

A photograph of a large flock of waterbirds, likely grebes, in a shallow pond. The birds are densely packed in the water, with some visible on the muddy banks. In the background, a large industrial structure, possibly a power plant or refinery, is visible under a clear blue sky. The text "Waterbird Response to Pond Management" is overlaid in large, bold, yellow letters.

Waterbird Response to Pond Management

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In Memoriam

Phillip Hockey (1956-2013)

Director, Percy Fitzpatrick Inst. of African Ornithology, coastal & estuarine birds expert; coastal waders & food resource specialist, South African Bird Atlas author; leader of S. Africa climate change response studies; Coastal Communicator of the Year; Zool. Soc. Of S. Africa -- Public Awareness Medal; 8 Postdocs, 18 PhD, & 33 MS students.

Velasquez, CR and PAR Hockey. 1992. The importance of supratidal foraging habitats [saline ponds] for waders at a south temperate estuary. Ardea 80: 243-253.

Presentation Outline

- Waterbird Management in the SBSP Restoration Project
- **Monitoring Waterbirds for Adaptive Management**
- Lessons from Phase I Water Level Management in SF2
- **Implications for the 50-Year SBSP Restoration Project**



SBSP Restoration Project

-- A Brief Timeline

- 1994: Purchase of North Bay Salt Ponds
- 1995-1999: Bay Area Ecosystem Goals Project
- 1999-2013: USGS Salt Pond Science Support Program
- 2003: Purchase of South Bay Salt Ponds (SBSP)
- 2003-2007: SBSP Programmatic EIS, 50-year Project
- 2004-2008: SBSP Interim Stewardship Plan (ISP)
- 2009-2013: Phase I, SBSP Restoration Project, Year 1-5

SBSP Restoration Project

-- Key Uncertainties

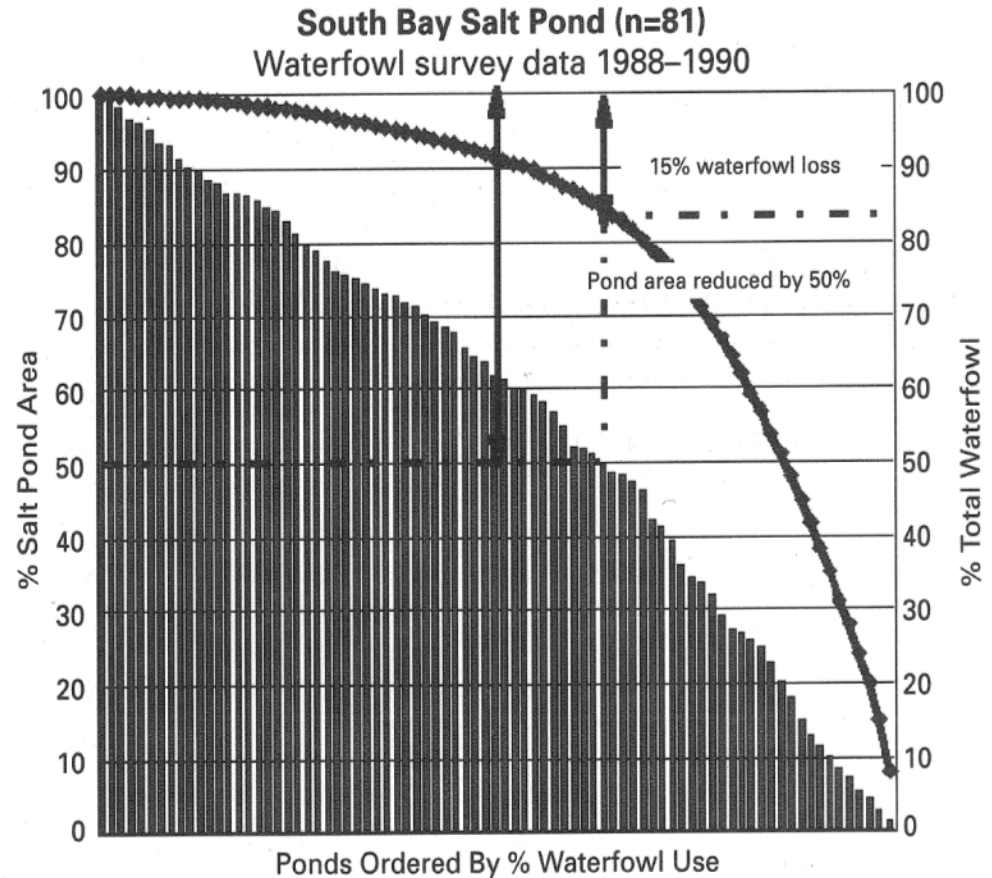
- Sediment dynamics
- **Bird use of changing habitats**
- Effects on non-avian species
- **Mercury**
- Water quality
- **Invasive and nuisance species**
- Public access and wildlife
- **Social dynamics**

Projecting Change in Waterbird Numbers: Pre-SBSP Restoration Project

If 50% of salt ponds are converted, 15% of 76,000 or 11,400 waterfowl may be lost.

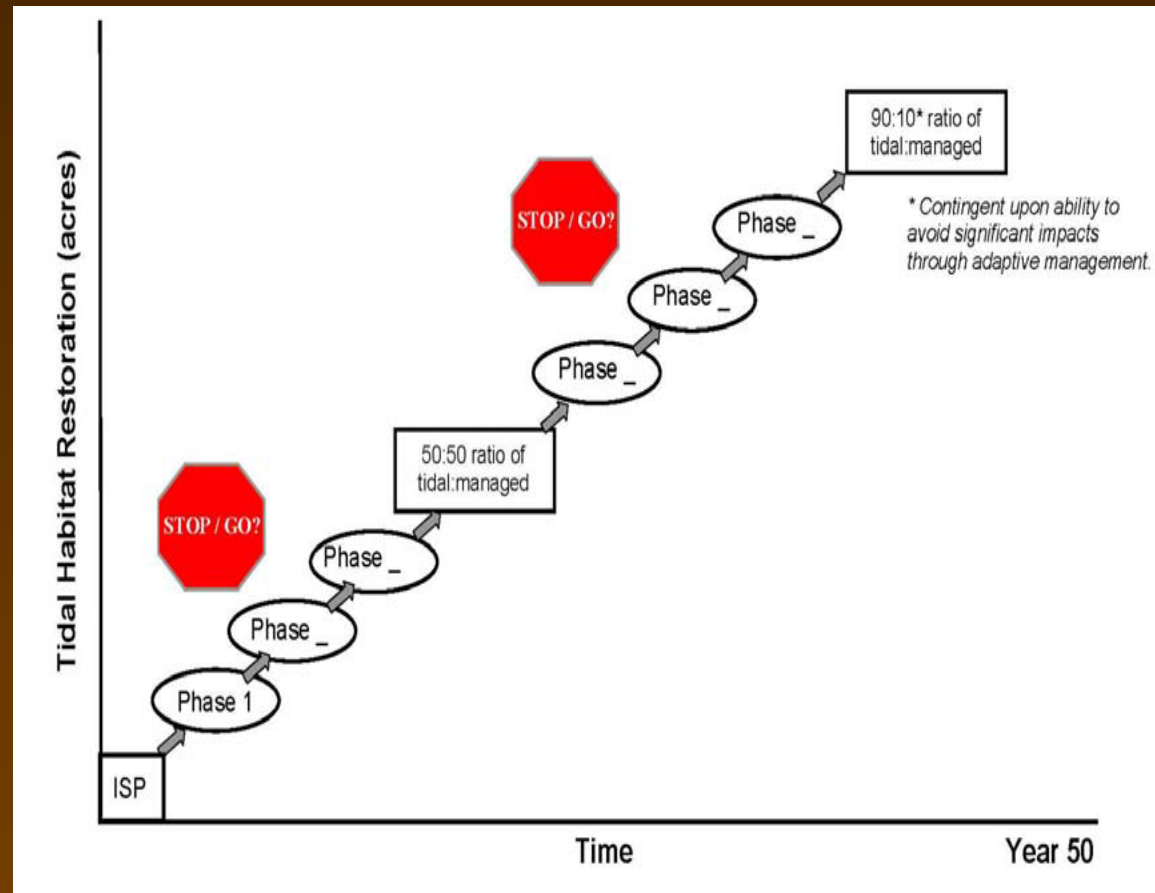
(Goals Project 1999)

FIGURE 2 Waterfowl Use of Salt Ponds in the South Bay Ordered from Most to Least Waterfowl Use.



Adaptive Management and the Staircase Approach

A major SBSP project uncertainty was how to maintain waterbirds with fewer salt ponds while restoring 50-90% to tidal marshes. Waterbird monitoring of project ponds was initiated to support adaptive management decisions.



(Trulio et al. 2007)

Wintering Waterbirds

SBSP Monitoring Survey Total

Wintering Waterbirds, Nov-Feb 2011-2013	
Waterbird Guild	SBSP Total ¹ Number
Small Shorebirds	19,287
Medium Shorebirds	46,020
Dabbling Ducks	62,596
Diving Ducks	47,380
Gulls	2,398
Hérons	6,894
Terns	349
Piscivores	337
Total	185,261
Number of Species	69

¹ Wintering waterbird monthly means for all project ponds Nov-Feb, 2011-2013

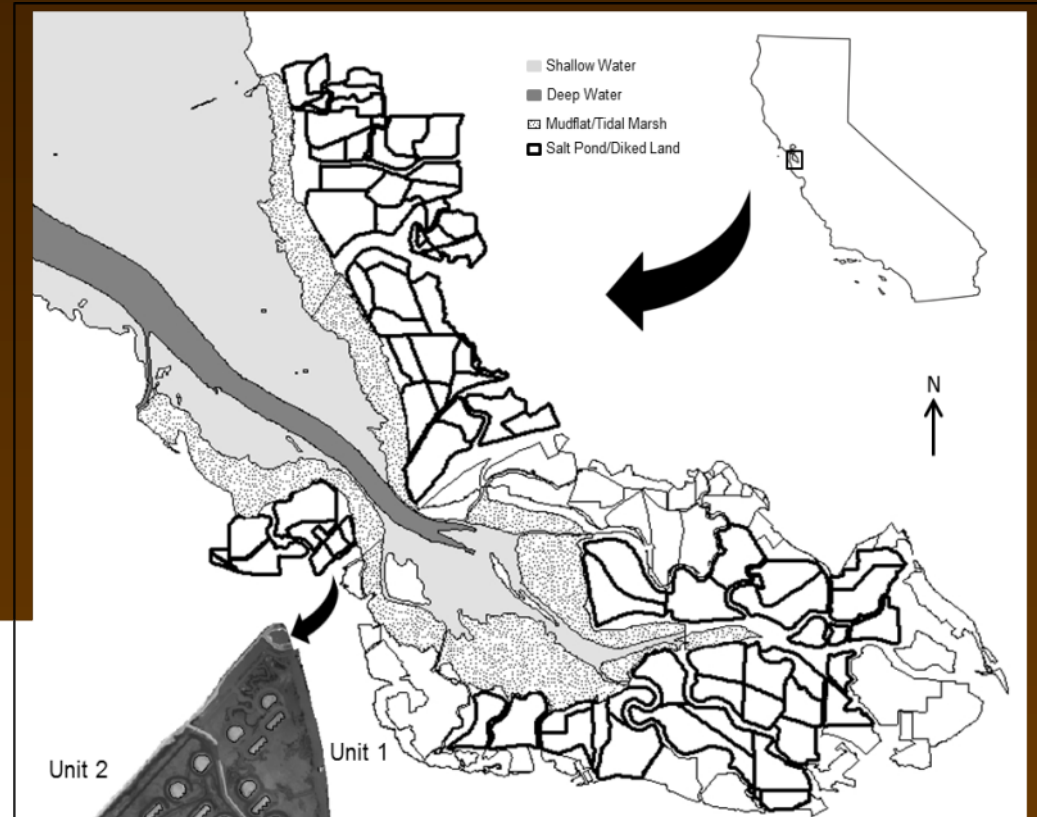
SBSP Restoration Project Phase I (2009-2013)

Managed Pond SF2

Size: 97 ha

Construction cost: \$9.2 M

Infrastructure: islands, weirs



Wintering Waterbirds

SBSP Monitoring Survey Total

Wintering Waterbirds, Nov-Feb 2011-2013			
Waterbird Guild	SBSP Total ¹	Pond SF2	
	Number	Number	%
Small Shorebirds	19,287	1,237	6.4
Medium Shorebirds	46,020	710	1.5
Dabbling Ducks	62,596	380	0.6
Diving Ducks	47,380	302	0.6
Gulls	2,398	28	1.1
Hérons	6,894	26	0.4
Terns	349	25	7.2
Piscivores	337	12	3.6
Total	185,261	2,720	1.5
Number of Species	69	43	

¹ Wintering waterbird monthly means for all project ponds Nov-Feb, 2011-2013

Wintering Waterbirds

SBSP Monitoring Survey Total

Wintering Waterbirds, Nov-Feb 2011-2013					
Waterbird Guild	SBSP Total ¹	Pond SF2		50% Restored ²	
	Number	Number	%	Number	%
Small Shorebirds	19,287	1,237	6.4	66,260	+244
Medium Shorebirds	46,020	710	1.5	38,050	-17
Dabbling Ducks	62,596	380	0.6	20,380	-67
Diving Ducks	47,380	302	0.6	16,200	-66
Gulls	2,398	28	1.1	1,500	-37
Hérons	6,894	26	0.4	1,400	-80
Terns	349	25	7.2	1,340	+284
Piscivores	337	12	3.6	620	+84
Total	185,261	2,720	1.5	145,750	-21
Number of Species	69	43		?	

¹ Wintering waterbird monthly means for all project ponds Nov-Feb, 2011-2013

² Salt pond conversion 50% tidal marsh, 3,036 ha ponds

Wintering Waterbirds

SBSP Monitoring Survey Total

Waterbird Guild	Wintering Waterbirds, Nov-Feb 2011-2013						
	SBSP Total ¹	Pond SF2		50% Restored ²		90% Restored ³	
	Number	Number	%	Number	%	Number	%
Small Shorebirds	19,287	1,237	6.4	66,260	+244	14,130	-27
Medium Shorebirds	46,020	710	1.5	38,050	-17	8,120	-82
Dabbling Ducks	62,596	380	0.6	20,380	-67	4,350	-93
Diving Ducks	47,380	302	0.6	16,200	-66	3,460	-93
Gulls	2,398	28	1.1	1,500	-37	320	-87
Hérons	6,894	26	0.4	1,400	-80	300	-96
Terns	349	25	7.2	1,340	+284	290	-17
Piscivores	337	12	3.6	620	+84	130	-61
Total	185,261	2,720	1.5	145,750	-21	31,100	-83
Number of Species	69	43		?		?	

¹ Wintering waterbird monthly means for all project ponds Nov-Feb, 2011-2013

² Salt pond conversion 50% tidal marsh, 3,036 ha ponds

³ Salt pond conversion 90% tidal marsh, 648 ha ponds

Spring Waterbirds

SBSP Monitoring Survey Total

Spring Waterbirds, Mar-May 2011-2013	
Waterbird Guild	SBSP Total ¹ Number
Small Shorebirds	66,055
Medium Shorebirds	9,180
Dabbling Ducks	20,122
Diving Ducks	16,064
Gulls	9,812
Hérons	247
Terns	603
Piscivores	1,231
Total	123,314
Number of Species	66

¹ Spring waterbird monthly means for all project ponds Mar-May, 2011-2013

Spring Waterbirds

SBSP Monitoring Survey Total

Spring Waterbirds, Mar-May 2011-2013			
Waterbird Guild	SBSP Total ¹	Pond SF2	
	Number	Number	%
Small Shorebirds	66,055	5,931	9.0
Medium Shorebirds	9,180	842	9.2
Dabbling Ducks	20,122	175	0.9
Diving Ducks	16,064	124	0.8
Gulls	9,812	46	0.5
Hérons	247	33	13.4
Terns	603	27	4.5
Piscivores	1,231	24	1.9
Total	123,314	7,202	5.8
Number of Species	66	38	

¹ Spring waterbird monthly means for all project ponds Mar-May, 2011-2013

Spring Waterbirds

SBSP Monitoring Survey Total

Waterbird Guild	Spring Waterbirds, Mar-May 2011-2013				
	SBSP Total ¹	Pond SF2		50% Restored ²	
	Number	Number	%	Number	%
Small Shorebirds	66,055	5,931	9.0	317,730	+381
Medium Shorebirds	9,180	842	9.2	45,090	+391
Dabbling Ducks	20,122	175	0.9	9,380	-53
Diving Ducks	16,064	124	0.8	6,640	-59
Gulls	9,812	46	0.5	2,460	-75
Hérons	247	33	13.4	1,740	+604
Terns	603	27	4.5	1,430	+137
Piscivores	1,231	24	1.9	1,260	+2
Total	123,314	7,202	5.8	385,730	+213
Number of Species	66	38		?	

¹ Spring waterbird monthly means for all project ponds Mar-May, 2011-2013

² Salt pond conversion 50% tidal marsh, 3,036 ha ponds

Spring Waterbirds

SBSP Monitoring Survey Total

Waterbird Guild	Spring Waterbirds, Mar-May 2011-2013						
	SBSP Total ¹	Pond SF2		50% Restored ²		90% Restored ³	
	Number	Number	%	Number	%	Number	%
Small Shorebirds	66,055	5,931	9.0	317,730	+381	67,780	+3
Medium Shorebirds	9,180	842	9.2	45,090	+391	9,620	+5
Dabbling Ducks	20,122	175	0.9	9,380	-53	2,000	-90
Diving Ducks	16,064	124	0.8	6,640	-59	1,420	-91
Gulls	9,812	46	0.5	2,460	-75	520	-95
Hérons	247	33	13.4	1,740	+604	370	+50
Terns	603	27	4.5	1,430	+137	300	-50
Piscivores	1,231	24	1.9	1,260	+2	270	-78
Total	123,314	7,202	5.8	385,730	+213	82,280	-33
Number of Species	66	38		?		?	

¹ Spring waterbird monthly means for all project ponds Mar-May, 2011-2013

² Salt pond conversion 50% tidal marsh, 3,036 ha ponds

³ Salt pond conversion 90% tidal marsh, 648 ha ponds

Assumptions

- Waterbird response to management of all ponds will be similar to SF2.
Response will be pond-specific, but this is the first SBSP management pond with detailed monitoring of management response.
- Waterbirds use of SF2 will not vary over the 50-year restoration.
Waterbirds may increase over time with fewer ponds, but islands also may deteriorate and result in decreased use.
- As tidal ponds transition from shoals preferred by waterbirds to vegetated marsh, use will be the same.
Expect decreases in waterbirds with vegetation closure.
- Factors including sea-level rise and storm events will not change the restoration trajectory.
Waterbird response may change greatly within the 50-year horizon.

Projected Waterbird Changes with Pond Restoration

	50% Restored		90% Restored	
	Winter	Spring	Winter	Spring
Small Shorebirds	+244	+381	-27	+3
Medium Shorebirds	-17	+391	-82	+5
Dabbling Ducks	-67	-53	-93	-90
Diving Ducks	-66	-59	-93	-91
Gulls	-37	-75	-87	-95
Hérons	-80	+604	-96	+50
Terns	+284	+137	-17	-50
Piscivores	+84	+2	-61	-78
Total Waterbird % Change	-21	+213	-83	-33

	50% Restored		90% Restored	
	Winter	Spring	Winter	Spring
Total Waterbird % Change	-21	+213	-83	-33



Phase I (2009-2013): SF2

Changing Water Management Regimes

Five Alternating 2-Week Periods

Inflow Only

Inflow & Outflow



Inflow Only



Inflow and Outflow



Phase I (2009-2013): SF2

Changing Water Management Regimes

Five Alternating 2-Week Periods

Inflow (magenta)

Inflow & Outflow (purple)

When outflow was restricted (inflow only):

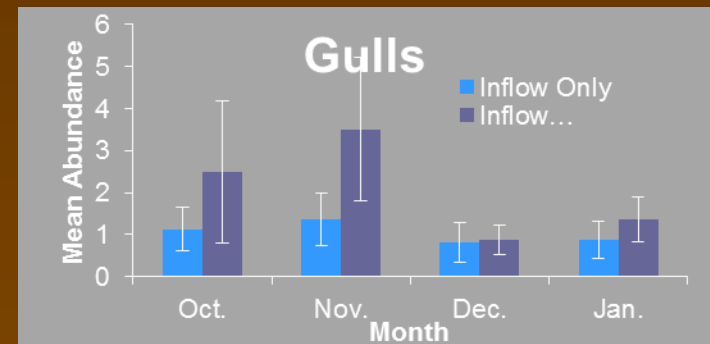
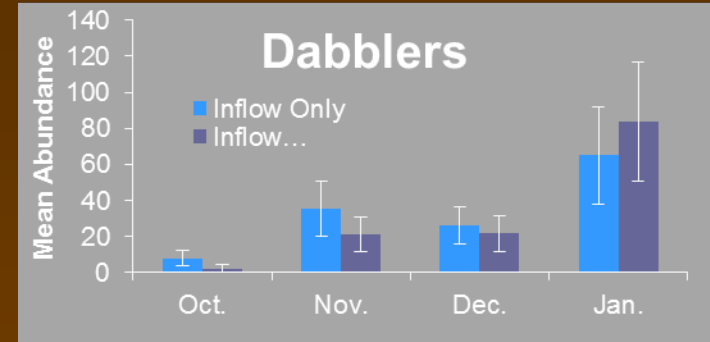
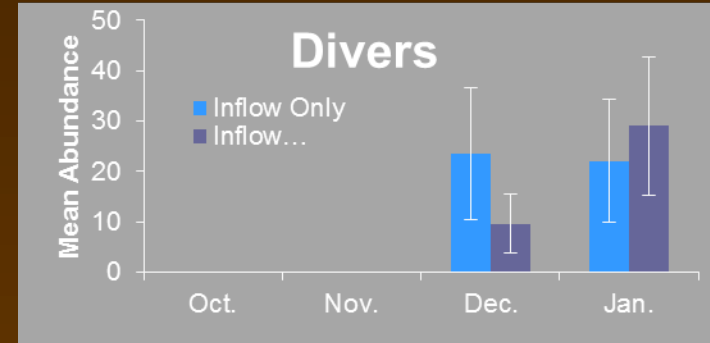
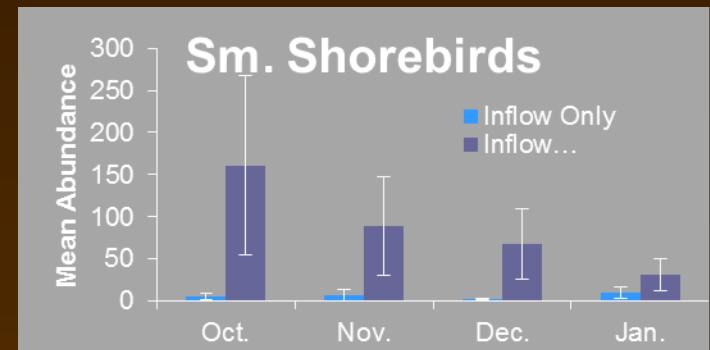
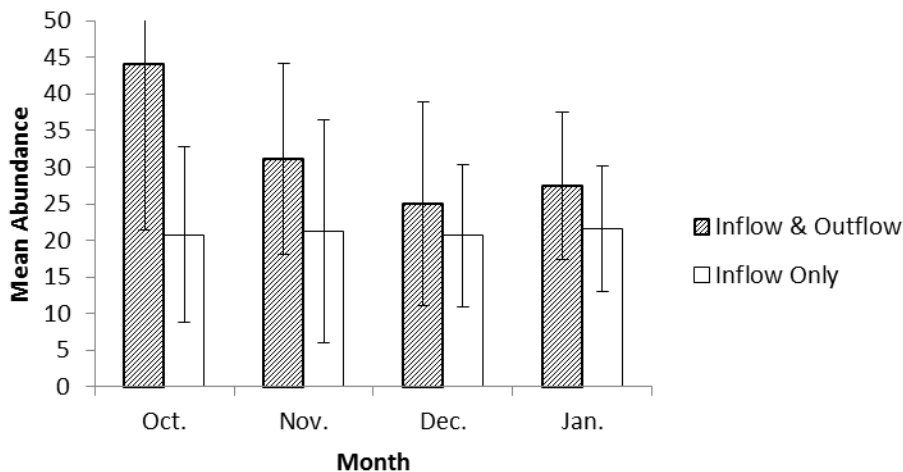
--decrease in total wintering waterbirds

--decrease in early winter small shorebirds

--increase in divers in December

--similar dabbler numbers

--more gulls in early winter (Oct-Nov)



Conclusions

- Pond SF2 results indicates pond management may increase waterbird densities, but total numbers may decrease if 90% is restored.
- Water management changes under the SF2 pond design can either increase shorebird abundance or diver abundance, but probably not both.
- To guide successful restoration through the next 45 years or 90%, integrated applied science including waterbird monitoring must remain a critical component of the SBSP restoration project.
- The Bay Area is known as a leader in ecological restoration – the same should be true for leading integration and support of monitoring and adaptive management in restoration processes.



Acknowledgments

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