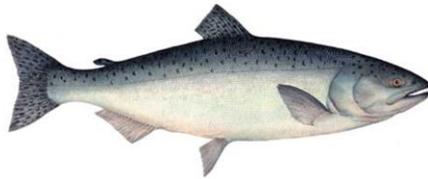


Hatchery influences on puberty in male salmon

Don Larsen

Northwest Fisheries Science Center, NOAA
Fisheries, Seattle, WA



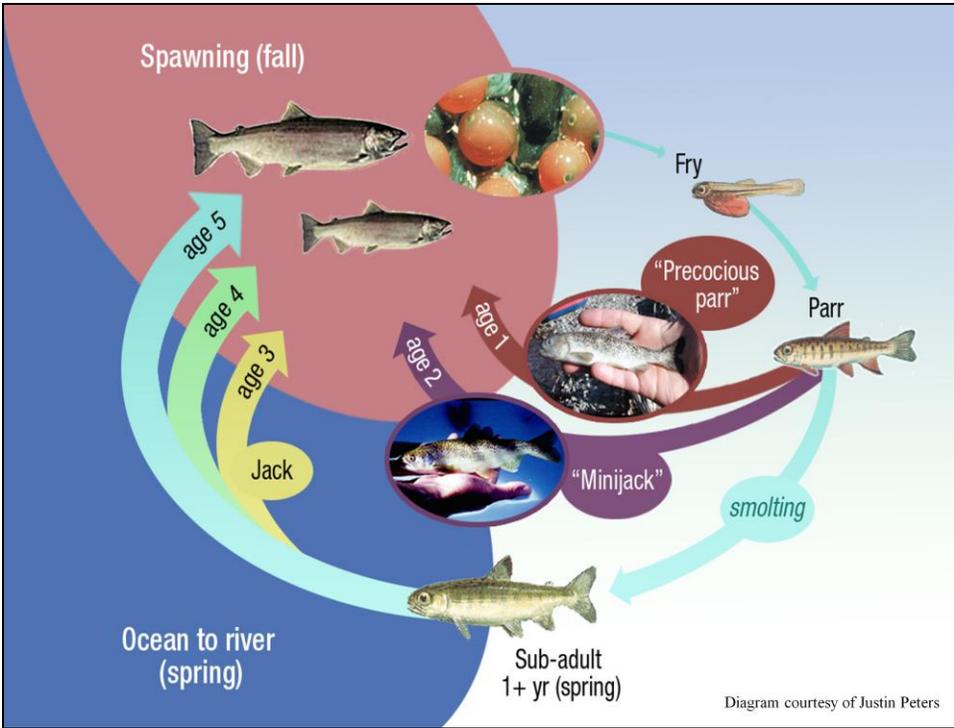
Chinook Salmon

Oncorhynchus tshawytscha



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- CTWSR- Chris Brun, Ryan Gerstenberger, Lindsay Brewer, Jim Gidley, Albert Santos
- Carson National Fish Hatchery - John Hitron, Thomas Hogan and staff
- Bonneville Power Administration (Deborah Docherty, Jay Marcotte, Richard Golden), NOAA BiOp Funding



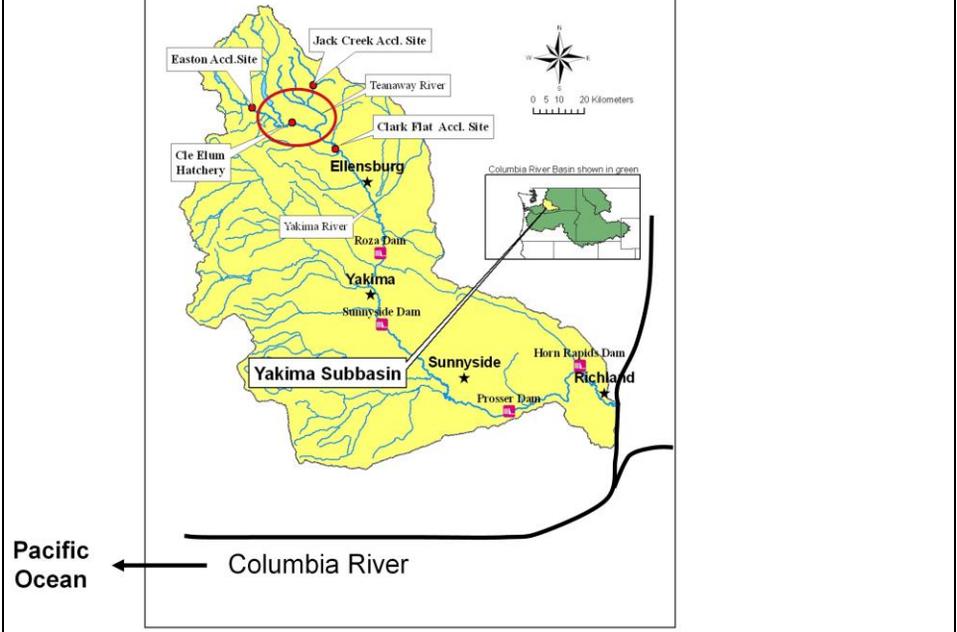
Question:

Are the principals described by Penny and Brian just an academic exercise or is there cause for concern in Columbia Basin hatchery salmon?

Outline

- **A case study of early male maturation-
The Yakima Spring Chinook Supplementation
Program**
- **Hatchery vs. Wild minijack rates**
- **What happens to minijacks?**
- **Early male maturation throughout the
Columbia Basin-Spring, Summer, Fall Ch.**
- **Consequences and Conclusions**

The Yakima River Basin



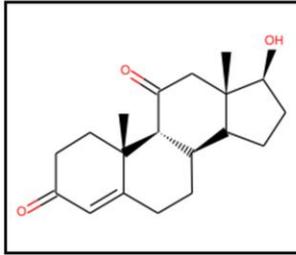
We've been monitoring the physiology of Yakima Supplementation Hatchery Spring Chinook since implementation in 1997



**On average, 41% of male Yakima hatchery spring
Chinook precociously matured at age-2**

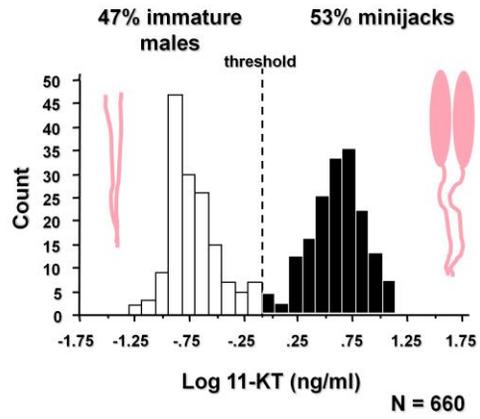
Hatchery, River	Stock	Brood Year	Minijacks (% males)	Average % Minijacks
		1997	44.0	
		1998	72.0	
		1999	48.8	
		2000	35.5	
		2001	54.3	
Cle Elum, Yakima R., WA	Spring Chinook	2002	36.2	41
		2003	19.9	
		2004	22.0	
		2005	28.8	
		2006	51.0	
		2007	34.2	

Plasma 11-ketotestosterone



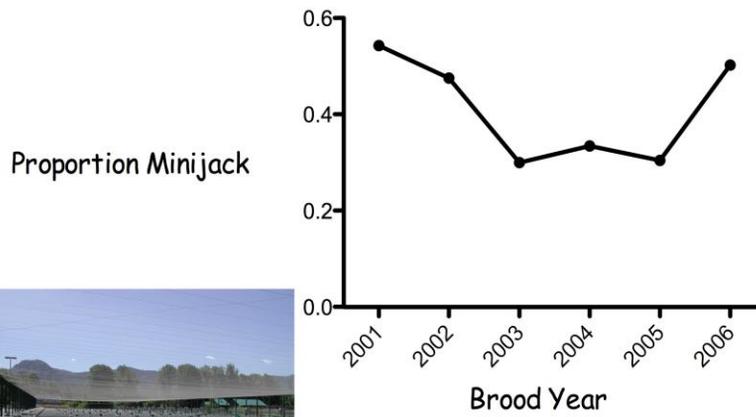
- Major androgen in teleost fish
- Instrumental in the regulation of spermatogenesis

Every spring the Yakima Chinook are screened for pathology and reproductive development



Larsen et al. 2004 TAFS

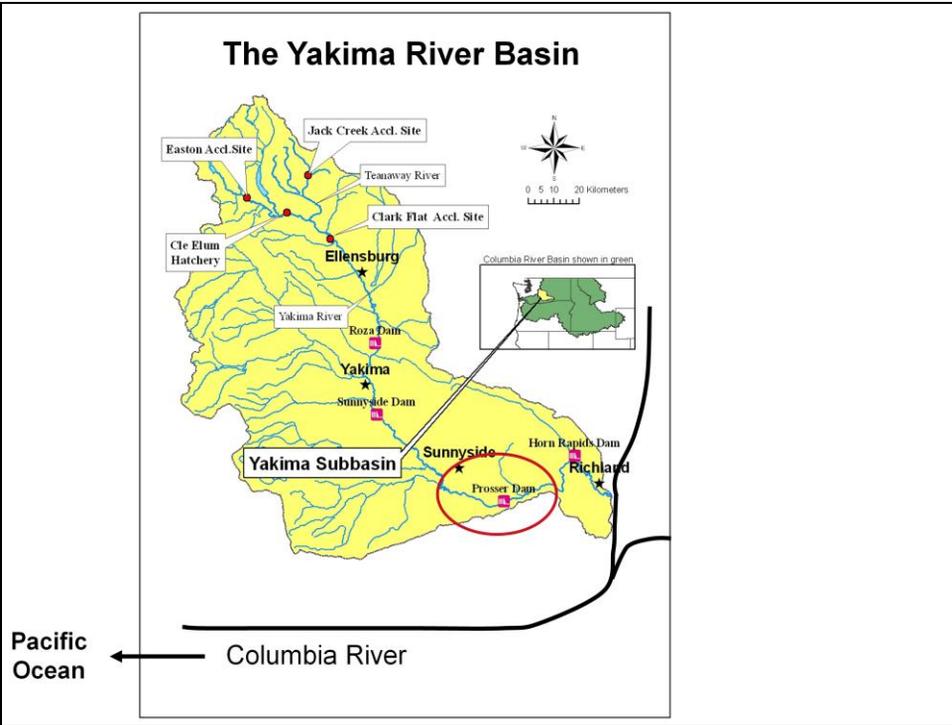
Minijack rates have been variable



**How do minijack rates compare between wild
and hatchery fish?**

or

How do you know this isn't normal?

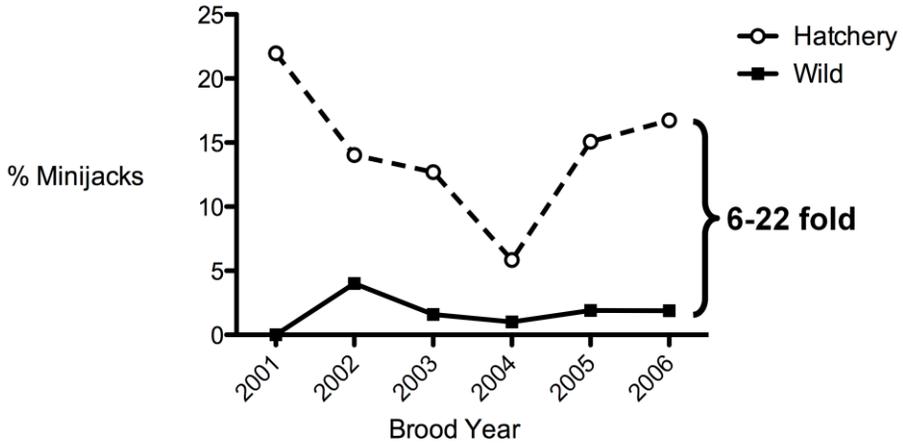




**Chandler smolt by-pass
facility**
Prosser Dam, Yakima River



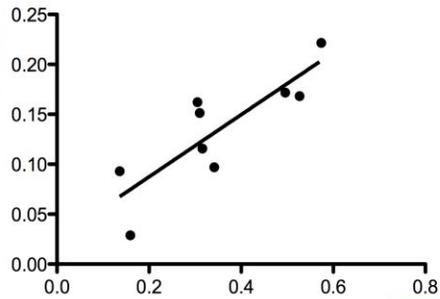
Co-migrating hatchery and wild minijacks are surveyed at Prosser Dam, lower Yakima R.



The proportion of minijacks at release is strongly correlated with the proportion of migrating minijacks



Proportion Minijack at Proseer



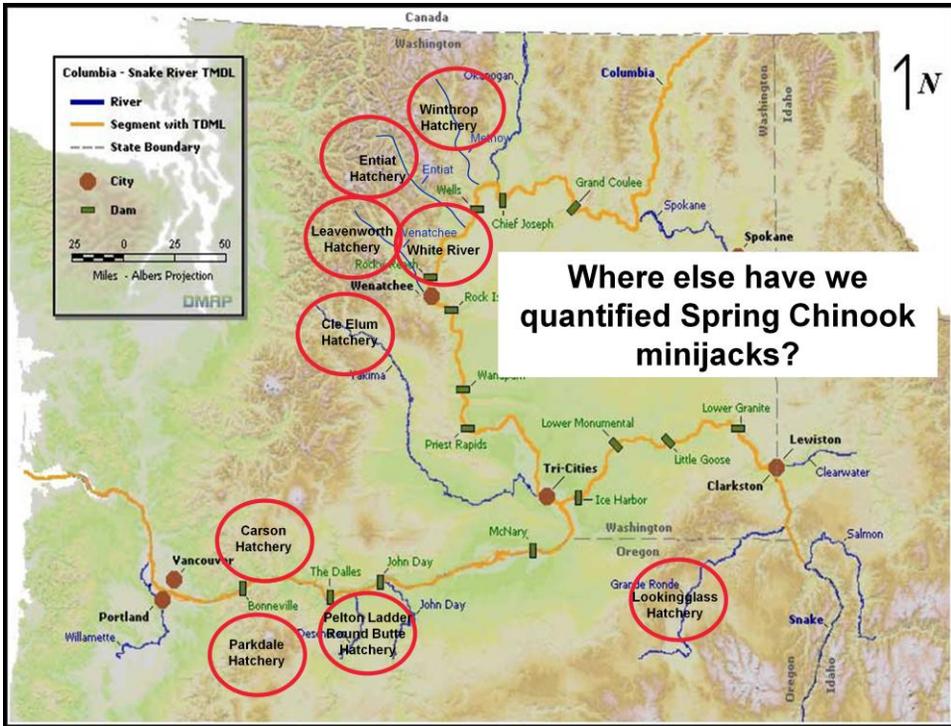
$r^2 = 0.71$
 $p = 0.0043$

Proportion Minijack at Acclimation Sites



Where do all the minijacks go?

Is this just a Yakima Hatchery phenomenon?

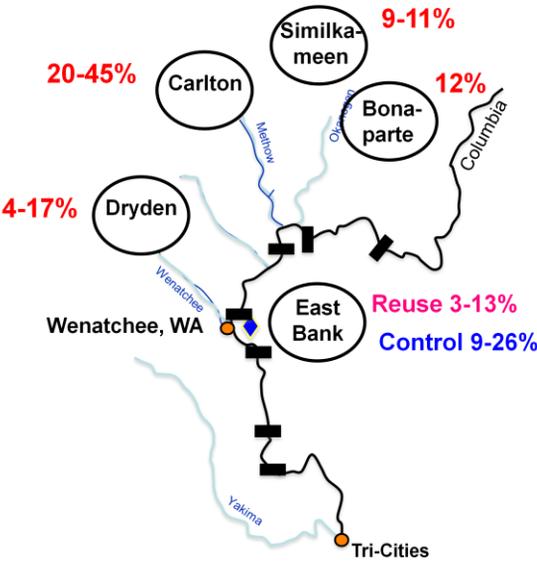


Spring Chinook Minijacks are Ubiquitous

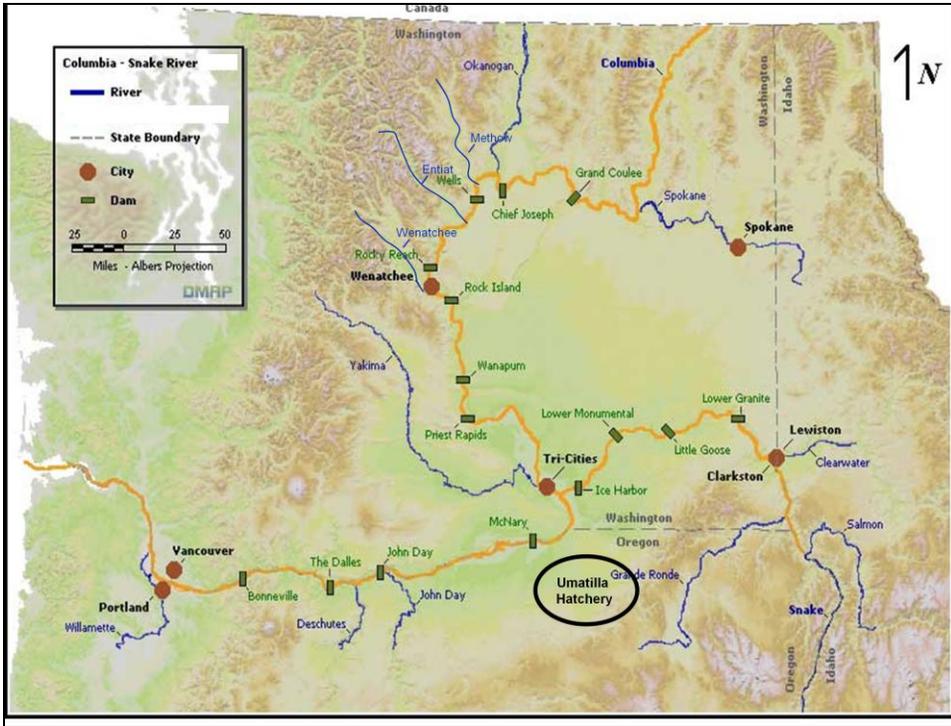
Hatchery, River	Stock	Brood Year	Minijacks (% males)	Average % Minijacks
Leavenworth, Wenatchee R., WA	Spring Chinook	2003	9.4	19
		2004	14.2	
		2005	33.1	
		2006	28.8	
		2007	16.3	
		2008	10.3	
Entiat, Entiat R. WA	Spring Chinook	2003	13.2	11
		2004	7.9	
		2005	10.7	
Winthrop, Methow R. WA	Spring Chinook	2003	16.6	24
		2004	28.1	
		2005	35.3	
		2006	38.5	
		2007	14.2	
2008	12			
Carson, Wind R. WA	Spring Chinook	2008	20.0	20
Pelton Ladder, Deschutes R., OR	Spring Chinook	2008	34.0	34
Parkdale, Hood R., OR	Spring Chinook	2008	53.0	53
Lookingglass, Lostine R., OR	Spring Chinook	2006	47.3	52
		2007	56.2	
Lookingglass, Imnaha R., OR	Spring Chinook	2006	51.7	52
White R., Lk. Wenatchee, WA	Spring Chinook	2009	69.4	69

**Are Minijacks an issue for Summer
Chinook?**

Yes, minijacks appear to be an issue for yearling Summer Chinook?



Are minijacks an issue for Fall Chinook?



Since 2002, over 1/2 of returning Umatilla Hatchery Fall Chinook are minijacks

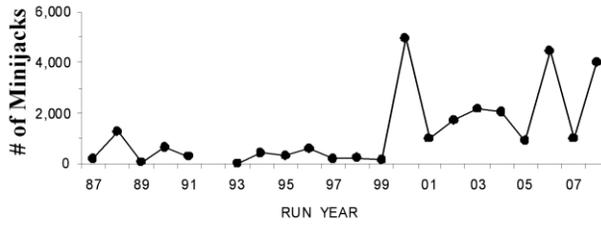


Table 1: The percentage of male fall Chinook salmon returning to Three Miles Falls Dam on the Umatilla River that are precocious, 2002 to 2008.

Migration Year	2002	2003	2004	2005	2006	2007	2008	Mean
Percentage Precocious	56.4	64.8	46.3	35.5	79.3	37.3	74.9	56.4

Data courtesy of Lance Clarke, ODFW



Fresh off the press.....

**Brood year 2009 Umatilla River Up-River Bright
Fall Chinook sampled this spring....**

40% minijack rate

**Yes, minijacks appear to be an issue for
yearling Fall Chinook?**

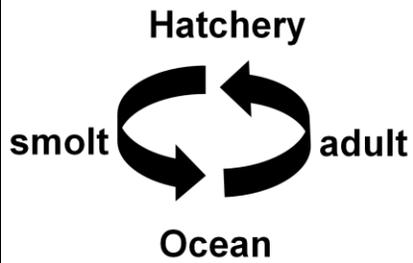
Consequences of high levels of precocious maturation

- **Ecological impacts**
- **Genetic impacts**
- **Increased straying**
- **Skewed gender ratio**
- **Loss of adult production**
- **Alter accuracy of Smolt-to-adult (SAR) return rates**
- **Potential source of domestication**



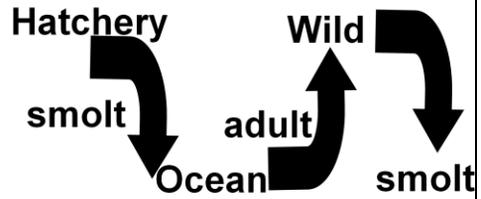
Two types of salmon hatcheries

Segregated



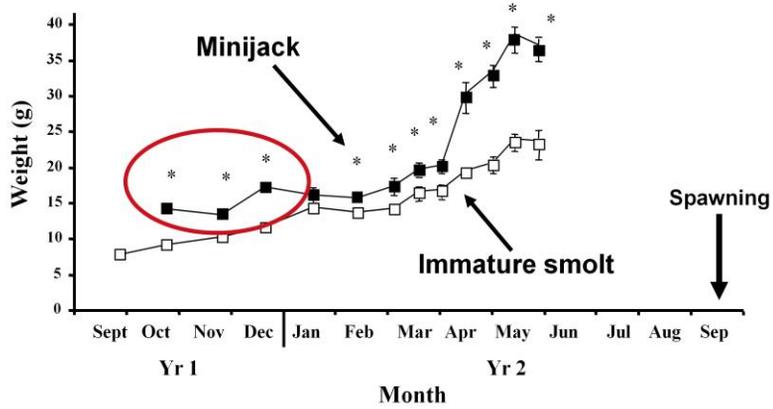
“Conventional”

Integrated



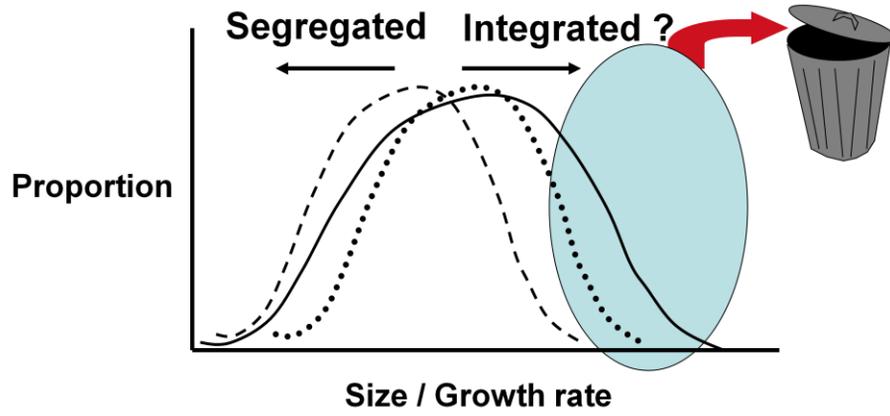
“Supplementation”

Minijacks are larger than immature smolts already in their first year of life



Shearer and Swanson, Aqua. 2000
Campbell et al. Biol. of Repr. 2003
Larsen et al. TAFS 2010

Highly sophisticated conceptual model

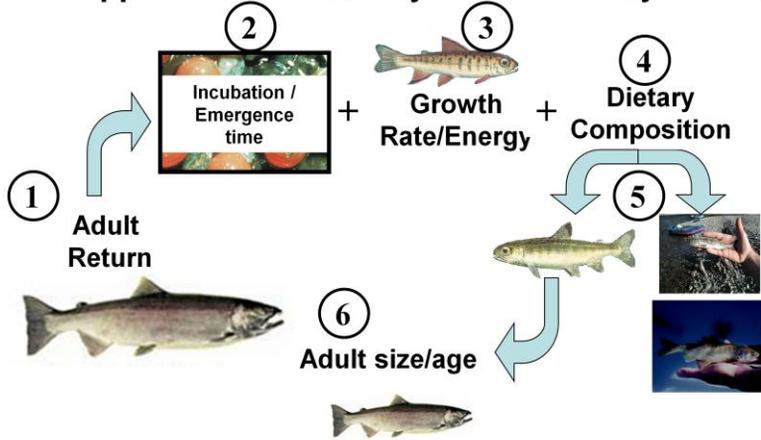


Physiology - Overall Conclusions

Unlike Las Vegas.....

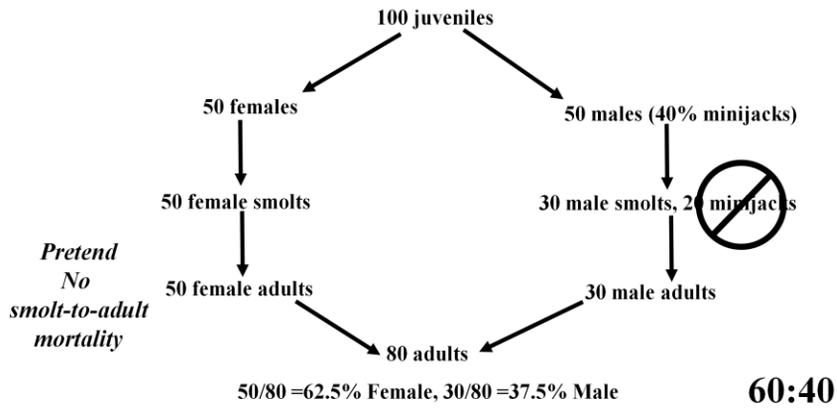


What happens in the hatchery does NOT stay in the hatchery





A thought exercise for Don's simple mind: A.K.A. "arm waiving"



Adult Gender Compensation

- Males return as jacks which have one less year in the ocean, thus higher survival
- Studies have shown that females experience higher exploitation rates in the ocean