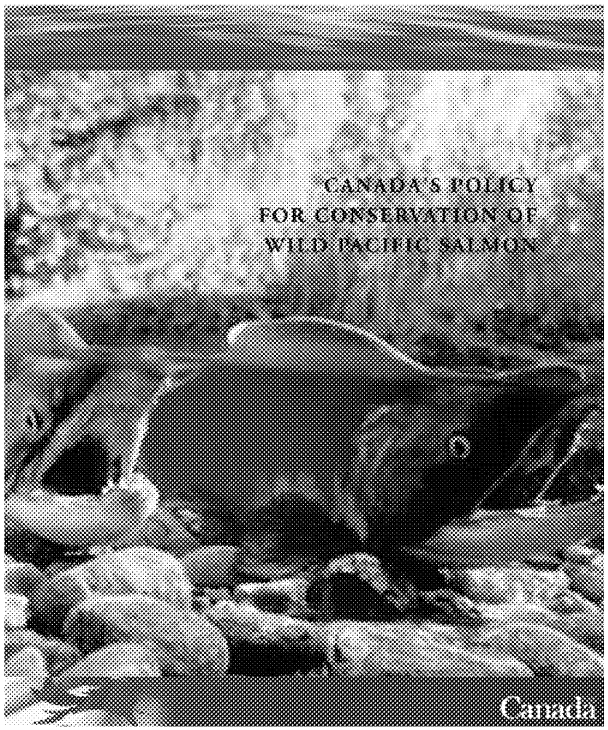


Assessing status and identifying benchmarks of Conservation Units for the Wild Salmon Policy

Carrie Holt
Research Scientist
Pacific Biological Station

Outline

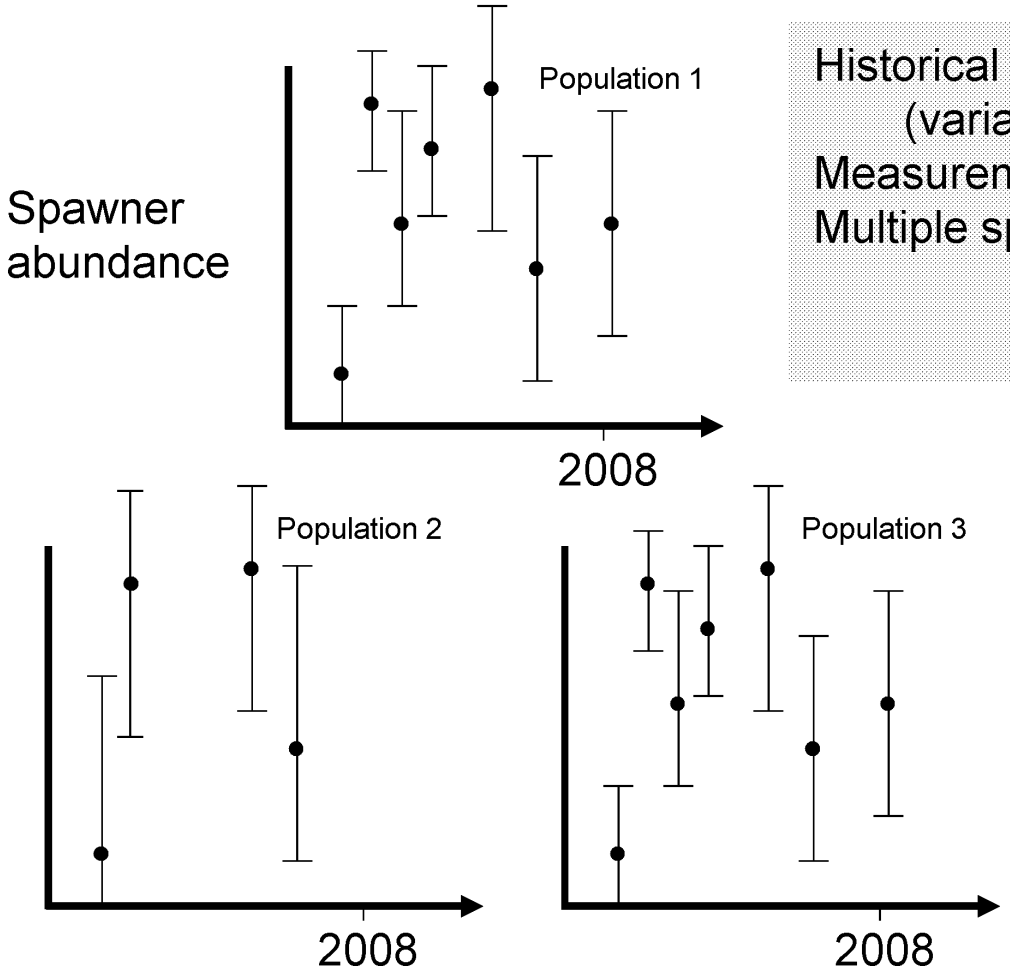
1. Introduction: Goal and Complexities
2. Classes of indicators
3. Candidate benchmarks
4. Methodology for evaluating lower benchmarks
5. Indicators of distribution
6. Application of indicators and benchmarks to one example CU
7. Next steps

Goal

"Develop criteria to assess CUs and identify benchmarks to represents biological status. The biological status of a CU will normally be based on the abundance and distribution of spawners in the unit, or proxies thereof."

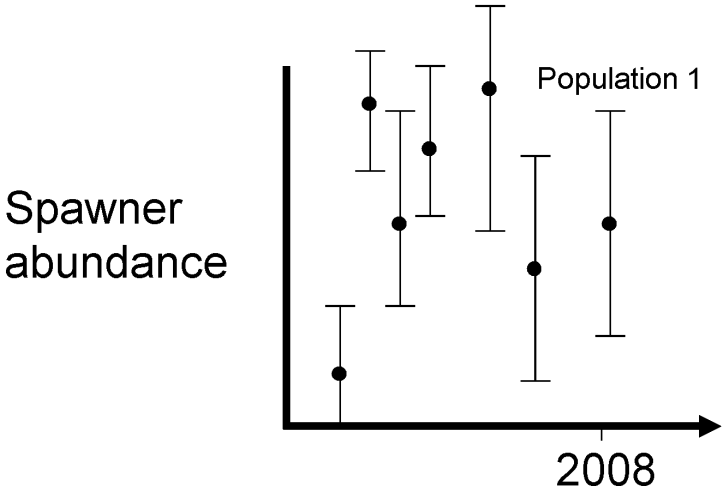
~Wild Salmon Policy
(Strategy 1)

Assessing status: Complexities

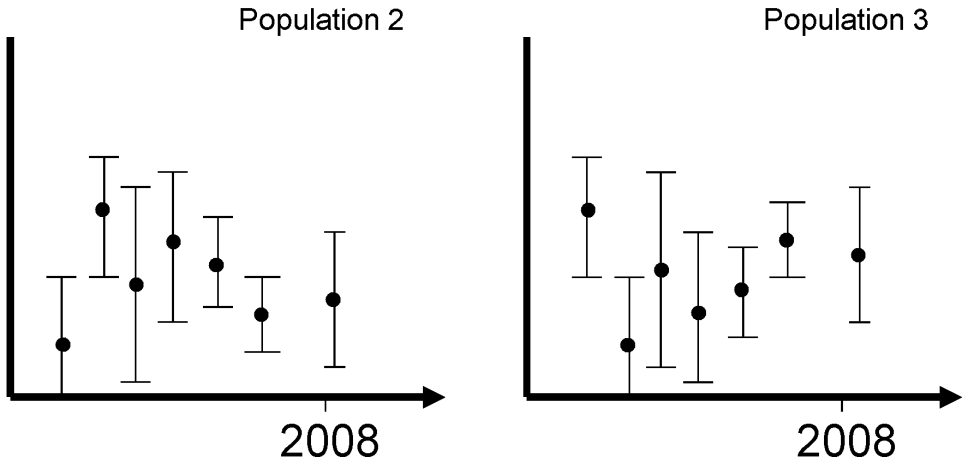


Historical context
(variability, trends, capacity)
Measurement errors
Multiple spawning groups in a CU

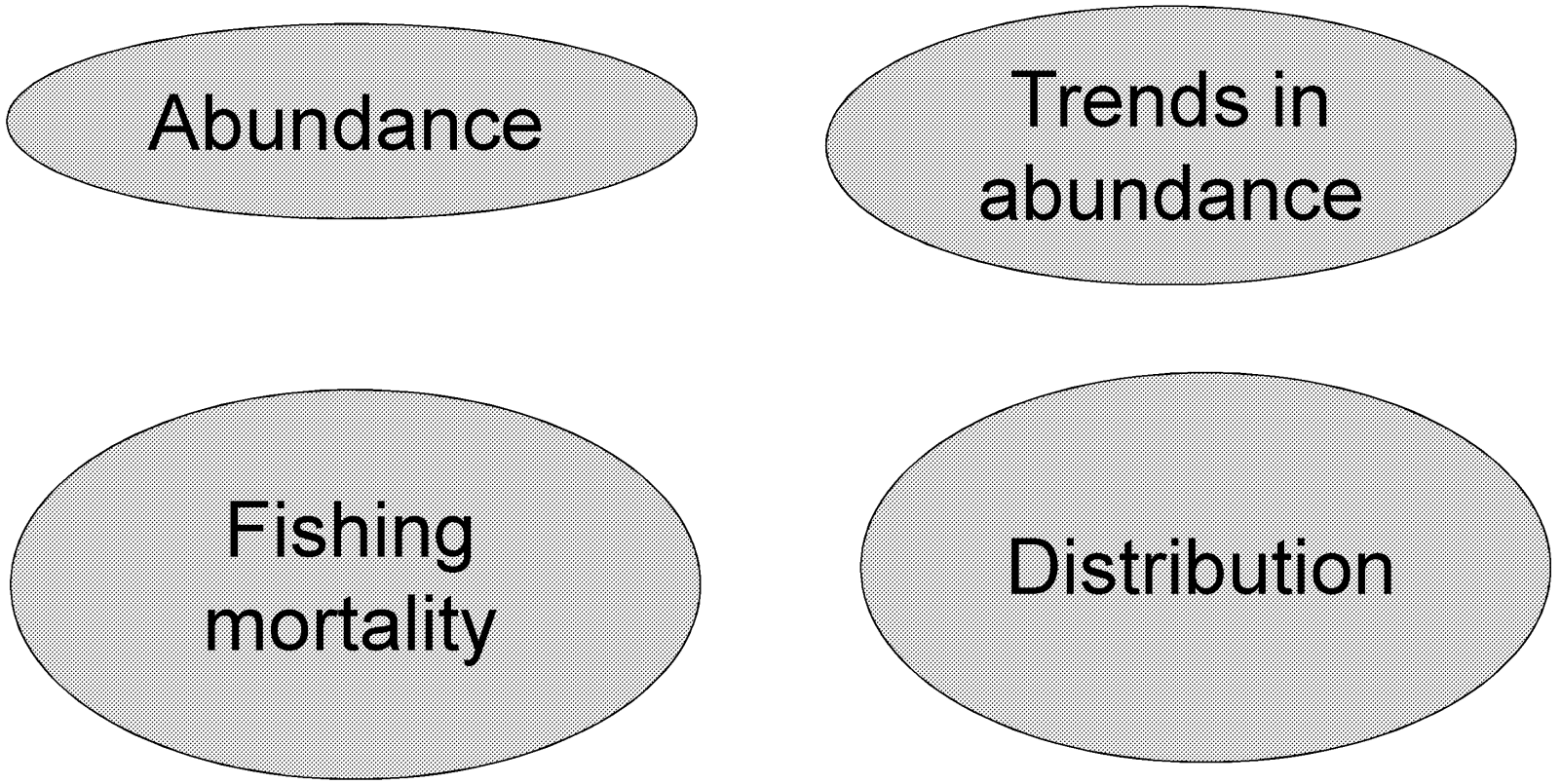
Assessing status: Complexities



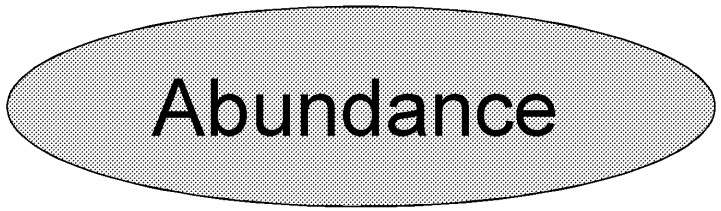
Historical context
(variability, trends, capacity)
Measurement errors
Multiple spawning groups in a CU
Distribution of spawners across populations



Assessing status

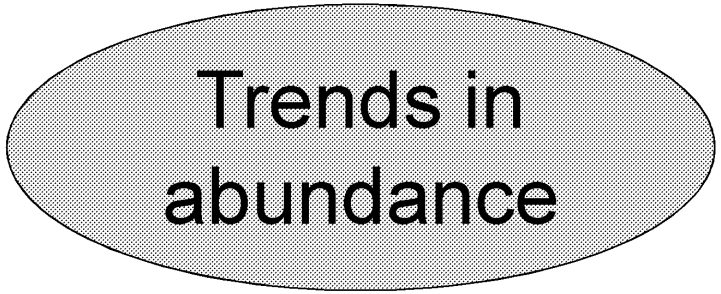


Assessing status



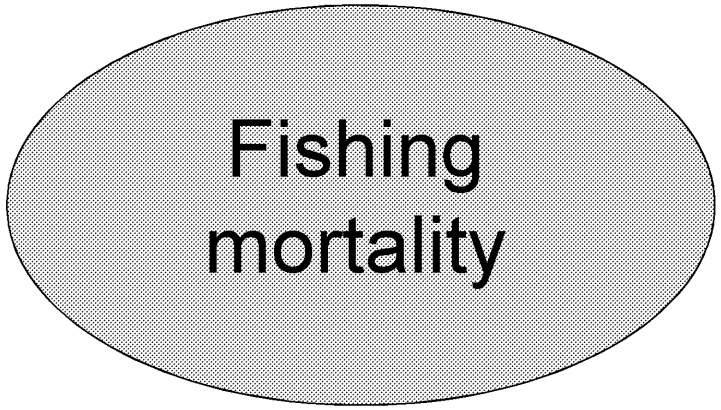
Low abundance greater risks of extirpation due to depensatory mortality, environmental variation, genetic processes, ecological interactions, demographic stochasticity

Assessing status



Declines may warrant management attention despite abundances not at levels of concern

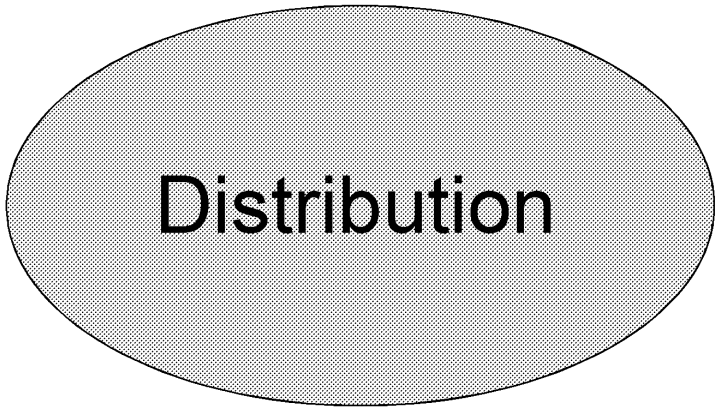
Assessing status



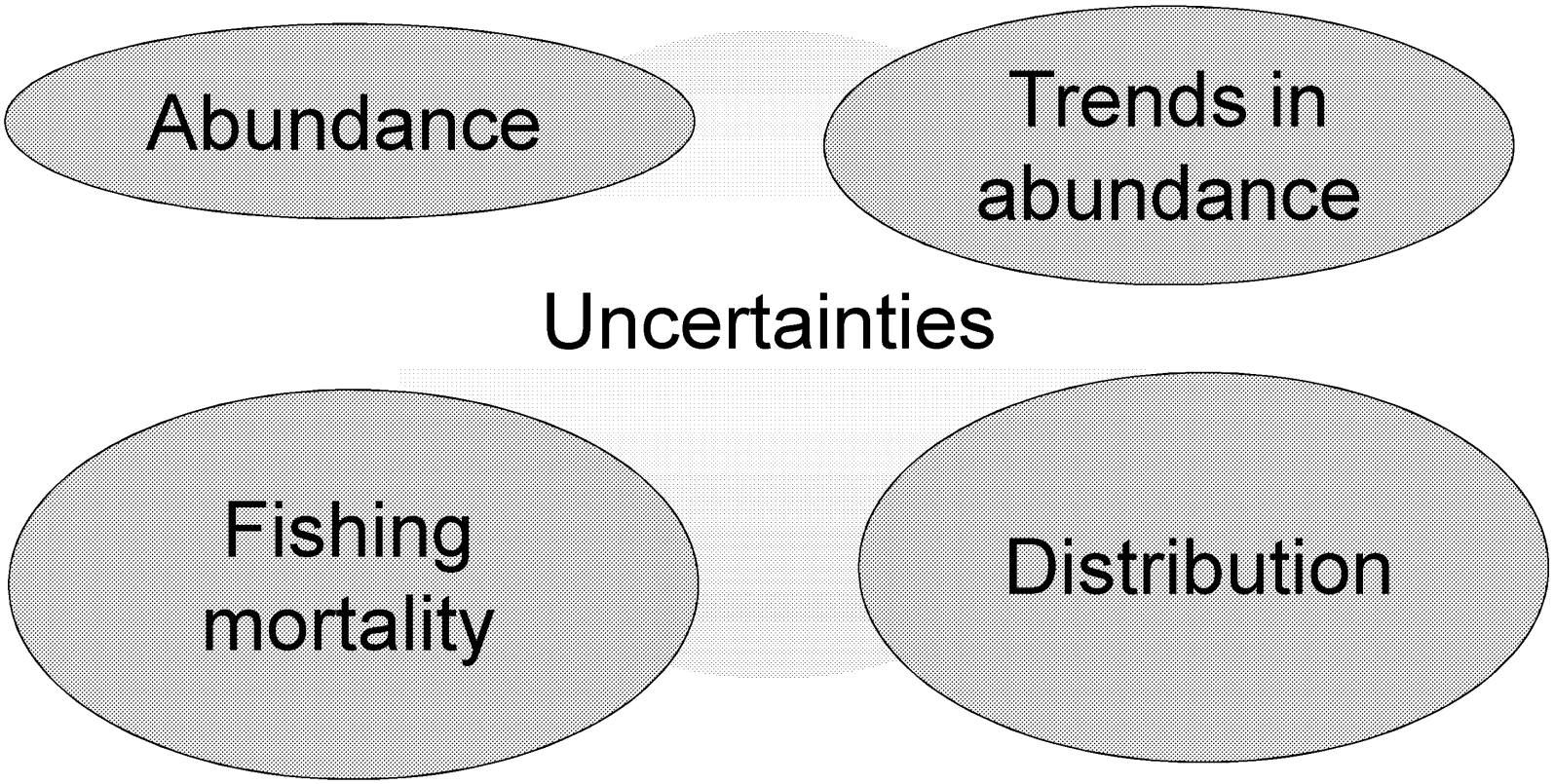
Fishing mortality relative to stock productivity reflects the ability of a CU to sustain that fishing pressure

Assessing status

Distribution may be related to the diversity of habitats and life-history characteristics, and hence responses to changes in environmental conditions

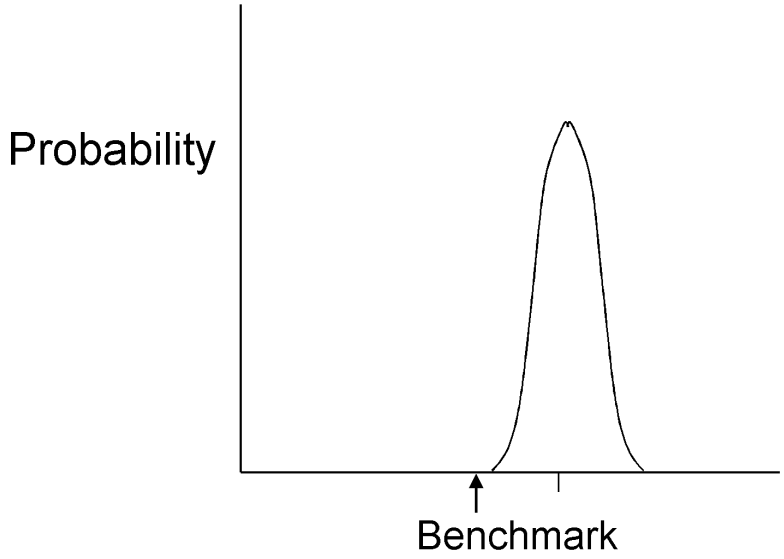


Assessing status



Risk

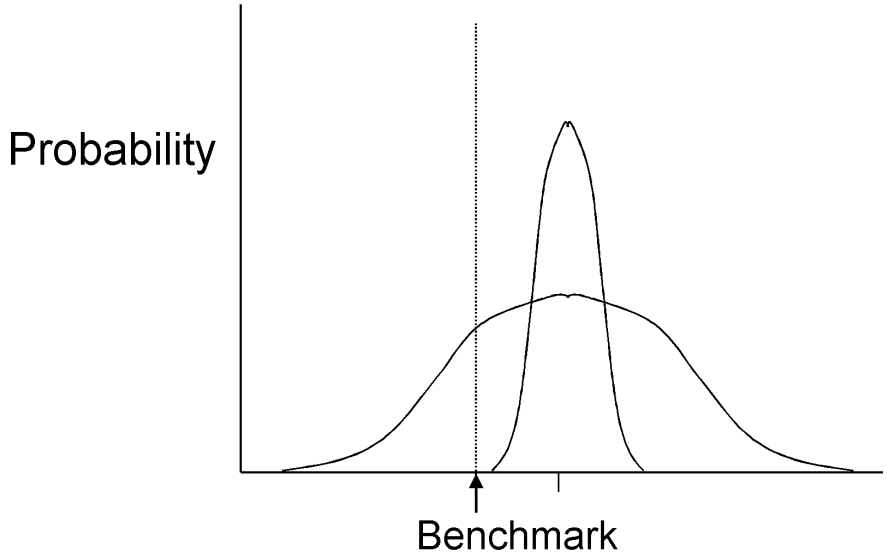
Risk ~ consequences + probability of occurrence



~100% certain that spawner abundances > benchmark

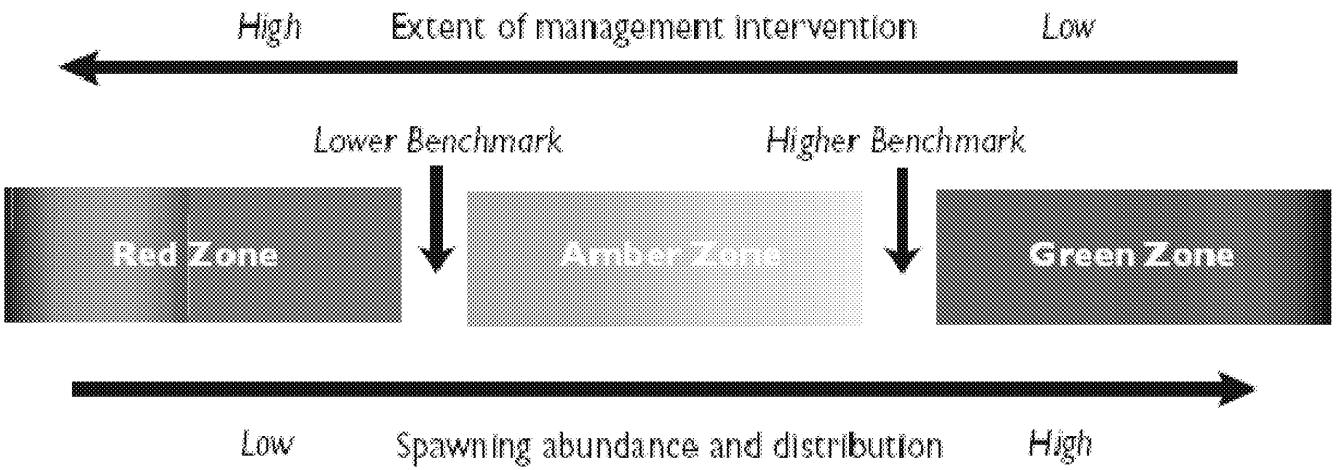
Risk

Risk ~ consequences + probability of occurrence

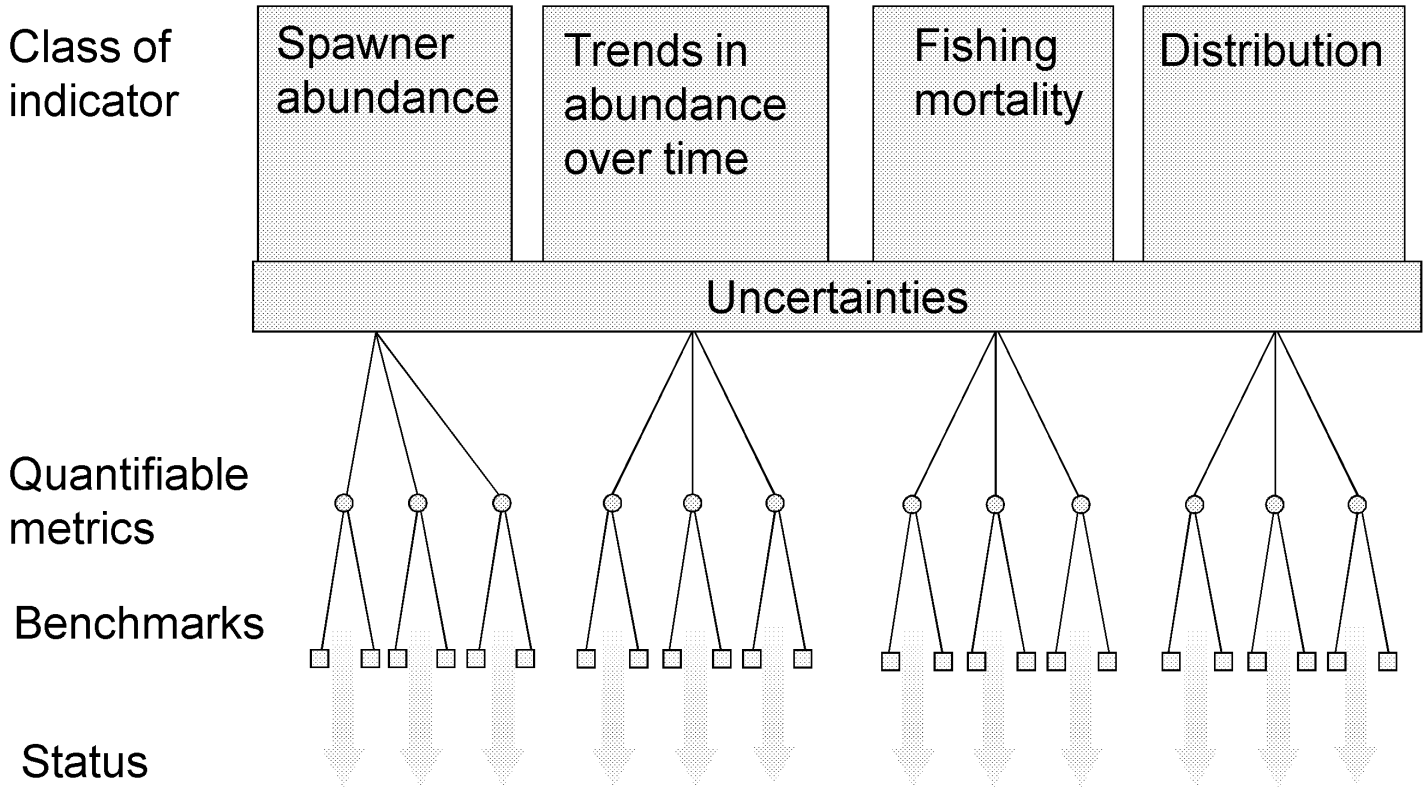


65% certain that spawner abundances > benchmark

Assessing status



Assessing status



Assessing status: Data requirements

Minimum data required	**Metrics of status (examples)**				
	S relative to *SRR*	*S* relative to capacity	Trends in *S*	Fishing mortality relative to productivity	Distribution of *S* across spawning groups
Current *S*	**x**	**x**			
Time series of *S* (absolute)	**x**				
Time series of *S* (relative)			**x**		
Carrying capacity		**x**			
Time series of recruitment	**x**				
Current *F*				**x**	
Estimate of productivity				**x**	
Current *S* by spawning group					**x**

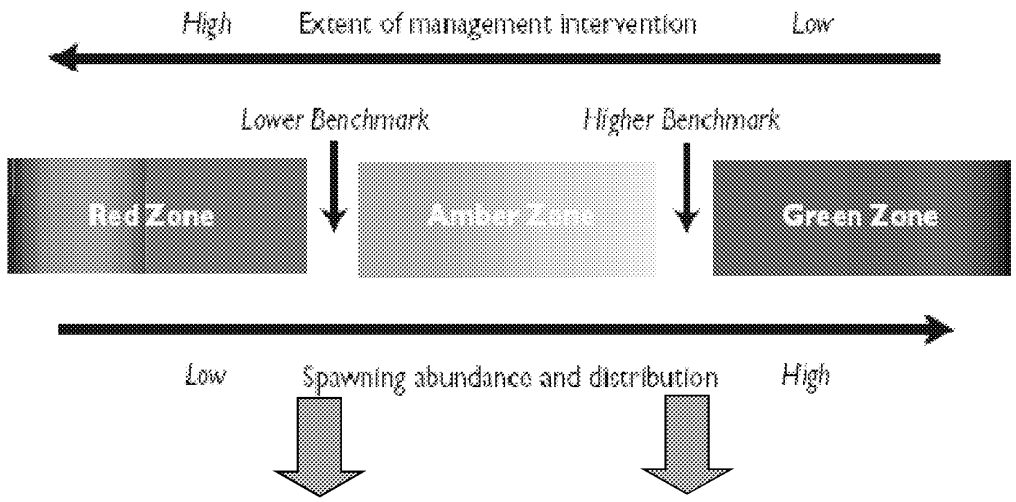
Benchmarks

Spawners

Metric: average spawning abundance of most recent generation

Lower benchmark	Upper benchmark
S at 50% of *MSY*	S_{MSY}
40% of S_{MSY} (DFO Fisheries Sustainability Framework)	80% of S_{MSY} (DFO Fisheries Sustainability Framework)
S at 50% of max *R* (Myers et al. 1994)	50% of carrying capacity
S resulting in recovery to S_{MSY} in one generation (Johnston et al. 2002)	90th percentile of S_{MSY}
10% of carrying capacity	
90th percentile of *S* at 50% of *MSY*	

Benchmarks



Little theoretical basis
and historical experience

Strong theoretical basis
Historical experience

How precautionary are candidate lower benchmarks?

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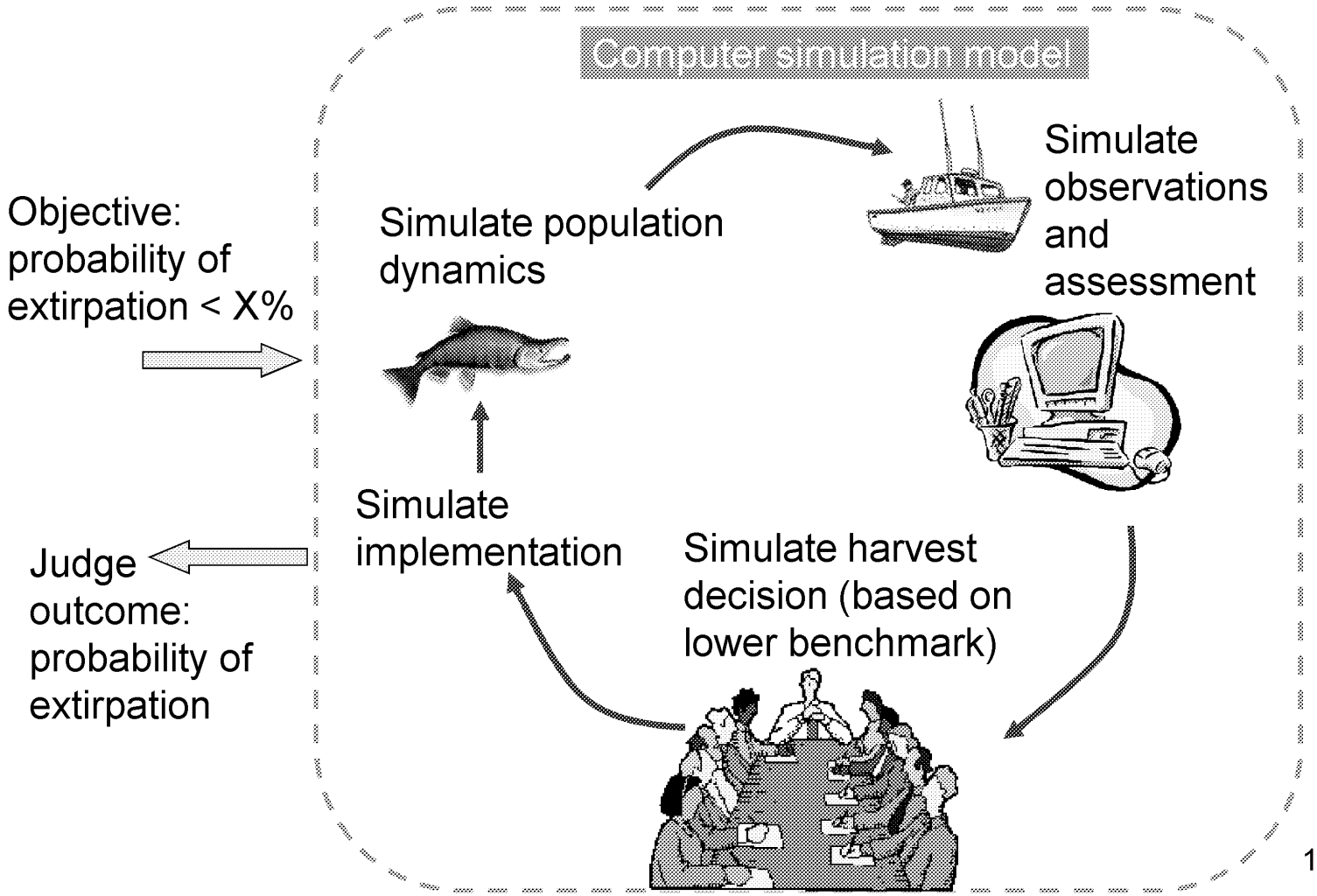
Benchmarks



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Benchmarks

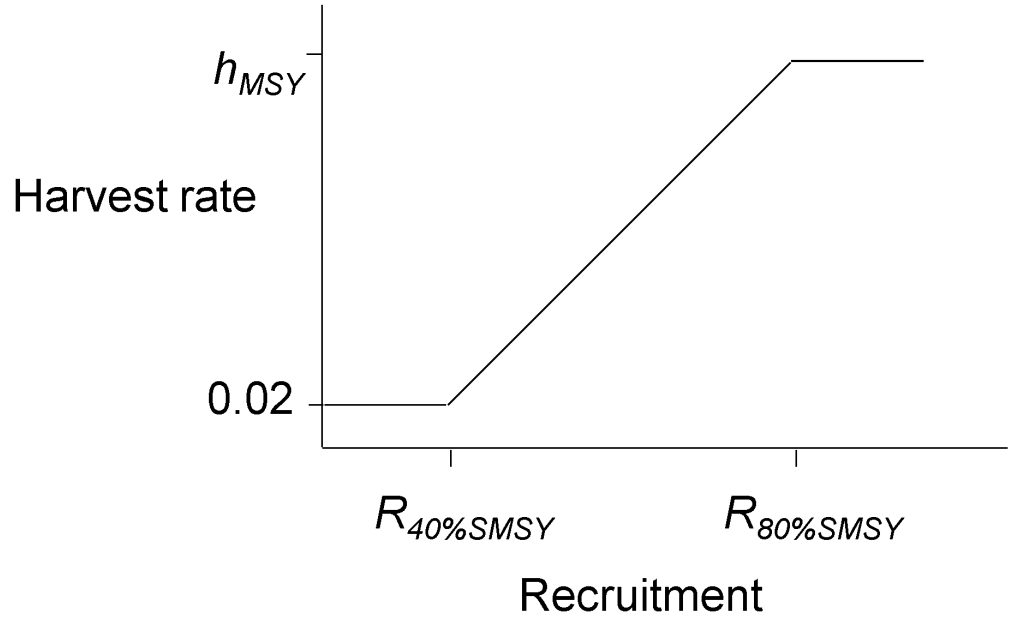
Spawners

Metric: average spawning abundance of most recent generation

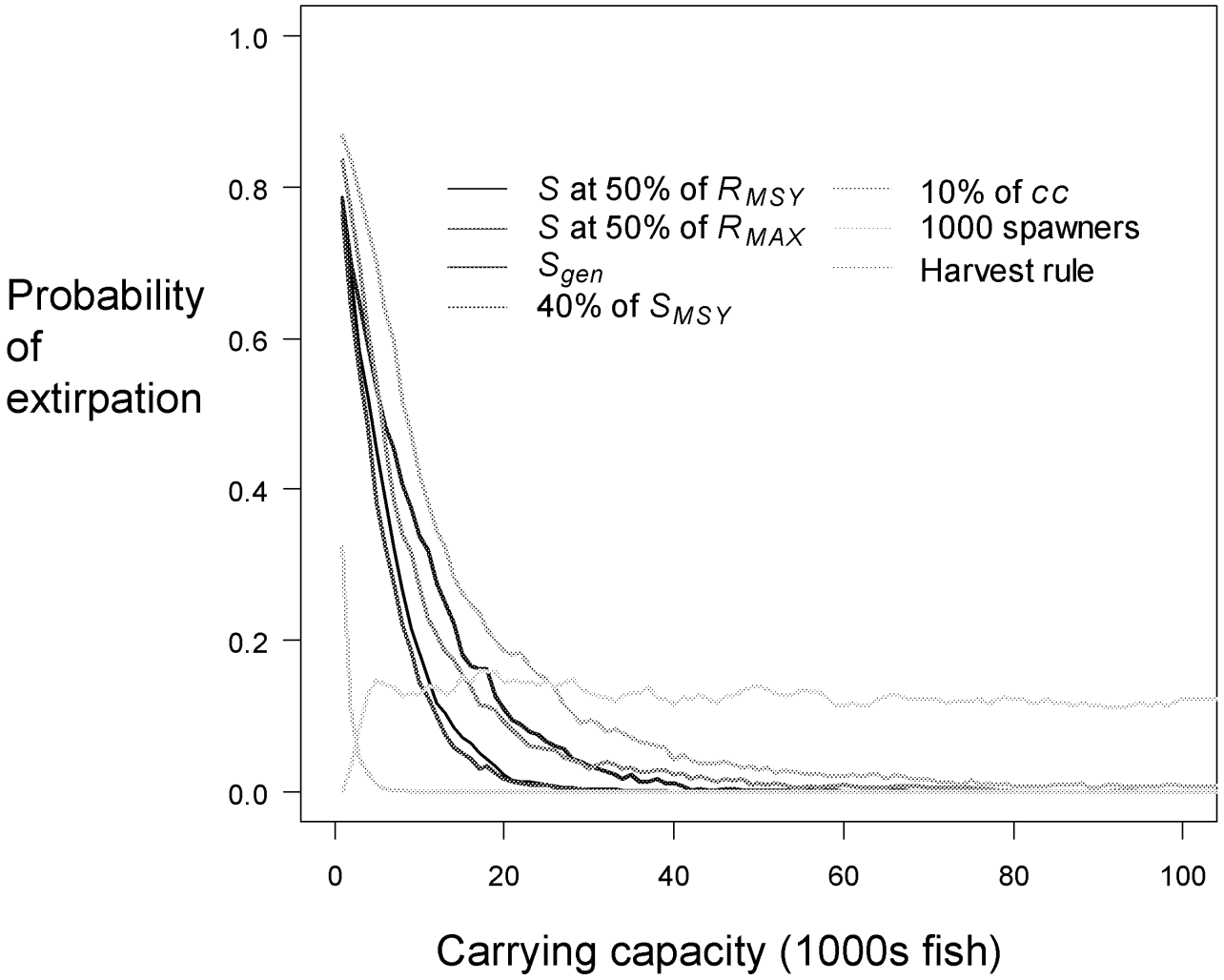
Lower benchmark
S at 50% of *MSY*
40% of S_{MSY} (DFO Fisheries Sustainability Framework)
S at 50% of max *R* (Myers et al. 1994)
S resulting in recovery to S_{MSY} in one generation (Johnston et al. 2002)
10% of carrying capacity
90th percentile of *S* at 50% of *MSY*

Benchmarks

Harvest rule (DFO Fisheries Sustainability Framework)



Simulation results



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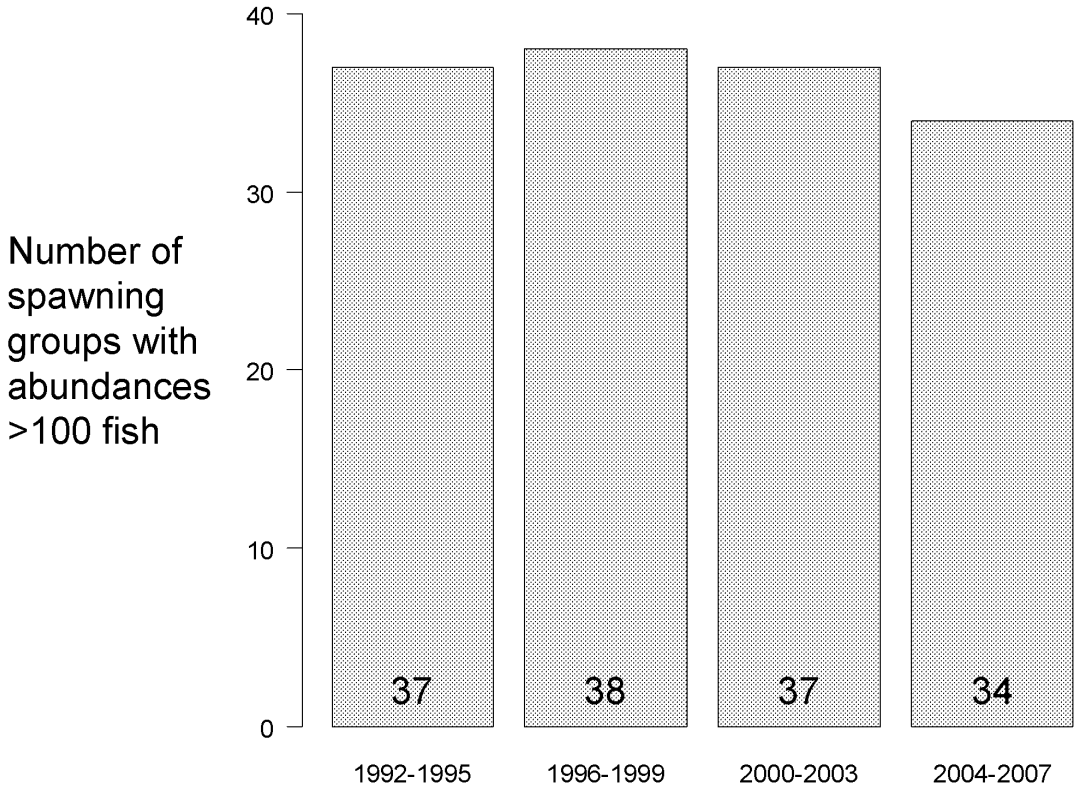
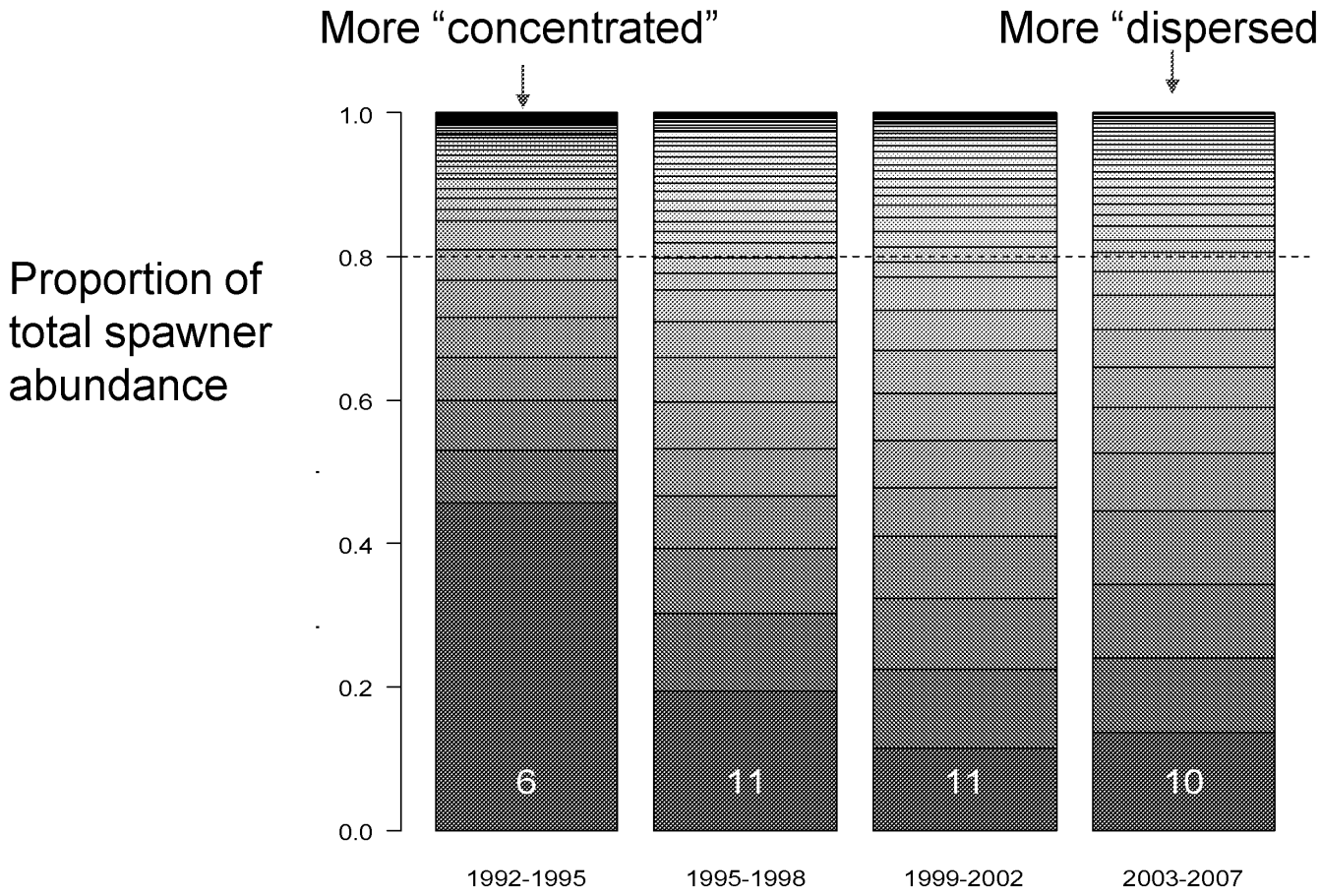
Metrics of Distribution

(1) Number of spawning groups



Metrics of Distribution

(2) Number of spawning groups that make up 80% of the total *S*



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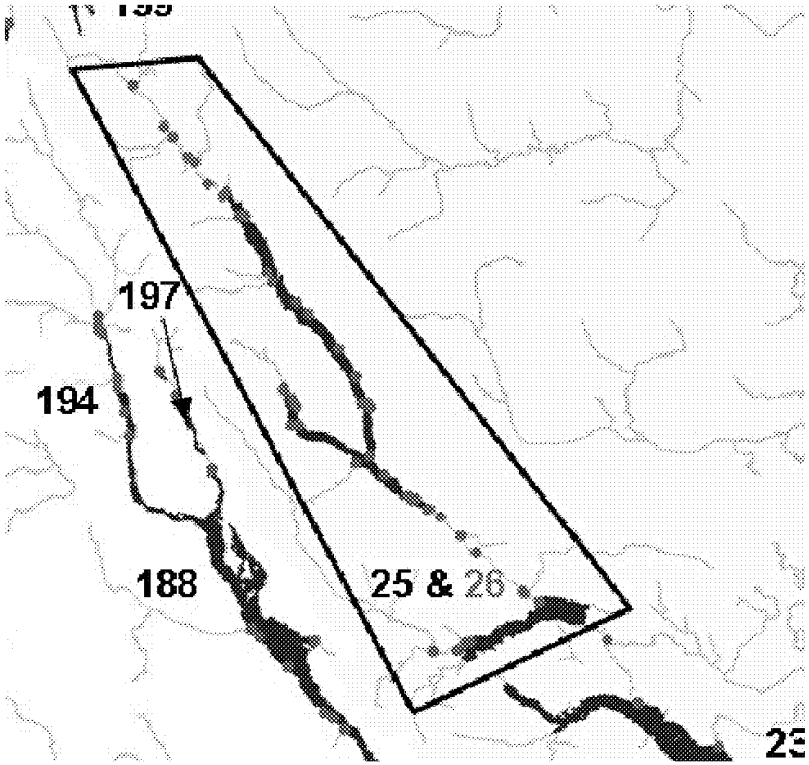
Metrics of Distribution

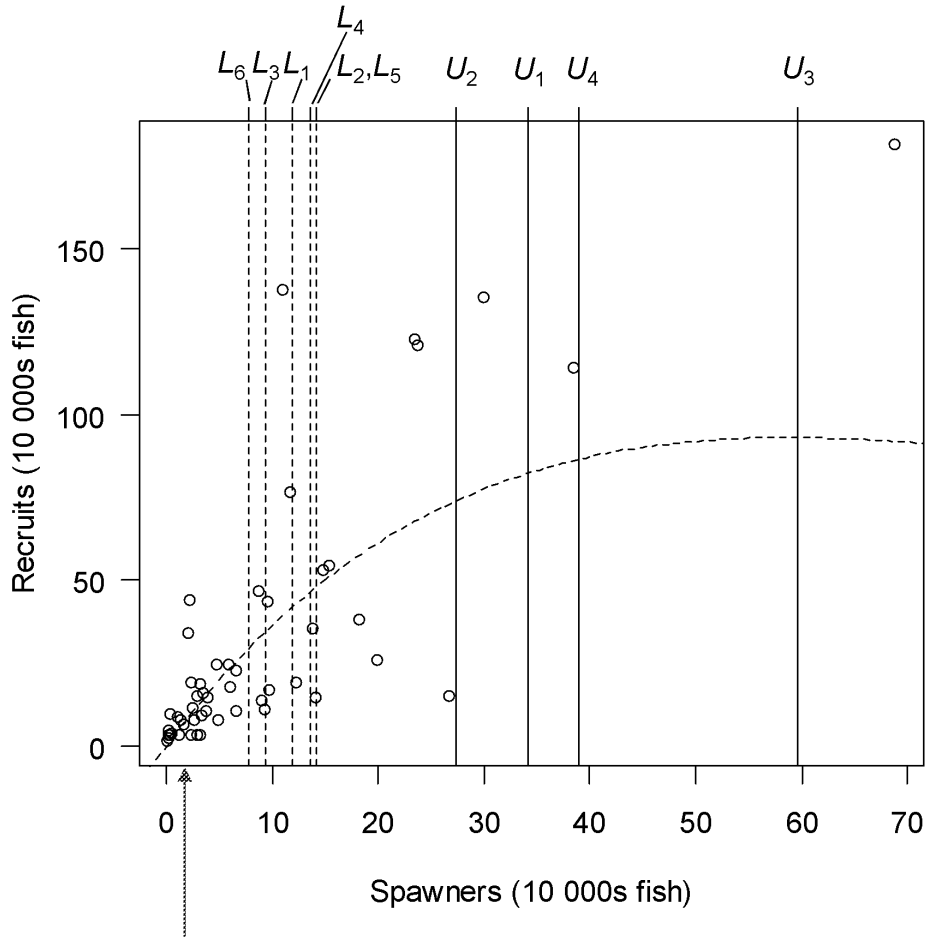
- Distribution of trends over time
- Distribution among habitat types
- Spatial structure (risk of catastrophe)

Example

Takla/Trembleur CU for sockeye salmon



Takla / Trembleur Sockeye CU



Current generational mean

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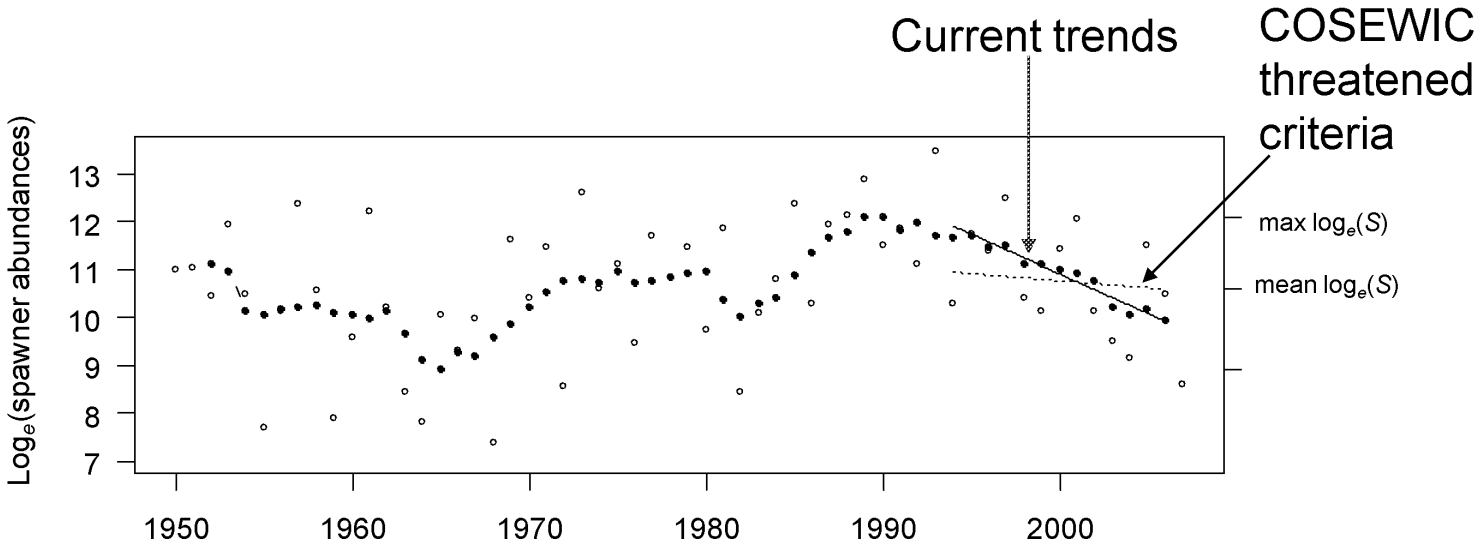
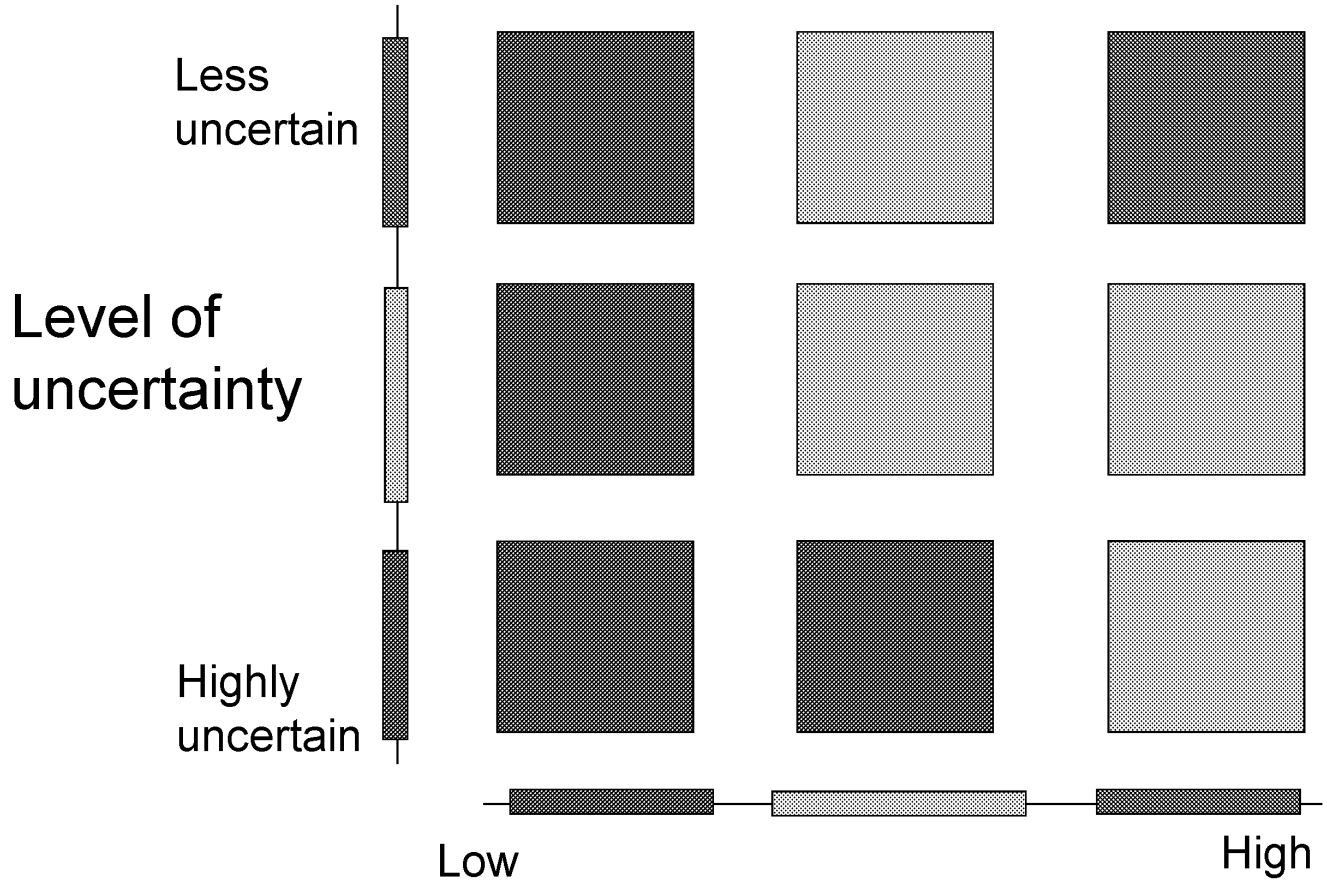
Takla/Trembleur Sockeye CU



Takla/Trembleur Sockeye CU

S relative to *MSY* and *S* at 50% of *MSY*
S relative to 80% and 40% of S_{MSY}
S relative to 50% of maximum recruitment
S relative to S_{gen}
S relative to 90th percentiles of *MSY* and *S* at 50% of *MSY*
S relative to 50% and 10% of carrying capacity
Recent linear trends in *S* relative to COSEWIC "threatened" criteria
S relative to historical mean
S relative to highest generational mean
F relative to slope at origin of stock-recruit relationship and F_{MSY}
F relative to median recruits/spawner and F_{MSY}
Distribution of *S* among spawning groups
Uncertainty in *S* and *R* data

Assessment Framework



Next steps

- PSARC workshop on candidate indicators, metrics, and benchmarks, and methodology to evaluate benchmarks (January 2009)
- Dialogue with Area Managers about candidate indicators, metrics, and benchmarks (Fall 2009)
- Identify appropriate buffer for lower benchmarks
  - What level of precaution is appropriate?
  - Determine by when? (recommend in Nov.)
- Develop stock assessment framework to combine information from all metrics
- Compile data for all CUs to assess status
- Provide Areas with tools and data to identify benchmarks and assess status of individual CUs

Discussion Points

- Benchmarks are consistent with DFO's Fisheries Sustainability Framework
- Need to incorporate the effects of enhancement on status of wild stocks into assessment processes (internal discussion paper in preparation)
- Engage stakeholders and consider socio-economic factors to identify lower benchmarks
- Identify priority CUs for early determination of benchmarks (e.g., Fraser and Skeena sockeye, others?)

Appendix

Benchmarks

Trends in spawner abundances

Metrics: slope of linear change; current *S* compared to historical levels

Lower benchmark	Upper benchmark
•Slope of change in smoothed, log-transformed *S* over most recent 3 generations or 10 years, *m*, equal to criteria for COSEWIC "threatened" listing •Probability that *m* < criteria for COSEWIC "threatened" criteria = 0.1 •Ratio of geometric mean *S* of current generation to historical mean equal to 0.25 (Pestal and Cass 2007) •Ratio of geometric mean spawner abundance of current generation to the highest generational geometric mean on record equal to 0.25 (Pestal and Cass 2007)	•Slope of change in *S* , *m*, equal to a fraction (e.g., 2/3) of criteria for COSEWIC "threatened" listing •Probability that *m* < a fraction of the criteria for COSEWIC "threatened" criteria = 0.1 •Ratio of geometric mean *S* of current generation to historical mean equal to 0.5 (Pestal and Cass 2007) •Ratio of geometric mean spawner abundance of current generation to the highest generational geometric mean on record equal to 0.5 (Pestal and Cass 2007)

Benchmarks

Fishing mortality

Metric: mean fishing mortality over most recent generation

Lower benchmark	Upper benchmark
•F_{MAX} (slope at origin of stock-recruitment relationship) (Mace and Sissenwine 1993)	•F_{MSY} (e.g., Kadowaki et al. 1994.)
•F_{MED} (median recruits/spawner) (Sissenwine and Shepherd 1987)	•10th percentile of F_{MSY}
•F_{MAX2}; slope at origin of smolt-recruit relationship (Bradford et al. 2000)	