Waterbird Response to Trail Use around San Francisco Bay

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Background to the Research

- Bay Trail Program identified the need to understand trail-wildlife interactions based on public comment.
- Developed research question after literature search & questionnaire to land managers and stakeholders.
- Research question selected:

  Do trail users have a significant impact on bird use of mudflat foraging habitat adjacent to non-motorized trails in the Bay Area?

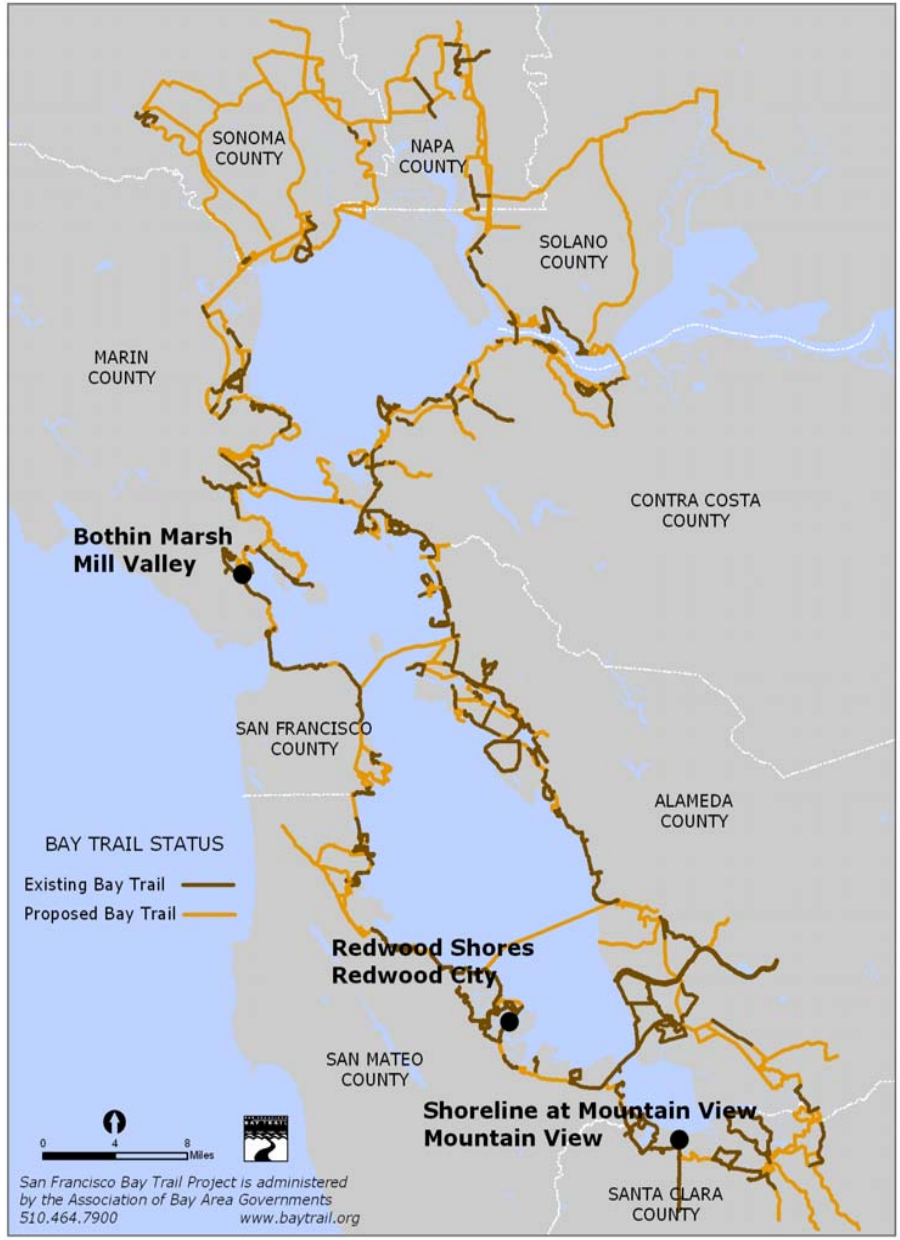
Study Methodology

- Three Locations with Paired Trail and Non-Trail Control Sites
- Set up 100-foot x 100-foot Quadrats (30.5 m^2) at each of the six sites
- Collected data 4 times/month, 2 weekdays and two weekend days, for 24 months (1 July 1999-30 June 2000 & 1 Oct 2000 to 30 Sept 2001)
- Two Observers at each site collected 4 hours of Data during Outgoing Tide
- Collected Data on Number and Type of Trail Users &

  Bird Abundance, Species Richness and Behavior
- Statistical Analyses included t-Tests, ANOVA, MANOVA and Qualitative Analysis

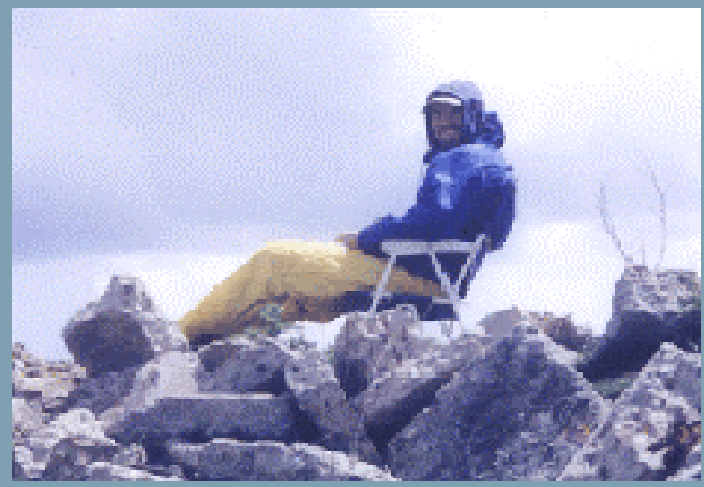
Study Locations

- Bothin Marsh, Marin County
- Redwood Shores, San Mateo County
- Shoreline at Mountain View, Santa Clara County



Study Observers

- 3 Site Supervisors
- 21 Field Observers
- Worked in pairs logging 4,608 hours of field observations resulting in 2,304 hours of data
- Conducted quarterly meetings and trainings to advance team's knowledge



Factors Tested

- Independent variables:
  - Year (2)
  - Season (4)
  - Location (Bothin, Redwood Shores, Shoreline)
  - Site (Control vs. Trail)
  - Day of Week (Weekday versus Weekend day)
- Dependent variables:
  - Bird abundance
  - Species richness
  - Foraging behavior
  - Trail use

Two key analyses

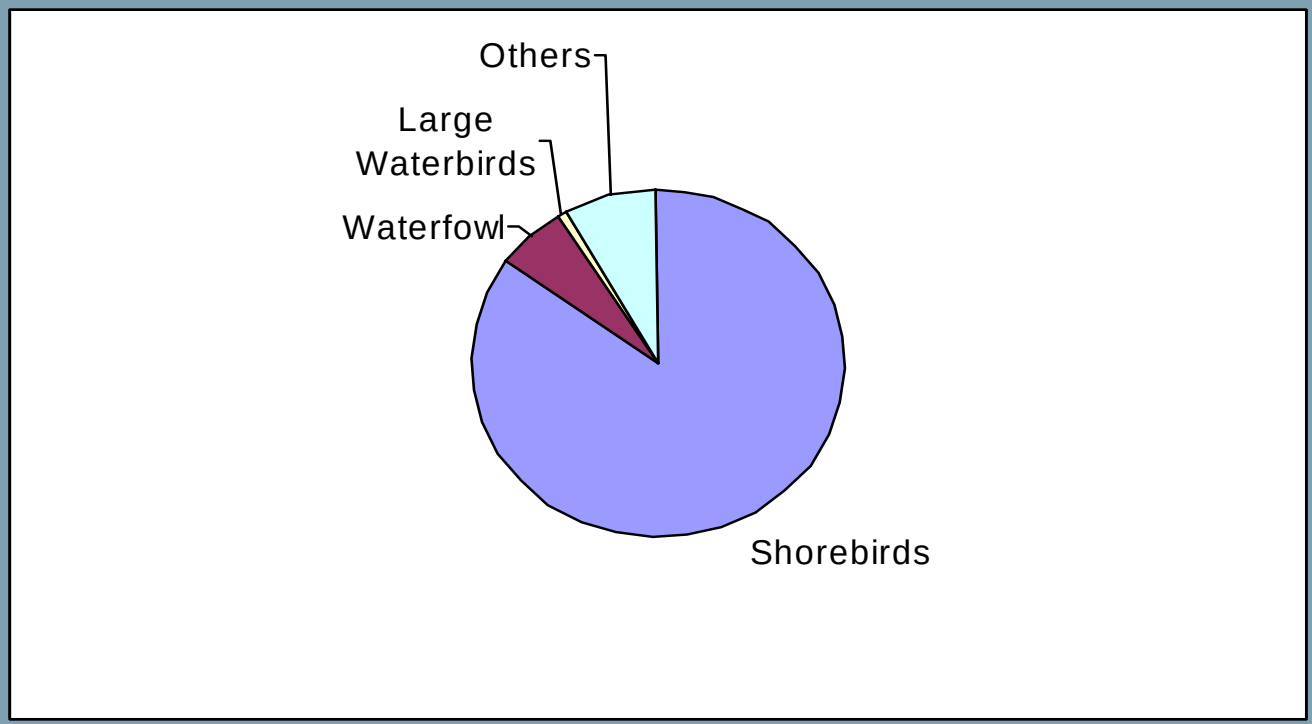
- Is there a significant difference in bird use at Trail versus Control sites?
  - Strengths: Expect very different trail use levels; one site never with many people
  - Weakness: Variations in mud flat quality
- Is there a significant difference in bird use during weekdays versus weekends?
  - Strength: Same plot of mud, limits variation in mud flat quality
  - Weakness: Regular exposure to people

Hypotheses Tested

1. Human trail use does not differ significantly at the by location, site, year, season or day of week.
2. Location, site, year, season, or day of week do not significantly effect bird abundance or species richness. When controlling for these factors, trail use is not a significant factor affecting on bird abundance or species richness.
3. Bird use is not more sensitive to human presence during particular seasons.
4. Trail use does not have a significant impact on bird behavior, especially percent of birds foraging.

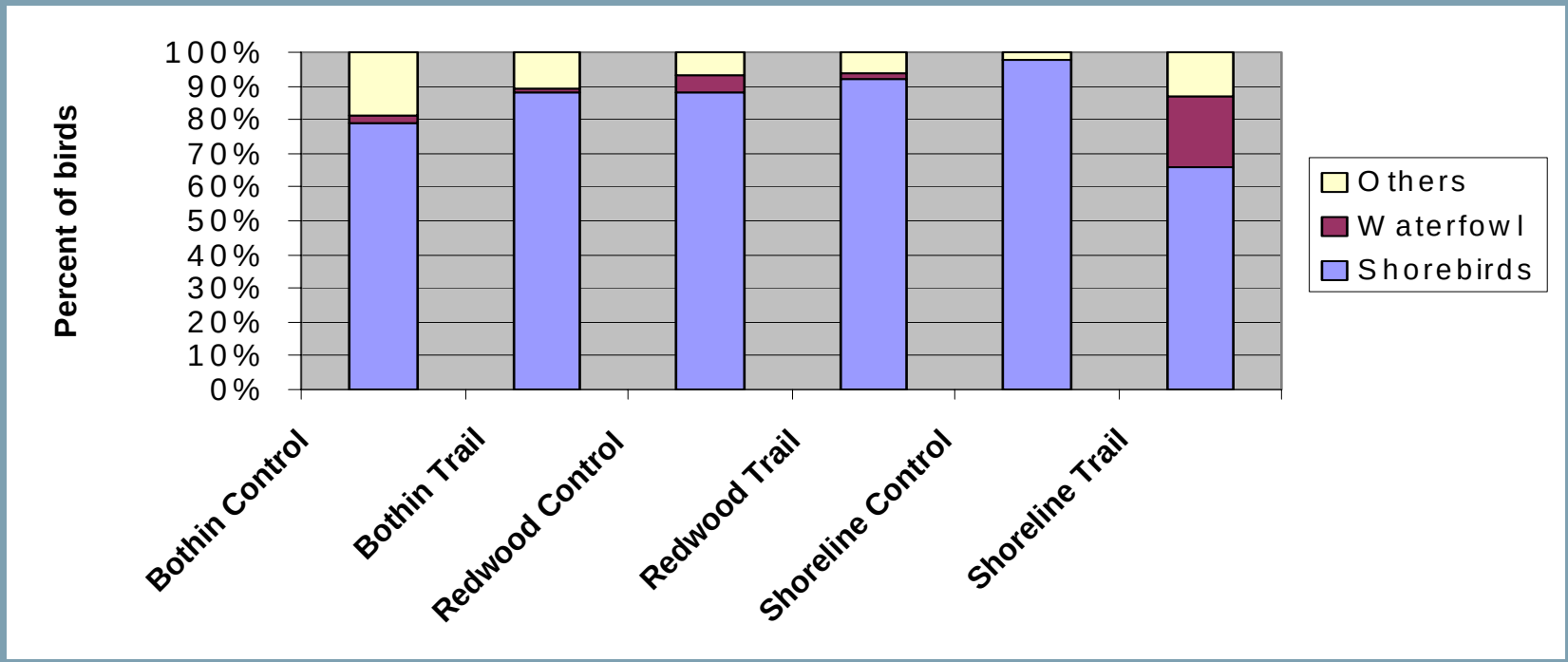
General Bird Use

- Shorebirds: 85%, Waterfowl: 6%, Large Waterbirds: 1%, Others: 8%



General Bird Use

- Sites similar for percent of birds in different guilds, although Shoreline Trail had the greatest numbers of waterfowl.



Hypothesis 1: Trail Use

- Trail use differed significantly between location ($P>0.001$), Trail and Control sites ($P>0.001$), seasons ($P>0.001$), and day of week ($P>0.001$), but not between years ($P=0.106$) (MANOVA: $R^2=0.947$, $n=575$)
- Results allow comparisons at Control/Trail and Weekday/Weekend at Trail sites
- 95% of variation in trail use explained

Hypothesis 2: Factors Affecting Bird Use

- *Bird Abundance:*
  - Significant effects of the three locations (P>0.001) and seasons (P>0.001)
  - Not significantly affected by (P=0.824), Trail versus Control sites (P=0.196), day of week (P=0.928).
  - Trail use was not a significant factor (P=0.172)
  - 47% of variation explained (MANOVA: R^2=0.469, n=575)
- *Species Richness:*
  - Significant effects of location (P>0.001), season (P>0.001), and day of week (P=0.024).
  - Not significantly affected by year (P=0.107), Trail versus Control site (P=0.797)
  - Trail use was not a factor (P=0.489)
  - 46% of variation explained (MANOVA: R^2=0.464, n=575)

Hypothesis 3:
Trail User Effects by Location and Season

- Analyzed by location and season, significant factors in bird use
- Tested differences in bird abundance and species richness at Control vs. Trail
- Tested correlations between Trail User numbers and bird numbers as well as species richness at Trail sites

Hypothesis 3:
Trail User Effects at Trail vs. Control Sites

- Trail Use at Trail vs. Control Sites
  - Bothin: Only one significant difference; Fall Abundance T>C
  - Redwood Shores: Significant differences in Summer and Winter; C>T
  - Shoreline: Significant differences; T>C

Location	Abundance				Species Richness			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Bothin	NS	NS	T>C	NS	NS	NS	NS	NS
Redwood Shores	NS	C>T	NS	C>T	NS	C>T	NS	C>T
Shoreline	NS	NS	NS	T>C	T>C	NS	T>C	T>C

Hypothesis 3:
Trail User Effects at Trail Sites by Season

- No significant correlations between trail user numbers and bird abundance or species richness at any Trail location for any season

Hypothesis 4: Trail User Effects on Bird Behavior

- **Compared percent of birds foraging, standing or moving**
- **Trail vs. Control Foraging:**
  - Bothin - Control=71% vs Trail=82%
  - Redwood – Control=77% vs Trail=84%
  - Shoreline – Control=90% vs Trail=91%
- **Weekday vs. Weekend Foraging:**
  - Bothin - Day=80% vs End=84%
  - Redwood – Day=85% vs Trail=82%
  - Shoreline – Day=91% vs End=91%

Hypothesis 4: Trail User Effects on Bird Behavior

- Compared % of waterfowl foraging at the Bothin and Redwood Shores Trail and Control sites (Shoreline Trail was too different hydrologically to include)
- For the two locations, combined:
  - 61% (962 of 1578 waterfowl) foraged at the Control sites;
  - 40% (171 of 425 waterfowl) foraged at the Trail sites.

The Bottom Line…

- Study sites were dominated by shorebirds. Trail use differed greatly by location, Trail versus Control site and Weekday versus Weekend.
- Trail versus Control sites show no consistent pattern of trail user effect on bird abundance or species richness.
- Bird abundance and species richness did not correlate with trail user numbers at Trail sites.
- No reduction in percent of shorebirds foraging. Waterfowl may show reduced foraging due to trail use.

Why no measured effect of trail use? Relevant Literature

- Few studies have tested effects of trail use on shorebirds
- Many studies show nesting birds are susceptible to human disturbance (Carney and Sydeman 1999)
- Tangential approach disturbs shorebirds less than direct approach (Burger and Gochfeld 1981)
- Rapid movement & loud noises are significant disturbance factors (Rodgers & Schwikert 2002, 2003)
- Large waterbirds respond sooner than small ones (Rodgers & Schwikert 2003)
- Some species of shorebird do not avoid walking paths, tangential to foraging habitat (Klein et al. 1995, Gill et al. 2001)

Relevance to South Bay Salt Pond Restoration Project

- Results from these three study locations indicate that non-motorized trail use, on raised levees, tangential to tidal mudflat habitat does not have a significant overall effect on shorebird numbers, species diversity or percent of birds foraging.
- Results not applicable to nesting or roosting waterbirds, to other waterbird guilds, to individual species, to trails with other configurations, or to trails adjacent to other types of habitat

Caveats…

- Paper is still in review—not yet published.
- Several other analyses remain to be done.
- Results are NOT final—will not be final until publication.

Future Analyses and Studies

- Existing Data:
  - Species-specific analysis
  - Analysis of weekday v. weekend by season

- Future Research:
  - Before and after studies
  - Studies of specific trail uses
  - Studies of waterfowl in foraging habitat
  - Studies of clapper rail response to trail use

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Save those Questions!

Citations

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