Distributing TCEY

Allan Hicks, Ian Stewart, Ray Webster

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L. Boiter

Purpose

- Review the outcomes of AM093

- Determine definitions related to distributing TCEY

- Discuss the estimation of stock distribution

- Present ideas for distributing the TCEY

- Solicit ideas for distributing the TCEY
  - Management Procedures

AM093 (Victoria, BC, January 2017)

30. … the Commission **RECOMMENDED** that the presentation of harvest advice be changed to be based on the TCEY, which includes all O26 commercial, sport, personal use/subsistence, bycatch and wastage removals, for the 2018 Annual Meeting cycle, …

- We will discuss the implementations of this with Commissioners at the September work meeting

- For now we will assume that we are distributing the TCEY

AM093 (Victoria, BC, January 2017)

38. **NOTING** that the term "apportionment" has connotations broader than stock distribution that are not reflective of its meaning in the IPHC context, the Commission **RECOMMENDED** that it be replaced with the terms "stock distribution" or "stock distribution model(ing)".

- We will discuss the definition of "stock distribution" and if there are other components to distributing the TCEY

AM093 (Victoria, BC, January 2017)

39. The Commission **RECOMMENDED** that the IPHC MSE process be accelerated so that more of the elements contained within the current Program of Work are delivered at the 94th Annual Meeting of the Commission in 2018.

- We talked about this when discussing the timeline and work plan

AM093 (Victoria, BC, January 2017)

40. The Commission **REQUESTED** that the IPHC Secretariat initiate a process to develop alternative, biologically based stock distribution strategies for consideration by the Commission and its subsidiary bodies. This should also be incorporated into the MSE Program of Work.

- It is a part of the work plan and will be discussed in 2017 and considered in 2018 and later

- MSAB will take it further by addressing management choices in distribution as well

Definitions

- Distribution: the management procedure for distributing the TCEY among Regulatory Areas. This may be composed of the purely scientific component (stock distribution) and a management component of distributing harvest (management distribution).

- Stock distribution: the analytical process of estimating the proportion of biomass in defined areas of the coast relative to the coastwide biomass. This is a science product which may not specifically align with Regulatory Areas.

- Management distribution: the process of distributing the TCEY among Regulatory Areas that is based on management decisions. This may be based on area-specific production, data (e.g., WPUE), management decisions and/or defined allocations

Current Harvest Policy
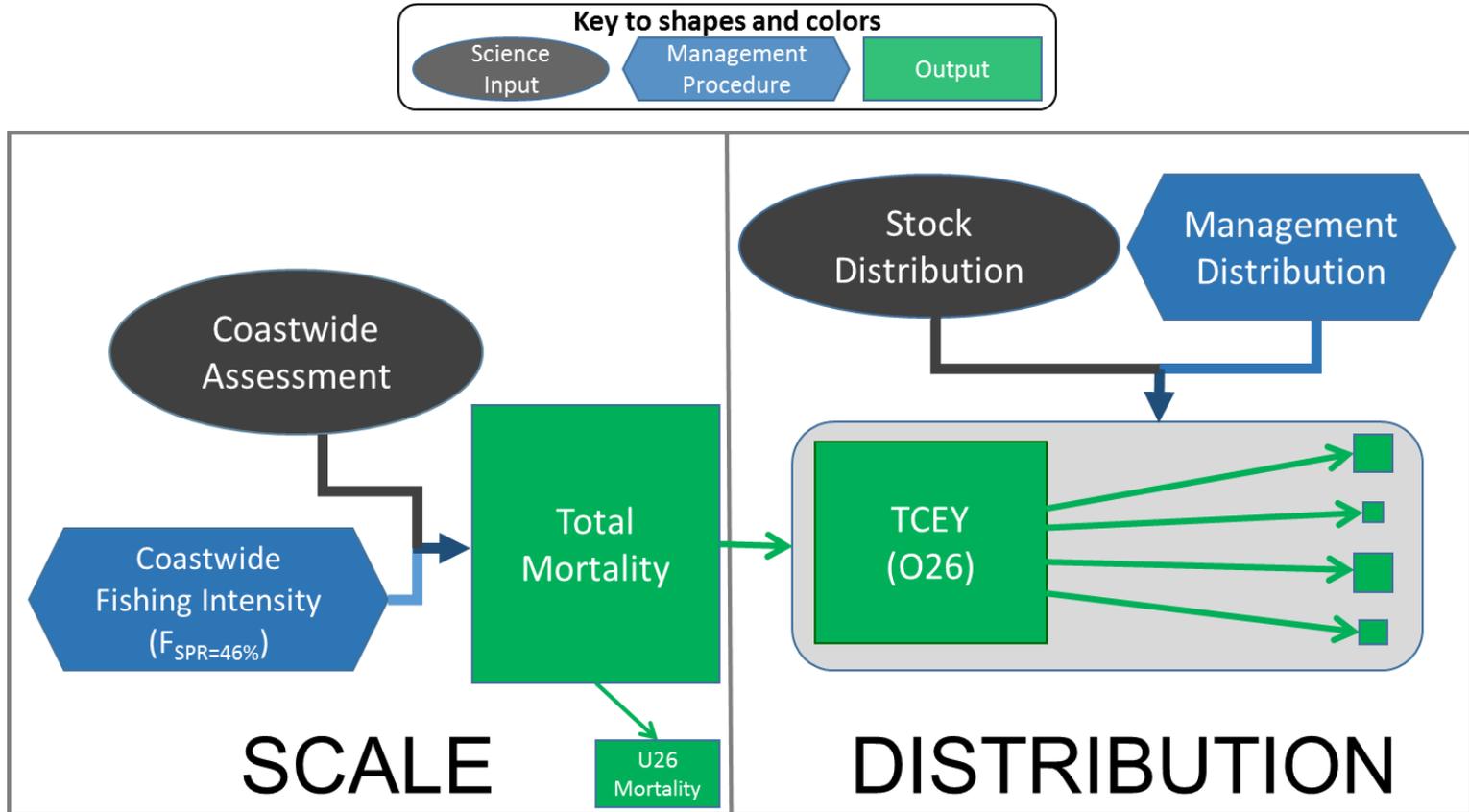
Distribution
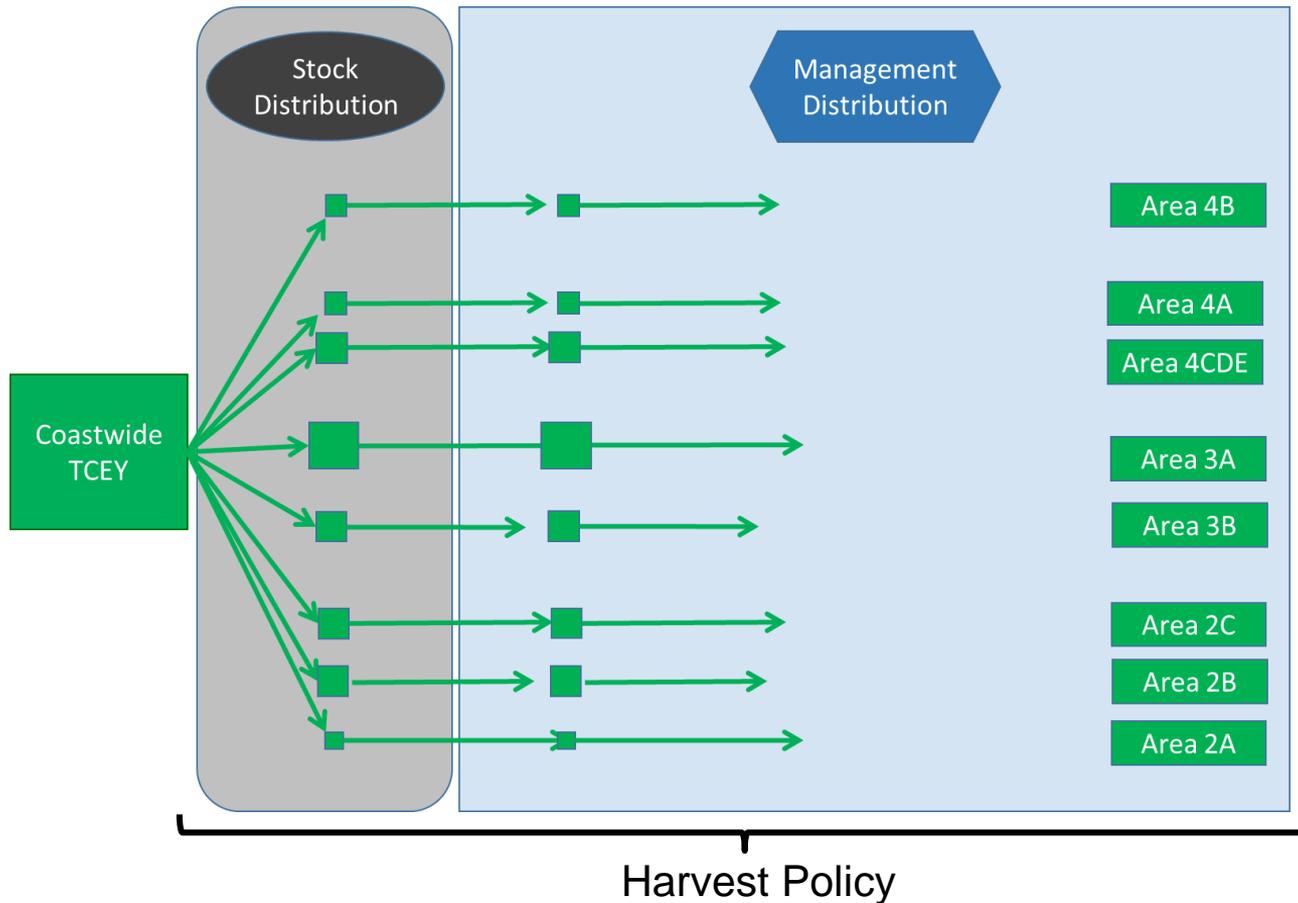
A requiem for apportionment

- Apportionment was meant to refer to only the estimation of the distribution of the stock

- Further determining the CEY based on area-specific harvest rates was part of the harvest policy

- These concepts were often confused, thus it is time to honor the death of apportionment and refer to

  – Stock distribution (scientific, estimation)

  – Management distribution (management, decision making)

Distributing the TCEY

- Separating these concepts allow us to focus on the scientific parts and the management parts

  – The MSAB is more concerned with the management components while the SRB with the scientific

- There may be many steps in the management distribution component

  – Each step is a management procedure that will be evaluated by the MSAB

An overview of stock distribution

- Each year, the IPHC estimates the proportion of the O32 biomass in each Regulatory Area

- Ian Stewart will give a brief overview of this procedure

Overview: Stock distribution

- Estimation of stock distribution is a scientific process
- Currently based on **O32** survey Weight-Per-Unit-Effort (WPUE) for each **Regulatory Area**
- WPUE estimated via fitting space-time models to annual fishery-independent data
  - IPHC setline survey data (including expansions), NMFS and ADFG trawl surveys, and data from the sablefish longline survey
  - Includes: station-level adjustments for the effect of bait competition, and differences in the timing of the survey relative to the harvest

Background: Setline survey

- IPHC's fishery-independent setline survey
  - Over 1200 annually-fished stations
  - Fixed 10 nmi grid since 1998
  - Expansion stations to provide data in annual coverage gaps (2014-2019)
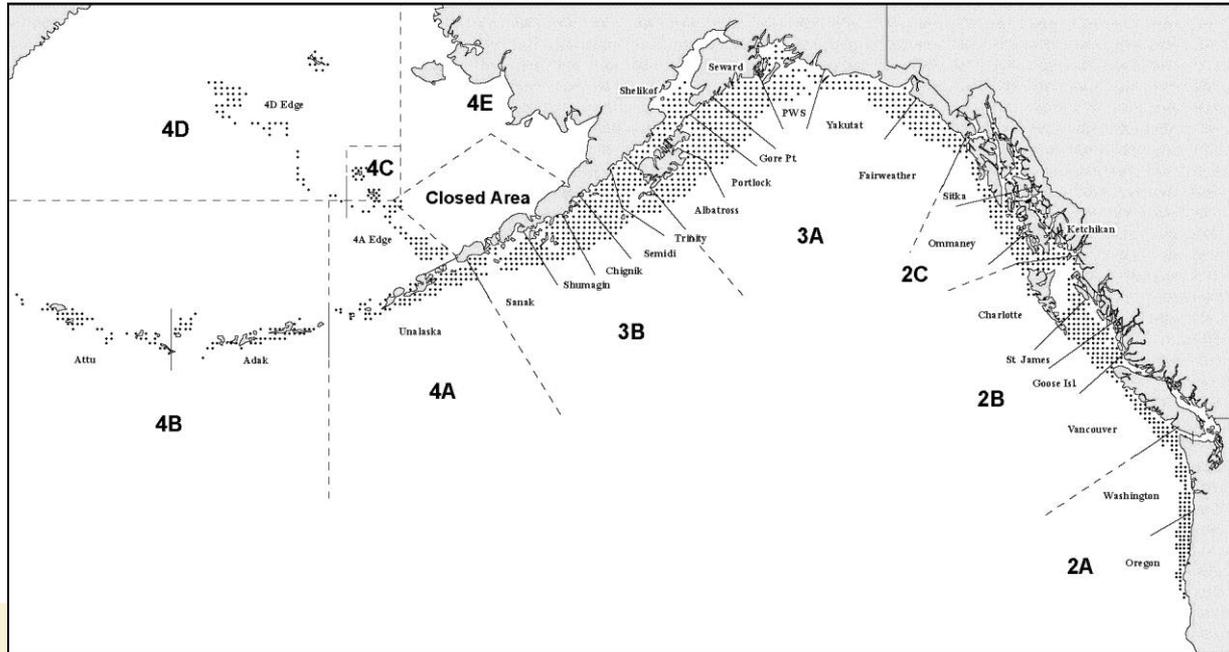
Background: Space-time modelling

- Reviewed and implemented in 2016
- Extracts more information from the data than previous methods
  - Stations close to each other in space are more likely to have similar halibut density than those far apart (spatial dependence)
  - Sets made at a station in consecutive years are more likely to have similar WPUE than those made several years apart (temporal dependence)
- In other words, halibut density is patchy and patches persist with time
- Space-time models estimate these relationships to improve estimates of relative density

Background: Space-time modelling

- Estimating the degree of spatial and temporal dependence helps distinguish the underlying halibut density from random variation in halibut catch
  - "Sorts out the signal from the noise"
- Estimation of WPUE (and NPUE for the assessment) is further improved by use of covariates in the models:
  - Depth
  - Year (time trend)
  - Latitude and longitude
  - And potentially: environmental variables such as temperature, pH, dissolved oxygen

Background: Survey WPUE

- Survey WPUE is used as an index of relative halibut density:

  - Weighted by bottom area (0-400 fa) to create aggregated or coastwide indices

  - O32 WPUE provides the most direct comparison with current commercial WPUE

Stock distribution estimation

- For each Regulatory Area, we calculate a biomass index:

  Biomass index = average WPUE × bottom area

- We then compute the annual coastwide biomass index as the sum of the biomass indices for all regulatory areas

Stock distribution estimation

- The proportion of coastwide biomass estimated in a given Regulatory Area is that area's biomass index divided by the coastwide index

$$\text{Biomass proportion in an area} = \frac{\text{Area's biomass index}}{\text{Coastwide biomass index}}$$

- The space-time model allows us to calculate estimates of uncertainty in the stock proportion estimates

2017 estimates of stock distribution

- Uncertainty (95% intervals) represented by vertical bars
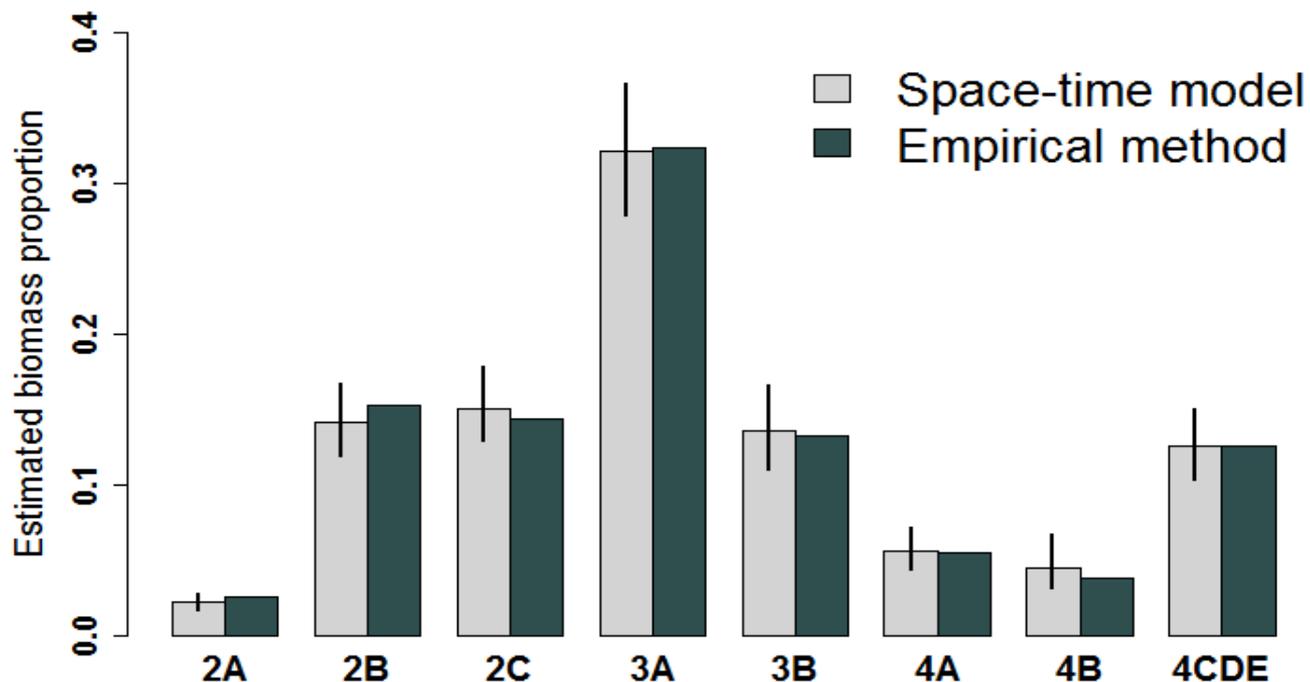
Stock distribution estimation

- The IPHC's Scientific Review Board has endorsed the space-time model approach as the basis for stock distribution (and assessment)

  - This is the state-of-the-art for survey analyses

Stock distribution estimation

- **Moving forward** in response to Commissioner's request to evaluate alternative biologically-based stock distribution approaches:
  - Estimating distribution by *geographic region* (2,3,4,4B)
    - Using better biological boundaries, rather than management (Regulatory Area) boundaries
    - More stable due to less observation error
  - Comparing *total survey WPUE* (all sizes) to O32 WPUE as a proxy for density
    - Consistent with managing all sizes and sources of mortality
    - A substantial proportion of the survey catch (and fishery removals) is U32
- These topics to be evaluated with the SRB during 2017

Stock distribution

Thanks Ian and Ray

Why should we distribute the stock?

- A useful objective is to spread effort geographically
  - Preserve unknown biocomplexity
  - Fish on the stock in proportion to how it is distributed

- Do not need to estimate stock distribution to Regulatory Areas
  - Using biologically relevant regions will achieve the biocomplexity objective
  - More certain estimates for larger areas

Geographic regions

- Four biologically relevant regions that meet management needs

- Distributing stock to these geographic regions still allows further distribution to Regulatory Areas
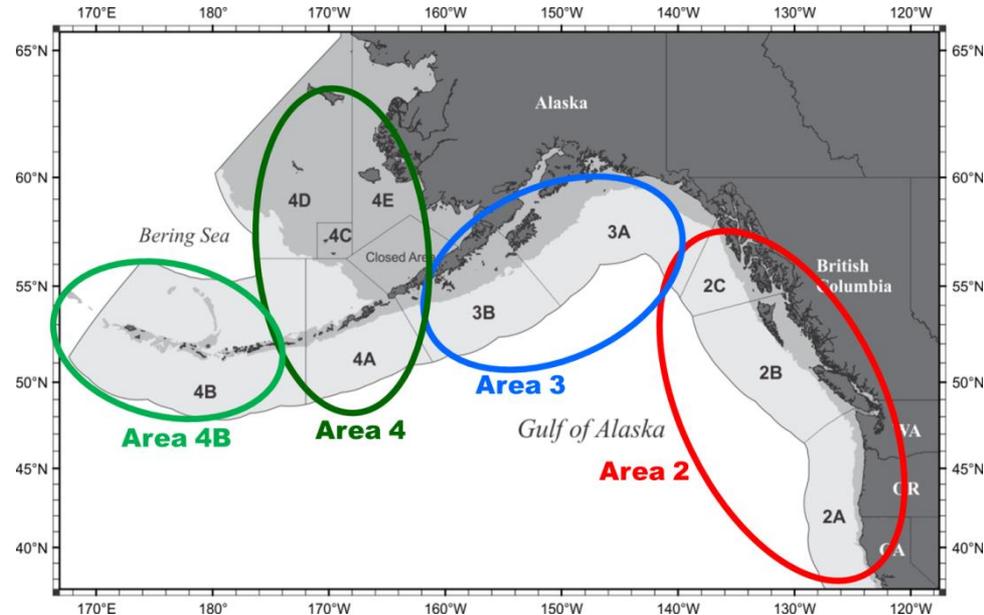
Distributing the TCEY (example)
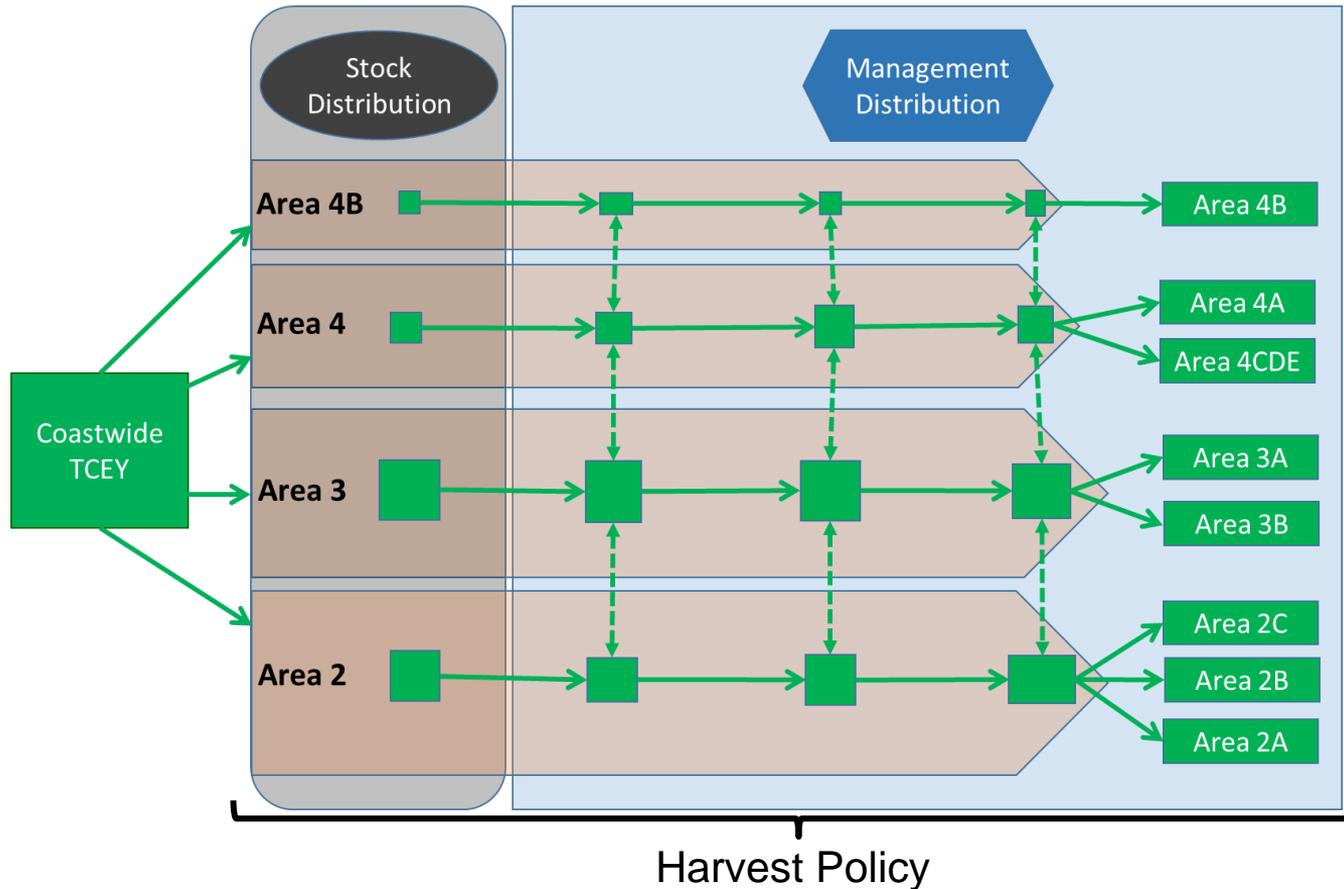
Management distribution

Modifications through management decisions

- Different harvest rates in some areas

  – Could be based on productivity

- Fishery-dependent WPUE

- Age/size compositions

- National shares

- Allocation

Distribution to Regulatory Areas may occur at any step

Other thoughts

- Preserving the fishing intensity

  - The Scale is set with a fishing intensity

  - If the fishing intensity changes after Distribution, then the harvest policy has changed

  - There is a back and forth between Scale and Distribution to check for consistencies

- Fixed distribution for some years

  - A fixed distribution may provide some stability in area-specific CEY's

Example management procedures

Pseudo-previous harvest policy

- Mimic old method of distribution to Regulatory Areas

- Relative harvest rates related to 21.5% and 16.1%

- Note that the old method did not preserve the fishing intensity

  - Could range from 16.1% to 21.5% depending on where stock is

  - This pseudo method would preserve the fishing intensity

Psuedo-previous harvest policy

$$TCEY_A = TCEY \frac{\rho_A \times F_A}{\sum_A \rho_A \times F_A}$$

- The symbol ρ_A is stock distribution
  - The proportion of the O32 stock in each Regulatory Area
- F_A is the relative fishing intensity in each Area
  - 21.5% Areas would be 1.0
  - 16.125% Areas would be 0.75

Psuedo-previous harvest policy

$$\sum_{all\ A} TCEY_A = TCEY \frac{\sum_{all\ A} \rho_A \times F_A}{\sum_{all\ A} \rho_A \times F_A} = TCEY$$

Sum of TCEY's
from each area

=

Coastwide TCEY
from fishing intensity

Example management procedures

Regional distribution

- Distribute to biological regions

  - Stock distribution and Management distribution

$$TCEY_R = TCEY \frac{\rho_R \times F_R}{\sum_A \rho_R \times F_R}$$

- Note that 3A and 3B are in same region but previously used different harvest rates. They would have the same harvest rate here

Regional distribution MP

- Further distribute to Areas

  - Management distribution

$$TCEY_A = TCEY_R \times P_{A|R}$$

- $P_{A|R}$ is proportion of Area A given region R

  - Must sum to 1 within a region to preserve fishing intensity

  - This is where different harvest rates for 3A and 3B could be included

Other ideas

- Use additional data to inform additional adjustments to the distribution of the TCEY to regions or Areas within a region

  – WPUE, age/size, etc.

- Assign a specific allocation when distributing the TCEY to Areas within a region

- Annually negotiate the allocation to Areas within a region

  – this would be difficult to simulate, but could be evaluated against regional objectives

Timeline for distribution

- May 2017
  - Discuss the concept of distribution
  - Begin thinking of ideas to evaluate in the future
- October 2017
  - Continue the discussion
  - Form specific ideas to evaluate in the future
  - Stay informed of SRB thoughts on alternative stock distribution methods
    - e.g., regional stock distribution
- 2018
  - Develop multi-area OM to evaluate distribution management procedures

Next steps

- Is preserving stock biocomplexity an objective? If so, what is the measurable objective?

- Are these new terms and definitions acceptable?

- Are there management implications with regional stock distribution?

- Come up with specific management procedures for the management distribution component

We should make time to discuss these in October