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COASTAL CONFERENCE 2009

*Whose Coast Is It?
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Climate Change:
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Orion Room

Climate Change in South West Estuarine and Inland Fisheries: What are the Potential Impacts and are We Ready for Them?

PRESENTER:

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1. Introduction

This paper summarises the outcomes of a project entitled: 'Climate Change in South West Estuarine and Inland Fisheries: What are the Potential Impacts and are we ready for them?'

The objectives of the project were to:

- Raise understanding of how climate change will impact on the communities associated with South West estuarine and inland fisheries.
- Develop a set of agreed and collaborative strategies on how best to respond to these potential impacts.
- Report these strategies to relevant agencies/funding bodies/stakeholders.
- Develop a generic consultative methodology, which can be transferred to other primary production/regional sectors.

2. Background

Since 1950 there has been a 0.3 to 0.7°C warming in the Australian and New Zealand region, with more heatwaves, fewer frosts, less rain in the SW of WA, and an increase in Australian droughts alongside a rise in sea level of 70 mm [1]; [2]. If these warming trends continue as is expected from climate models, Australian droughts will continue to be associated with increasing mean daily maximum temperature and evaporation

levels [3]. In temperate areas such as the SW of WA, this translates to an additional 1 to 32 days over 35°C by 2020 [4]; [1].

Observed changes in summer rainfall per degree of global warming for 1950–2004 show extensive drying has occurred in the SW of WA [5]. Around half of the reduction in observed rainfall from 1958–1975 to 1976–2003 was due to a decrease in the number of troughs linked to wet conditions, with the remaining half associated with other synoptic types in the SW of WA [6]. Winter rainfall in the SW has decreased substantially since 1950, with the largest decline observed from March to July, while August to October rainfall has slightly increased. In the mid 1970s there was an abrupt increase of between 15–20% in the rate of winter rainfall decline. This sudden reduced rainfall in the SW of WA is likely a combination of increased greenhouse gas concentrations, natural climate variability and land-use change [7].

In a summary of the ranges of uncertainty for rainfall changes simulated by 15 climate models published in the IPCCs AR4, the 'annual-average rainfall by 2030 decreases 3 to 22% in the extreme southwest and, 0 to 22% in the rest of the southwest and 0 to 15% for southern coastal regions' [4]. By 2070 these rainfall change model simulation uncertainties projected annual 'decreases of 7 to 70% occur in the extreme southwest, 0 to 70% in the rest of the southwest and 0 to 45% for southern coastal regions' [4].

Noting the magnitude, spatial, and temporal uncertainties in projections such as these, climate change is expected to exacerbate current stresses on the SW inland and estuarine fisheries from competing uses of water resources, from population growth, and from economic and land-use changes. These changes and the development of adaptation responses to changes were the focus of the initiative reported in this paper.

3. Methodology

This initiative was based on the methodologies used in the 2007 WA Department of Health initiative 'Health Impacts of Climate Change: Adaptation Strategies for WA' [8], which itself drew upon the methodologies outlined in the National Greenhouse Office guide 'Climate Change: Impacts and Risk Management: A Guide for Business and Government, and for Health Impact Assessment' [9]. The current project was conducted in two phases, incorporating two half-day workshops and an internal risk assessment.

3.1 Phase 1 (Workshop 1): Impacts, Vulnerabilities and Coping Capacity

A wide range of stakeholders, from government agencies, local government, NRM groups, industry, representative bodies, were invited to the Phase 1 workshop. Attendees were asked to nominate their area of interest from the categories below:

Inland:

- Recreational Freshwater.
- Protection of Biodiversity.

Estuarine:

- Commercial Fishing and Aquaculture.
- Recreational Fishing.
- Protection of Biodiversity.

Potential impacts for each of the interest areas were considered in relation to:

- Sea level increase.
- Rainfall change.
- Temperature change.
- Extreme events.

Each of these impacts above was considered for possible environmental changes and their impact under the following general interest areas:

- The impact of climate change on the ecology and biodiversity of south west estuarine and inland fisheries.
- The impact of climate change on the management, availability and reliable supply of commercially and recreationally valuable seafood species from south west estuarine and inland fisheries.
- The impact of climate change on stakeholder settlements and infrastructure.
- The impact of climate change on economic wellbeing of relevant stakeholders.
- The impact of climate change on social wellbeing of relevant stakeholders.

Attendees (sitting in their interest category) worked in small groups of four to eight. Impacts of each of the climate change effects (sea level increase, rainfall change, temp change and increased frequency of extreme events) were defined by group members for each of the five interest areas above. Data was pooled, and then attendees spent some time defining vulnerabilities and coping capacities for the identified impacts.

3.2 Risk Assessment

A risk assessment was completed on the impacts identified in the Phase 1 Workshop. This risk assessment was to be used as the basis for identifying a range of risk management or adaptation measures. The risk assessment was undertaken based on impacts to permanently open estuaries, seasonally open estuaries, permanently closed estuaries and inland freshwater systems as it was considered there would be differences in the risk assessments based on the system type.

A small group of participants was invited to undertake the preliminary risk assessment. These results were then verified by the larger group which attended the Phase 2 workshop. Impacts were assessed on a scale that considered the consequences and the likelihood of the impact occurring. Risk was assessed based on based on the relationship between consequence and likelihood.

Consequence x Likelihood = Risk Priority Level

Table 1: Consequence Rating used in the Risk Assessment Process.

Level	General
Negligible (0)	Very insignificant impacts. Unlikely to be even measurable at the scale of the stock/ecosystem/community against natural background variability.
Minor (1)	Possibly detectable but minimal impact on structure/function or dynamics.
Moderate (2)	Maximum appropriate/acceptable level of impact (e.g. full exploitation rate for a target species)
Severe (3)	This level will result in wider and longer term impacts now occurring (e.g. recruitment overfishing)
Major (4)	Very serious impacts now occurring with relatively long time frame likely to be needed to restore to an acceptable level
Catastrophic (5)	Widespread and permanent/irreversible damage or loss will occur – unlikely to ever be fixed (e.g. extinctions)

Table 2: Likelihood Rating used in the Risk Assessment Process.

Likelihood	Description
Almost certain	Is expected to occur in most circumstances
Likely	Will probably occur in most circumstances
Possible	Might occur at some time
Unlikely	Could occur at some time
Rare	May occur only in exceptional circumstances.

Table 3: Matrix used to Inform Risk Assessment Process.

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Medium	Medium	High	Extreme	Extreme
Likely	Low	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	High
Unlikely	Low	Low	Medium	Medium	Medium
Rare	Low	Low	Low	Low	Medium

Table 4: Guide for Management Actions for Risk Priorities.

Risk levels	Description of Management Action
Extreme	Risks require urgent attention at the most senior level and cannot be simply accepted by the community
High	Risks are the most severe that can be accepted by the community
Medium	Risks can be expected to be part of normal circumstances but maintained under review by appropriate sectors
Low	Risks will be maintained under review but it is expected that existing controls will be sufficient and no further action will be required to treat them unless they become more severe.

3.3 Phase 2 Workshop: Assessment of Risk and Development of Adaptation Strategies

Invitations and a Phase 1 report were sent to the same range of stakeholders invited to the first workshop. This workshop commenced with a verification of an internal risk assessment which enabled prioritisation of the impacts defined in Workshop 1.

A range of adaptive responses was then identified for the higher risk impacts. The adaptive responses were developed under the following headings:

- Legislative/regulatory.
- Public education and communication.
- Surveillance and monitoring.
- Ecosystem intervention.
- Infrastructure development.
- Technological or engineering.
- Research.

The workshop concluded with each table developing a comprehensive outline for the adaptive strategy deemed the most important.

4. Results (Performance Assessment)

The Phase 1 workshop: Impacts, Vulnerabilities and Coping Capacity was held on November 14, 2008 with over 50 participants from a range of government agencies, relevant local governments, relevant NRM groups, commercial fishing, aquaculture, recreational fishing, conservation groups, universities and insurance companies.

An internal risk assessment of the identified impacts was completed prior to the Phase 2 workshop: Assessment of Risk and Development of Adaptation Strategies. The Phase 2 workshop was attended by over 30 participants from a range of government agencies, relevant local governments, relevant NRM groups, commercial fishing, aquaculture, recreational fishing, conservation groups and universities.

Extensive detail of the workshop outcomes can be viewed in the draft final report available from the first author.

4.1 Results of Risk Assessment of Identified impacts.

Due to the large number of impacts identified only extreme and high risk impacts are discussed. For further detail, including description of moderate and low risk impacts readers are directed to the draft final report available from the first author.

The risk assessment identified that inland freshwater systems were the most vulnerable with extreme impacts for these systems considered in relation to change in species diversity, habitat loss, change in community structure, increased risk of invasive species becoming more successful, impacts on tourism, environmental/economic cost of water allocation, increase risk of phytoplankton blooms and fish kills, and need for fishways/low fly bypasses.

High risk impacts for all estuarine systems were identified in the areas of alteration of food web balance, increased phytoplankton blooms and fish kills, property damage, costs of clean up, conservation and recovery projects and replacement of facilities and costs of building protective structures. For seasonally open and permanently closed estuaries additional high risk impacts were considered to be increase in saline habitats, detrimental impact on tourism, and increased need for artificial opening, pumping and

dredging. Further high risk impacts for permanently closed estuaries were loss of social value due to decline in recreational fishing and health risks due to mosquitoes.

4.2 Summary of Adaptation Strategies developed from the workshops

The following summarises the adaptation strategies developed from the second workshop. A series of general strategies were developed, and then specific strategies in the areas of legislative/regulatory, public education and communication, surveillance and monitoring, ecosystem intervention, infrastructure development, technological or engineering and research.

4.2.1 General Strategies for Climate Change Adaptation in SW Inland and Estuarine Systems

- Climate change is a cross-government issue, which requires a coordinated response through an adequately resourced lead agency
- Modelling is required to identify local risks and impacts for each individual SW estuarine or inland system. This will enable local understanding of impacts and development of local adaptation strategies. This will also assist in prioritising risk assessments of specific SW estuarine/freshwater ecosystems.
- There is a need to develop agreed climate change education and communication strategies that are reliable to offset sensationalist media reporting.
- Investigate aquacultural options for climate change mitigation strategies in SW estuarine/freshwater systems (carbon sequestration, regional employment, food source, uptake of nutrients etc).
- Development of Freshwater Fish Strategy

4.2.2 Specific adaptation strategies

Legislative or Regulatory

- Allocation accountability strategy—develop policy framework, develop a legislative structure to provide effective management of estuaries and adjoining lands/systems.
- Development of (local/regional/state) integrated water use management groups with DOW, DEC, DoF, OCC, irrigation groups, appropriate shires, irrigation groups, Water Corporation etc. The focus of these management groups should be on the examination of unmanaged water allocation and regulation of river infrastructure.
- Legislative control/limitations in use of agricultural fertilisers/chemicals
- Modification of planning/building laws to integrate researched risks from sea level rise
- Informed/regulated 'bar opening' procedures.

Public Education and Communication

- Public education/communication/school based programs of importance for inland ecosystems and threats from climate change (freshwater systems identified in risk assessments as highest risk) and why habitat use may need to change to offset threats
- Greater landholder education of current fertiliser/alternative water use/source options.

Surveillance and Monitoring

- Need coordination (between university, government departments, catchment groups etc.) and integration of current databases to facilitate common access by all researchers. Ensure (where possible) data collection consistency. There is a need to identify appropriate indicator species (which is likely to require more information on non-commercial/recreational species that are sensitive to climate change).
- Inland fish monitoring improvements required by government departments.

Ecosystem Intervention

- Seminal report study to direct or provide a framework to guide ecosystem intervention strategies (e.g. effectiveness/appropriateness of replacement of riparian vegetation, installation of reoxygenation devices, installation of fishways etc).
- Implement best practice management in catchment areas to reduce nutrient input.
- Development/protection of 'refuges' to maintain biodiversity, genetic variation etc.

Infrastructure Development

- Development of clear guidelines for separation of sewage infrastructure and water drainage.
- Review of strategies for more effective water use (e.g. investigate off stream storage to capture high flow events, recycling etc).
- Investigate barrages on the Swan River

Research

- Risk tables for endangered species, greater understanding of temperature and salinity thresholds for endangered species.
- Assessment of potentially emergent pest species due to climate change. Development of capacity to respond to serious pest infestations.

5. Conclusion

This paper describes a consultative process which has been used to develop a series of climate change adaptation strategies for SW inland and estuarine systems. The initiative emphasised the magnitude of the consultation required to develop and implement appropriate adaptation strategies. The adaptive strategies developed by this workshop series have been inputted into the consultation around the National Climate Change and Fisheries Action Plan and have been reported to the Australian Fisheries Management Forum. An extensive report on the findings is in preparation. It is expected that the methodology and outcomes for this workshop can be adapted as a template for other primary production sectors.

6. Acknowledgements

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7. References

- [1] Hennessy, K., Fitzharris, B., Gates, B.C., Harvey, N., Howden, S.M., Hughes, L., *et al.*, Australia and New Zealand, in *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, *et al.*, Editors. 2007, Cambridge University Press: Cambridge, United Kingdom.
- [2] Parry, M.L., Canziani, O.F., and Palutikof, J. 2007: Technical Summary, in *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, *et al.*, Editors. 2007, Cambridge University Press: Cambridge, United Kingdom.
- [3] Nicholls, N. The El Nino / Southern Oscillation and Australian vegetation. *Plant Ecology*, 1991. 91: 23–36.
- [4] Suppiah, R., Hennessy, K.J., Whetton, P.H., McInnes, K., Macadam, I., Bathols, J., *et al.*, Australian climate change projections derived from simulations performed for the IPCC 4th Assessment Report. *Australian Meteorological Magazine*, 2007. 131: 131–52.
- [5] Whetton, P.H., McInnes, K.L., Jones, R.N., Hennessy, K.J., Suppiah, R., Page, C.M., *et al.*, Australian climate change projections for impact assessment and policy application: A review, in *CSIRO Marine and Atmospheric Research 2005*, CSIRO.
- [6] Hope, P.K., Drosowsky, W., and Nicholls, N. Shifts in the synoptic systems influencing southwest Western Australia. *Climate Dynamics*, 2006. 26: 751–64.
- [7] Australian Greenhouse Office. *Detecting, understanding & attributing climate change*, Department of the Environment and Water Resources, Editor. 2007, Australian Greenhouse Office.
- [8] DOHWA (2006) 'Health Impacts of Climate Change: Adaptation Strategies for WA.'
- [9] Australian Greenhouse Office. *Climate change impacts & risk management: a guide for business and government*, Department of Environment and Heritage. 2006, Australian Greenhouse Office.