Appendix D2: Bycatch Risk Pools

Slide 1

Science, Service, Stewardship

Bycatch Risk Pools

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## Slide 2

Individual Bycatch Quotas and Risk Pools

- Individual bycatch quotas can be more efficient and effective at reducing bycatch than regulations
- When bycatch is highly uncertain and rare individual quotas markets may may fail to allocate quota efficiently and result in financial risk (Holland 2010).
- I'll discuss how pooling approaches can be used to reduce financial risk for fishermen in these cases

(Holland, D.S.2010. Markets, Pooling and Insurance for Managing Bycatch in Fisheries. *Ecological Economics.* 70(1):121-133)

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Slide 3

A Simple Model of Rare Bycatch

- Fishing events and bycatch are discrete homogeneous events.
- Each fishing event yields one unit of target catch with certainty and has a constant probability of catching one unit of bycatch.
- For simplicity, the bycatch is assumed to have no value and the target catch has a unit net value after harvest costs.
- Bycatch is purely random modeled as a Bernoulli process where bycatch events are independent over time and across fishermen
- With this specification the expected value of an individual bycatch quota allocation is equal to the sum of negative binomial probabilities of exactly reaching period k before exhausting IBQ holdings, j, summed over periods (ITQ use) $k <= t$ and IBQ holdings $j < q$ plus the probability of reaching the final period without exhausting IBQ times the profit associated with harvesting in all possible periods.

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Slide 4

The distribution of ITQ units used (with a maximum of 300) before for (a) one, (b) two, (c) three units of IBQ is exhausted with p=0.01.
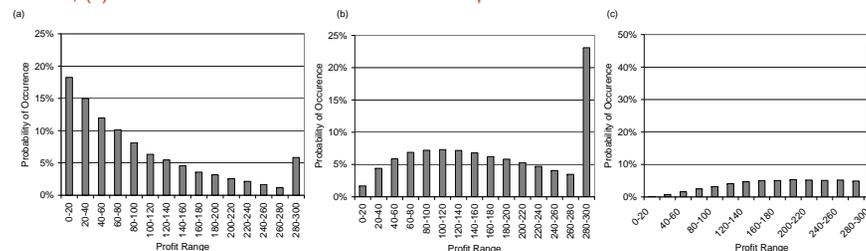
- With only one unit of IBQ the distribution of possible outcomes is skewed to the right but with three units it is skewed to the left
- Thus trading away a unit of quota always increases downside risk, in terms of increased right skew of the new distribution of outcomes, and may either increase or decrease standard risk as measured by the standard deviation of expected revenue.
- Sufficient standard risk aversion and or "prudence" (downside risk aversion) could inhibit trading even where it would lead to increases in total expected value.

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Slide 5

Simulated price paths for IBQ from simulations with p=0.01 and 50 fisher each with allocations of 100 units (aggregate ITQ=5000) and aggregate IBQ of (a) 45 units, (b) 50 units and (c) 55 units.

- Even prices, assuming an efficient market with not risk aversion vary widely during the year as actual bycatch departs from the expected level
- Think of these as values of highly leveraged investments

Quota Price   Cumulative Bycatch
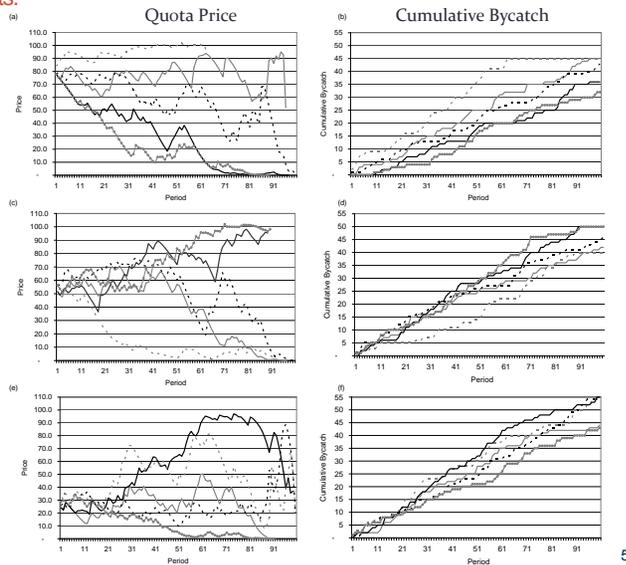
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Pooling

- Pooling bycatch quota can protect pool members from variability in profit due to individual variability in bycatch and exposure to price variability in the IBQ market
- While larger pools decrease price variability they may also increase problems associated with moral hazard and adverse selection – so limited pool sizes may be preferable

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Key Problems in Risk Pool Design and Operation

- **Basic pool design:**
  - What is the appropriate species scope of pools?
  - What is the appropriate pool size and geographic scope?
- **Adverse selection:**
  - Who should you let in or keep out of your pool?
  - Should pool members be expected to contribute to the pool in-kind or monetarily?
- **Moral hazard (reduced incentives to avoid bycatch):**
  - Can/should risk pools specify observable "best fishing practices" that reduce expected bycatch rates and mitigate moral hazard?
  - Should the pools consider other mechanisms such as coinsurance or deductibles to reduce moral hazard?
  - Could the risk pool actually aggravate a race for fish and if so how can this be mitigated?

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Percent of Observed Tows with Overfished Rockfish and Halibut Between 2002-2009 (pre IFQ)

- Several species were caught in less than 5% of tows and some on less than 1% of tows
- Distributions of positive tows are roughly lognormal
- Some species can have very large "disaster" tows
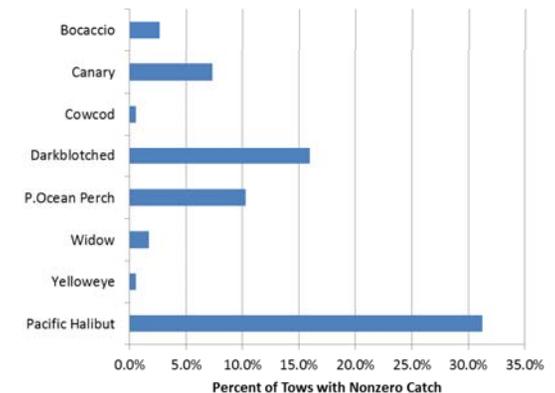
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Methods – Nonparametric Analysis

- Data: West Coast Groundfish Observer Program data from over 26,000 observed tows between 2002-2009 segregated by latitudinal strata
- Draw 100 tows with replacement 1000 times to construct distributions of potential QP requirements for individual vessels
- Evaluate risk and risk reduction from pools of different sizes using tail conditional expectation (TCE)
- Caveat: Bycatch risk reflects historical behavior under different incentives

Latitudinal Strata for Rockfish Bycatch Analysis

Nonparametric Monte Carlo Analysis of Risk Reduction from Pooling

- Which species should be included in risk pools?
- How big should risk pools be?
- What is the appropriate geographic scope of risk pools?

95th Percentile Tail Conditional Expectation (TCE) vs. Median QP holdings for Canary Rockfish by Latitudinal Strata

Species	Risk Measure	North of 47'	45'20" to 47'	44' to 45'20"	42'30" to 44'	40'10" to 42'30"
	95th Perc TCE	3,627	1,148	1,413	2,502	7,504
	TCE (Pool=10)	1,842	489	844	1,111	2,239
Canary	TCE (Pool=50)	1,524	336	723	862	1,345
	TCE/Median QP	10.7	3.4	4.2	7.4	22.1
	TCE Pool=10/Median QP	5.4	1.4	2.5	3.3	6.6
	TCE Pool=50/Median QP	4.5	1.0	2.1	2.5	4.0
	95th Perc TCE	22,574	3,575	14,841	5,254	3,566
	Pool=10	15,406	2,531	11,099	3,154	2,471
Pacific Halibut	Pool=50	14,149	2,298	10,178	2,787	2,232
	TCE/Median QP	24.0	3.8	15.8	5.6	3.8
	Pool=10/Median QP	16.4	2.7	11.8	3.4	2.6
	Pool=50/Median QP	15.1	2.4	10.8	3.0	2.4

Estimating Expected Catch Per Tow

- Probability of encounter bycatch for species j is (binary logit):

- (1) $$P(Catch_j > 0) = \frac{\exp(\beta_j x_j)}{1 + \exp(\beta_j x_j)}$$

- Catch per tow for positive tows (assume lognormally distributed):

- (2) $$\ln(Catch_j \mid Catch_j > 0) = \alpha_j x_j + \varepsilon_j$$

- An unbiased estimate of expected conditional catch is:

- (3) $$E(Catch_j \mid Catch_j > 0) = \exp(\alpha_j x_j) * \exp(\sigma^2 / 2)$$

- The unconditional expected bycatch for a given fishing tow:

- (4) $$E(Catch_j) = P(Catch_j > 0) * E(Catch_j \mid Catch_j > 0)$$

Expected Catch Per Tow for Canary Rockfish by Latitude and Depth
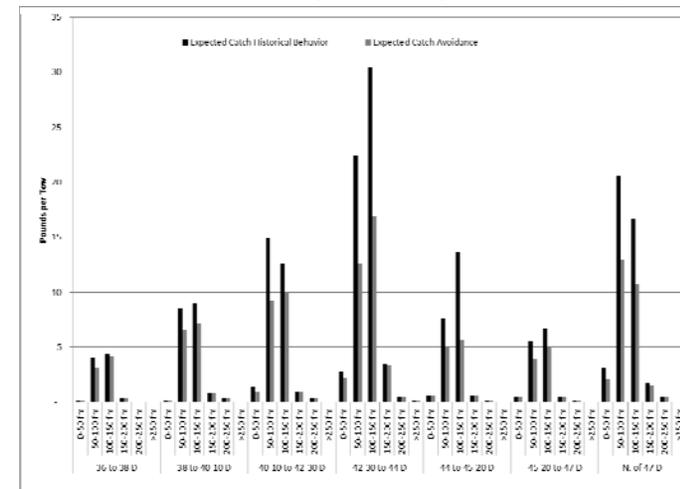
Holland, D.S.2010. Markets, Pooling and Insurance for Managing Bycatch in Fisheries. Ecological Economics. 70(1):121-133.

Holland, D.S. and J.E. Jannot 2012. Bycatch Risk Pools for the US West Coast Groundfish Fishery. Ecological Economics 78:132-47.

Consistent Elements Across Existing Risk Pools in West Coast Groundfish Fishery

- At least three risk pools operated in 2011 (the initial year of the West Coast Groundfish ITQ).
- Avoided monetizing bycatch quota – didn't charge a price for withdrawls to cover bycatch events
- Created system to share real-time information to avoid bycatch
- Defined best practices for minimizing bycatch risk (e.g. require short test tows, delineate areas
- Quota pounds for bycatch species all transferred to a holding vessel and access to that quota for large bycatch events is contingent on whether vessel was compliant with risk pool rules fishing).

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Risk Management and Fishery Management

- Sources of risk faced by risk pools are due in part to a lack of flexibility in the regulatory structure.
- Individual and pooled risk could be reduced by allowing greater carryover of QP (10% allowed now but British Columbia ITQ allows 30%).
- Multi-year TACs would also reduce risk but are not allowed under current US law
- Market insurance could address residual risk for the risk pool but practicality (and supplier) is uncertain.

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Risk Pools Vs. Group Allocation

- If pooling makes sense, why allocate to individuals in the first place?
- Enables risk pool to control free- riders
  - Threat of exclusion
  - Contingent access to quota

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Related Publications

- Holland, D.S.2010. Markets, Pooling and Insurance for Managing Bycatch in Fisheries. Ecological Economics. 70(1):121-133.
- Holland, D.S. and J.E. Jannot 2012. Bycatch Risk Pools for the US West Coast Groundfish Fishery. Ecological Economics 78:132-47.

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