Linking tidal marshes, open water, novel ecosystems, and geography for fish recovery in the upper San Francisco Estuary

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Novel Ecosystems: Suisun Marsh and the Delta

A new reality
NOVEL ECOSYSTEMS
Most aquatic ecosystems in California

- Superficial resemblance to historic ecosystems
- Irreversibly altered
- Native + alien species
- Novel in structure and function?
NOVEL ECOSYSTEMS
Most aquatic ecosystems in California

• Novel in structure and function?
• More species, in unprecedented combinations
Historic ecosystems limited as model for modern ecosystems

• Hint at conditions under which native species evolved

• Baselines are altered ecosystems?
From Whipple et al. SFEI
Why emphasize novel ecosystems?

• Reality – the way things are
• We need novel approaches to conserve native species
Novel Ecosystems, this talk

- North Delta
- Central Delta
- Suisun Marsh
North Delta Arc of Native Fishes

Sacramento River

Sacramento Deep Water Ship Canal

Lindsey Slough

Suisun Marsh

Shornan Island

UC Davis Arc Project

Amber Manfree
North Delta. Cache Slough complex
Native vs Non-native Fish: Electrofishing Cache Slough Regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Native</th>
<th>Non-Native</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Lindsey</td>
<td>1.0</td>
<td>2.5</td>
</tr>
<tr>
<td>Lower Lindsey</td>
<td>1.2</td>
<td>3.0</td>
</tr>
<tr>
<td>Lower Cache</td>
<td>1.1</td>
<td>2.2</td>
</tr>
<tr>
<td>Upper Cache</td>
<td>1.5</td>
<td>2.8</td>
</tr>
</tbody>
</table>
Seasonal shifts in species

Matthew Young
Cache Slough: Longitudinal Variation

Matthew Young

January
February
March
April
May
June
July
August
September
October
November
December

Upper Cache Slough

Lower Cache Slough

ASH  BB  BC  BF  BG  BLB  BLP  CCF  CP  DS  GSH  HCH  ISS  LFS  MSF  RESF  SB  SCP  SG  SKR  SPM  ST  STBK  TFS  TP  WC  WCF  YFG
CENTRAL DELTA
Alien “ecosystem engineers” dominate

Overbite clam

“MOST INVADED ESTUARY IN THE WORLD.”

Brazilian waterweed
Fish, Central Delta, from Grimaldo et al. 2012
Seines in SAV
URBAN AF BASE
Fairfield-Suisun Waste Water Treatment Plant
Potrero Hills Landfill

HUNTING CLUBS

WILDLIFE REFUGE

INDUSTRIAL

US Navy Ready Reserve Fleet

470 km²

370 km of dikes
Native vs alien fish: Suisun Marsh

% native fish

% native fishes

Natives

Aliens
A is for Alien

SOME MICROHABITAT SEGREGATION
CORE GROUP VARIES IN RELATIVE ABUNDANCE BY TIME AND PLACE

Denverton Slough dominant species 1993-2011
# TOP TEN SPECIES 1980-89 vs 2002-12

<table>
<thead>
<tr>
<th>Rank</th>
<th>First 10 Years</th>
<th>Last 10 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>STRIPED BASS</td>
<td>STRIPED BASS</td>
</tr>
<tr>
<td>2</td>
<td>THREESPINE STICKLEBACK</td>
<td>SPLITTAIL</td>
</tr>
<tr>
<td>3</td>
<td>TULE PERCH</td>
<td>TULE PERCH</td>
</tr>
<tr>
<td>4</td>
<td>SPLITTAIL</td>
<td>WHITE CATFISH</td>
</tr>
<tr>
<td>5</td>
<td>LONGFIN SMELT</td>
<td>YELLOWFIN GOBY</td>
</tr>
<tr>
<td>6</td>
<td>PRICKLY SCULPIN</td>
<td>SHIMOFURI GOBY</td>
</tr>
<tr>
<td>7</td>
<td>YELLOWFIN GOBY</td>
<td>PRICKLY SCULPIN</td>
</tr>
<tr>
<td>8</td>
<td>COMMON CARP</td>
<td>THREESPINE STICKLEBACK</td>
</tr>
<tr>
<td>9</td>
<td>SACRAMENTO SUCKER</td>
<td>COMMON CARP</td>
</tr>
<tr>
<td>10</td>
<td>SHIMOFURI GOBY</td>
<td>BLACK CRAPPIE</td>
</tr>
</tbody>
</table>

Not in top ten in other time period
Major macro-invaders 1980-2012
Zooplankton Abundance

Suisun City

Denverton

Montezuma

Suisun Marsh

Jacob Montgomery

(Limnoithona omitted)
Conclusions -1

• Suisun Marsh and Delta are novel ecosystems
• Alien fishes and invertebrates dominate in most areas
Conclusions - 2

- Tidal marsh structure and function variable and complex
- Pelagic tidal habitat also highly altered
- Tidal marsh habitat benefits native fishes most in Suisun Marsh
Implications

• Novel biotic assemblages will persist in all habitats
• Management for desirable species
Implications

• Passive restoration of tidal marsh unlikely to benefit most native fishes, but especially pelagic species.
Implications

Active management and monitoring of all restoration projects required for success

—Breach and leave rarely works
Managed wetlands:
Mixed residence time
Tidal Trapping
Ponding

Luco Pond

John Durand
Novel Ecosystems: Novel Management Approaches

John Durand
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THANK YOU