



International workshop on climate and oceanic fisheries: summary & outcomes

Karen Evans
CSIRO Marine & Atmospheric Research

National Research
FLAGSHIPS
Climate Adaptation



Cook Islands
Meteorological Service



World
Meteorological
Organization
Weather • Climate • Water



Australian Government



SPC
Secretariat
of the Pacific
Community



APN
CAPaBLE

Acknowledgements

- Valerie Allain (SPC)
- Jaclyn Brown (CSIRO)
- Peter Dexter (JCOMM)
- Sarah Grimes (IOC/BOM)
- Ed Harrison (NOAA)
- Boram Lee (WMO)
- Jim Salinger (UAuckland)
- Robert Stefanski (WMO)



Outline

- Background & structure to workshop
- Workshop objectives
- Summary of presentations & discussions in each of the workshop sessions
- Conclusions & recommendations arising from each of the workshop sessions



Workshop overview

- **Held 3 -5 October, Rarotonga, Cook Islands**
 - convened and sponsored by WMO, the Government of the Cook Islands, APN, IOC - UNESCO, the University of Auckland, the Australian Government (through CSIRO, BOM and AusAID) and SPC
- **44 attendees from 33 agencies/institutions**
 - national fishery managers, fisheries scientists, fisheries specialists, ocean modelers, climate scientists, meteorologists, NGO representatives, intergovernmental agencies
- **Diversity in backgrounds & expertise across all areas being discussed**

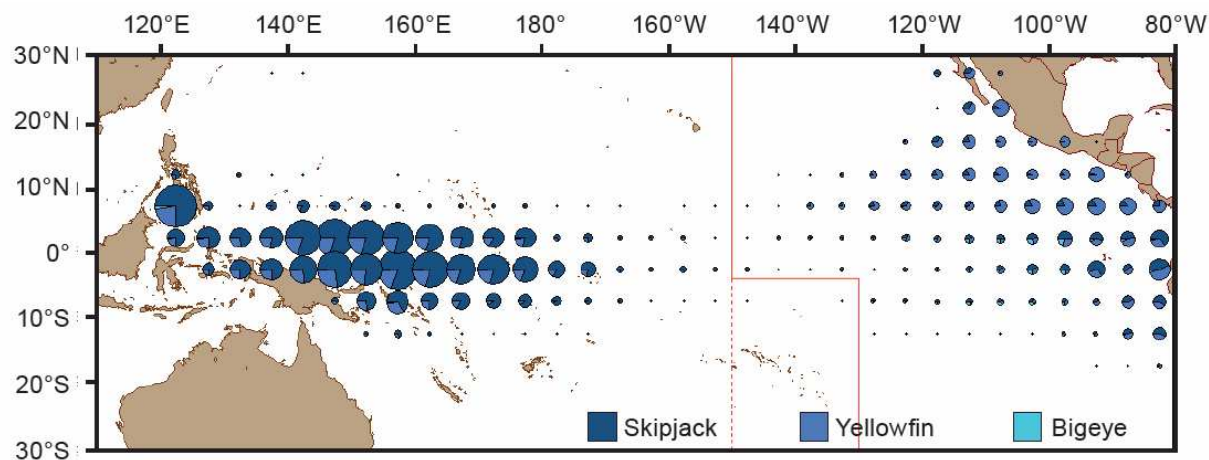
Workshop premise

- **Healthy marine ecosystems are critical to food security & economic security in many nations**
 - fishery products can comprise up to 90% of the protein in the diets of the people of many small island developing states
 - significant government revenue is generated via local & foreign fishing operations in many SIDS
- **Maintaining & improving access to fish is therefore an important element of future food security planning.**



Workshop premise

- Future changes in fishery access (distribution of key species) & production (total catch) as a result of climate change is likely to impact many SIDS.
- Climate change will add to challenges over & above those associated with overfishing & management of local and regionally shared ocean resources



Workshop premise

- Substantial information exists on the way in which climate change is likely to modify ocean environments
- Linkages between physical systems & biological systems are not as clear
 - biological systems often influenced by non-climate drivers such as over-fishing, habitat degradation etc.
 - data often temporally and/or spatially sparse
- Therefore, identification & forecasting of changes & their impacts on national food & economic security is difficult
- Little quantitative data to address adaptation measures & enhanced management practices for sustainable fisheries under climate change scenarios

Workshop objectives

- To review the current understanding & status of marine & oceanic climate and climate variability, in particular in the South Pacific
- To review the effects of climate & climate variability on seasonal to decadal time scales on oceanic fisheries, including through an evaluation of available historical data on marine climate & oceanic fish abundance
- To evaluate the impact of 21st century climate change on oceanic fisheries

Workshop objectives

- To identify fisheries risk assessment or management evaluation tools that incorporate climate variability in order to improve the sustainable management of oceanic fisheries
- To evaluate the implications of climate change for plans to optimise the use of oceanic fish for food security, livelihoods & economic growth & evaluate the potential use of fish abundance data for climate change research
- To recommend the adaptation & management measures needed to maintain oceanic fisheries in the face of climate change.



Session I: Effects of climate variability: seasonal to decadal scales

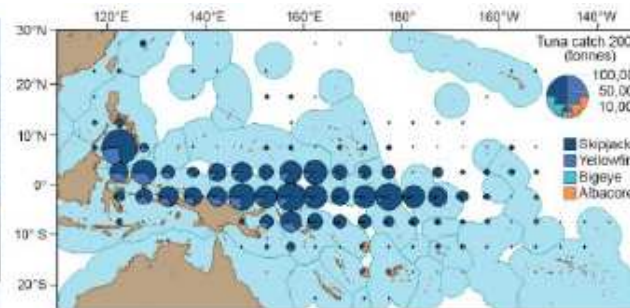
- Large scale climatic phenomena influence spatial distributions and abundances of oceanic fisheries
 - in the Pacific Ocean inter-annual variability & strength of ENSO modulated on decadal time scales by the PDO
 - during negative phases of the PDO there is an increased occurrence of El Nino, during positive phases, an increased occurrence of La Nina
 - in the Indian Ocean marine environmental variability is associated with the IOD
 - changes observed in fisheries associated with shifts in SST and NPP
- The SAM is the most important source of atmospheric variability in the mid-high latitudes of the Southern Hemisphere
 - to date there has been little research investigating influence of SAM on fisheries indices

Session II: Historical ocean climate and fisheries data

- Ocean & fisheries data currently available discussed
- Historical *in situ* marine climate data (paper/other media) are being rescued, evaluated and managed by JCOMM (WMO-IOC)
 - generating consistent observations & products from uniform products
 - data managed through ICOADS (hosted by NOAA) & WOD
- Ocean/climate data challenges limit ability to determine climate change at the regional level
 - smaller the scale, more inter-annual to decadal variability observed
 - inter-annual to decadal variability likely to dominate longer term trends
 - uncertainty in longer term trends & changes from historical data
 - sustained regional observations required to evaluate regional projections, however challenges to sustaining global & local observation systems

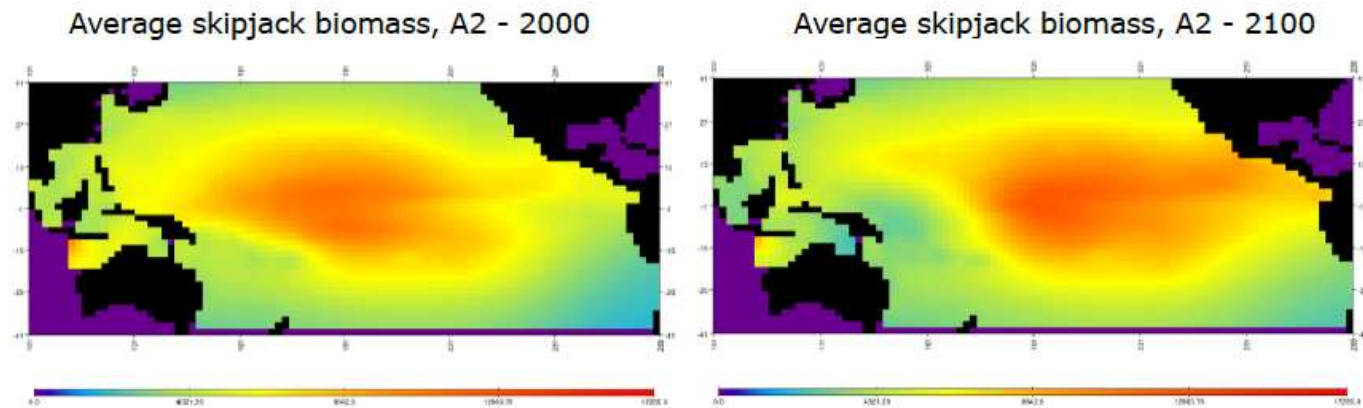
Session II: Historical ocean climate and fisheries data

- Fisheries data available: fisheries catch data, independent survey data, tagging (conventional and electronic) data & end-to-end models – each have varying potential & caveats
 - difficult to correctly attribute change associated with climate from change associated with other drivers (over-fishing, habitat degradation)
 - species are often (highly) migratory, are caught across multiple EEZs, multiple management areas & subject to varying fishing intensity/management regimes across their range
 - data often does not cover whole spatial range of the species, is often temporally disparate, sometimes not easy to access, often not standardised



Session III: Impacts of climate change on oceanic fisheries

- Methods using climate models to determine fishery impacts discussed
- Climate models can be used at different scales & using different methods to infer changes in higher predators
 - can be used to define biomes allowing examination of changes in the spatial and temporal extent – can then infer changes in species distributions associated with each biome
 - can be used to drive ecosystem models at specific locations
 - can be used to drive end-to-end models which are tuned & run on historical fishery stock assessment data



Session III: Impacts of climate change on oceanic fisheries

- The interaction between climate change & fishing practices can influence ecosystem patterns observed by altering ecosystem structure
 - this can be of benefit/detrimental to particular species depending on the interaction & the population dynamics of the species
- At present data on mid-trophic layers are sparse
 - manifests as uncertainty in coupling lower trophic (phytoplankton) with top predator (fishery) components
- Many exploited populations (fisheries) are subject to over-fishing
 - adds to uncertainty in projections of changes in spatial distributions & abundances (over and above uncertainty in climate models and projections)

Session IV: Impacts of 21st century climate on fisheries

- Current ocean models & some approaches for applying these to improve understanding of impacts on fisheries discussed
- Currently 24 models accepted by IPCC
 - have varying abilities to capture main features of the Pacific
 - are important biases & limitations that need to be considered – because of this better to look at all rather than just one
 - multi model mean allows for better simulation of current climate - however biases in individual models propagate through multi-model mean & projections of features are often ‘smeared’
- Models are increasingly being used on smaller scales than originally designed for
 - models are useful at larger scales (~ 40-50 degrees, depending on location & variables), not adequate at regional scales

Session IV: Impacts of 21st century climate on fisheries

- Although co-ordinated efforts (e.g. GOOS) provide near real time measurements on physical aspects of the ocean, only limited provision of data on biological aspects
- Fisheries observer programs can potentially provide data/samples
 - provide robust biological parameters for models (particularly on mid-trophics and non-target species)
 - generate time series from which change can be evaluated
 - WCPO: 100% coverage on PS, 5% coverage on LL as of 2012, already 100% observer coverage on PS in EPO



Session IV: Impacts of 21st century climate on fisheries

- Are various modeling approaches for investigating impacts on marine fisheries – however, there is no single perfect model
 - need to consider global demand for fish in the future – requires consideration of social and economic parameters
 - co-ordinated monitoring & assessment data required
 - uncertainty needs to be communicated
- Via PCCSAP program (funded by AusAID, implemented by CSIRO/Geoscience Australia) a web-based tool has been developed: ‘Climate Futures’
 - aims to assist decision makers with risk assessment & adaptation planning throughout PICTs
 - provides access to raw model output (no analyses/bias correction); understanding of uncertainty in models is required by users

Session V: Management tools to improve sustainable fisheries

- Four management 'tools' discussed
- Global Partnership for Climate, Fisheries and Aquaculture (PaCFA) – FAO
 - aims to draw together climate change activities into a co-ordinated framework & raise profile of fisheries/aquaculture in global climate change discussions
- Management Strategy Evaluation (MSE) – CSIRO
 - can be utilised to assess climate change as a risk to fisheries via changes in community composition, altered biodiversity & spatial heterogeneity & altered patterns of harvesting

Session V: Management tools to improve sustainable fisheries

- **Climate & Ocean Support Program for the Pacific (COSPPac) OC web portal – Australian BOM**
 - aims to allow easy access to marine & oceanographic information throughout Pacific region
- **Integrated Fisheries Risk Analysis Method for Ecosystems (IFRAME) framework – Pukyong National University**
 - tracks climate change impacts on the flow of energy through the low-trophic food web & projects implications of these shifts on fisheries

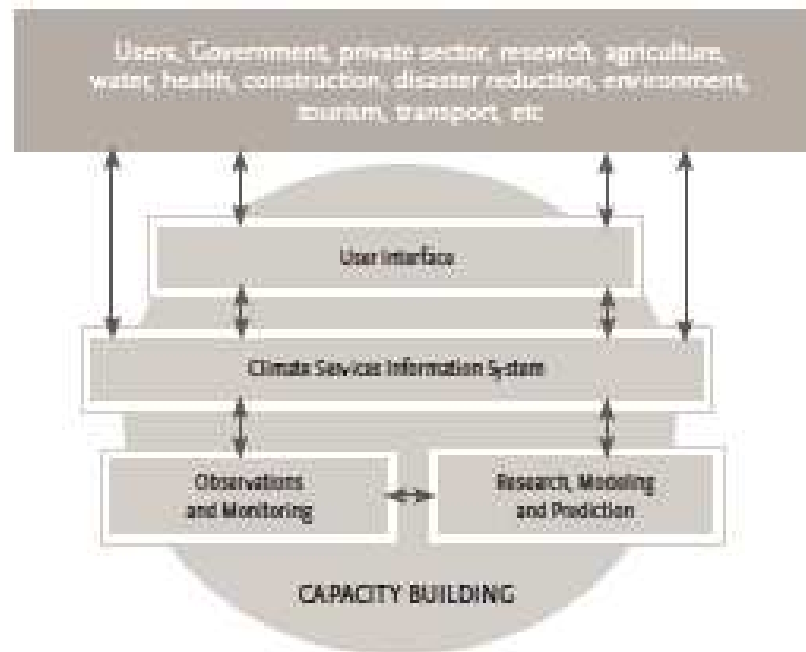


Session VI: Adapting to the impacts of climate change on fisheries

- Recent efforts led by the SPC to assess climate impacts on economic development & food security associated with fisheries discussed
 - Population parameters (increasing/decreasing populations) influence pressure on fishery outputs & flow-on impacts of climate change
 - assessments aim to provide adaptation and management measures to ensure maintenance of sustainable fisheries
- Key output: publication 'Vulnerability of Tropical Pacific Fisheries and Aquaculture to Climate Change'
 - provides assessment of changes to fisheries distributions & associated access based on projections from current ocean models, flow on effects on economic security in PICTs & potential impacts on current regional plans and policies

Session VII: Climate tools to assess vulnerability and for fisheries adaptation

- Overview of the WMO & Global Framework for Climate Services
 - aims to boost availability & access to climate information needed by policy makers & users for planning, decision making
 - requires involvement & contribution by international, regional & national organisations
 - will build on existing capacities & leverage these through co-ordination to address gaps/shortcomings



Conclusions and recommendations

- **Effective fishery management**

- shorter term impacts on fisheries such as increased pressure on fisheries associated with population growth & over-fishing of stocks are larger issues at present than longer terms impacts associated with climate change
- effective management important: healthy stocks have higher resilience & potential for adaptation to a changing climate
- important to communicate the benefits of a healthy ecosystem & personal cost of overfishing
- capacity building in, & co-ordinated approaches to fishery management need to be encouraged

Conclusions and recommendations

- **Monitoring of physical & biological oceanic parameters**
 - need to maintain, expand & improve meteorological, oceanographic & biological data (particularly mid-trophics) collected to better understand systems & impacts of change throughout systems, better improve models
 - time series need to be appropriate length in order to determine longer-term trends from smaller scale environmental variability – requires long term, co-ordinated monitoring
 - important to communicate the negative impacts of not supporting ongoing data collection schemes

Conclusions and recommendations

- **Determining longer-term climate trends from natural variability**
 - need to have an understanding of natural variability associated with short-term and longer term ocean/climate phenomena (e.g. seasonal/inter-annual/ENSO/PDO)
 - improved forecasting reliant on better building natural variability into models
 - is a need for downscaling of models to better understand local variability and projections – current models only operate at large scales, local variability may be larger/different to regional longer term trends – requires further development of models, robust data input

Conclusions and recommendations

- **Consideration & communication of uncertainty**
 - uncertainty in data/models/projections not well communicated/understood - required for better understanding variability in the outputs and projects of models
 - care is required in communicating uncertainty, particularly to non-scientific sectors – less aware of inherent uncertainty in scientific processes, may use uncertainty to slow efforts for policy change
 - capacity building should be encouraged across SIDS to aid better understanding

Conclusions and recommendations

- **Integration of social and economic impacts**

- fisheries data often influenced by social and economic drivers – is a need to better identify & integrate these drivers & their influence on variability in data
- is a need for better integration of social & economic impacts (increasing populations/changing management policies) on projections of fishery outputs associated with climate change
- time periods for policy development within SIDS (often lengthy) & support for better understanding social & economic impacts need to be considered

Conclusions and recommendations

- **Improved data/tool sharing & access**

- is a need for better communication of & understanding of uses of data/tools available – development of website detailing these?
- partnerships between those doing ocean modeling (bottom end) & fisheries modeling (top end) key to better understanding processes, systems & impacts & inherent uncertainty in these
- partnerships between higher capacity institutions (capable of modeling requirements) & SIDS key for better regional understanding of impacts, facilitating adaptive management policies essential for food & economic security

Outputs

- Workshop facilitated establishment of regional network of meteorologists, ocean/atmospheric/fisheries scientists, fisheries managers & international agencies
- Workshop raised interest in, & shared needs for further efforts in the Southern Hemisphere (particularly PO)
- Agreement that a joint CAgM/JCOMM task team on climate & fisheries to be established
 - help guide workshop follow-up implementation & address the marine service requirements of fisheries
 - assist relevant fields in facilitating co-ordination of monitoring networks, setting standards and data management to maximise synergies

Outputs

- Follow-up workshop to be held in December, Rarotonga, Cook Islands
 - trial tools for dissemination of climate products & services & develop ways of interfacing tools via various communication methods for communities
- Summary report will be distributed in coming weeks
 - abstracts of presentations available at:
www.wmo.int/ClimFish
- Selected papers to be published in a special issue of the journal Climatic Change in the first half of 2012



Dr Karen Evans

Email: Karen.Evans@csiro.au

Web: www.csiro.au/org/WealthOceansFlagship

CLIOTOP: Climate Impacts on Oceanic Top Predators

Web: www.imber.info/cliotop

www.csiro.au

Thank you

Contact Us

Phone: 1300 363 400 or +61 3 9545 2176

Email: Enquiries@csiro.au **Web:** www.csiro.au

National Research

FLAGSHIPS

Climate Adaptation



CSIRO