San Francisco Bay Climate Adaptation Decision Support
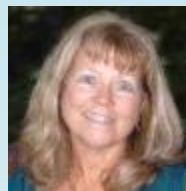
WEBINAR – FEB 27, 2015

Leadership Team

- **Project Coordinator, San Francisco Bay Joint Venture**
  - ➤**Beth Huning***

- **Structured Decision Making Coaches**
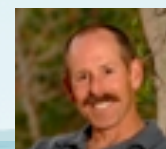 - ➤**Brady Mattsson*, Independent Contractor**
  - ➤**Kelly Robinson, Cornell University**
  - ➤**Giselle Block, FWS Inventory & Monitoring**
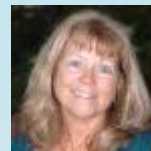 - ➤ **Jonathan Cummings, USGS Leetown**

- **Facilitator: Will Murray, Indep. Contractor**

* = Webinar Presenters

Webinar Agenda

- **9:00 Welcome, webinar overview**

- **9:15 Take-home messages**

- **9:25 Bayland-wide products**

- **9:40 Subregional decision tools**

- **10:30 Lessons learned**

- **10:35 Discussion**

Webinar Overview

- **Chat box & discussion periods**

- **Goals**
  - ➤ **Summarize & discuss main results**
  - ➤ **Path forward**

- **CADS is for managers, part of toolbox**

9:15

Finalizing CADS Phase 1 Report

- **Sending new version by March 3rd**

- **Asking for chapter reviewers**

- **Reviews due by March 17th**

- **Finalize report by end of March**

Webinar Agenda

- **9:00 Welcome, webinar overview**

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- **9:25 Bayland-wide products**

- **9:40 Subregional decision tools**

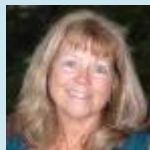- **10:30 Lessons learned**

- **10:35 Discussion**

Decision Question CADS

"How should **limited resources** be **allocated across time** and space *toward potential actions* **within subregions** to **conserve San Francisco Bay** estuarine ecosystems while accounting for uncertainties and constraints regarding climate change and other factors such as management effectiveness, regulations, recreation, and sediment dynamics?"

What the Decision Tools Tell Us

"Although we are unsure what will happen in the future (from the best available science), we should plan 2015-2029 as if there will be an increase in resources and a better-case scenario for climate change, even if it doesn't pan out that way"

Main Accomplishments

- **Measurable conservation objectives for each subregion to support adaptive management**

- **Action categories & external drivers linked to subregional objectives**

- **Subregional recommendations based on quantified predictions & stakeholder values**

- **Engaged >25 stakeholder groups**

Guiding Principles

- **Products by and for managers**

- **Transparent and open process**

- **Implementing BEHGU goals & recommendations**

- **Non-binding recommendations**

- **To be followed by Phase 2 & beyond**

9:25

CADS Implements BEHGU

- **Percentage allocations among action categories**

  ➢ **Cross-referenced to BEHGU subregional recommendations**

  ➢ **Near-term (2015-2029) and longer-term (2030-2100) management horizons**

- **Measurable conservation objectives**

  ➢ **Common metrics that can scale up from projects to subregions to region**

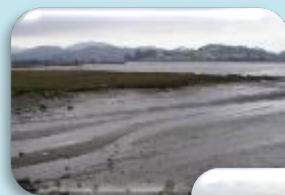 ➢ **Set up for formal adaptive management**

Webinar Agenda

- **9:00 Welcome, webinar overview**

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- **9:40 Subregional decision tools**

- **10:30 Lessons learned**

- **10:35 Discussion**

6 Bayland Ecosystem Types

Sub-tidal / intertidal mudflats

Tidal marsh

Managed/diked marsh & ponds

Upland transition zone

Migration space (adjacent uplands)

Watershed (i.e., riparian & fluvial)

SF Bay CADS Subregions

- **Suisun**

- **North Bay**

- **Central Bay**

- **South Bay**

Map courtesy of Brian Fulfrost

Overarching Conservation Objective

Perpetuate the physical integrity, functions, ***biodiversity, and wild populations of estuarine ecosystems***, while meeting demands for human health, safety, and well-being.

Bayland Action Categories

- **All subregions used:**
  - ➢ **Protect/acquire acreage**
  - ➢ **Manage sediment**
  - ➢ **Manage wildlife species** *(only 'nuisance' species included in South Bay)*
  - ➢ **Manage vegetation**
  - ➢ **Manage water**
  - ➢ **Manage human disturbance**

- **Suisun added "Collect information"**

- **South Bay added "Restore acreage"**

BEHGU Recommendations: North Bay

	Action categories						Ecosystems	
	Protect acreage	Manage sediment	Manage individual wildlife	Manage for native community	Manage water	Manage human disturbance	Subtidal & intertidal	Tidal marsh
Tidal marsh habitats should be restored wherever possible, but particularly at the mouths of streams, where they enter the Baylands.		X		X		X		X
Natural salt ponds on the East Bay shoreline should be restored, and shallow subtidal habitats (including eelgrass and oyster beds) should be protected and enhanced.	X	X		X	X	X	X	X
Enhance the ecological connections between creek mouths, tidal wetlands, and subtidal offshore habitats in several areas.	X	X			X		X	X
Living breakwaters could be created around fringing marshes to preserve and enhance unique features like native eelgrass and oyster beds.		X			X		X	X

Time Horizons for CADS

- **Outcomes**
  - ➢ **Near-term: 2015-2029**
  - ➢ **Long-term: 2030-2100**

- **Management**
  - ➢ **Near-term: 2015-2029**
  - ➢ **Longer-term: 2030-2050**

Bayland Scenarios 2015-2029

Rosy Picture

- **Extreme events spaced out in time**

- **Not coinciding with big high tides**

- **Resources at least double the current**

Not So Great

- **Consecutive big storm events 1986-style**

- **King tides during extreme events**

- **Resources less than double the current**

Bayland Scenarios <u>2030-2100</u>

<u>Rosy Picture</u>

- **Extreme events spaced out in time**
- **Not coinciding with big high tides**
- **Resources at least double the current**
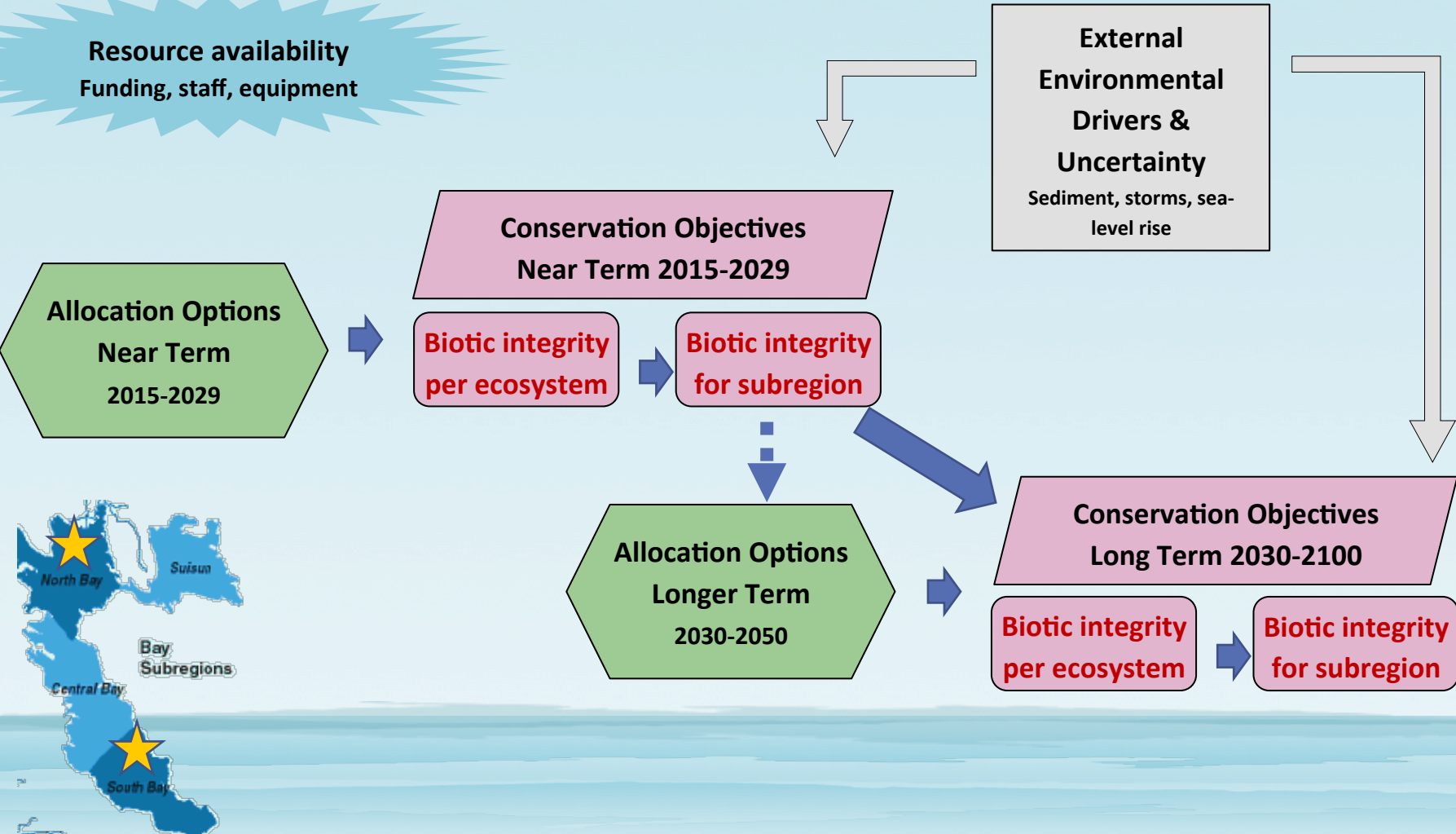- **Sea level rises by 55 cm 2014 - 2100**

<u>Not So Great</u>

- **Consecutive big storm events 1986-style**
- **King tides during extreme events**
- **Resources less than double the current**
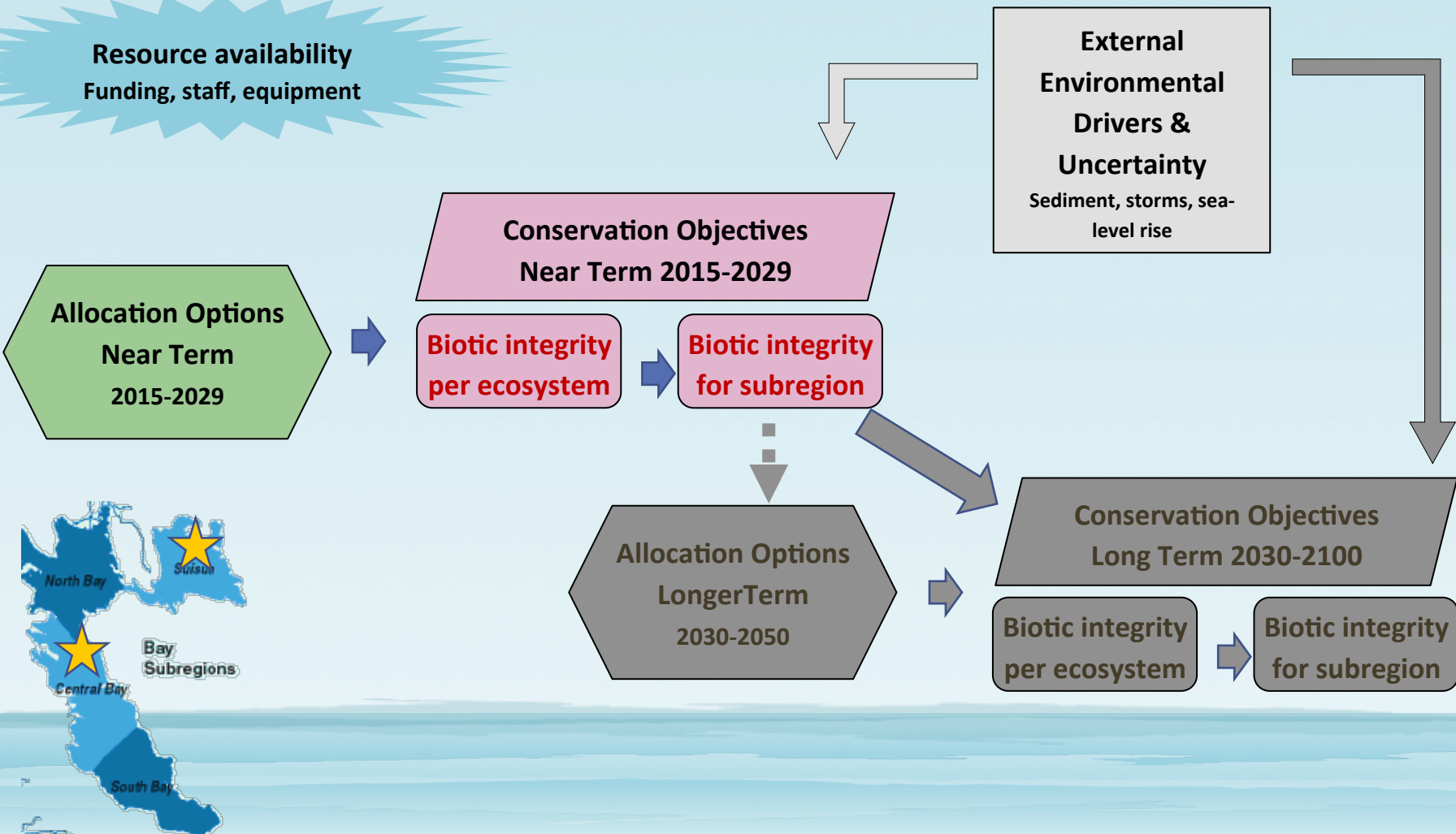- **Sea level rises by 165 cm 2014 - 2100**

Toward Subregional Decision Tools

PUTTING THE PIECES TOGETHER

Anatomy of Subregional Decision Tool

Resource availability
Funding, staff, equipment

External Environmental Drivers & Uncertainty
Sediment, storms, sea-level rise

Conservation Objectives Near Term 2015-2029

Biotic integrity per ecosystem

Biotic integrity for subregion

Allocation Options Near Term
2015-2029

Allocation Options LongerTerm
2030-2050

Conservation Objectives Long Term 2030-2100

Biotic integrity per ecosystem

Biotic integrity for subregion

North Bay

Suisun

Bay Subregions

Central Bay

South Bay

Discussion Period

BAYLAND-WIDE PRODUCTS

9:35

Webinar Agenda

- **9:00 Welcome, webinar overview**

- **9:15 Take-home messages**

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- **9:40 Subregional decision tools**

- **10:30 Lessons learned**

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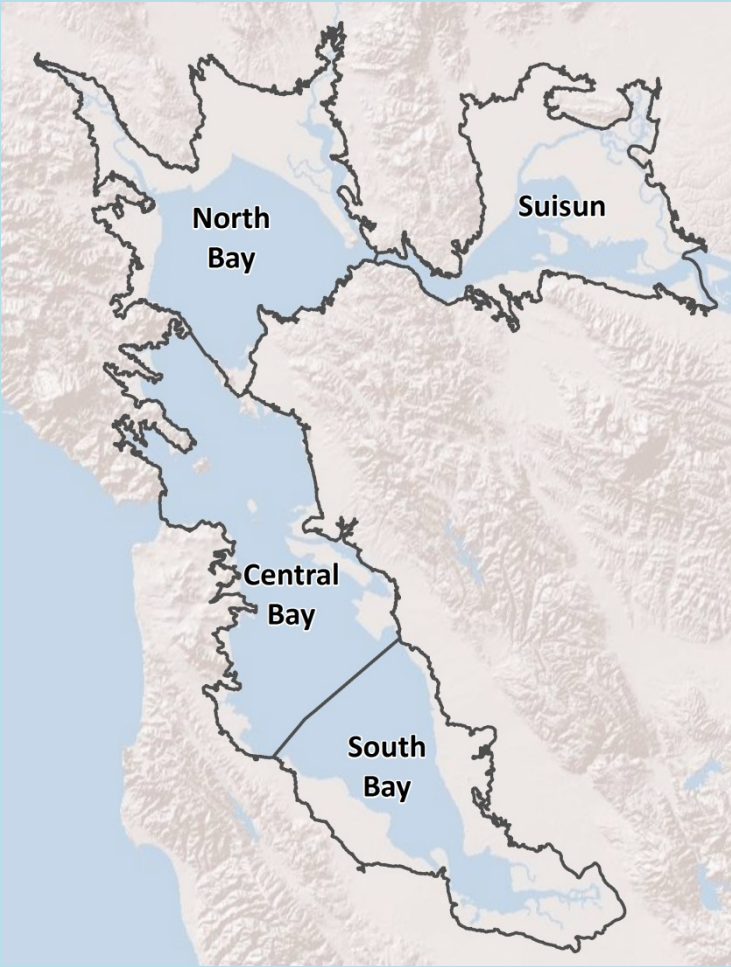
**Map courtesy of Brian Fulfrost**
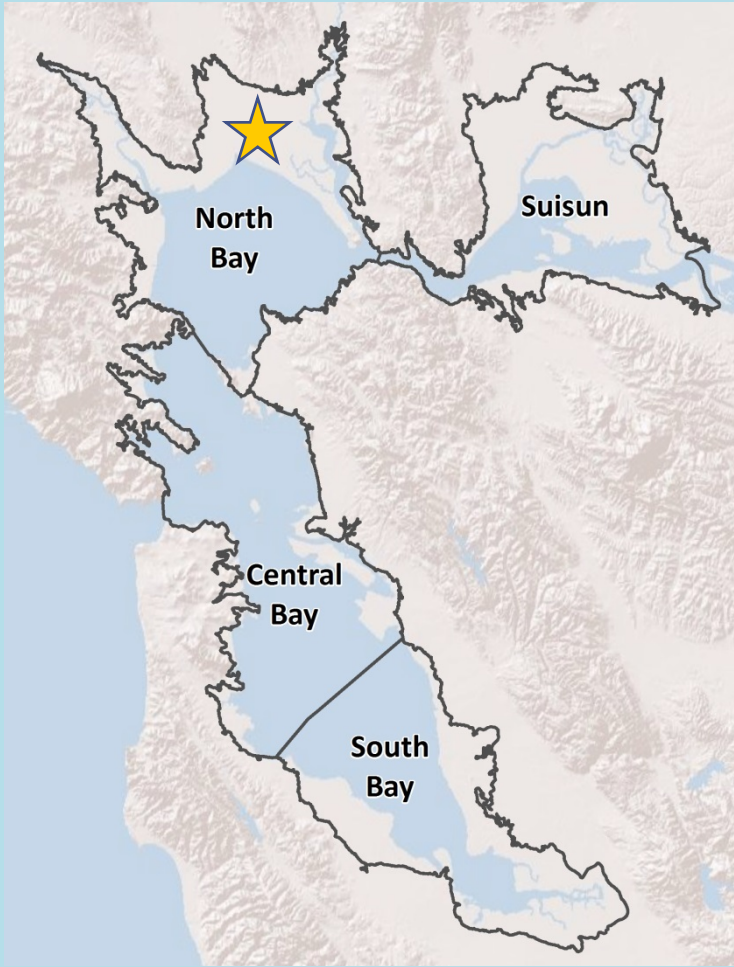
Map courtesy of Brian Fulfrost

North Bay Indicators of Biotic Integrity

Subtidal & intertidal mudflats (5)

- **Shorebird diversity and abundance**

- **Shellfish bed acreage**

- **Eelgrass bed acreage**

- **Forage for diving duck populations**

- **Salmonid abundance (representing subtidal fish community)**

Tidal marsh (4)

- **Ridgeway's rail density (representing marshbirds)**

- **Salt marsh harvest mouse density (representing small mammals)**

- **Native fish diversity and abundance**

- **Acreage dominated by native plants**
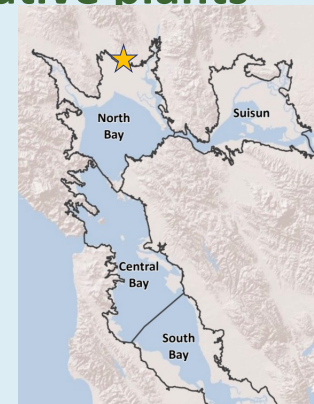
North Bay Indicators of Biotic Integrity

Managed wetlands (3)

- **Fish abundance**

  ➢ **Abundance of natives (2015-2029)**

  ➢ **Density of natives per wetland structure (2030-2100)**

- **Shorebird richness and density**

  ➢ **Total richness and density (2015-2029)**

  ➢ **Average richness and density per wetland structure (2030-2100)**

- **Duck richness and density**

Upland transition zone (4)

- **Acres dominated by native plants**

- **Density of song sparrows and common yellowthroats**

- **Acres with vegetated refu** **at king tide** (represents impo salt marsh harvest mouse and R

- **Herpetofauna abundance**
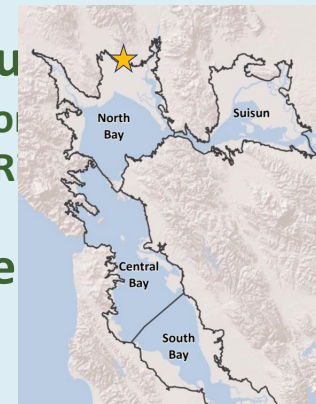
North Bay: Assume Rosy Allocation Near-term 2015-2029

Action Category	Sub-tidal/ intertidal mudflat	Tidal marsh	Diked baylands and managed ponds	Upland transition zone	Migration Space	Watershed	TOTAL
Assume Rosy Future							
Protect acreage	1	1	7	9	9	0	27
Manage sediment	5	0	13	6	5	0	29
Manage individual wildlife species	1	3	1	3	0	0	8
Manage vegetation for multiple species	1	2	2	4	3	0	12
Manage water	0	1	2	0	0	0	3
Manage human disturbance	3	5	3	5	5	0	21
TOTAL	11	12	28	27	22	0	100

North Bay: Assume Rosy Allocation Near-term 2015-2029
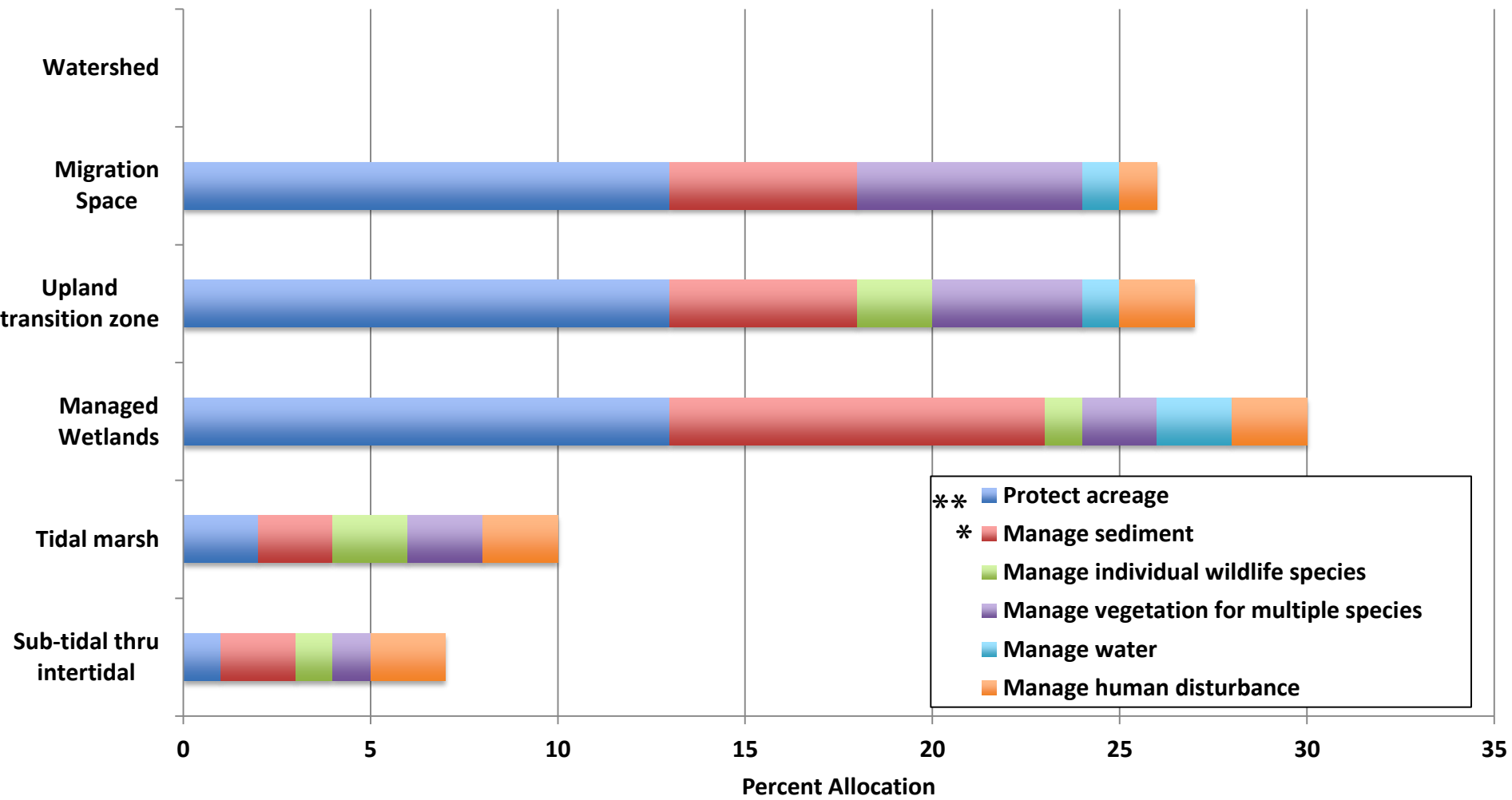
# North Bay: Assume <u>Not-Great</u> Allocation Near-term 2015-2029
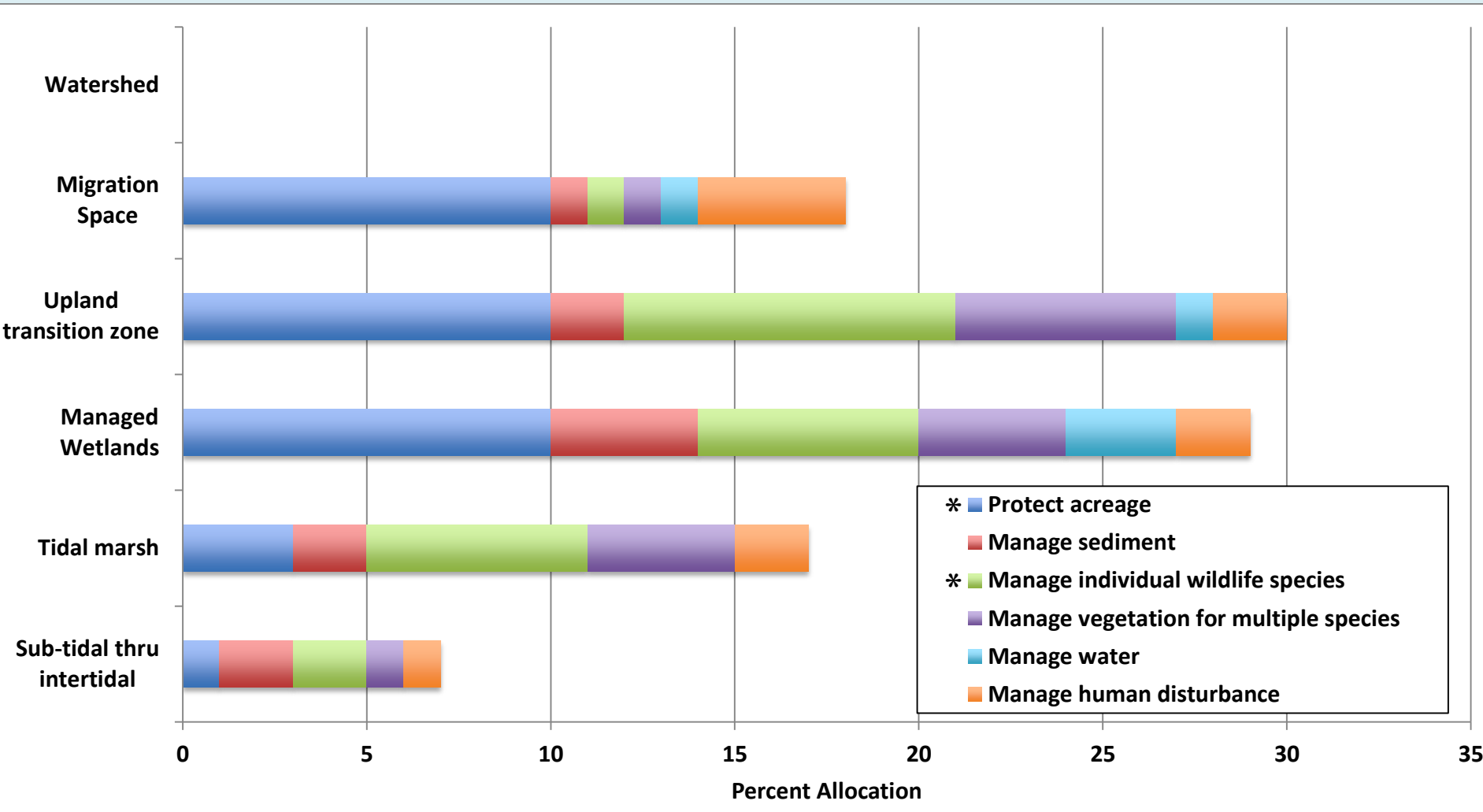
Which Allocation is Recommended?

Expected Conservation Performance of Allocation Options in North Bay
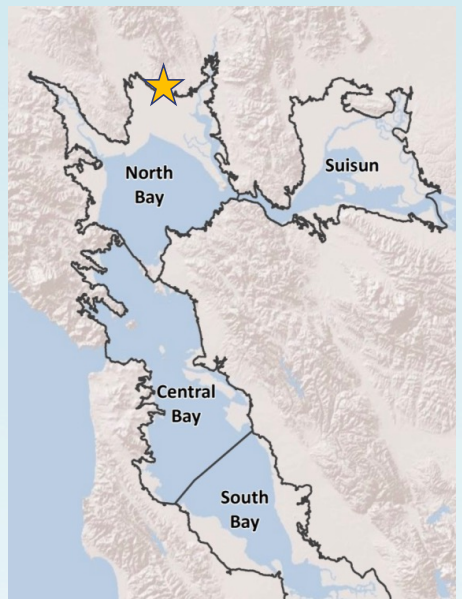
- **Prognosis for biotic integrity across estuarine ecosystems, under particular resource allocation**

- **0% performance = Decreasing biotic integrity for all ecosystems in both outcome horizons**

- **100% performance = Stable/increasing biotic integrity for all ecosystems in both time horizons**

- **Assume Rosy Allocation: 53% performance**

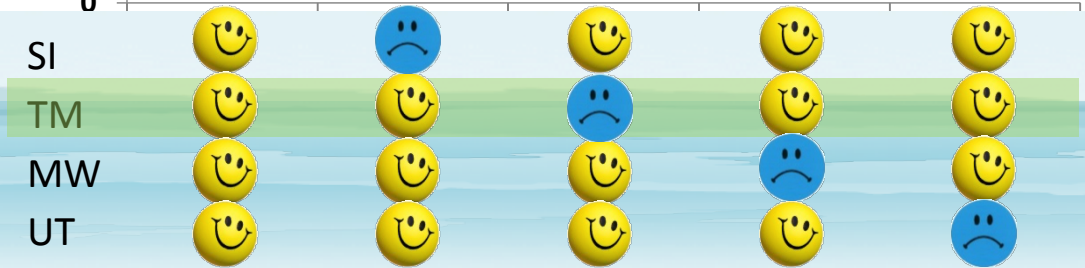 ➢ **Assume-not-so-great allocation: 47% performance**
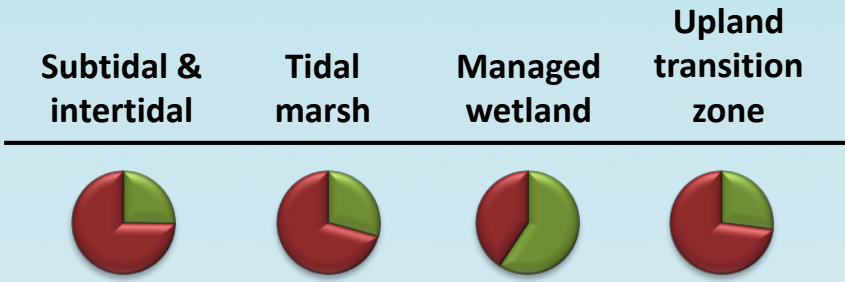
Expected Conservation Performance of Assume Rosy Allocation in North Bay

Subtidal & intertidal	Tidal marsh	Managed wetland	Upland transition zone

53% = Weighted average:

- **Probabilities of changes in biotic integrity under assume-rosy allocation (ecology)**
- Stakeholder values

North Bay

Suisun

Central Bay

South Bay

Expected Conservation Performance of Assume Rosy Allocation in North Bay

53% = Weighted average:
- Probabilities of changes in biotic integrity under assume-rosy allocation (ecology)
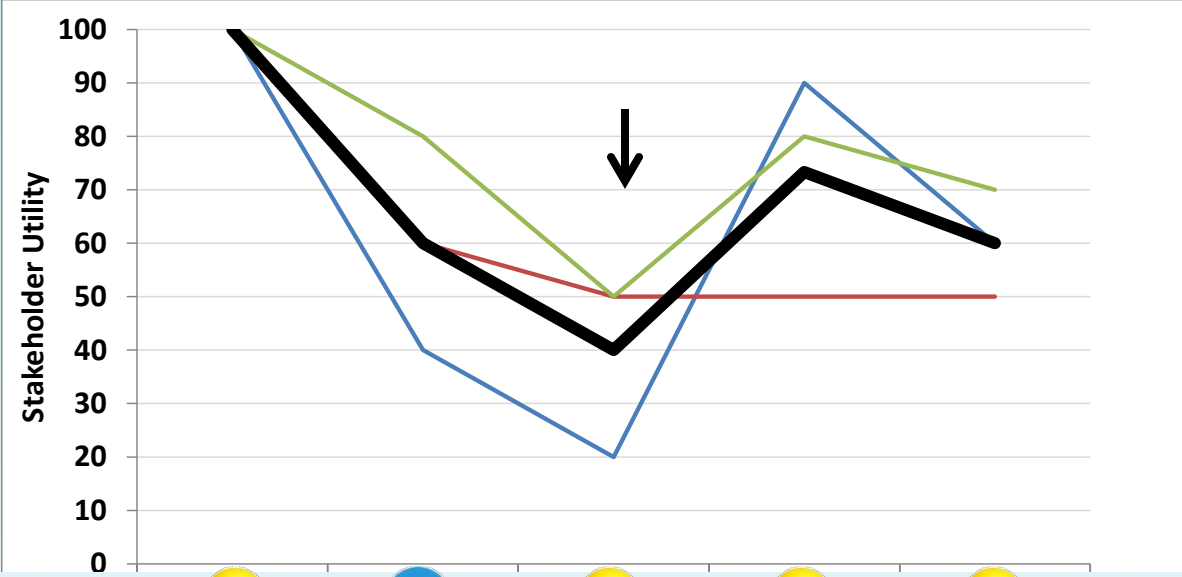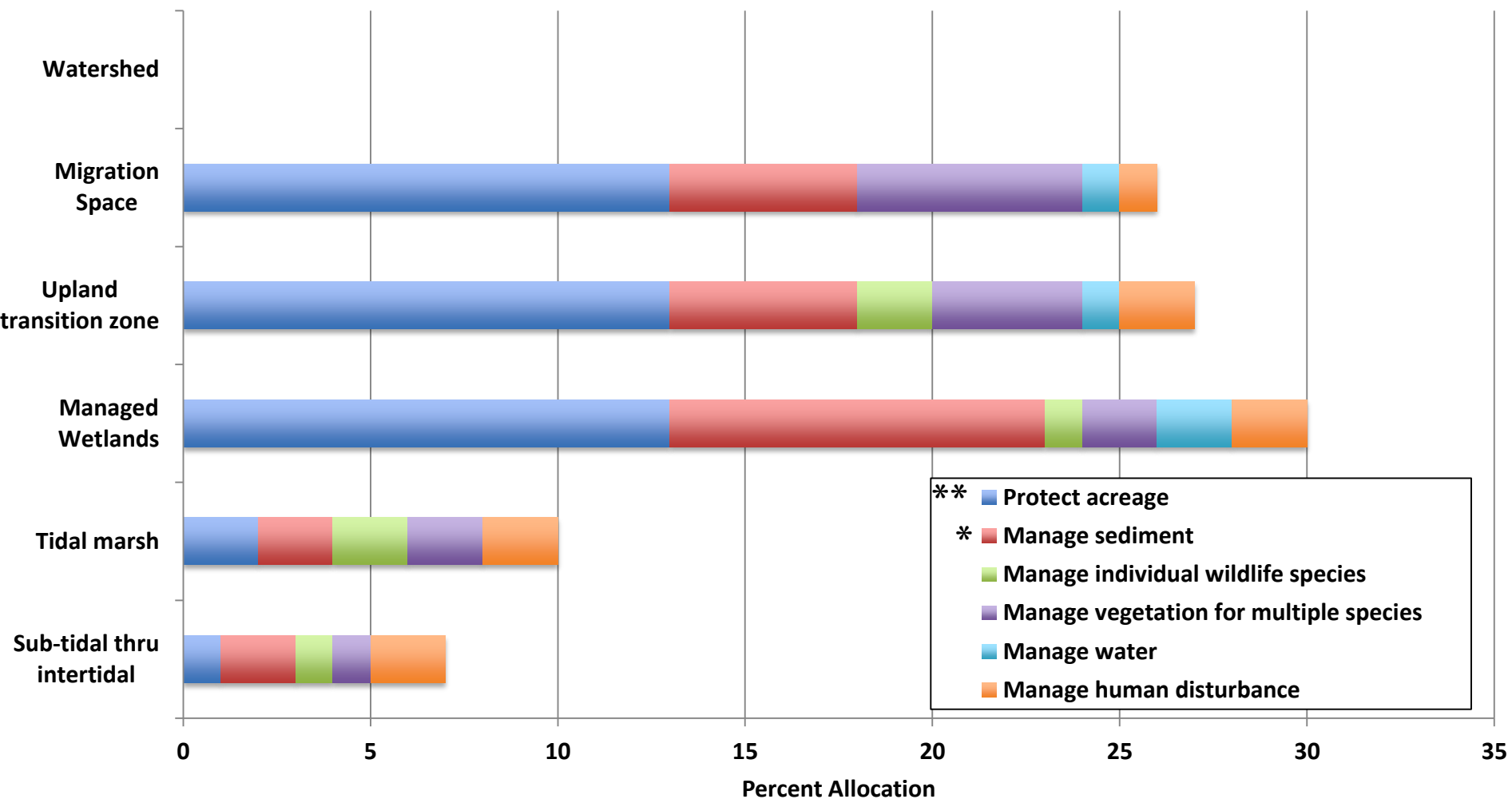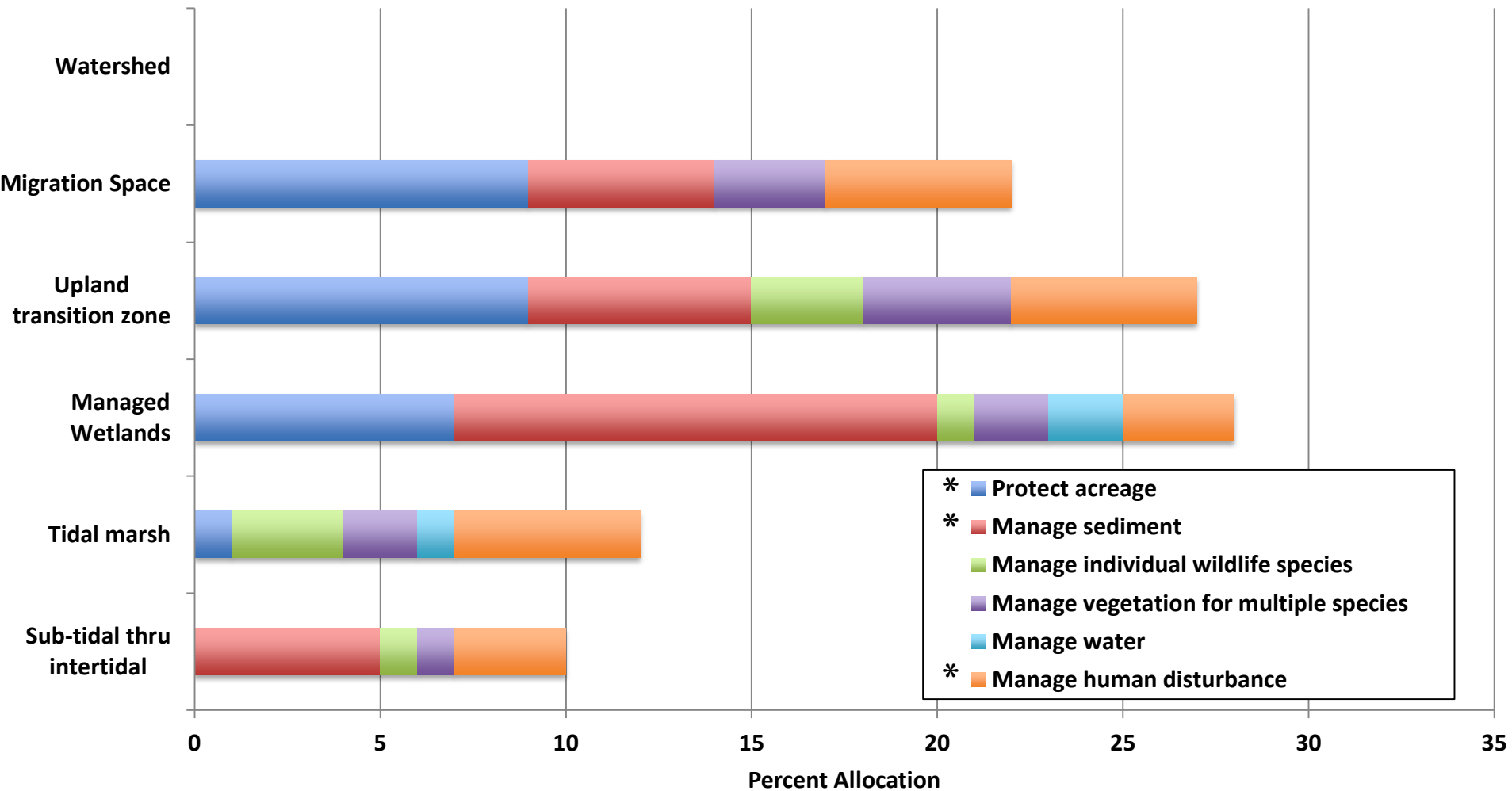- **Stakeholder values**

North Bay: Assume Rosy Allocation Near-term 2015-2029

Discussion Period

NORTH BAY RESULTS

9:55

North Bay
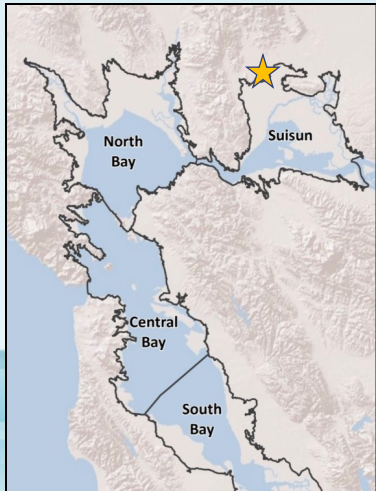
Suisun

Central Bay

South Bay

Map courtesy of Brian Fulfrost

Suisun Indicators of Biotic Integrity

Subtidal & intertidal mudflats (2)

- **Acreage dominated by native submerged aquatic vegetation**

- **Delta smelt abundance**

- **Implicit indicators:**
  - ➢ **Wintering shorebird abundance**
  - ➢ **Native shellfish bed acreage**

Tidal marsh (2)

- **Obligate native tidal marsh bird diversity and abundance** (e.g., rails)

- **Native small mammal diversity and abundance** (e.g., salt marsh harvest mouse, shrew)

- **Implicit indicators:**
  - ➢ **Acres of tidal marsh with optimal native plant composition**
  - ➢ **Native fish diversity**

Suisun Indicators of Biotic Integrity

Managed wetlands (2)

- **Salt marsh harvest mouse abundance (index: capture efficiency)**

- **Dabbling and diving duck wintering population size**

- **Implicit indicator:**

  ➢ **Winter population size of waders and shorebirds**

Upland transition zone (2)

- **Acres dominated by native upland transition zone-associated plant species**

- **Implicit indicators:**

  ➢ **Obligate native tidal marsh bird diversity**

  ➢ **Salt marsh harvest mouse abundance (index: capture efficiency)**

  ➢ **Vernal pool native plant species richness**

Suisun: Assume Rosy Allocation Near-term 2015-2029
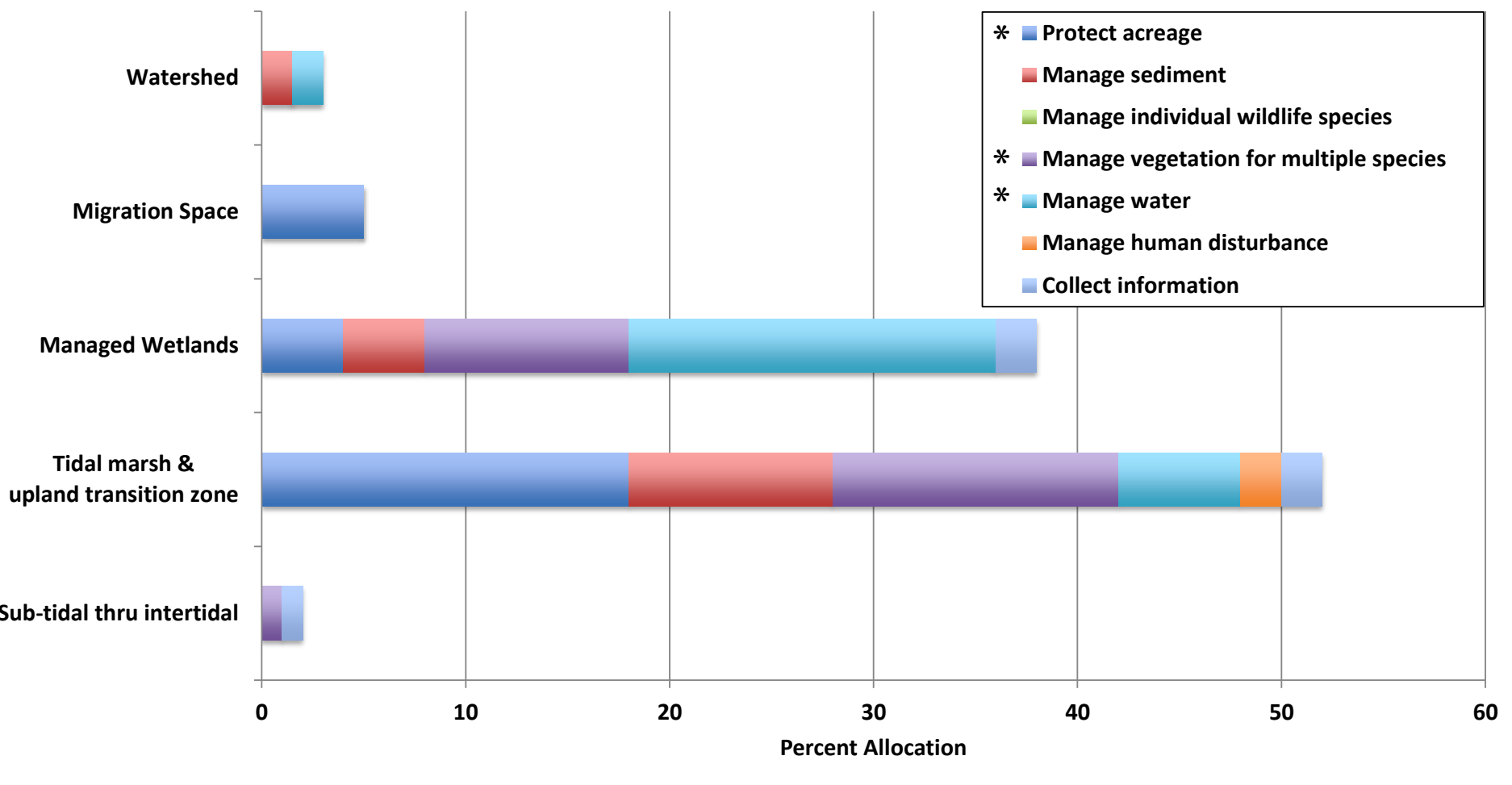
- **Expected performance: 58%**
  - ➢ **vs. 55% for assume-not-so-great allocation**

10:00

Discussion Period

SUISUN RESULTS

10:05

Map courtesy of Brian Fulfrost

Central Bay Indicators of Biotic Integrity

Subtidal & intertidal mudflats (4)

- **Increasing total mudflat acreage**

- **Stable/increasing subtidal water quality**

- **Increasing subtidal forage fish biomass**

- **Increasing subtidal acreage dominated by native living substrate**

- **Tidal marsh recovery criteria are met**

- **Increasing plant and invertebrate biomass**

- **Implicit indicators:**
  - ➤ **Increasing acreage dominated by native plants**
  - ➤ **Increasing connectivity among marshes**
  - ➤ **Stability of native wildlife populations**

North Bay

Suisun

Central Bay

South Bay

Tic

Central Bay Indicators of Biotic Integrity

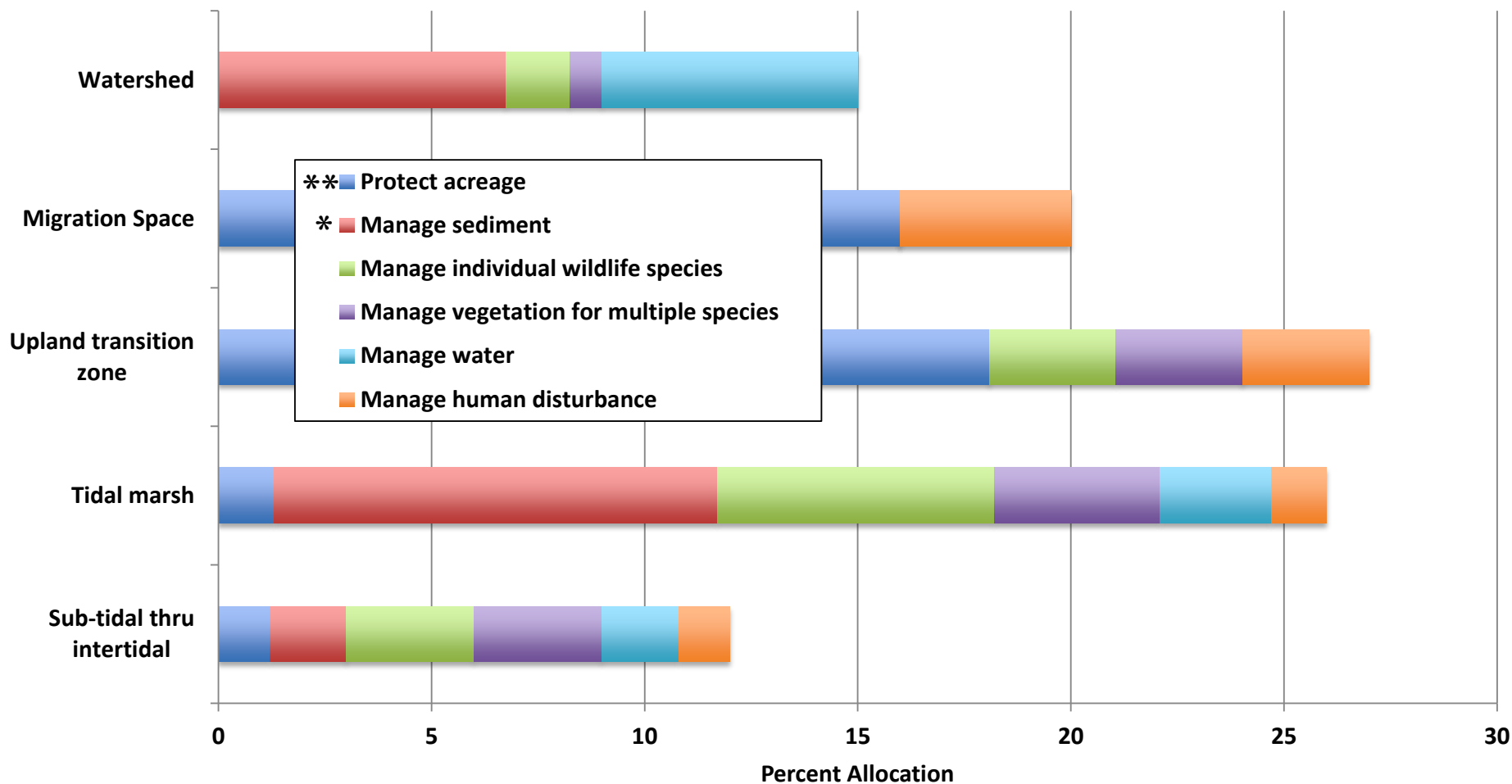*Managed wetlands*

- **NA**

Upland transition zone (1)

- **Upland transition zone recovery criteria are met**

- **Implicit indicators:**
  - ➤ **Increasing acreage dominated by native plants**
  - ➤ **Stability of native wildlife populations**

# Central Bay: Assume Rosy Allocation Near-term 2015-2029

Legend:
- ✳✳ Protect acreage
- ✳ Manage sediment
- Manage individual wildlife species
- Manage vegetation for multiple species
- Manage water
- Manage human disturbance

X-axis: **Percent Allocation** (0, 5, 10, 15, 20, 25, 30)

Categories: Watershed, Migration Space, Upland transition zone, Tidal marsh, Sub-tidal thru intertidal

- **Expected performance: 47%**
  - ➤ **vs. 39% for assume-not-so-great allocation**

10:10

Discussion Period

CENTRAL BAY RESULTS

10:15

North Bay

Suisun

Central Bay

South Bay
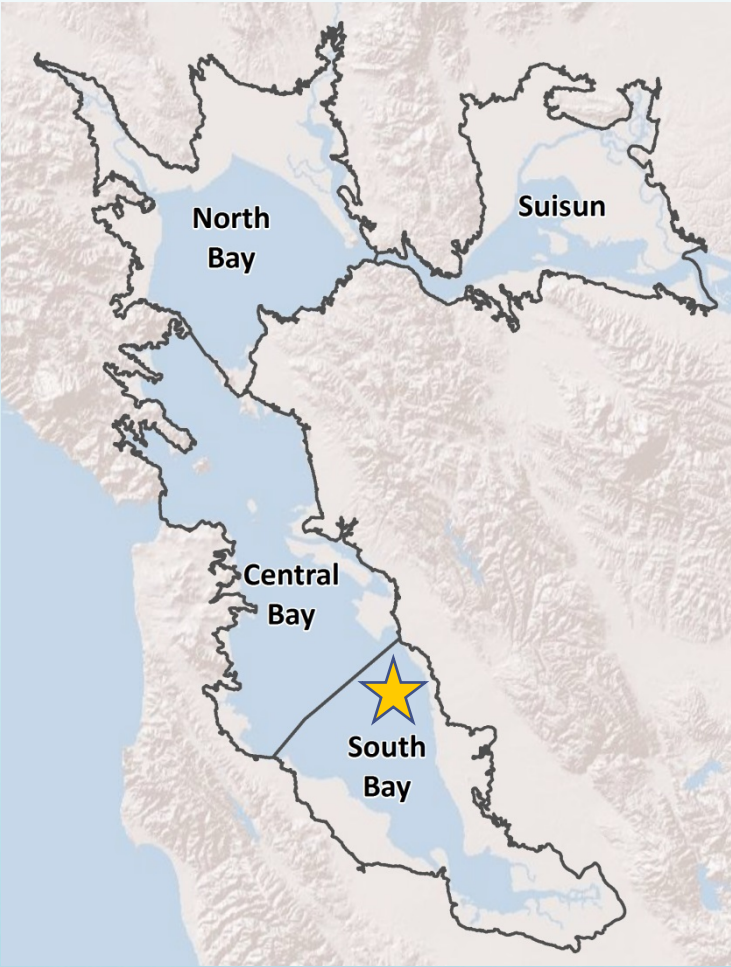
Map courtesy of Brian Fulfrost

Indicators of Biotic Integrity

Subtidal & intertidal mudflats

- **Harbor seal abundance**

- **Diving duck abundance**

- **Shellfish and eelgrass acreage**

- **Winter shorebird abundance**

Tidal marsh

- **Ensure 1999 Bayland Goals for tidal marsh acreage, size, and connectivity are met**

- **Abundance of Ridgeway's Rail and salt marsh harvest mouse**

- **Dabbling duck abundance**
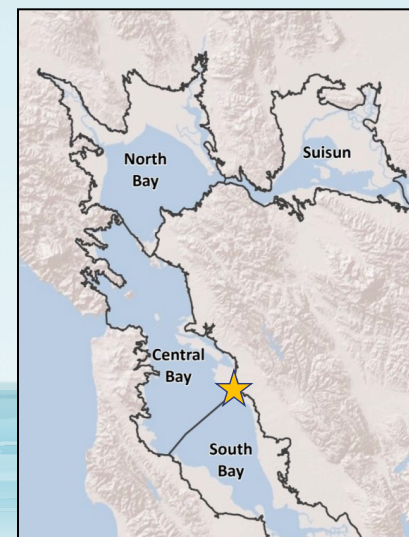
Indicators of Biotic Integrity

Managed ponds (6)

- **Abundance of small and medium shorebirds**

- **Snowy plover abundance**

- **Breeding waterbird abundance**

- **Diving duck abundance**

- **Dabbling duck abundance**

- **Abundance of birds that are salt-pond specialists**

Upland transition zone (2)

- **Ridgeway's Rail abundance**

- **Acreage dominated by…**
  - ➤ **tall vegetation (near-term, 2015-2029)**
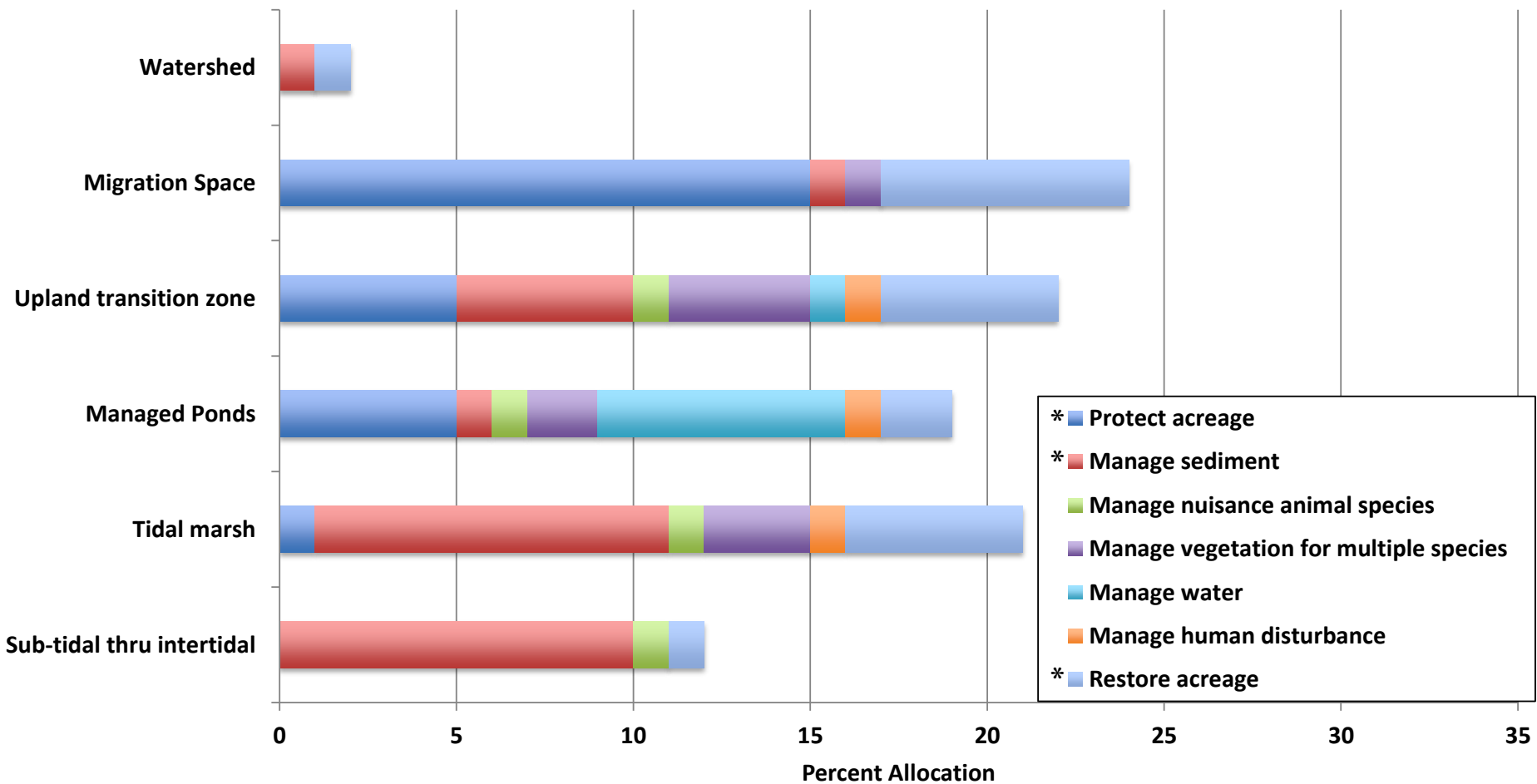 - ➤ **native plant species (long-term, 2030-2100)**
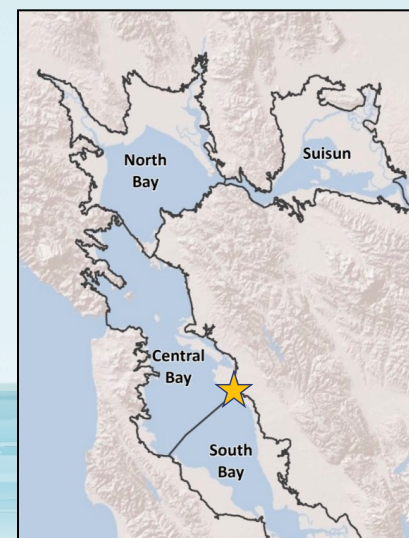
South Bay: Assume Rosy Allocation Near-term 2015-2029
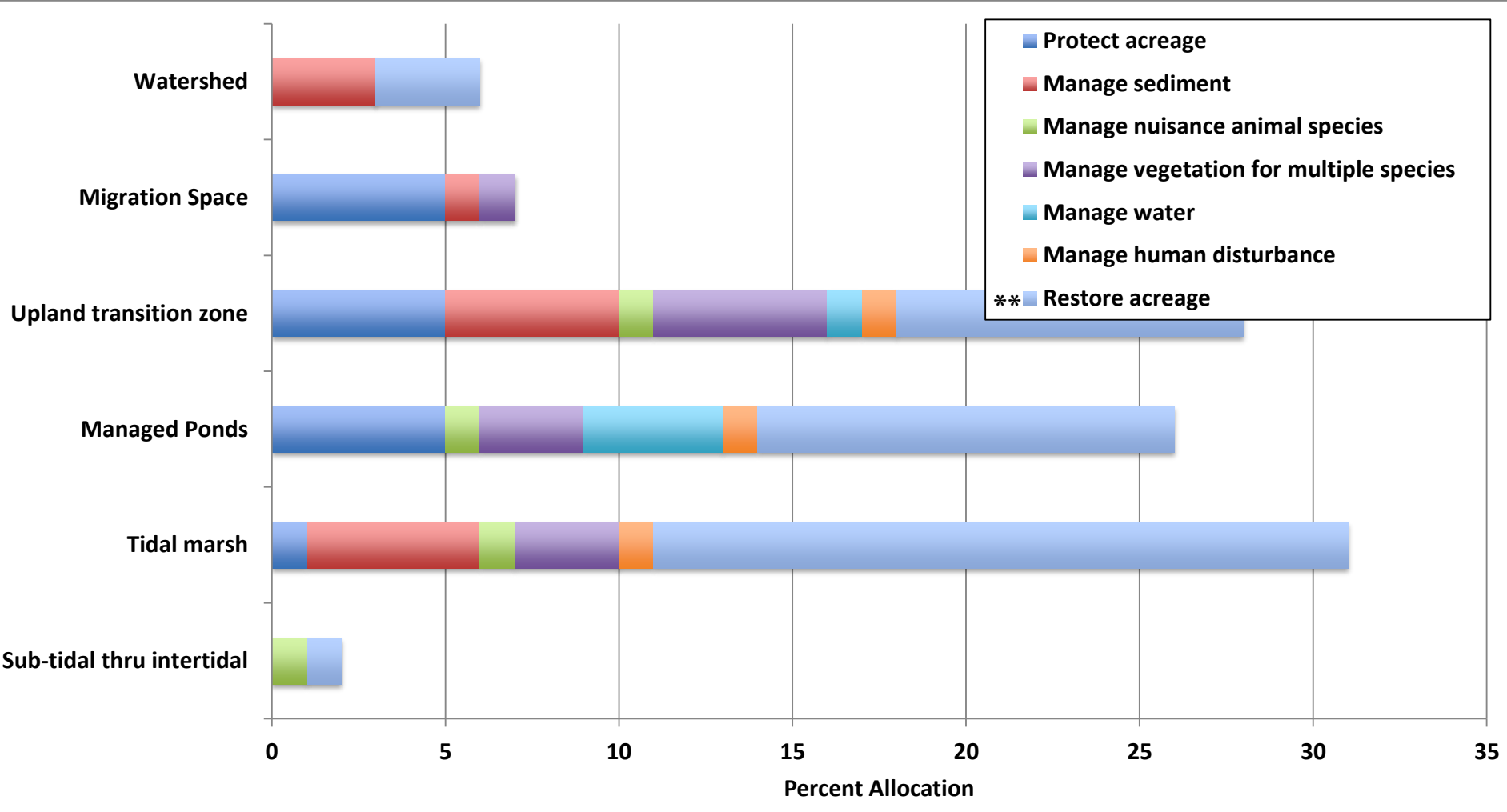
- **Expected performance: 53%**
  - ➤ **vs. 42% for assume-not-so-great allocation**

South Bay: Assume Rosy Allocation Long-term 2030-2100

- **Expected performance: 53%**
  - ➤ **vs. 42% for assume-not-so-great allocation**

10:20

Discussion Period

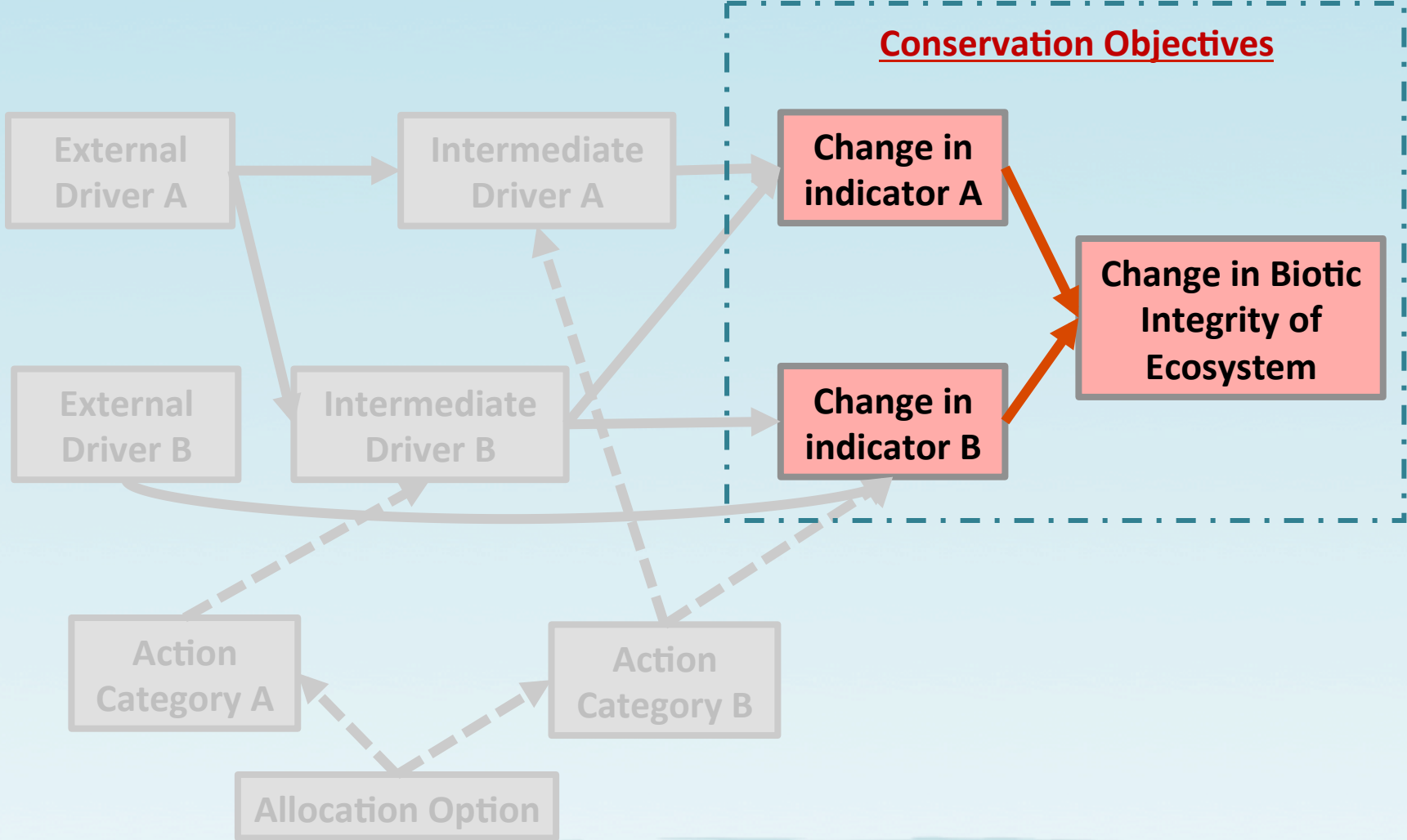## SOUTH BAY RESULTS

10:25

Brief Synthesis of Subregional Results

Comparing Subregional Decision Tools

- **Started with same template**

- **Main similarities**
  - ➤ **External drivers** (e.g. extreme storms)
  - ➤ **Some indicators of biotic integrity**

- **Main differences**
  - ➤ **Intermediate drivers** (e.g. invasive spp.)
  - ➤ **Projected changes in biotic integrity**

Ecosystem-Specific Influence Diagram

Scaling up Subregional Indicators

Subtidal and intertidal mudflats (3)

- **Acreage with native living substrate**

- **Native fish diversity & abundance**

- **Shorebird diversity & abundance**

Managed wetlands (2)

- **Diversity & abundance of ducks**

- **Diversity & abundance of shorebirds**

Tidal marsh (2)

- **Criteria for endangered species in the tidal marsh recovery plan are met**
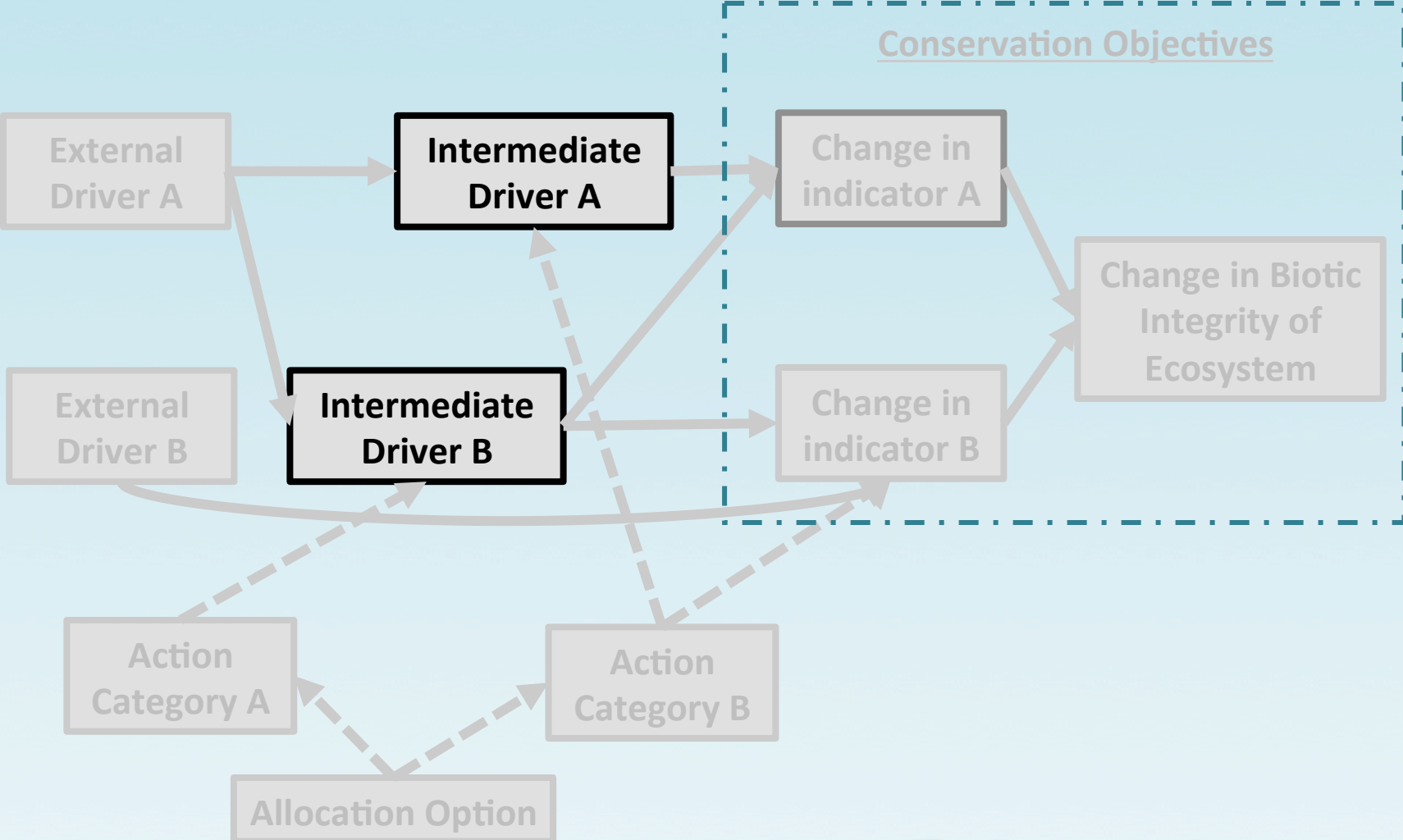
- **Acreage dominated by native plants**

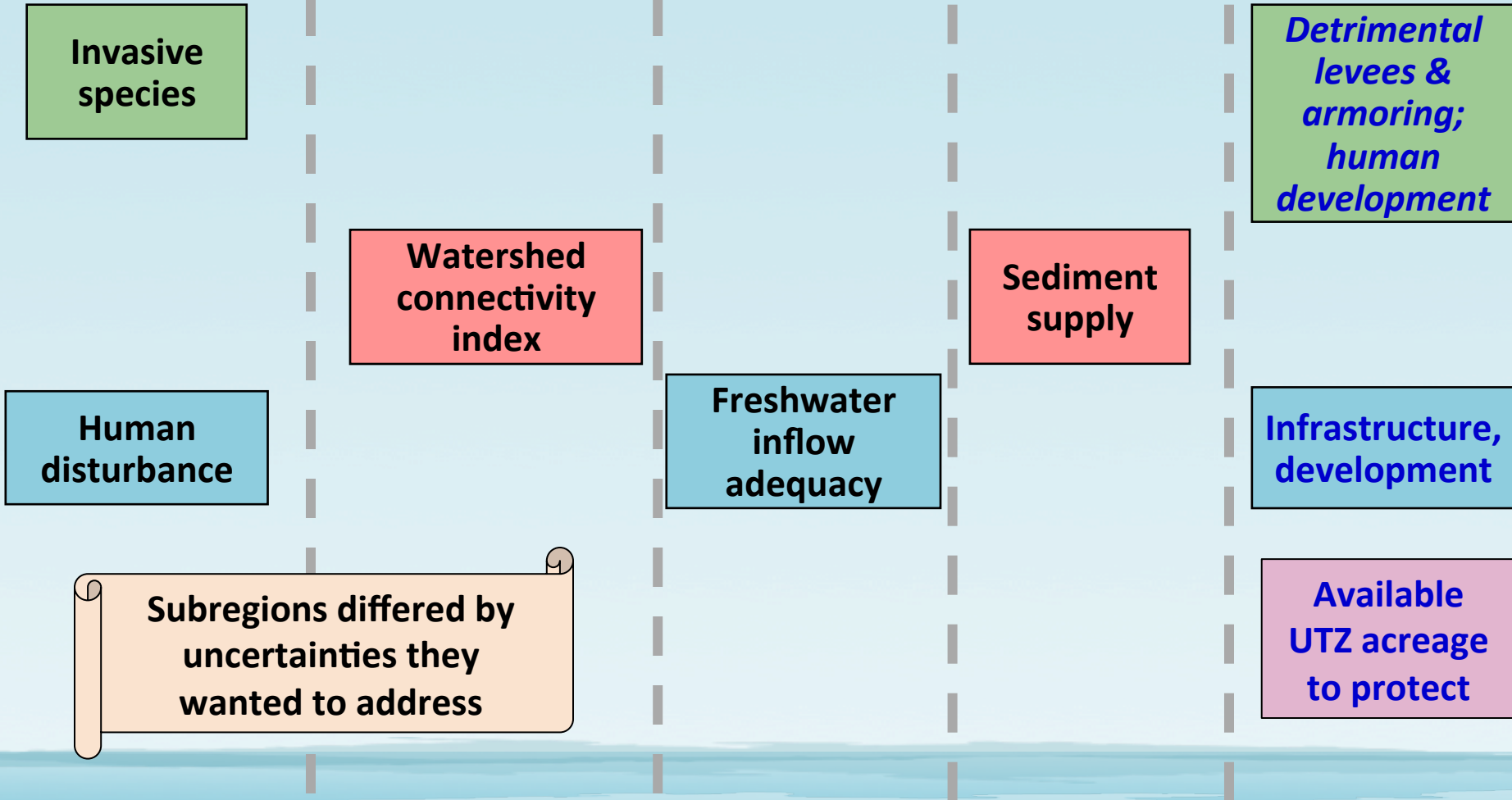*Upland transition zone (2)*

- **Criteria for endangered species in the tidal marsh recovery plan are met**

- **Acreage dominated by native plants**

Ecosystem-Specific Influence Diagram

Intermediate Drivers for Upland Transition Zone

Invasive species

Detrimental levees & armoring; human development

Watershed connectivity index

Sediment supply

Human disturbance

Freshwater inflow adequacy

Infrastructure, development

Subregions differed by uncertainties they wanted to address

Available UTZ acreage to protect

North Bay **Suisun** **Central Bay** **South Bay**

Ecosystems with Greatest Allocation under Assume-Rosy

Subregion	Outcome horizon	Subtidal & intertidal	Tidal marsh	Managed wetlands	Upland transition zone	Migration Space	Water-shed
North Bay	2015-2029			X	X	X	
	2030-2100			X	X	X	
Suisun	2015-2029		(X)	X	(X)		
	2030-2100*		(X)	X	(X)		
Central Bay	2015-2029		X		X		
	2030-2100*	X	X		X		
South Bay	2015-2029		X	X	X		
	2030-2100		X	X	X	X	

* = Long-term allocation options completed, but not yet incorporated in decision tool

# Action Categories with Greatest Allocation under Assume-Rosy

Subregion	Outcome horizon	Protect acreage	Manage sediment	Manage individual wildlife	Manage vegetation	Manage water	Manage human disturbance
North Bay	2015-2029	XX	X				
	2030-2100	X	X				X
Suisun	2015-2029	X			X	X	
	2030-2100	XX				X	
Central Bay	2015-2029	XX	X				
	2030-2100	X	X	X			
South Bay	2015-2029		(X)		(X)	(X)	
	2030-2100	X	X		(X)	(X)	

Robustness of Recommendations

- **Assume-rosy allocation even if**

  - ➤ **Bad environmental conditions** (e.g. extreme events, sea level rise)
  - ➤ **Less than double resource availability**

- **Recommendation changes if optimistic about effectiveness of assume-not-so-great allocation**

- **Further research & analysis about allocation effectiveness -- especially tidal marsh indicators**

10:30

Webinar Agenda

- **9:00 Welcome, webinar overview**

- **9:15 Take-home messages**

- **9:25 Bayland-wide products**

- **9:40 Subregional decision tools**

- **10:30 Lessons learned**

- **10:35 Discussion**
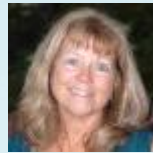
Main Challenges

- **Scope**
  - **4 subregions & 4 ecosystems**
  - **2 time horizons (2015-2029 & 2030-2100)**
  - **Over 25 stakeholders**

- **Depth**
  - **Measurable attributes, % allocation options**
  - **Quantified predictions & tradeoffs**

- **Capacity**
  - **Project management & coordination**
  - **Stakeholder engagement & communication**

Main Successes

- **Collaboratively developing subregional decision tools with stakeholders**

  ➢ **Measurable subregional conservation objectives**

  ➢ **Explicit linkages with external drivers & action categories**

  ➢ **Action categories cross-referenced with BEHGU**

  ➢ **Guidance under uncertainty about resources & climate**

  ➢ **New opportunities for coordinating in subregions**

- **Substantial progress with relatively small investment of time & funding**

Next Steps for CADS

- **Finalize report**

- **Integrate in SFB JV Implementation Plan**

- **Launch Phase 2, San Pablo Bay NWR**

- **Seek funding to continue effort**
  - ➢ **Improve subregional decision tools**
  - ➢ **Scale up to regional-level objectives**

Thank You to All Participants

- **Joy Albertson**, US Fish & Wildlife Service (USFWS), SF Bay National Wildlife Refuge Complex

- **Donna Ball** , Save the Bay

- **Grant Ballard**, Point Blue Conservation Science

- **Giselle Block**, USFWS, Inventory and Monitoring Program

- **Valary Bloom**, USFWS, Ecological Services

- **John Bourgeois**, State Coastal Conservancy, South Bay Salt Pond Restoration Program

- **Catherine Burns**, San Francisco Bay Bird Observatory

- **Cecille Caterson**, CA State Parks

- **Steve Chappell**, Suisun Resource Conservation District

- **Tim Doherty**, National Oceanic and Atmospheric Administration

- **Rebecca Fris**, CA Landscape Conservation Cooperative

- **Brian Fulfrost**, Brian Fulfrost and Associates

- **Matt Gerhart**, CA State Coastal Conservancy

- **Letitia Grenier**, CA State Coastal Conservancy

- **Andy Gunther**, Bay Area Ecosystem Climate Change Collaborative

- **Judy Kelly**, SF Estuary Partnership - Association of Bay Area Governments

- **John Klochak**, USFWS Coastal Program

- **John Krause**, CA Dept. Fish & Wildlife

- **Marilyn Latta**, CA Coastal Conservancy

- **Roger Leventhal**, Marin County Public Works

- **Javier Linares**, USFWS

- **Meg Marriott**, USFWS, San Pablo Bay National Widlife Refuge

- **Julian Meisler**, Sonoma Land Trust

- **Anne Morkill**, USFWS, San Pablo Bay National Widlife Refuge

- **Nadav Nur**, Point Blue Conservation Science

- **Peggy Olofson**, Invasive Spartina Project

- **Leo Salas**, Point Blue Conservation Science

- **Barbara Salzman**, Marin Audubon

- **Stuart Siegel**, Independent contractor

- **Christina Sloop**, Blue Earth Consultants

- **Renee Spenst**, Ducks Unlimited

- **Karen Taylor**, CA Dept. Fish & Wildlife

- **Rachel Tertes**, USFWS, San Francisco Bay National Wildlife Refuge Complex

- **Karen Thorne**, US Geological Survey (USGS), Western Ecological Research Center

- **David Thomson**, San Francisco Bay Bird Observatory

- **Laura Valoppi**, USGS South Bay Salt Pond Restoration Program

- **Susanne von Rosenberg**, Gaia Consulting

- **Mike Vasey**, San Francisco Bay National Estuarine Research Reserve

- **Jordan Wellwood**, Richardson Bay Audubon

Thank You to Project Funders

- **California Landscape Conservation Cooperative**

- **U.S. Fish & Wildlife Service Inventory & Monitoring**
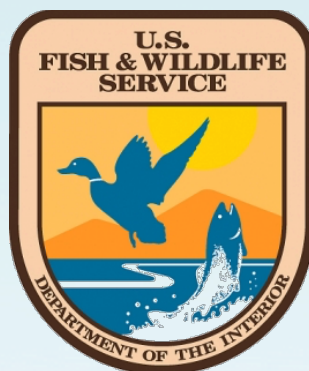
Webinar Agenda

- **9:00 Welcome, webinar overview**

- **9:15 Take-home messages**

- **9:25 Bayland-wide products**

- **9:40 Subregional decision tools**
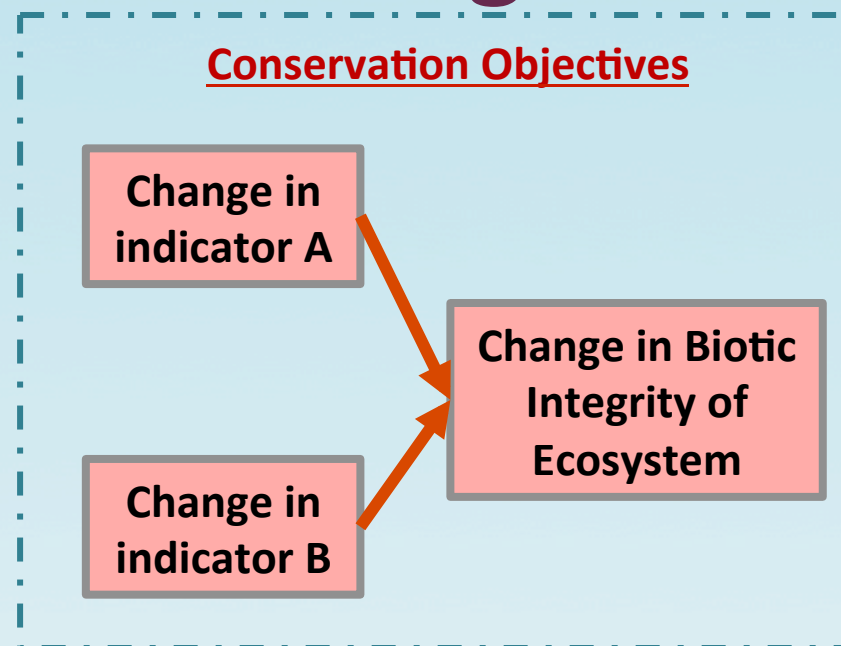
- **10:30 Lessons learned**

- **10:35 Discussion**

> - **How can CADS be used by managers now?**
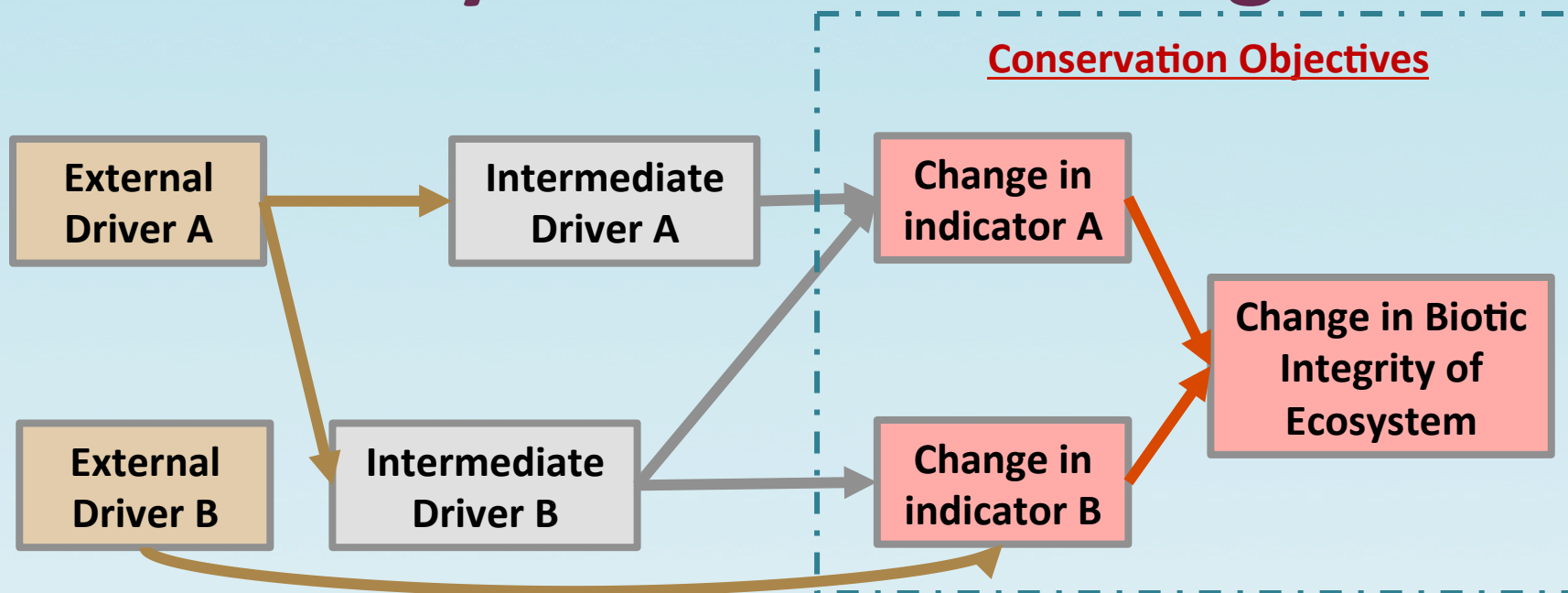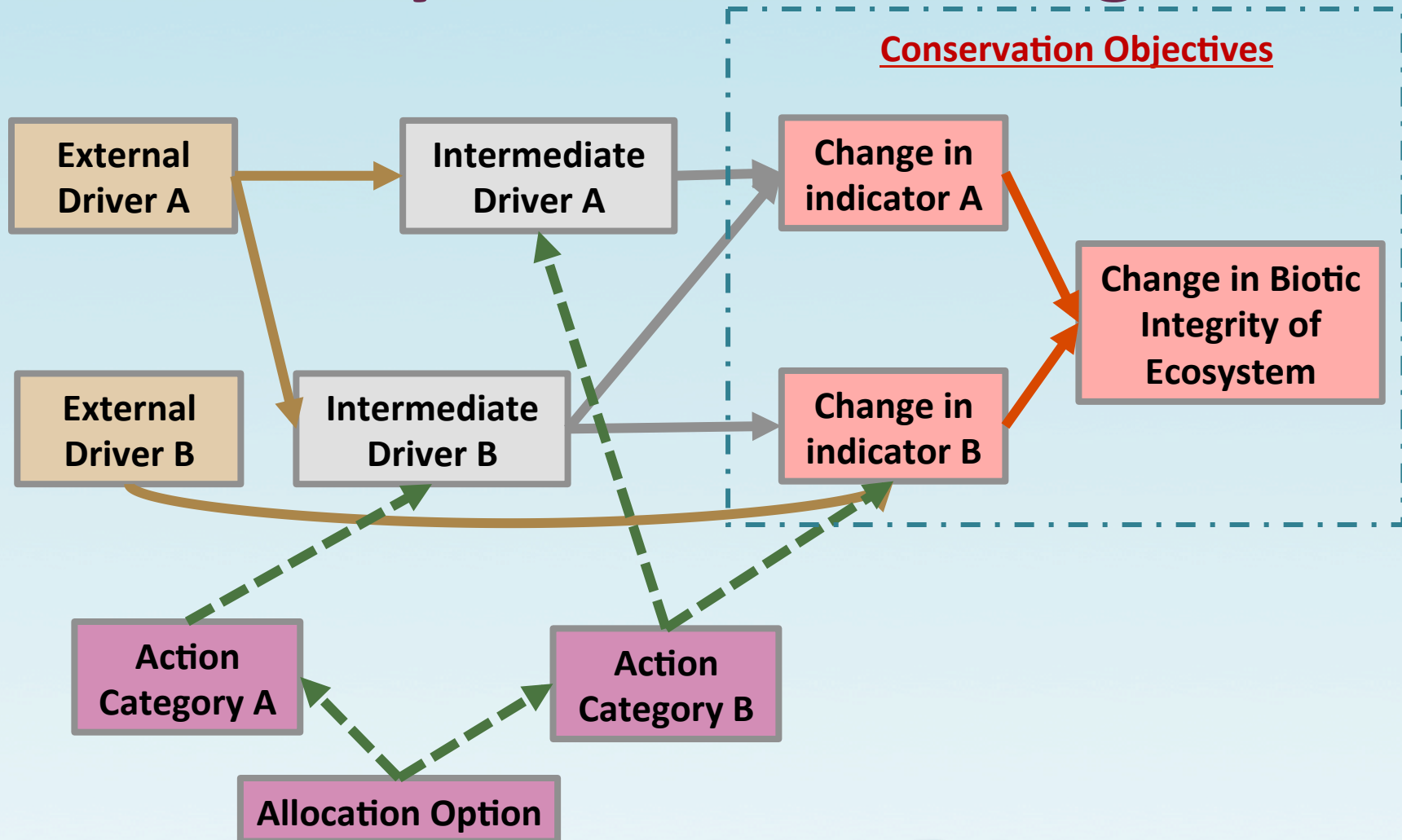> - **What questions & concerns remain?**

Extra Slides If Needed

Anatomy of Influence Diagram

Anatomy of Influence Diagram

Conservation Objectives

External Driver A → Intermediate Driver A → Change in indicator A → Change in Biotic Integrity of Ecosystem

External Driver B → Intermediate Driver B → Change in indicator B → Change in Biotic Integrity of Ecosystem

Anatomy of Influence Diagram

Overarching Objective: Biotic Integrity

Managed Wetland Biotic integrity
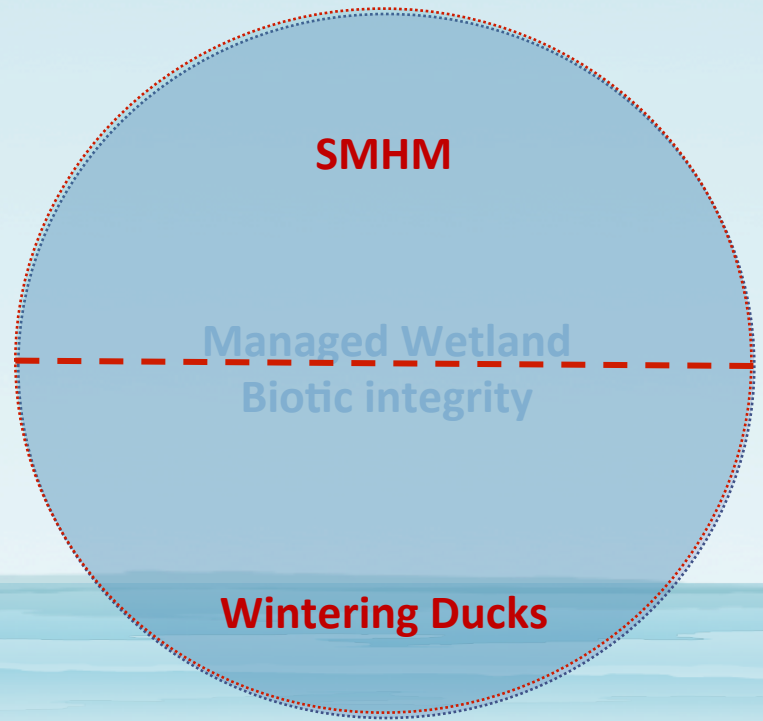
Overarching Objective: Biotic Integrity

Complete representation

SMHM

Managed Wetland
Biotic integrity

Wintering Ducks
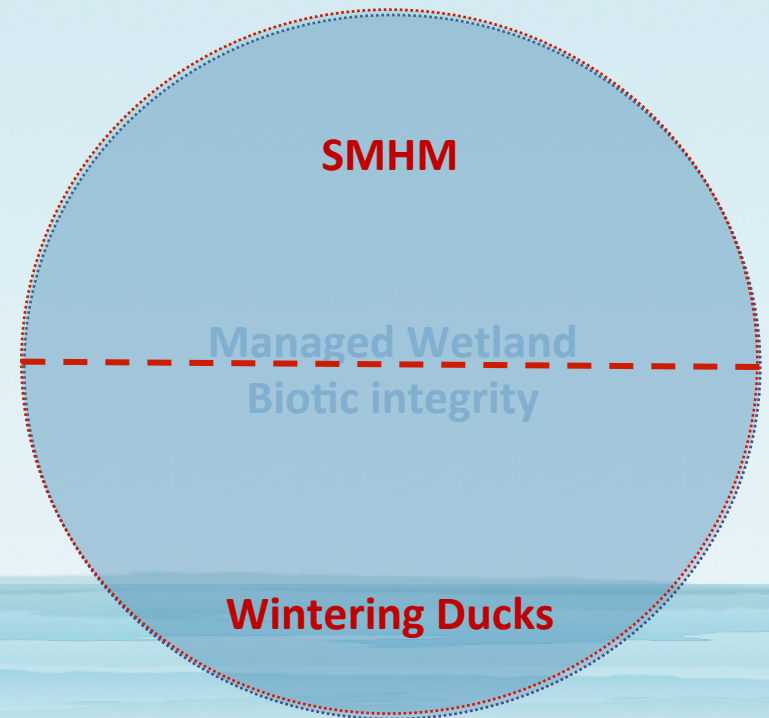
Overarching Objective: Biotic Integrity

Partial representation

SMHM

Wading birds, other?

Managed Wetland Biotic integrity

Ducks

Complete representation

SMHM

Managed Wetland Biotic integrity

Wintering Ducks
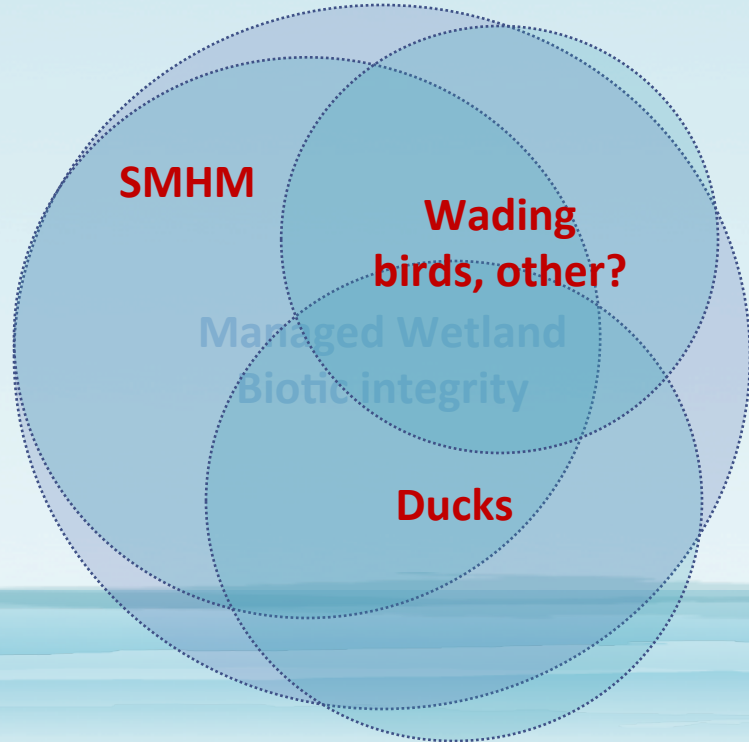
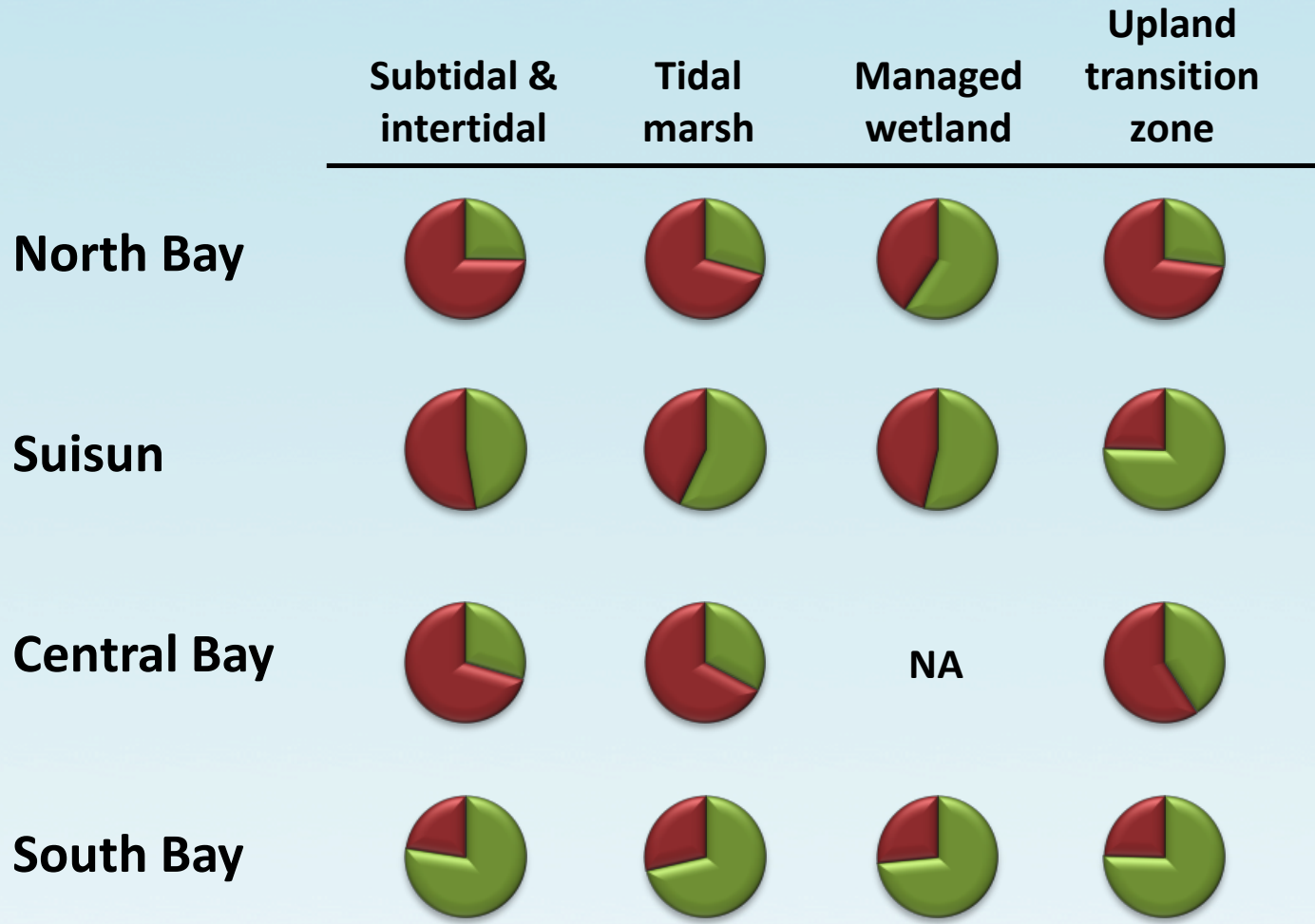# North Bay: Assume Rosy Allocation Near-term vs. Long-term (2030-2100)
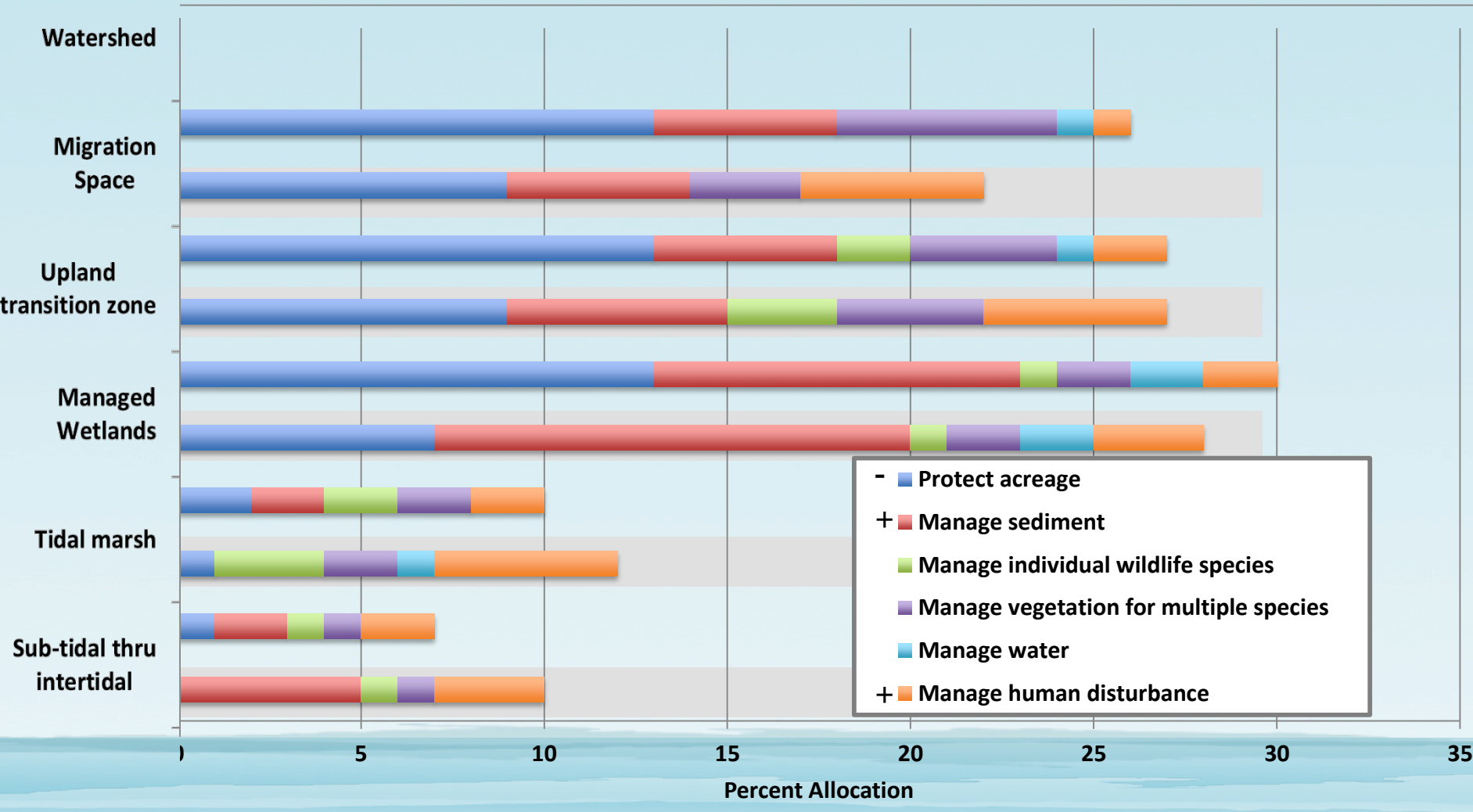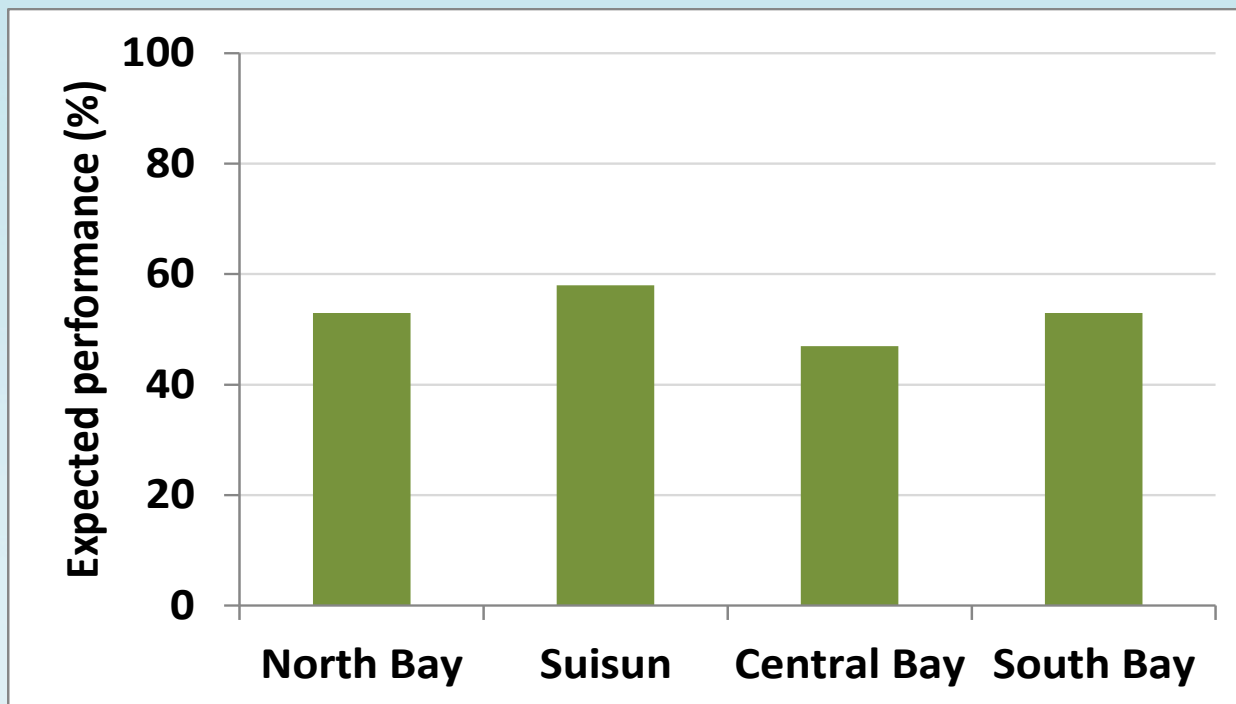
Sensitivity Analysis: South Bay Examples

- ## Subtidal & intertidal mudflats 2015-2029
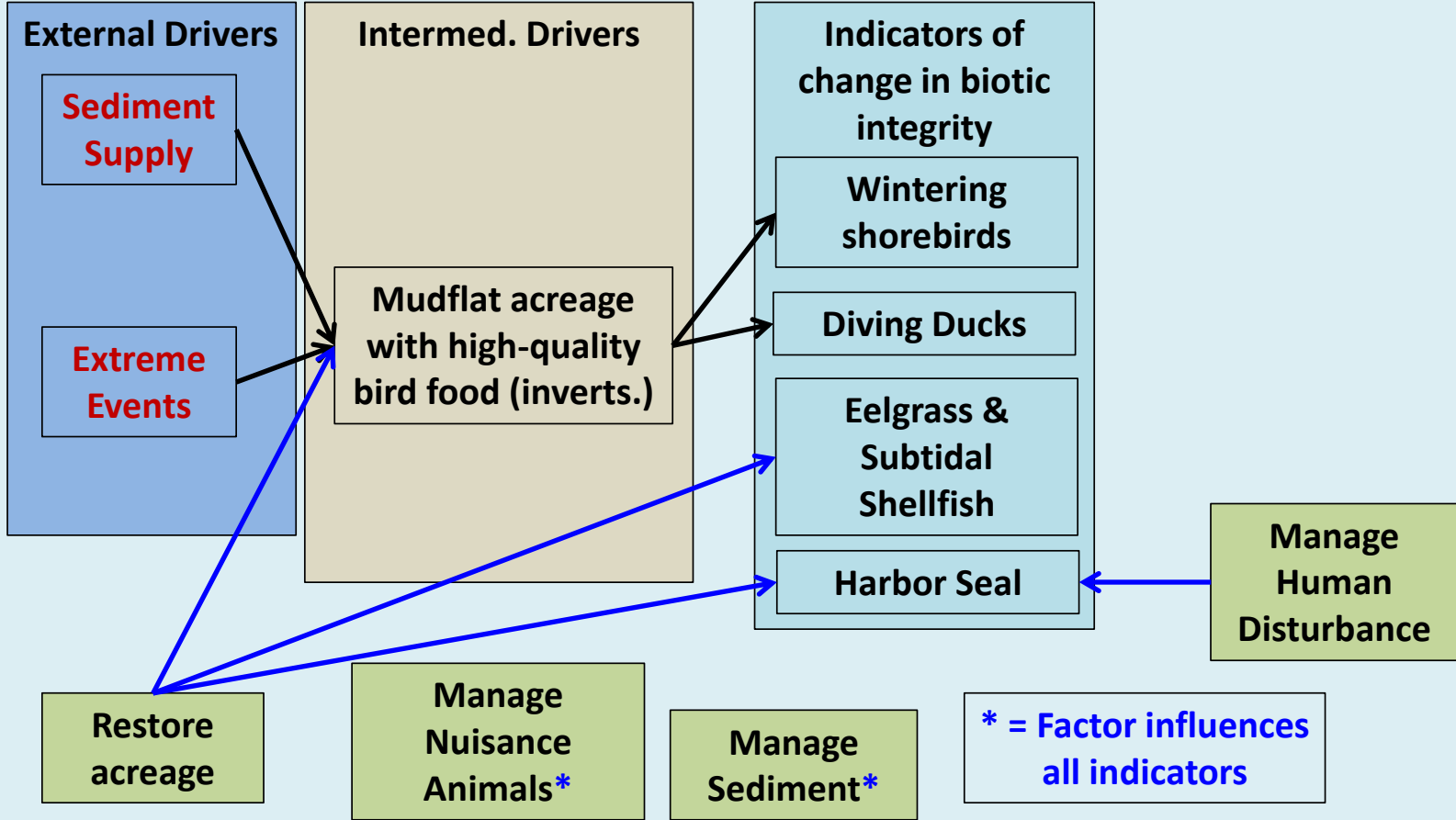
Near-term Changes in Biotic Integrity

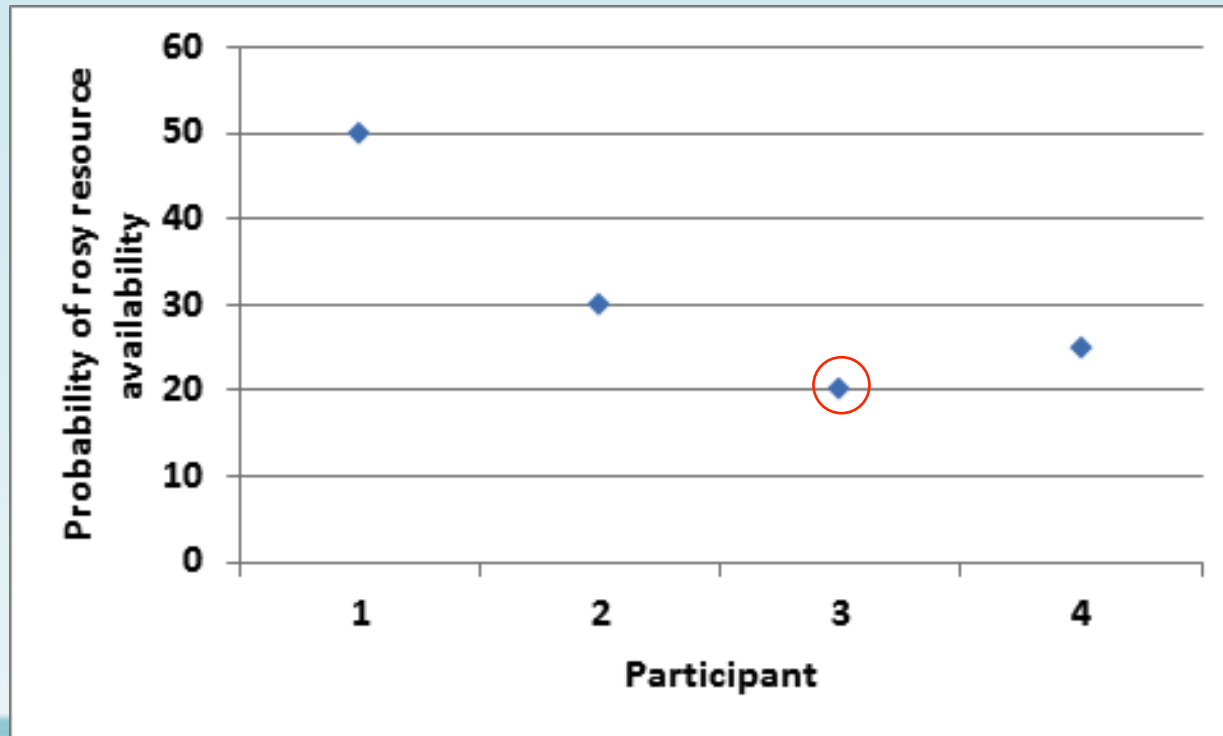|	Subtidal & intertidal	Tidal marsh	Managed wetland	Upland transition zone
North Bay				
Suisun				
Central Bay			NA	
South Bay				

10:30

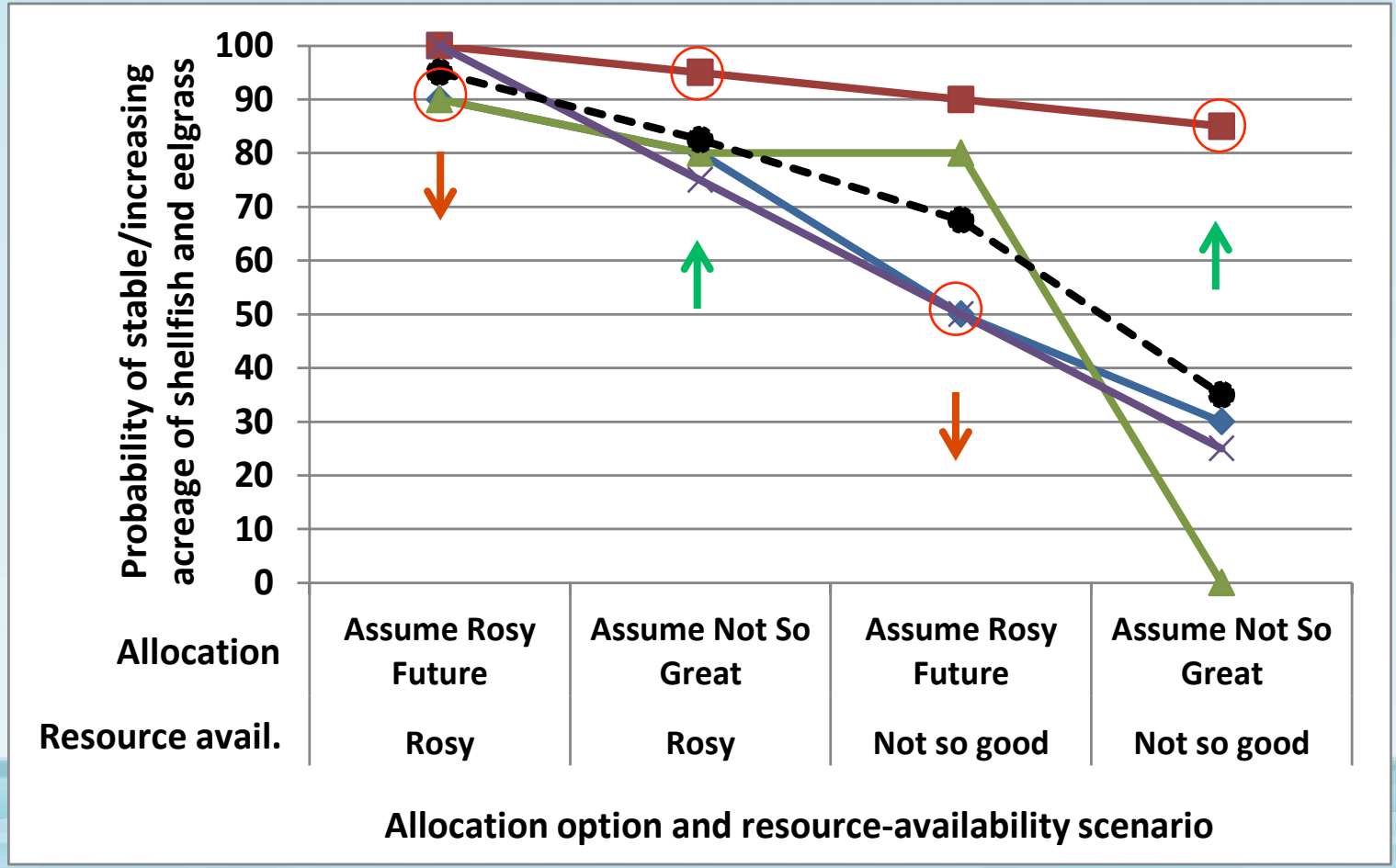# Expected Conservation Performance of Subregions

Sensitivity Analysis: South Bay Examples

- **Pessimistic probability for resource availability**

Sensitivity Analysis: South Bay Examples
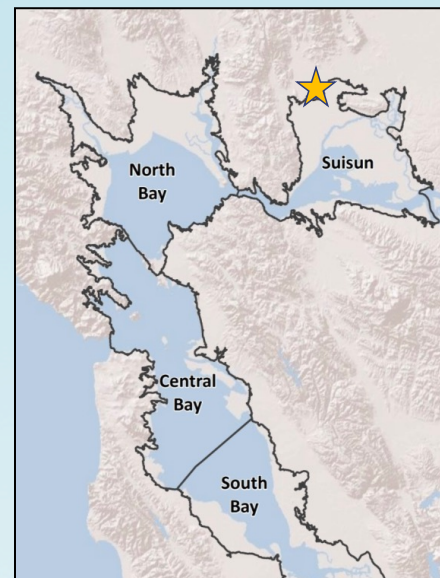
- **Torque allocation effects on shellfish & eelgrass**

Resolving Uncertainties about Management Effectiveness

- **Tidal marsh**

- **Upland transition zone**

- **Both near-term & long-term**

- **Up to 5% gain in expected performance**

9:50

Resolving Uncertainties about Management Effectiveness in Suisun

- **Tidal marsh**

- **Managed wetlands**

- **Up to 4% gain in expected performance**

10:00

Resolving Uncertainties about Management Effectiveness

- **Tidal marsh**

- **Managed wetlands**

- **Up to 4% gain in expected performance**

10:10

Resolving Uncertainties about Management Effectiveness in South Bay

- **Subtidal & Intertidal Mudflats (near-term only)**

- **Tidal marsh**

- **Managed wetlands**

- **Upland transition zone (long-term only)**

- **Up to 5% gain in expected performance**

10:20