Marine subsidy contributions to steelhead diet

Alison Collins*, Morgan Bond, Jeff Harding, Arnold Ammann, and Sean Hayes

*MWD

NOAA Southwest Fisheries Science Center

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Investigate subsidies that contribute to productivity of lagoons

Used stable isotopes to compare the contribution of marine and terrestrial subsidies to steelhead diet

Steelhead diet dominated by marine subsidies

Estuaries are productive habitats

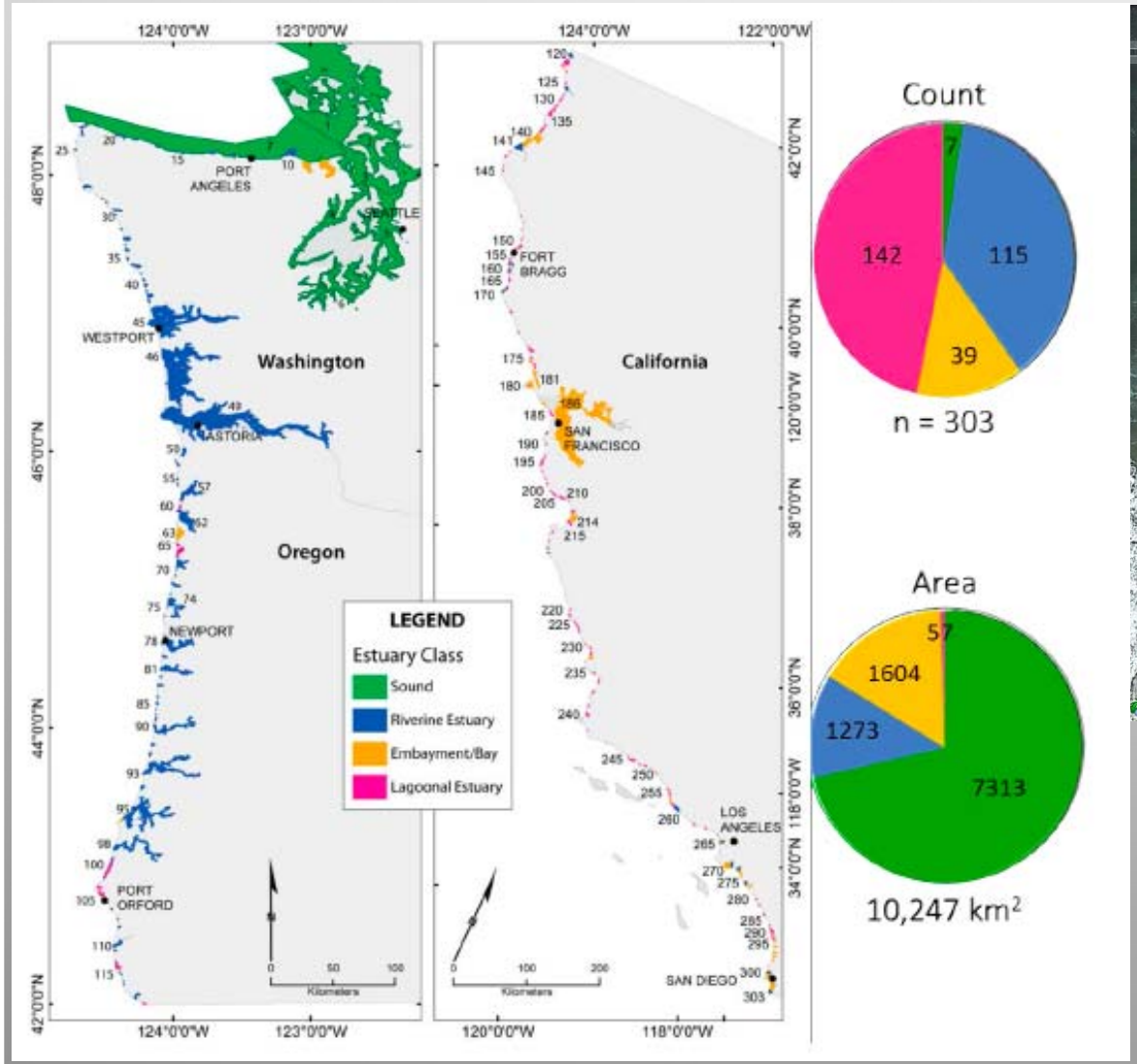

http://www.solaripedia.com/13/374/5076/estuary_battery_mattole_river.html


http://oceanservice.noaa.gov/facts/estuary.html


http://news.discovery.com/tech/alternative-power-sources/battery-harvests-the-energy-of-estuaries-110425.htm

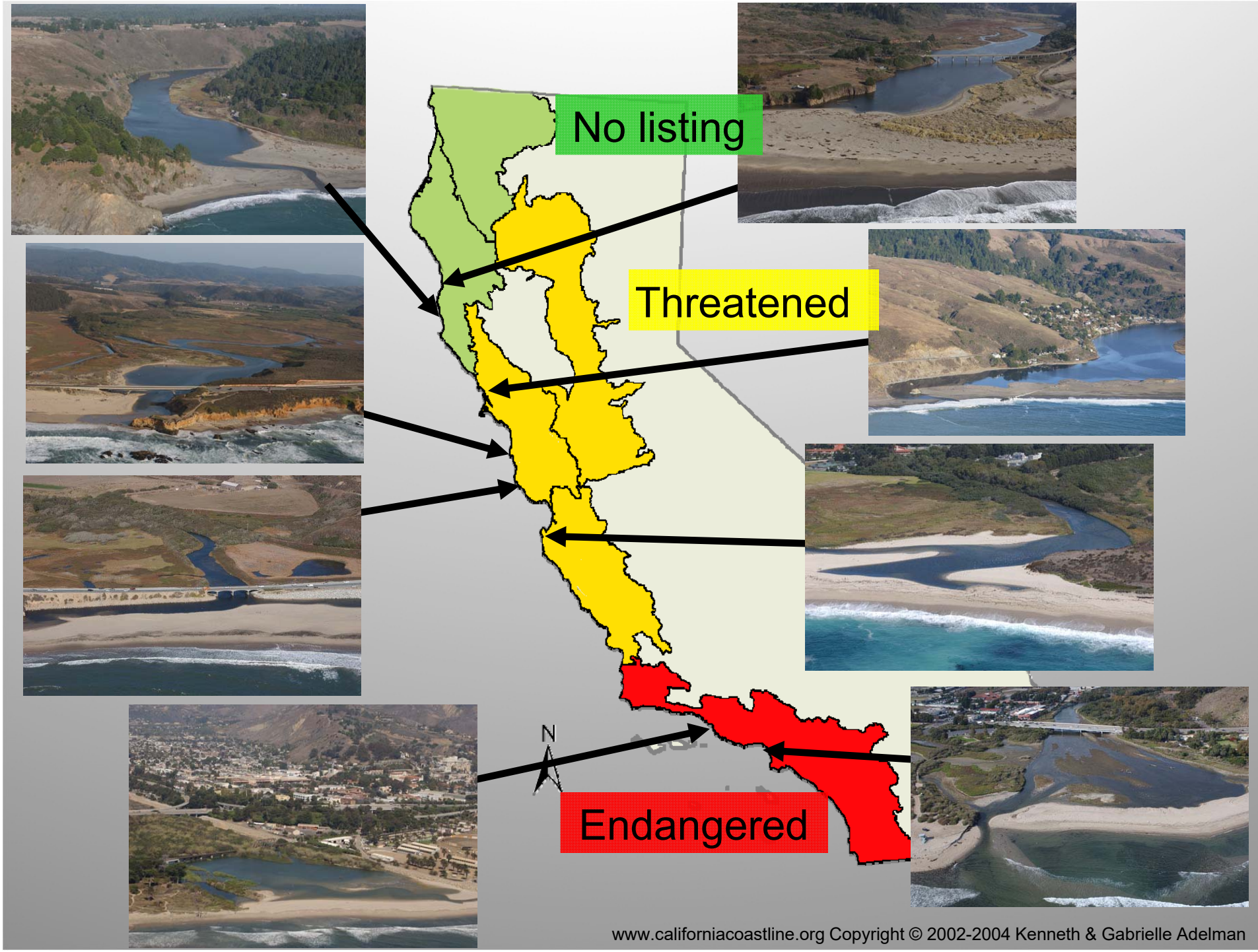

http://pixshark.com/estuary.htm

Lagoonal estuaries small in area but abundant across the landscape

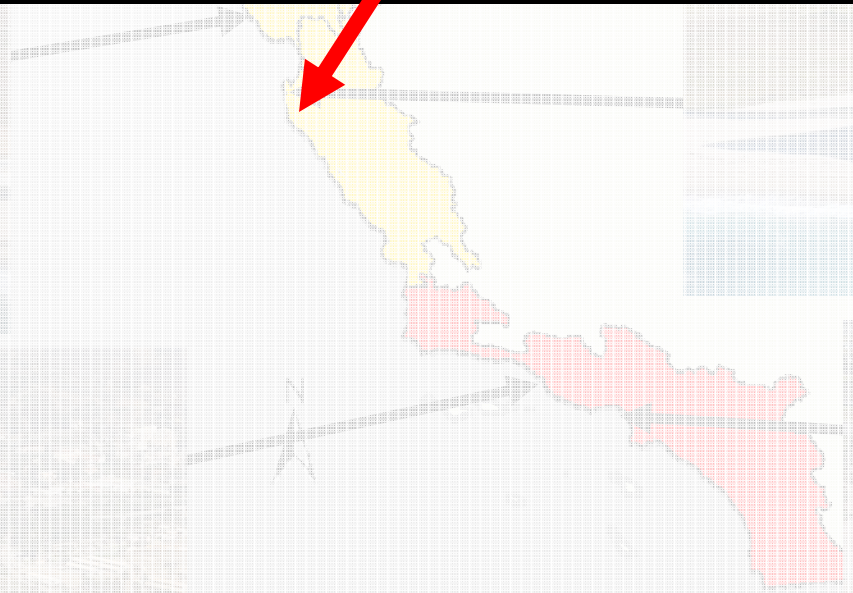


Low flow conditions physically separate habitats and accumulate marine and terrestrial subsides

Heady et al., TNC Report 2015



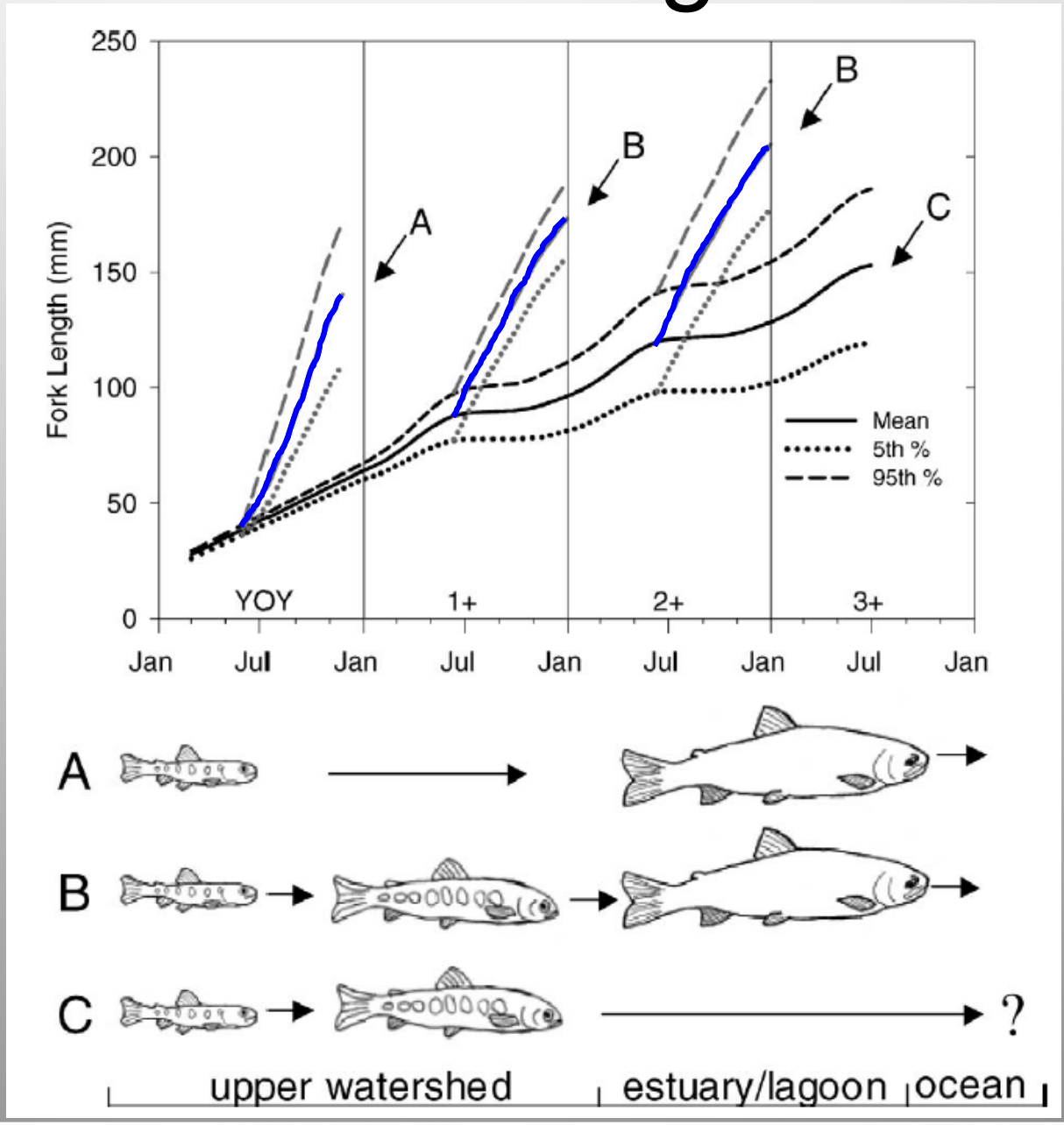
Scott Creek Watershed



Growth rates in lagoon

Upper watershed growth

Lagoon growth

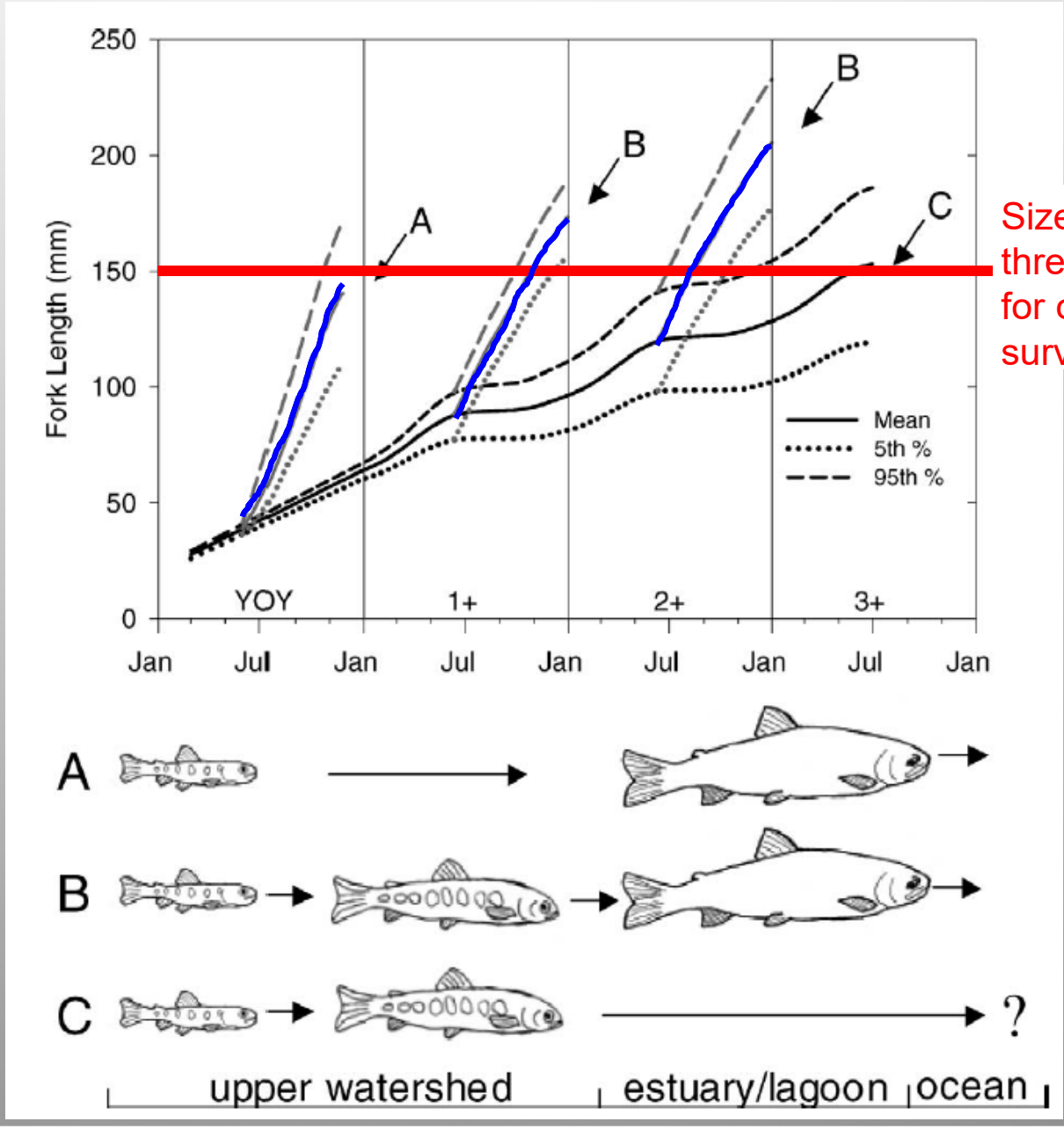


Hayes et al., TAFS 2008

Lagoon reared fish = ↑ marine survival

Upper watershed growth

Lagoon growth



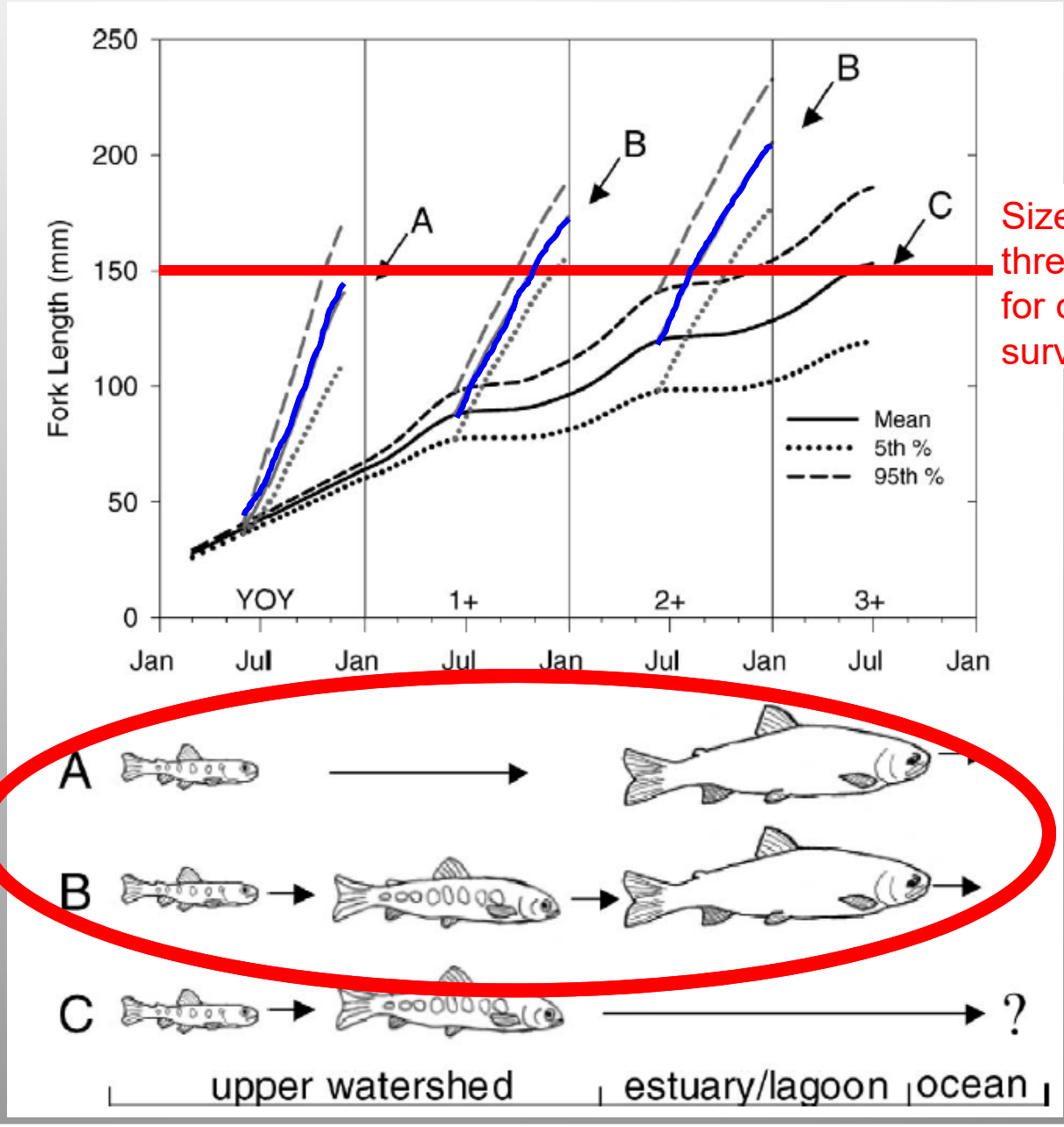
Hayes et al., TAFS 2008
Bond et al., CJFAS 2008

Spawning adult population dominated by lagoon reared fish

Upper watershed growth

Lagoon growth

87 – 95.5% of the returning adults use estuary pathway

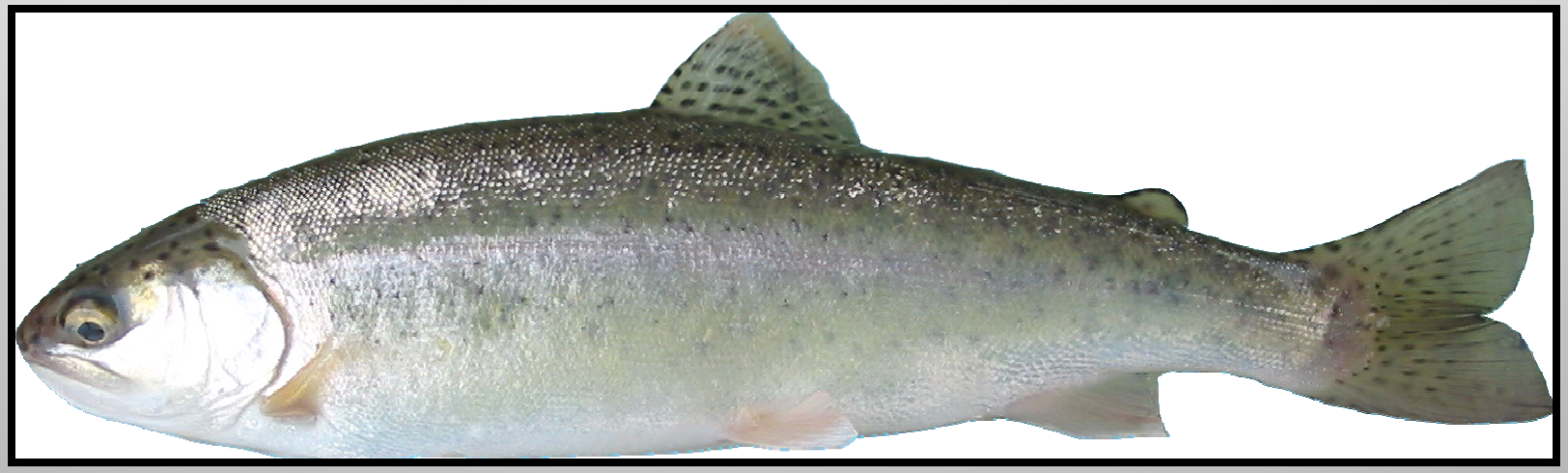


Size threshold for ocean survival

Hayes et al., TAFS 2008
Bond et al., CJFAS 2008

Lagoon reared fish are big and disproportionally contribute to adult population

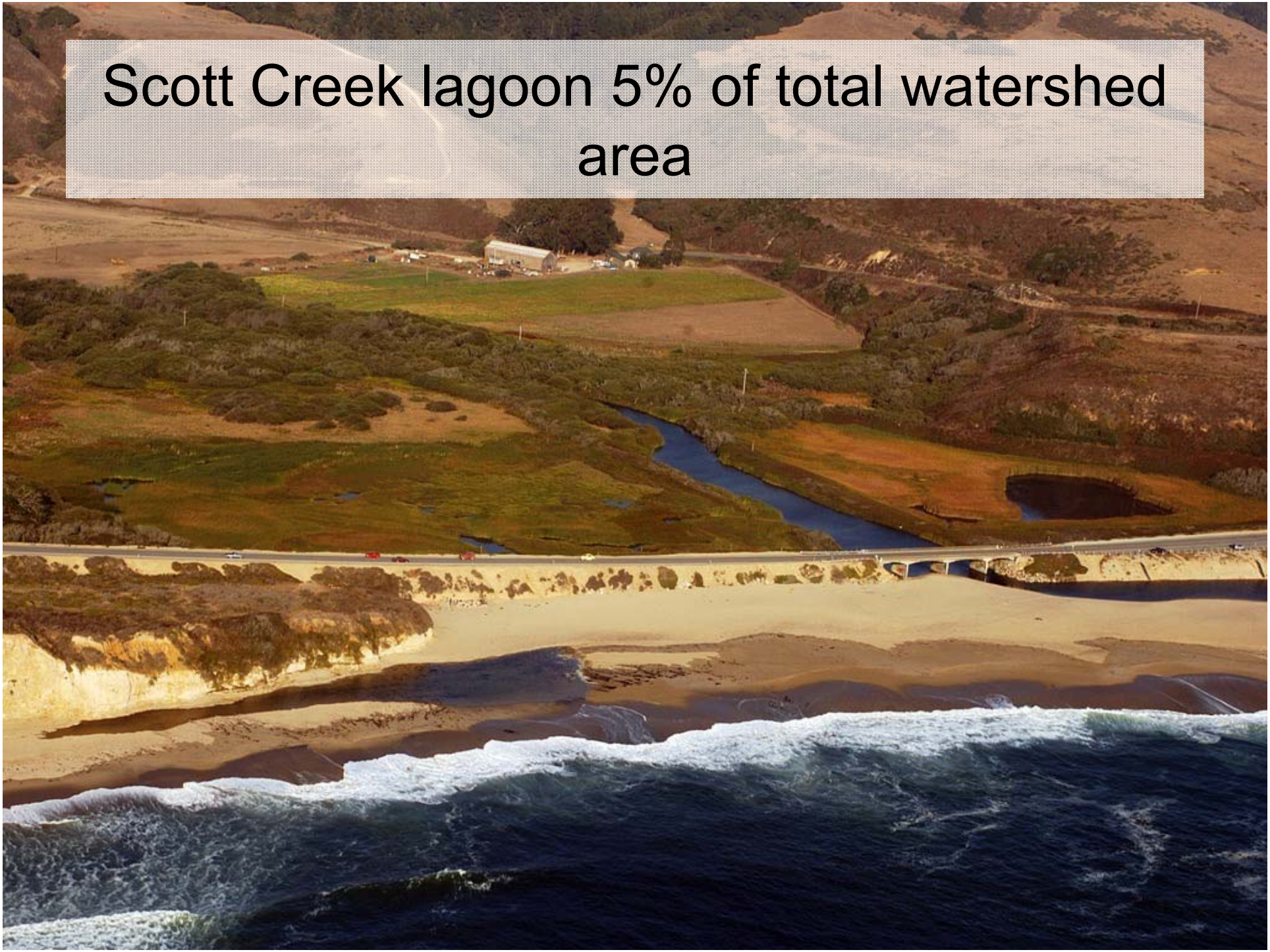
Lagoon-reared steelhead



Upper watershed reared steelhead

100 mm

Scott Creek lagoon 5% of total watershed area



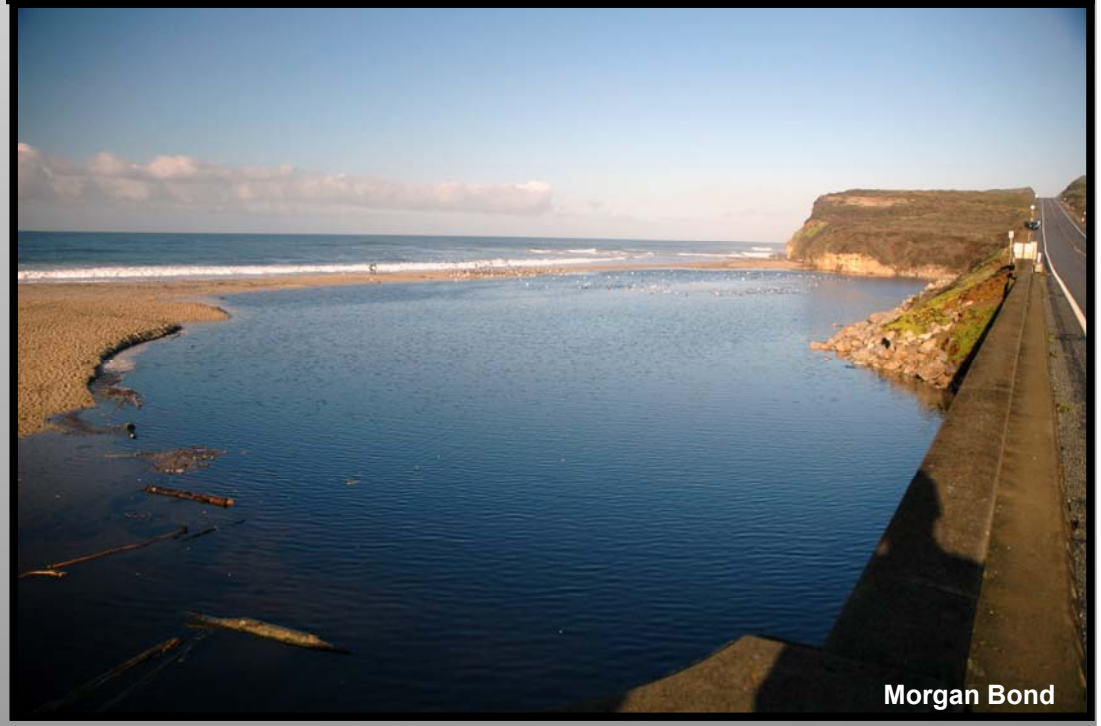
Scott Creek Estuary

OPEN

Connectivity between FW and Marine

CLOSED

NO Connectivity between FW and Marine

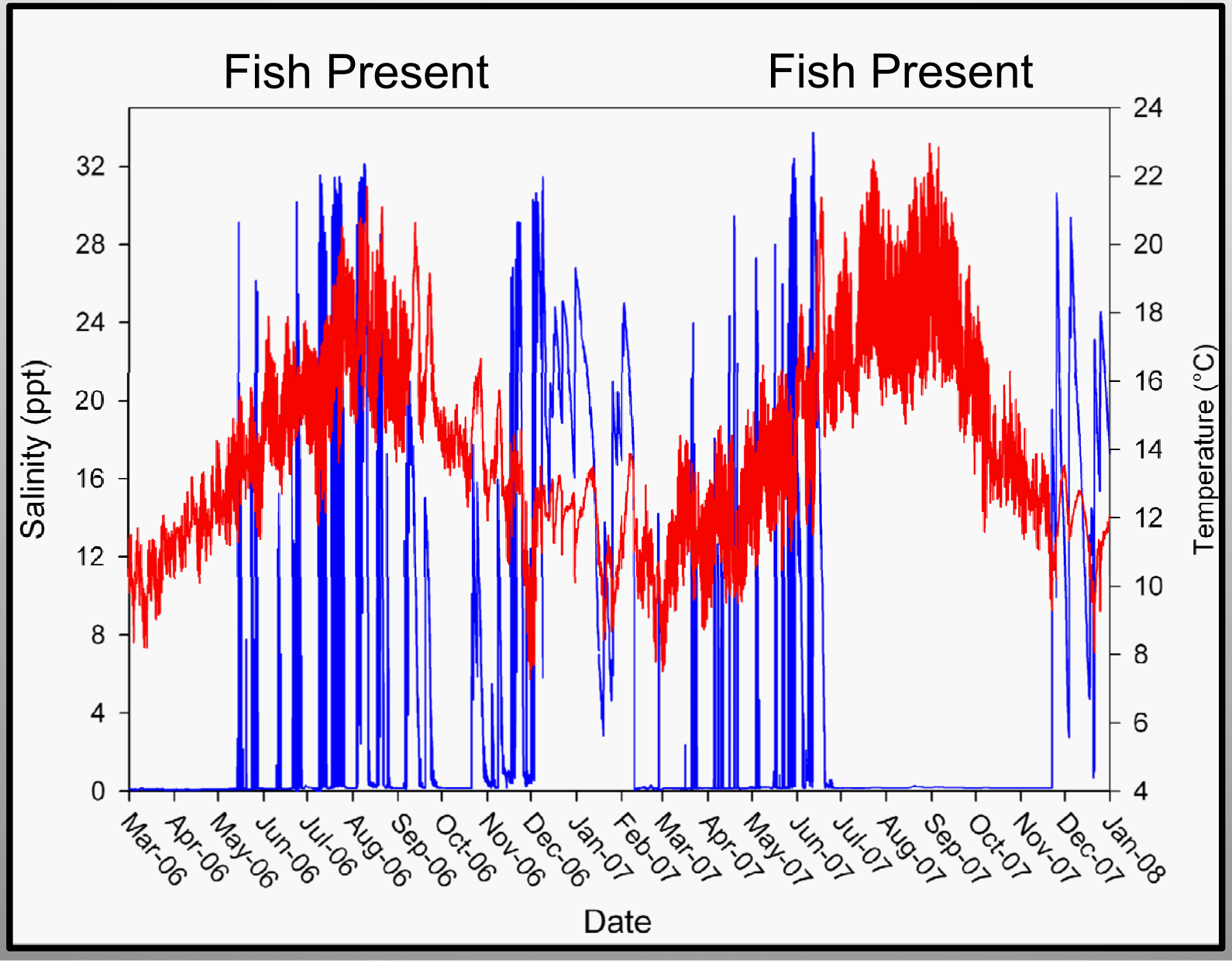


Scott Creek Estuary


Morgan Bond


Morgan Bond

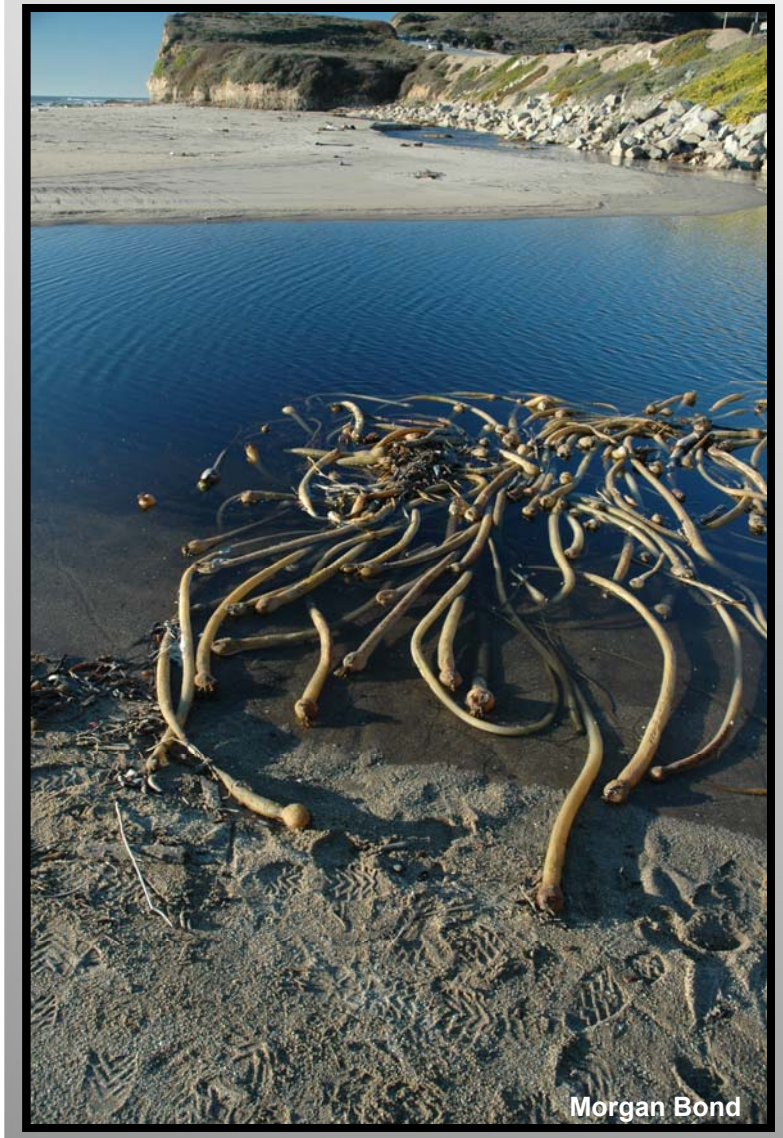
Saline influx quickly dissipates from lagoon



Salinity

Temp

Marine subsidies trapped in lagoon



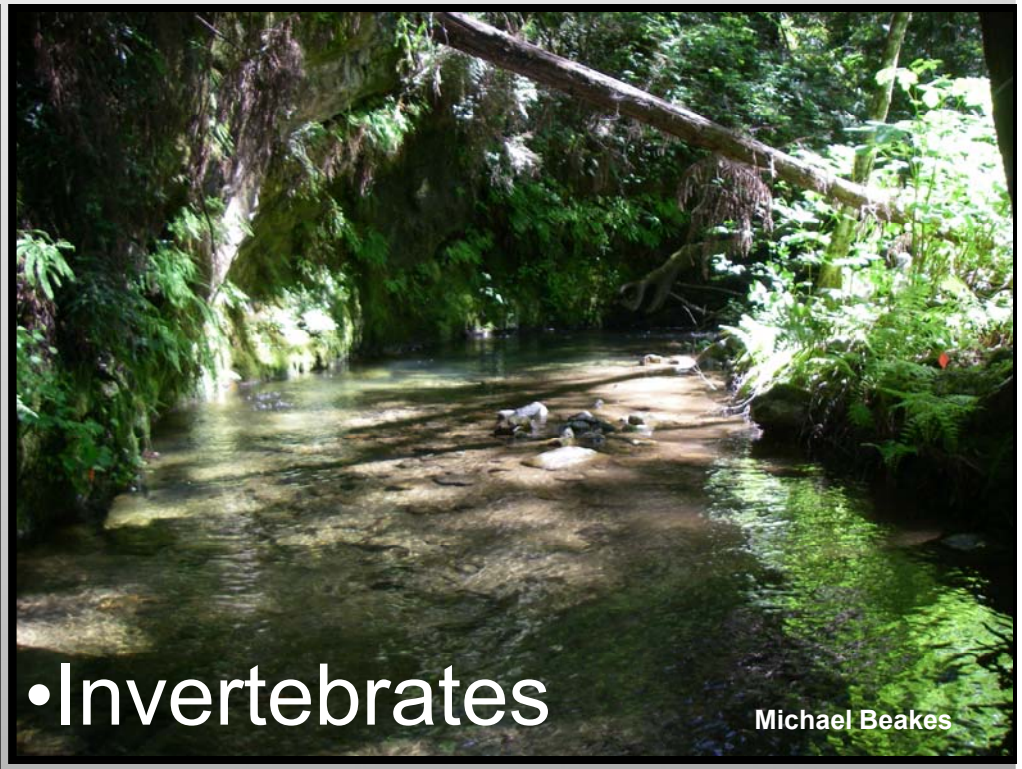
Upstream processes driving lagoon productivity?

Marine processes driving lagoon productivity?

$\delta^{13}C$ and $\delta^{15}N$ isotope composition measured

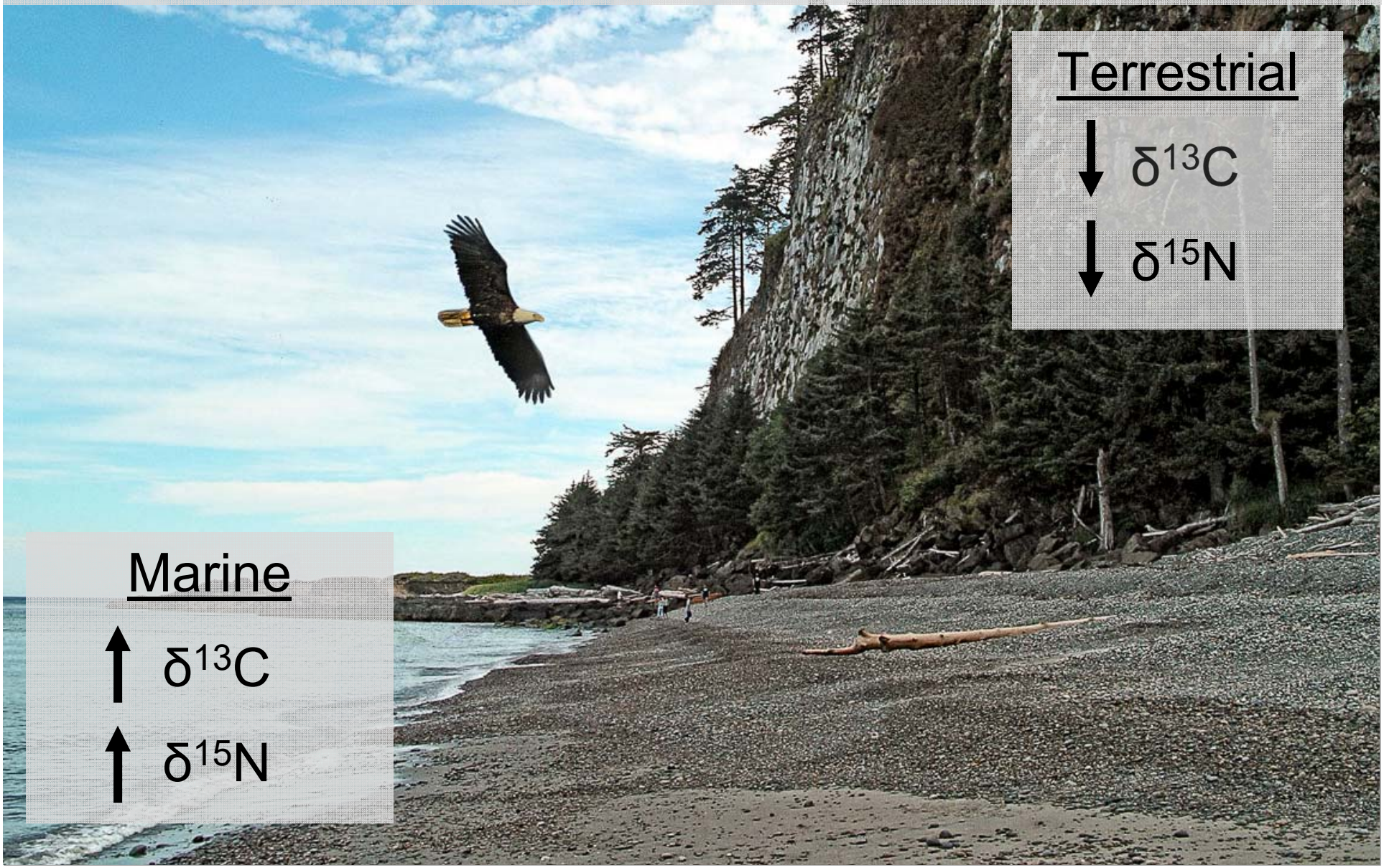
Lagoon

Upper Watershed



The relative abundances of heavy and light isotopes for many elements are spatially varied

Marine and freshwater isotope values differ



Scott Creek sampling sites

Lagoon invertebrate sampling sites

Invertebrates grouped by location

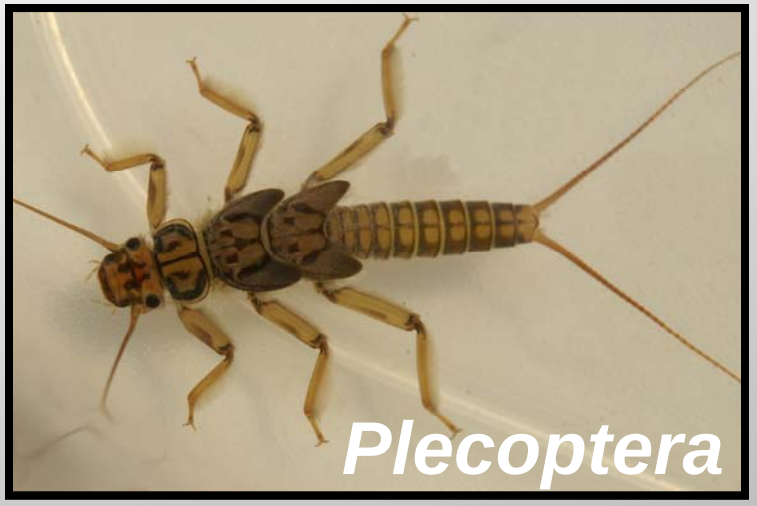
Lower Lagoon	Middle Lagoon	Upper Lagoon
0 – 150 m	200 – 400 m	450 – 650 m

Lagoon invertebrates sampled

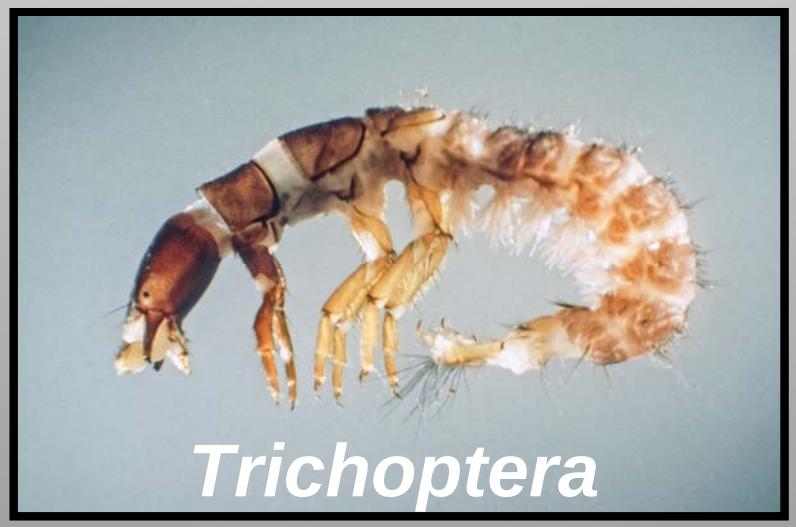
Dominate species of invertebrates

90% of Steelhead diet

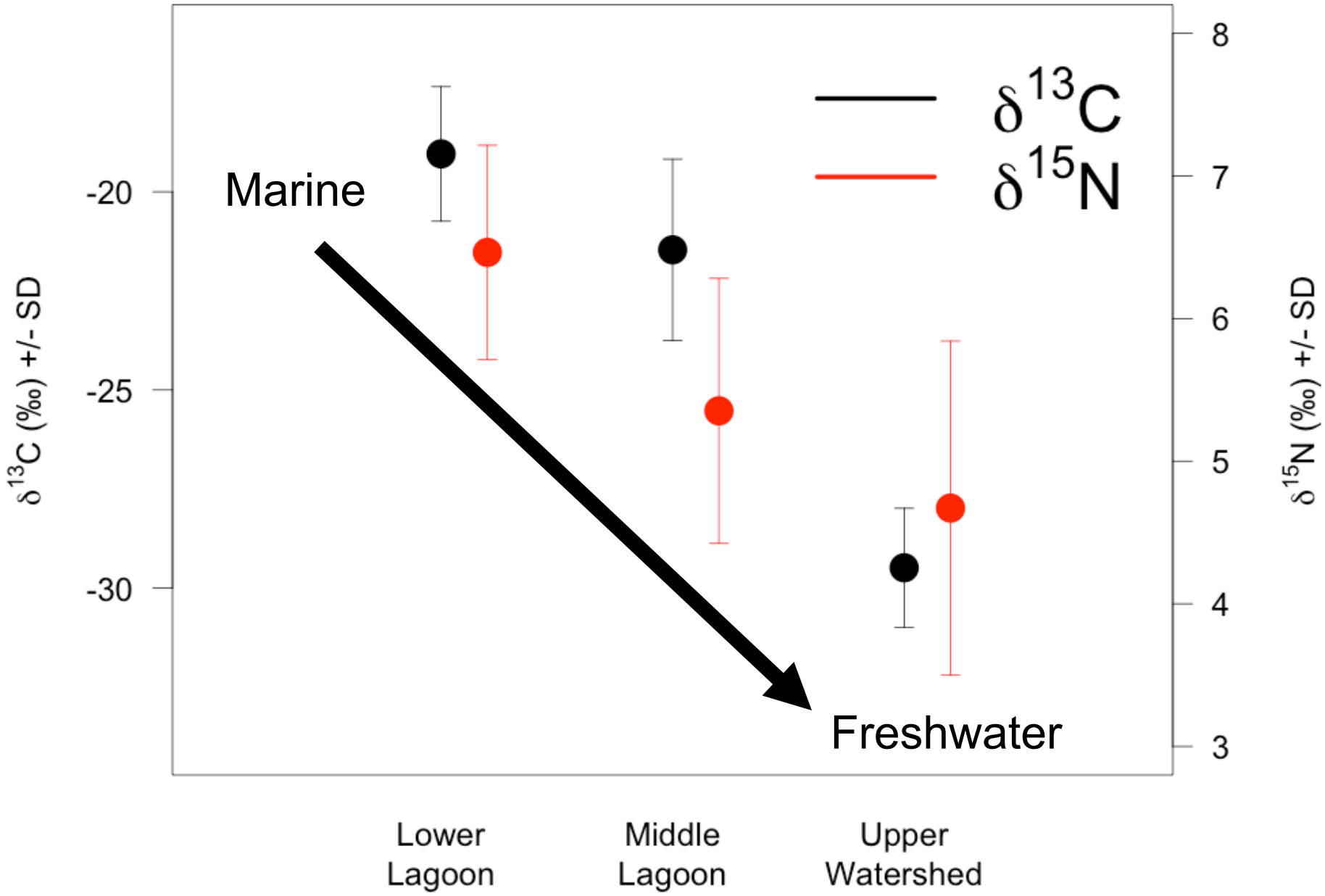
Upper watershed invertebrates sampled



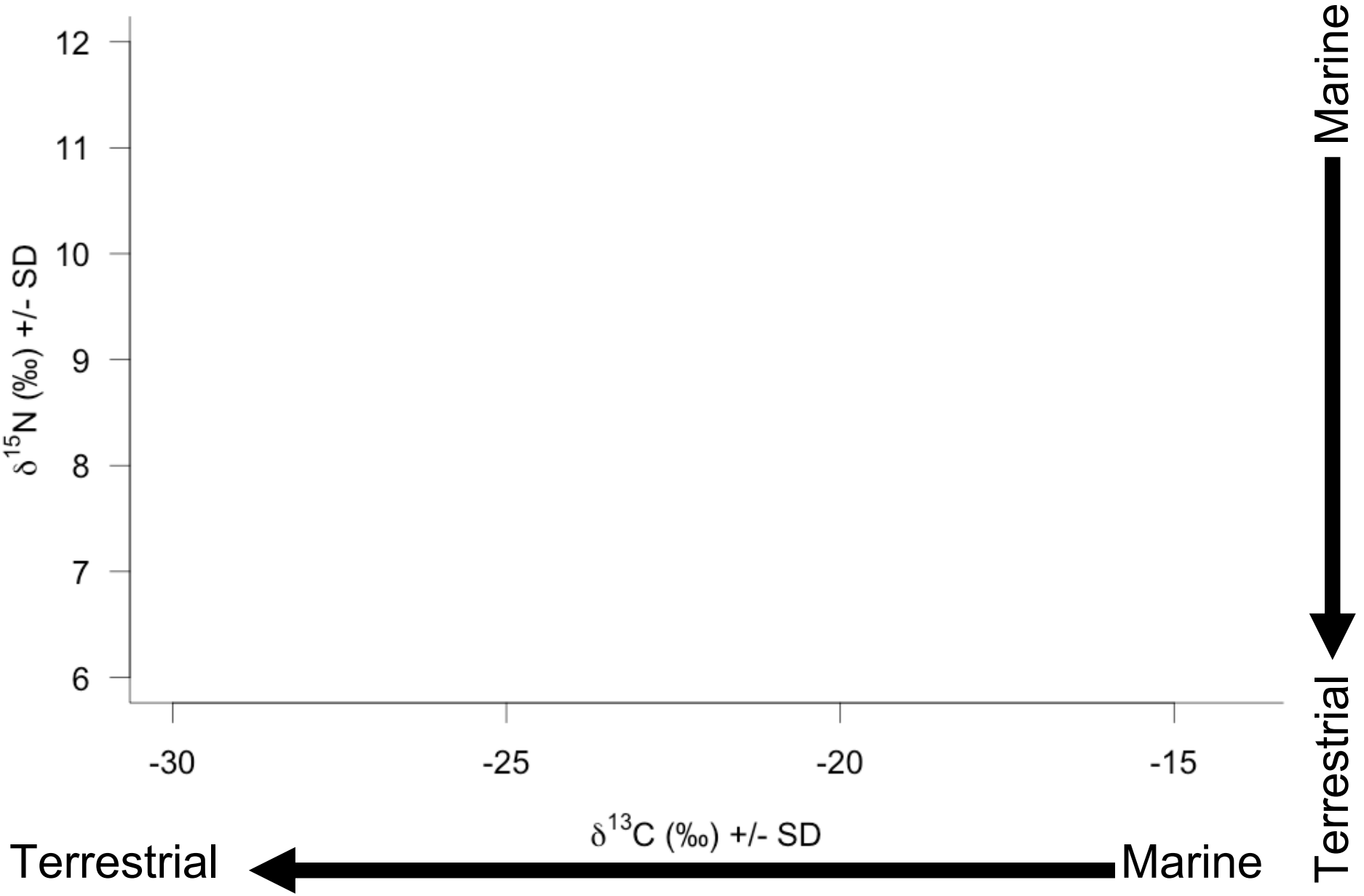
Dominate species of invertebrates



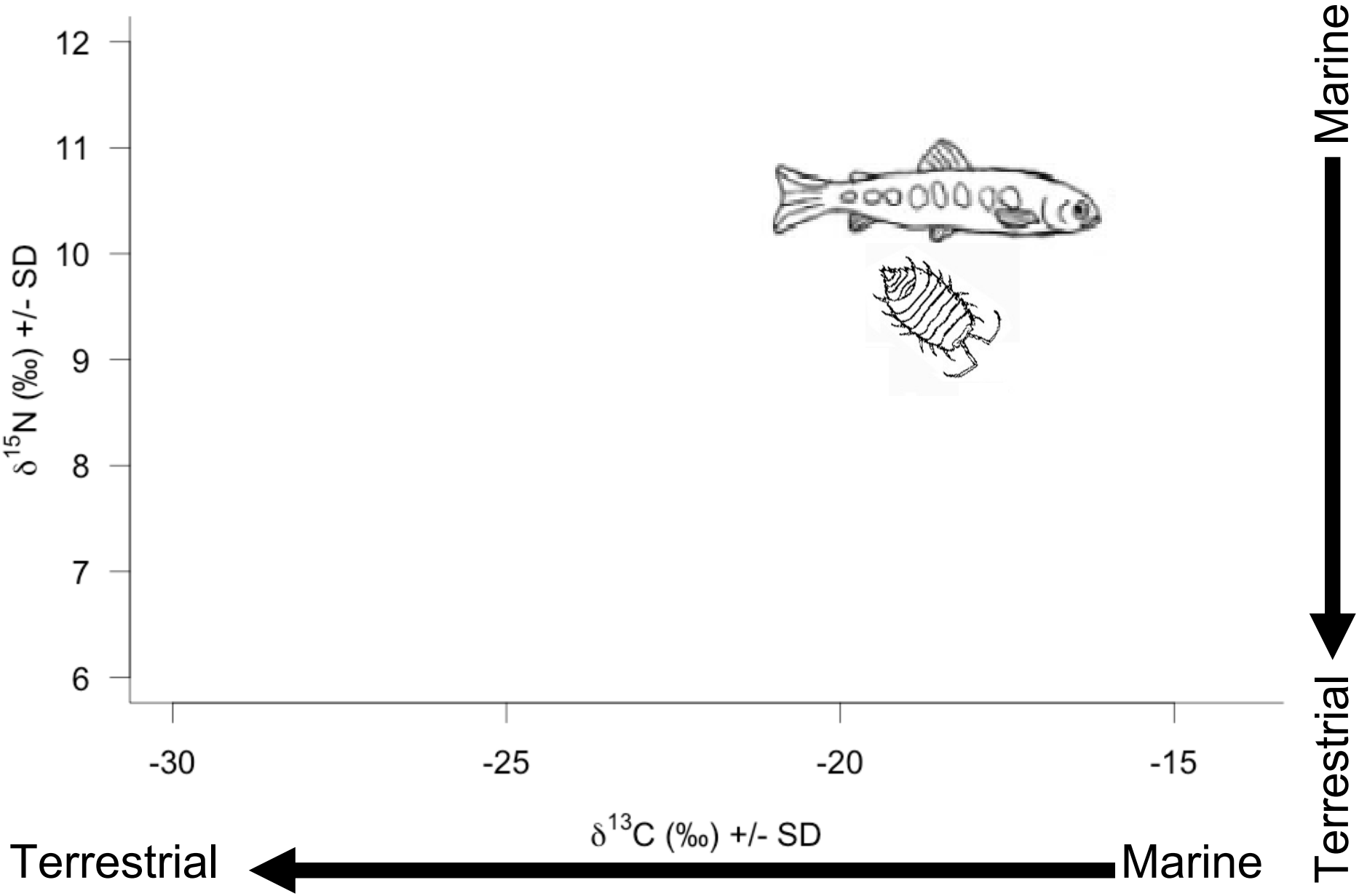
Marine signature ↓ with ↑ distance from the ocean



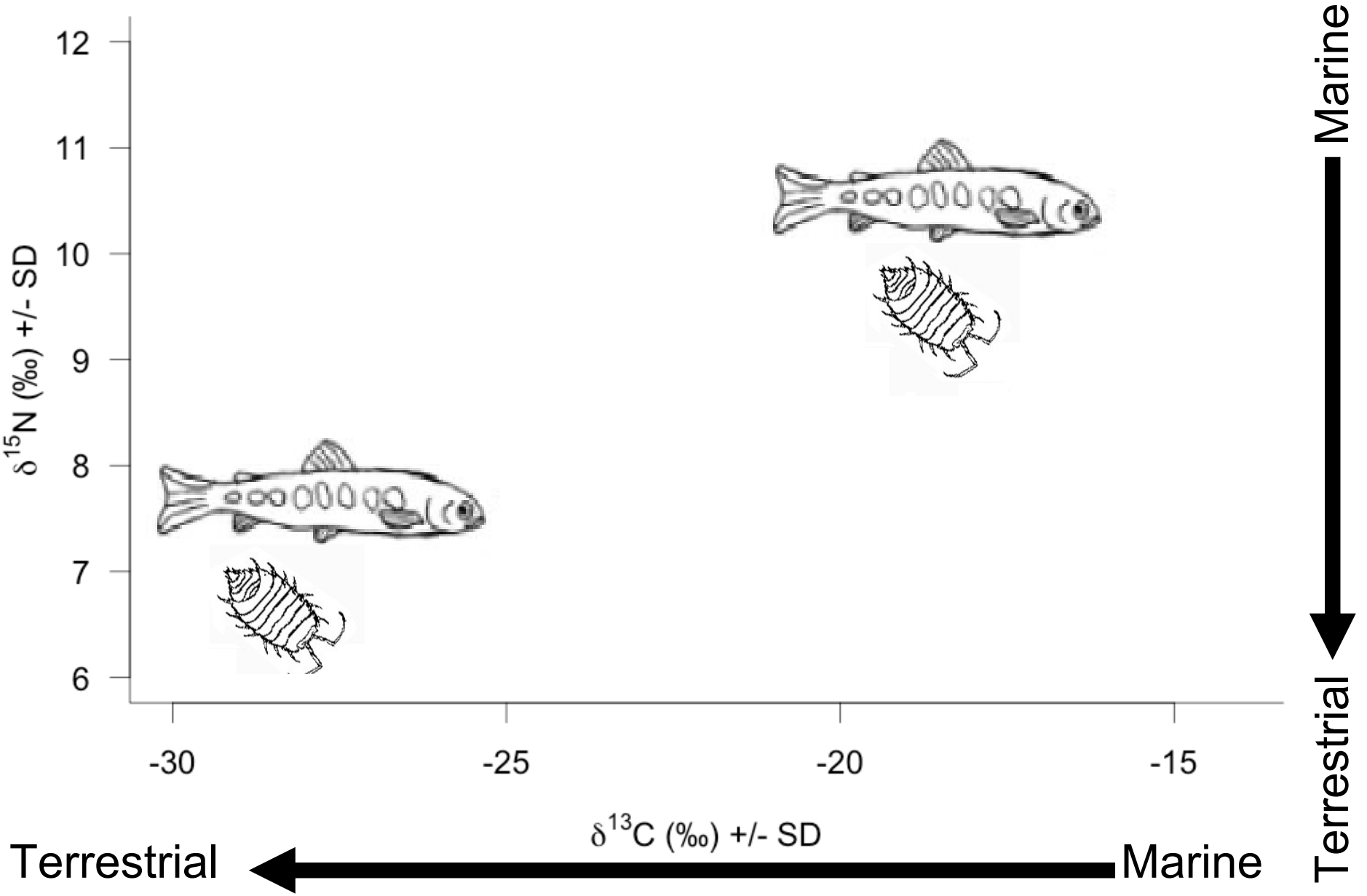
Isotope composition



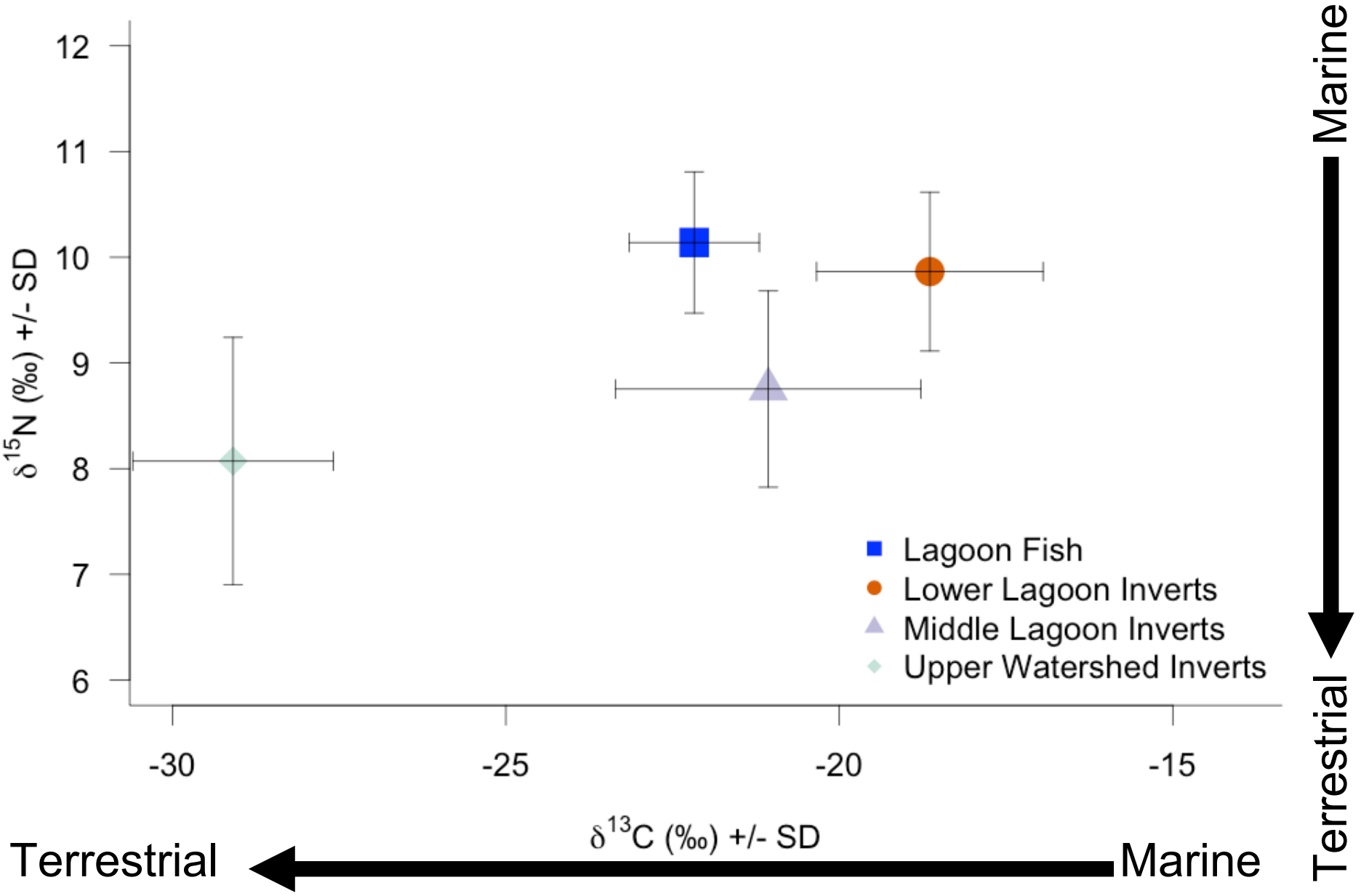
Isotope composition



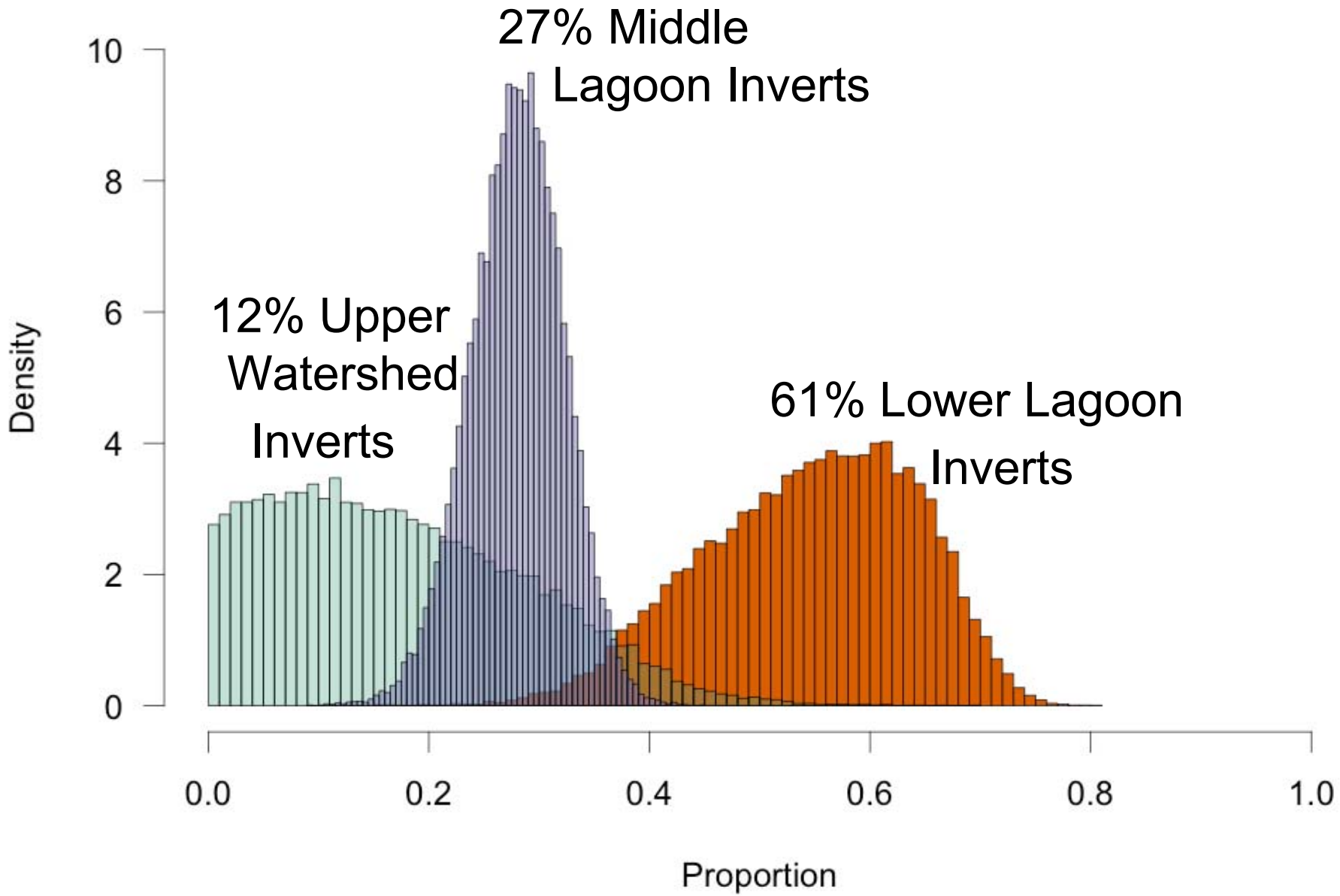
Isotope composition



Lagoon fish and lower lagoon inverts enriched with marine sources

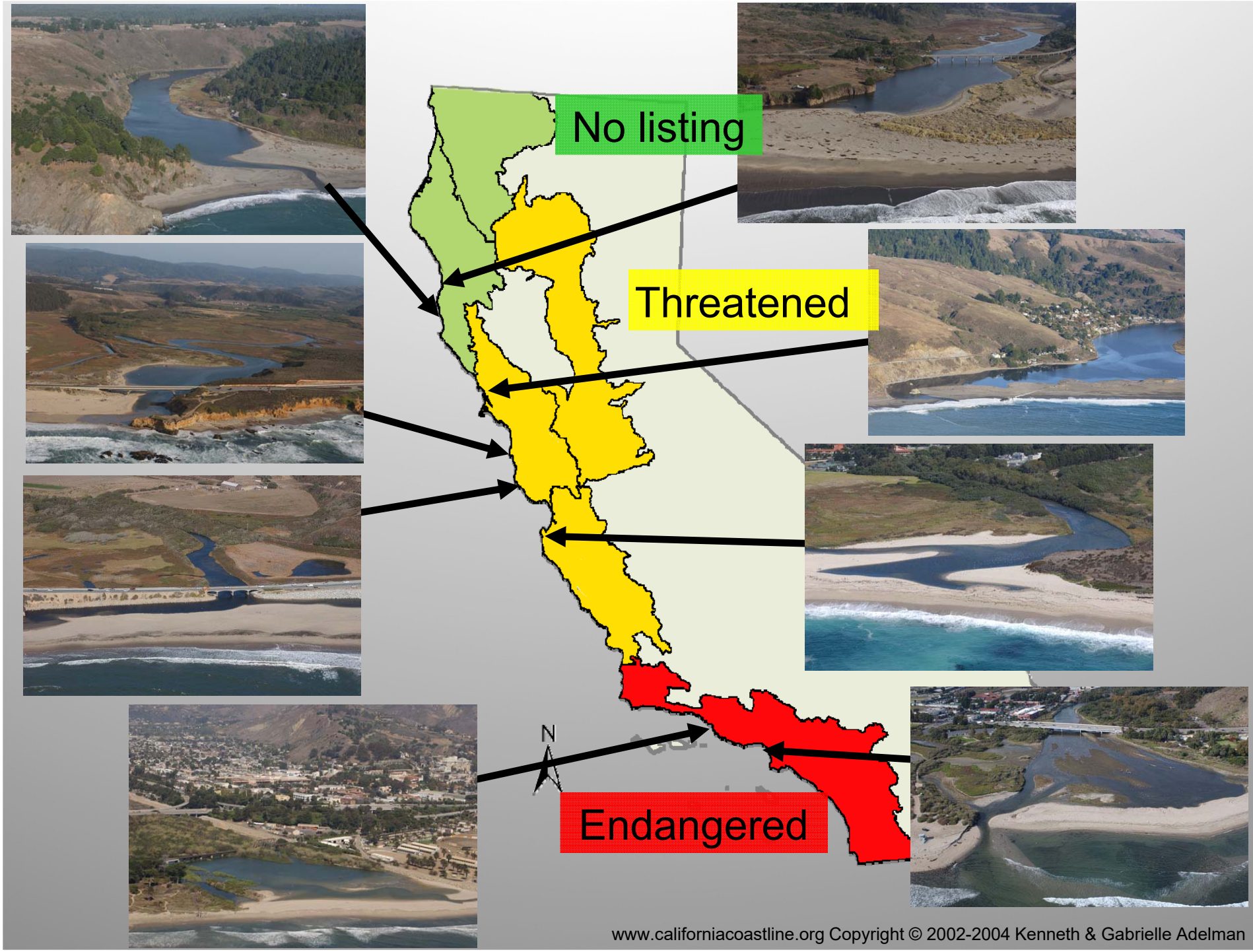


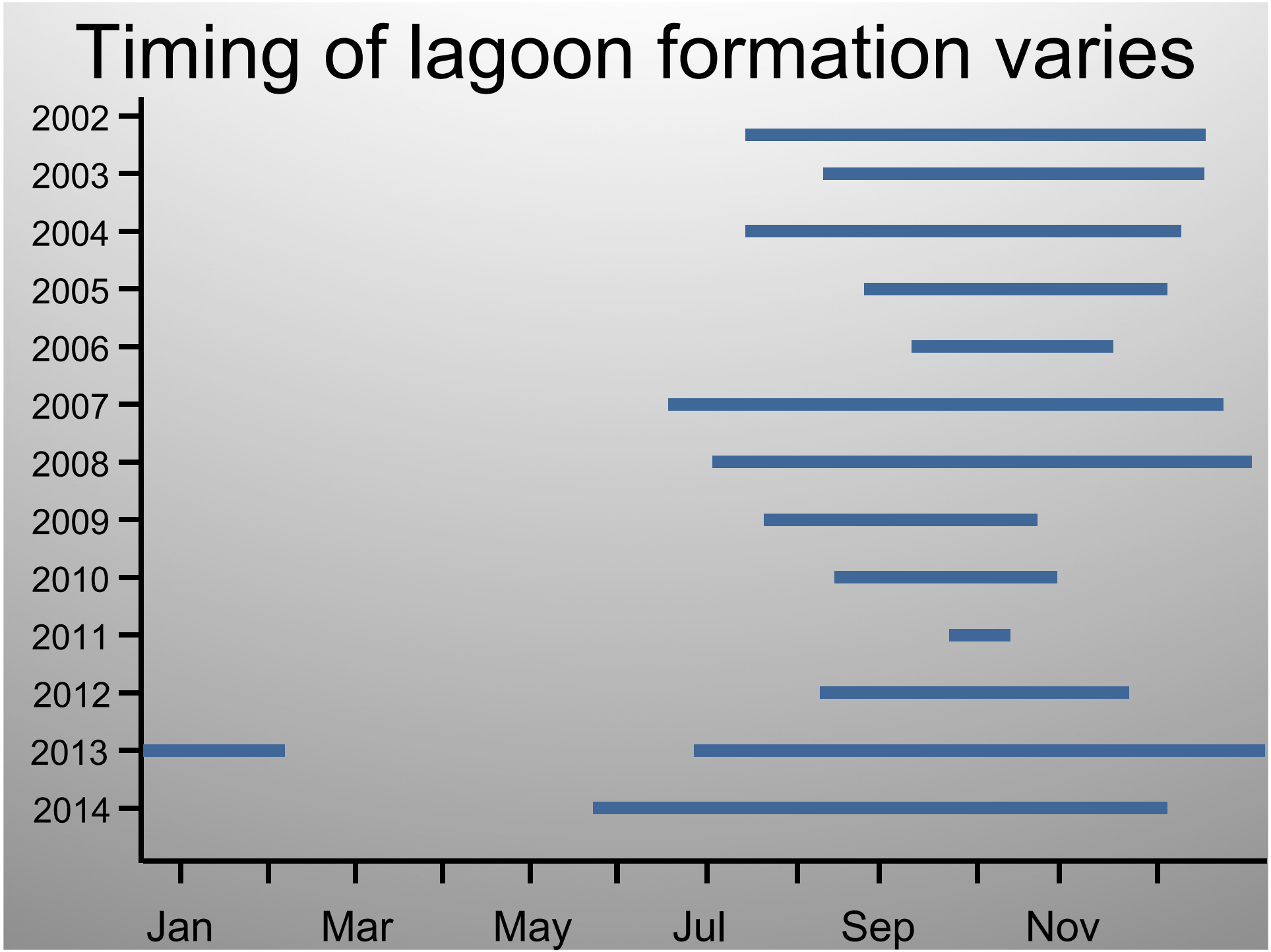
Steelhead diet dominated by lower lagoon inverts

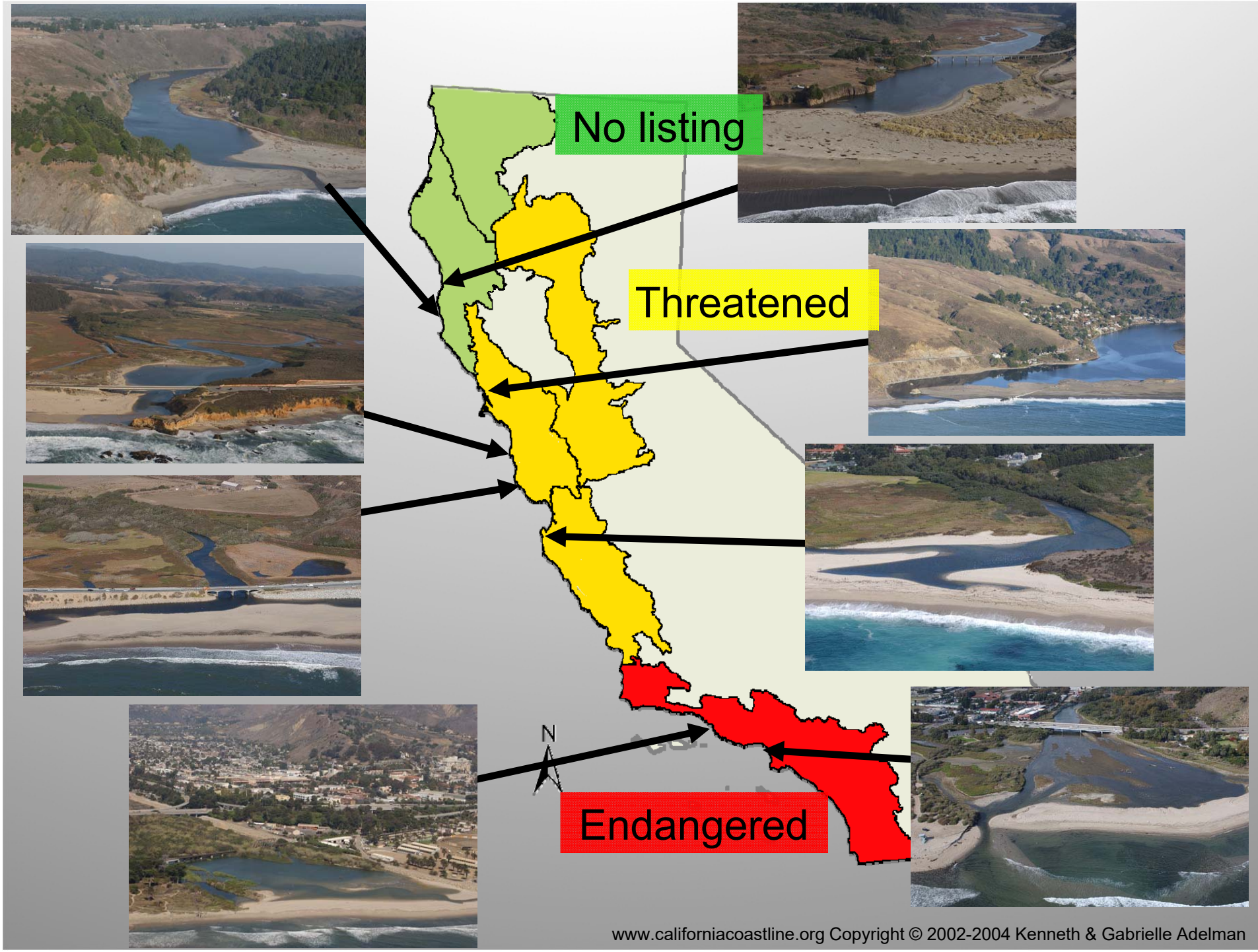


Inverts from lagoon enriched with marine nutrients contribute >50% to steelhead diet

Marine subsidies drive steelhead population productivity



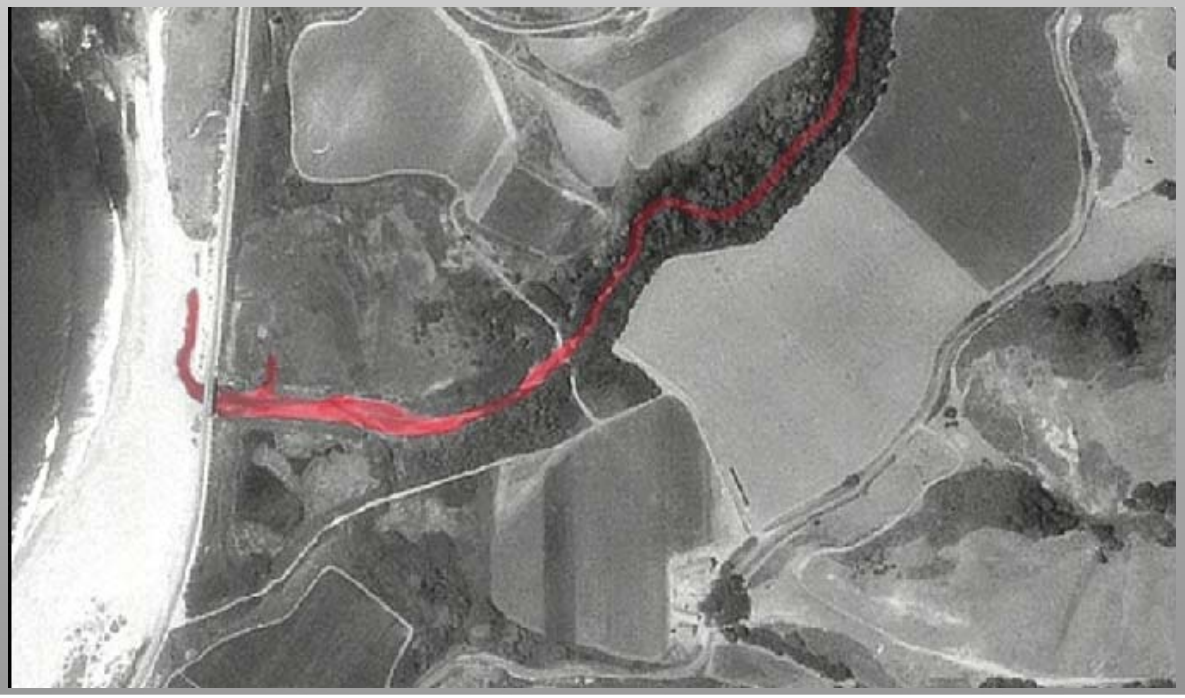

Timing of lagoon formation varies
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Jan
Mar
May
Jul
Sep
Nov



Scott Creek Estuary

1928

1991



Outstanding questions

- Has the contribution of marine subsidies varied through time
- Poor understanding of how important ocean processes are in the formation of this sandbar
- Little knowledge regarding the contribution of marine subsidies to steelhead diet in larger lagoonal systems
- Not thoroughly investigated the importance of these lagoonal habitats to resident *O. mykiss*

- Nursery habitats trap marine subsidies
- Lagoon invertebrates enriched with marine nutrients
- Marine subsidies contribute >50% to steelhead diet

Morgan Bond

- Nursery habitats trap marine subsidies
- Lagoon invertebrates enriched with marine nutrients
- Marine subsidies contribute >50% to steelhead diet

alisonl.collins@gmail.com, alisonl_collins

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