"I'm worried, Charlie! A catch like this could knock the bottom out of the market."

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Considerations for Evaluating Potential Economic Yield for Alaska Sablefish

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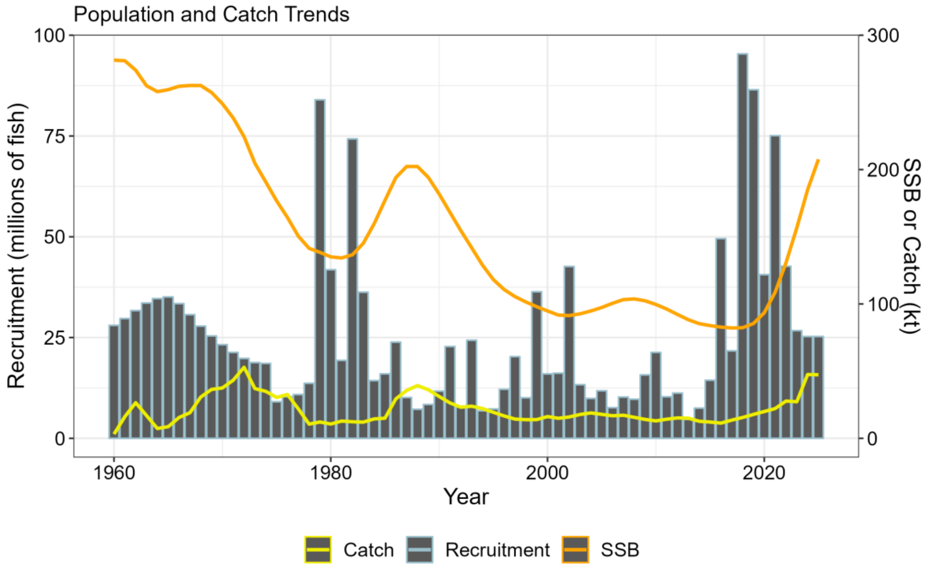
Outline

- Motivation – why evaluate economic yield now?
- Defining and operationalizing Maximum Economic Yield and Optimal Yield
- Key things that an analysis of economic yield for Alaska sablefish should consider

Alaska sablefish yields likely to remain high for at least a decade



Year	Maximum Permissible F	Author's F (Specified Catches)	Half maximum F	5-year Average F	No Fishing	Overfished	Approaching Overfished
	Yield (t)						
2023	27,160	27,160	27,160	27,160	27,160	27,160	27,160
2024	47,367	31,485	24,138	30,664	-	55,385	47,367
2025	46,361	30,816	24,535	30,843	-	53,489	46,361
2026	44,536	46,905	24,436	30,412	-	50,735	52,069
2027	42,336	44,441	24,026	29,621	-	47,666	48,833
2028	40,051	41,881	23,438	28,648	-	44,618	45,618
2029	37,845	39,413	22,764	27,608	-	41,772	42,616
2030	35,812	37,140	22,066	26,576	-	39,216	39,921
2031	34,043	35,158	21,407	25,630	-	37,040	37,623
2032	32,556	33,488	20,817	24,799	-	35,246	35,726
2033	31,293	32,067	20,283	24,063	-	33,746	34,141
2034	30,203	30,845	19,796	23,402	-	32,409	32,763
2035	29,254	29,795	19,355	22,814	-	31,111	31,443
2036	28,429	28,899	18,969	22,308	-	29,955	30,251

Source: Goethel, D.R., Cheng, M.L.H., Echave, K.B., Marsh, C., Rodgveller, C.J., Shotwell, K., and Siwicke, K. 2023. Assessment of the sablefish stock in Alaska. North Pacific Fishery Management Council, Anchorage, AK.

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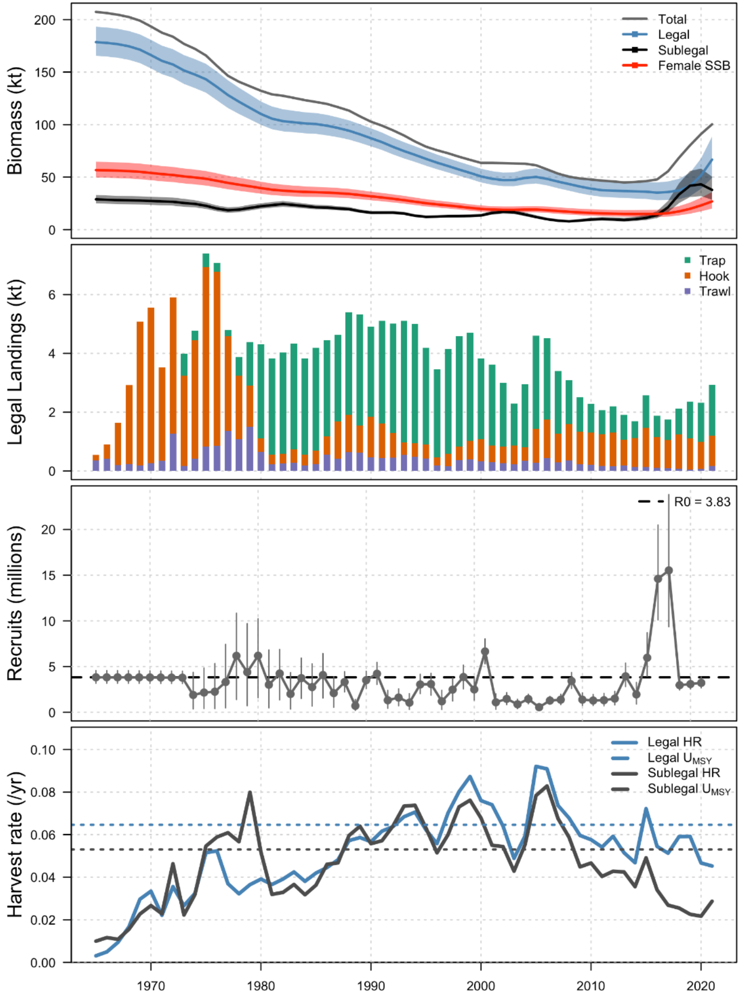
West Coast Sablefish Yields also greatly increased

Table 9: The adopted 2023–24 overfishing limit (OFL; mt), annual catch limit (; mt), and assumed removals (mt) and the projected OFL (mt), Acceptable Biological Catch (ABC; mt), spawning biomass, and fraction unfished for 2025–2034. The projected ABCs are calculated using a P* of 0.45 and category-1 time-varying sigma. (2023 West Coast Sablefish Assessment)

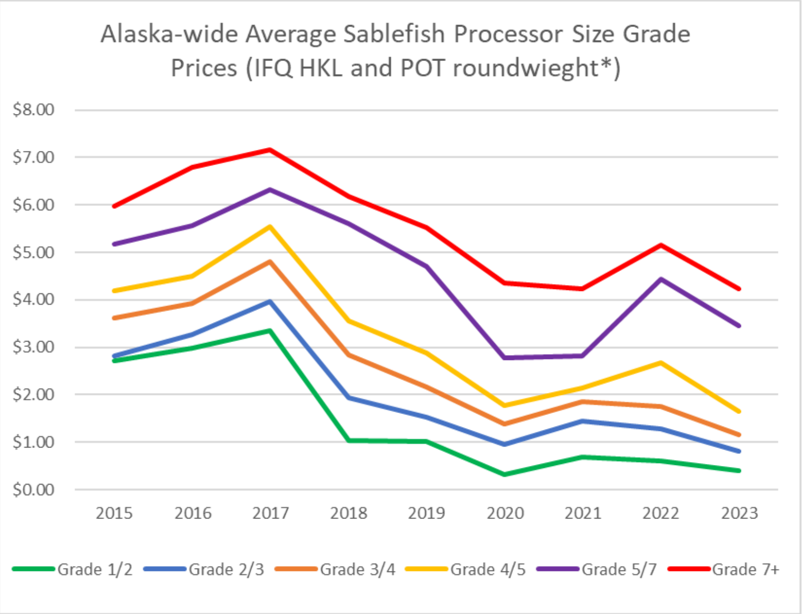
Year	Adopted OFL	Adopted ACL	Assumed Removals	OFL	ABC	Spawning Biomass	Fraction Unfished
2023	11,577.00	10,824.00	9,118.00	NA	NA	117,519.00	0.63
2024	10,670.00	9,923.00	8,359.00	NA	NA	141,875.00	0.76
2025	NA	NA	NA	39,085.30	36,544.69	183,592.00	0.98
2026	NA	NA	NA	37,310.40	34,698.66	207,142.00	1.11
2027	NA	NA	NA	34,160.00	31,632.18	214,059.00	1.15
2028	NA	NA	NA	29,701.30	27,384.65	210,719.00	1.13
2029	NA	NA	NA	25,318.50	23,217.10	203,091.00	1.09
2030	NA	NA	NA	21,811.90	19,914.27	194,403.00	1.04
2031	NA	NA	NA	19,379.70	17,616.13	185,924.00	1.00
2032	NA	NA	NA	17,842.70	16,129.76	177,993.00	0.95
2033	NA	NA	NA	16,898.00	15,208.22	170,621.00	0.91
2034	NA	NA	NA	16,280.60	14,587.40	163,747.00	0.88

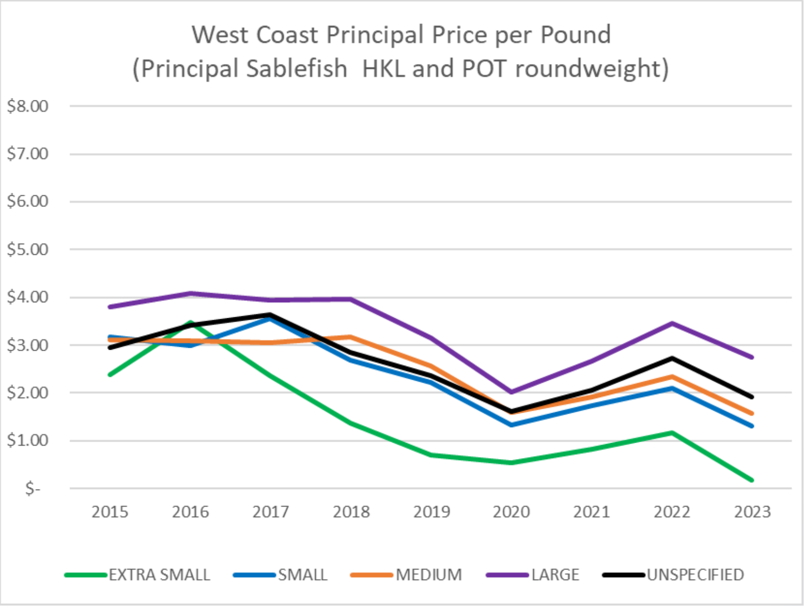
British Columbia Sablefish up as well

BC Sablefish female spawning stock biomass for 2022 (B2022) was estimated to be well above the level of female spawning stock biomass associated with maximum sustainable yield (BMSY). The weighted average estimate of B2022 is above BMSY with 92% probability (median value of 1.32 times BMSY).



- Prices declining in both Alaska and West Coast
- Large price differentials by size persist
- There are a lot of small fish in the current population that are likely to become more valuable (per pound) as they grow





**Caveat: converted to round weight from Table 2 in NPFMC D1 Small Sablefish Release Update JUNE 2023 assuming those prices were for eastern cut dressed*

Implementing MEY – the Australian experience

Dichmont, C.M., Pascoe, S., Kompas, T., Punt, A.E. and Deng, R., 2010. On implementing maximum economic yield in commercial fisheries. Proceedings of the National Academy of Sciences, 107(1), pp.16-21.

- *In the literature MEY has traditionally been an equilibrium concept like MSY. In reality, fisheries are not in equilibrium…….Operationalizing MEY requires developing models that take the dynamics of stocks, costs, and prices into account. Maximizing the net present value of profits over time is a more appropriate objective and is consistent with the concept of MEY*

- *Given that the optimal trajectory is state-dependent, a new trajectory will need to be re-estimated regularly, taking into consideration what the management system actually achieved in terms of catch and effort in the fishery during the transition period, as compared with the goals it was aiming to achieve. For the NPF, the decision was made to have a continuously rolling transition period of 7 years, so that each time MEY is estimated (taking into account also the latest price and cost forecasts),*

MEY and MSY

- Key Point: both MSY and MEY are dependent on fishery selectivity and population age structure and MEY is dependent on a number of economic factors (costs, prices, discount rates, etc.)
- Economic yield and optimal effort over a limited time horizon will depend on starting conditions including age/size structure of population and future recruitment assumptions
- It is unlikely that economic yield will be maximized by a fixed harvest control rule

Optimum Yield (OY)

- (33) The term "optimum", with respect to the yield from a fishery, means the amount of fish which—
  - (A) will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems;
  - (B) is prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and
  - (C) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery.
- To evaluate optimal yield we need to consider ecological, economic and social outcomes including distribution of benefits

Operationalizing MEY vs. OY

- MEY implies optimization but is that really what is needed?
- Optimization requires simplification and may not reveal multiple competing objectives
- Operationalizing OY requires balancing potentially competing objectives
- The Council will set Total Allowable Catch (TAC) to meet its policy objectives – needs information on trade-offs between alternatives

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Bioeconomic models and MSE

- Dynamic bioeconomic models can explore alternative harvest strategies and evaluate performance on multiple objectives under alternative assumptions
- Management strategy evaluation (MSE) can do this as well with advice consistent with the adopted stock assessment
- MSE can identify strategies robust to uncertainty but adds complexity for modelers and customers
- True uncertainty in either a bioeconomic model or MSE may be better modeled as alternative assumptions (scenarios) instead of random parameters if the range and distribution of the parameter and correlation with other parameters is not well understood

Key Assumptions and Characteristics for Bioeconomic Model or MSE for AK Sablefish

- Catch and selectivity
  - catch≠TAC - what determines catch?
  - exploitation rates by substock and age may vary based on fleet behavior
  - both targeting behavior and gear may impact size selectivity
  - ability (cost) to avoid incidental catch in other fisheries
- Costs per unit harvest
  - CPUE effects of biomass and fleet behavior (catchability not constant)
  - fleet and vessel effects on cost of nominal effort
  - (no recent AK cost data – some West Coast data might be useful)

Key Assumptions and Characteristics for Bioeconomic Model or MSE for AK Sablefish

- Prices
  - size-dependent
  - impact of supply from other regions
  - downward sloping demand (market growth?)
- Discount rate and value of stock at end of planning horizon
- Distributional constraints (e.g. shares of TAC by sector including non-target and incidental catch)

Outputs of interest

- F and SSB relative to reference points
- Biological risk – risk of becoming overfished
- Economic risk and stability of harvests
- Revenue and profit over time
- Distribution of revenue, net revenue, jobs, other benefits
- Constraints on fisheries with sablefish incidental catch
- **Model should illustrate trade-offs between alternative management strategies!**

Handling Uncertainty of the Human System

- Modeling behavior of fleets and markets predictively is probably unrealistic
- Scenario modeling with alternative reasonable assumptions about fishing and markets may be more informative
- Building on existing MSE may be useful but will add complexity and skills requirements for modeler or require close coordination and cooperation with MSE modeler

Skill Sets Needed

- Numerical fishery modeling
- Fleet behavior modeling
- Fleet cost modeling
- Market analysis
  - Hedonic price modeling (price by grade, area, gear)
  - Demand analysis (Export and domestic markets)

Summary

- To evaluate optimal yield we need to consider ecological, economic and social outcomes including distribution of benefits
- Maximizing benefits over time is a more appropriate objective than static MEY and is consistent with the concept of MEY
- Evaluating fishery benefits requires developing models that take the dynamics of stocks, costs, and prices into account.
- A predictive model with endogenous fishing and market behavior may be too ambitious – scenario modeling can still be useful even if deterministic
- The model should inform not prescribe policy