Overview of Escapement Goal Policy and Processes

A Presentation to the Alaska Board of Fisheries
October 19, 2017

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and
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Division of Sport Fish
Roadmap for Presentation

- Review policy framework and processes for escapement goals in Alaska
- Overview of current escapement goal types by region and species
- Concepts and theory of salmon production
- Why and how do escapement goals change?
- How does declining productivity affect escapement goals?
- Why hasn’t ADF&G used SETs?
Providing for Sustained Yield

Constitution:
Article VIII, Sec(4). Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the State shall be utilized, developed, and maintained on the sustained yield principle, subject to preferences among beneficial uses.

Statute:
AS 16.05.020(2). The commissioner (of the Department of Fish and Game) shall manage, protect, maintain, improve and extend the fish, game and aquatic plant resources of the state in the interest of the economy and general well-being of the state.
Providing for Sustained Yield

Policies and regulations

- Policy for management of mixed stock fisheries, 5 AAC 39.220
- Policy for the management of sustainable salmon fisheries, 5 AAC 39.222
- Policy for statewide salmon escapement goals, 5 AAC 39.223
- Salmon Management Plans
Escapement Goal Policy

(b) Department responsibilities:

1. Document salmon escapement goals

2-5. Establish BEG’s, SEG’s and SET’s for salmon stocks or population aggregates

6. Review goals on the Board of Fisheries cycle

7. Prepare scientific analyses for goals

8. Notify public when goals are established or modified

9. Report allocative impacts of goals to the Board of Fisheries
(c) The Board of Fisheries responsibilities:

(1) Take regulatory action to address allocative issues

(2) Review goals and consider establishing Optimal Escapement Goals or in-river run goals.
Sustainable Salmon Fisheries Policy

(c) (2) Fisheries managed for escapement necessary to conserve and sustain salmon production

(A) Escapement monitoring appropriate to scale, intensity and importance of stock

(B) Goals established in a manner consistent with sustained yield; to the extent possible, fisheries managed for maximum sustained yield

(C) Goal ranges to consider uncertainty and environmental variability

(D) Escapement managed to maintain genetic and phenotypic characteristics

(F) Escapement and management decisions should protect non-target stocks

(G) Ecosystem function considered in escapement goal setting
Definition of Terms

- Stock, escapement, run, return, yield
- Sustained yield, maximum sustained yield, and optimum sustained yield
- Stock of concern
Types of Escapement Goals

- Biological Escapement Goal (BEG)
- Sustainable Escapement Goal (SEG)
- Optimal Escapement Goal (OEG)
- Sustained Escapement Threshold (SET)
Biological Escapement Goal (BEG)

- Determined by the Department
- Escapement with greatest potential for **maximum sustained yield** (MSY)
- Based on best available biological information
- Scientifically defensible
- Always a range
- Department will maintain evenly distributed escapements within the bounds
Sustainable Escapement Goal (SEG)

- Determined by the Department
- Escapement known to provide for sustained yields over a five to ten year period
- Used where a BEG cannot be estimated
- Based on best available biological information
- Scientifically defensible
- Can be a range or a bound
- Department will maintain escapements within the bounds of a range or above a lower bound
Optimal Escapement Goal (OEG)

- Set in regulation by the Board of Fisheries
- Considers biological and allocative factors
- Can differ from BEG or SEG, but must be sustainable
- May be expressed as a range
- Department will maintain evenly distributed escapements within the bounds of the range
Sustainable Escapement Threshold (SET)

- Established as needed by the Department in consultation with the Board of Fisheries
- Escapement level, below which sustainability is jeopardized
- Lower than the lower bound of BEG or SEG
- Can be based on lower levels of escapement that consistently sustain themselves
ADF&G Escapement Goal Development Process

Regional Escapement Goal Review Team

- Create work assignments
- Review regional/area escapement goals
- Draft stock escapement goal analyses
- Draft escapement goal report

ADF&G staff and public review

Approval of escapement goal recommendations by Regional Supervisor

Presentation of recommendations to Board of Fisheries
Board may adopt OEG’s or in-river run goals based on biological or allocative factors

Formal adoption by Division Directors
Current Escapement Goal Types
Regional Escapement Goals
By species

Central
N = 119

Southeast
N = 52

AYK
N = 63

Westward
N = 53

King
Chum
Coho
Pink
Sockeye

Other
LB
SEG
BEG
## Success Meeting Escapement Goals
### 2010-2016

#### Current number of goals – 287

#### Goals achieved – 77% overall

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<tr>
<th>Species</th>
<th>Percentage</th>
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Terms for Speaking about Salmon Production

**Return** = Adult salmon produced from a single brood year escapement

**Run** = Adult salmon returning to the vicinity of the natal stream in a calendar year

**Escapement** = Count of spawners in a year (or index)

**Yield** = Adult salmon produced in excess of escapement from a single brood year
Understanding Age Structure
Simple model

Year 1 → Year 2 → Year 3 → Year 4 → Year 5
Brood Year Age 2 Age 3 Age 4
Understanding Age Structure
Simple model
Understanding Age Structure
Simple model

The “run” in year 5 comes from fish spawned in years 1, 2 & 3
The “return” from year 5 contributes to years 7, 8 & 9
Understanding Age Structure

Simple model

Spreading the returns across 3 years reduces the influence of each contributing brood year on the resulting run
Theory of Salmon Production
Theory of Salmon Production

Escapement and the subsequent production can be plotted on a graph like this...
Theory of Salmon Production

...with a **Replacement Line** where escapement = production (i.e. no yields).
Theory of Salmon Production

There is a potential for yields only when production is greater than escapement

Area of Potential Yields

Production (Harvest + Escapement) vs. Escapement
Theory of Salmon Production

Potential yields can be realized because of the **reproductive capacity** of salmon, but...
Theory of Salmon Production

...as escapements are increased, *competition* increases, which limits potential yields.
We can model the interaction of reproductive potential and competition using our data.
Theory of Salmon Production

The model helps to define potential yields relative to escapements.
Theory of Salmon Production

MSY is the maximum sustained yield based on the model...
Theory of Salmon Production

...and is associated with a level of escapement that is expected to produce MSY.
Another quantity we can estimate from the model is the carrying capacity.

**Theory of Salmon Production**
A range around the escapement that produces MSY is the theoretical basis of an escapement goal.
Escapement Goal with Full Harvest Information

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Uncertainty and Escapement Goals
Uncertainty and Escapement Goals

Actual production data will look very different from our simple production model…
Uncertainty and Escapement Goals

...and this uncertainty is factored into the choice of escapement goal range.
Why and How Do Escapement Goals Change Over Time?
Why Do Escapement Goals Change?

- Changes in One or More Factors
  - Assessment
  - Biological
  - Fishery-Related
How Do Escapement Goals Change?

- Evolution of a goal is usually driven by improvement in information content and model development

- Some Simple Scenarios
  - Low Harvest Rate Scenario
  - High Harvest Rate Scenario
How Do Escapement Goals Change?
Low Harvest Rate Scenario

- Assessment begins with indexing of escapement only
- Stock-specific harvests are unknown
- Initial escapement goal based on history of escapement only
- Improvement of assessment drives refinement of goal
How Do Escapement Goals Change?

Low Harvest Rate Scenario

Assessment is by a simple aerial survey, with a goal based on keeping indexed escapements within the observed range.
Once assessment improves, our understanding of harvest rate and production improves.
How Do Escapement Goals Change?

Low Harvest Rate Scenario

Production model shows that escapement goal should be lowered to increase yields.
How Do Escapement Goals Change?
Low Harvest Rate Scenario

New escapement goal can be recast back to original aerial survey index units if needed.
How Do Escapement Goals Change?
High Harvest Rate Scenario

- Full assessments are available early on
- Initial goal analyses are inconclusive
- Initial escapement goal based on history of escapement only
- Inclusion of more information drives refinement of goal
How Do Escapement Goals Change?
High Harvest Rate Scenario

Assessment begins with complete estimates of catch and escapement...
How Do Escapement Goals Change?

High Harvest Rate Scenario

...but our production model is not informative about what the escapement goal should be.
The initial escapement goal is based on the history of escapements, not the production model.
How Do Escapement Goals Change?
High Harvest Rate Scenario

As we collect more production data, the range of escapements increases...
How Do Escapement Goals Change?
High Harvest Rate Scenario

...and we are able to build a defensible production model.
How Do Escapement Goals Change?
High Harvest Rate Scenario

Results of the production model show that yields could be increased by increasing the escapement goal.
Effect of Productivity Declines on Escapement Goals
Escapement Goals as Productivity Declines

During a period of ‘normal’ productivity...
Escapement Goals as Productivity Declines

...we can fit the production model and develop an escapement goal range.
Escapement Goals as Productivity Declines

As productivity declines we will see reductions in production and escapement...
Escapement Goals as Productivity Declines

...and can fit a new production model to all of the data...
Escapement Goals as Productivity Declines

...but the estimate of $S_{\text{MSY}}$ goes up only slightly.
Escapement Goals as Productivity Declines

The original escapement goal should not change as productivity declines.
Why Hasn’t ADF&G used SETs?
Why Hasn’t ADF&G used SETs?

- Smallest escapement, below which the stock’s ability to sustain itself is jeopardized
  - Escapement levels that result in high probability of extinction of stock

- Only to be used “as needed” for conservation
  - To date they have not been “needed”

- Conceptually difficult to estimate from observations
  - Escapement goal management prevents the observation of very low escapements
  - Need consistent observations at very low escapements
SETs and Jeopardy

- Species effects — average productivity
- Environmental effects — catastrophes
- Demographic effects — individuals
- Depensatory effects — space, time, movements
- Genetic effects — inbreeding
SETs and “as needed”

- Since 2000 – 30 stock of concern designations

- Currently 14 stocks of concern
  - 5 yield concern
  - 9 management concern

- Most stocks delisted within 3 to 6 years
  - current stocks of concern most listed 7 years or less
SETs difficult to observe and estimate

- Escapement goal management prevents consistent observation of very low escapements.

- Depensatory models need this information to estimate SET.

- Proxies for SET require reliable estimates of productivity AND carrying capacity.
Roadmap for Presentation

- Review policy framework and processes for escapement goals in Alaska
- Overview of current escapement goal types by region and species
- Concepts and theory of salmon production
- Why and how do escapement goals change?
- How does declining productivity affect escapement goals?
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