

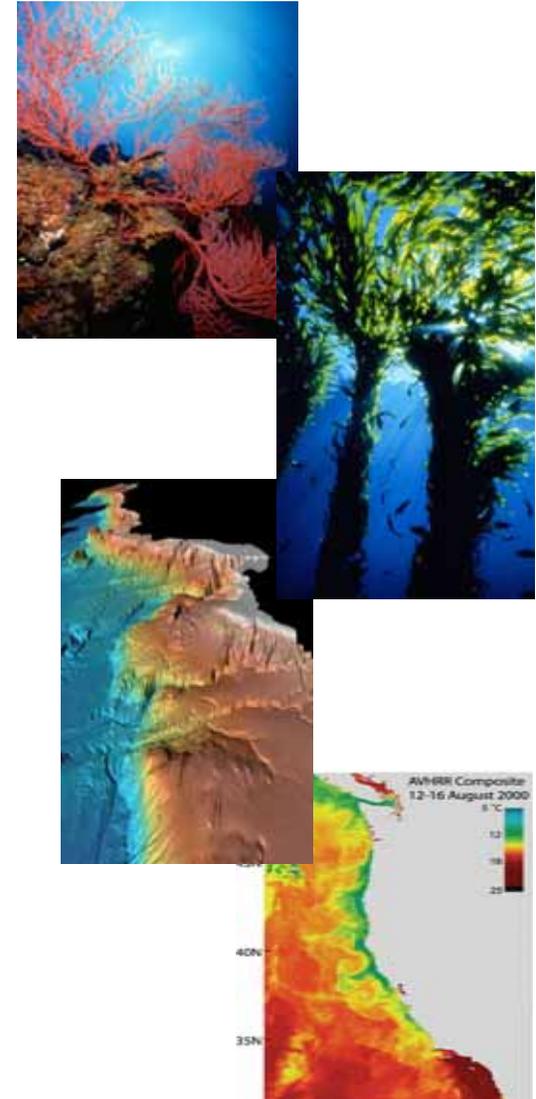
# Simple Guidelines From Complex Connectivity





# MLPA Goals

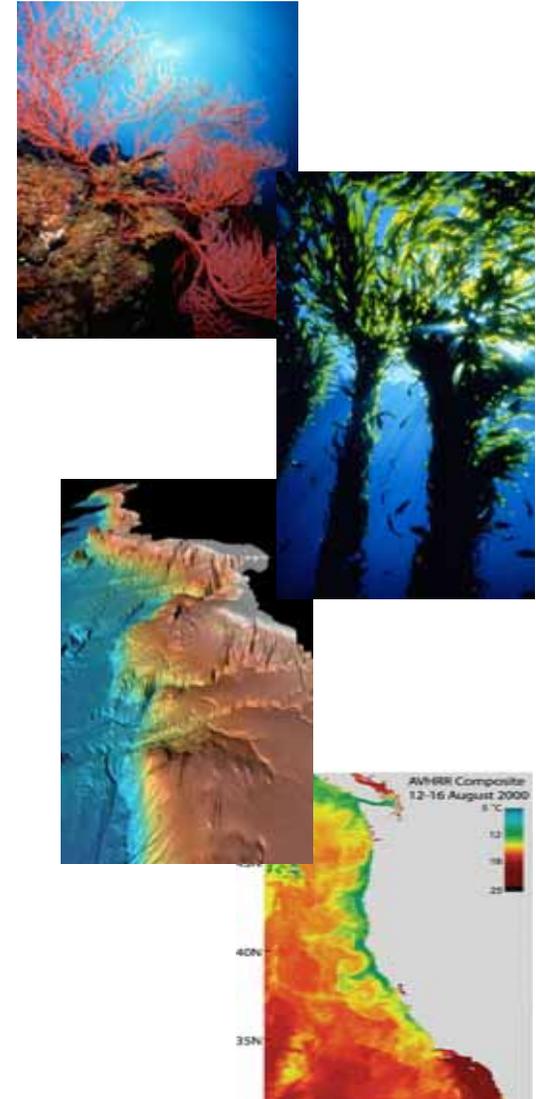
1. To protect the natural diversity and function of **marine ecosystems**.
2. To help sustain and restore **marine life populations**.
3. To improve **recreational, educational, and study opportunities** in areas with minimal human disturbance.
4. To protect representative and unique **marine life habitats**.
5. Clear objectives, effective management, adequate enforcement, sound science.
6. To ensure that MPAs are designed and managed as a **network**.





# MLPA Goals: Habitats

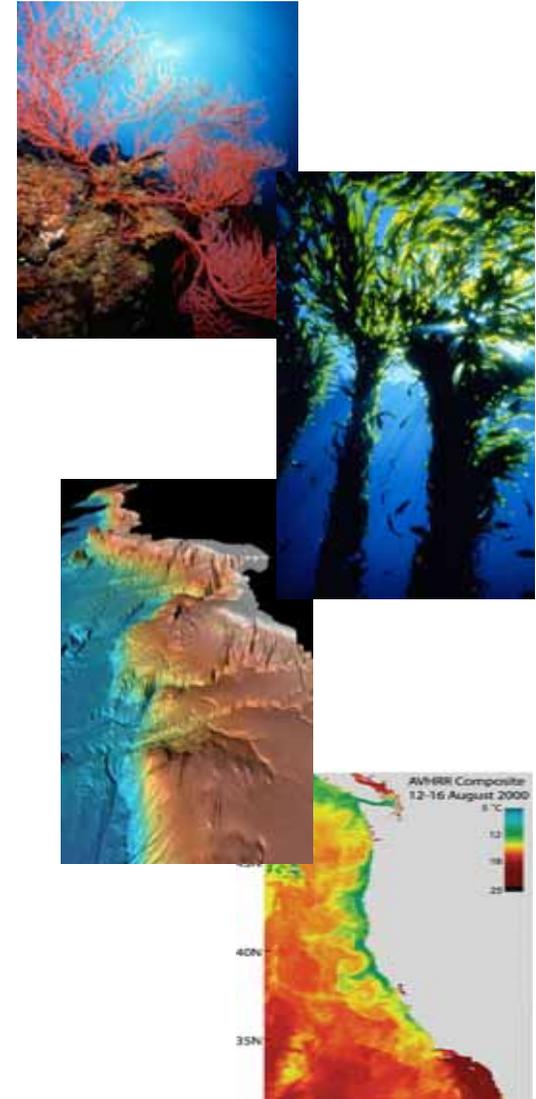
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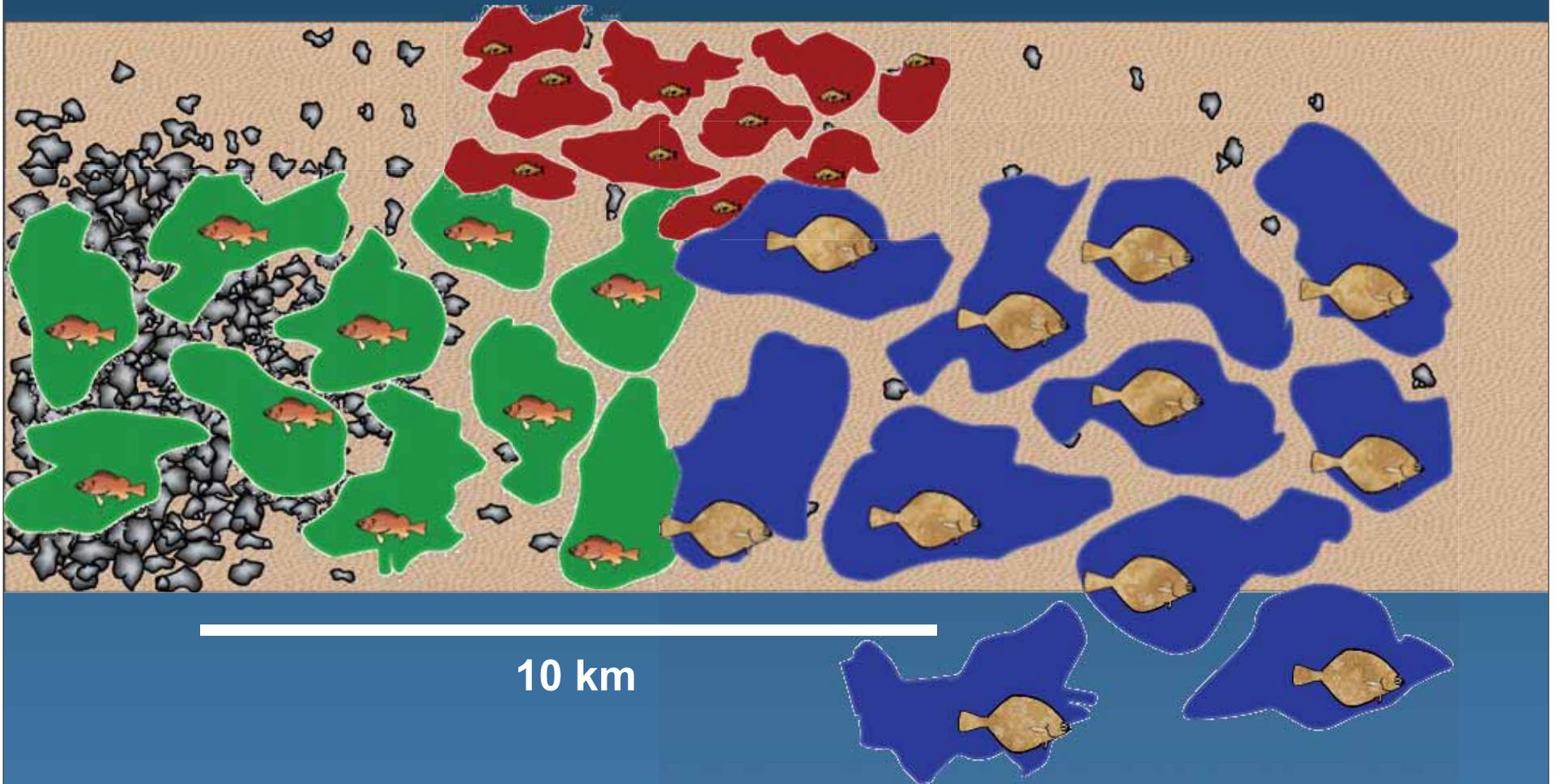


# MLPA Goals: Populations

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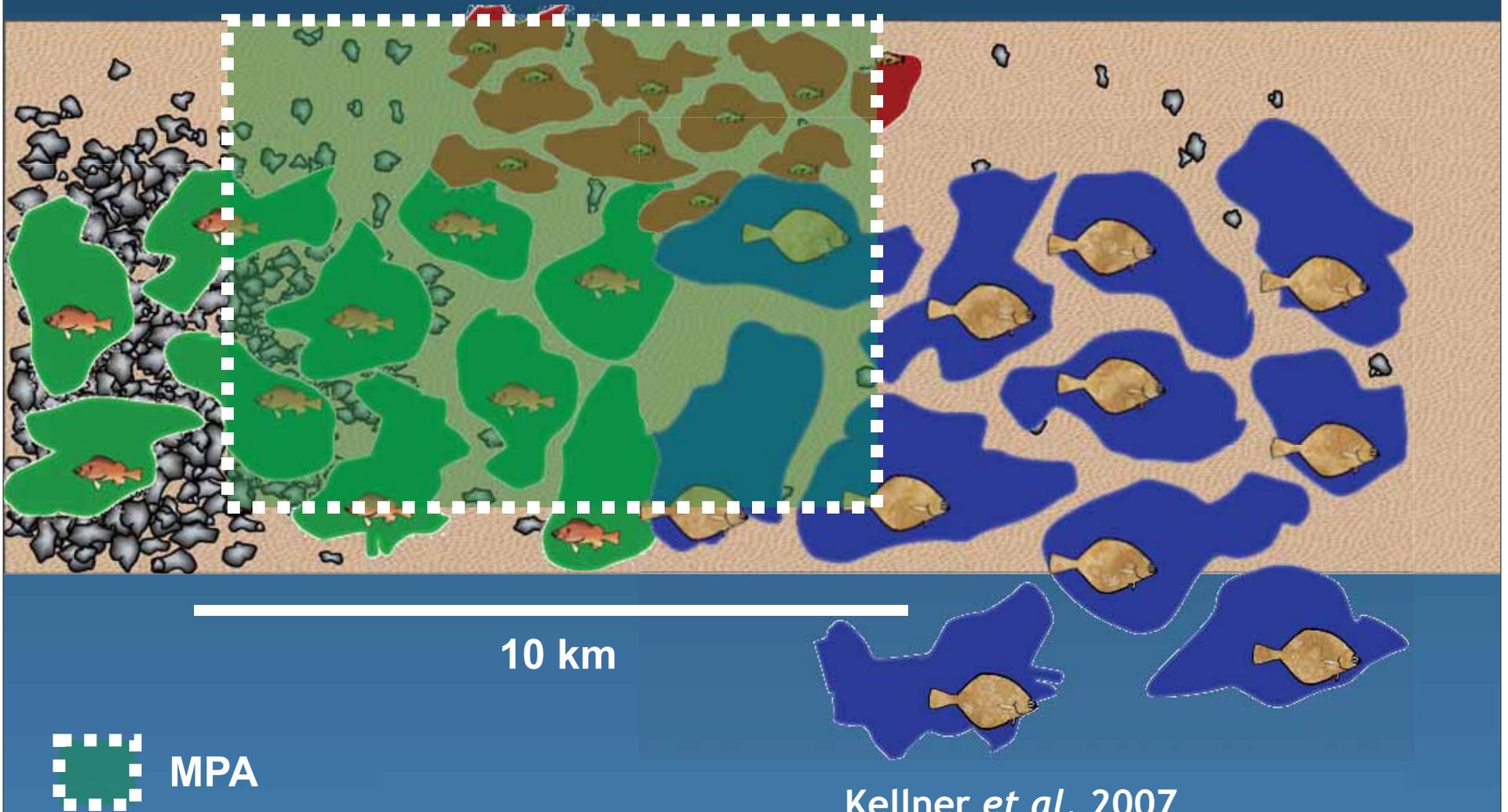


To achieve sustainable populations:  
MPA size  $>$  movement of adults.



*Kellner et al. 2007*

To achieve sustainable populations:  
MPA size > movement of adults.



# Adult Movement for Species of Interest

0 – 1 km	1 – 10 km	10 – 100 km	100 – 1000 km	> 1000 km
<p><b>Invertebrates</b></p> <ul style="list-style-type: none"> <li>Abalone</li> <li>Mussel</li> <li>Octopus</li> <li>Sea Star</li> <li>Snail</li> <li>Urchin</li> </ul> <p><b>Rockfishes</b></p> <ul style="list-style-type: none"> <li>Blk. &amp; Yellow</li> <li>China</li> <li>Gopher</li> <li>Kelp</li> </ul> <p><b>Other Fishes</b></p> <ul style="list-style-type: none"> <li>Gobie</li> <li>Sculpin</li> </ul>	<p><b>Rockfishes</b></p> <ul style="list-style-type: none"> <li>Black</li> <li>Brown</li> <li>Copper</li> <li>Greenspotted</li> <li>Olive</li> <li>Vermilion</li> </ul> <p><b>Other Fishes</b></p> <ul style="list-style-type: none"> <li>Cabazon</li> <li>Ca. Halibut</li> <li>Lingcod</li> </ul> 	<p><b>Invertebrates</b></p> <ul style="list-style-type: none"> <li>Dung. Crab*</li> </ul> <p><b>Rockfishes</b></p> <ul style="list-style-type: none"> <li>Bocaccio</li> <li>Canary</li> <li>Yellowtail</li> <li>Widow</li> </ul> <p><b>Other Fishes</b></p> <ul style="list-style-type: none"> <li>Anchovy</li> <li>Herring</li> <li>Sardine</li> </ul> <p><b>Birds</b></p> <ul style="list-style-type: none"> <li>Gulls</li> <li>Cormorants</li> </ul> <p><b>Mammals</b></p> <ul style="list-style-type: none"> <li>Harbor Seal</li> <li>Otter</li> </ul>	<p><b>Fishes</b></p> <ul style="list-style-type: none"> <li>Big Skate</li> <li>Pacific Halibut</li> <li>Sablefish*</li> <li>Salmonids*</li> <li>Sturgeon</li> <li>Whiting*</li> </ul> <p><b>Birds</b></p> <ul style="list-style-type: none"> <li>Gulls*</li> </ul> <p><b>Mammals</b></p> <ul style="list-style-type: none"> <li>Porpoises</li> <li>Sea Lions*</li> </ul>	<p><b>Invertebrates</b></p> <ul style="list-style-type: none"> <li>Jumbo Squid*</li> </ul> <p><b>Fishes</b></p> <ul style="list-style-type: none"> <li>Sharks*</li> <li>Tunas*</li> </ul> <p><b>Turtles*</b></p> <p><b>Birds</b></p> <ul style="list-style-type: none"> <li>Albatross*</li> <li>Pelican*</li> <li>Shearwater*</li> <li>Shorebirds*</li> <li>Terns*</li> </ul> <p><b>Mammals</b></p> <ul style="list-style-type: none"> <li>Dolphins</li> <li>Sea Lions*</li> <li>Whales*</li> </ul>

\* Seasonal Migration

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<p>* Seasonal Migration</p>				

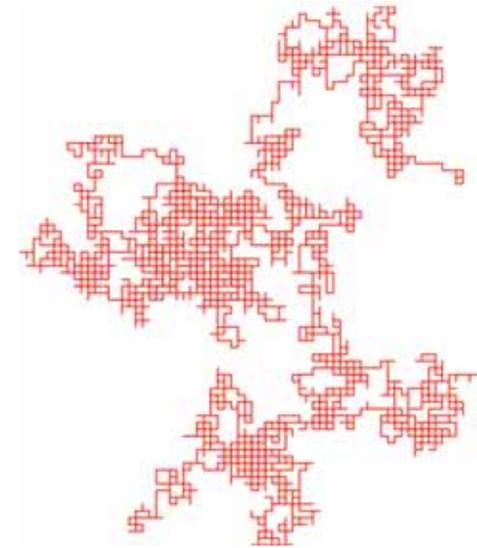
# Dispersal Between MPAs is Just as Beneficial as Retention Within MPAs

 MPA

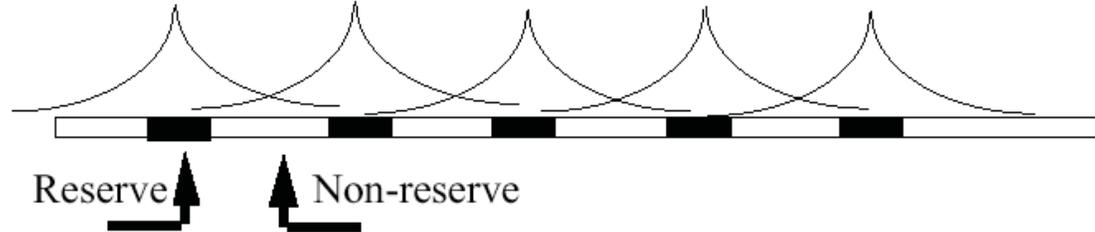




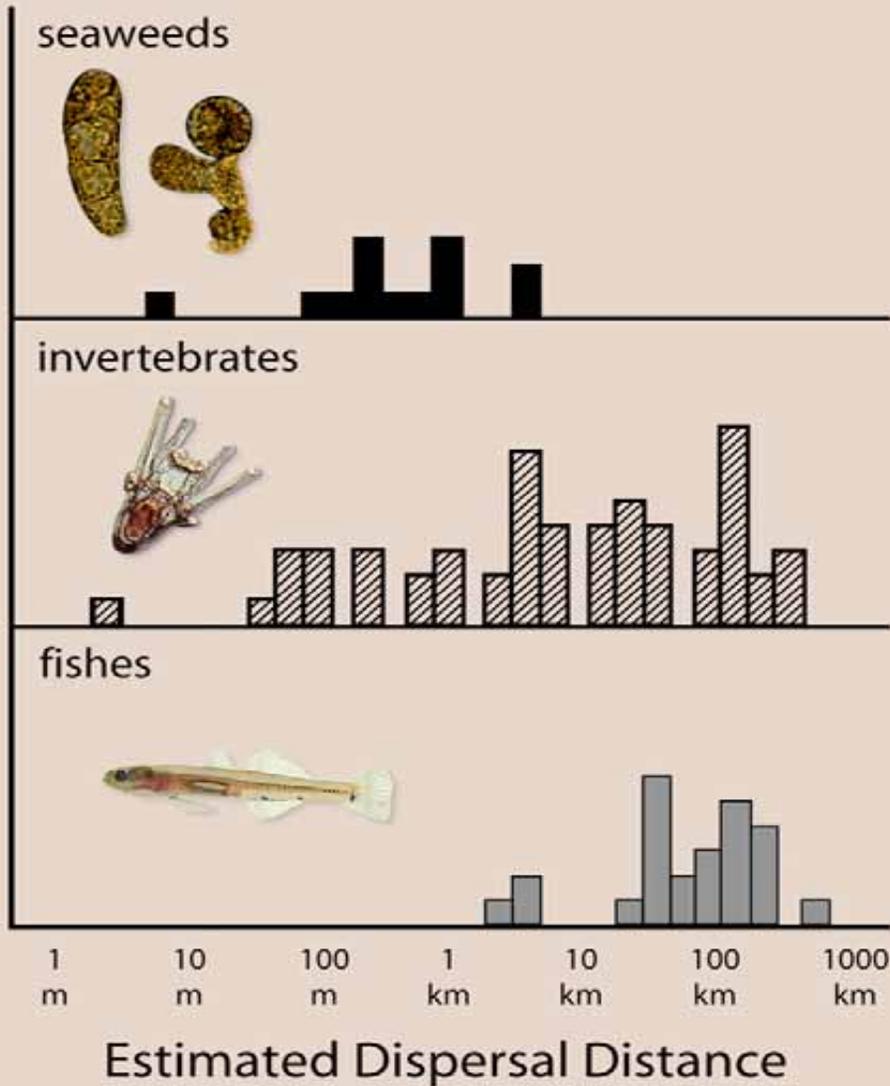
# Larval Dispersal & Population Dyn.



larval dispersal profile

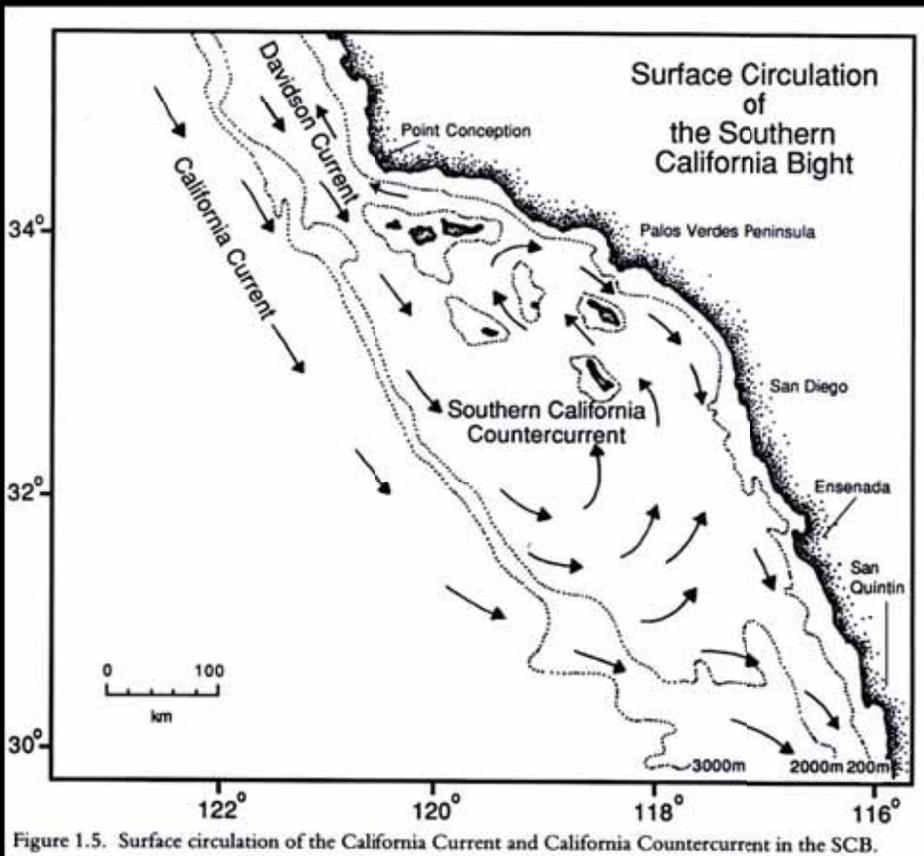


# Dispersal of Young



# Simple

## Surface-Circulation Cartoon



## 6 synoptic views of circulation in SCB

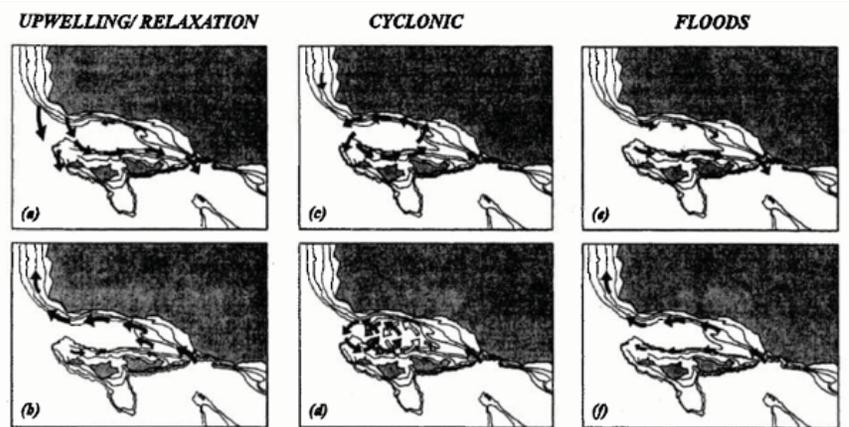
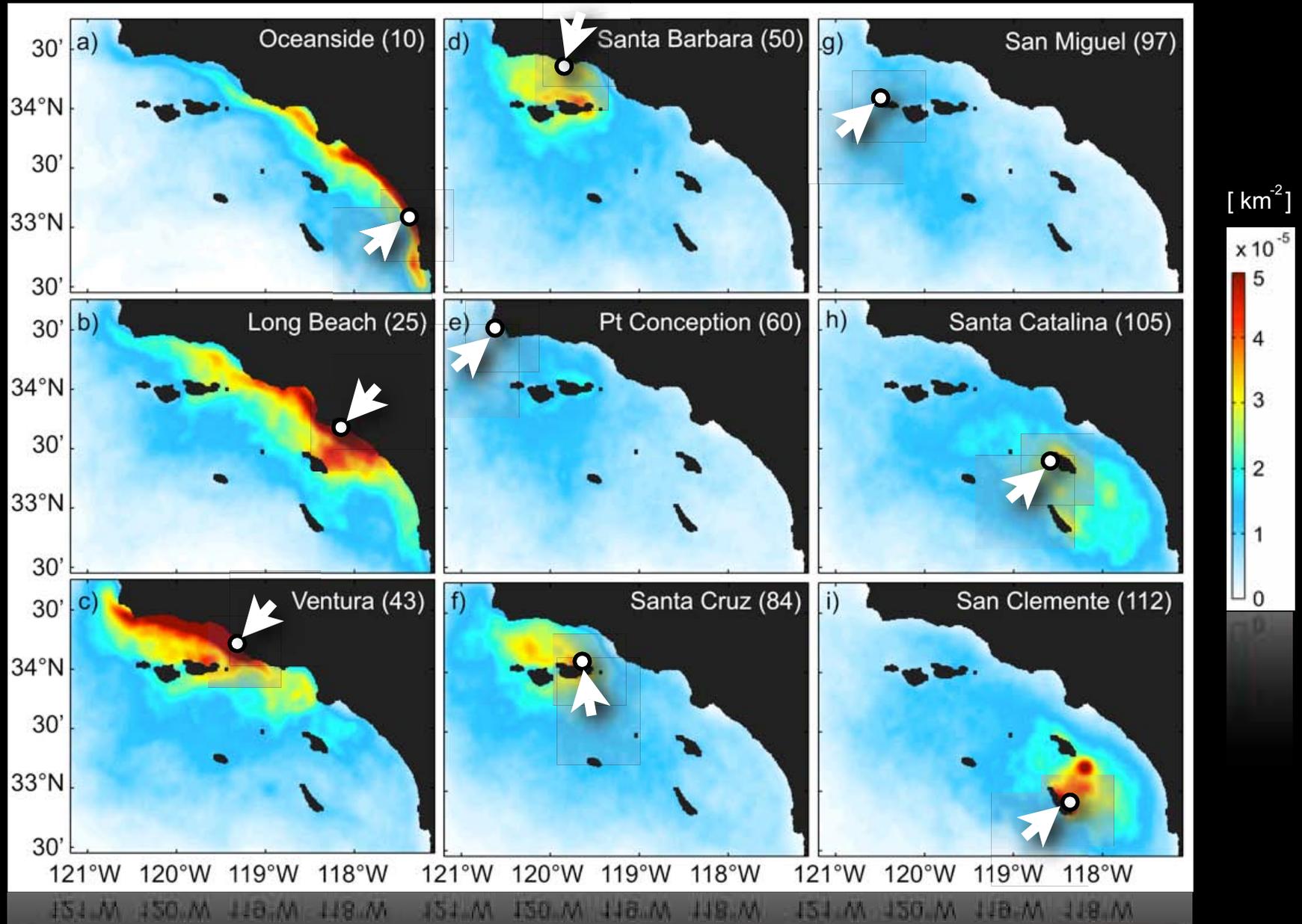


Figure 10. Schematic diagram of the six synoptic views of circulation in the Santa Barbara Channel. (a) Upwelling, (b) Relaxation, (c) Cyclonic, (d) Propagating Cyclones, (e) Flood East, and (f) Flood West.

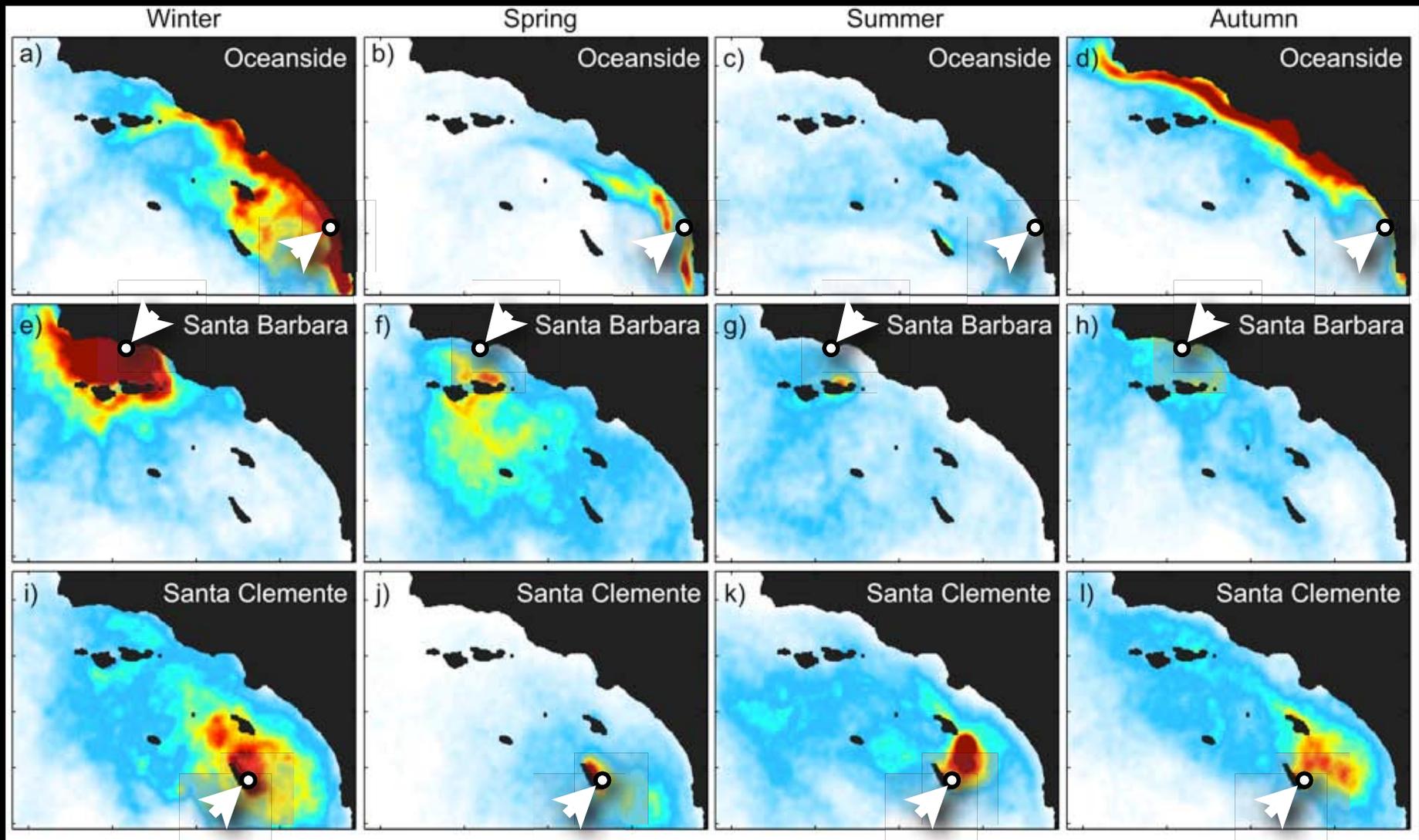
Dever et al. (1991)

# Kernels From Different Sites (30 d)



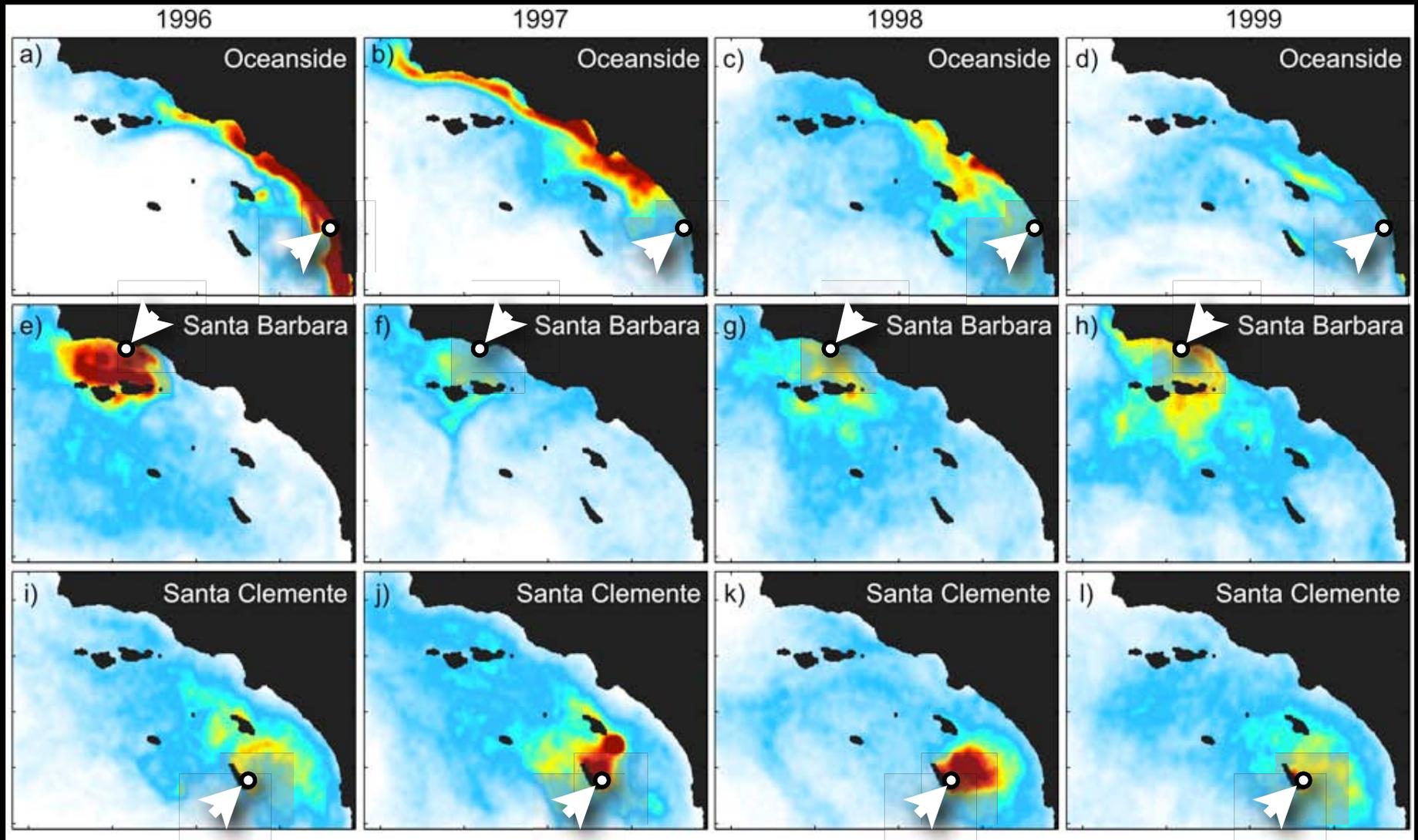
# Seasonal Variability

Advection time = 30 days



# Interannual Variability

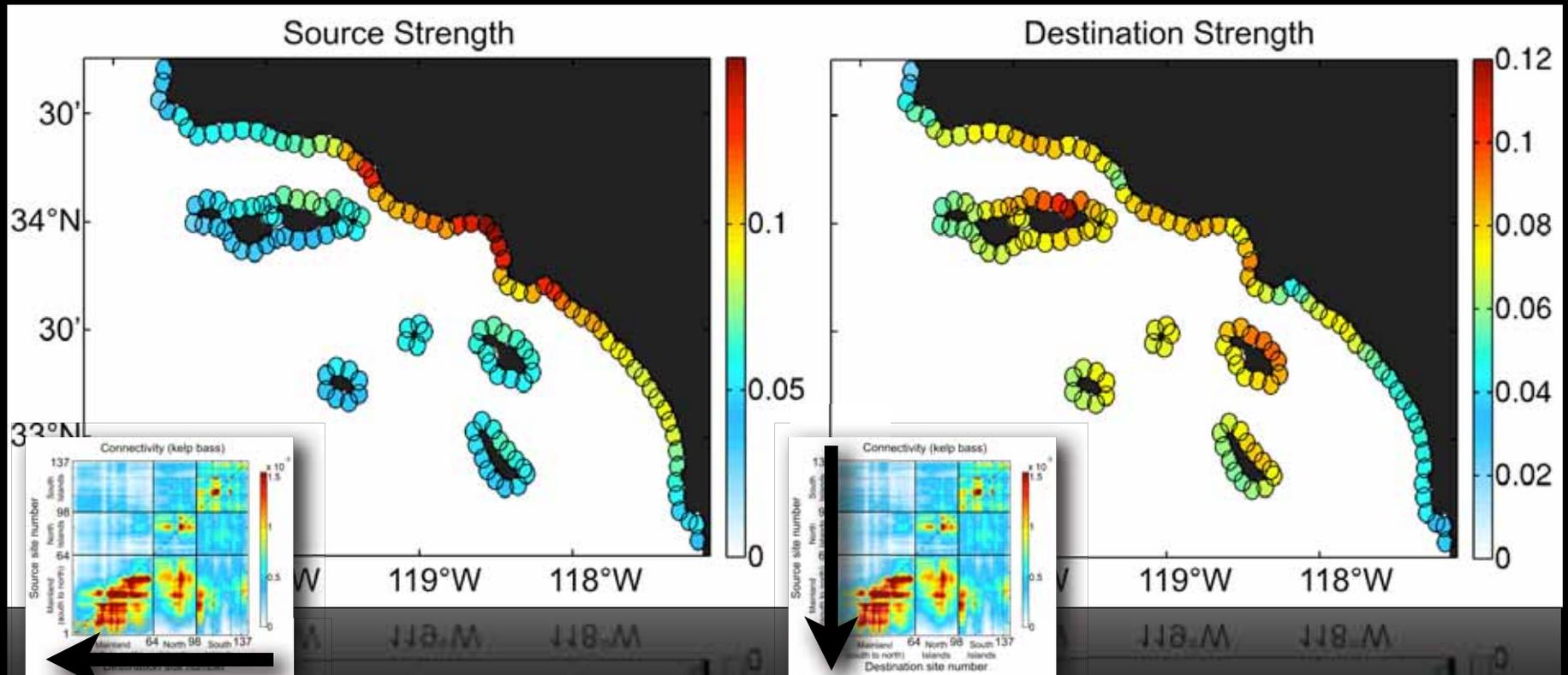
Advection time = 30 days



# Source & Destination Strength (Kelp Bass)

PLD = 25 – 33 d, Spawning = Apr – Nov

- Source: Long beach, Santa Monica, Venture
- Destination: Chinese Harbor

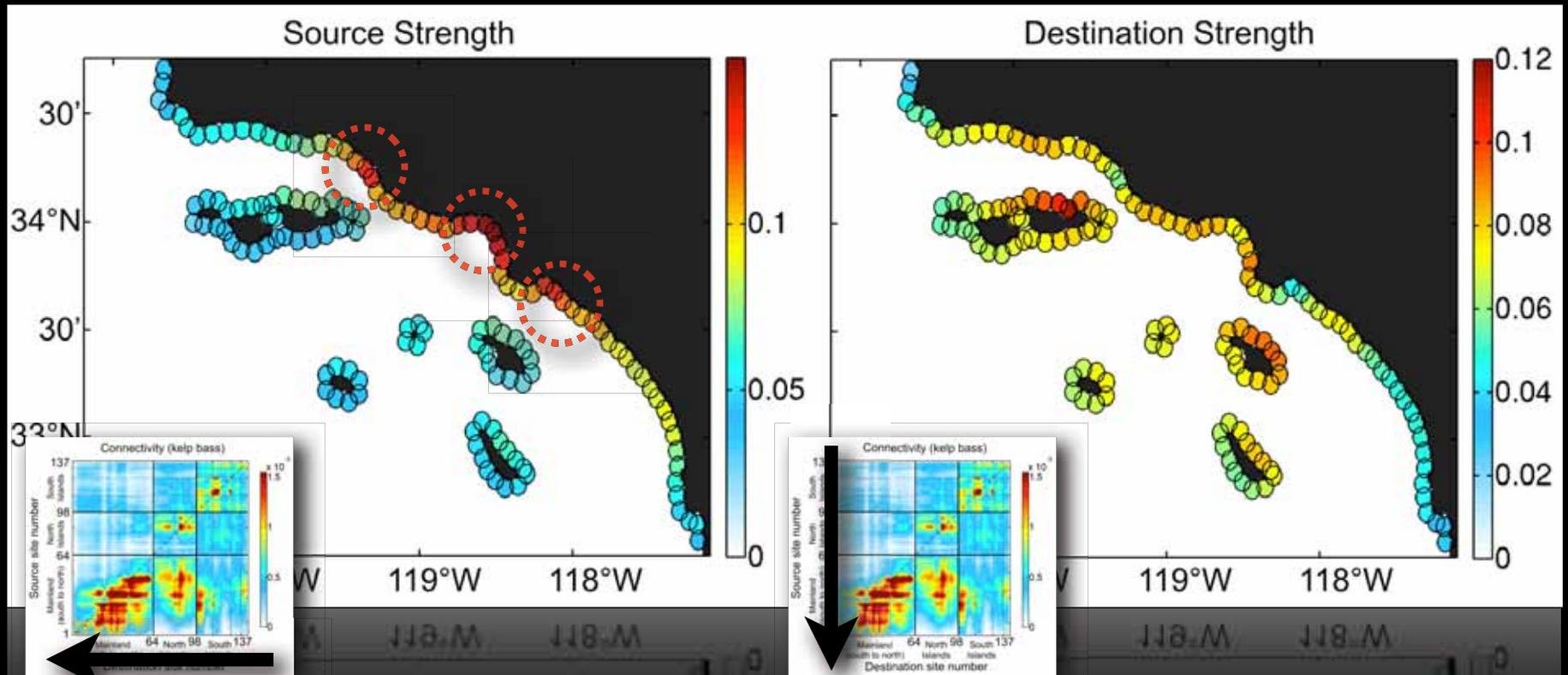


Assuming uniform larval production; averaged 1996 – 1999

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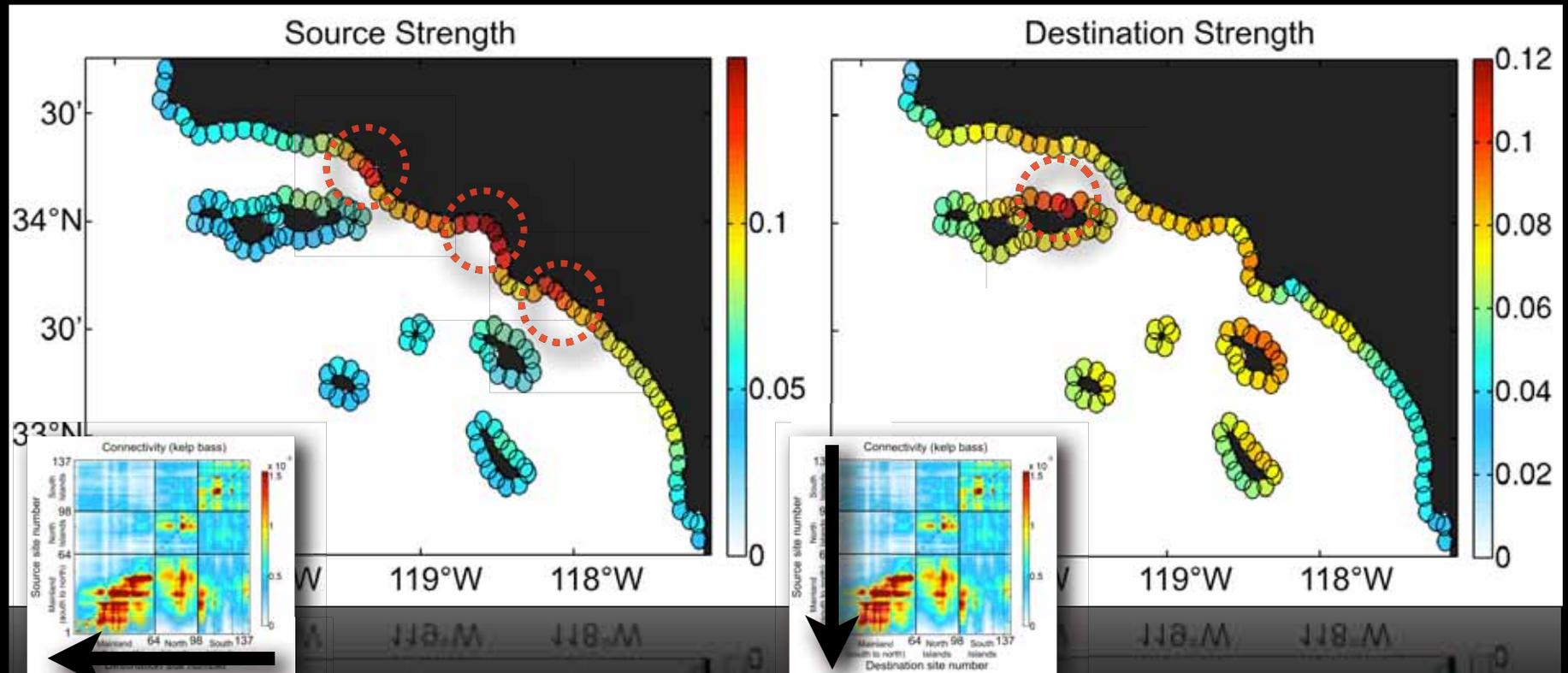


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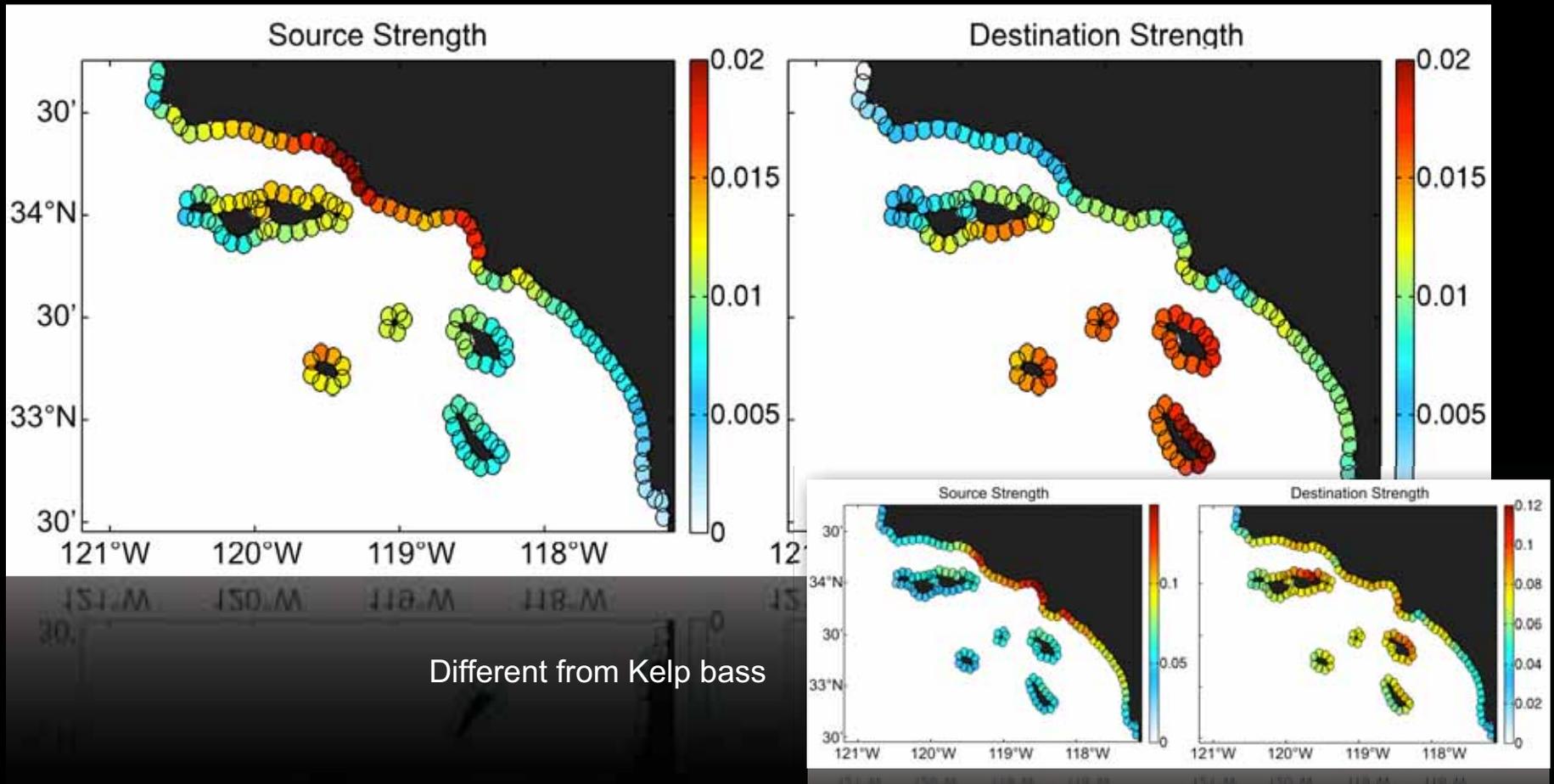


Assuming uniform larval production; averaged 1996 – 1999

# Source & Destination Strength (Rockfish)

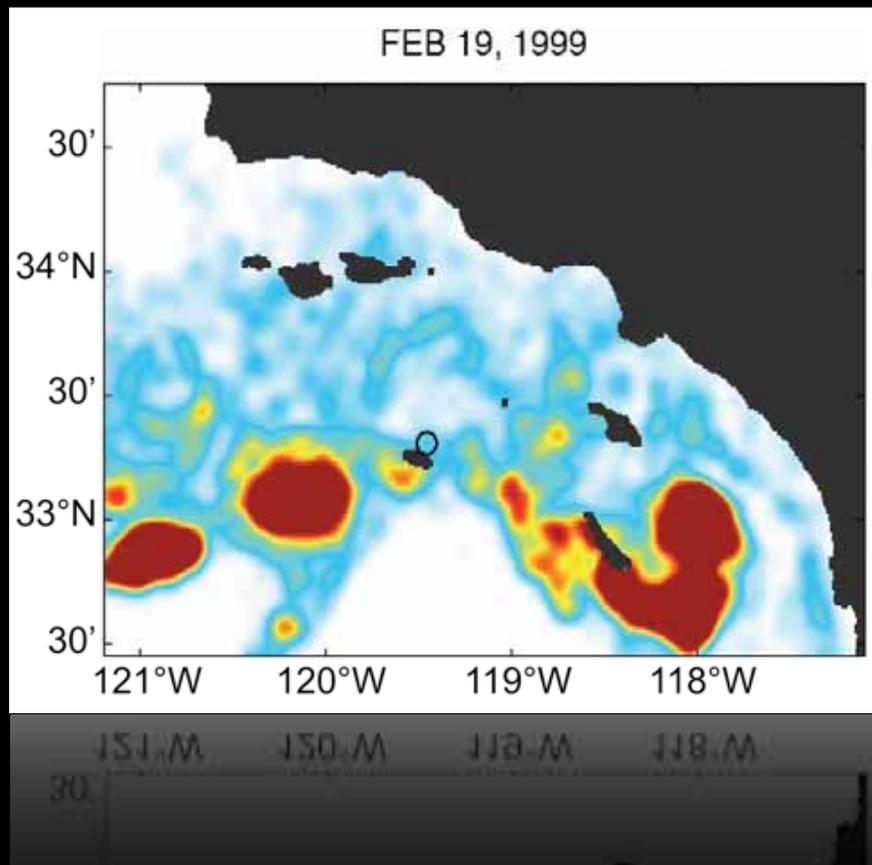
PLD = 60 – 120 d, Spawning = Jan – May

- Source: **N. Mainland, N. shore of N. Islands, San Nicholas**
- Destination: **All S. Islands, S. shore of N. Islands**



# Realizations (Not Expectations)

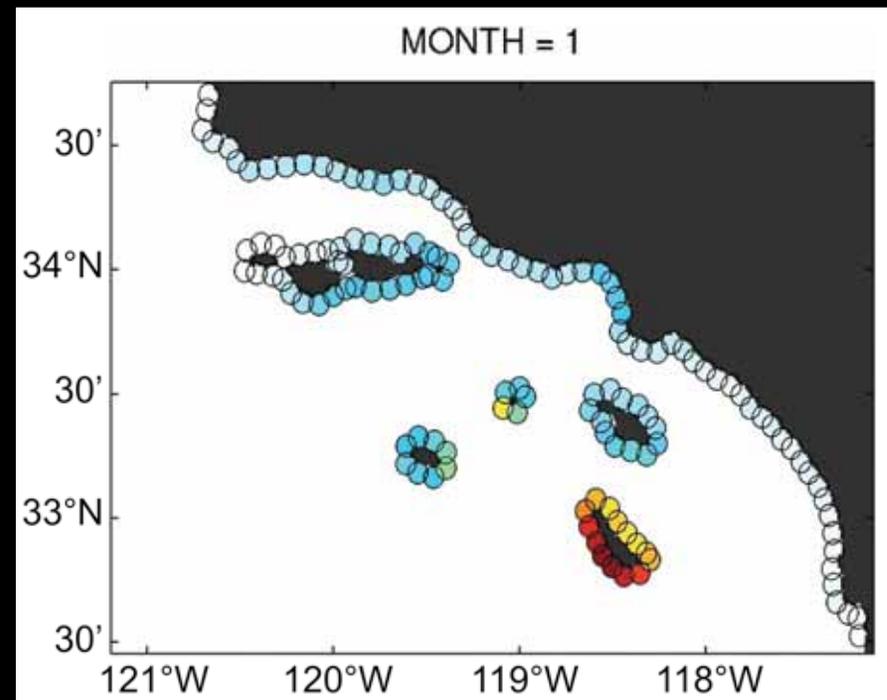
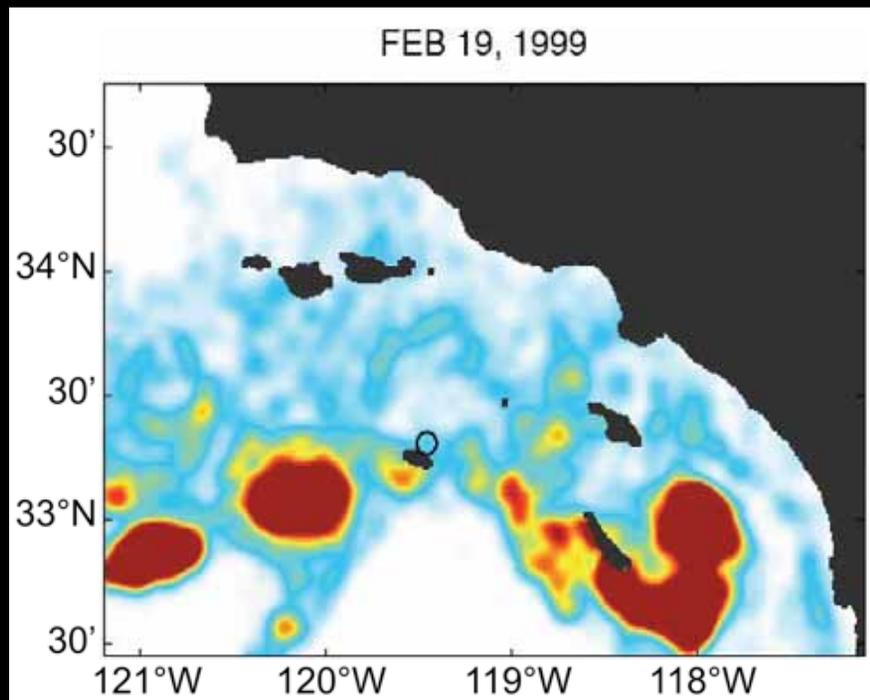
Release = 1/1/96 – 1/31/96, San Nicholas



# Realizations (Not Expectations)

Release = 1/1/96 – 1/31/96, San Nicholas

Monthly connectivity from San Nicholas



Assuming PLD = 30 d

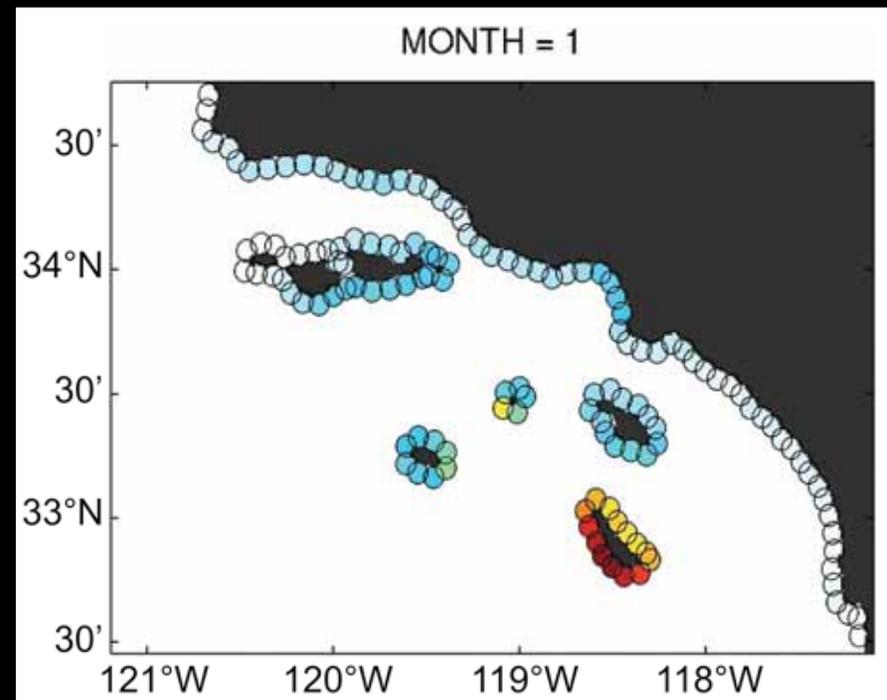
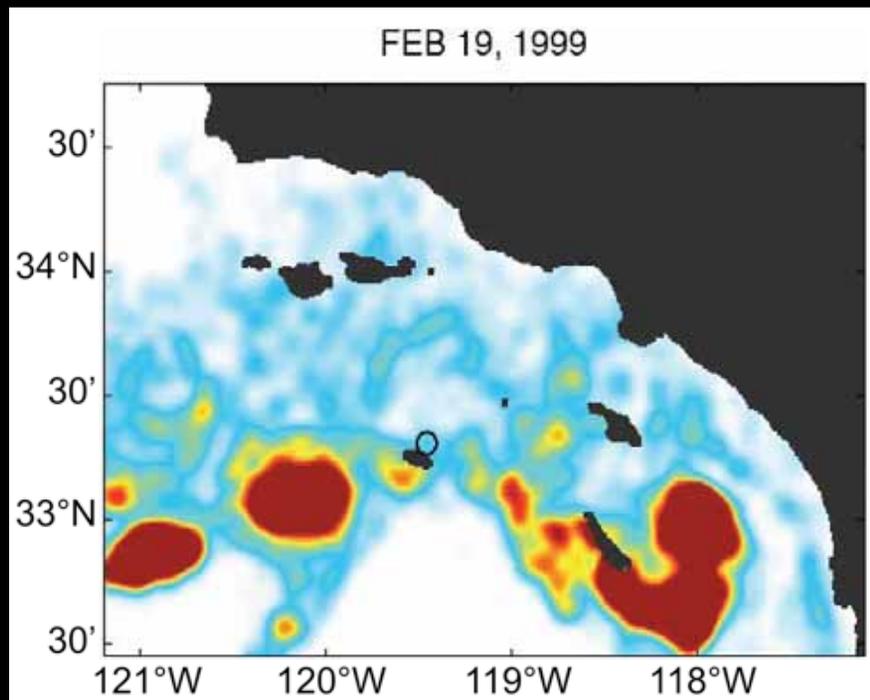
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- **Connectivity is not persistent month to month**

Very different from mean

Release = 1/1/96 – 1/31/96, San Nicholas

Monthly connectivity from San Nicholas



Assuming PLD = 30 d