# Considering climate change for sandy beach ecosystems in southern California

Jenny Dugan
UC Santa Barbara

# Iconic Assets

- Recreation
- Coastal economy
- Aesthetics
- Cultural identity

# Beaches as Ecosystems

# Beach Ecosystem Functions & Services

Water filtration

Nutrient cycling

# High Biodiversity & Rich Prey Resources for Birds & Fish

# Beach Fisheries:

Pismo Clams

California Grunion

Abundant & Diverse Shorebirds Use Beach Prey

Critical Habitat & Prey
for Shorebirds

Western Snowy Plover
young chick with prey

Development
Coastal Squeeze
Sea level rise

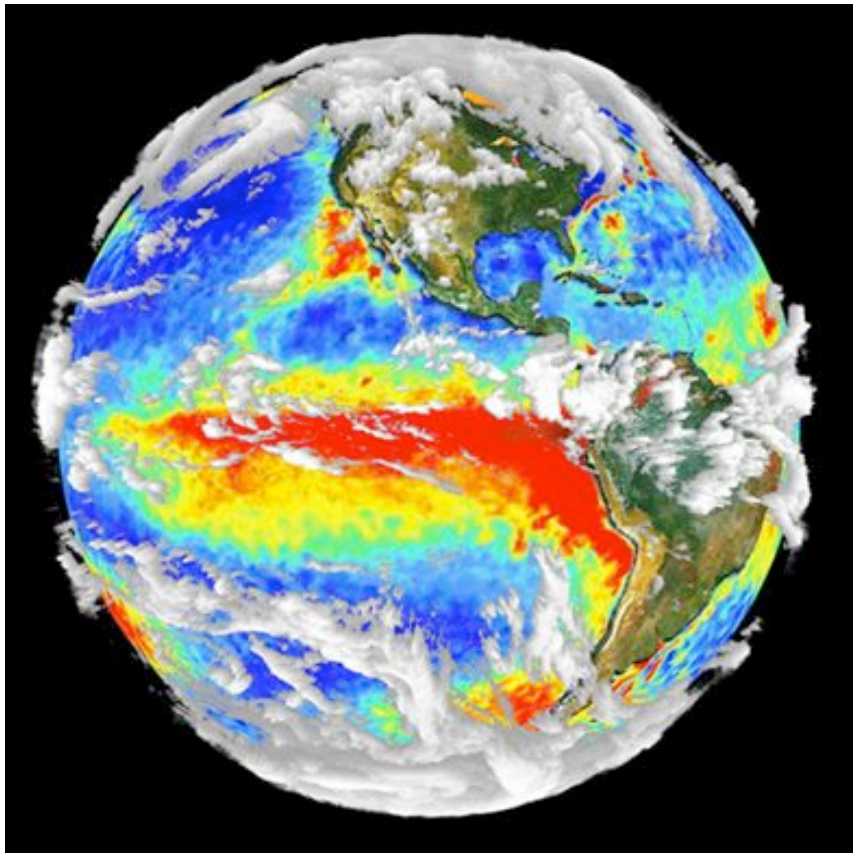
# Beach Ecosystems & Climate Change

Preliminary hypotheses:

- Habitat Loss/Conversion
- Habitat Fragmentation
- Shorter “summer” season
- Loss of biodiversity
- Reduced function
  - Wildlife support
  - Nutrient cycling
  - Water filtration

Information gaps: Ecological >>> Physical

# Insights from ENSO events in southern California



- Sea level rise of 30+ cm
- Altered storm tracks and wave direction
- Greater wave heights
- Higher precipitation
- Intensified coastal erosion

# Insights from armoring studies

- Inhibit shoreline retreat
- Interact with waves/tides
- Increase wave reflection
- Result in narrowing of beaches
- Disproportionate loss of upper beach zones

Beach Zone
Responses
Upper
Mid
Surf
Swash

# Upper beach zones

- Nesting Habitat
- Ecotone- coastal strand
- Wrack deposition & processing
- Buffer mobile intertidal life in wave events

Dynamic Ecotone
Summer 2009

Post 2009-2010 ENSO

# Depositional Conditions: Low tide & small swell

# Erosive: Large swell & high tide

Seawall at high tide

# Beach Zone Change: 1997-1998 ENSO

Southern Santa  Barbara County Coast, California

## Fall 1997 vs.Winter 1998

## Total intertidal width **-20%**

- Upper zone overall **-70%**

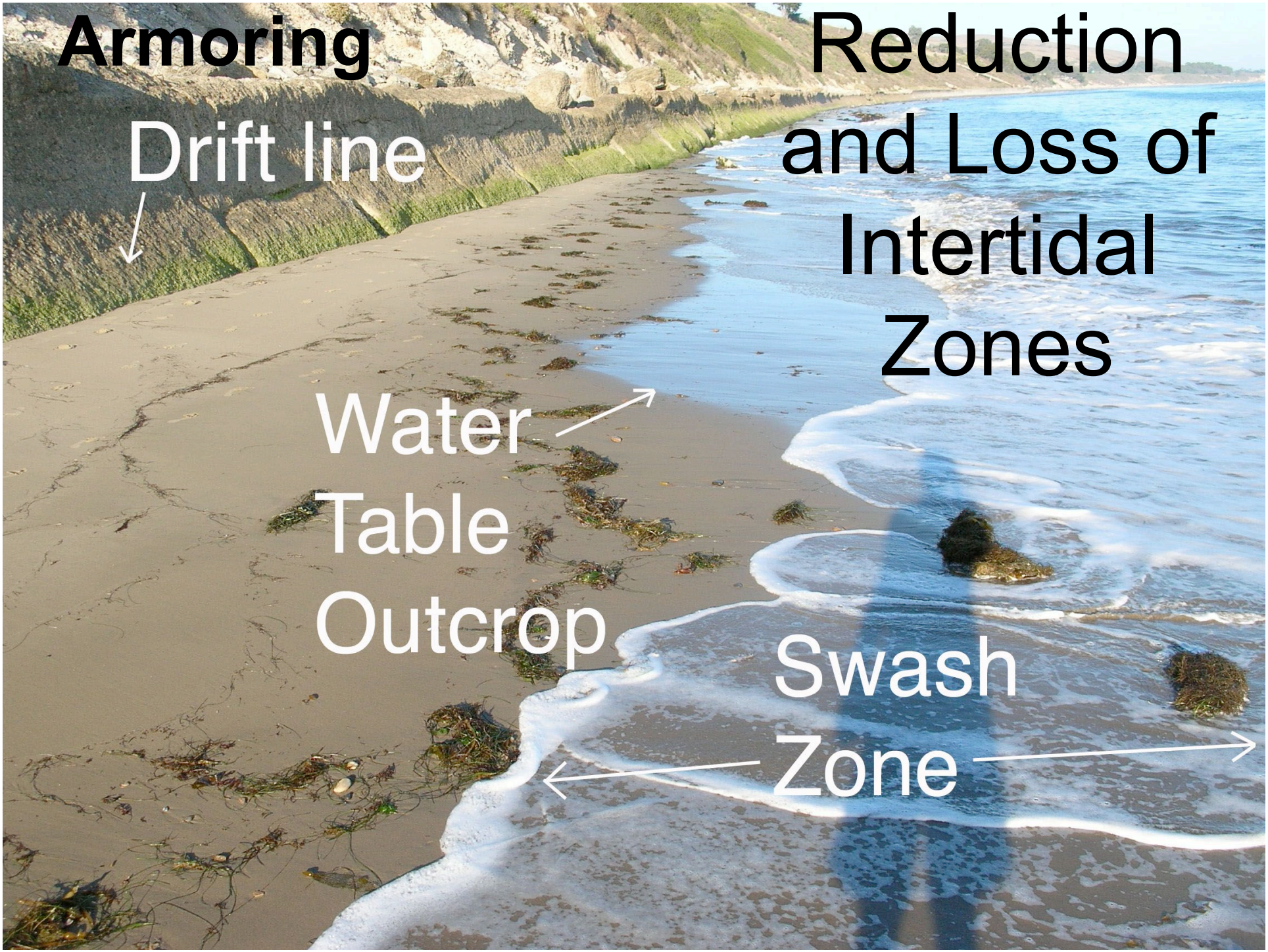
  Armored >Bluff-backed> Dune-backed

- Mid zone overall **+20%**

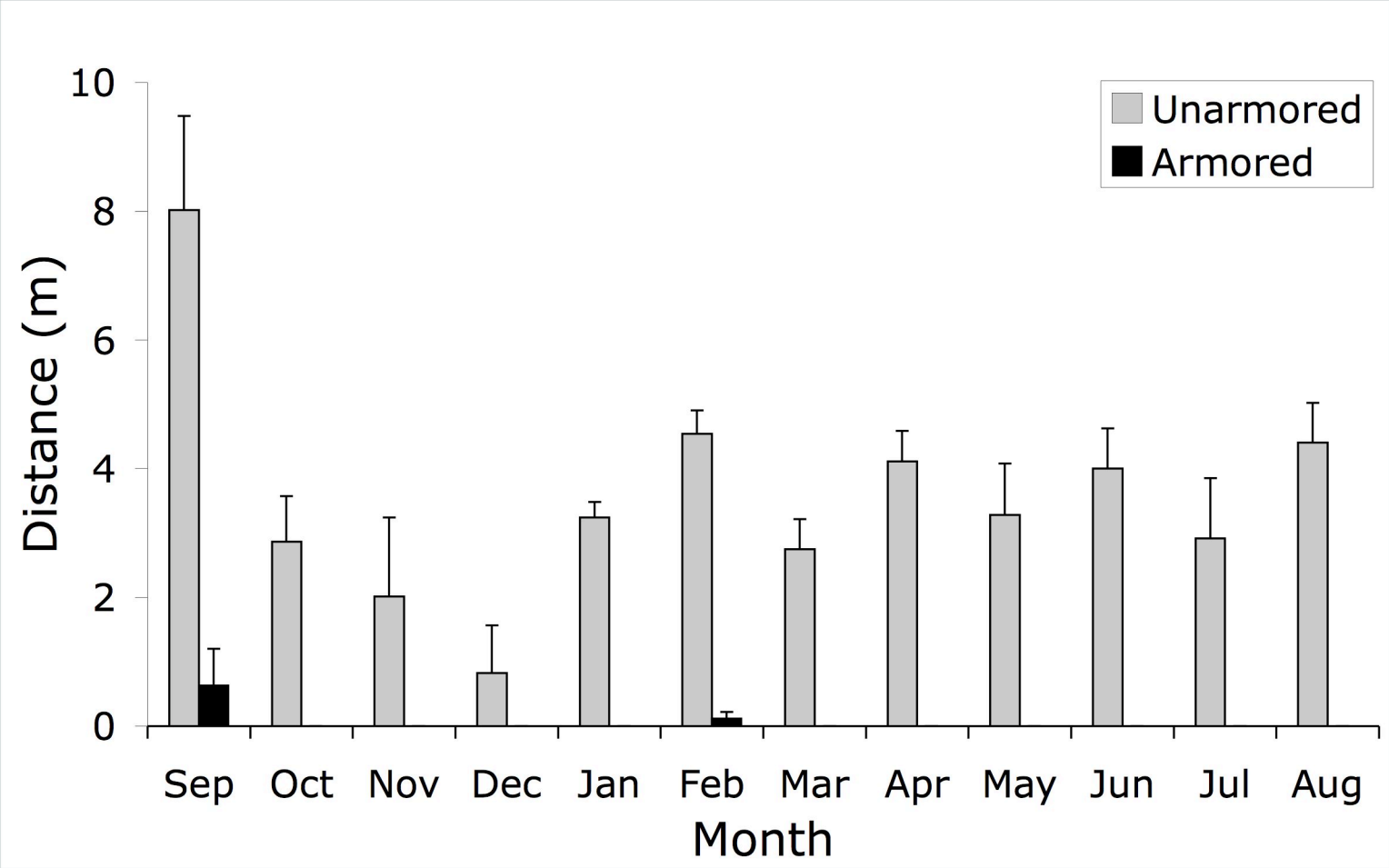
  Armored & Bluff-backed lost width

  Dune-backed beaches gained in mid zone

Conversion of sandy substrate to
cobble or bedrock


Armoring
Reduction and Loss of Intertidal Zones
Drift line
Water Table Outcrop
Swash Zone

# Upper Zone Widths

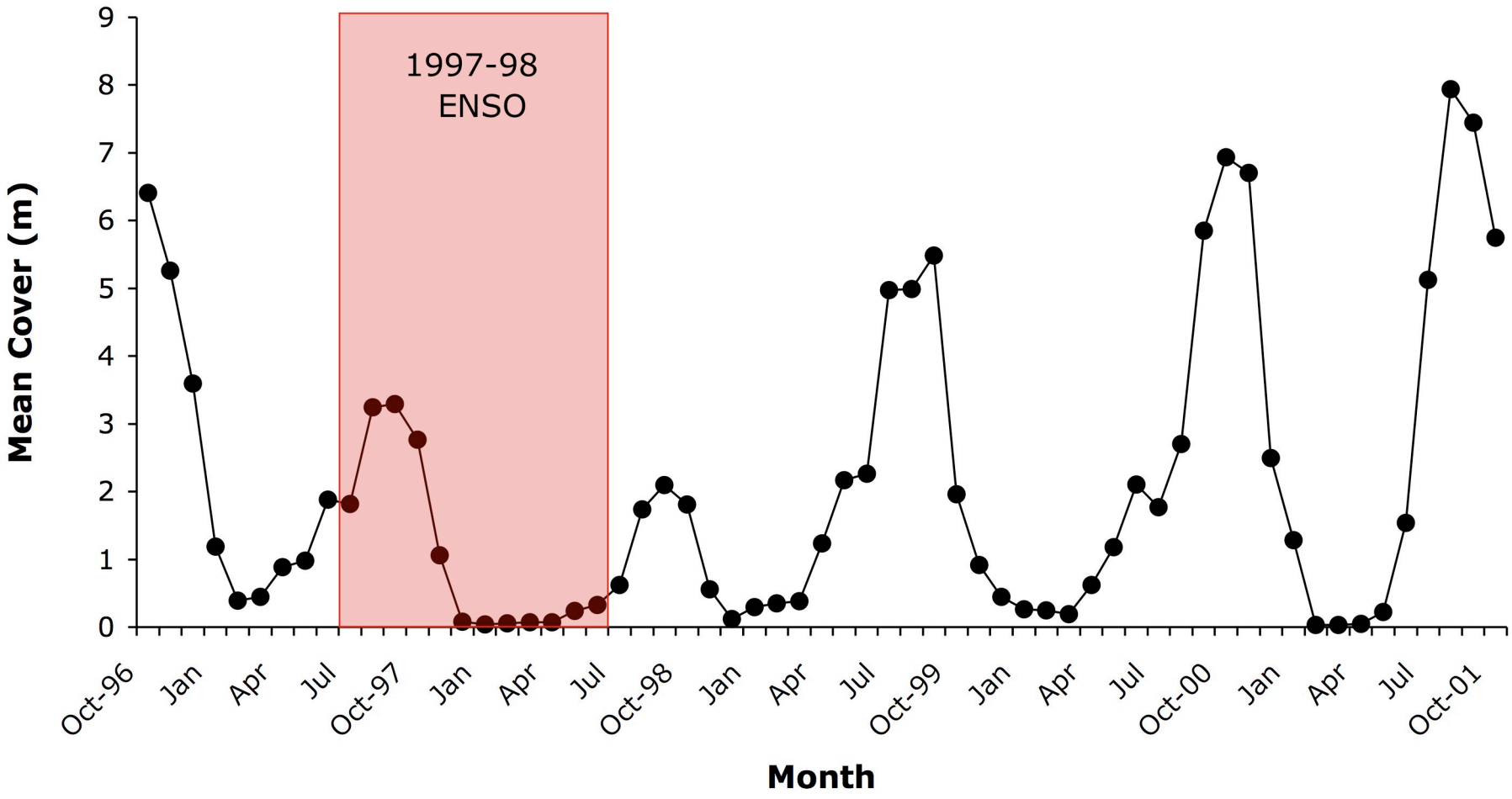



Dugan et al. 2008, Mar. Ecol.

Macroalgal
Wrack

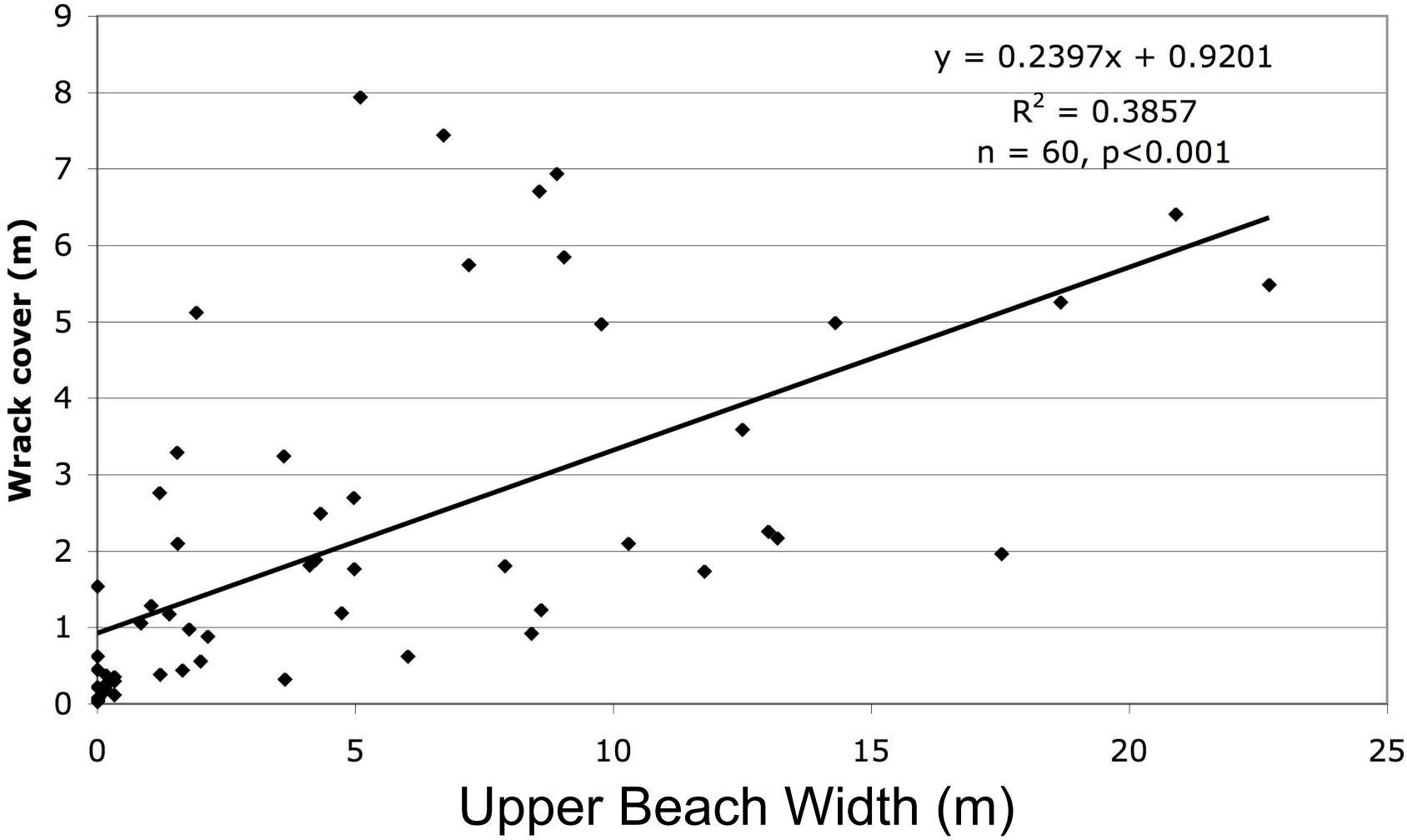
# Wrack : ~40% intertidal biodiversity

# 1997-98 ENSO: Wrack Abundance



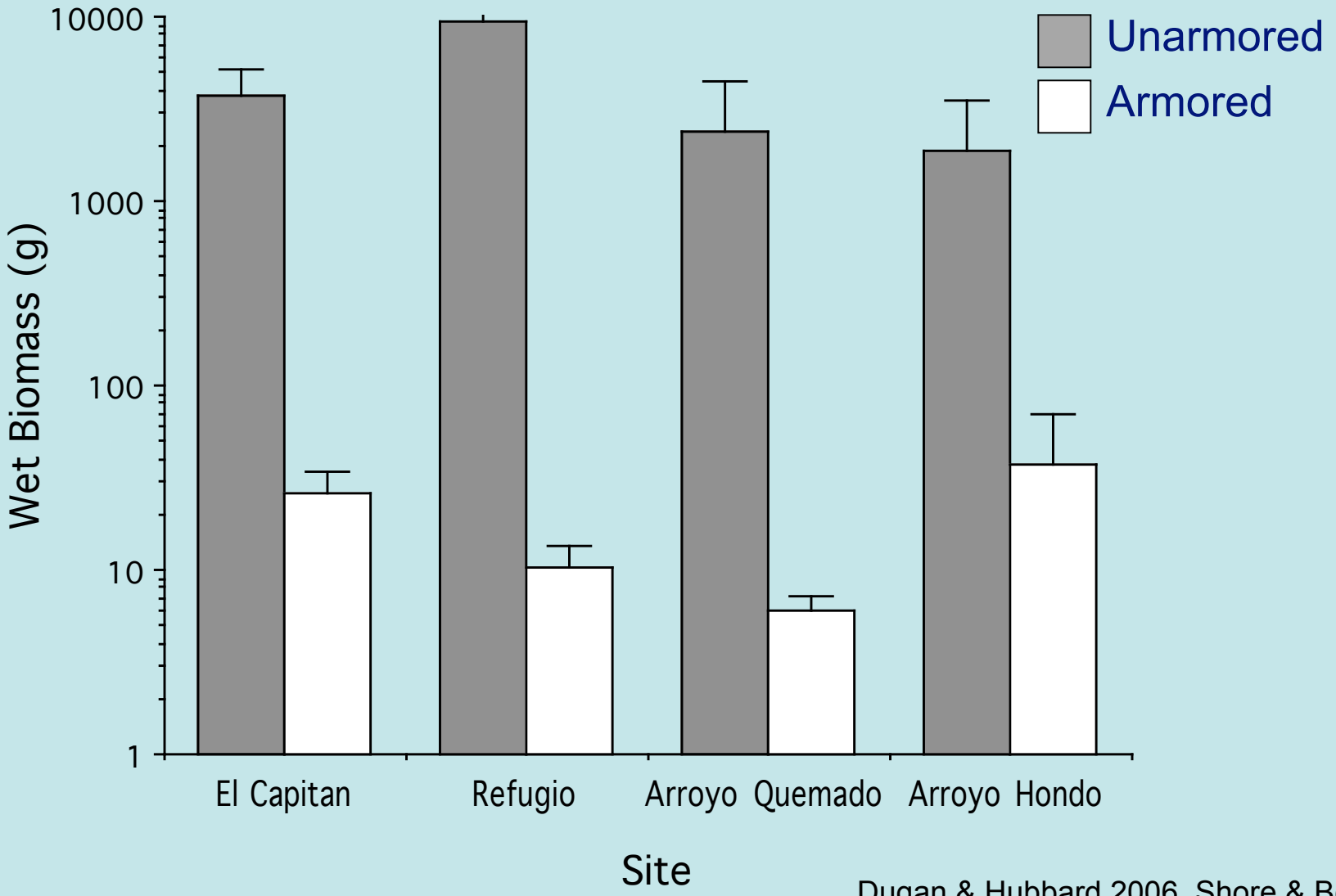

Revell et al 2011, J.Coastal Res.

# Upper Beach Width & Wrack 1996-2001




Revell et al 2011, J.Coastal Res.

# Armoring: Wrack Abundance

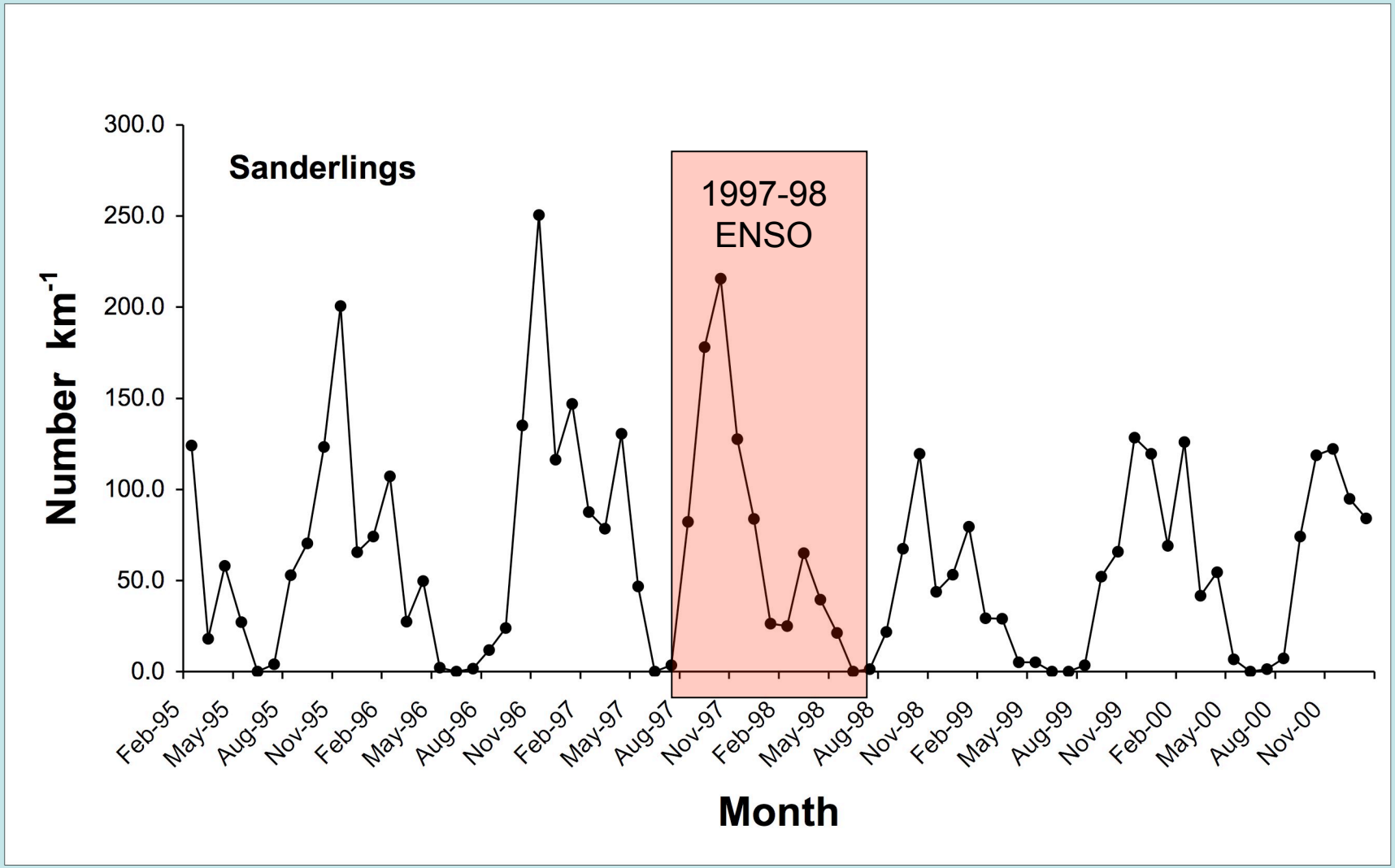



Dugan & Hubbard 2006, Shore & Beach

# Shorebirds

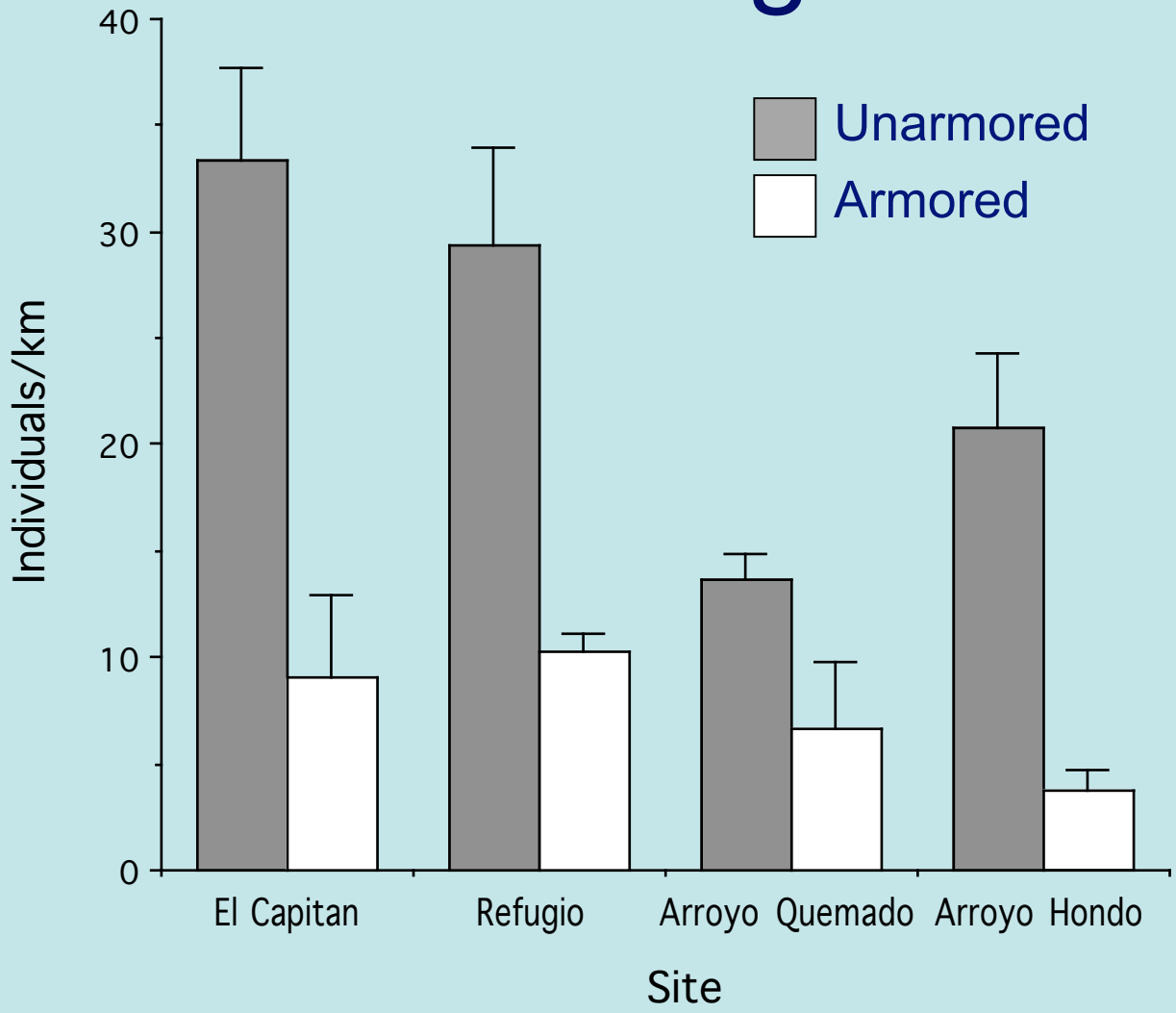
- Feeding habitat
- High tide refuges
- Habitat  & prey preferences

# ENSO: Shorebird Abundance



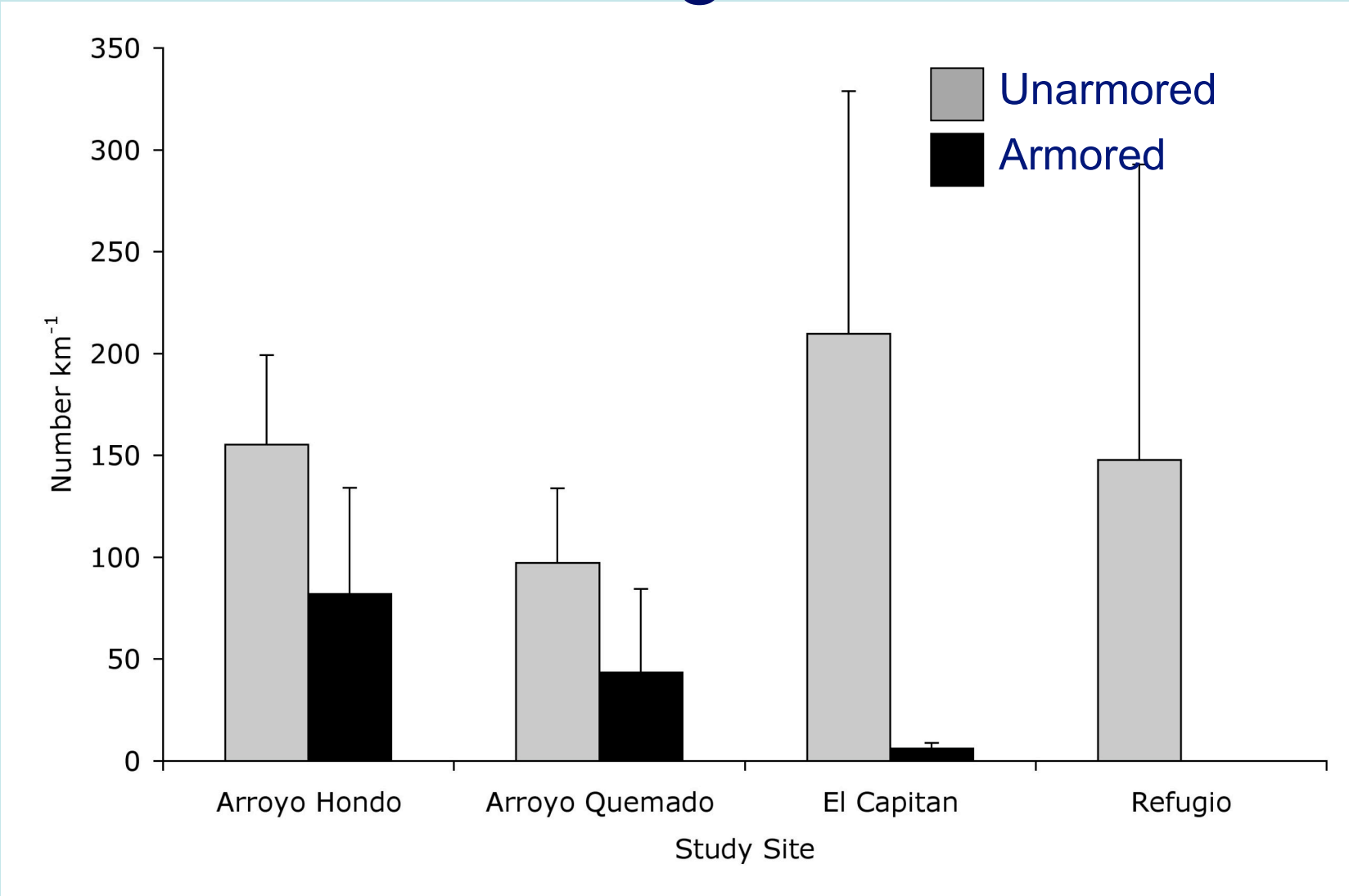

Revell et al 2011, J.Coastal Res.

# Armoring: Shorebird Abundance Fall Migration




Dugan & Hubbard 2006, Shore & Beach

# Armoring: Roosting Gulls & Seabirds Fall Migration




Dugan & Hubbard 2006, Shore & Beach

# Conservation of beaches as ecosystems

# Planning for Climate Change

- Prioritize beaches with high biodiversity and ecological function
- Allow shoreline retreat where possible
- Identify beaches that have room to retreat
- Restore/enhance biodiversity of beaches that can retreat

# Many thanks for supporting our research:

- Santa Barbara Coastal LTER
- National Science Foundation
- UCSB Shoreline Preservation Fund
- California Sea Grant
- Minerals Management Service