



Canadian Ocean Observations and Potential PaCOOS Collaborations

Presented at PaCOOS Board of Governors
Meeting

May 16- 17, 2007 (Seattle, WA)

Robin Brown

Fisheries and Oceans Canada

Institute of Ocean Sciences



Internal Bureaucracy - DFO Program Activity Architecture

- **Safe and Accessible Waterways – SAW**
 - Largely delivered by CHS (charting, tides, currents, nautical publications etc.)
 - Some components delivered by Ocean Sciences (waves, ice, tsunamis, currents)
 - 18.6% of Science PYs
- **Sustainable Fisheries and Aquaculture – SFA**
 - The largest portion of the Science program; delivered primarily by MEAD and SAFE
 - Support in several areas from OSD
 - 47.9% of Science PYs
- **Healthy and Productive Aquatic Ecosystems - HaPAE**
 - Delivered by OSD , SAFE and MEAD
 - assessing impacts of development on aquatic ecosystems
 - assessing the state of aquatic ecosystems and supporting integrated Oceans management
 - role of the ocean in climate change and impacts of climate change
 - 22.5% of Science PYs

(note – Science Management - 8.7% of Science PYs)



PaCOOS Objectives – compatible with DFO?

- “The goal of PaCOOS is to provide the ocean information needed for the sustained use of fishery resources and protection of marine species and their ecosystem under a changing climate.”
- Compatible with DFO's *Healthy and Productive Ecosystems; Sustainable Fisheries and Aquaculture*.
 - Silent on: *Safe and Accessible Waterways*



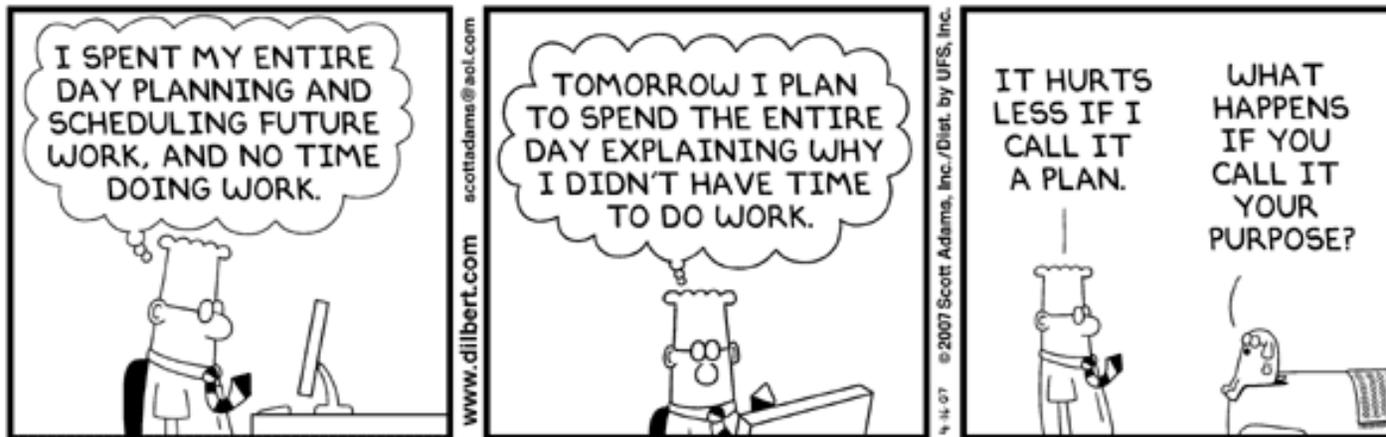
If OOS are good – why don't we get on with it?

- MONITORING is expensive; if it is going to be good, it has to be rigorous and sustained (= expensive)
- It is difficult to separate monitoring from long-term RESEARCH
- We think we are already spending a lot on this activity (by Canadian standards anyway)
- We aren't convinced that we are making the most of the data that's we have (DATA MANAGEMENT issues)
- We aren't convinced that we know how to integrate this data into ADVICE.



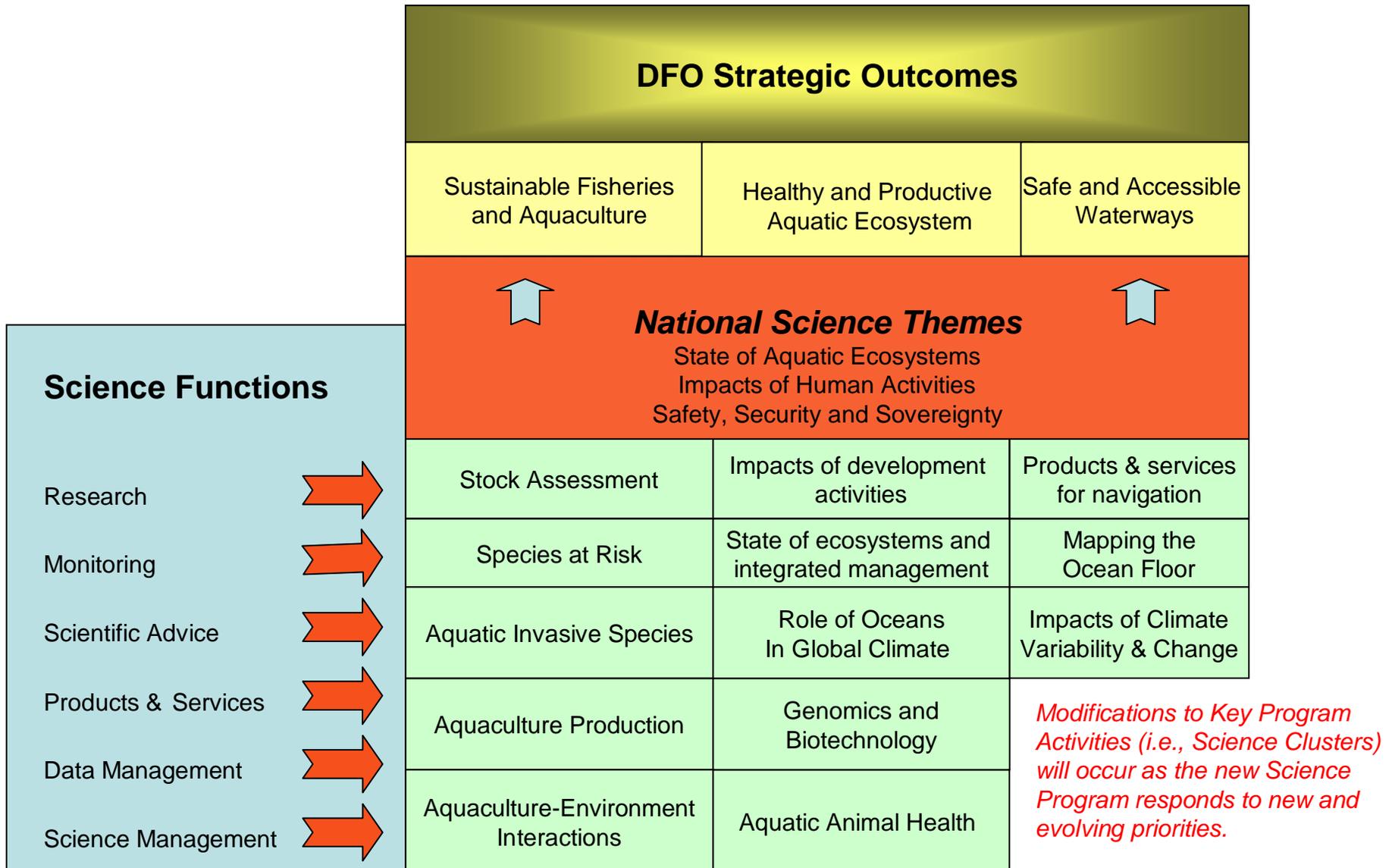
So what are we doing? (1)

- Organizational introspection and review; decomposition of activities, programs and functions. Create plans of various types.



© Scott Adams, Inc./Dist. by UFS, Inc.

Science support for DFO Strategic Outcomes





So what are we doing? (2)

- Inventory of existing efforts and activities:

**Aquatic Monitoring in Canada - A Report from the DFO
Science Monitoring Implementation Team.**

<http://www.dfo->

[mpo.gc.ca/csas/Csas/Proceedings/2006/PRO2006_003_E.pdf](http://www.dfo-mpo.gc.ca/csas/Csas/Proceedings/2006/PRO2006_003_E.pdf)

- Lots of recommendations
- No new money



So what are we doing? (3)

- Regional DETAILED review of what we are doing in terms of monitoring is *in progress*

(break to Pacific Monitoring Framework)



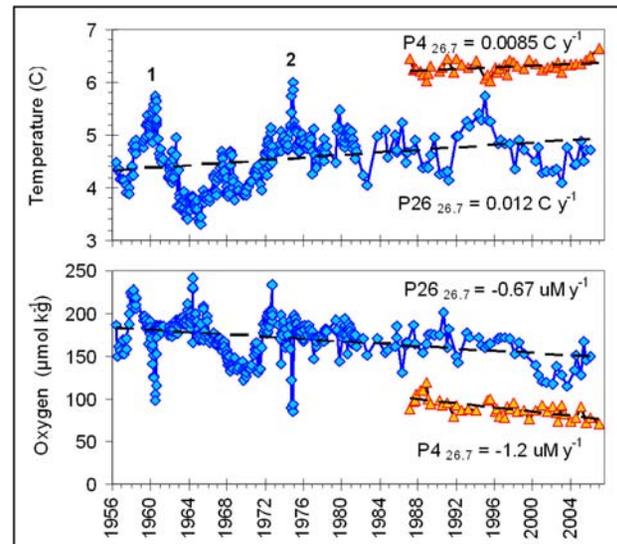
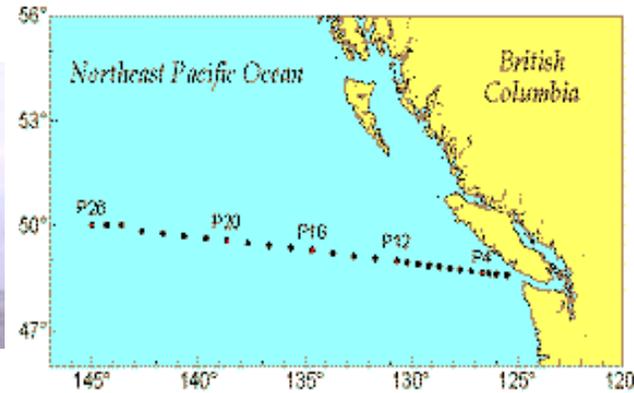
So what are we doing? (4)

- Developing a focus on REPORTING on the RESULTS of a IOOS in the form of Annual State of the Ocean Reports (the ADVICE function)
- *(break to 2006 report)*



Open Ocean – Line P

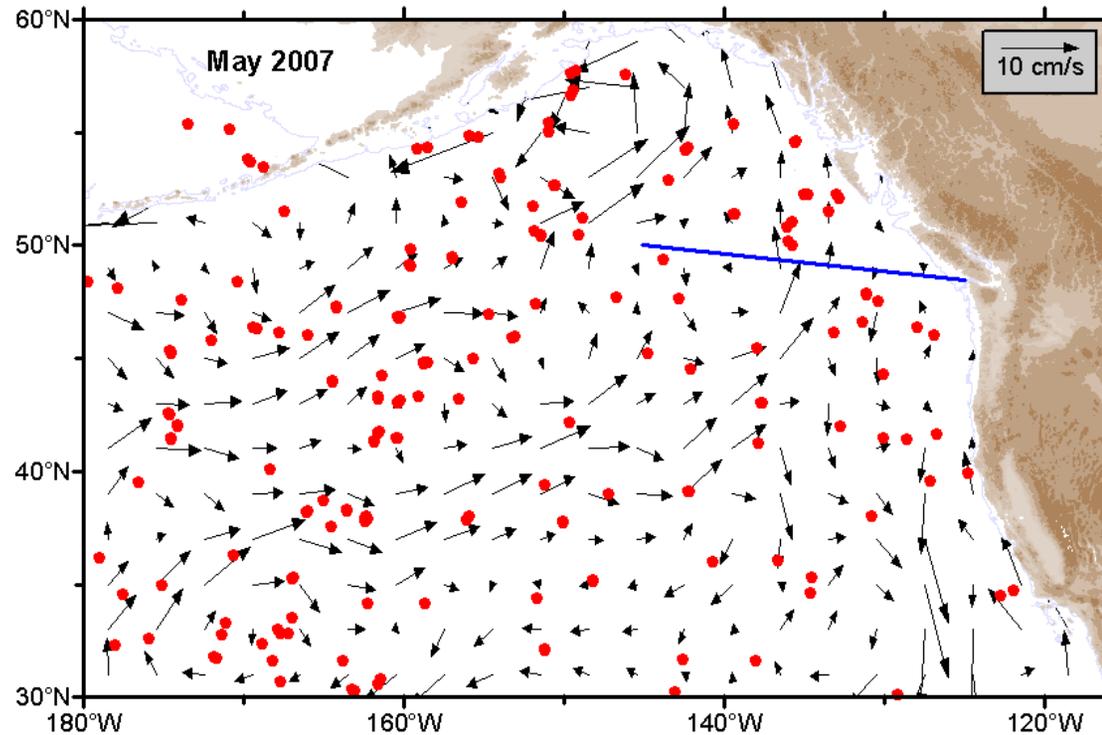
- 3x per year
- Research vessel-based
- 50 year + time series
- Climate change, lower trophic level and carbon flux focus
- *Opportunities for additional scientists and collaborators*





Open Ocean – Argo

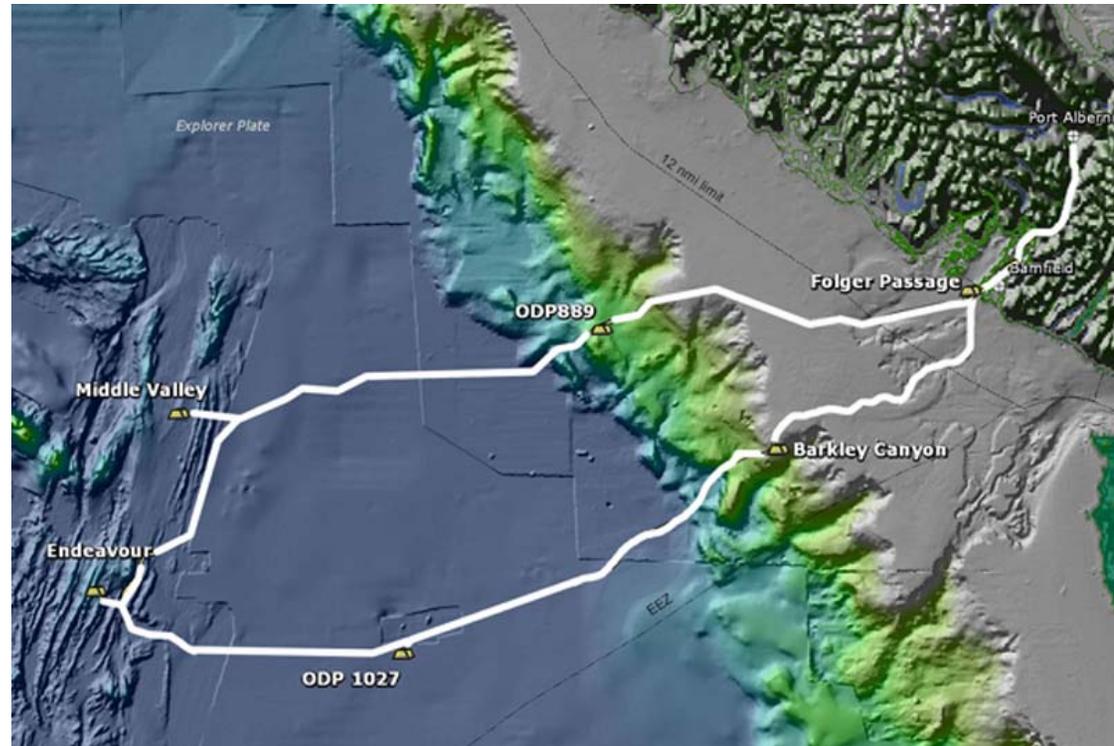
- Profiling robotic floats
- Research vessel-based
- Approaching target density
- Climate change, physics focus
- *Lots of Canada/US collaboration at the international level*
- *Opportunities for additional biological sensors*





Endeavour Ridge MPA – continental shelf - NEPTUNE

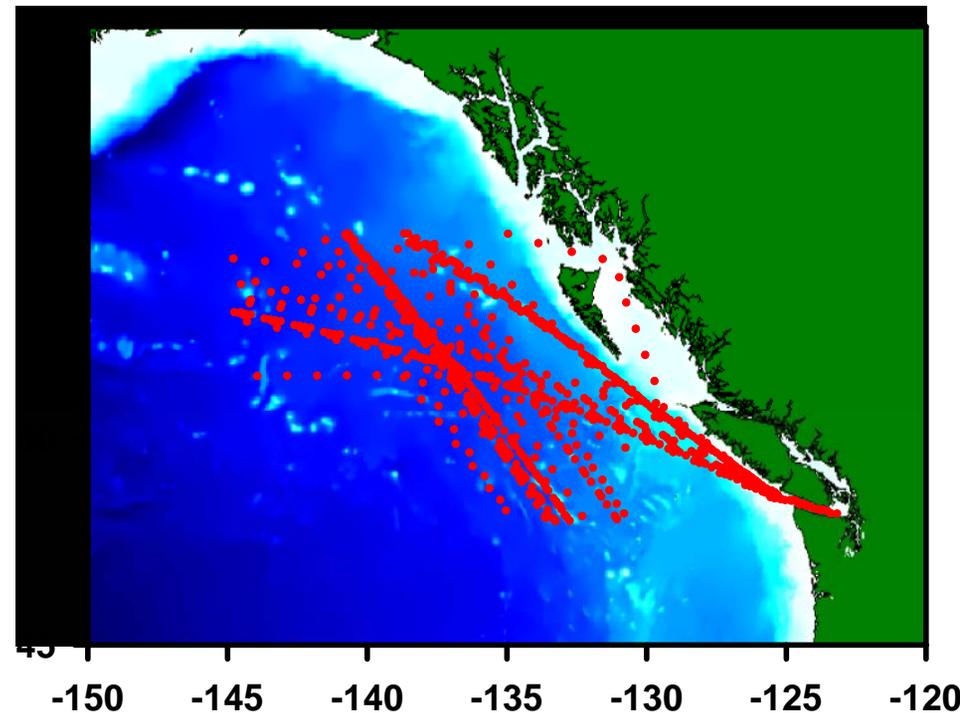
- Cabled observatory
- Canada will deploy in 2008
- University-led initiative
- Climate change, physics and geophysics focus
- VENUS provide inshore system.
- *Lots of Canada/US collaboration at the international level*
- *Opportunities for additional biological sensors*





Open Ocean – Continuous Plankton Recorder

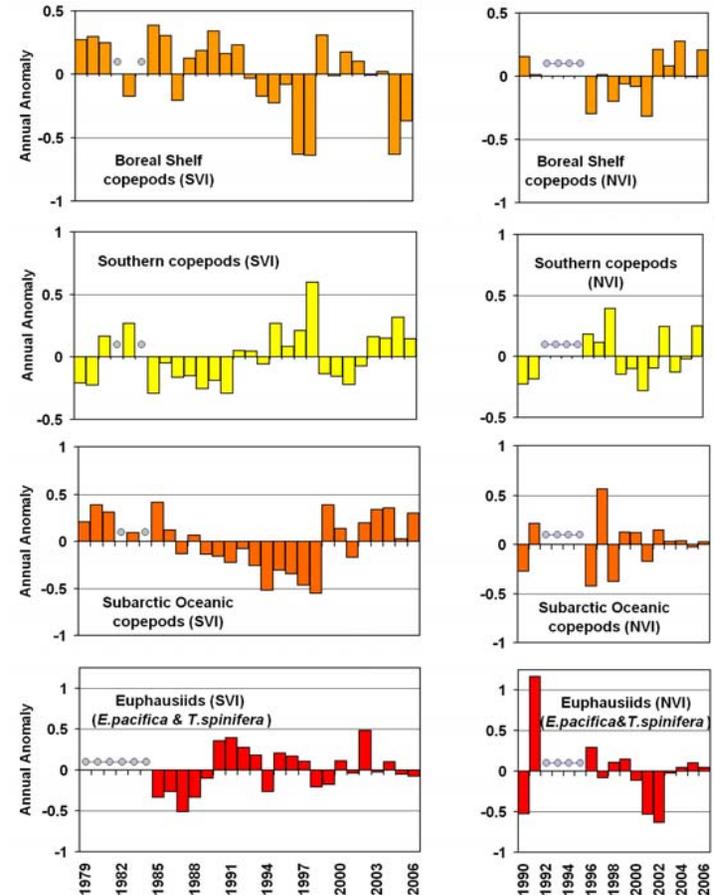
- 1997 to 2006 (with gaps)
- Ship of Opportunity-based
- Similar to North Atlantic program
- Mostly supported by EVOS
- Climate change, lower trophic level focus
- *Lots of Canada/US collaboration at the international level thanks to PICES*
- *Canada ought to pick up some of the costs.*





Continental Shelf – Zooplankton

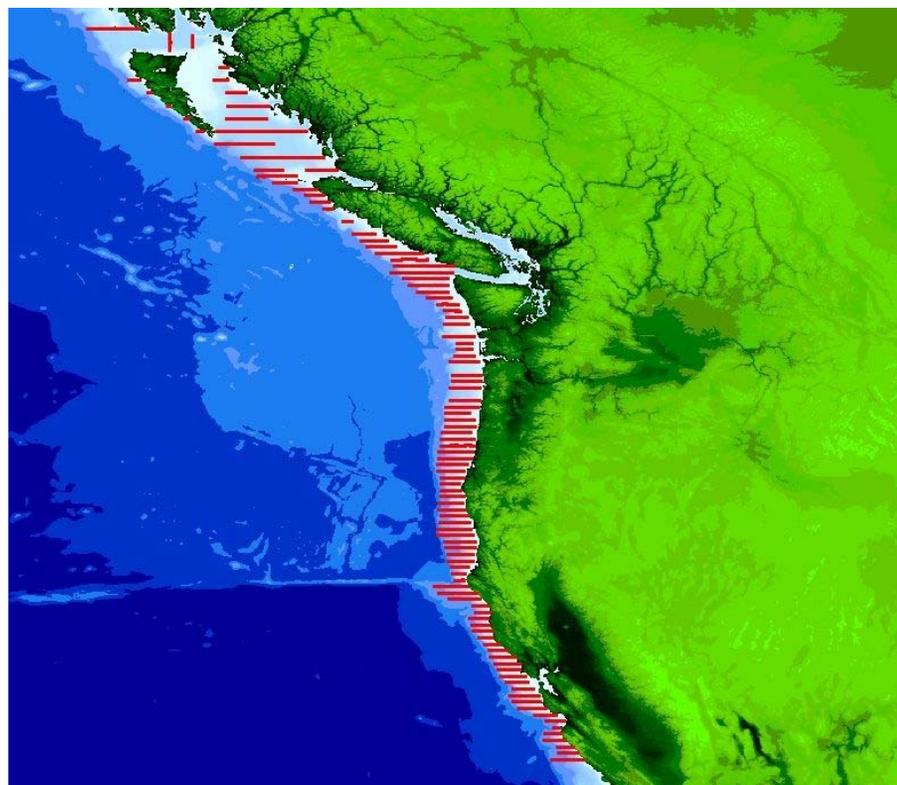
- 3 – 5x per year
- Research vessel-based
- 20 year + time series
- Climate change, lower trophic level and fisheries production focus
- *Already incredibly well-coordinated in the CCS amongst the co-conspirators (Mackas, Peterson, Checkley et al), thanks to PICES*





Mid-water fishes – the coast-wide hake survey

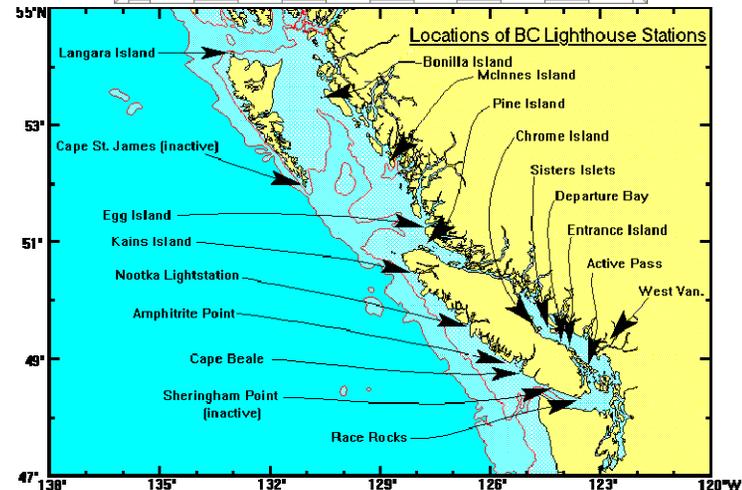
- Every 2 to 3 years
- Research vessel-based
- Fisheries recruitment/ production focus
- *Already well coordinated between NMFS and DFO*
- *Is the survey “under-exploited” terms of oceanographic observations?(e.g. oxygen)?*





Coastal Observations – sea level, temperature and salinity

- T and S – up to 80 years of data
- Sea levels – nearly 100 years of data
- *Key long term coastal time series*
- *Many thanks to the visionaries who started and maintained these over the years!*





Where could better integration could really pay off?

- **Primary production** - amount, location and timing (in a foggy ocean)
- **Harmful Algal Blooms** – weak program area in Canada
- **Forage fishes** – a difficult problem everywhere
- **Invasive Species** – detection and tracking
- **Contaminants** – a tricky jurisdictional issue (in Canada, at least)
- **Benthic ecosystem** on continental shelf – weak program area in Canada



Where could better integration could really pay off? (more)

- **Better biological/ecosystem monitoring systems for NEPTUNE (Canada and US)**
 - Currently a strong physical/geophysics focus, but probably due to the fact that these communities have better instruments.
- **Ecosystem Status reporting for the LME**
 - There are some difficult issues around new scientific understanding required here. Includes the “Holy Grail” of affordable and robust ecosystem indicators.
- **Integrated Ecosystem Assessment for the LME**
 - Joining forces on ecosystem modeling might be a good idea here
- **Joint planning (and funding?) for surveys?**
 - Lots of bureaucratic and institutional barriers here, but perhaps some opportunities as well.



Potential Emerging Priorities in Canada

- North Pacific-wide study on the distribution, marine survival and growth of Pacific salmon (NPAFC – ‘son of BASIS’)
- Strait of Georgia/Puget Sound/Georgia Basin Ecosystem study (the real battle ground for Integrated Ecosystem Management)



Questions?



Pacific Region Science – Organization

Regional Director – Laura Richards

Salmon and Freshwater Ecosystems – B. Riddell

- Salmon stock assessment
- Freshwater habitat
- Salmon genetics, stock identification
- High seas salmon

Marine Ecosystems and Aquaculture – T. Perry

- Marine species stock assessment
- Conservation biology (including SARA)
- Marine habitat
- Fish health
- Aquaculture production
- Aquatic Invasive Species
- Marine technology development

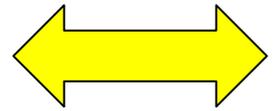
Ocean Science – R. Brown

- Ocean productivity
- Toxic chemicals
- Oceanography
- Ocean's role in climate change
- Tsunamis and waves

Canadian Hydrographic Service – D. D'Amours

- Charts and surveys
- Nautical publications
- Water levels
- Tides and currents
- Tsunami warning

18.7%



Safe and Accessible Waterways (210-260)

- **Sample Activities**
 - Surveying, chart production, tide tables, nautical publications, seabed mapping and classification
 - Assessing impact of climate change on navigation
 - Tsunami warning system; tsunami research; extreme waves and sea levels
- **Funding Trend**
 - Stable
- **Challenges**
 - Mapping of sensitive habitat
 - high cost of at-sea surveys
 - NDI
- **Key Clients/Partner – Internal**
 - CCG, Ocean Sciences, OHEB
- **Key Clients/Partners – External**
 - Shipping industry, commercial fishers, recreational boaters
 - BC PEP
 - NRCan
- **Risks**
 - Groundings (damage and deaths) due to inadequate charting
 - Inadequate emergency response (tsunami)
 - inadequate understanding of Arctic shipping/industrial activity

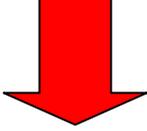
8.7%



SFA-Managing Science in DFO and GoC (805)

- **Sample Activities**
 - RDS Office, including facilities
 - Coordinate priority setting activities
 - HR, finance and facilities mgmt
 - Science libraries
 - PSARC Office and processes
 - Coordinate annual multi-sector requests for science-based advice and link to Science delivery capacity
 - Coordinate priority setting activities with the regional executive (RMEC) to establish the annual peer-review schedule
 - Establish level of review consistent with National standards & SAGE principles
 - Assessment review, advice formulation and advisory products
 - Interact with CSAS and other RAP offices to ensure consistency in standards
- **Challenges**
 - Increasing advisory product demand and diminishing capacity
 - Balancing competing demands; SARA, Oceans, FAM
 - Integrating traditional resource assessment with environmental/ecosystem factors
 - More complex advice required
- **Key Clients/Partner – Internal**
 - Fisheries and Aquaculture Management
 - Oceans Habitat and Enhancement Branch
 - SARA coordinators
- **Key Clients/Partners – External**
 - First Nations
 - Aquaculture, fishing and offshore oil and gas Industries
 - ENGOS; Province of BC
 - Other federal resource-based departments
- **Risks**
 - Compromised inclusiveness, openness and transparency plus other principles of SAGE
 - Poorly informed science-based decision making
 - Loss of credibility

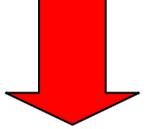
23.2%



SFA – Assessing Status of Fisheries Resources (810)

- **Sample Activities**
 - Salmon stock assessment
 - Groundfish stock assessment
 - Invertebrate stock assessment
 - Habitat assessment
- **Challenges**
 - Implementing SR plan to increase the share of this activity borne by industry
 - High expectations (salmon)
 - high cost of at-sea surveys
 - Impacts of climate change
 - Increasing international commitments
 - New approaches – ecosystem-based
- **Key Clients/Partner – Internal**
 - FAM, OHEB, TAP
- **Key Clients/Partners – External**
 - Province; International agencies
 - First Nations
 - Fishing Industry
 - Recreational fishers
 - PFRCC
- **Risks**
 - Lost economic opportunity
 - Resource depletion
 - DFO credibility (domestically and foreign)

3.5%



SFA – Assessment and Supporting Recovery of Species at Risk (820)

- **Sample Activities**
 - Prepare status reports
 - Review COSEWIC reports
 - Advise on listing decisions
 - Develop recovery plans
 - Advise on incidental harm permits and critical monitoring and evaluation
- **Challenges**
 - requires data and expertise in non-commercial species
 - demanding public process
 - complex interactions (commercial fishing; climate change; habitat modification)
 - tight timelines for assessment and review
- **Key Clients/Partner – Internal**
 - FAM; OHEB
- **Key Clients/Partners – External**
 - First Nations
 - Fishing Industry
 - ENGOs
 - Province
 - COSEWIC
 - Environment Canada
 - Academic sector
- **Risks**
 - Lost economic opportunity (restrictions on fisheries and other industrial activities)
 - loss of biodiversity
 - Non-delivery of legislated responsibilities

0.6%



SFA – Aquatic Invasive Species (831)

- **Sample Activities**
 - understanding of threats posed by AIS
 - Monitoring/detection of AIS
 - Strategies for prevention and control of AIS
 - Ballast water exchange zones
 - monitoring and evaluation
- **Challenges**
 - requires data and expertise in non-commercial species
 - no monitoring in place
 - requires extensive international collaboration
 - complex interactions (commercial fishing; climate change; habitat modification)
- **Key Clients/Partner – Internal**
 - Fisheries Management
 - Oceans, Habitat and Enhancement
- **Key Clients/Partners – External**
 - First Nations
 - Fishing and aquaculture industries
 - Commercial shipping industry
 - ENGOS
 - Environment Canada; DND; Transport Canada
 - Province
 - US Agencies
- **Risks**
 - Lost economic opportunity (displacement of fisheries and other industrial activities)
 - loss of biodiversity
 - Economic losses (e.g. fouling of intakes)

2.5%



SFA – Aquatic Animal Health (832)

- **Sample Activities**
 - prevention and control of aquatic animal health disease
 - Monitoring/detection of pathogens
 - Research and strategies for prevention and control of pathogen spread
 - certification of products and areas as “disease free”
- **Challenges**
 - Expansion of regulatory support role
 - NAAHP funding limited to a very specific set of pathogens (e.g. NOT sea lice; NOT Toxic algae) related to international trade
 - complex interactions (aquaculture; climate change; Invasive species)
 - Need to balance core research with other demands
- **Key Clients/Partner – Internal**
 - FAM ; OHEB (SEP)
- **Key Clients/Partners – External**
 - First Nations
 - Fishing industries
 - Aquaculture Industry
 - CFIA
 - Province of BC
- **Risks**
 - Lost economic opportunity (export restriction on seafood products)
 - human health
 - New regulatory demands could exceed resources

4.9%



SFA – Supporting Sustainable Aquaculture (840)

- **Sample Activities**
 - development of new species for aquaculture
 - Improved culture/husbandry techniques
 - Advise on aquaculture applications
 - Advise on fish health management plans
- **Challenges**
 - “competition” for internal science resources between support for a growing industry vs. environmental impacts research
 - ACRDP focus has been on the development NOT environmental impacts/sustainability
 - limited public confidence in “sustainability”
 - complex interactions (aquaculture; climate change; Invasive species; wild stocks)
- **Key Clients/Partner – Internal**
 - FAM; OHEB
- **Key Clients/Partners – External**
 - First Nations
 - Aquaculture Industry
 - ENGOS
 - Province of BC
 - CFIA
 - Academic sector
- **Risks**
 - Lost economic opportunity (restrictions on aquaculture products)
 - loss of public support for aquaculture industry
 - conflict amongst sectors (commercial fishing and aquaculture)

3.1%



SFA – Aquaculture/Environment Interactions (845)

- **Sample Activities**
 - siting guidelines (e.g. DEPOMOD)
 - Interactions research (e.g. sea lice)
 - escapes / invasive species
 - support for regulations
 - Advise on aquaculture applications
- **Challenges**
 - “competition” for internal science resources between support for a growing industry vs. environmental impacts research
 - vigorous and capable ENGOs
 - limited public confidence in “sustainability”
 - complex ecosystem science questions
 - monitoring and evaluation
- **Key Clients/Partner – Internal**
 - FAM; OHEB
- **Key Clients/Partners – External**
 - Aquaculture Industry
 - First Nations
 - ENGOs
 - Province of BC
 - Environment Canada (?)
 - Academic sector
- **Risks**
 - Lost economic opportunity (restrictions on aquaculture sites/species)
 - loss of public support for aquaculture industry
 - conflict amongst sectors (commercial fishing and aquaculture)

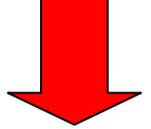
1.6%



SFA – Applying genomic and biotechnology (850)

- **Sample Activities**
 - risk assessment of GMOs
 - research in support of regulation
 - development of new techniques for stock ID
 - development of new techniques for disease and pathogen detection
- **Challenges**
 - limited public confidence for GMOs
 - external (soft) funding sources
 - complex ecosystem science questions
 - monitoring and evaluation
- **Key Clients/Partner – Internal**
 - FAM; OHEB (SEP)
- **Key Clients/Partners – External**
 - Aquaculture Industry
 - ENGOS
 - Province of BC
 - Environment Canada (CEPA)
 - Academic Sector
- **Risks**
 - Lost economic opportunity (restrictions on aquaculture sites/species)
 - loss of public support for aquaculture industry

6.3%



HaPAE- Assessing impacts of development on aquatic ecosystems (860)

• Sample Activities

- toxic chemicals - transport through ecosystems and impacts
- impacts on fish habitat of freshwater and marine development activities (e.g. oil and gas exploration, mining, forestry, fishing practices, aquaculture)
- research in support of regulation
- Expert witness advice for prosecutions

• Challenges

- external (soft) funding sources
- changing role of DFO Science
- diverse range of partnerships
- complex ecosystem science questions
- monitoring and evaluation

• Key Clients/Partner – Internal

- Fisheries and Aquaculture Management
- Oceans Habitat and Enhancement Branch

• Key Clients/Partners – External

- Aquaculture and fishing Industries
- Freshwater and marine development industries
- First Nations
- ENGOs
- Province of BC
- Environment Canada ; CFIA
- Academic Sector

• Risks

- Lost economic opportunity (restrictions on oceans activities)
- conflict amongst sectors (commercial fishing vs. aquaculture vs. oil and gas)

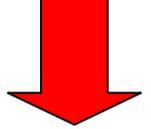
5.4%



HaPAE- Assessing aquatic ecosystems and supporting integrated Oceans management (871)

- **Sample Activities**
 - biodiversity science
 - understanding aquatic ecosystems
 - State of the Ocean reporting
 - Ecosystem monitoring and indicators
 - Ecosystem models
- **Challenges**
 - complex, interdisciplinary ecosystem science questions
 - high public expectations
 - required new scientific expertise, data and approaches
 - high cost of at-sea research and monitoring
- **Key Clients/Partner – Internal**
 - FAM; OHEB
- **Key Clients/Partners – External**
 - Aquaculture, fishing
 - Freshwater and marine development industries
 - First Nations
 - ENGOs; Province of BC
 - Environment Canada , NRCan, CFIA
 - Academic Sector
- **Risks**
 - Lost economic opportunity (restrictions on oceans activities)
 - conflict amongst sectors (commercial fishing vs. aquaculture vs. oil and gas)
 - reductions in biodiversity
 - DFO credibility

4.3%



HaPAE- Integrated Management of Scientific Data (872)

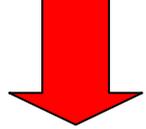
- **Sample Activities**
 - Management of all science data and information products
 - exchange, sharing and integration of data and information
 - Data standards and systems
- **Challenges**
 - existing data systems not designed for this access and integration
 - complex data sharing / exchange / privacy requirements with partners and clients
 - rapid changes in information technology
 - weak strategic planning in this area (department-wide)
 - large volumes of important legacy data (and systems)
 - targeted corporate reductions
 - large increase in external demand for DFO data
- **Key Clients/Partner – Internal**
 - FAM; OHEB; TAP
- **Key Clients/Partners – External**
 - Aquaculture, fishing industries
 - Freshwater and marine development industries
 - First Nations
 - ENGOs; Province of BC
 - Environment Canada , NRCan, CFIA, DND
 - Academic Sector
- **Risks**
 - loss of historical data due to retirements
 - large data system projects are expensive and have high risk
 - data sharing vs. data security vs. transparency



HaPAE- Mapping the Ocean floor (873)

- **Sample Activities**
 - multibeam and other high tech surveys
 - map-based data products
 - Relating fish abundance to habitat capacity (e.g. rockfish)
 - Evaluation/definition of proposed marine protected areas
- **Challenges**
 - High cost of at-sea surveys
 - Existing data systems poorly suited for this kind of data integration
 - High demand from external parties (FN, industry; ENGOs)
 - Difficulties in sharing DFO data (the NDI problem)
- **Key Clients/Partner – Internal**
 - FAM; OHEB
- **Key Clients/Partners – External**
 - Aquaculture, fishing and offshore oil and gas Industries
 - ENGOs; Province of BC
 - Environment Canada , NRCan, CFIA, DND
 - Academic Sector
- **Risks**
 - Poor decision-making due to lack of data
 - High costs of acquisition of these data in the absence of a integrated plan

6.6%



HaPAE- Climate and aquatic resources (880)

- **Sample Activities**

- monitoring and understanding the ocean's role in climate change
- understanding and anticipating the impacts of climate change on marine ecosystems

- **Challenges**

- complex, interdisciplinary ecosystem science questions
- requires strong, strategic work planning and relationships (nationally and internationally)
- complex interactions with stock assessments, species at risk and invasive species
- high cost of at-sea research and monitoring

- **Key Clients/Partner – Internal**

- FAM; OHEB

- **Key Clients/Partners – External**

- Aquaculture, fishing industries
- Freshwater and marine development industries
- ENGOS; Province of BC
- Environment Canada , NRCan
- Academic Sector

- **Risks**

- climate change recently evaluated as high probability to occur and have high impacts on ecosystems and fisheries

Critical Priorities for Pacific Region Science

1. Develop new approaches for determining harvest rates in commercial fisheries that include maintaining biodiversity, resilience and ecosystem integrity.
2. Complete the research required to restore confidence in a sustainable aquaculture industry (siting guidelines, regulation, disease and parasite transfer, interactions with wild stocks and contaminant loading).
3. Carry out risk assessment and develop inundation maps for coastal communities to improve tsunami and storm surge disaster planning.
4. Develop longer-term plans and forecasts for fisheries and aquaculture that include the impacts of climate change.

Critical Priorities for Pacific Region Science - more

5. Develop improved indicators of the state of marine and freshwater ecosystems and employ these to reduce the likelihood of “surprises” in ecosystem state.