

Recent Environmental Conditions in southern BC Marine waters, and Unusual Algal Blooms

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Content

- 1) Overview of recent ocean conditions in NE Pacific and BC coast
- 2) Unusual phytoplankton events
- 3) Possible futures (re climate and phytoplankton blooms)



Content

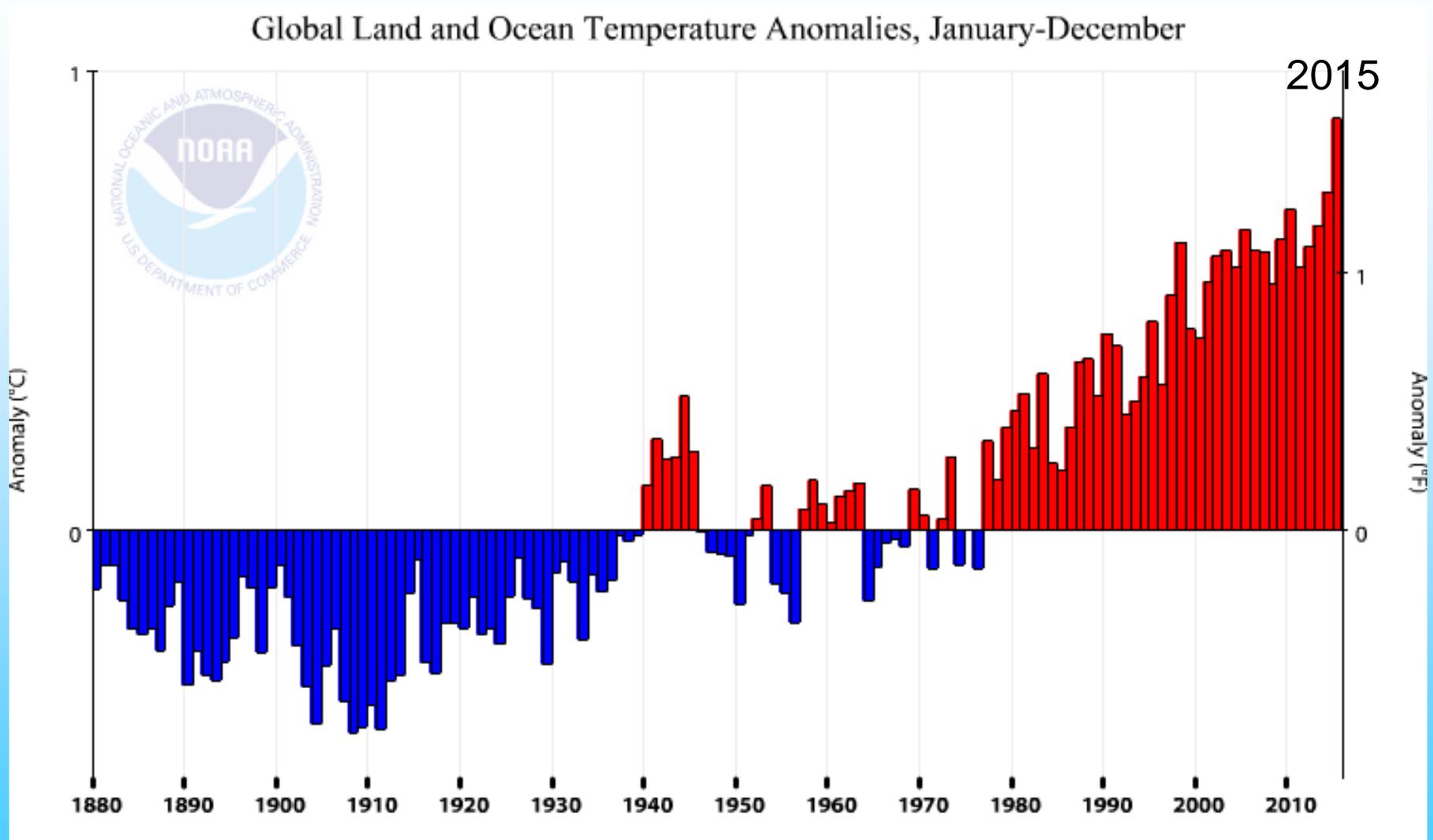
1) Overview of recent ocean conditions in NE Pacific and BC coast

3 main features:

- Warming global climate
- “The Blob” (2013-2015)
- El Niño (2015-2016)



Global land and ocean temperature anomalies, 1880-2015



NOAA



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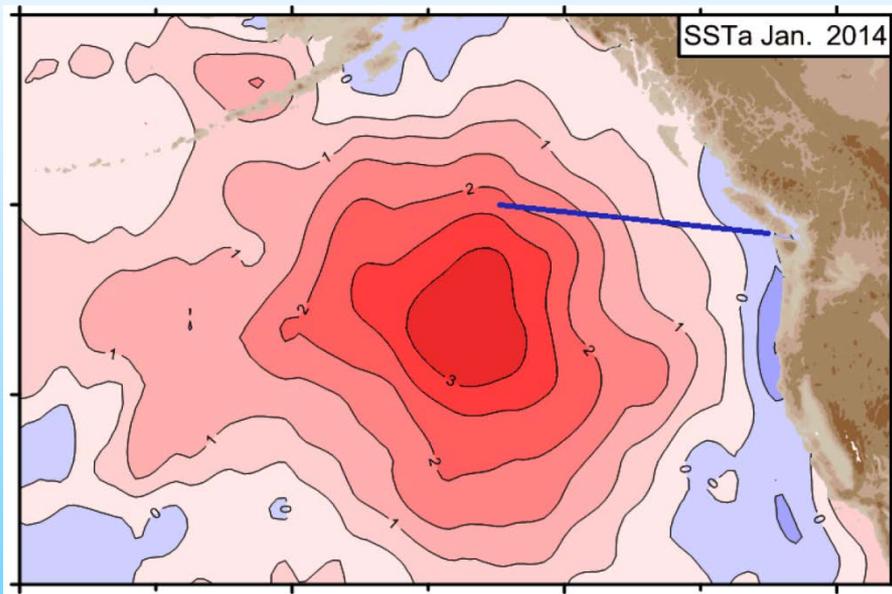
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24-25 October 2016

North Pacific Marine Heatwave (a.k.a. “The Blob”)

January 2014

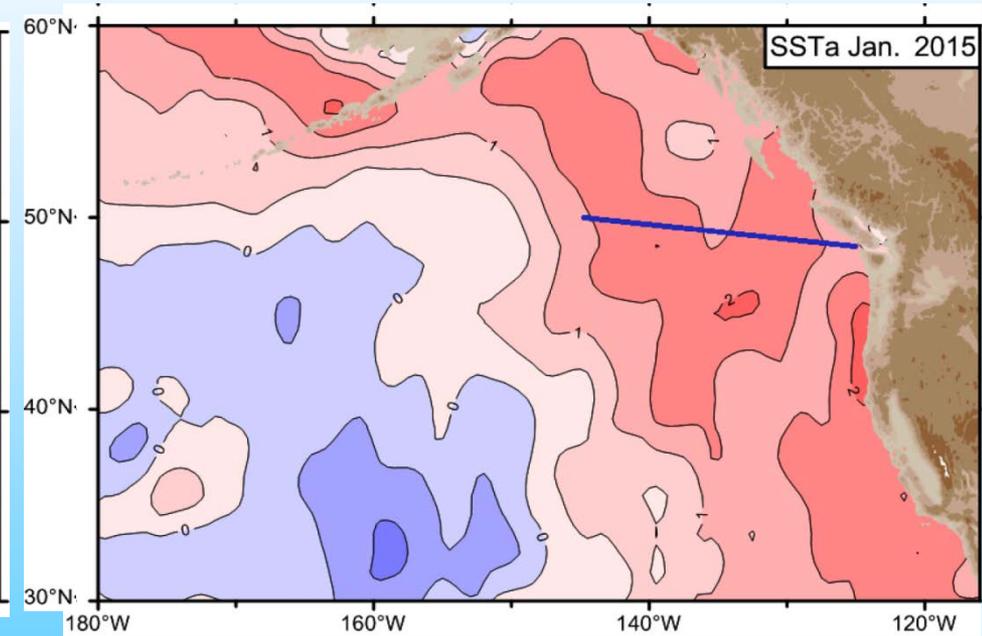
Difference from normal temperatures



Very intense warm water (red: up to 3 °C above normal) in NE Pacific, but cool (blue) along BC coast

January 2015

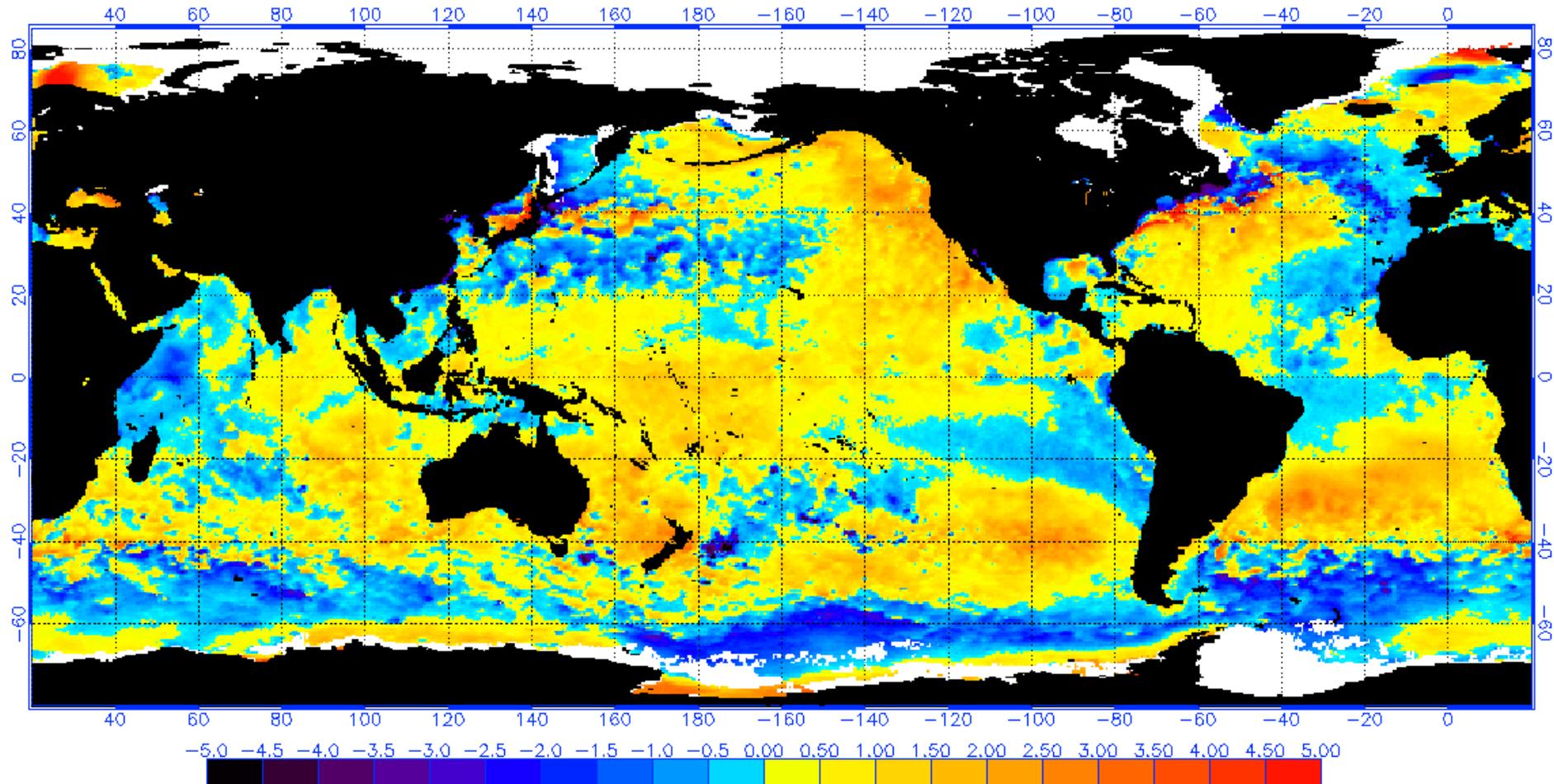
Difference from normal temperatures



NE Pacific has cooled (blue), but warm water (red) moved to BC coast

2 Feb 2015

NOAA/NESDIS 50 KM GLOBAL ANALYSIS: SST Anomaly (degrees C), 2/2/2015
(white regions indicate sea-ice)



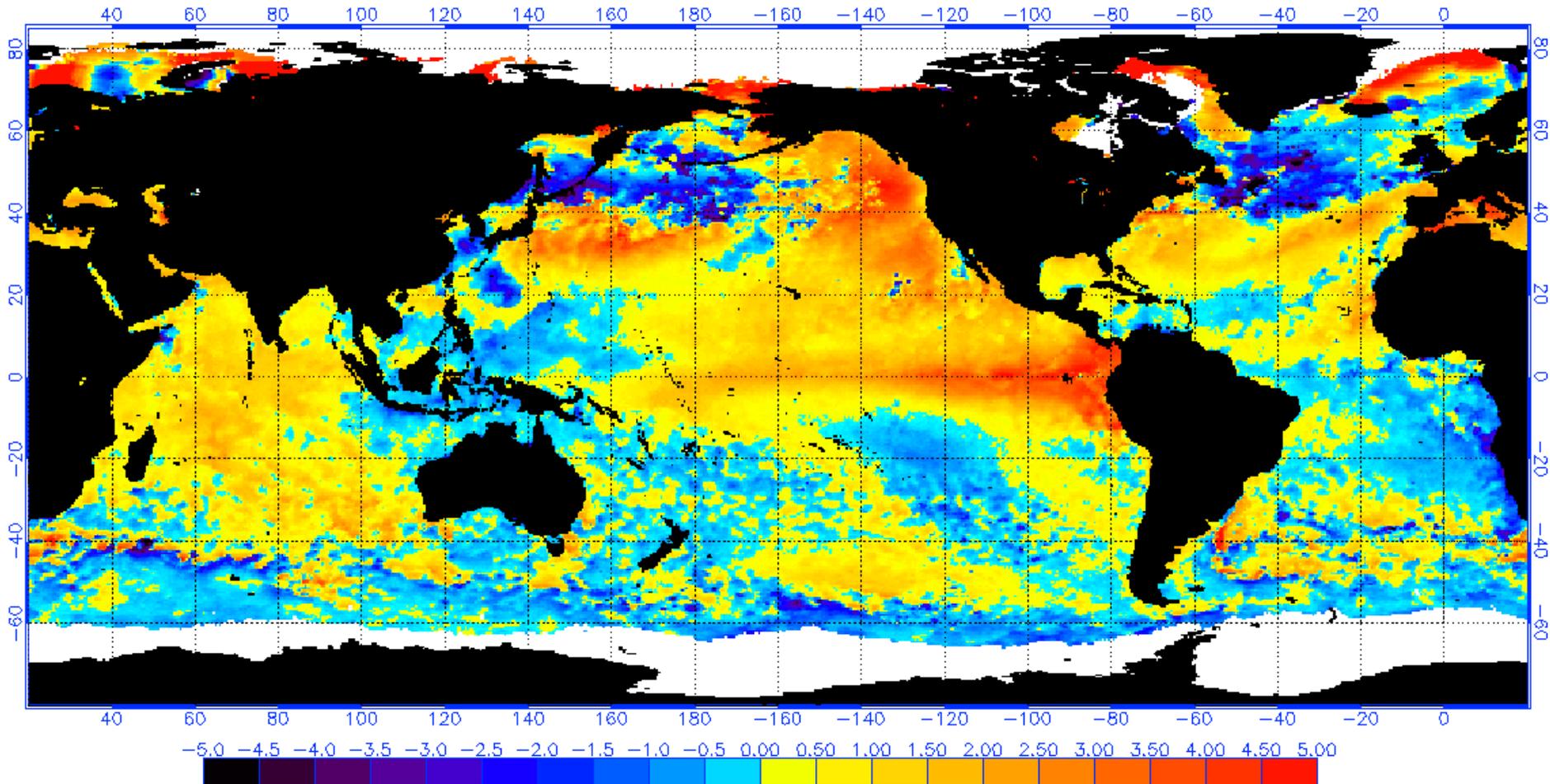
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16 Jul 2015

NOAA/NESDIS 50 KM GLOBAL ANALYSIS: SST Anomaly (degrees C), 7/16/2015
(white regions indicate sea-ice)



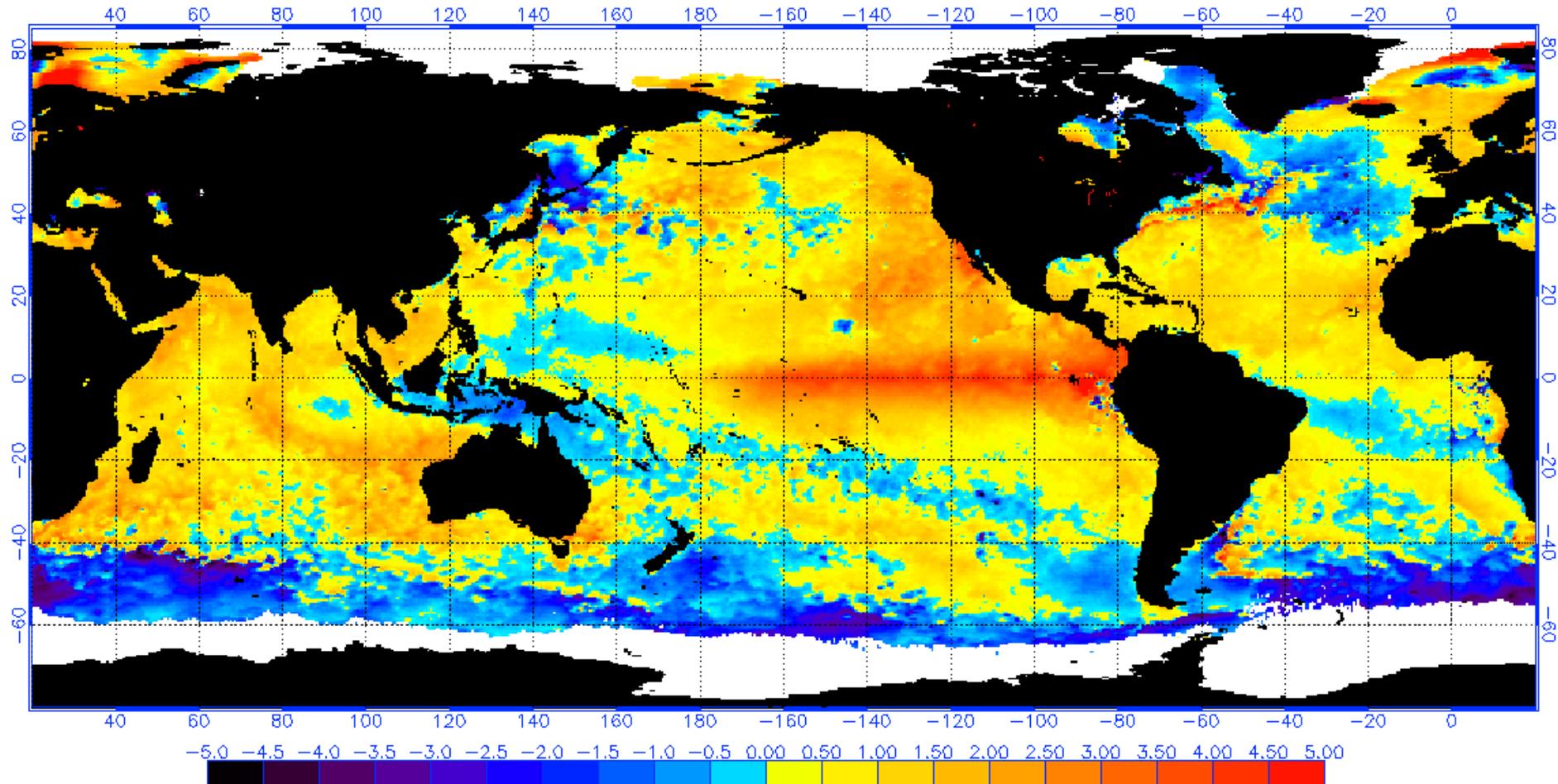
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2 Nov 2015

NOAA/NESDIS 50 KM GLOBAL ANALYSIS: SST Anomaly (degrees C), 11/2/2015
(white regions indicate sea-ice)

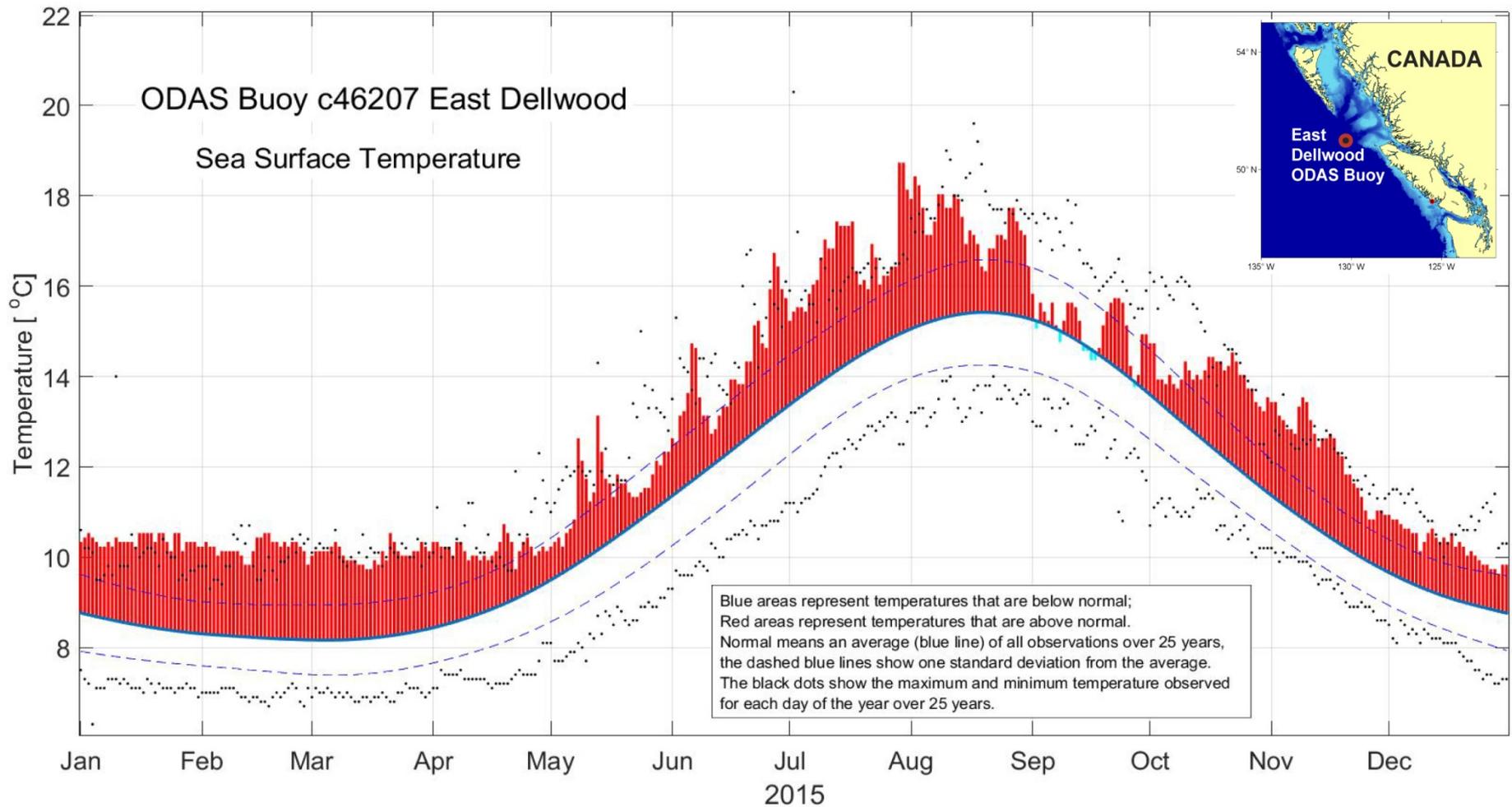


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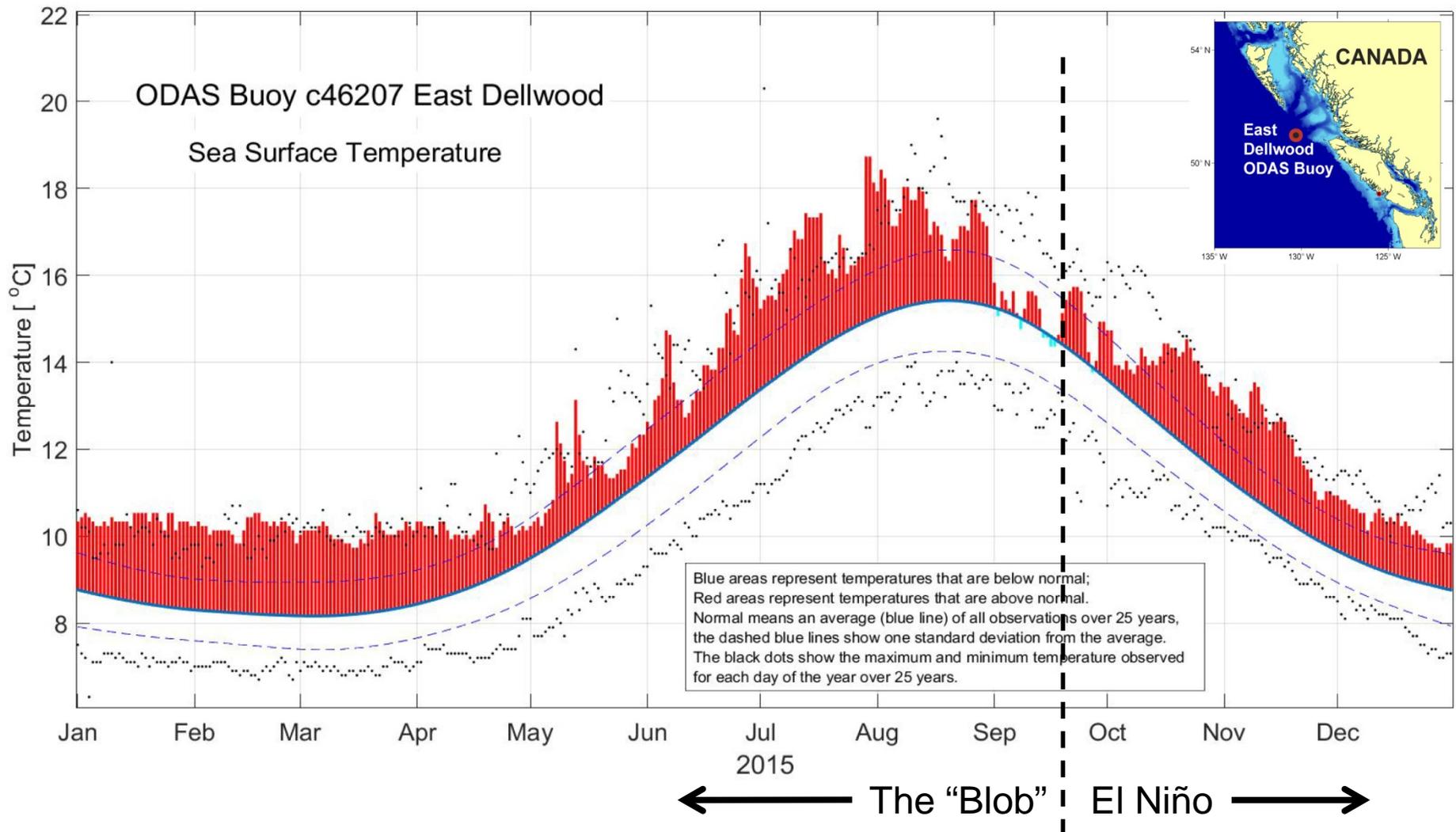
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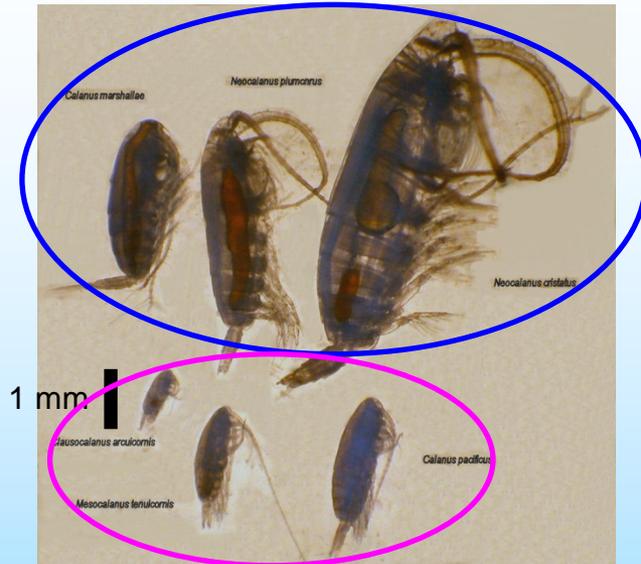
Coastal BC: SSTs remain high in 2015



Coastal BC: SSTs remain high in 2015



Changes in water temperature are reflected in changes in zooplankton species composition



- northern-type zooplankton occurred along Vancouver Island in 1st half of 2014 when water was cool (large nutritious species, good for fish)
- but, southern-type zooplankton in 2nd half of 2014 and in 2015 when water was warm (small poor quality species)



Doliolids



Sea butterfly (*Clione*)

Exceptional abundances of gelatinous zooplankton (not good fish food)



Ocean sunfish (*Mola mola*)



© Daniel Botelho / Barcroft Media



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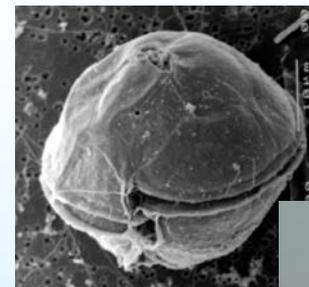
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Types of Harmful Algal Blooms

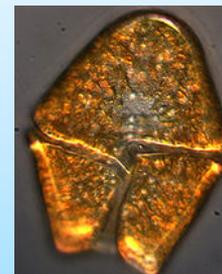
1. **Toxin producers** (e.g. *Alexandrium catenella*, *Pseudonitzschia australis*)

Contaminate seafood affecting human health and wild animals (turtles, dolphins, whales, birds)



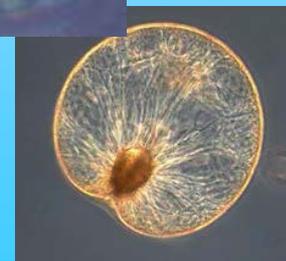
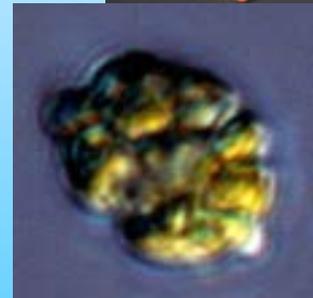
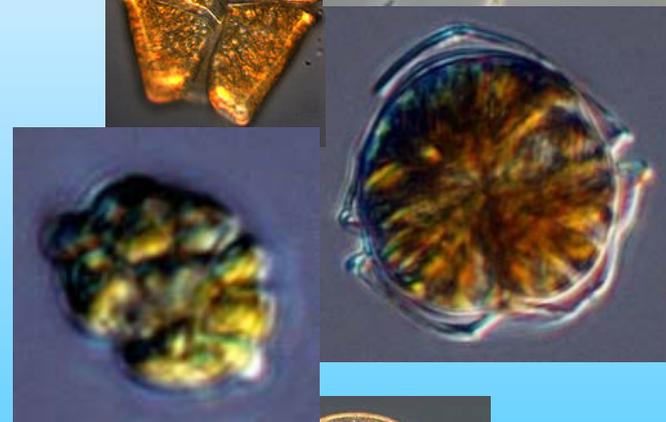
2. **Non-toxic to humans but harmful to fish, invertebrates and birds** (e.g. *Heterosigma akashiwo*, *Akashiwo sanguinea*)

Damage or clog fish and invertebrates gills; produce foam that damages bird feathers



3. **High biomass producers** (e.g. *Noctiluca spp*, *Alexandrium taylorii*)

Disruption of food web; kill fish and invertebrate due to O₂ depletion, or alter ecosystems in other ways that we perceive as harmful.



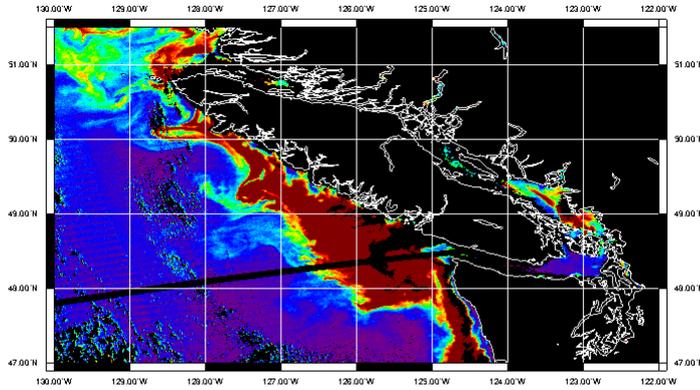
Exceptional phytoplankton bloom occurred along North American coast from May-Sept 2015

MODIS NFLH satellite images

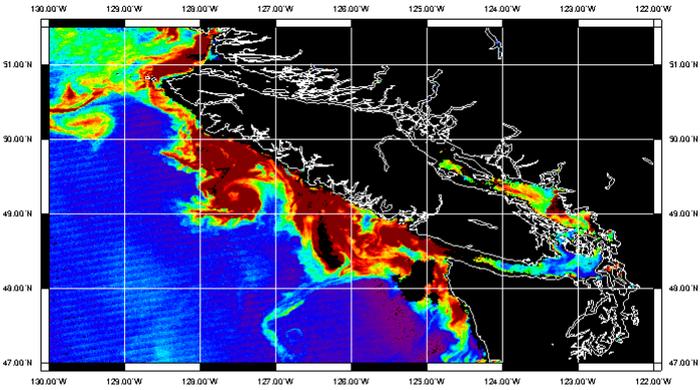
Unusual in terms of:

- spatial extent of bloom (California to Alaska)
- duration of bloom (May to Sept)
- presence of toxic phytoplankton species (domoic acid producers)

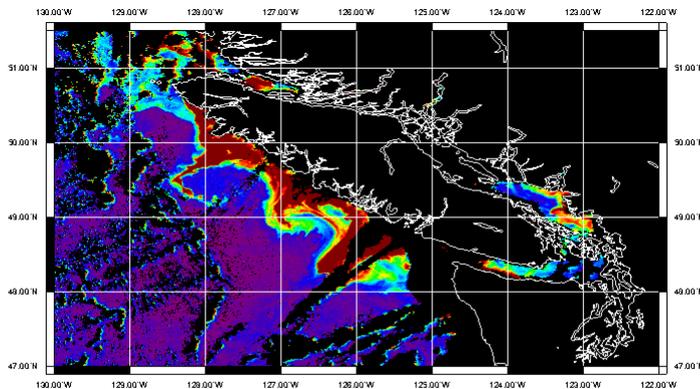
9 June
2015



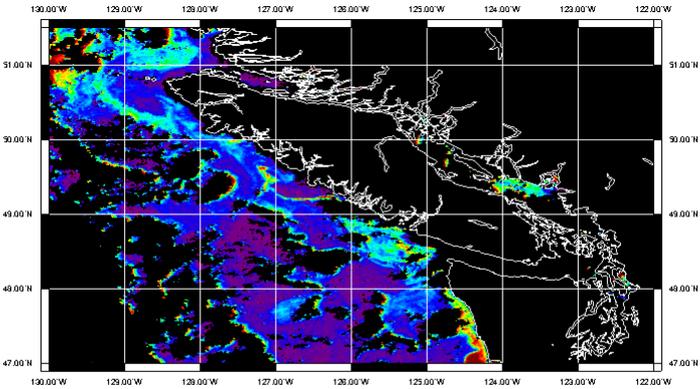
4 July
2015



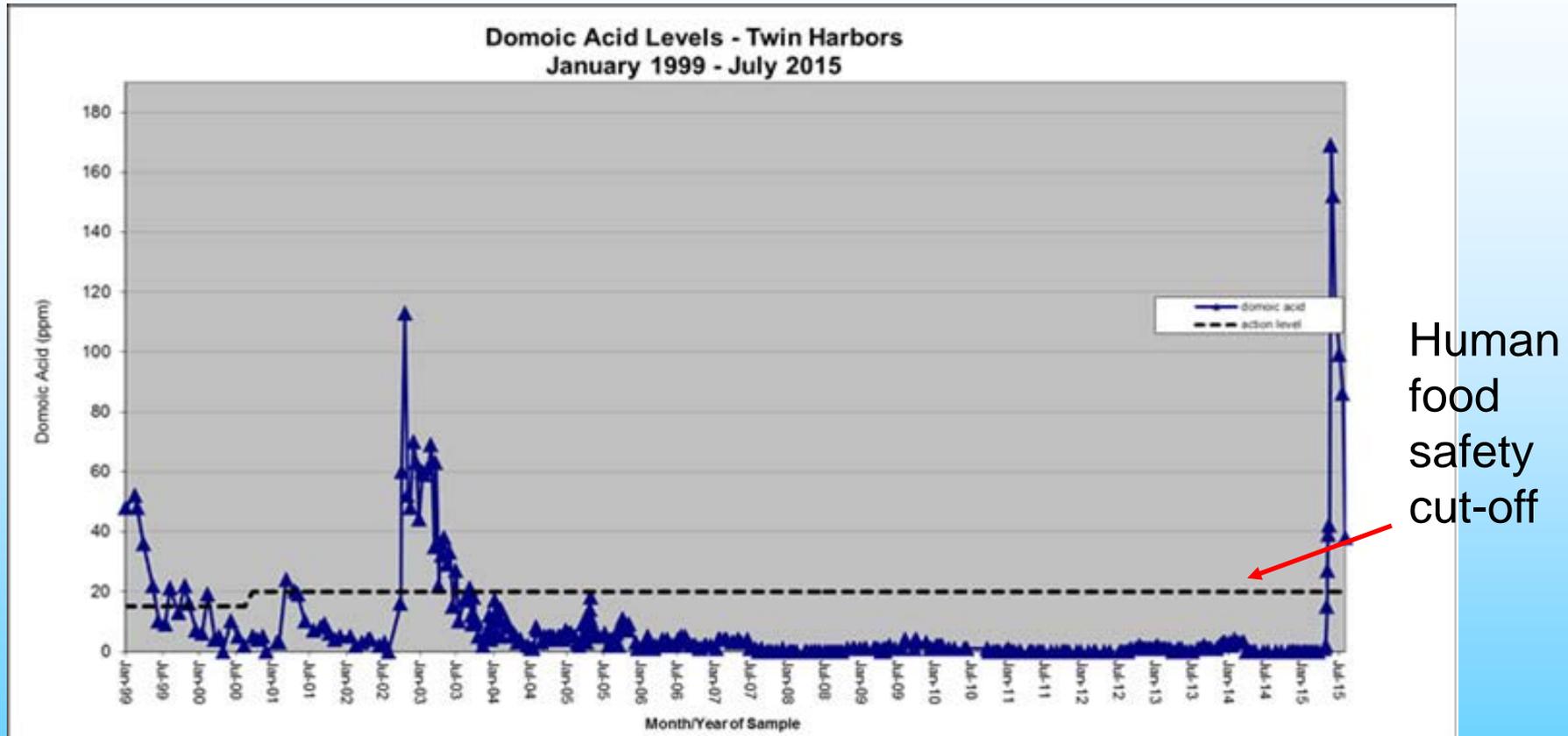
6 Aug
2015



3 Sept
2015



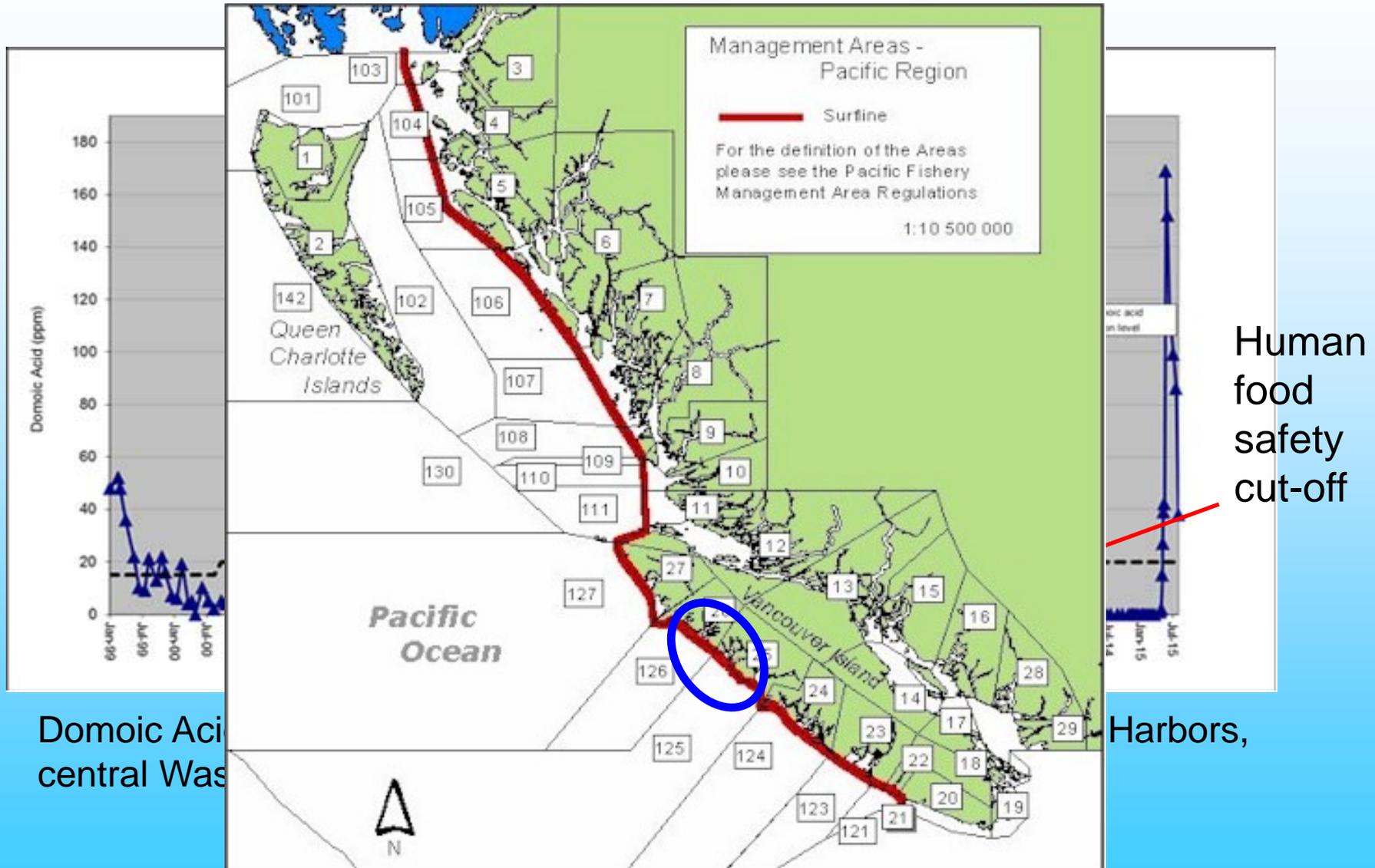
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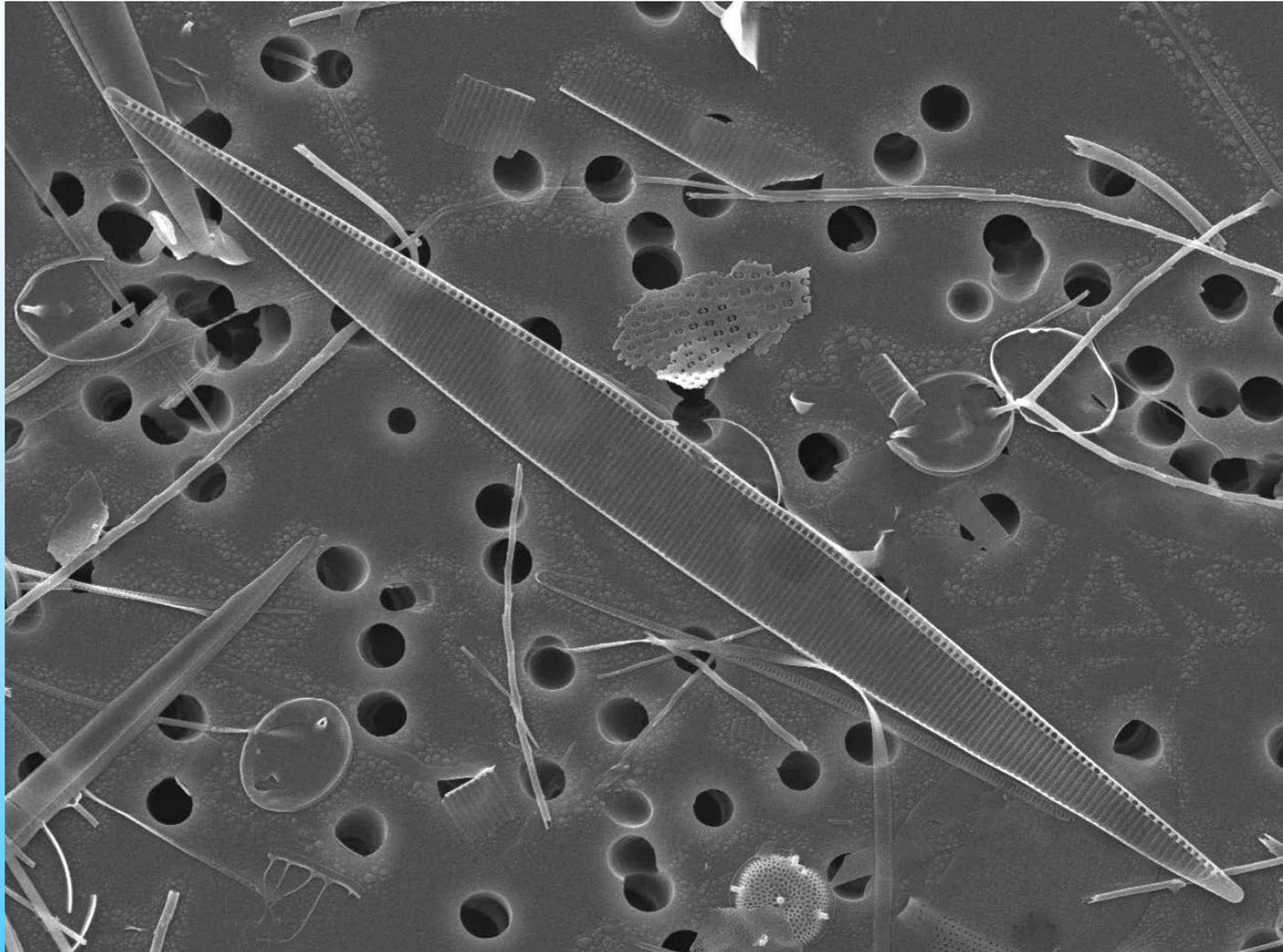
Domoic Acid concentrations, as measured in razor clams at Twin Harbors, central Washington State (January 1999 to July 2015)



Exceptional phytoplankton bloom occurred along North American coast from May-Sept 2015



Exceptional phytoplankton bloom occurred along North American coast from May-Sept 2015



Pseudo-nitzschia fraudulenta

In early July 2015 at the shelf break, *Pseudo-nitzschia fraudulenta* comprised 32% of all diatoms, and 19% of all microplankton sampled

James Ehrman
Digital Microscopy Facility
Mount Allison University
Sackville, NB

10 kV X1,700 10 µm 0001 09/28/15 Moira G Stn LB12
8 mm 7 sp SEI 092815_0001.bmp 4:35:39 PM Digital Microscopy Facility



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Unusual phytoplankton events

(19 August 2016)



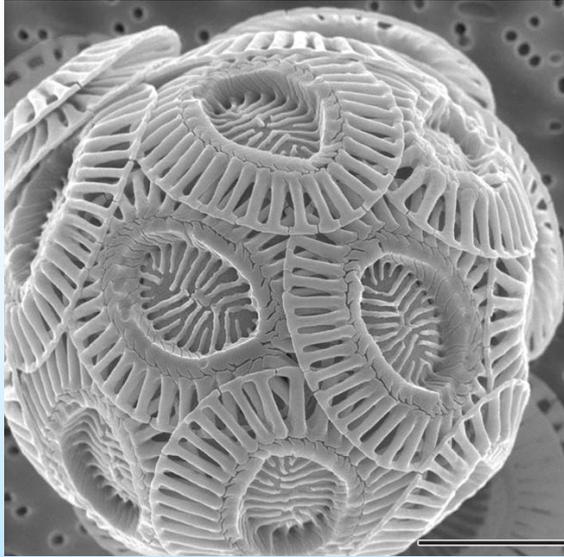
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(19 August 2016)



Emiliana huxleyi

Image from

https://en.wikipedia.org/wiki/Emiliana_huxleyi



Bright green water in Saanich Inlet

(Photo courtesy N Nemcek)



HAB's in BC marine environments

- All 3 types of HAB's have been observed in Pacific Region
- Some type of harmful algal bloom can occur at most locations, at almost any time of year
- Difficult to say if frequency of HABS has been increasing in BC waters because of lack of structured monitoring program

Canadian roles & responsibilities for HAB's:

- **Canadian Food Inspection Agency (CFIA)**
 - Monitoring sample organisms
- **DFO**
 - Closing beaches; scientific research
- **Province**
 - Human health issues related to HABs
- **Industry**
 - Monitoring of algae at fish farms

Possible futures (re climate and phytoplankton blooms)

Table 1: Projected dates of climate departure of mean annual surface temperature from historical variability.

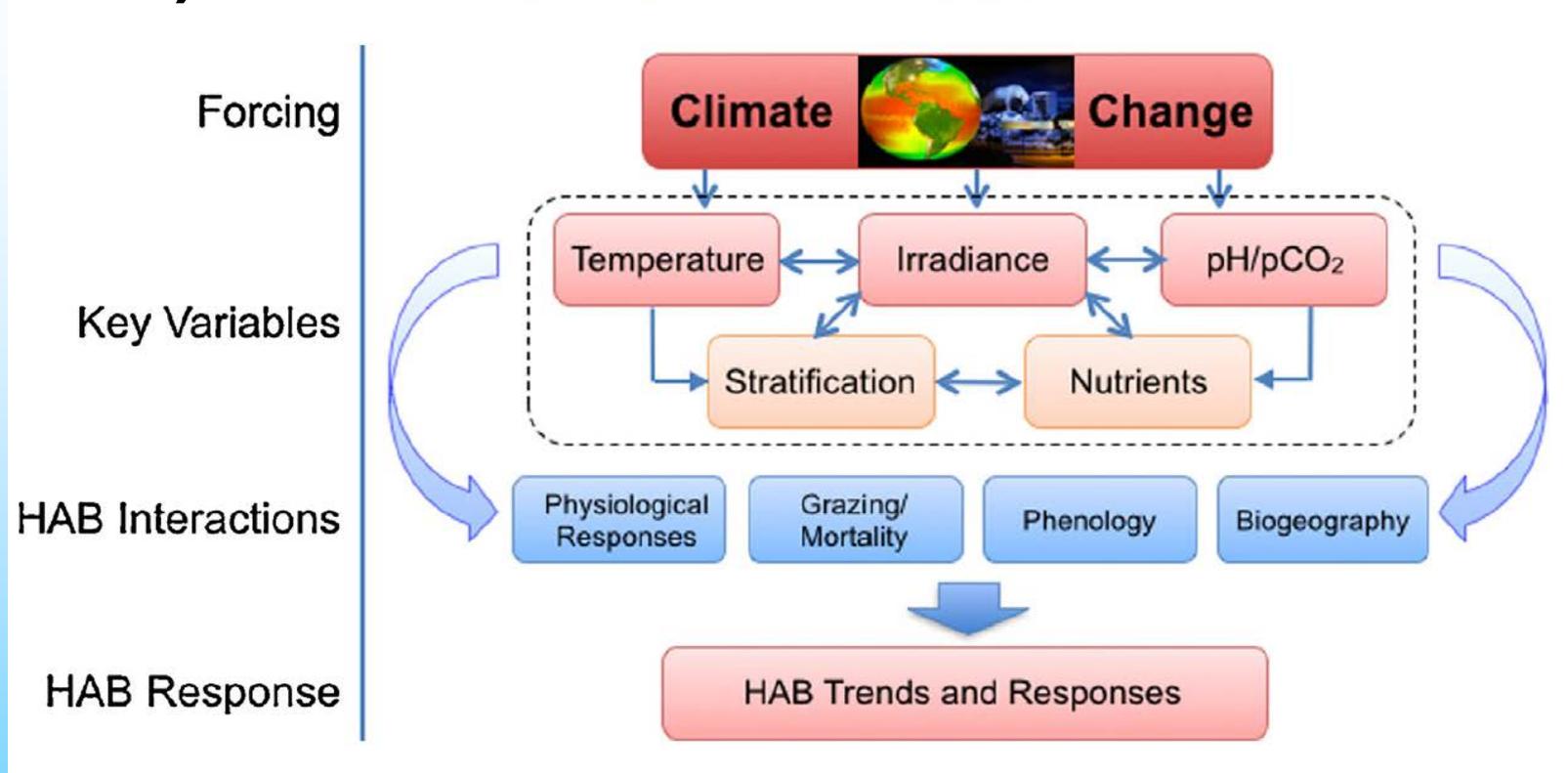
Region	Emissions reductions	Business as usual
Cariboo	2089	2061
Kootenay/Boundary	2085	2057
Northeast	2091	2066
Omineca	2091	2065
Skeena	2092	2067
South Coast	2084	2056
Thompson/Okanagan	2086	2056
West Coast	2089	2064
Yukon	2093	2067

Pacific Climate Impacts Consortium



Possible futures (re climate and phytoplankton blooms)

M.L. Wells et al./Harmful Algae 49 (2015) 68–93



Pressures: alterations in temperature, stratification, light, ocean acidification, precipitation-induced nutrient inputs, grazing

Outcomes: expansion in time and space of distributions and occurrences;
Species-specific outcomes highly uncertain

Summary

1) Overview of recent ocean conditions in NE Pacific and BC coast

- Warming global climate
- “The Blob” (2013-2015)
- El Niño (2015-2016)
- Outcomes: changes in food web species composition & distribution

2) Unusual phytoplankton events

- Large and persistent diatom bloom off west coast of North America in 2015, including toxic species
- Exceptional coccolithophore bloom in Strait of Georgia (2016)

3) Possible futures (re climate and phytoplankton blooms)

- “clear” climate impact signal expect about 2050
- Expansions of harmful algal bloom distributions and timing likely
- Species-specific impacts uncertain

