Understanding Differences in Regulatory Effort Across Stocks: A Preliminary Analysis



Tracy Yandle ~ Emory University Michael Melnychuk ~ University of Washington Scott Crosson ~ NOAA Southeast Fisheries Science Center Ray Hilborn ~ University of Washington



How do regulators make decisions about fisheries?



The popular answer ...





Searching for the real answer...

Insights from the literature

- Scientific Rationality (Purcell et al, 2010; Schneider and Ingram, 1997)
- <u>Economic Rationality</u> (Sanvido et al, 2012; Gomez-Baggethun et at 2010)
- A Political Rationality(Coffe, 2005; Cochrane, 1999)
- ▲ <u>Administrative Rationality</u> (Cropper et al, 1992; Laffont & Tirole, 1991)



Mapping Literature to Dependent Variables

Measuring levels of regulatory activity <u>not</u> types of regulation

- ▲ Federal Register Rules completed regulatory activity
- ▲ Federal Register Proposed Rules regulatory activity
- ▲ Federal Register Notices broader activity

Mapping Literature to Independent Variables (1)

▲ Scientific Rationality

- ▲ FSSI Score
- ▲ Taxon (pelagic, etc)
- ▲ Years since 1st assessment
- ▲ Age 50% maturity

▲ Economic Rationality

- ▲ Total landed value
- ▲ Targeting status
- ▲ Years since fishery developed



Mapping Literature to Independent Variables (2)

▲ Political Rationality

- ▲ Public Awareness/Cultural Value (coming soon!)
- ▲ % Recreational Catch
- ▲ % Tribal/CDQ
- ▲ International Agreement
- Administrative Rationality
 - ▲ % Open Access
 - ▲ % Individual Allocation
 - ▲ Years since first TAC



Data

FSA Management Attributes Database (Washington)

- ▲ Global database
- ▲ Data on biological, management and social characteristics fisheries at the stock level
- ▲ 161 stocks used in this analysis

▲FSSI Data (Emory)

▲ compiled from NOAA website

Regulatory Activity (Emory)

- ▲ Counts of notice, proposed rules, rules
- ▲ Each "hit" requires individual validation
 - ▲ Relevance, mapping to correct region



Preliminary Analysis

▲ Random Forest Analysis

- ▲ Approach based on machine learning (most likely decision trees)
- ▲ Multiple analyses (trees) to increase stability
- ▲ Easier to see natural breaks in patterns, more transparent to users.
- ▲ Clearer interactions between variables.
- ▲ Shows effects of a given variable given interactions with other variables
- ▲ National & Regional Analysis

▲ "Regions" ≠ Regional Councils



Preliminary Findings: Variable Importance

0

	Notices
Tavan	
Taxon	
Years since 1st TAC	•••••••••••••••••••••••••••••••••••••••
log(landed value)	••••••
log(age 50% maturity	• • • • • • • • • • • • • • • • • • • •
Years since 1st assessment	••••••
Region	•••••
% catch recreational	•••••
International agreements	•••••
Targeting status	••••••
% catch indiv. allocation	••••••
% catch open access	•••••••••••••••••••••••••••••••••••••••
FSSI score	••••••
Year of fishery development	•••••
% catch tribal/CDQ	•••••••••••••••••••••••••••••••••••••••
	10 30 50 70
Ν	lean decrease in accurac

log(landed value) Targeting status Region Years since 1st TAC Years since 1st assessment International agreements Taxon log(age 50% maturity % catch recreational FSSI score % catch open access % catch tribal/CDQ Year of fishery development % catch indiv. allocation

Proposed rules

10

30



Preliminary Findings: Variable Importance

Years since 1st TAC				• • • • •
Taxon				••••
log(landed value)			•••••	
Region			••••	
Targeting status		••••		
log(age 50% maturity		••••		
Years since 1st assessment		•••		
FSSI score				
% catch tribal/CDQ	•••••			
International agreements	•••••			
Year of fishery development	• • • • • • • • • • •			
% catch open access	••••			
% catch recreational	• • • • • • • • • •			
% catch indiv. allocation	•			
				
	10	20	30	40

Rules

Total citations

log(landed value)	
Years since 1st TAC	
Taxon	
Years since 1st assessment	• • • • • • • • • • • • • • • • • • • •
Targeting status	••••••
log(age 50% maturity	•••••
Region	•••••
International agreements	•••••
FSSI score	•••••
% catch indiv. allocation	• • • • • • • • • • • • • • • • • • • •
% catch recreational	•••••
% catch open access	•••••
Year of fishery development	••••
% catch tribal/CDQ	•

Mean decrease in accuracy

30

10

50



Mean decrease in accuracy

Preliminary Findings: Variable Importance

- ▲ High importance of landed value for proposed rules and total, and moderate/high influence for notices and rules
- ▲ High importance of the years since first use of TACs for rules and total, moderate/high influence for notices, and moderate importance for proposed rules.
- ▲ High importance of taxon for notices and rules, and moderate importance for proposed rules.
- ▲ High importance of targeting status for proposed rules, and moderate importance for notices, rules, and total.
- ▲ Moderate/high importance of region for rules and proposed rules, and moderate importance for notices and total.



Preliminary Findings: Partial Dependence Plots

- Plots show the marginal effect of a given predictor variable on regulatory activity (number of citations) after accounting for the effects of other predictor variables.
- ▲ The line thickness is proportional to the variable importance score in the plots shown above, for each response variable separately
- Predictors are shown by the four rationality groups. All plots show the overall relationship in black as well as region-specific analyses (AK=green, SW=blue, NE=red, SE=purple). Analyses occurred for each response variable across all rationality groups



Preliminary Findings: Economic Rationality



Log(landed value) Year of fishery development

Targeting status



Preliminary Findings: Economic Rationality

- Stocks with landed value > \$1m, citations increases proportional to landed value across all types.
- Below landed value of about \$1m, citations are relatively insensitive to changes in landed value. These relationships hold less well for SE stocks.
- ▲ No particularly strong influence of development year.
- ▲ In general Alaskan stocks had more rules than those from other regions, while NE stocks had more notices.



Preliminary Findings: Scientific Rationality "

Scientific Rationality





Preliminary Findings: Scientific Rationality

▲ Not much influence of FSSI scores.

- SE stocks with low/intermediate FSSI scores have slightly greater proposed rules and rules.
- ▲ Ignoring the outliers beyond the 90th percentile, not much of an effect of the time since the first assessment on citations.
 - ▲ Perhaps in AK, stocks with a longer assessment history have more rules.
- Rockfish, elasmobranchs and invertebrates tend to receive less regulatory effort/activity compared to whitefish and other fish.
 - \checkmark The high counts for whitefish are mostly driven by rules for Alaskan stocks
 - The high counts for other fish are mostly driven by notices for New England/mid-Atlantic stocks.



Preliminary Findings: Political Rationality





Preliminary Findings: Political Rationality

- ▲ Not much influence of % rec catch or % tribal catch on citation measures.
 - NE, there is a slightly tendency for more proposed rules and rules with higher % rec catch.
- Stocks with substantial international issues & agreements tend to have slightly more notices and proposed rules than those with only some or no international agreements.



Preliminary Findings: Administrative Rationality

Administrative Rationality



Years since 1st TAC

% catch indiv. allocation % catch open access



Preliminary Findings: Administrative Rationality

- Citations (especially rules) were positively related to the number of years since TACs were implemented
 - ▲ This pattern is mostly driven by Alaska stocks.
 - ▲ Ignore the right half of these plots, beyond the 90^{th} percentile.
- ▲ Very little influence due to % catch in IQs or % catch in open access.



Systematic Issue: Can we Aggregate Data Across Councils?

Are we dealing with ...





Systematic Issue: Can we Aggregate Data Across Councils?

- Differences in ...
- ▲ Scale of catch
- ▲ Value of catch
- ▲ Influence of recreation



Thank you!

- Walton Family Foundation
 NSERC Banting Fellowship
- Emory University Undergraduate Students
 - ▲ Willa Brooks, Elliyah Dossantos, Brenda Chew Michael Ache, Rachel Westmoorland, Gaby Suarez



Advice?

