California Current HIGHLIGHTS

Highly anomalous environmental conditions since 2013!

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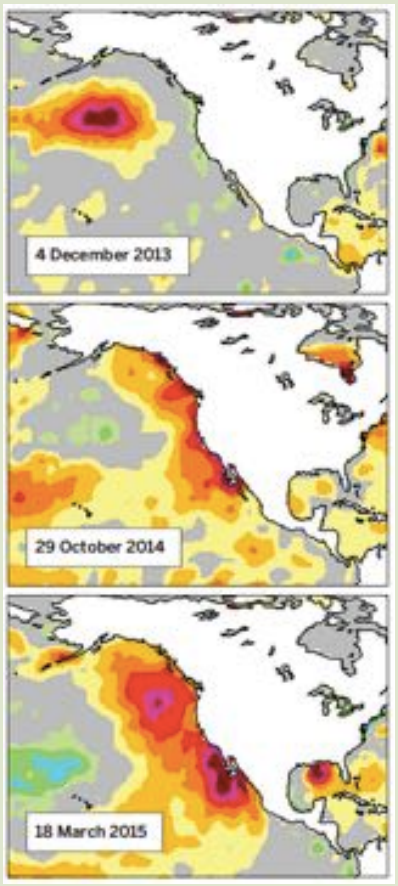
The 'Blob'



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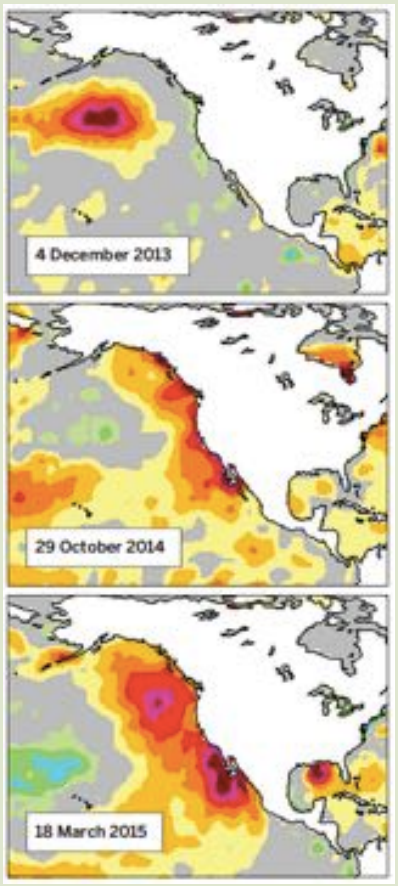
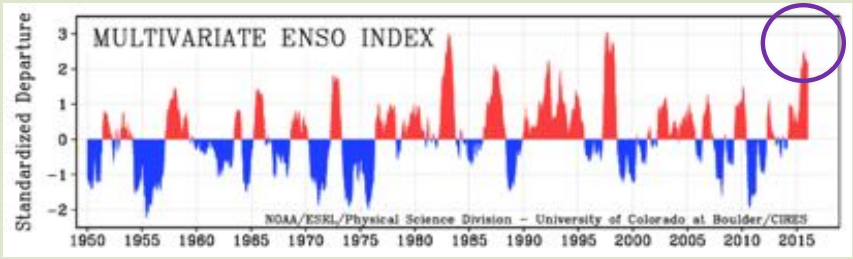


Godzilla El Niño



MARINE SCIENCE

'The Blob' invades Pacific, flummoxing climate experts

Persistent mass of warm water is reshuffling ocean currents, marine ecosystems, and inland weather

By **Eli Kintisch**

Marine biologist Robert Pitman thought he'd seen it all after decades of conducting marine mammal surveys off the coast of southern California. But little prepared him for what he noticed off

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Blob 2.0

MARINE SCIENCE

North Pacific 'blob' stirs up fisheries management

Unusual warmth strengthens calls for ecosystem-based decisions.

BY VIRGINIA GEWIN

Unprecedented conditions in the Pacific Ocean have sent fisheries managers into uncharted waters. 'The blob', an unusually warm mass of water that has been parked in the northern Pacific for 18 months, has quelled upwelling that delivers nutrients to

Fisheries Society annual meeting in Portland, Oregon, last week. Managers tend to base limits on assessments that focus on individual species and presume that population trends are stable. Ecosystem-based fisheries management aims for a more comprehensive approach that considers variables such as predator–prey relationships, climate conditions and

The biggest barrier may be the need to collect and analyse relevant biological data, such as information on how fluctuations in the population of a prey species will affect its predators. Supporters of ecosystem-based fisheries are creating tools such as the California Current Predator Diet Database, which is amassing information about the eating habits of 119 species. At the fisheries meeting, Amber Szoboszlai, a research analyst at the Farallon Institute for Advanced Ecosystem Research in Petaluma, California, showed how she had used the database to determine that fish eat 75% of the anchovies consumed in the Pacific, whereas mammals eat only 16% and seabirds 7%.

If the blob signals a regime change in the Pacific, conservationists argue that ecosystem-based management will be essential to preventing a catastrophe. "The whole system seems to be changing radically," says Rebecca Goldburg, director of ocean science for the Pew Charitable Trusts in Washington DC. ■

Latest forecast suggests 'Godzilla El Niño' may be coming to California

By **Rong-Gong Lin II**
Contact Reporter

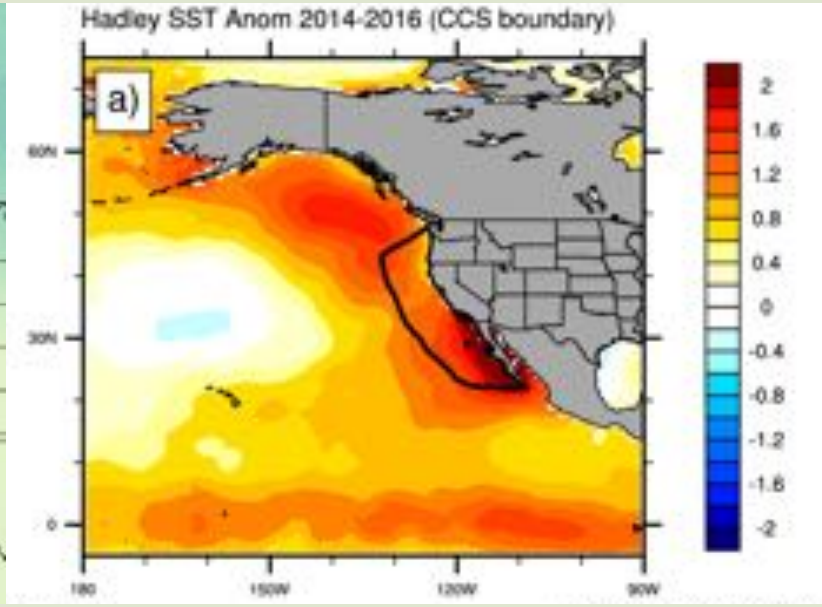
AUGUST 13, 2015, 12:54 PM | REPORTING FROM SAN FRANCISCO

The strengthening El Niño in the Pacific Ocean has the potential to become one of the most powerful on record, as warming ocean waters surge toward the Americas, setting up a pattern that could bring once-in-a-generation storms this winter to drought-parched California.

California Current HIGHLIGHTS

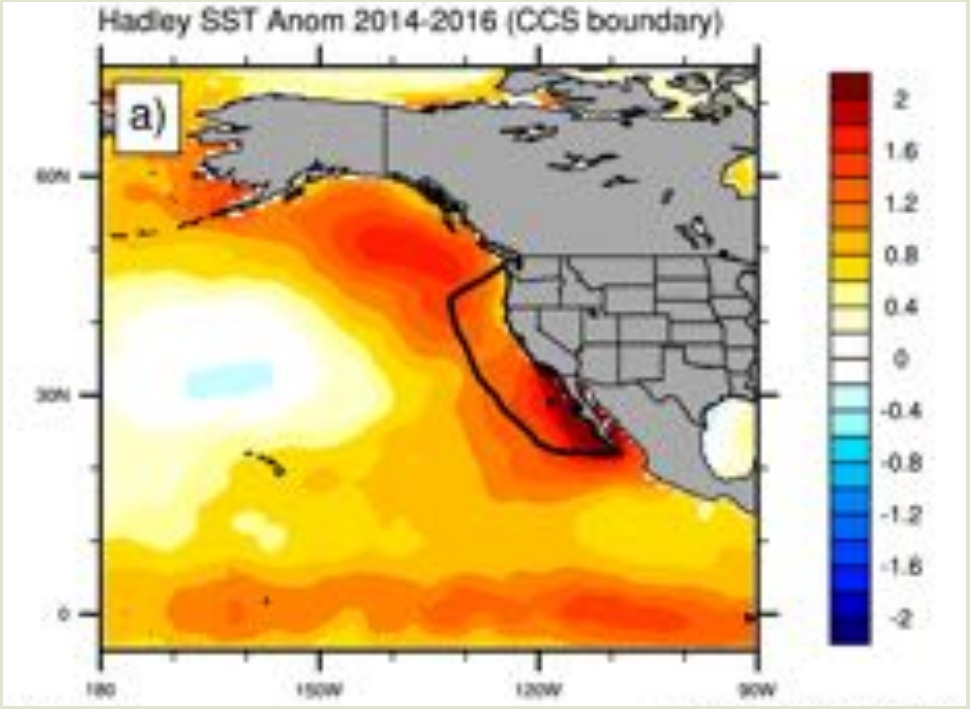
Highly anomalous environmental conditions since 2013!

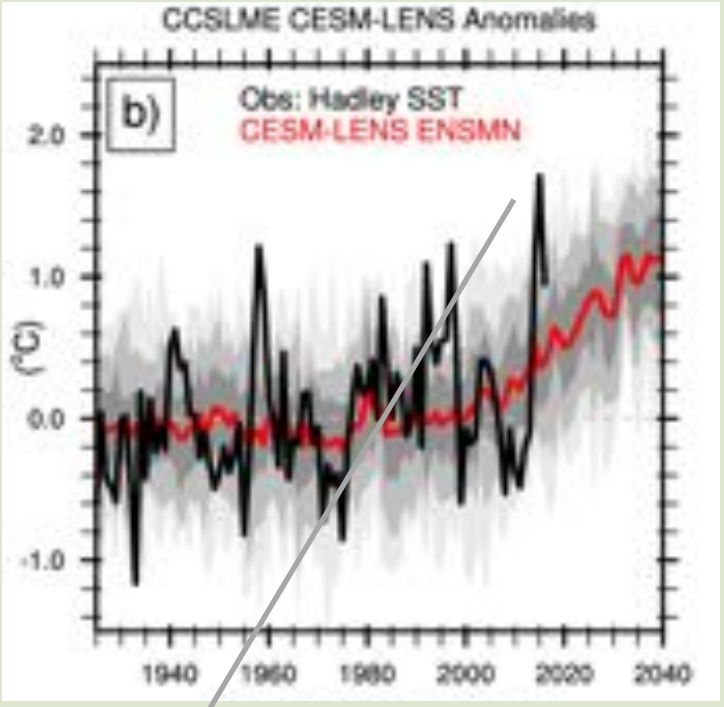
The ‘Blob’: anomalous warming in the NE Pacific



Jacox et al. (2017)

The ‘Blob’: anomalous warming in the NE Pacific

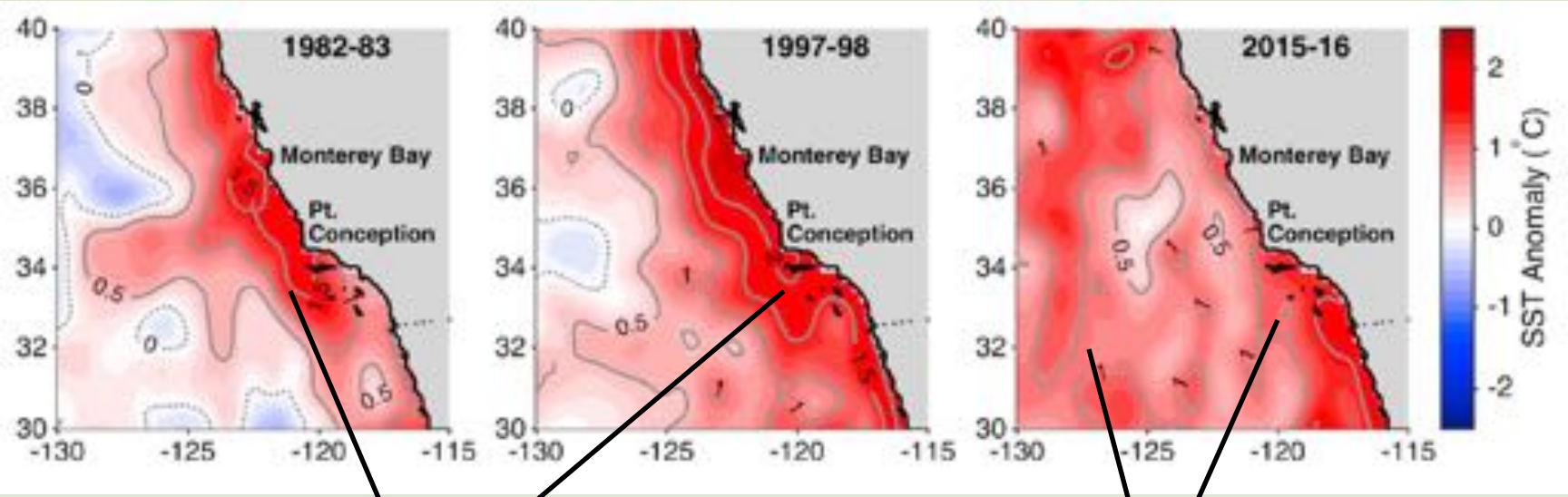




Unprecedented SST anomalies

Jacox et al. (2017)

Comparison of SST Anomalies in Strong El Niños



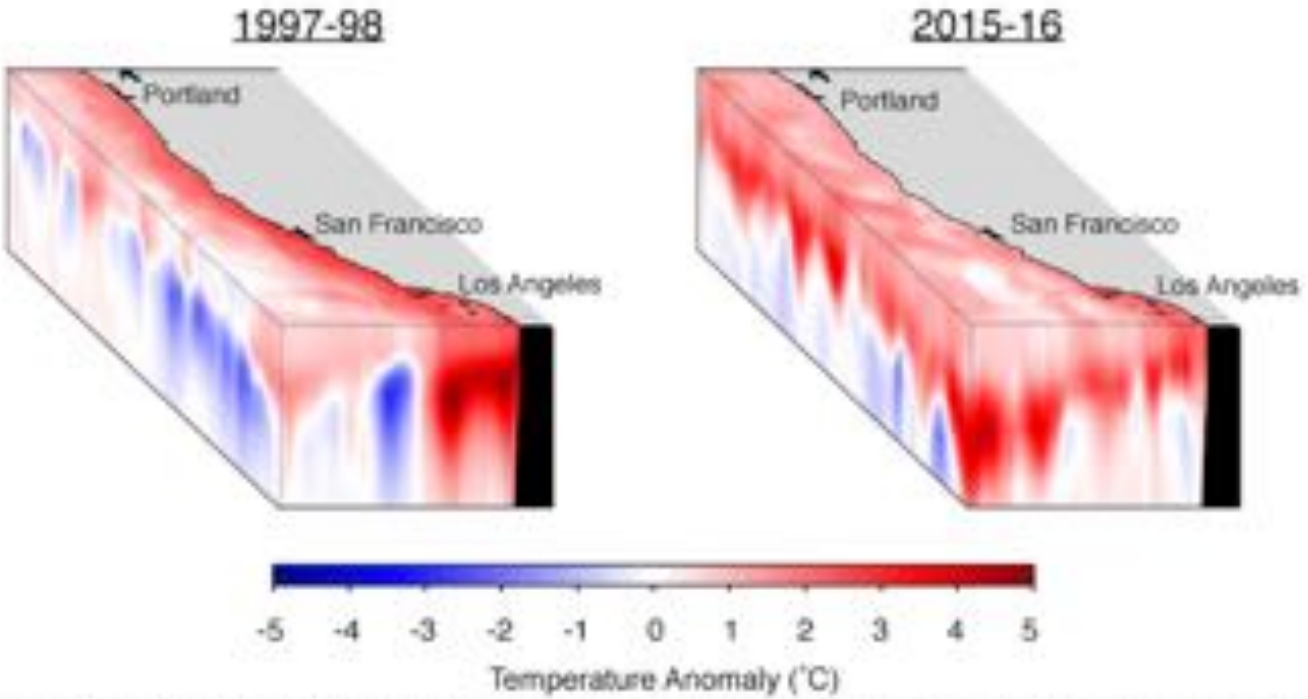
Coastal anomalies in 1982-83 and 1997-98

Widespread anomalies in 2015-16

= Blob + El Niño

Jacox et al. (2016)

Comparison of Thermal Structure in Strong El Niños



Caption: *Wintertime temperature anomalies off the U.S. west coast during the strong El Niños of 1997-98 and 2015-16. In 1997-98 warming was strongest near the coast, consistent with effects of El Niño. In 2015-16, warming was more uniform and widespread, consistent with pre-existing warming known as 'the Blob.'* (Michael Jacox)

Jacox et al. (2016)

July 6, 2016

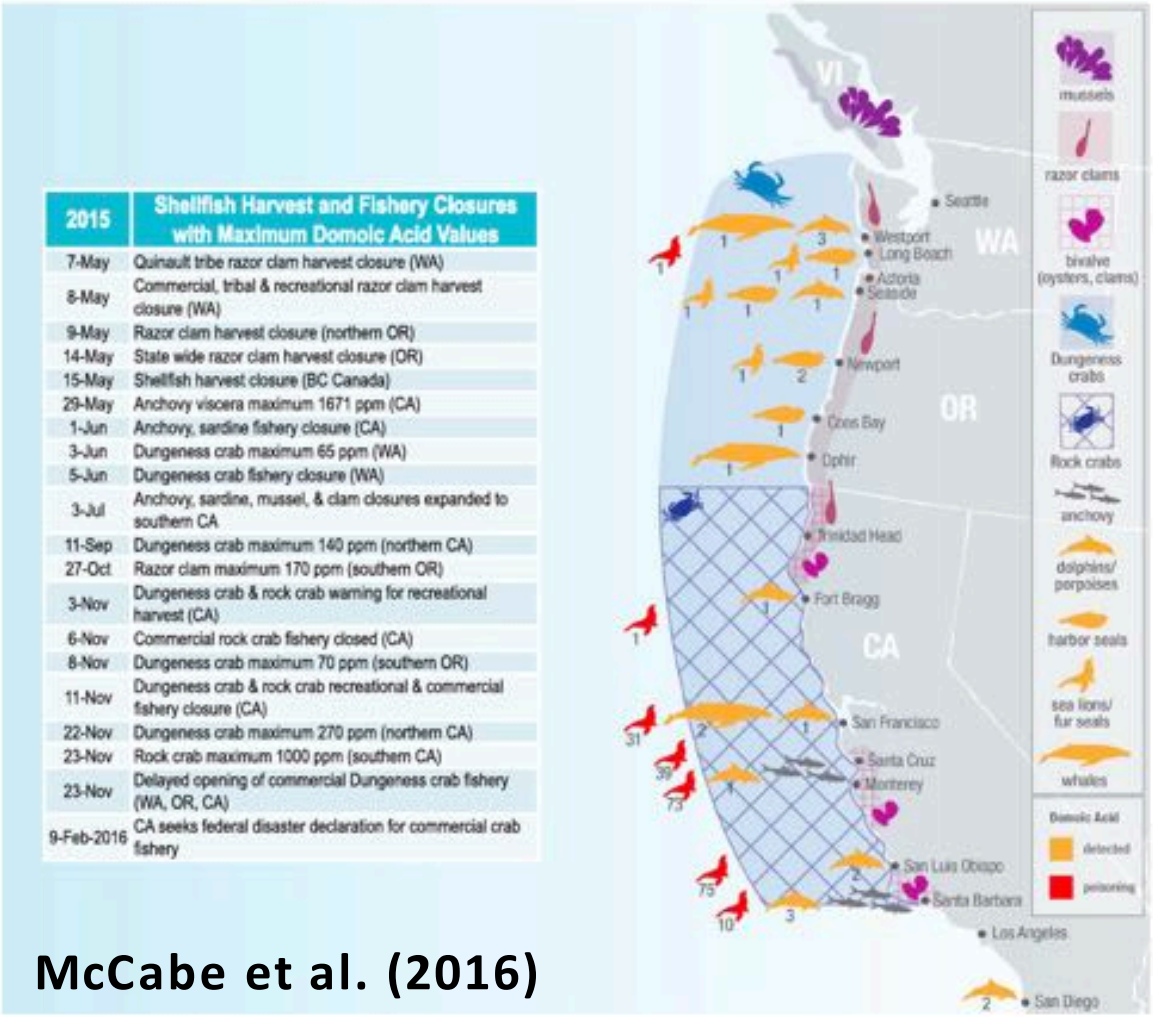
'The Blob' overshadows El Niño

Research identifies earlier ocean warming as dominant effect off West Coast

Caption: *The Blob and El Niño are on their way out, leaving a disrupted marine ecosystem behind.* (Michael Jacox)

Biological Impacts in the California Current

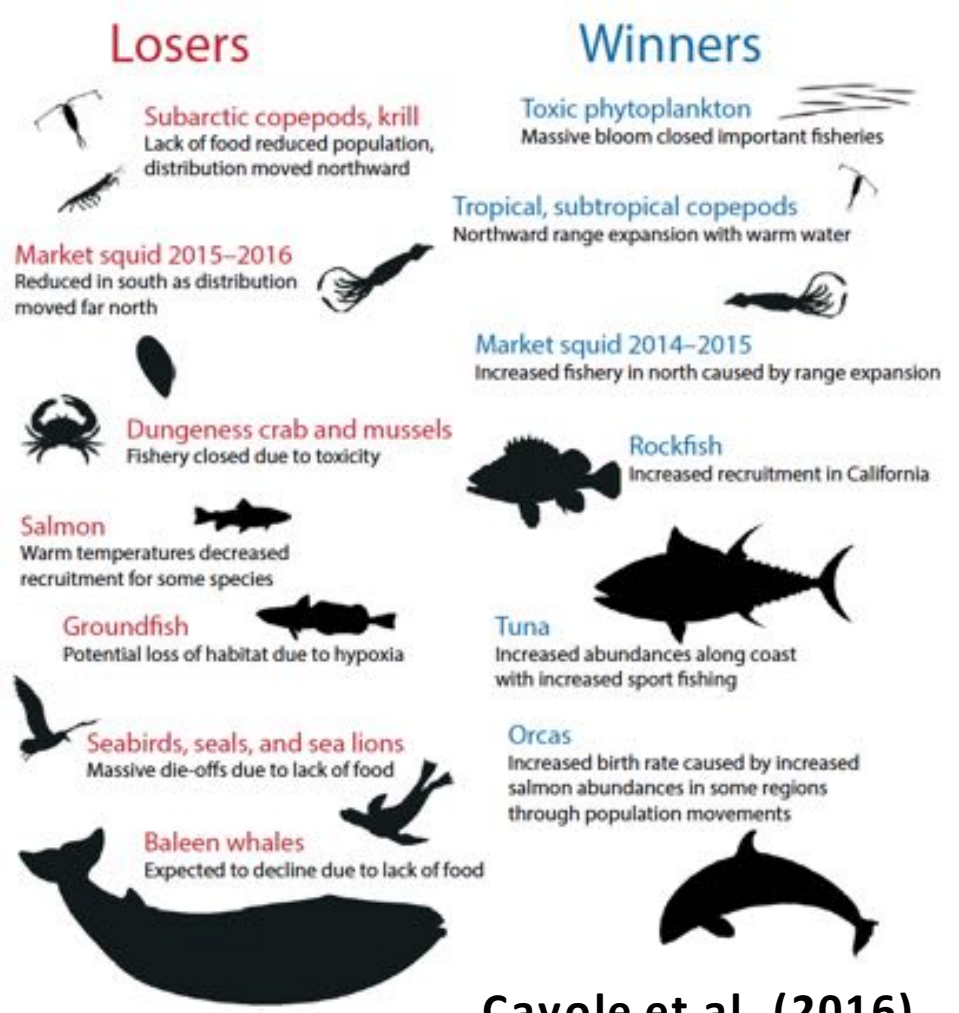
2015	Shellfish Harvest and Fishery Closures with Maximum Domoic Acid Values
7-May	Quinault tribe razor clam harvest closure (WA)
8-May	Commercial, tribal & recreational razor clam harvest closure (WA)
9-May	Razor clam harvest closure (northern OR)
14-May	State wide razor clam harvest closure (OR)
15-May	Shellfish harvest closure (BC Canada)
29-May	Anchovy viscera maximum 1671 ppm (CA)
1-Jun	Anchovy, sardine fishery closure (CA)
3-Jun	Dungeness crab maximum 65 ppm (WA)
5-Jun	Dungeness crab fishery closure (WA)
3-Jul	Anchovy, sardine, mussel, & clam closures expanded to southern CA
11-Sep	Dungeness crab maximum 140 ppm (northern CA)
27-Oct	Razor clam maximum 170 ppm (southern OR)
3-Nov	Dungeness crab & rock crab warning for recreational harvest (CA)
6-Nov	Commercial rock crab fishery closed (CA)
8-Nov	Dungeness crab maximum 70 ppm (southern OR)
11-Nov	Dungeness crab & rock crab recreational & commercial fishery closure (CA)
22-Nov	Dungeness crab maximum 270 ppm (northern CA)
23-Nov	Rock crab maximum 1000 ppm (southern CA)
23-Nov	Delayed opening of commercial Dungeness crab fishery (WA, OR, CA)
9-Feb-2016	CA seeks federal disaster declaration for commercial crab fishery



McCabe et al. (2016)

Figure 1. Impacts of domoic acid (DA) on fisheries and marine mammals in 2015. Shaded areas with shellfish symbols on land denote shellfish closures. Fish symbols indicate northern anchovy closures at designated landing sites. Shaded or hatched areas offshore (Dungeness crab and rock crab) correspond to the closures listed on the left. Stranded marine mammals with detectable DA (orange) and California sea lions diagnosed with DA poisoning (red) are pictured with the number of individuals indicated. DA poisoning is defined as the presentation of at least two of the following: neurologic signs (seizures, head weaving, ataxia), detectable DA, histopathologic lesions, and/or blood chemistry changes.

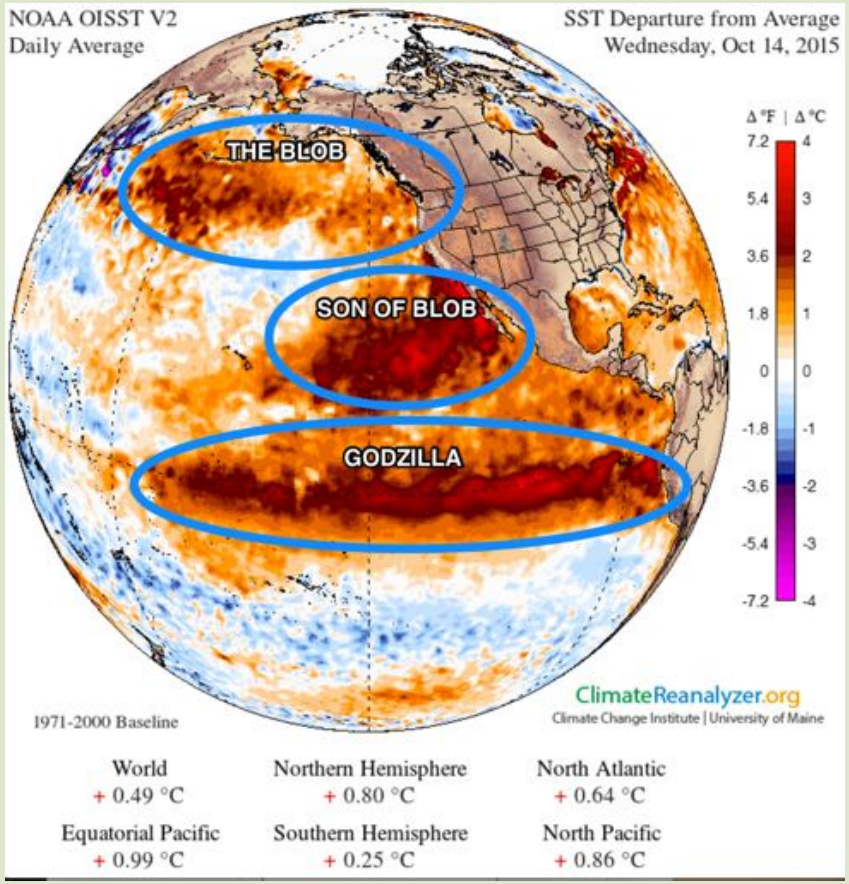
Biological Impacts in the California Current

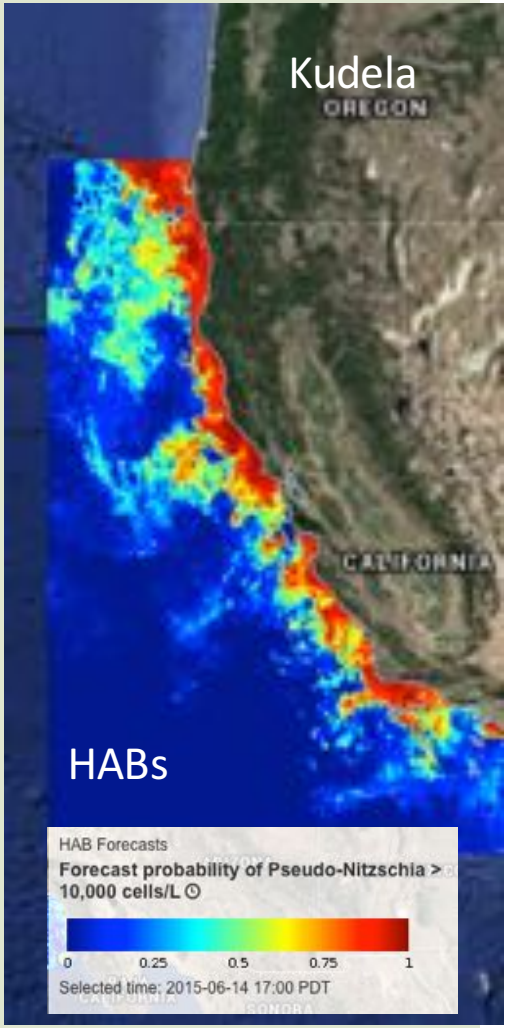


Cavole et al. (2016)

FIGURE 5. Organisms observed to be positively and negatively impacted by the WWA. Negatively affected organisms are labeled as "Losers" (left column), while organisms positively affected are labeled as "Winners" (right column). Organisms are presented in both columns from lower (top of the column) to higher (bottom of the column) trophic levels.

2014-16 'Climate Stress Test'





California Current HIGHLIGHTS

- **Environmental conditions dominated the CCLME with record-high SST anomalies (the warm 'Blob') in the NE Pacific and off Baja California in 2014–2016, continued drought, followed by one of the largest El Niños of the past 100 years in 2015-2016.**

- **Multiple indicators → poor productivity & anomalous events including:**
  - Huge harmful algal blooms → fishery closures,
  - In-stream pre-spawn Chinook salmon die-offs & low catches
  - Mass mortalities of CA sea lions, Guadalupe fur seals, & common murres,
  - Record entanglements of baleen whales in nearshore fishing gear,
  - Observed high numbers of juvenile leatherback turtles.

- **Need for EBFM tools (IEA); 'climate-ready' strategies; dynamic ocean management**

Biological Impacts in the California Current

TABLE 1. Unusual sightings of species associated with the 2013–2015 warm-water anomaly in the northeastern Pacific. B = Bird, M = Marine mammal, F = Fish, I = Invertebrate, R = Reptile, NC = No change, NA = Not applicable.

Sightings	Common Name	Scientific Name	Sightings Site	Typical Northernmost Distribution	Range Extension (km)
Mass Strandings	Brown Booby (B)	*Sula leucogaster*	37.72°N [1]	27.84°N [20]	1,360
	Tristram's Storm-Petrel (B)	*Oceanodroma tristrami*	37.72°N [1]	21.00°N [21]	3,670
	Guadalupe Fur Seal (M)	*Arctocephalus townsendi*	37.00°N [2]	NC	NA
Shift in Distribution	Blue Marlin (F)	*Makaira nigricans*	59.80°N [3]	34.00°N [22]	3,400
	Largemouth Blenny (F)	*Labrisomus xanti*	32.84°N [4]	28.18°N [23]	540
	Louvar (F)	*Luvarus imperialis*	53.64°N [5]	47.40°N [22]	1,000
	Mahi Mahi (F)	*Coryphaena hippurus*	59.80°N [3]	47.40°N [22]	1,700
	Scalloped Hammerhead (F)	*Sphyrna lewini*	59.80°N [3]	34.43°N [22]	3,300
	Slender Snipefish (F)	*Macroramphosus gracilis*	47.40°N [6]	34.01°N [22]	1,700
	Smooth Hammerhead (F)	*Sphyrna zygaena*	59.80°N [3]	37.00°N [22]	2,800
	Thresher Shark (F)	*Alopias vulpinus*	59.80°N [7]	53.64°N [22]	1,030
	Wahoo (F)	*Acanthocybium solandri*	59.80°N [3]	32.55°N [22]	3,500
	Whitetail Damselfish (F)	*Stegastes leucorus*	33.38°N [8]	29.03°N [22]	460
	Yellowtail (F)	*Seriola lalandi*	59.79°N [9]	53.64°N [22]	1,030
	Yellowfin Tuna (F)	*Thunnus albacares*	59.80°N [10]	49.30°N [22]	1,570
	Greater Argonaut (I)	*Argonauta argo*	36.80°N [11]	34.00°N [22]	640
	Painted Sea Urchin (I)	*Lytechinus pictus*	36.80°N [12]	34.45°N [22]	290
	Spiny Black Urchin (I)	*Arbacia stellata*	37.00°N [12]	27.84°N [24]	1,200
	Tuna Crab (I)	*Pleuroncodes planipes*	36.80°N [13]	27.84°N [25]	1,200
	Green Sea Turtle (R)	*Chelonia mydas*	33.53°N [14]	32.71°N [26]	120
Shift in Abundance	Alaskan Pollock (F)	*Gadus chalcogrammus*	59.80°N [15]	NC	NA
	Albacore (F)	*Thunnus alalunga*	59.79°N [9]	59.79°N [22]	NA
	Bluefin Tuna (F)	*Thunnus orientalis*	59.80°N [11]	59.79°N [22]	NA
	Krill (I)	*Euphausia pacifica*	37.00°N [16]	NC	NA
Repeating Unusual Record	Bullseye Puffer (F)	*Sphoeroides annulatus*	34.05°N [17]	33.86°N [22]	NA
	Ocean Sunfish (F)	*Mola mola*	59.80°N [10]	59.79°N [22]	NA
	Pacific Bonito (F)	*Sarda chiliensis*	59.79°N [9]	59.79°N [22]	NA
	Skipjack Tuna (F)	*Katsuwonus pelamis*	59.80°N [10]	59.60°N [22]	NA
	Tope Shark (F)	*Galeorhinus galeus*	53.64°N [5]	53.64°N [22]	NA
	Whale Shark (F)	*Rhincodon typus*	36.97°N [17]	36.97°N [22]	NA
	Humboldt Squid (I)	*Dosidicus gigas*	59.80°N [10]	34.45°N [27]	NA
	Pilot Whale (M)	*Globicephala* sp	59.80°N [18]	59.80°N [25]	NA
	Pygmy Killer Whale (M)	*Feresa attenuata*	36.80°N [18]	23.15°N [28]	1,770
	Yellow-Bellied Sea Snake (R)	*Pelamis platura*	34.19°N [19]	30.00°N [29]	260