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Overview of Current Biological Reference Point Methods and Estimates for Multispecies Groundfish in the Northeast US

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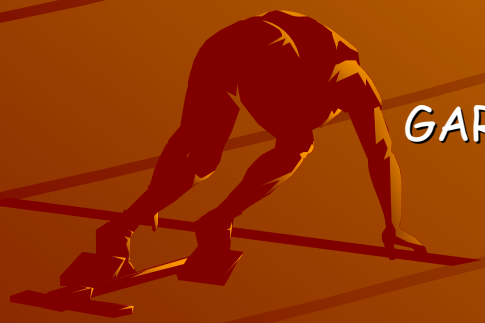
GARMathon III—Biological Reference Points



April 28-May 2, 2008
Woods Hole, MA 02543

Term of Reference 4a

For each stock, list what the current BRPs and/or BRP Proxies are (e.g., BMSY, BMAX, FMSY, F40%MSP, historical catch per tow, etc.) and give their values (i.e., typically from GARM II).

SPECIES	STOCK	NUMERICAL ESTIMATE OF STATUS DETERMINATION CRITERIA				
		B_{TARGET} (metric tons or NEFSC survey index)	**$B_{THRESHOLD}$** (metric tons or NEFSC survey index)	**F_{MSY} (Maximum fishing mortality) (5)**	**Ftarget (at biomass target) (5)**	**MSY** (metric tons)
COD	GB	216,800	108,400	0.18	0.14	35,200
	GOM	82,800	41,400	0.23	0.17	16,600
HADDOCK	GB	250,300	125,150	0.26	.20	52,900
	GOM	22.17 kg/tow	11.09 kg/tow	0.23C/I	0.17 C/I	5,100
YELLOWTAIL FLOUNDER	GB	58,800	29,400	0.25	0.19	12,900
	SNE/MA	69,500	34,750	0.26	0.20	14,200
	CC/GOM	12,600	6,300	0.17	0.13	2,300
AMERICAN PLAICE		28,600	14,300	0.17	0.13	4,900
WITCH FLOUNDER		25,240	12,620	0.23	0.17	4,375
WINTER FLOUNDER	GB	9,400(1)	4,700	0.32	0.24	3,000
	GOM	4,100	2,050	0.43	0.32	1,500
	SNE/MA	30,100	15,050	0.32	0.24	10,600
REDFISH		236,700	118,350	0.04	0.03	8,200
WHITE HAKE[2] ***top row ASPIC bottom row index method***		14,700(2) 7.70 kg/tow	7,350 3.35 kg/tow	0.29 0.55 C/I	0.22 0.41 C/I	4,200
POLLOCK		3.0 kg/tow	1.5 kg/tow	5.88 C/I	4.41 C/I	17,600
WINDOWPAN FLOUNDER	North	0.94 kg/tow	0.47 kg/tow	1.11 C/I	0.83	1,000
	South	0.92 kg/tow	0.46 kg/tow	0.31 C/I	0.23 C/I	900
OCEAN POUT		4.9 kg/tow	2.95 kg/tow	0.31 C/I	0.23 C/I	1,500
ATLANTIC HALIBUT		5,400(1)	2,700	0.06	0.4	300

Background: Overfishing Definition Review Panel

- First treated as a group in the report of the Overfishing Definition Review Panel (Applegate et al. 1998).
  - Surplus production models to derive BMSY and FMSY levels for 42 stocks
    - 20 MSYs
    - 19 Proxies
    - 3 Unknowns
  - Difficulties comparing with assessment models
    - Biomass weighted F vs Full F
    - Total biomass vs SSB
    - Estimating K

Working Group on Re-Evaluation of BRPs for NE Groundfish (2002)

- Moderately controversial
- Generally higher than Overfishing Definition Review Panel
- "Moving the goal posts"
- Objectives
  - Consistency with assessment model outputs
  - Focused on potential productivity implied by cohorts fished at modest rates.

Working Group on Re-Evaluation of BRPs for NE Groundfish (2002)

- General Groups
  - 1. Parametric, Beverton-Holt
    - {GB Cod, GOM cod, GOM winter, SNE winter}
    - {GB winter—Surplus production}
  - 2. Nonparametric: Recruitment + Yield/Recruit methods
    - {GB haddock, GB yt, SNE yt, CC yt, Amer plaice, witch, redfish}
  - 3. Model Resistant stocks: various Index methods
    - {GOM haddock, white hake, pollock, windowpane (N & S), ocean pout, halibut}

Taxonomy of Reference Points

- Internal
- External
  - Parametric
  - NonParametric
- Index Methods
  - Relative F
  - Replacement Ratio: Stable point
  - Biomass Ref Pt externally derived

“Internal” BRP estimation

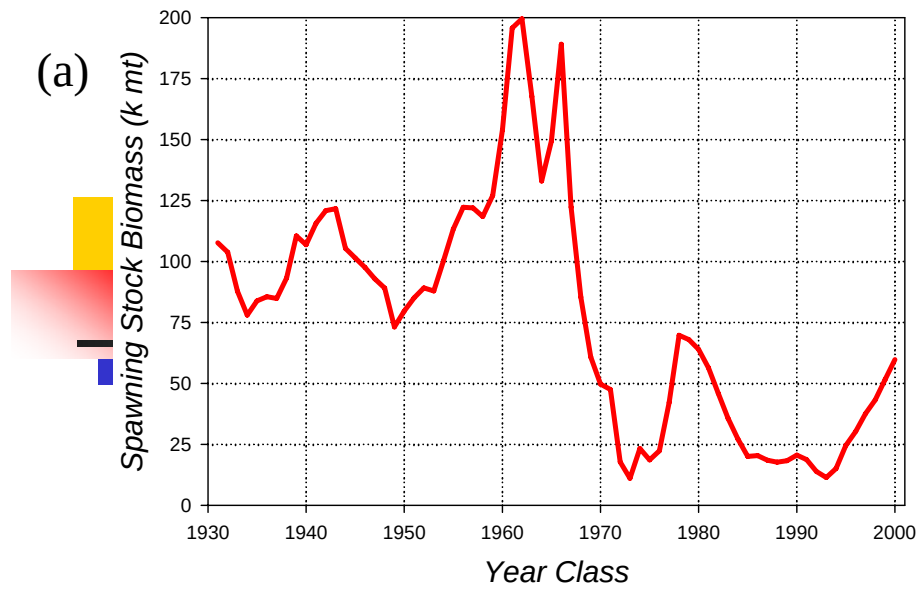
- Stock recruitment function is included as part of the model parameterization
- Incorporate full uncertainty of estimation but this can be a problem if the model doesn’t fit well.
- Biomass dynamics models (surplus production) represent one of the simpler forms of parametric “internal” estimation.
- Only Georges Bank winter flounder falls into this category.

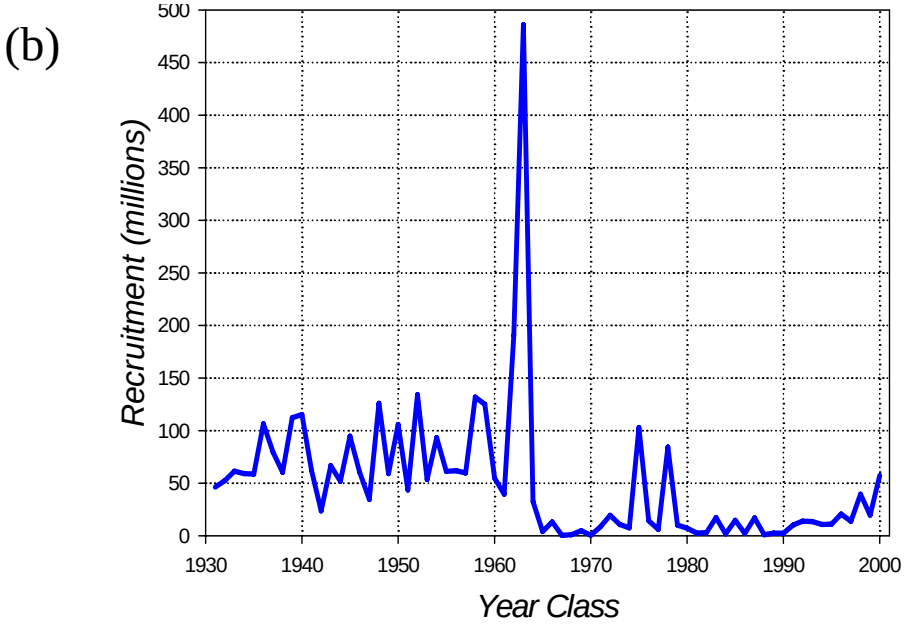
External: Parametric

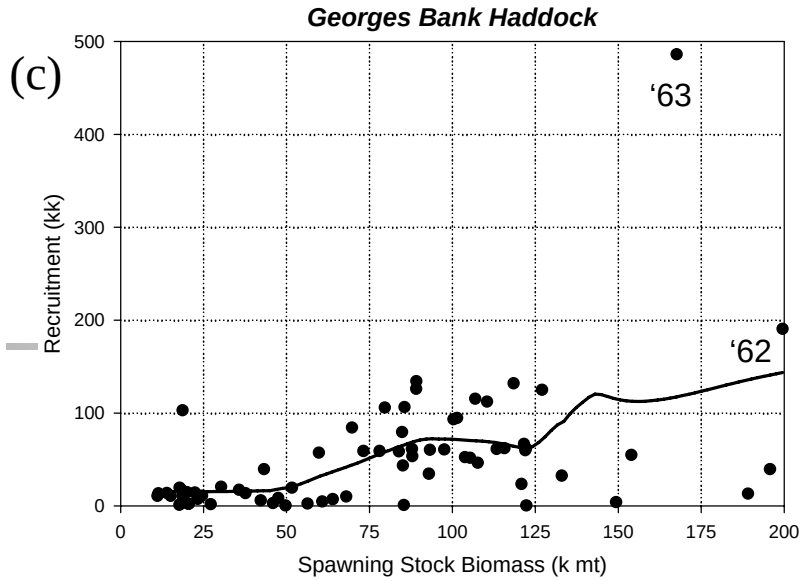
- S-R Models are fit to estimates of recruitment and spawning stock biomass derived from estimation model such as VPA Adapt or ASAP.
- Lack of fit has no influence on estimates of R or SSB.
- Use AIC methods + a logic hierarchy to select best model (Brodziak and Legault 2005)

External: Non parametric

- Three requirements:
  - Assessment model to estimate R and SSB
  - Unacceptable parametric S-R model fits
  - Estimator of Yield per Recruit and SSB/recruit
- Basic approach
  - Select appropriate F reference point: generally, F40%MSP
  - Compute SSB/R at F40%MSP
  - Multiply SSB/R at F40%MSP by Ave(Recruitment Series)
- Variations on the theme
  - Hindcast of historical Recruitment based on model q's {GB yt, SNE yt}
  - Restrict set of recruits associated with higher values of SSB {Redfish, GB yt}
  - Use F50%MSP for redfish
  - Exclude a yearclass based on its magnitude {GB haddock, 1963}



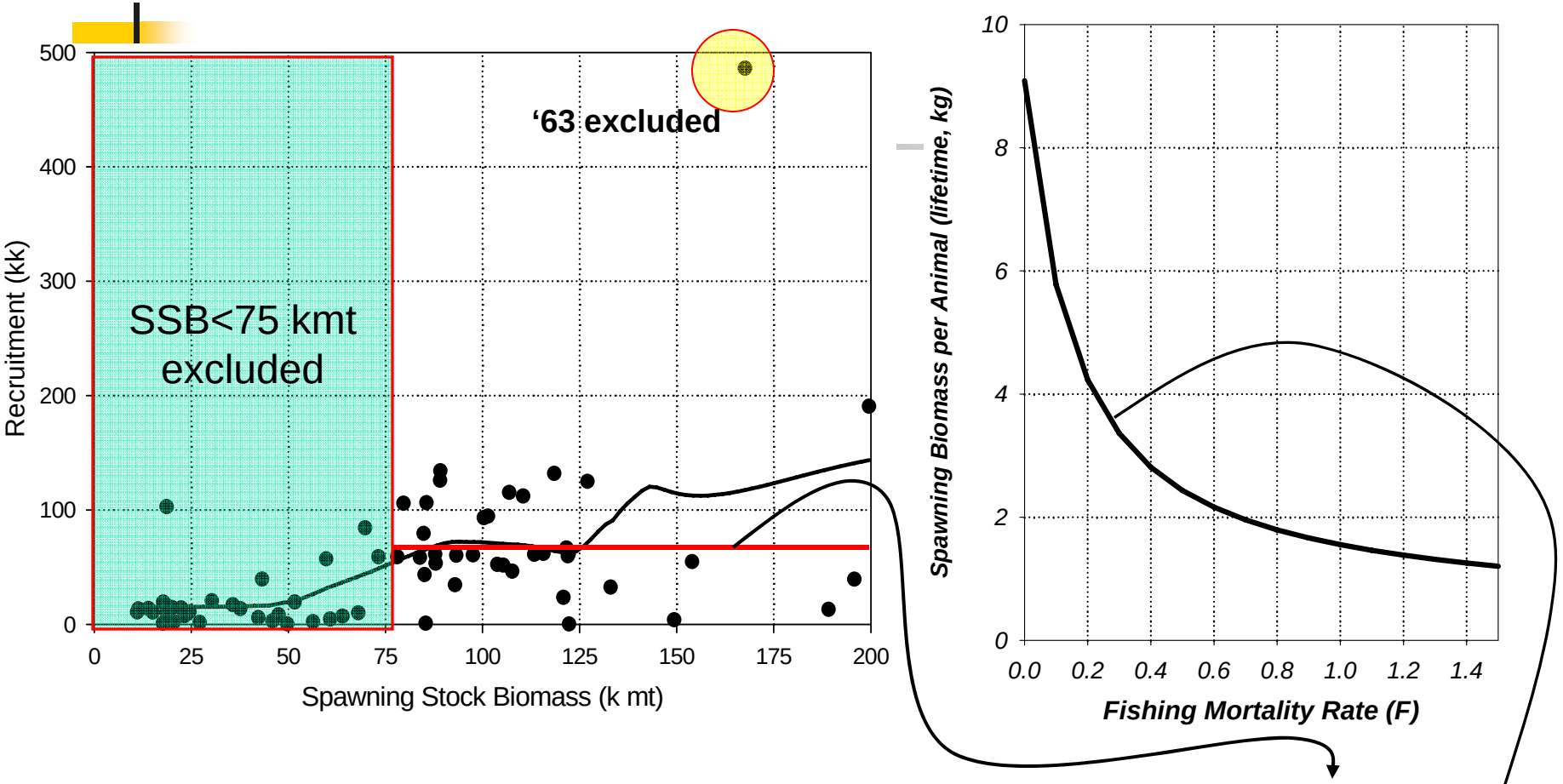




		F0.1	F40% MSP
F reference point		0.263	0.263
ssb per recruit at F		3.6374	3.6341
	Recruitment (millions)	SS Biomass at F0.1	SS Biomass at F40%
n	70	70	70
mean	51.09	185.83	185.66
min	0.42	1.53	1.53
max	486.22	1768.56	1766.95
10th %'tile	2.49	9.07	9.06
25th %'tile	10.30	37.47	37.43
50th %'tile	37.08	134.86	134.74
75th %'tile	61.80	224.78	224.58
90th %'tile	112.58	409.51	409.14
Std Dev	67.73	246.38	246.15
CV	1.33	1.33	1.33
For SSB >/= 75 kmt - w/o '63 YC			
Mean	68.87	250.49	250.27
Median	60.57	220.30	220.10
Mean w/'63 YC	80.15	291.52	291.26

Figure 3.3.2. Spawning stock (a), recruitment (age 1 millions, b), and scatterplot (c) for Georges Bank haddock. Data are the calculated spawning stock biomasses for various recruitment scenarios multiplied by the expected SSB per recruit for F0.1 and F40% MSP, assuming recent patterns of growth, maturity and partial recruitment at age (Table 3.3.2). Smoother in the stock-recruitment plot is lowess with tension = 0.5.

How was the New Biomass target for Georges Bank Haddock Computed?

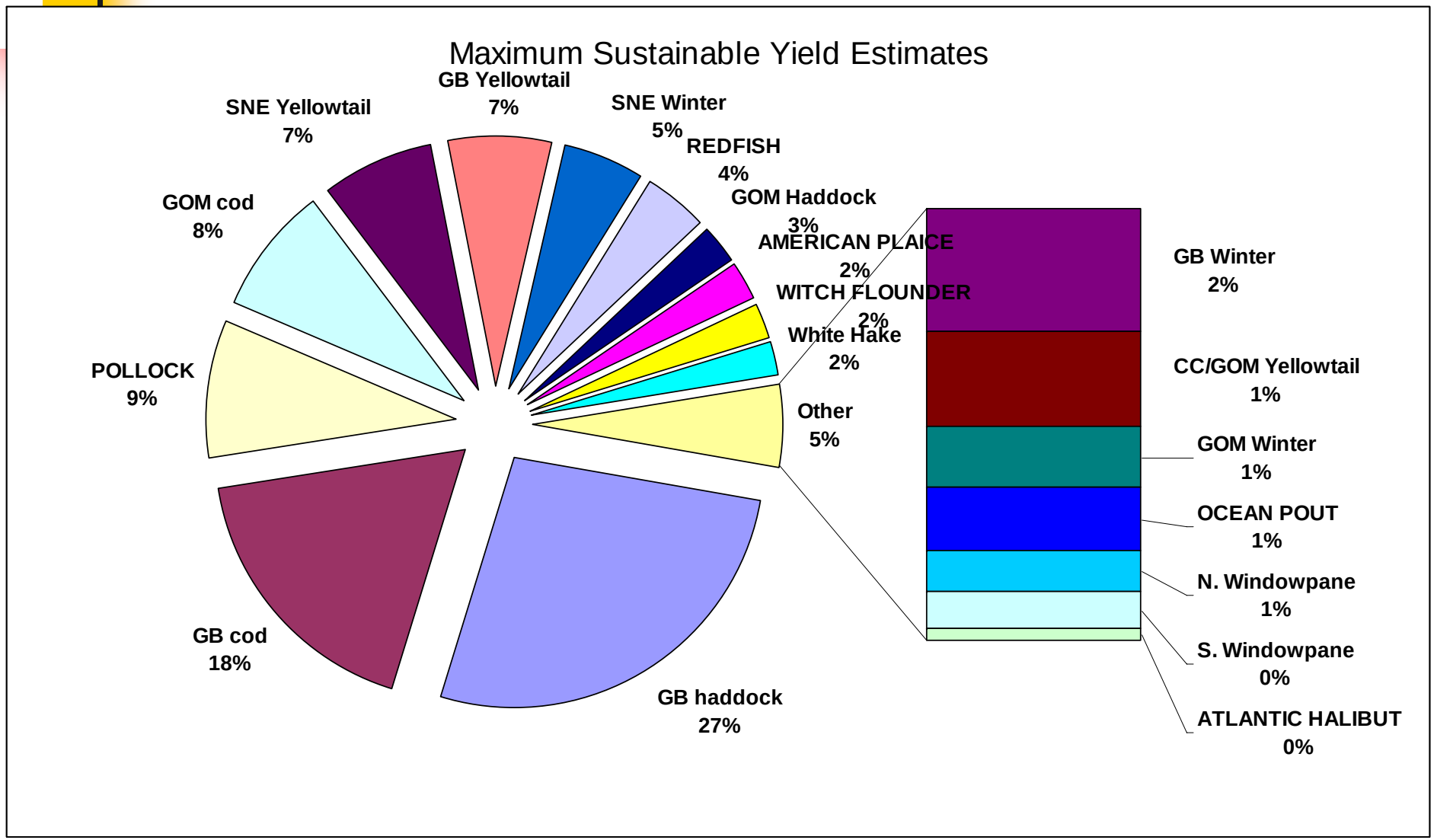


Bmsy = mean recruitment when SSB > 75,000 mt = 68.9 million
times spawning biomass per animal at F = 0.263 = 3.63 kg
= 250 thousand metric tons

Index Methods

- Ingredients: Fishery Independent abundance index, total catch.
- Key question: Does an independent measure of relative abundance respond to the magnitude of removals?
  - "response" of index is expressed as ratio of current abundance to average of previous n years = Replacement ratio or pseudo finite rate of increase
  - "magnitude of removals" is expressed as catch divided by average index over m years
  - Write ln(Replacment Ratio) = a + b ln(relative F). Parameter a is ~finite rate of increase, b is ~q.
  - Nearly equivalent to Butterworth replacement yield
- Theme and Variations
  - Randomization tests used to identify strength of relationship
  - When time series are uninformative, expert judgment approaches applied
  - Example: Halibut→given MSY =300 mt, $F_{0.1}$=0.06➔Bmsy=5400 mt
  - Example 2: White hake combines Bmsy from Surplus production with relative F from AIM

Maximum Sustainable Yield Estimates: Total =192,275 mt.



Tasks for This Week

- Recommend a revised set of biological reference points
- Ensure consistency among estimation, reference point, and projection models
- Consider uncertainty of estimation: observation, process
- Implications of environment.