

An Evaluation of the Percentile Approach to Establish Sustainable Escapement Goals

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Overview

- Background
 - BEGs vs SEGs
 - Current Percentile Approach
- Methods
 - Three types of analysis
 - Compare Current Percentile Approach to S_{MSY} Range
- Results
- Recommendations

Background

- Sustainable Salmon and Escapement Goal Policies
 - BEG Range – Stock-Recruitment Data, MSY-based (S_{MSY})
 - SEG Range – Escapement Data, Sustainable Yields
- SEG ranges as proxies for S_{MSY}
 - Simple averages
 - Habitat models
 - Percentile Approach

BEGs

➤ Escapement and Recruit Data

- Harvest rate known
- Productivity and carrying capacity estimated
- Must be expressed as a range

➤ Maximum Sustained Yield

- Range must encompass S_{MSY}
- The range of escapements that produce a high level of MSY (e.g., at least 70-90%)

SEGs

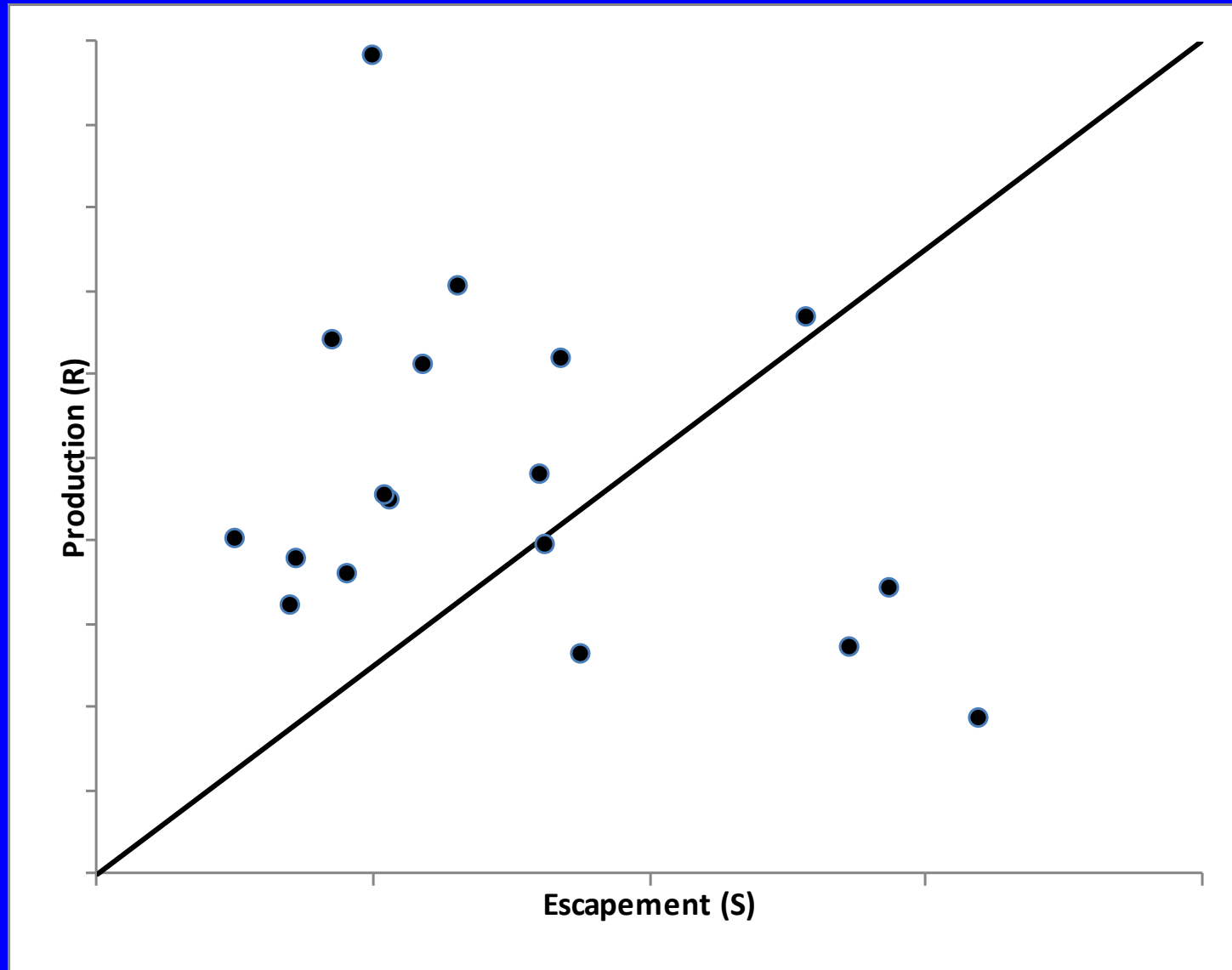
➤ Escapement Data Only

- No/Little harvest rate information
- No productivity information

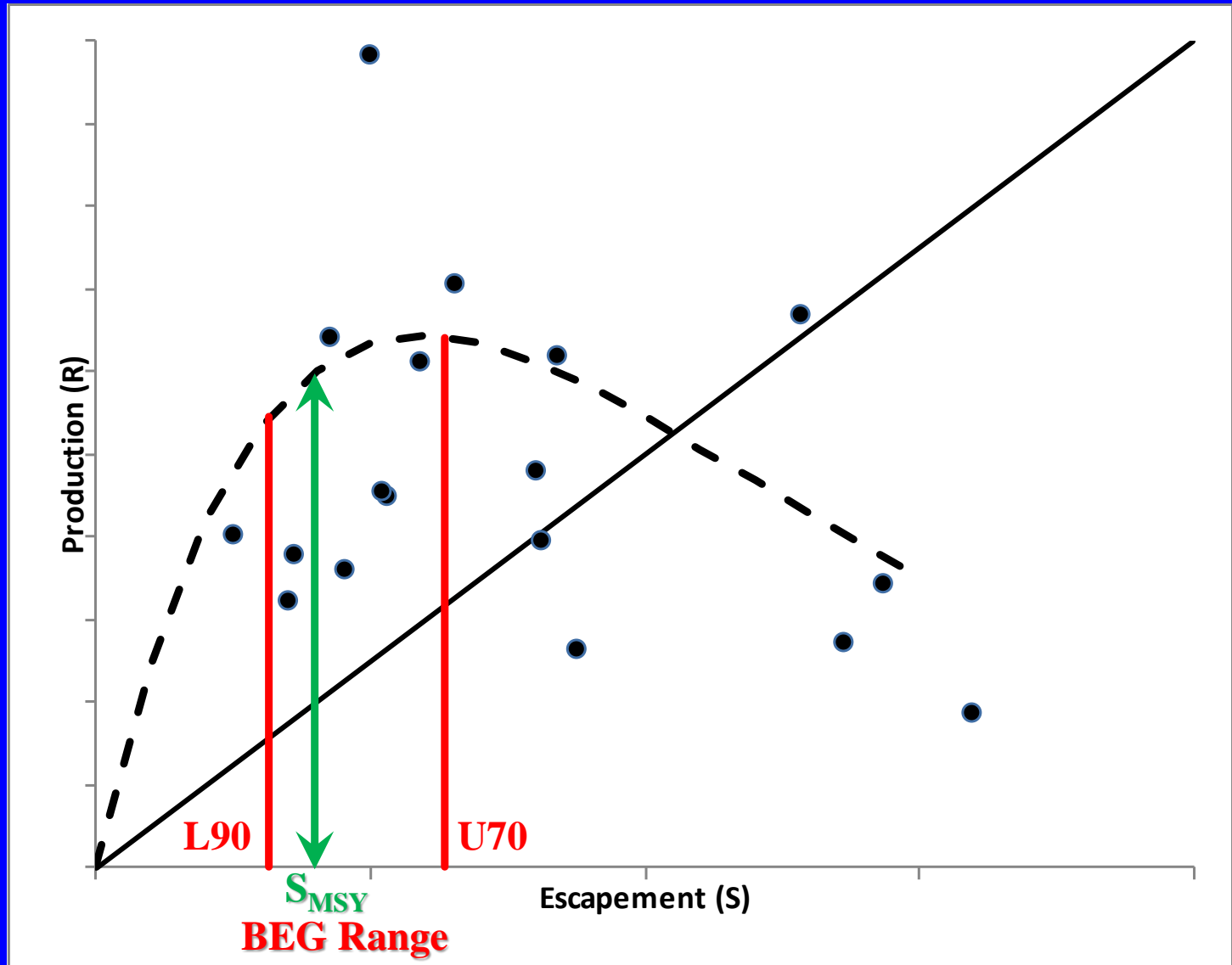
➤ Sustained Yield Assumed

- A range of observed escapements sufficient to sustain a range of observed harvests
- While not mandated, a proxy for S_{MSY} is preferred

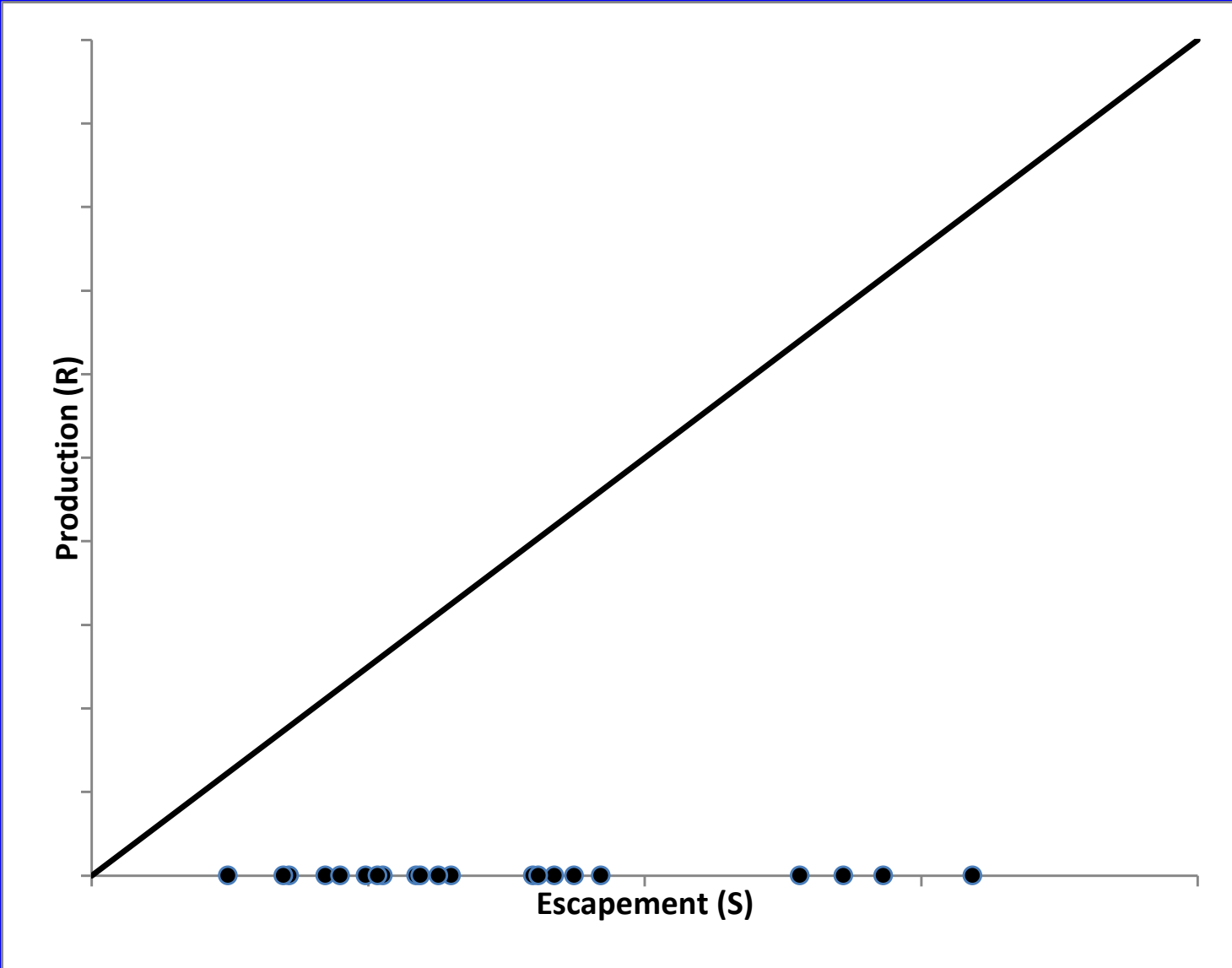
BEGs vs SEGs



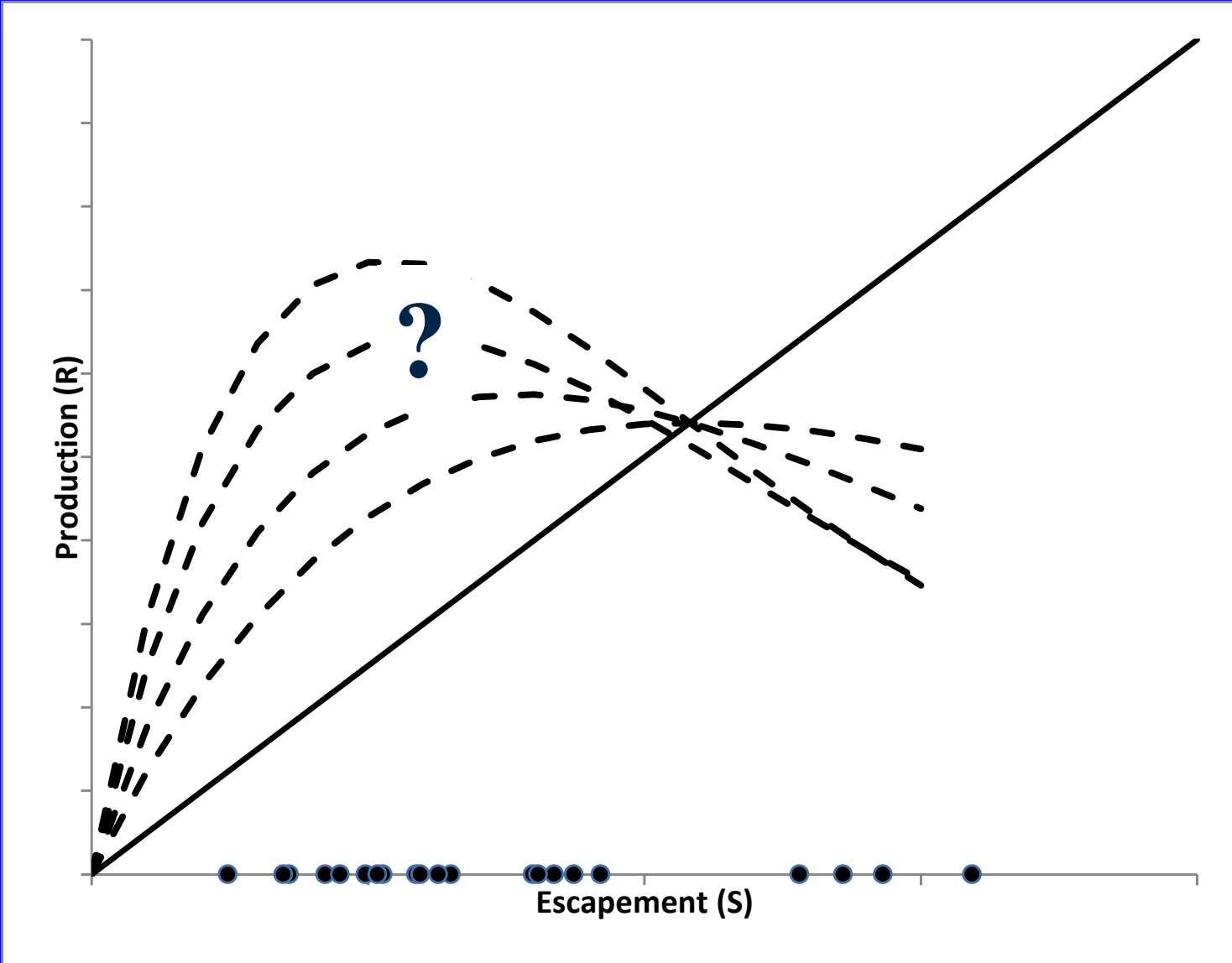
BEGs vs SEGs



BEGs vs SEGs



BEGs vs SEGs



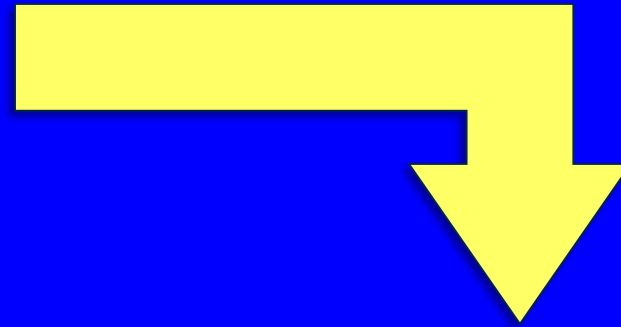
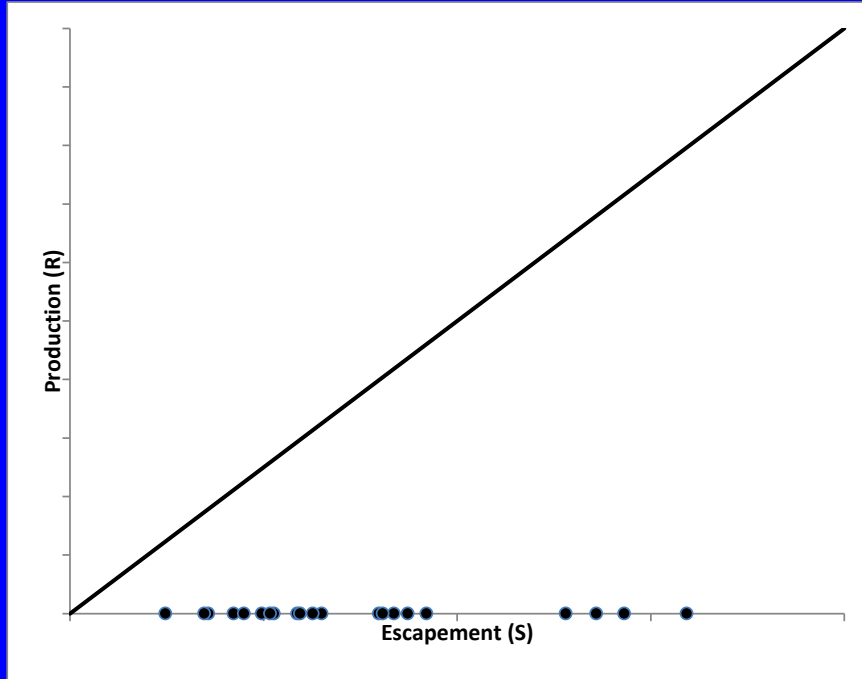
Percentile Approach (2001) – 4 Tiers

Tier. Contrast & Harvest Rate	Percentile Range
1. High contrast (>8), at least moderate harvest rate	25 th to 75 th
2. High contrast (>8), at most low harvest rate	15 th to 75 th
3. Medium contrast (4-8)	15 th to 85 th
4. Low contrast (<4)	15 th to Max

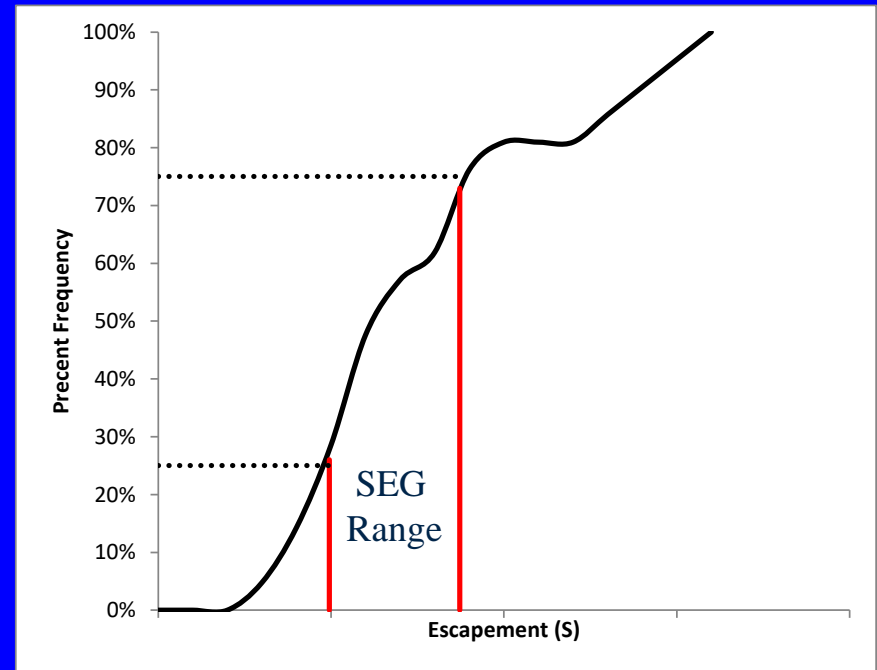
A simple non-parametric approach based on the cumulative percentiles of observed escapements. Higher contrast, higher harvest rate stocks have narrower goal ranges and lower contrast stocks have wider goal ranges.

Contrast = maximum divided by minimum observed escapements

Percentile Approach (2001) – 4 Tiers



Example: Given the time series of escapements above, the SEG range (25th to 75th percentiles; Tier 1) can be plotted on the cumulative frequency graph to the right.



Percentile Approach (2001) – 4 Tiers

- Is the approach scientifically defensible?
 - Does the approach have a basis in production theory?
 - Are the tiers reasonable proxies for S_{MSY} ?
 - Are the tiers robust to:
 - A wide range of productivities
 - A wide range of harvest rates
 - Serial correlation in production
 - Measurement error in escapements (counts vs. surveys)
 - Length of the time series of escapements

Methods of Evaluation

- Theoretical Analysis
 - Compare 4-tier percentile ranges with those predicted from S-R theory
- Simulation Analysis
 - Compare 4-percentile ranges with those from a closed-loop simulation of Spawner to Recruit and Recruit to Spawner processes
- Empirical Meta-Analysis
 - Compare 4-tier percentile ranges with those from empirical S-R analyses of 66 stocks from throughout Alaska

Results of Evaluations

- All analyses indicate 4 percentile ranges may not be optimal
- Range is sensitive to contrast and measurement error
- Lower bound < 25th percentile, Upper bound < 75th percentile

Example: Low Measurement Error

Contrast	Theoretical	Simulation	Meta-analysis	4-Tier Approach
High (>8)	10 th to 74 th	15 th to 65 th	20 th to 55 th	25 th to 75 th
Low (≤8)	2 nd to 42 nd	5 th to 70 th	Min to 45 th	15 th to 85 th

Recommendations (2014)

- Replace 4 percentile ranges with 3 ranges (tiers)

Tier. Contrast & Measurement Error	Percentile Range
1. High contrast (>8), high measurement error	20 th to 60 th
2. High contrast (>8), low measurement error	15 th to 65 th
3. Low contrast (≤ 8)	5 th to 65 th

- For harvest rates <40% only
- Sensitive to productivity once harvest rate exceeds 40%
- Not recommended for stocks w/ low contrast & high measurement error
- Not replacement for stock-recruit analysis, especially for stocks with high harvest rate
- Generally 3 percentile range recommendation agrees or more conservative (higher goal range)

2016 LCI chum salmon EG review

System	2001 SEG	2016 SEG	% Change Lower	% Change Upper
Port Graham River	1,450-4,800	1,200-2,700	-17%	-44%
Dogfish Lagoon	3,350-9,150	3,500-8,600	4%	-6%
Rocky River	1,200-5,400	1,500-4,400	25%	-19%
Port Dick Creek	1,900-4,450	1,900-4,300	0%	-3%
Island Creek	6,400-15,600	5,100-11,900	-20%	-24%
Big Kamishak River	9,350-24,000	6,800-15,600	-27%	-35%
Little Kamishak River	6,550-23,800	8,000-16,800	22%	-29%
Bruin River	6,000-10,250	5,200-10,000	-13%	-2%
Ursus Cove	6,050-9,850	5,900-10,100	-2%	3%
Cottonwood Creek	5,750-12,000	5,200-12,200	-10%	2%
Iniskin Bay	7,850-13,700	5,900-13,600	-25%	-1%

All stocks

- Contrast: High, > 8 (10-350)
- Measurement Error: High (aerial or foot surveys)
- Harvest Rate: Low to moderate, < 40% (11%-34%)

References

- Clark, R.A., D.M. Eggers, A.R. Munro, S.J. Fleischman, B.G. Bue, and J.J. Hasbrouck. 2014. An evaluation of the percentile approach for establishing Sustainable Escapement Goals *in lieu* of stock productivity information. Alaska Department of Fish and Game, Fishery Manuscript No. 14-06, Anchorage.
<http://www.adfg.alaska.gov/FedAidPDFs/FMS14-06.pdf>
- Clark, R.A., D.M. Eggers, A.R. Munro, S.J. Fleischman, B.G. Bue, and J.J. Hasbrouck. 2017. An evaluation of the percentile approach for establishing Sustainable Escapement Goals *in lieu* of stock productivity information. [In] Proceedings of an International Symposium on Tools and Strategies for Assessment and Management of Data-Limited Fish Stocks, Alaska Sea Grant College Program.

Questions?

