A Group Approach to Understanding Ecosystem Dynamics in the Northeast Pacific Ocean

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53 contributors for 35 individual reports in 2009 show 5% of figures today

Advisory report in English and French (30 p); Research document in English (130 p).
http://sci.info.pac.dfo.ca/PSARC/OSR's/OSR.htm Google: PSARC Ocean Pacific

Goals:

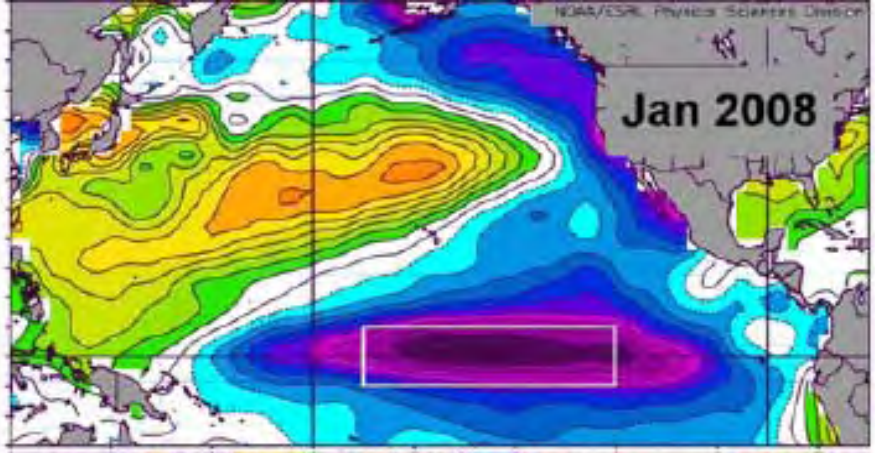
1. Offer timely overview of changes in marine conditions in the previous year (and forecasts if possible) in the context of many years of observations.
2. Offer insight into marine ecology, climate and fisheries.
3. Report on new conditions not reported previously.

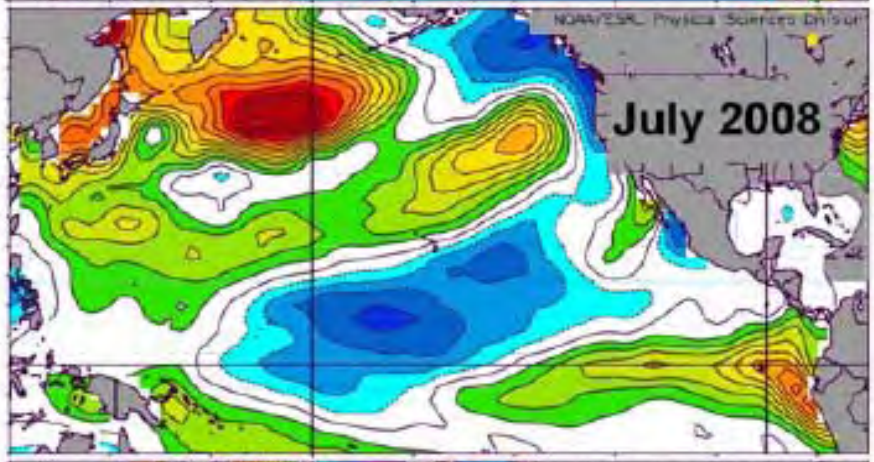
Individual reports should:

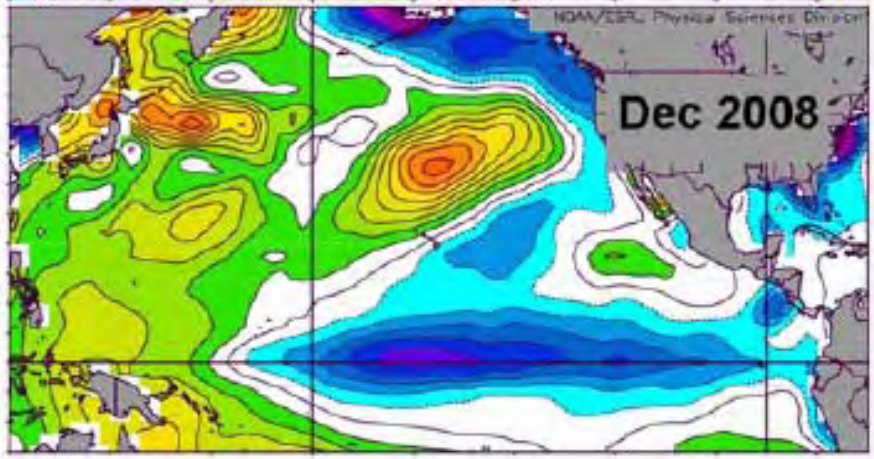
1. be several pages long, with one or two figures including a time series.
2. describe what happened, with brief description of causes and linkages and impacts. Forecasts are useful but not necessary.
3. not offer detailed scientific analyses of why these events happened.
4. have minimal use of jargon. ("Jargon" denotes words or expressions used by a particular group that are difficult for others to understand.)

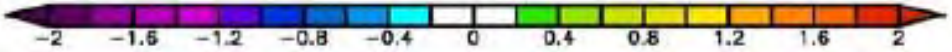
Other notes:

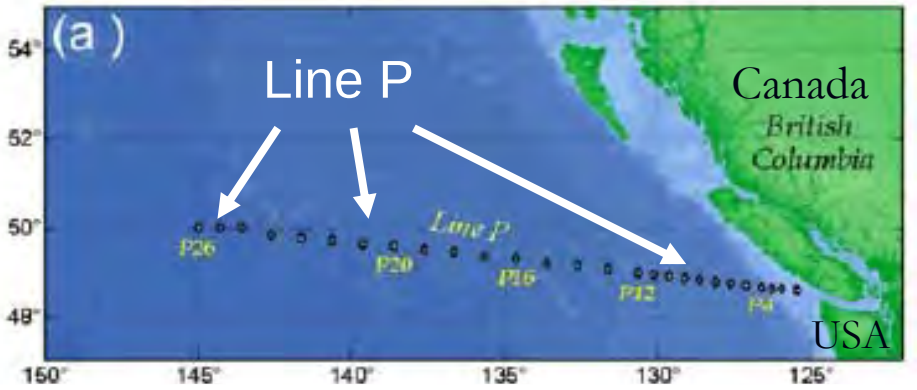
1. All reports are voluntary, so some species and stories are missing, Editors need to "twist arms" to encourage reports.
2. Funding only for translation into French.
3. Process expanded to Canadian Atlantic and Arctic regions for 2010.





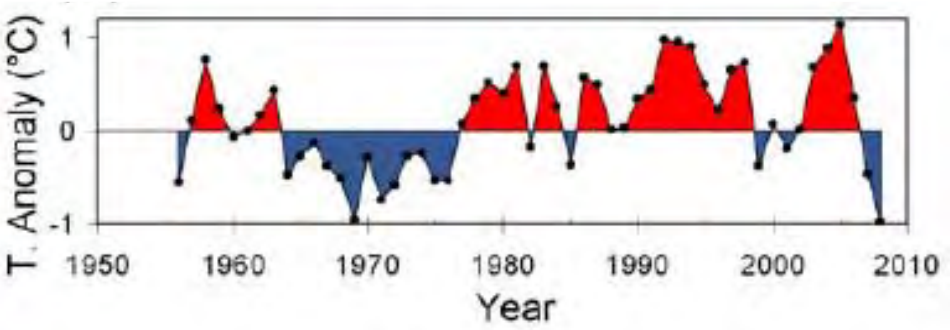




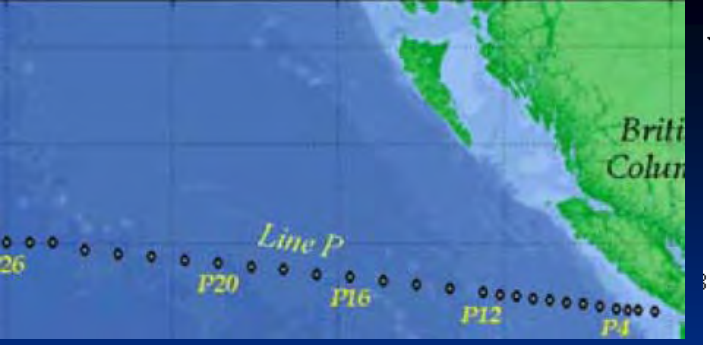


The panels **at left** show temperature anomalies over the Pacific Ocean in 2008, a recent La Niña year.

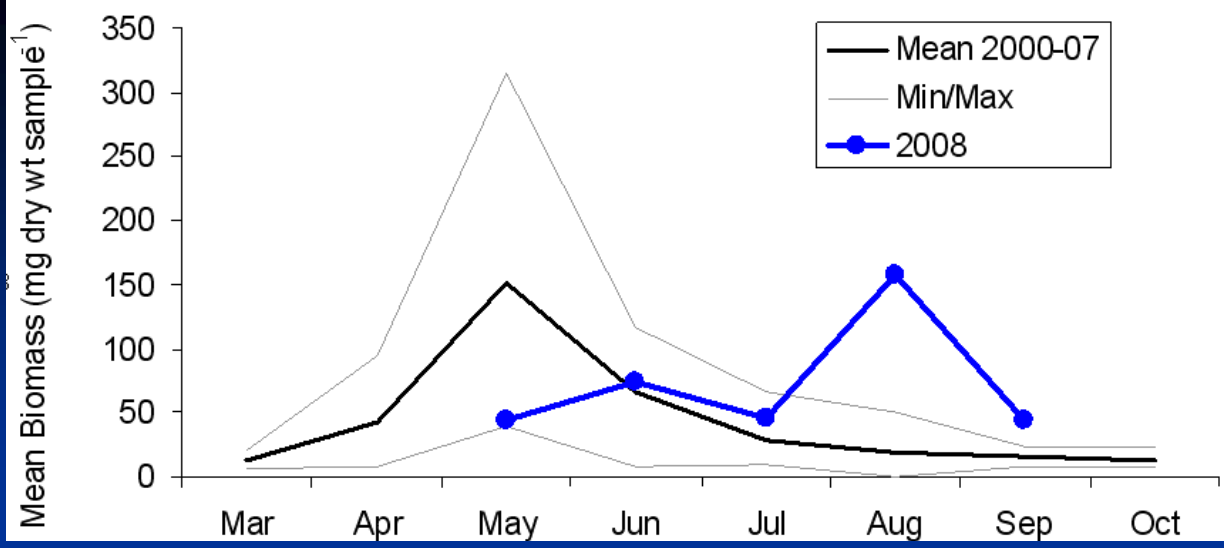
The graph **below** shows annual near-surface ocean temperatures along Line P.



•overview of changes in marine conditions

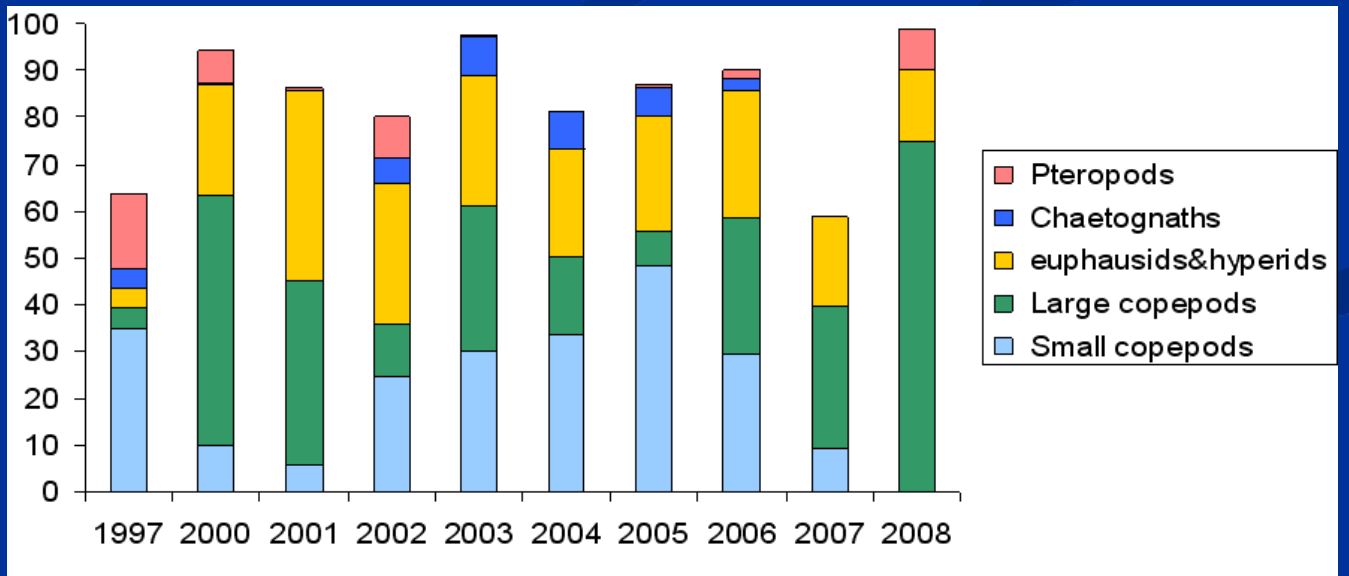


Credit: S. Batten



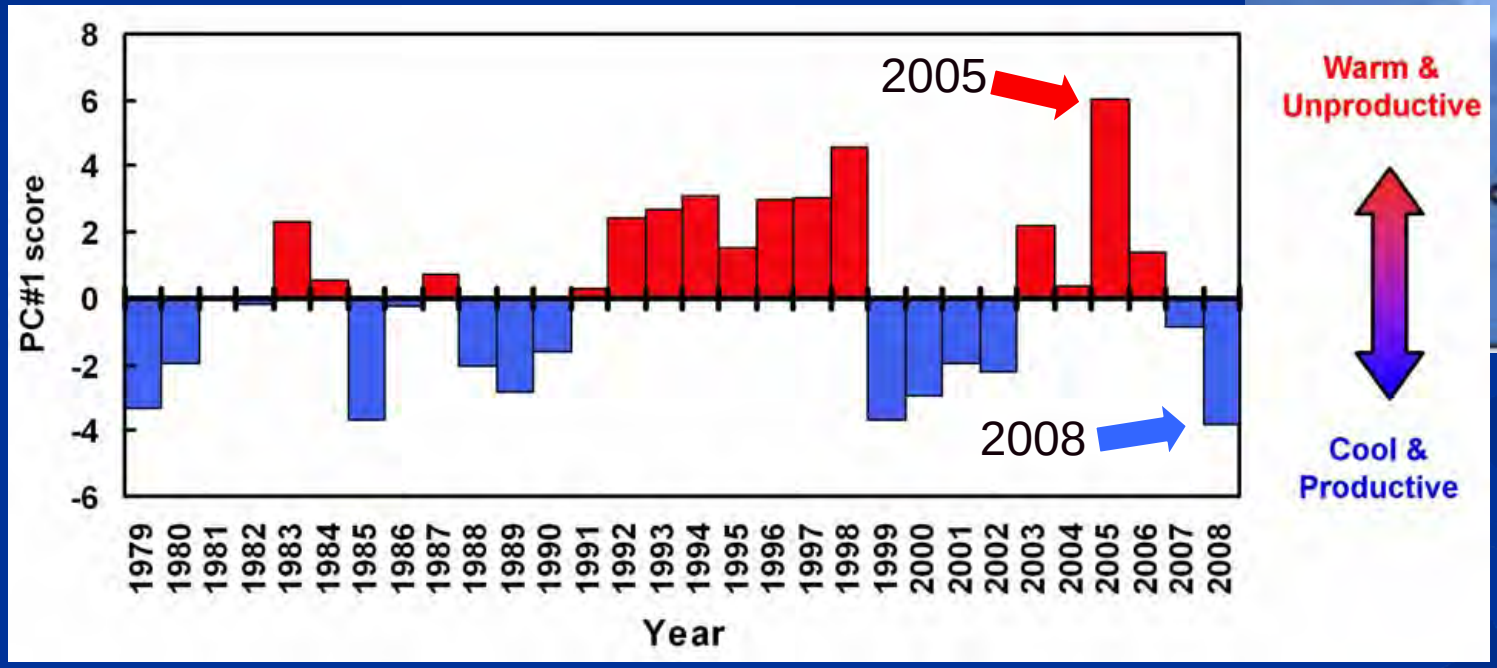
Above right: Mean monthly biomass for 2008, together with monthly mean, minimum and maximum mesozooplankton biomass (2000-07) in mg dry weight per sample (~3m^3) from Continuous Plankton Recorder sampling (which occurs approximately monthly 6-9 times per year between March and October) in the off-shore Gulf of Alaska area. Data for summer 2008 are preliminary.

Mean biomass contribution of major taxonomic groups in July/August each year.



•Offer insight (and forecasts if possible) into linkages among changes of marine populations, climate and fisheries.

Time series of scores of the marine survival index in coastal waters west and north of Vancouver Island



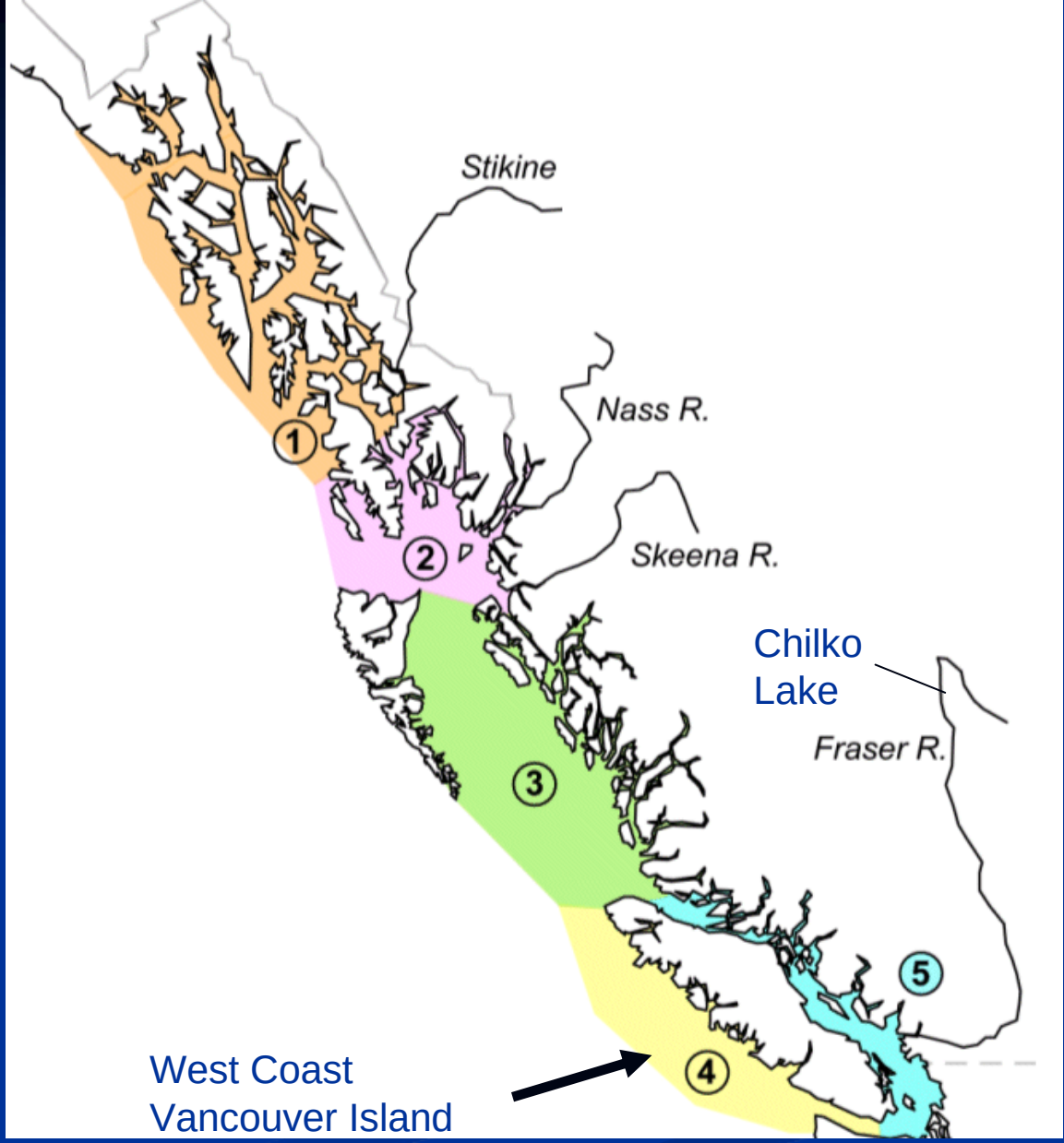
Based on observations of zooplankton species type, ocean temperatures, as well as juvenile salmon, sablefish and seabirds. Cool is good for these species. Offers insight into fishery recruitment several years into the future.

Credit: D. Mackas, M. Galbraith, D. Yelland, M. Trudel, M. Hipfner

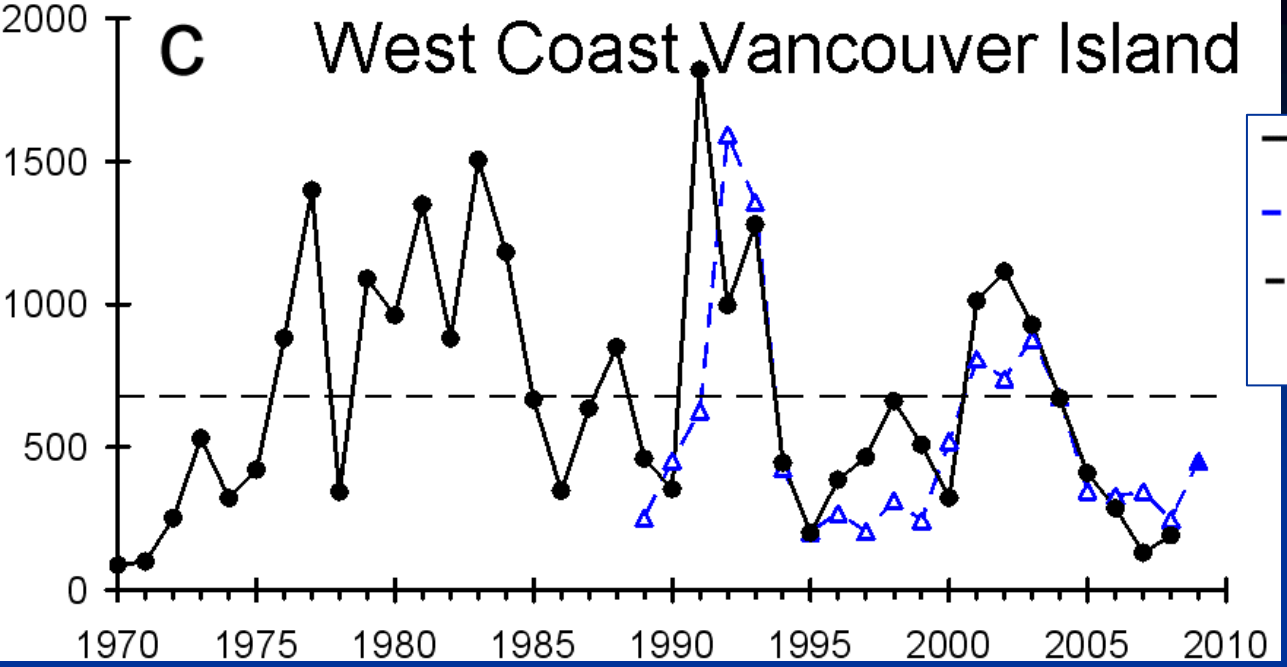
Sockeye Salmon Index Stocks –Regional Trends and 2009 Returns.

In at least one river in each of 5 regions in British Columbia, the juvenile salmon entering the ocean and the adults returning have been counted every year for decades, giving a record of marine survival and improving our ability to predict returns.

The next slides present information on regions 4 and 5.



Credit: K. Hyatt



Black lines above show adult returns (1000s); blue lines show pre-season predictions.

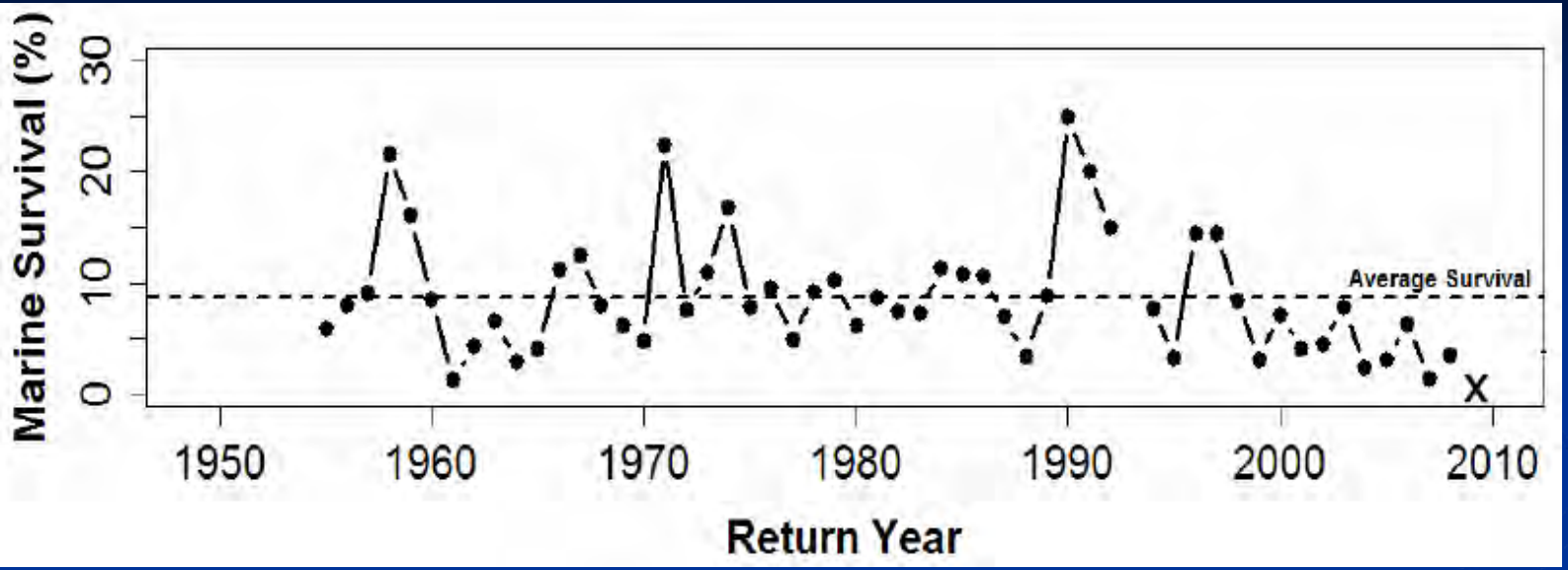
Sockeye salmon on the west coast of Vancouver Island exhibit annual recruitment variations that have altered adult returns by more than a factor of ten within 2-3 years.

“La Niña-like” conditions (SST < 30 yr average during smolt migration, weak northward currents, average to below-average sea level at the coast) are associated with relatively high marine survival (5 %). “El Niño-like” conditions (SST > 30 yr average, high sea level, strong northward currents) are associated with lower marine survival (2.5 %).

Returns in 2009 generally followed the forecast.

Credit: K. Hyatt

Salmon in Chilko Lake are an index for Fraser River sockeye salmon



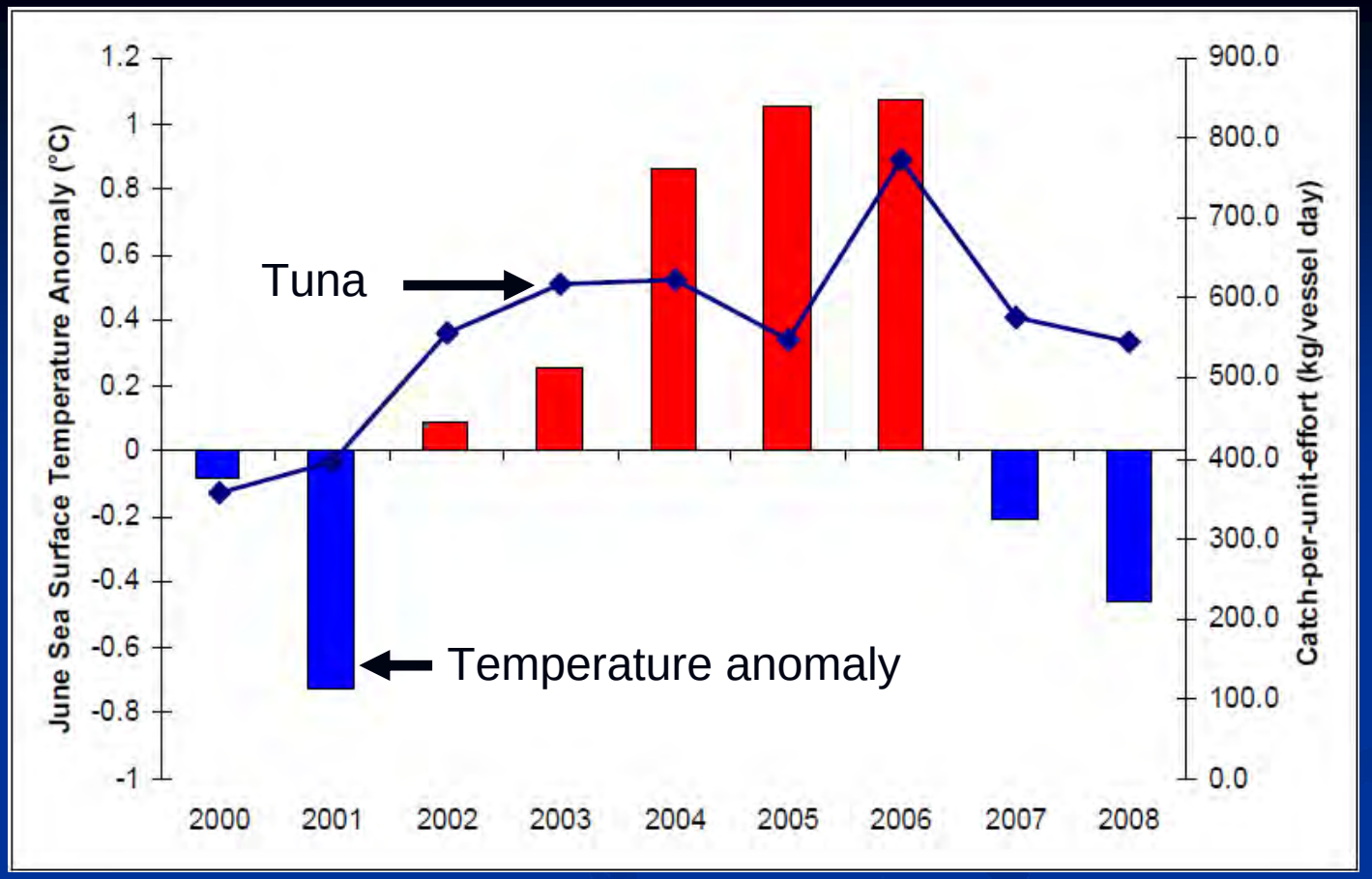
Sockeye smolts departing Chilko Lake have been counted every year for decades. This is only one of many sockeye stocks on in Fraser River, and the only one whose smolts are counted. We have almost no observations of these salmon after they depart Chilko Lake as smolts.

Note the declines in marine survival over the past decade, and lowest-ever marine survival in 2009 (x on graph).

Credit: S. Grant

Albacore Tuna

Credit: J. Holmes

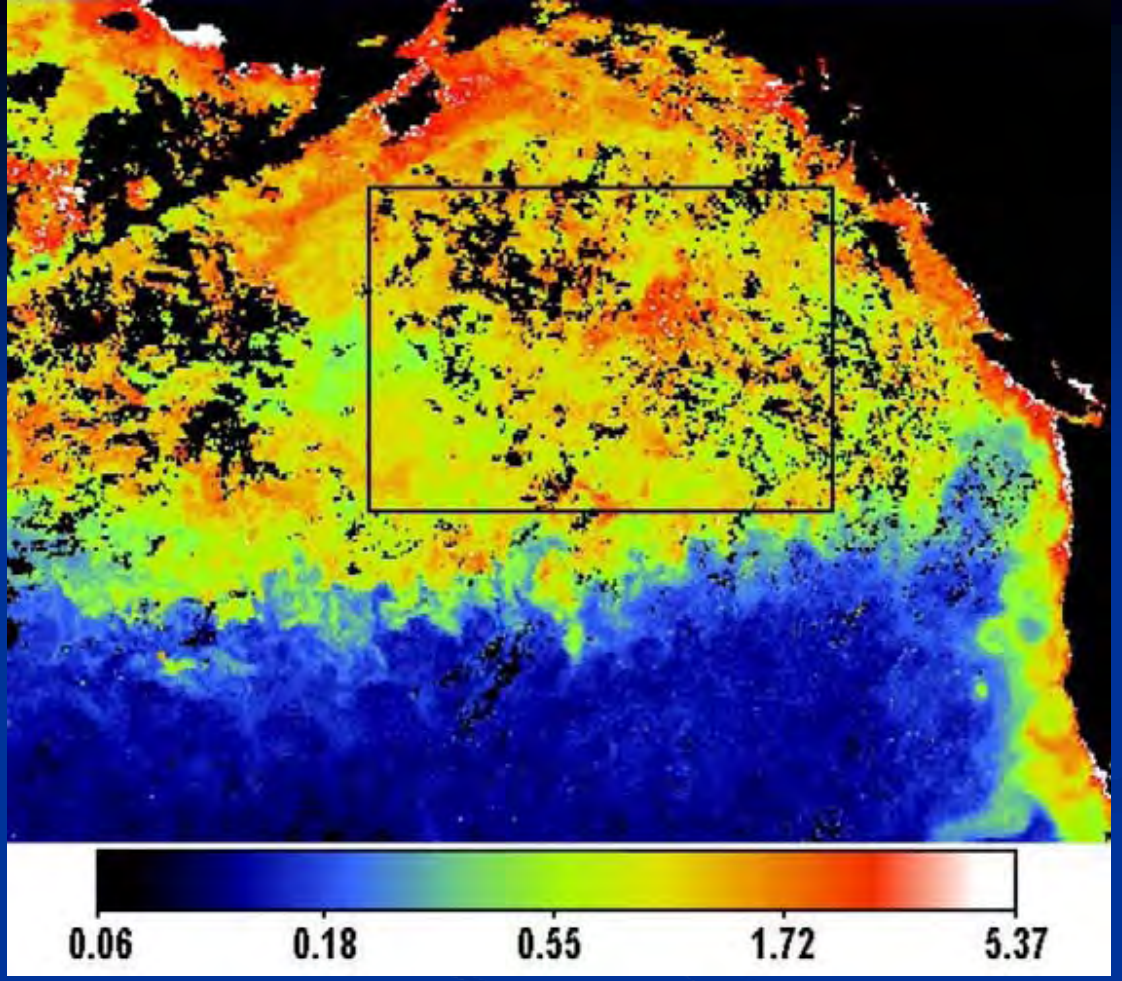


Availability of albacore tuna in the coastal waters of western Canada as measured by catch per-unit-effort (blue line) in relation to June sea surface temperature anomaly.

Red bars indicate warmer-than-average June temperature and blue bars indicate cooler-than-average June temperature where the average is calculated for the 1956-1991 period.

•Report on new conditions.

•Chlorophyll concentration in the Gulf of Alaska in August 2008, based on observations by NASA MODIS satellite.



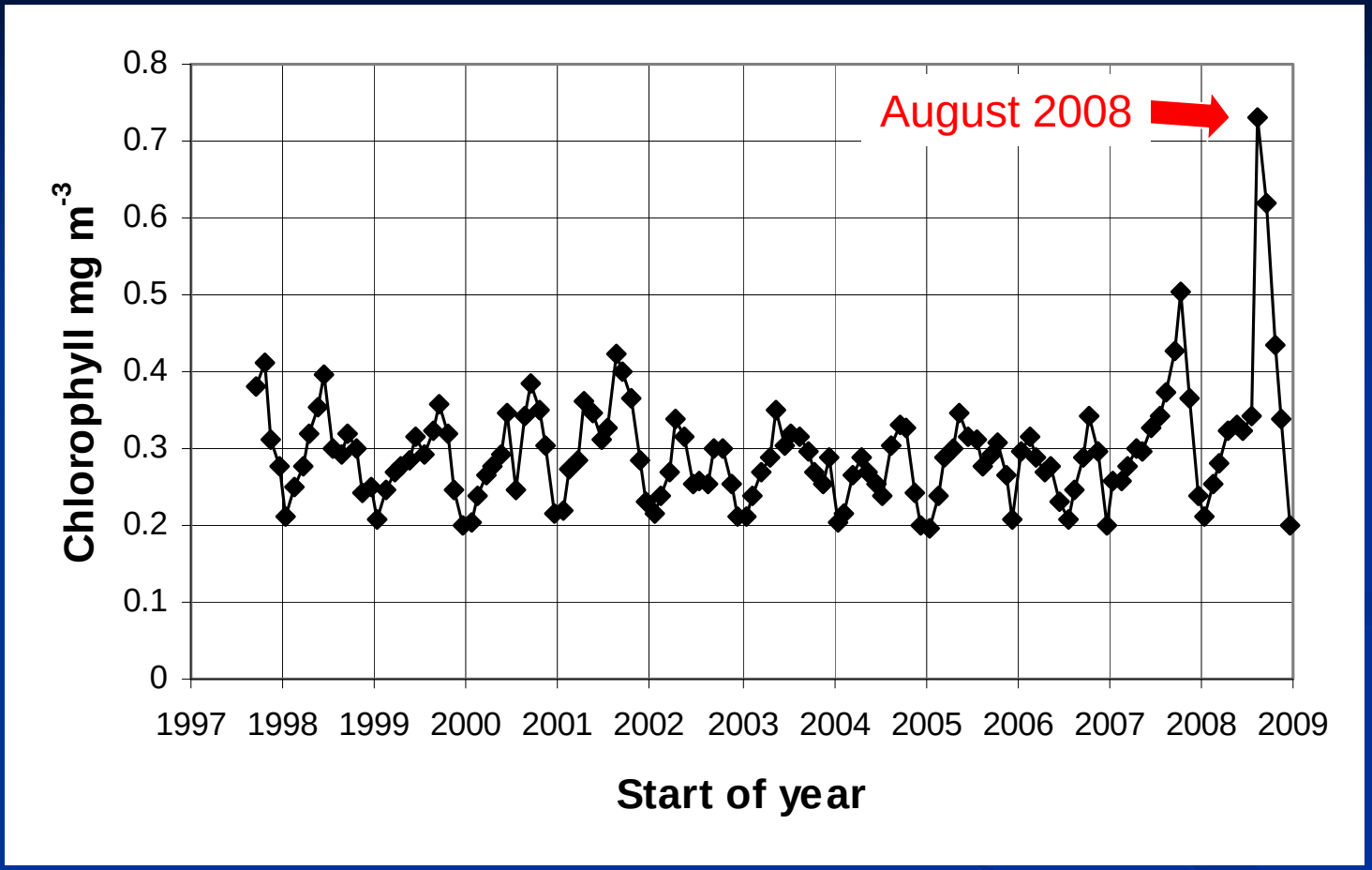
•Colour bar below the figure presents chlorophyll scale in mg m^{-3}. White regions near the coast hold highest concentrations, due to local nutrient enrichment. Red and yellow colours reveal waters with abnormally high levels for August in mid-ocean.

•The black box outlines the regions over which a time series of chlorophyll concentrations is plotted in the next figure.

Credit: J. Gower

Note the extreme high chlorophyll levels in August and September 2008, attributed to volcanic dust injections in August 2008.

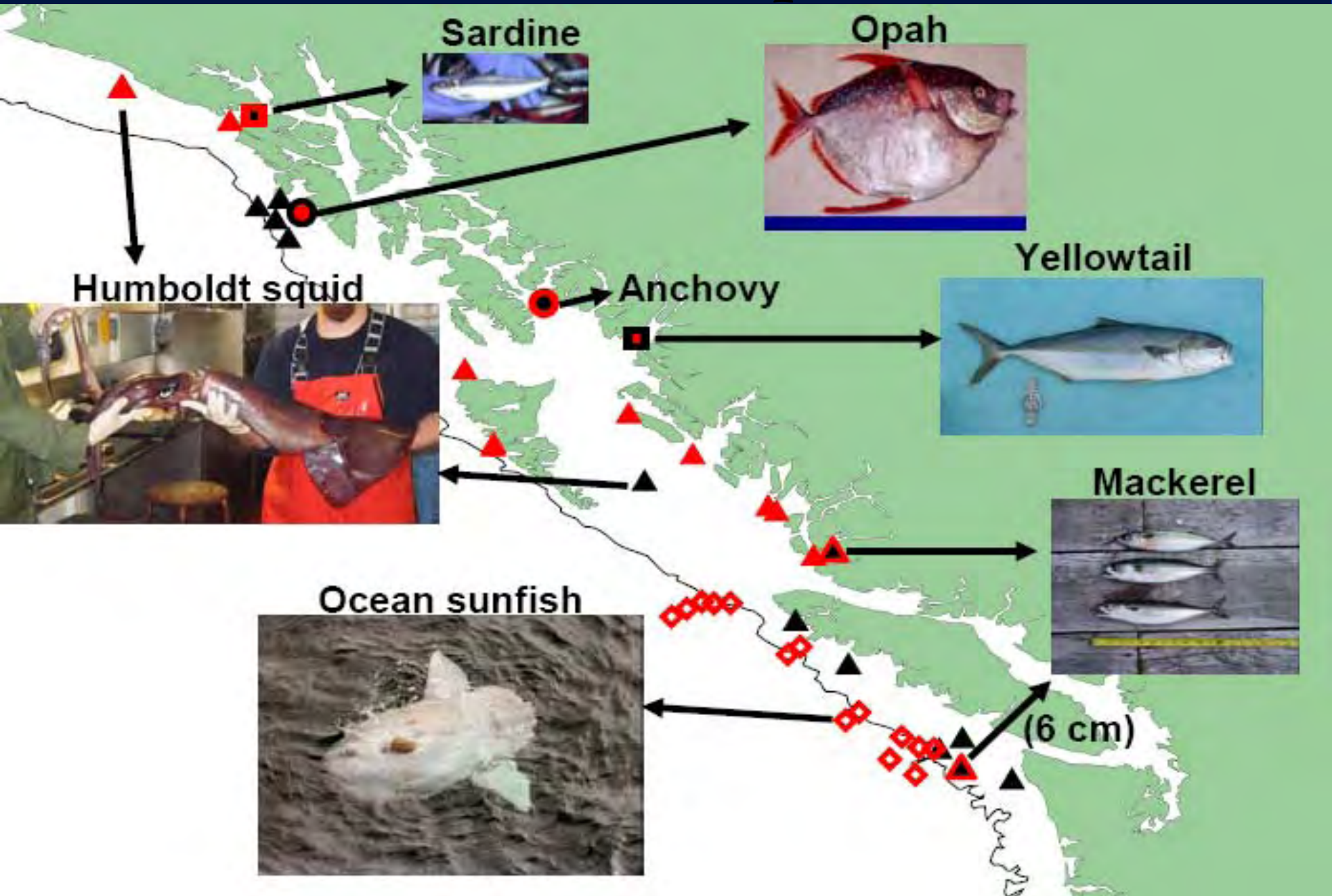
Reported in more detail by Roberta Hamme et al. in *Working Group 1: "Natural supplies of iron to North Pacific and linkages …"*



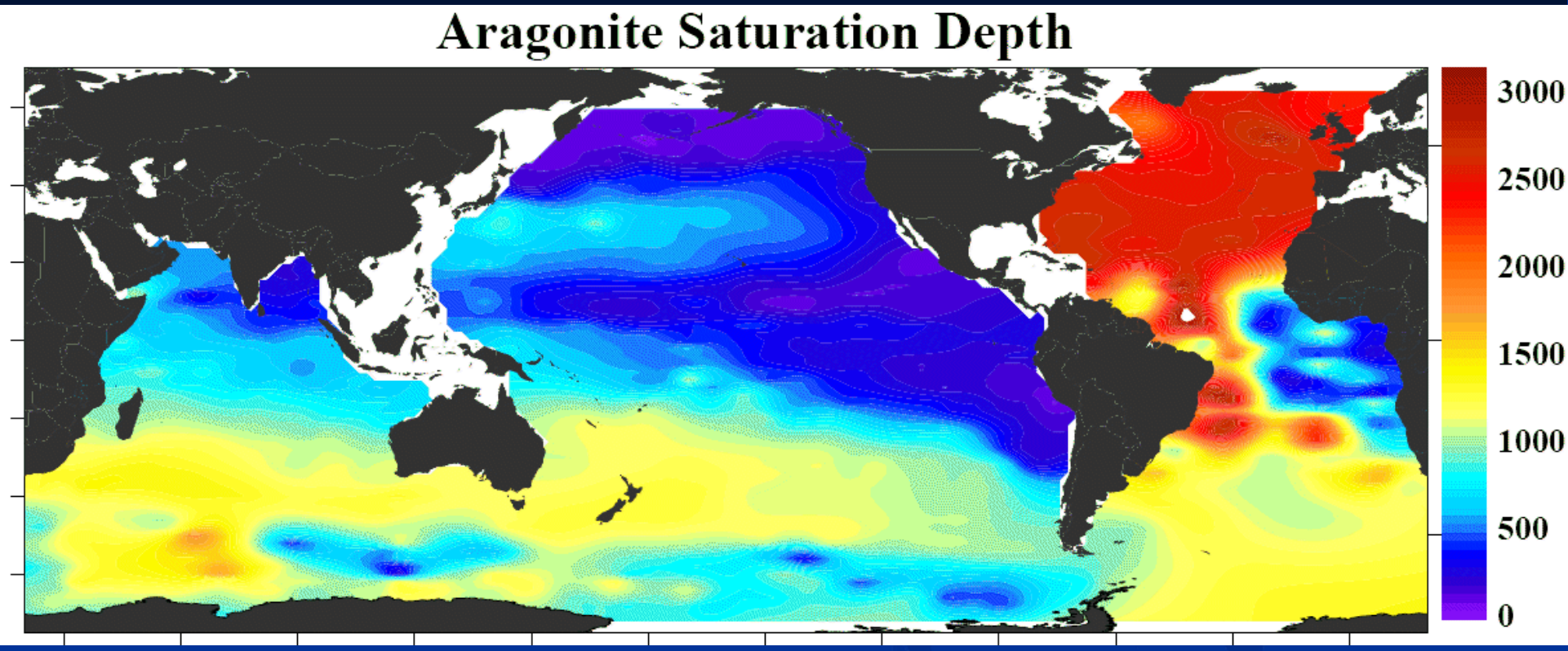
•Time series of monthly chlorophyll in the Gulf of Alaska averaged over the black box shown in previous slide.
•Data are usually provided by NASA satellites: SeaWiFS and MODIS. Observations in 2008 are by MODIS sensor on Aqua satellite.
•Data provided by: http://oceancolor.gsfc.nasa.gov/

Credit: J. Gower

Unusual warm-water species in 2005



Ocean Acidification



Source: R. Feely, D. Ianson

Aragonite is the form of **calcium carbonate** in the shells of tropical corals and pteropods. It dissolves below its "Saturation Depth" in the ocean.

Within this century, the saturation depth will approach the ocean surface in some regions as the ocean acidifies. The saturation depth now near the bottom of our continental shelf in summer, and at the ocean surface of Canadian waters in the Arctic Ocean in summer.

35 reports in 2008:

1	global temperature	2	sea level
7	ocean temperature	4	ocean salinity
2	ocean currents	3	phytoplankton
3	zooplankton	12	fish stocks
3	ecology (1 USA)	2	weather

Data sources:

- Satellites for sea level, ocean temperature and chlorophyll
- Argo array of floats measuring temperature and salinity
- Research vessels for ocean water properties, plankton, chlorophyll
- Fisheries cruises (test fisheries and acoustics)
- Fish catch statistics
- In-stream counts of juvenile salmon
- Underwater observatory
- Ships of opportunity (zooplankton, chlorophyll, nutrients and temperature)
- Tide gauges
- Bird counts
- Beach sampling
- Lighthouse keepers

Annual cycle:

Two-day meeting in February each year gathers scientists to present their observations for the previous year.

Written reports are completed in March, then edited and gathered into 100 pages, and a 30-page summary report is written in April. These are internally reviewed, and the summary document is translated into French May.

Final documents are published on-line just before Oceans Day on 8 June.

Since the first report in 1999, local waters have seen two cycles of warm and cool waters (ranges of 1° and 2°C). These cycles have led to changes in species composition, leading to an understanding of how this ecosystem might respond to future climate warming, leading to better forecasting of individual species, as well as ecosystem changes.

As a result of this process, we see a “temperature syndrome” that hits many species. Plankton and juveniles respond within one year, adult fish migrating in from the south in respond in one or more years. Some changes are irreversible.

Something new and unexpected happens in most years, and is quickly reported and usually investigated. These unexpected events remind us of the uncertainty of ecosystem trends.

Impacts for others:

Needed information for fisheries harvesters, resource managers, coastal and river communities, “wilderness businesses”, sports fishing industry, 1st Nations, fishers, educators and public in learning of the ocean and climate change, and planning for the future. Tour speakers and listeners.

Printed record of conditions in 2008 for future reference.

Annual updates !

Lessons learned from other Canadian regions:

- Less participation by individual scientists, but more integration of information among species (Nova Scotia).
- More active participation by harvesters (Newfoundland).
- Reporting fatigue (Quebec, Newfoundland, Nova Scotia).
- Interannual changes in oceans and fisheries are lower in Atlantic Canada.
- Native (1st Nations) issues are very important in the Arctic.

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