WF4313/6613-Fisheries Management

Class 11– Size Structure & Management Case Study

Announcements

- Exam I September 27th…

Fresh Florida lobster won't be easy to find after Hurricane Irma

BY CARLOS FRÍAS
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SEPTEMBER 24, 2017 6:00 AM

Marooned on no-name sandbars among the mangroves in the Florida Keys are acres of broken lobster traps and the crumbled livelihoods of Florida fishermen.

Many marinas and harbors in the middle Keys are closed. Boats that normally would carry lobster trappers and fishermen into the Keys' fruitful waters were forbidden by the U.S Coast Guard from sailing for more th and underwater power lines tha fisherman.

More than two weeks after Hur trapping industry is at a standst the fisherman to the restaurant at your local market, it will und

"The fishing industry in the Ke said Luis Garcia, owner of Garc a pair of commercial fishing bo place of picking up the pieces a

Hurricane Irma paralyzed the Keys' fishing industry, the second-largest industry in the island chain, and wrecked the commercial lobster trapping industry. If you see Florida spiny lobster on a menu, you can bet it's frozen. - Peter Maczek

Commercial versus Recreational

Value: Biomass

Value: Size

Stock density indices

PSD (which specifically indicates Quality/Stock) is a basic measure of size structure, and thus, balance within fish populations. "Balance" suggests a stable predator prey dynamic with adequate recruitment and growth of both predator and prey.

Proportional stock density (PSD)

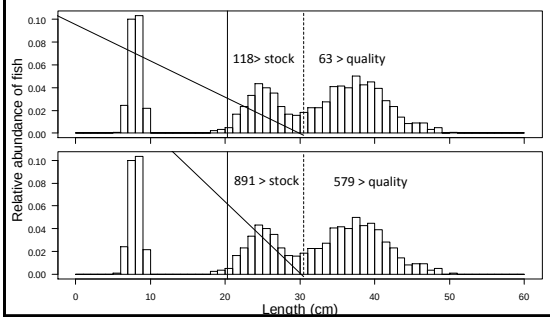
$$PSD = \frac{\text{Number of fish} \geq \text{ quality length}}{\text{Number of fish} \geq \text{ stock length}} \cdot 100$$

Where

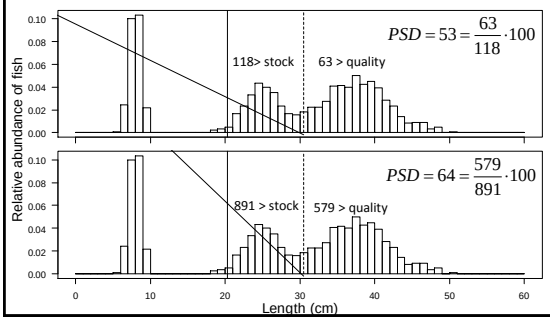
- Stock length fish = 8 inches
- Quality length fish = 12 inches

For largemouth bass

Stock and quality largemouth bass



Largemouth bass PSD



Interpreting PSD

$$PSD = 53 = \frac{63}{118} \cdot 100$$

- 53% of stock size fish are quality size

$$PSD = 64 = \frac{579}{891} \cdot 100$$

- 63% of stock size fish are quality size

Adjusting stock and quality lengths

Anderson and Weithman (1978)

- Defined stock and quality lengths as percentages of all-tackle world record lengths
- Suggested stock and quality lengths for 26 species

New stock and quality lengths

Stock: 20-26% of world record

Quality: 36-41% of world record

Relative stock density

$$RSD = \frac{\text{Number of fish} \geq \text{ specified length}}{\text{Number of fish} \geq \text{ stock length}} \cdot 100$$

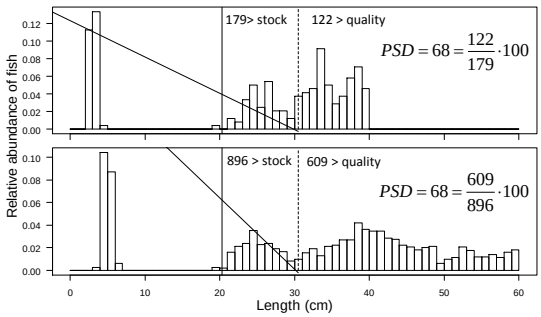
Where a:

- Stock length fish 20-26% of world record
- Quality length fish 36-41% of world record
- **Or any other specified length (e.g., 15 inches)**

$$RSD-15 = 30 = \frac{30}{100} \cdot 100 = \frac{\text{Number of fish} \geq 15 \text{ inches}}{\text{Number of stock fish}} \cdot 100$$

- 30 fish greater than 15 inches
- 100 fish that were stock size or greater

Issues?



Adding length categories

Gabelhouse (1984): need to move beyond a two-cell model of length categorization and further refine PSD by using:

- stock (S)
- quality (Q)
- preferred (P)
- memorable (M)
- trophy (T)

Calculation of length categories

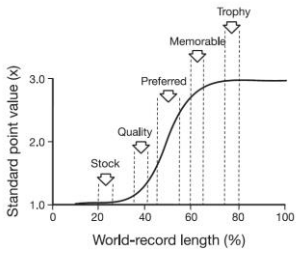


Figure 14.3 Gabelhouse's adoption of Weithman's (1978) fish quality index to identify length ranges from which (or near to which) minimum stock, quality, preferred, memorable, and trophy lengths were selected (from Gabelhouse 1984a).

Length categories

Category	Largemouth bass (mm)	Bluegill (mm)
Stock	200	80
Quality	300	150
Preferred	380	200
Memorable	510	250
Trophy	630	300

Traditional PSD

$$PSD - X = \frac{\text{Number of fish} \geq \text{specified length}}{\text{Number of fish} \geq \text{stock length}} \cdot 100$$

Category	N	Value
PSD-S	400	100
PSD-Q	100	40
PSD-P	75	25
PSD-M	80	14
PSD-T	10	2

Incremental PSD

$$PSD - X = \frac{\text{Number of fish in bin}}{\text{Number of fish} \geq \text{stock length}} \cdot 100$$

Category	N	Value
PSD-S-Q	400	60
PSD-Q-P	100	15
PSD-P-M	75	11
PSD-M-T	80	12
PSD-T	10	2

Should sum to 100

Linguistic uncertainty?

- PSD
- RSD
- Incremental PSD
- Traditional PSD

Terminology

Table 14.1 Terminology for former proportional stock density (PSD) and relative stock density (RSD) indices and corresponding revised terminology for proportional size distribution (PSD) index. Note that under the former terminology PSD and RSD-Q were equivalent. Suffixes are stock (S), quality (Q), preferred (P), memorable (M), and trophy (T) lengths.

Former terminology	Current terminology
PSD	PSD
RSD-P	PSD-P
RSD-M	PSD-M
RSD-T	PSD-T
RSD-S-Q	PSD S-Q
RSD Q-P	PSD Q-P
RSD P-M	PSD P-M
RSD M-T	PSD M-T

Formalities…

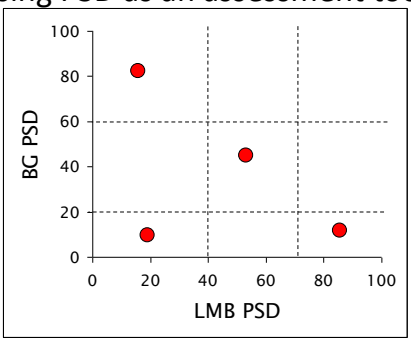
- All expressions of PSD should be rounded to the nearest whole number and reported without the percent symbol; decimals represent significant digits beyond the original data
- Willis et al. (1993) encouraged fisheries biologists to use values as established in either English or metric units rather than converting from English to metric units.

Using PSD for management

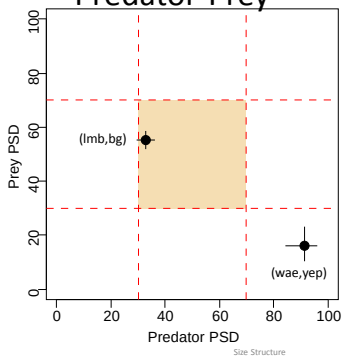
Table 14.4 Proportional size distribution values for largemouth bass and bluegill under three different management strategies described in section 14.3.3 (from Willis et al. 1993).

Management strategy	Largemouth bass			Bluegill	
	PSD	PSD-P	PSD-M	PSD	PSD-P
Panfish	20–40	0–10	0	50–80	10–30
Balanced	40–70	10–40	0–10	20–60	5–20
Big bass	50–80	30–60	10–25	10–50	0–10

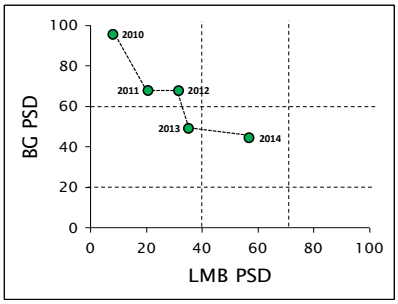
Using PSD as an assessment tool:



Predator-Prey



Tracking Predator-Prey Dynamics



An assessment tool?

- This index *supposedly* gives insight or predictive ability of population dynamics.
- Both high and low values and wide variation in PSD over time are indicative of populations with functional problems such as unstable recruitment, growth, or mortality.

Does PSD correlate fish density?

Largemouth bass in small impoundments

TABLE 3
Correlation Coefficients (r) between Proportional Stock Density and Density, Relative Abundance, Condition, or Rate Functions for Single Species as Reported by Various Authors

Species	Density	CPUE[a]	Wr[b]	Recruitment	Growth	Mortality	Ref.
Largemouth bass	Inverse[c]					-0.64	Reynolds and Babb (1978)
		-0.85					Gabelhouse (1984b)
		-0.70					Guy and Willis (1990)
		-0.98					Saffel et al. (1990)
					0.69[d]	-0.52[d]	Miranda (1983)
			-0.75[e]				Wege and Anderson (1978)
		-0.79					Boxrucker (1987)
Bluegill				-0.85	0.87		Novinger and Legler (1978)
Crappies			0.90				Gabelhouse (1984b)
Northern pike			0.59[f]		0.96[g]		Willis and Scalet (1989)
Walleye			0.36				Murphy et al. (1990)
Sauger			0.38				Guy et al. (1990)
Yellow perch			0.27[h]		0.85[i]		Willis et al. (1991)
Brook trout	-0.76		0.81				Johnson et al. (1992)

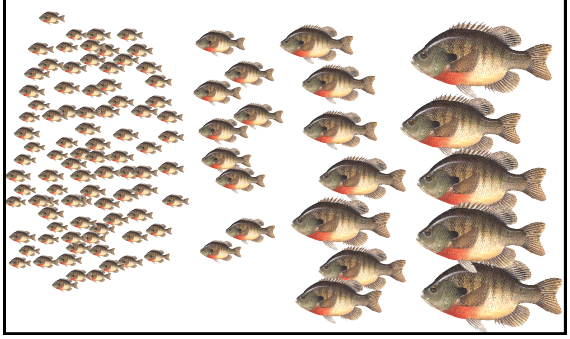
Willis et al 1993

Pond Management

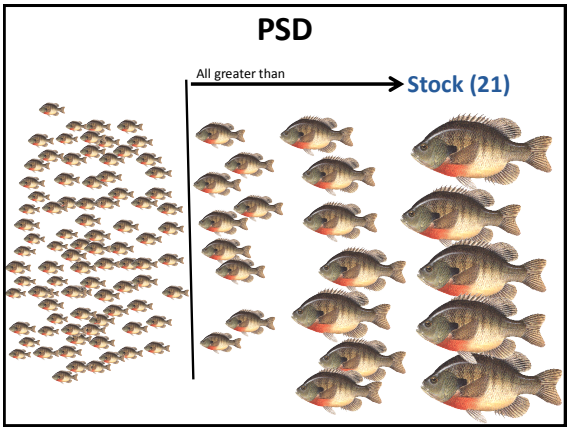
Cautions

- Predicting or drawing conclusions about population dynamics based on the structural indices is not as straightforward in larger waters or in systems with more complex fish communities.
- These systems require stock assessments
- Management decisions should be grounded in other procedures (e.g., relative abundance, recruitment , growth, mortality)

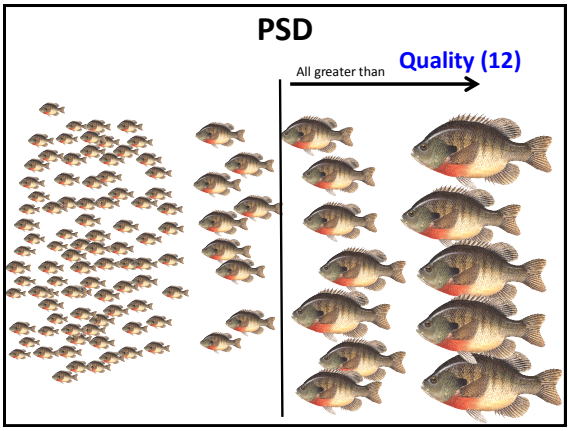
PSD

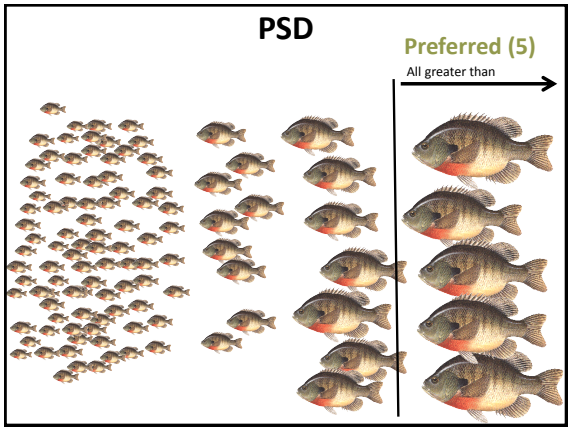


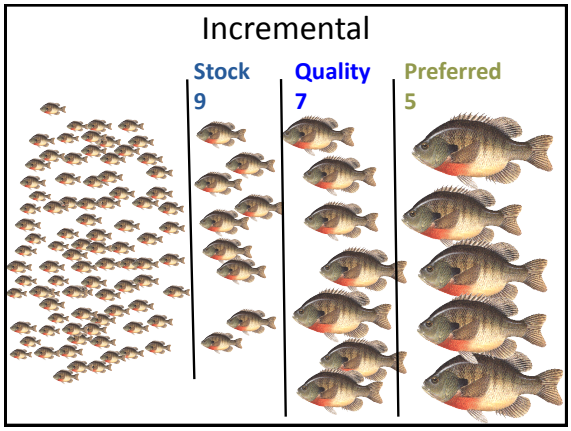
PSD



PSD



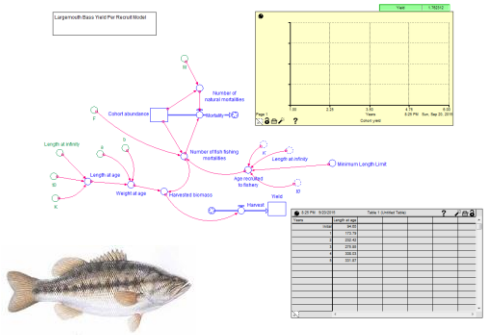




Counts and PSD

Size class	Total	PSD-X	Incremental	PSD-X-Y
Stock	21	100	9	42
Quality	12	57	7	33
Preferred	5	41	5	24

Yield and PSD



Largemouth Bass PSD Values

Stock	200
Quality	300
Preferred	380
Memorable	510
Trophy	630

Predicted number at length

10 Inch Minimum Length Limit

		F			
Initial	Length	0	0.1	0.3	0.5
0	106.77	1,000	1,000	1,000	1,000
1	194.18	175	175	175	175
2	265.75	**31**	**30**	**30**	**29**
3	324.35	**5**	**5**	**4**	**3**
4	372.32	**1**	**1**	**0**	**0**
5	411.6	**0**	**0**	**0**	**0**
6	443.75	**0**	**0**	**0**	**0**
7	470.08	**0**	**0**	**0**	**0**
8	491.64	**0**	**0**	**0**	**0**
9	509.29	**0**	**0**	**0**	**0**
10	523.74	**0**	**0**	**0**	**0**
11	535.57	**0**	**0**	**0**	**0**

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PSD Values-Traditional

F	Stock	Quality	PSD
0.00	37	6	18
0.10	37	6	16
0.30	34	1	12
0.50	32	0	1

10 Inch Minimum Length Limit

F	Stock	Quality	PSD
0.00	37	6	18
0.10	37	6	17
0.30	36	5	15
0.50	5	0	9

12 Inch Minimum Length Limit

PSD Values-Incremental

F	Stock	Quality	PSD
0.00	37	6	82
0.10	37	6	83
0.30	34	1	88
0.50	32	0	99

10 Inch Minimum Length Limit

F	Stock	Quality	PSD
0.00	37	6	82
0.10	37	6	83
0.30	36	5	85
0.50	5	0	99

12 Inch Minimum Length Limit

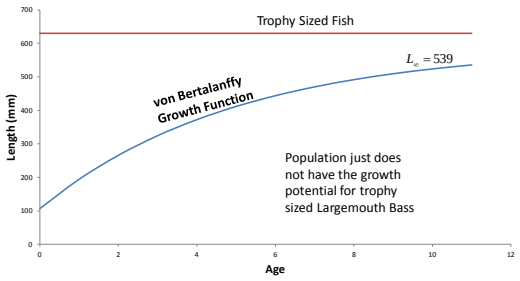
Where are the trophy fish?

12 Inch Minimum Length Limit

		F			
Initial	Length	0	0.1	0.3	0.5
0	106.77	1,000	1,000	1,000	1,000
1	194.18	175	175	175	175
2	265.75	**31**	**31**	**31**	**31**
3	324.35	**5**	**5**	**5**	**4**
4	372.32	**1**	**1**	**1**	**0**
5	411.6	**0**	**0**	**0**	**0**
6	443.75	**0**	**0**	**0**	**0**
7	470.08	**0**	**0**	**0**	**0**
8	491.64	**0**	**0**	**0**	**0**
9	509.29	**0**	**0**	**0**	**0**
10	523.74	**0**	**0**	**0**	**0**
11	535.57	**0**	**0**	**0**	**0**

630 mm!

Where are the trophy fish?



Management Case Study

New regulations displease some Oregon bass fishermen

GEORGE PLAVEN, East Oregonian 7:21 a.m. PDT September 8, 2015

(Photo: Special to the Statesman Journal)

PENDLETON, Ore. (AP) — Bud Hartman can sense 55 years of progress beginning to unravel.

As one of the original members of the Oregon Bass and Panfish Club in 1958, Hartman, of Portland, fought for the state's first ever bag limits on bass fishing to protect the species from overharvest.

The Oregon Fish and Wildlife Commission last week approved sport fishing regulations for 2016 that includes removing bag limits on all warmwater fish — including bass, walleye, crappie, panfish and catfish — in the Columbia, John Day and Umpqua rivers, leaving Hartman deflated.

"I've been at the forefront of making sure these fish have the right to exist in Oregon," he said. "As of last Friday, I felt like all of these efforts we put in have all been in vain."

Hartman, who attended the commission's meeting in Seaside, said he felt his arguments against ending bag limits on warmwater fish fell on deaf ears. He isn't worried the fisheries will become overly degraded, but said it simply sends the wrong message to anglers.

"To me, it devalues the resource," Hartman said. "It says to the angling public that (these fish) don't mean anything."

STATESMAN JOURNAL

Commission approves 2016 fishing rules

(http://www.statesmanjournal.com/story/travel/outdoors/hunting-fishing/2015/09/04/commission-approves-2016-fishing-rules/71726808/?from=global&sessionKey=&autologin=)

Eighteen percent of Oregon fishermen said they consider themselves primarily warmwater anglers, according to a 2006 survey by the state Department of Fish & Wildlife. Another 26 percent said they fished for warmwater species at some point during the past year.

Management case study

Management Decision to Remove
Bag Limits on Warmwater Fishes

Governance

"The Oregon Fish and Wildlife Commission consists of seven members appointed by the governor for staggered four-year terms. One commissioner must be from each congressional district, one from east of the Cascades and one from the west of the Cascades."

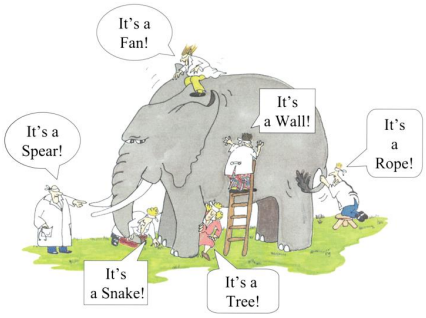
"The Commission was formed July 1, 1975 when the formerly separate fish and wildlife commissions were merged. ODFW consists of the commission, a commission appointed director and a statewide staff of approximately 1000 permanent employees. ODFW operates under ORS chapters 496 through 513. Commissioners formulate general state programs and policies concerning management and conservation of fish and wildlife resources and establishes seasons, methods and bag limits for recreational and commercial take.

"The ODFW headquarters are in Salem (as of August 18, 2003), with regional offices in Clackamas, Roseburg, Bend, and La Grande. Ten district offices are strategically located statewide. ODFW operates a variety of facilities designed to enhance fish and wildlife resources, including fish hatcheries, wildlife areas, public shooting grounds, hunting and fishing access sites and several research stations."

Transparency

Visibility

Only part of the picture

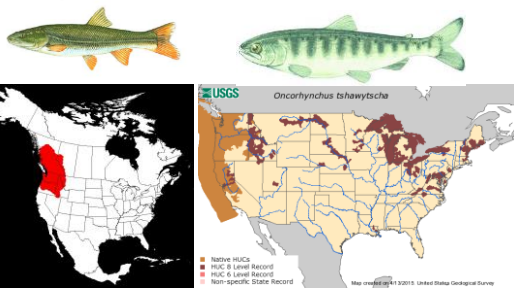


Geographic Scope

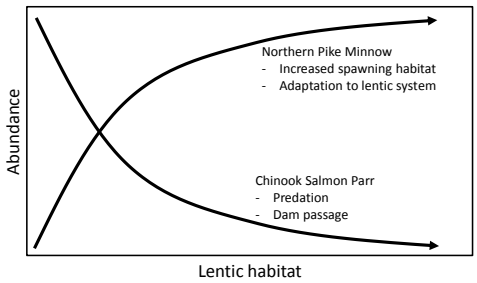
More of the picture

The Elwaha River

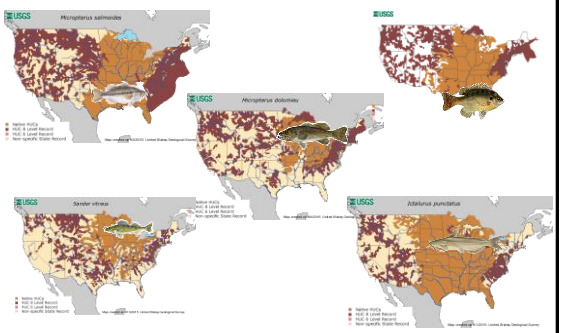
Native fish



Functional model

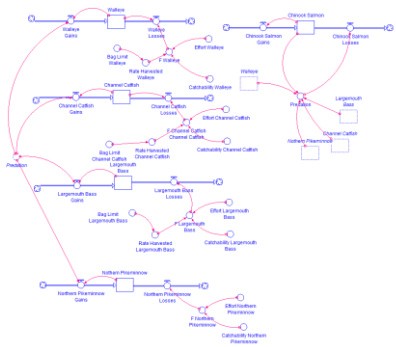


Non-Native Fish



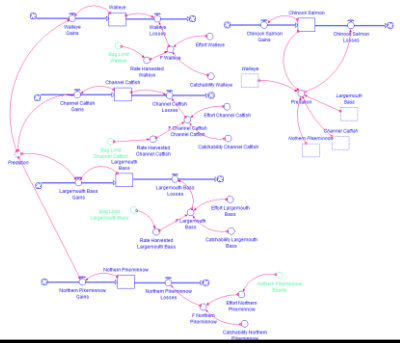
http://nas.er.usgs.gov/

The System-Conceptually I



N. Pikeminnow Bounty

The System-Conceptually II



Some points to consider

- Impoundment of Columbia River created more lentic habitat
- Introduction of non-native species for recreational and subsistence fishing
- Increased native and non-native piscivore abundance

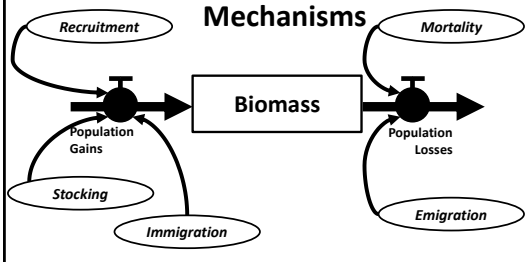
Management implications

1. Bounty on native fish
2. No bag limits on non-native fish

What is right? Is it the role of the management agency to protect native species?

- How do you value native and non-native fishes to make decisions?

Fish dynamics: States, Processes, & Mechanisms



$$\frac{dAbundance}{dt} = (recruitment + stocking + immigration) - (mortality + emigration)$$

Understand the system

- Processes: Gains & Losses
- Mechanisms: growth, mortality, predation,
- States: Abundance, Biomass
- Interactions among system components
- Formal representation of the system

Advantages & *Disadvantages*

1. Transparent representation of the system
2. Communication with stakeholders
3. Prediction and forecasting
4. Unintended consequences
5. Guide monitoring and research
6. *Complex?*
7. *Unrealistic assumptions?*