
  - Create sample frame for the state
  - First phase implementation (approx. 200 plots)

… Get involved, it's your "map"



http://www.sccwrp.org/Documents/TechnicalReports

QUESTIONS

Eric Stein
erics@sccwrp.org
714-755-3233

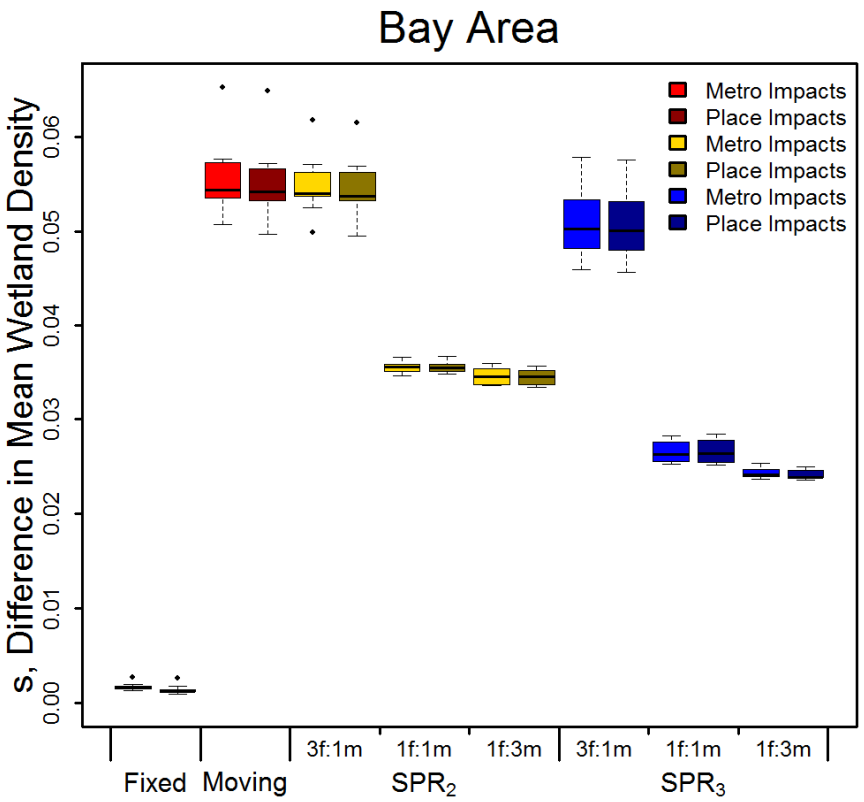
EXTRA SLIDES

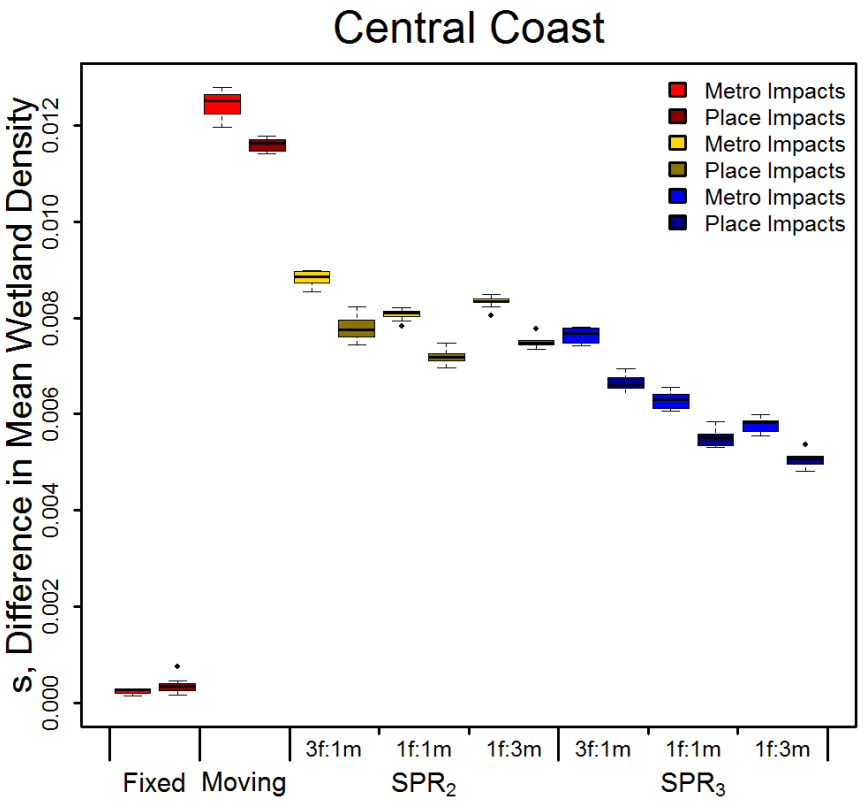
Recap Design Recommendations

- Utilize probabilistic sampling and analysis methods
- Use the entire state as a sample frame
- Do not pre-stratify
- Repeat mapping over time at fixed locations
- Use 4 km^2 plot size

Trends Monitoring

- Fixed sampling locations were substantially more precise than moving locations or SPR
- No method showed substantial bias





Challenges for California

Size and ecological heterogeneity	→	Static locations may not capture spatial variability
Relative scarcity of wetlands (~3% of land area)	→	More focused sample frame may be required
Unique and arid-region wetland types	→	Cowardin-derived classification may not support all types

Results for Plot Size

- Most sample plots contain aquatic resources
- Riverine resources are present in almost every plot
- Other types drop off substantially between 9 and 4 and between 4 and 1

Cost-savings

Central Coast

	16	9	4	1
N	30	29	27	26
Aq Res	30	29	27	26
Dep	20	20	14	5
Est	2	1	1	0
Lac	1	1	1	0
Mar	4	3	0	0
Riv	29	28	27	26
Slo	15	12	8	4

South Coast

	16	9	4	1
N	30	30	30	28
Aq Res	30	29	29	26
Dep	21	21	18	8
Est	0	0	0	0
Lac	3	3	2	2
Mar	0	0	0	0
Riv	30	29	29	26
Slo	11	9	6	3

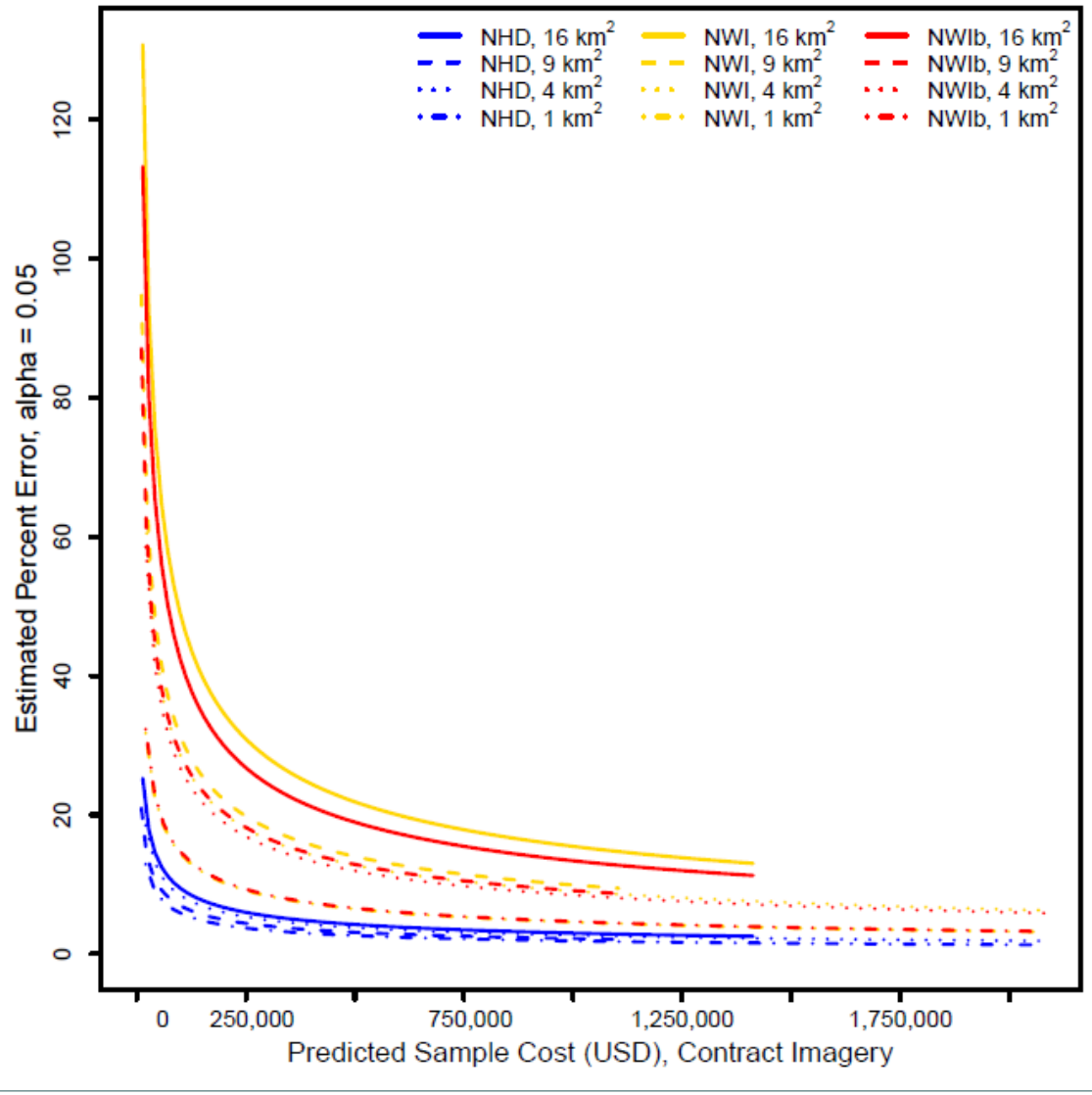
Potential regional issue

What Will it Cost?

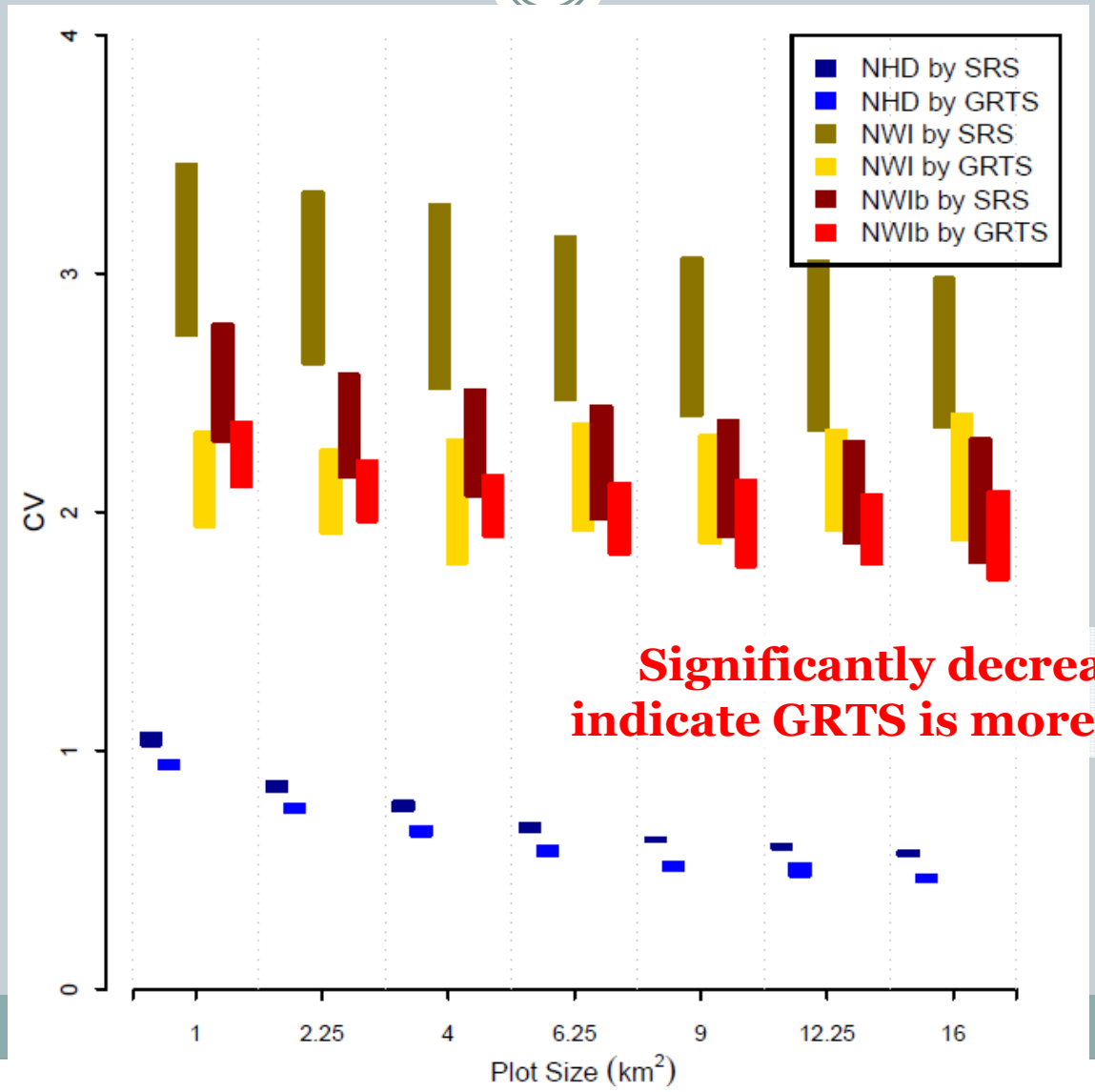
	± 10 error	±15% error
# of plots/cycle	2000	1000
Cost/plot w/NAIP	$100	$100
Cost/plot w/new imagery	$500	$500
Total cost w/NAIP	***$200,000***	$100,000
Total cost w/new imagery	$1,000,000	$500,000

- Assumes 4 km² plot size
- Assumes 95% CI
- Does not include program admin. Costs
- Cost/cycle decline if using fixed plots

Error, Cost and Plot Size

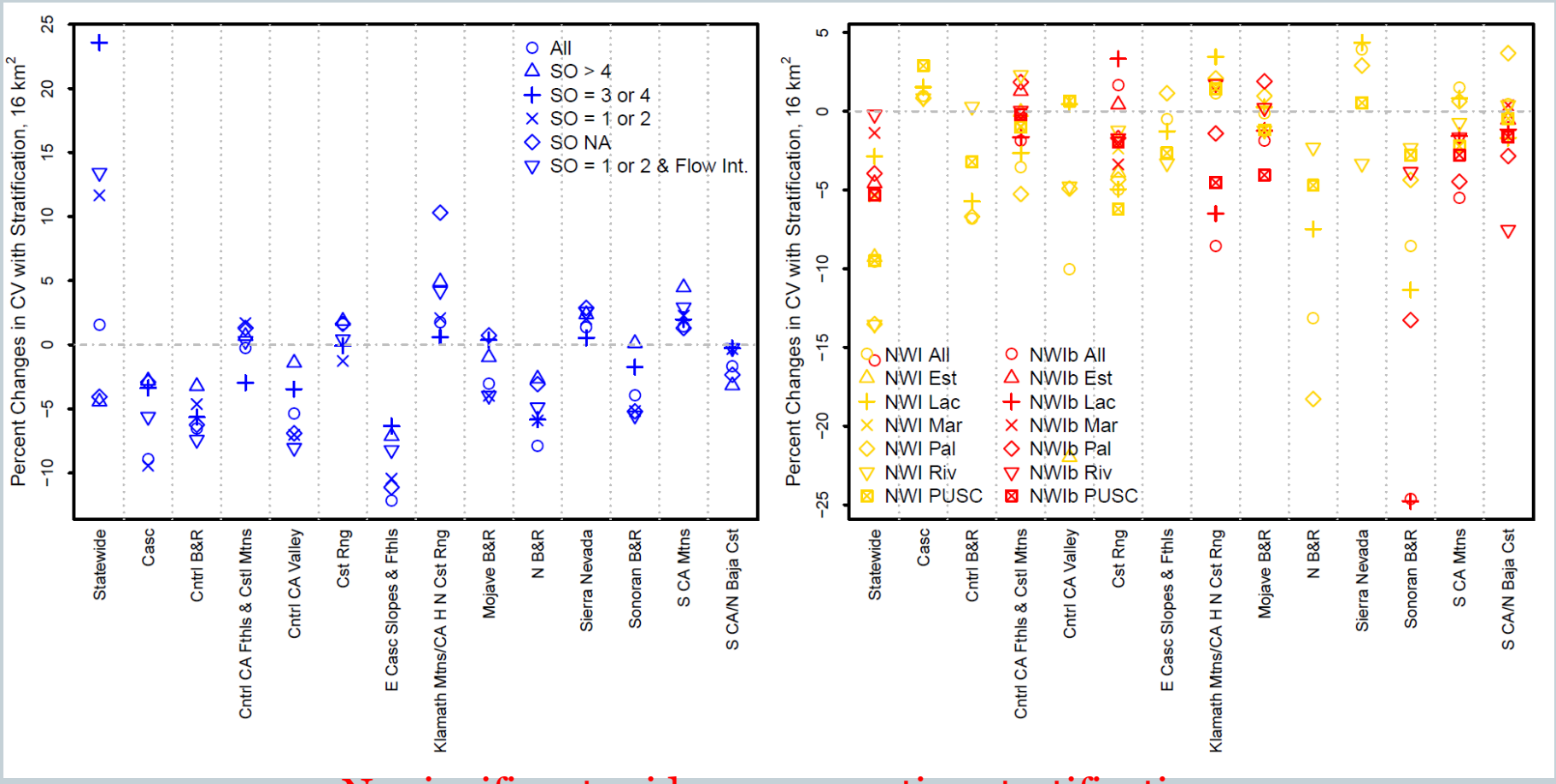


Which sampling method?



Significantly decreased CV values indicate GRTS is more precise than SR

Whether to Stratify?



No significant evidence supporting stratification

Unstratified sampling preserves flexibility for analysis and sampling

Supplemented Panel Design

	t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8	t_9	t_{10}	…
$p_{sup\ p}$	•	•	•	•	•	•	•	•	•	•	…
p_1	•					•					
p_2		•					•				
p_3			•					•			…
p_4				•					•		
p_5					•					•	

Existing Programs

- National Wetland Inventory, Status and Trends Program (NWI-S&T)

  US Fish and Wildlife Service

  http://www.fws.gov/wetlands/StatusAndTrends/index.html
- Natural Resource Inventory (NRI)

  US Department of Agriculture

  http://www.nrcs.usda.gov/technical/NRI/
- Minnesota Wetland Status and Trends Program (MN-S&T)

  Minnesota Department of Natural Resources

  http://www.dnr.state.mn.us/eco/wetlands/wstm_prog.html

Technical Advisory Committee

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- MN-S&T: Steve Kloiber
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