Human Dimensions of Ecosystem Variability and Human Response: An Exploration of Effect and Affect

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ABSTRACT

Marine ecosystems are variable at different spatial and temporal scales. Some sources of variability such as that associated with ENSO or PDO appear to produce palpable effects that coastal populations are beginning to recognize and even quantify. Despite this gradual recognition, relatively little response is noted in daily life. Fishery management is yet slow to incorporate such findings into stock assessments and other management measures. Similarly, the ability of humans to affect marine ecosystems through fishing practices in ways that may exceed the range of natural variability is being recognized, yet social and management institutions are slow to respond to this challenge. This paper explores the extent to which effects of variability in natural systems are buffered by robust social and economic mechanisms and examines how this buffering may explain societal and management responses to fisheries impacts in marine ecosystems. Such information may be useful in anchoring the discussions about what constitute acceptable levels of change in marine ecosystems that are associated with human use.

Ecosystem Variability and Human Response -- CONTEXT

All fisheries regions experience natural variability on fairly large spatial and temporal scales

YET WE MANAGE FISHERIES ON ANNUAL BASIS AND AS THOUGH THEY ARE HOMOGENOUSLY DISTRIBUTED

In a fished ecosystem it is difficult to sort the effects of fishing from natural variability and environmental change due to other human induced impacts

ADEQUATE MONITORING LACKING SO LIMITED TO RETROSPECTIVE ANALYSES OF FISH CATCH

Notes from PICES WG 1 Workshop OCT10-11/03

Ecosystem Variability and Human Response -- CONTEXT

This produces "consequence complexity"

THIS IS EASILY EXPLOITED TO ENDORSE FAVORITE HYPOTHESES IN PURSUIT OF SHORT TERM GOALS

Human induced impacts on fisheries and ecosystems are most likely to occur in coastal areas

LACK UNDERSTANDING OF RELATIONSHIPS TO MANAGED SPECIES

NORTH PACIFIC PERHAPS THE CLEAREST RECOGNITION OF REGIME SHIFT AFFECTING FISHERIES [WOC/BC/GOA/BSAI]

Ecosystem Variability and Human Response

REGIME SHIFTS

BIOGEOPHYSICAL

1976/77 SIGNIFICANT WARMING OF NE PACIFIC

SOCIO-ECONOMIC POLITICAL

1976/77 FISHERY CONSERVATION ZONES EXTENDED TO 200 NM

Ecosystem Variability and Human Response – CURRENT ISSUES

CONVENTIONAL VIEW

- FISHING PRODUCES BENEFIT [INCOME, FOOD, EMPLOYMENT]
- FISHERIES CAN BE MANAGED

COMPETING VIEW

- FISHING IMPOSES COSTS [OVERFISHING, BENTHIC DISTURBANCE, SPECIES DECLINE]
- FISHERY MANAGEMENT IS A FAILURE

WORLD PARKS CONGRESS 9/03 EXAMPLE

10-YEAR STRATEGY FOR PROTECTED AREAS

1. 20-30% OF ALL MARINE AND COASTAL HABITATS WORLD-WIDE AS NO-TAKE MARINE RESERVES
2. FIVE ECOLOGICALLY SIGNIFICANT MARINE RESERVES ON THE HIGH SEAS
3. UN MORATORIUM ON DEEP-SEA TRAWLING ON SEA MOUNTS AND COLD-WATER CORAL HABITATS [MPA News 10/03]

Ecosystem Variability and Human Response

ECOSYSTEM-BASED FISHERIES – A POSSIBLE SYNTHESIS

Ecosystems provide a diverse set of services to society.

Integrated study is critical to understanding the complexity of the ecosystem and to sustainable management or renewable resources.

[after Cury et al. 2003; Zabel et al. 2003].

Ecosystem Variability and Human Response

1. How does the Northeast Pacific ecosystem vary?
2. What effect does ecosystem variability have on fisheries?
3. How do humans respond when affected by ecosystem variability mediated through fisheries?
4. How can we use this knowledge to better manage fisheries? [Process, Delivery, Packaging, Interpretation]

CAVEATS

- DEALING AT HIGH LEVEL OF GENERALITY
- RECOGNIZE THE COMPLEXITY OF MARINE ECOSYSTEM INTERACTION
- NOT DEALING WITH DETAIL OF SEPARATING EFFECTS OF FISHING AND CLIMATE VARIABILITY
- NOT DEALING WITH OTHER ANTHROPOGENIC EFFECTS
- CALL ATTENTION TO THE NEED FOR MORE STUDY OF SOCIETAL EFFECTS

Ecosystem Variability and Human Response

How does the N E Pacific Ecosystem Vary?

NORMAL VS. ANOMALOUS VS. ABNORMAL [?]

SEASONAL
INTERANNUAL -- EL NINO/LA NINA
INTERDECADAL [PDO][AO]
MILLENIAL
[SEE PICES SCIENTIFIC REPORTS]

Ecosystem Variability and Human Response

What effect does ecosystem variability have on fisheries?

Seasonal variability -- winter/ summer/ transition

- Effects on Migration
- Effects on Spawning / other behaviors
- Effects on Growth, Etc.

TOTAL EFFECT IS ENORMOUS IN TERMS OF WHEN AND WHERE IT IS POSSIBLE AND MOST EFFICIENT [PROFITABLE] TO FISH

Ecosystem Variability and Human Response

What effect does ecosystem variability have on fisheries?

Interannual - El Nino/ La Nina

Warm water species advect / migrate

northward -- species range extensions;

WA/OR/CA salmon survival decreases, size decreases,

Albacore tunas closer to shore

SIGNIFICANT EFFECTS ON SPATIAL AND TEMPORAL EXTENT OF FISHING AND ON STOCKS AS WELL

Ecosystem Variability and Human Response

What effect does ecosystem variability have on fisheries?

Interdecadal

- Major shift in species abundance
- Reinforces El Nino/ La Nina effects depending on Phase of PDO
  - Inverse production regime for salmon

MAJOR RESTRUCTURING OF SPECIES ABUNDANCES AND ALTERATION OF ECOSYSTEM RELATIONSHIPS

Ecosystem Variability and Human Response

What effect does ecosystem variability have on fisheries?

Millennial

- Lower sea level
- Salmon/ice age
- ? Marine Mammals/ Seabirds

VERY DIFFICULT TO DISCERN CHANGES -- HIGHLY RELEVANT RESEARCH UNDERWAY

Ecosystem Variability and Human Response

How do humans respond when affected by ecosystem variability mediated through fisheries?

1. Live with it

Fishing viewed as highly variable activity

Fishing viewed as high risk

Under open access regime continue to fish or leave

2. Adapt to it

Fish harder

Fish for something else

Ecosystem Variability and Human Response

How do humans respond when affected by ecosystem variability mediated through fisheries?

3. Shift burden of risk / responsibility

- **Disaster loans from government**
- **Direct subsidies for hardship**

4. Manage for it

- **A. Without Forecast/Prediction**
  - **Maintain conservative harvest levels**
  - **Limit capacity to harvest**
- **B. With Forecast/ Prediction**
  - **Adjust harvest levels [slow down, rapid up]**
  - **Limit capacity to harvest**

Many individual and collective action coping behaviors observed.

Ecosystem Variability and Human Response

How do humans respond when <u>affected</u> by ecosystem variability mediated through fisheries?

<u>Millennial</u>

14-16K BP BERING SEA LAND BRIDGE ASSISTED MIGRATION OF PEOPLE FROM ASIA TO NORTH AMERICA

SUMMER BAY ARCHEOLOGY SHOWS MARINE MAMMAL/FISH REGIMES ON SEVERAL HUNDRED YEAR CYCLES [CLIMATE/ HUNTING/ OTHER HYPOTHESES]

ABUNDANCE AND ACCESSIBILITY OF SALMON DETERMINED SURVIVAL FOR MANY NATIVE PEOPLES

Ecosystem Variability and Human Response

How do humans respond when affected by ecosystem variability mediated through fisheries?

Mini Case Studies – Empirical/Illustrative

- Salmon WOC
- Capacity Limitation
- Annual Stock Assessments –Pacific Halibut /Groundfish

Ecosystem Variability and Human Response

Salmon WOC Case – Without Prediction

- Make stock assessments based on historical experience. Relatively few stocks estimated [OPI "jack returns"]
- Adjust in-season based on comparison with historical experience.
- Conservative approach would ensure escapement/ wild-hatchery fish – art not science

This approach is complicated by limited ability to control harvest location and rate for wild-hatchery fish.

Further, managers tend to treat habitat as three "black boxes" [freshwater/ estuary/ ocean habitat]

End result is loss of fishery, loans, buy outs --ESA listing

Ecosystem Variability and Human Response

Salmon WOC Case Study – With Forecast ENSO PDO

- Indicates to harvesters/ managers cause for concern or optimism depending on Phase of PDO for ENSO forecast
- Lack detailed understanding at the stock level of prediction value with respect to adjustment in production. Longer term experience needed.
- Full life cycle survival related to forecasts but little is known about freshwater and estuary relationships or spatial/temporal ocean distribution relative to forecast
- Most useful as “Background” for management
- Demand for forecast of PDO transition but instrumental record tends to lag biological observations [Hare and Mantua 2000]. Are there suitable indicators?

Ecosystem Variability and Human Response

Annual Stock Assessments – Groundfish / Halibut Case Study

W/0 Forecast --Extensive annual survey permits close monitoring of juvenile to adult fish

Stock estimation well developed based on these parameters

Long time series – testing models leads to explanation

W Forecast -- Some sensitivity to phase of PDO can make management choices to harvest or reduce harvest take PDO into account

Is vulnerability to bycatch increased/decreased under certain conditions? What is effect on movements? Answers could lead to geographically explicit adjustments in TAC

IFQ restricted fishery halibut/sablefish gives harvester incentive to support study to develop these relationships

Ecosystem Variability and Human Response

Capacity Limitation Case Study

1. Greatest interest in considering capacity reduction when stocks are low – CRISIS DRIVEN, e.g., crabs NPFMC
2. Increases incentive to know what is happening with stocks and to manage in sustainable manner
3. Increase in economic health of the fishery assists in obtaining cooperation to deal with other problems [e.g., AFA Cooperatives and Steller Sea Lion RPAs]
4. Potential concern about ability to adjust fishery configuration if catch decreases [no ability to move into other fisheries] or increases ["windfall profits"]. Measures like fishery portfolios, tax policies, etc. are mechanisms to deal with such issues

SCIENTIFIC UNCERTAINTY

"ONLY IDEOLOGY HOLDS DEFINITE TRUTHS. IN CONTRAST, SCIENCE AIMS TO SEPARATE THE ***PROBABLY TRUE*** FROM THE ***DEFINITELY FALSE***"

Pollack, H.N., 2003. *Uncertain Science…Uncertain World*. Cambridge University Press, Cambridge reviewed in EOS 84:30 [July 29]

BACK TO UNCERTAINTY

"…. EXAMPLES OF UNCERTAINTY IN SCIENCE ARE NOT ANOMALIES OR IMPERFECTIONS. RATHER, UNCERTAINTY IS A UBIQUITOUS STRENGTH INHERENT IN THE ENDEAVOR."

Pollack, H.N., 2003. *Uncertain Science…Uncertain World*. Cambridge University Press, Cambridge. Reviewed in EOS 84:30 [July 29]

Ecosystem Variability and Human Response

How can we use this knowledge to better manage fisheries?

Climate variability surrogate for ecosystem level information

Allows examination of how scientific information is used or not used in management context

Major improvements in our understanding of NE Pacific Climate / fisheries interactions

Less certainty about use in decision-making

Ecosystem Variability and Human Response

BARRIERS TO USE OF SCIENTIFIC INFORMATION IN FISHERY MANAGEMENT

QUALITY OF SCIENTIFIC INFORMATION ESPECIALLY FORECASTS

"BEST AVAILABLE SCIENTIFIC INFORMATION" STANDARD [MSFCMA]

CONFLICT WITH WHAT MANAGER "KNOWS"

LEVEL OF CONFLICT ABOUT THE ISSUE

Ecosystem Variability and Human Response

RECOMMENDATIONS:

1. USE TARGETED RESEARCH AND PEER REVIEW PUBLICATION ROUTE TO OVERCOME “QUALITY ISSUES”
2. IDENTIFY ALL SCIENTIFIC INFORMATION ON A SUBJECT AND CLEARLY STATE WHY SOME IS SELECTED AS “BEST AVAILABLE”

Ecosystem Variability and Human Response

3. WORK WITH MANAGERS TO DEVELOP A SCIENTIFIC CULTURE FOR MANAGEMENT PROCESSES [INCLUDING PROVIDING TRAINING, E.G., THROUGH A WORKSHOP]. THIS IS AN ITERATIVE PROCESS OF COMMUNICATION

4. HIGH AND LOW LEVELS OF CONFLICT OFFER DIFFERENT KINDS OF OPPORTUNITIES TO USE SCIENTIFIC INFORMATION AND PROCESS TO ADVANCE THE PROCESS

5. UTILIZE A PREDICTABLE, TRANSPARENT PROCESS TO "WORK" THE SCIENTIFIC INFORMATION INTO THE DECISION MAKING LEVELS

THANK YOU FOR YOUR KIND ATTENTION

Ecosystem Variability and Human Response

User/Broker of Scientific Information

Academic

- Consumer of Scientific Literature
- Research on Climate Variability and Fish Management

Applied

- West Coast El Nino Coordinator 1982-1983
- UW Climate Impact Group/JISAO
- Arctic Climate Impact Assessment [Ch. 12 Fisheries with Radchenko / Wilderbuer]
- Voting Member North Pacific Fishery Management Council [Alaska Region/NEP]1994-2003