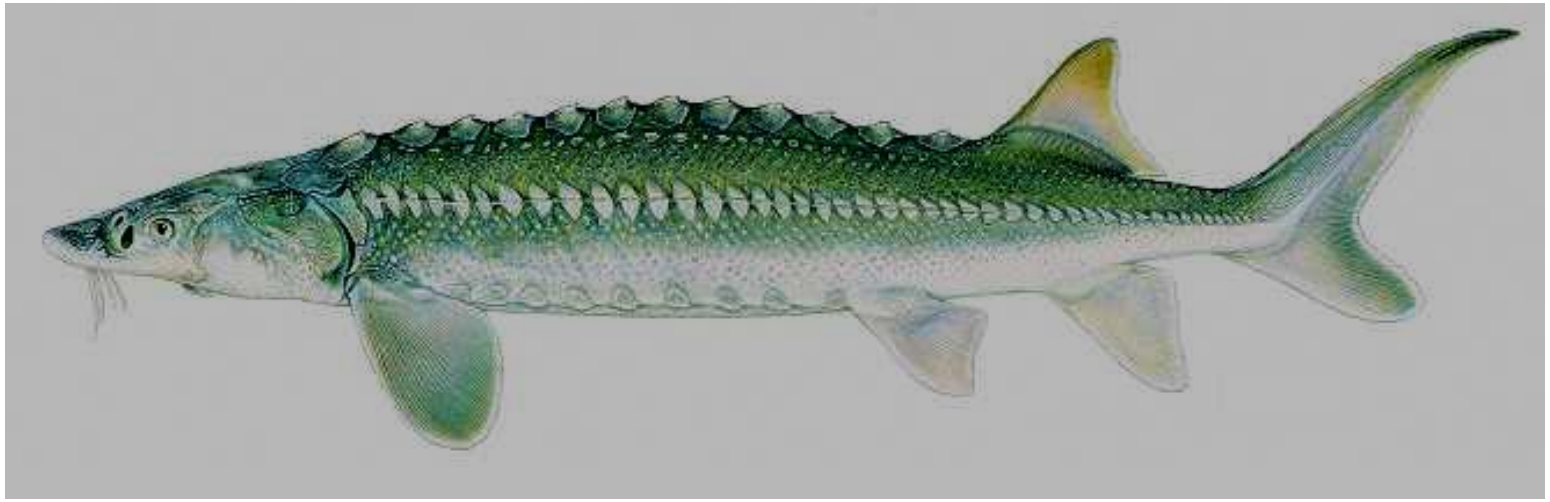
PRIEST RAPIDS WHITE STURGEON MANAGEMENT PLAN UPDATE

Priest Rapids Hydroelectric Project (FERC No. 2114)
Grant County PUD



Presentation to the White Sturgeon Workshop, 7 October 2015

Larry Hildebrand and Paul Grutter, Golder Associates Ltd.
Jason McLellan and Matt Howell, Colville Confederated Tribes

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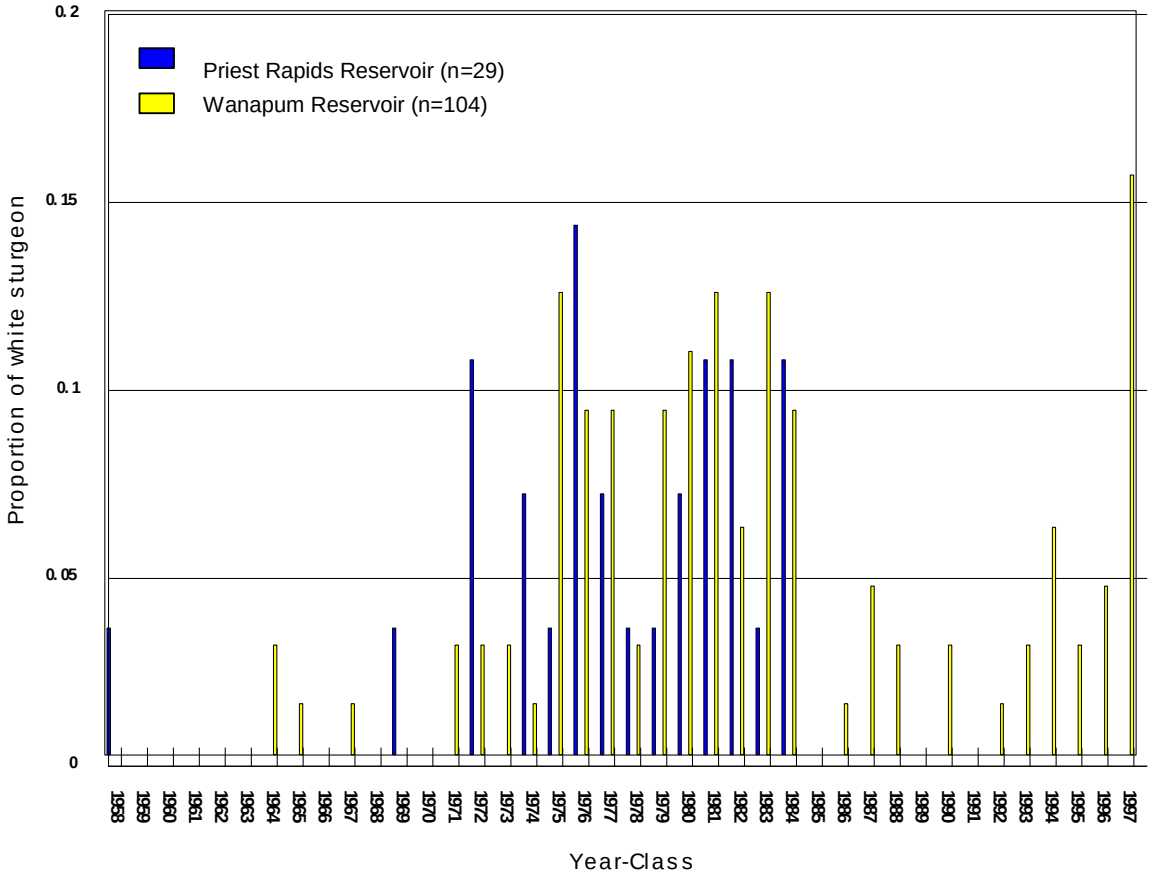
POPULATION STATUS IN 2001

- **Population status in PRPA initially examined from 1999-2001**
- **Wanapum Reservoir**
  - **551 (95% CI = 314 – 1460)**
- **Priest Rapids Reservoir**
  - **134 (95% CI = 48 – 2680)**



HISTORY OF THE WSMP

- **Original WSMP plan developed in 2002**
  - **Approved by PRFF**
- **Based on a conservation model**
  - **Future harvest not a requirement**
- **No hard targets for when "recovery" would be achieved or what population size constitutes "recovery"**
- **Aggressive; intent was to "front-load" the system**
- **Modifications as needed using adaptive management**

WSMP TASKS

- **Primary Tasks :**
  - **Task 1: Determine effectiveness of the supplementation program**
  - **Task 2: Determine the carrying capacity of each reservoir**
  - **Task 3: Participate and cooperate in the development of regional White Sturgeon management efforts**
  - **Task 4: Determine juvenile downstream passage rate and survival.**

SUPPLEMENTATION IN THE PRPA

Year	Priest Rapids	Wanapum
2011	2,101	6,986
2013	1,717	2,264
2014	1,501	5,094
2015	1,495	5,007
ALL YEARS	**6,814**	**19,351**

- **26,165 juveniles released in PRPA to date**

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2014BY Release in PRPA

- **6,502 fish released 30 April to 1 May 2015**
  - **5,007 in Wanapum Pool at Frenchman Coulee Launch (great release site!)**
  - **1,495 in Priest Pool at Wanapum tailrace launch**
  - **63 acoustic tagged fish released**

- **Mean Length and Weight**

	Mean	S.D.
Fork Length (mm)	313	30
Weight (g)	198	56

- **Fin deformity identified in 78.5% (5,104 of 6,502) fish released**

DEFORMITIES IN 2014BY RELEASE

2014BY Primary Fin Deformity	Fin Deformity Sub-type	No. of fish with Primary Deformity	No. of fish with Sub-type Deformity
Caudal deformity only		**571**	
	curled		465
	split or damaged		106
Both caudal and pectoral deformity		**2,208**	
	curled or damage pectoral and caudal		2,031
	missing pectoral and caudal deformity		143
	missing both pectoral and deformed caudal		34
Pectoral deformity only		**2,313**	
	curled, short or damaged		2,023
	missing pectoral		240
	missing both pectorals		50
Dorsal or anal fin deformity		**12**	
		5,104	

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2014BY MOVEMENTS

- Wanapum Reservoir
  - All 48 acoustic-tagged 2014BY released in Wanapum detected
  - 2 of 48 (4%) entrained into Priest Rapids Reservoir
  - Strong tendency for movement upstream and movement in general

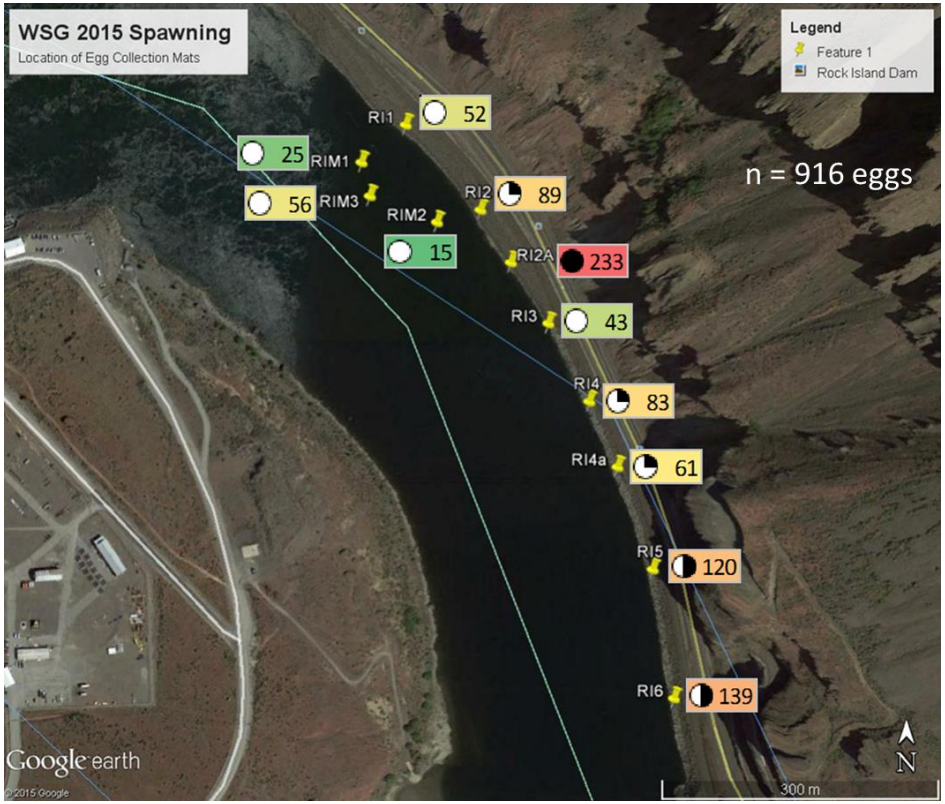
- Priest Rapids Reservoir
  - 11 of 15 tags detected; missing VRRM415.5 data from Wanapum tailrace station
  - Less downstream movement; entrainment into McNary Reservoir not detected

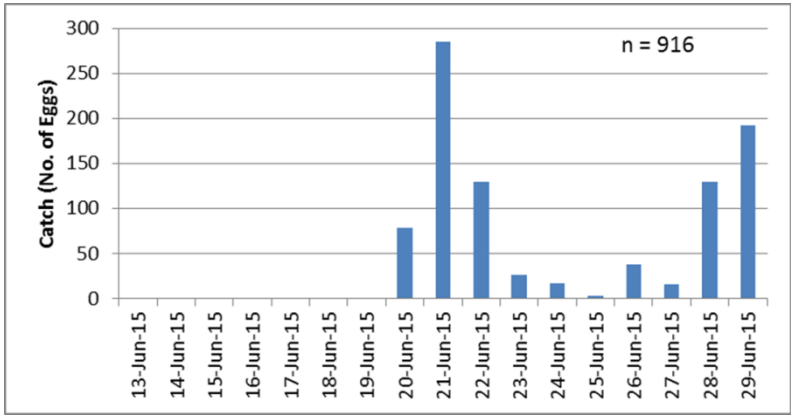
Entrainment by Broodyear WR->PR

- Entrainment rate (Wanapum to Priest Rapids) ~ 5%

Reservoir	Broodyear	Tags Released	No. Entrained	% Entrained
Wanapum	2010	70	9	12.9
Wanapum	2012	24	0	0
Wanapum	2013	52	3	5.7
Wanapum	2014	48	2	4.2

2015 Spawn Monitoring



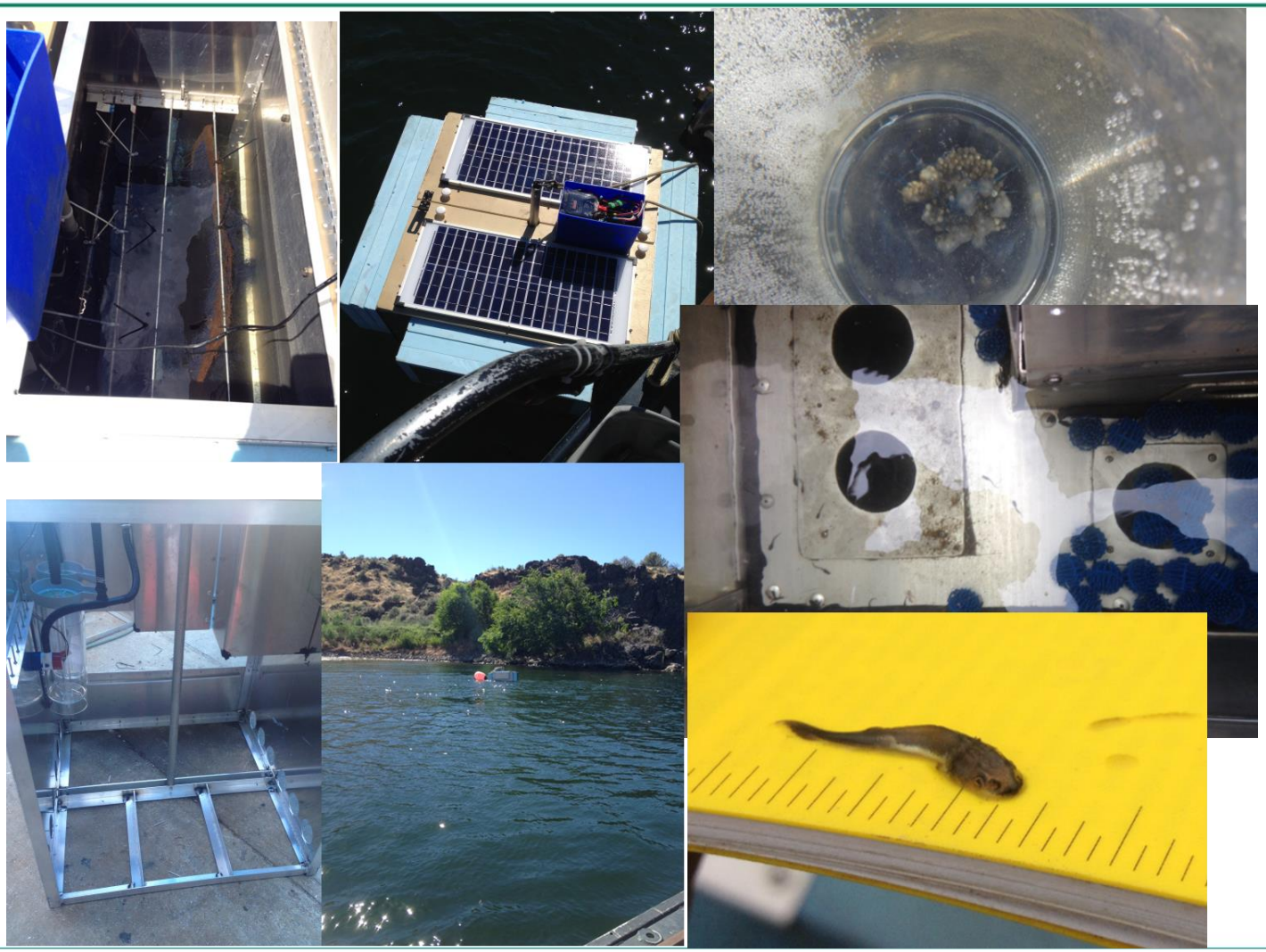


- Spawning protracted and of variable onset and cessation

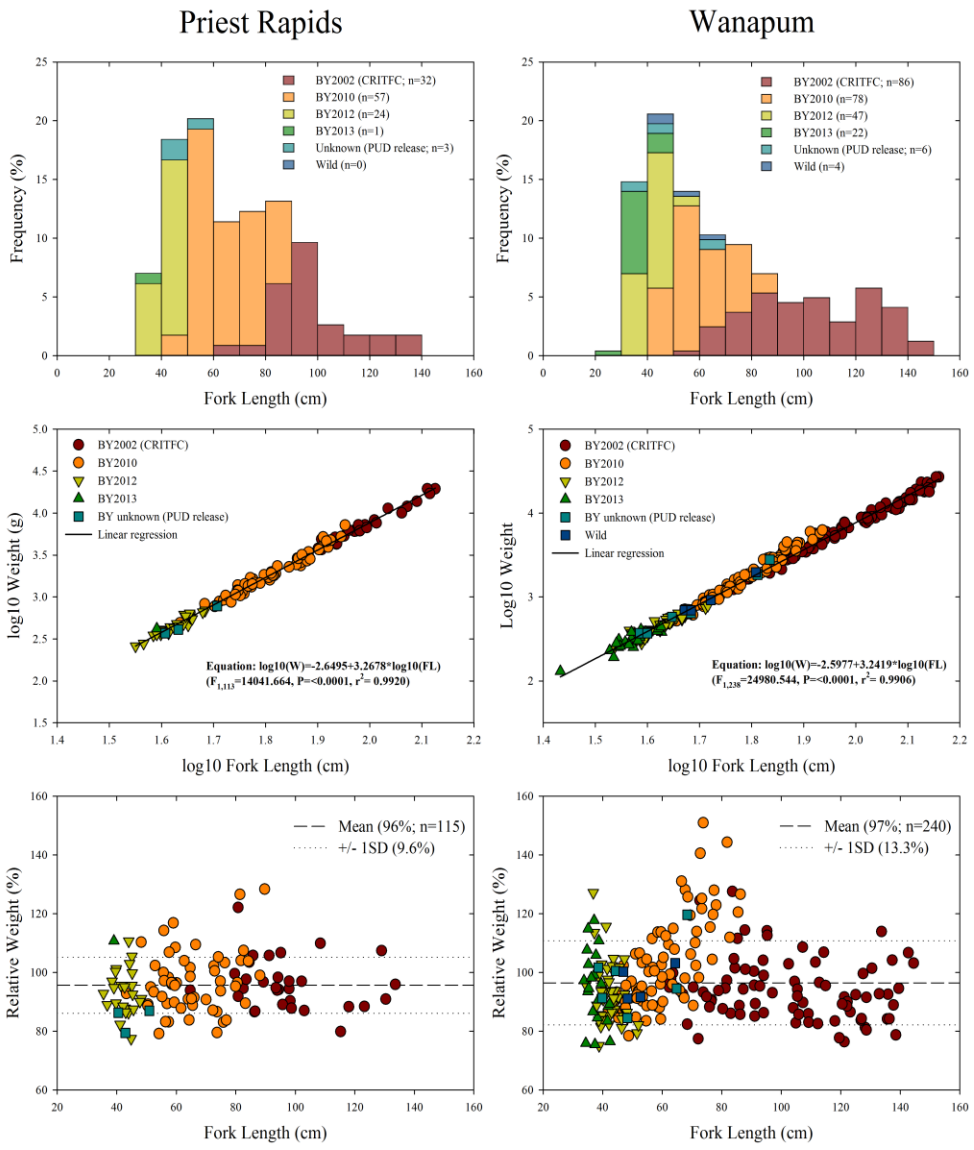
2015 *in situ* Incubation

- **Estimated four spawning events detected**
- **916 eggs captured and incubated *in situ***
- **115 larvae sent to Wells Hatchery (12.5% hatch)**
  - **Low survival attributed to fungus and use of MacDonald jars**
- **Higher survival expected with elimination of MacDonald jars**

In situ Incubation Chamber



ORIGIN, SIZE, AND CONDITION – 2014 DATA



BY (program)	Fork Length (cm)				
	n	mean	SD	min	max
2002 (CRITFC)	118	101.6	22.0	58.3	145.8
2010 (CPUD)	20	65.0	8.8	51.0	85.5
2010 (GPUD)	115	62.1	11.8	41.8	89.7
2012 (GPUD)	71	42.4	3.6	34.3	52.0
2013 (GPUD)	23	37.2	3.4	27.1	42.4
Unknown (Hatchery)	9	48.7	10.9	38.5	68.4
2010-2013 (All PUD)	238	53.6	13.9	27.1	89.7
Wild	5	82.4	66.0	46.9	199.8
All sturgeon	361	69.6	29.0	27.1	199.8

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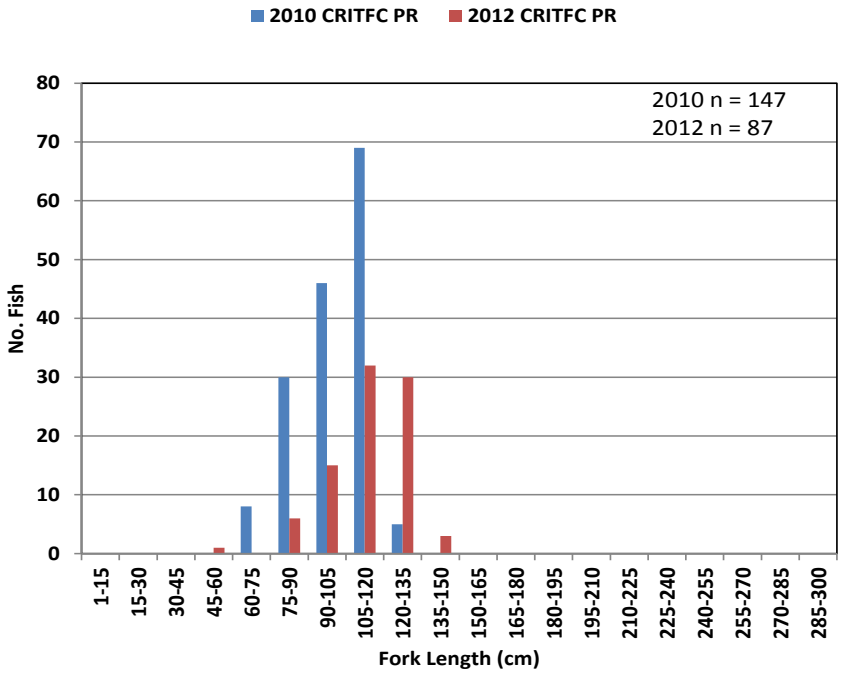
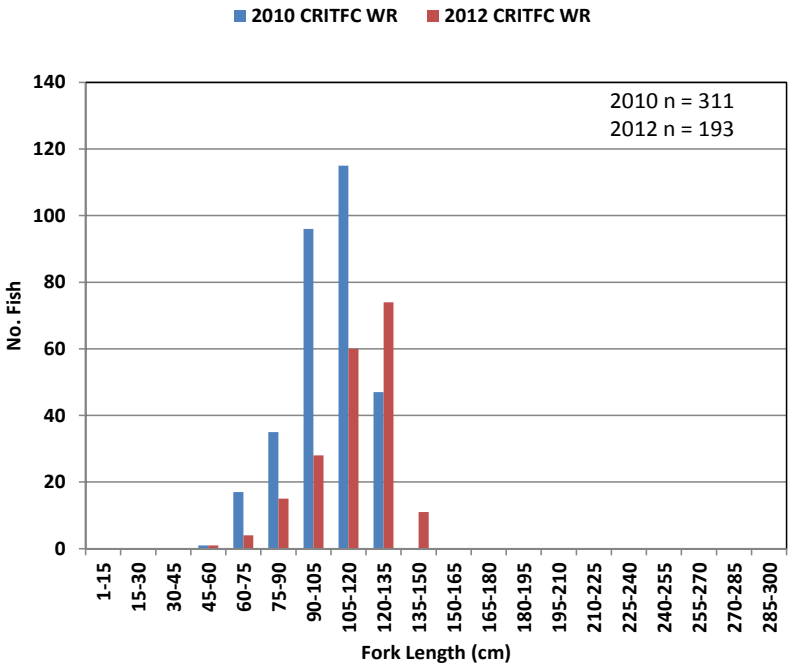
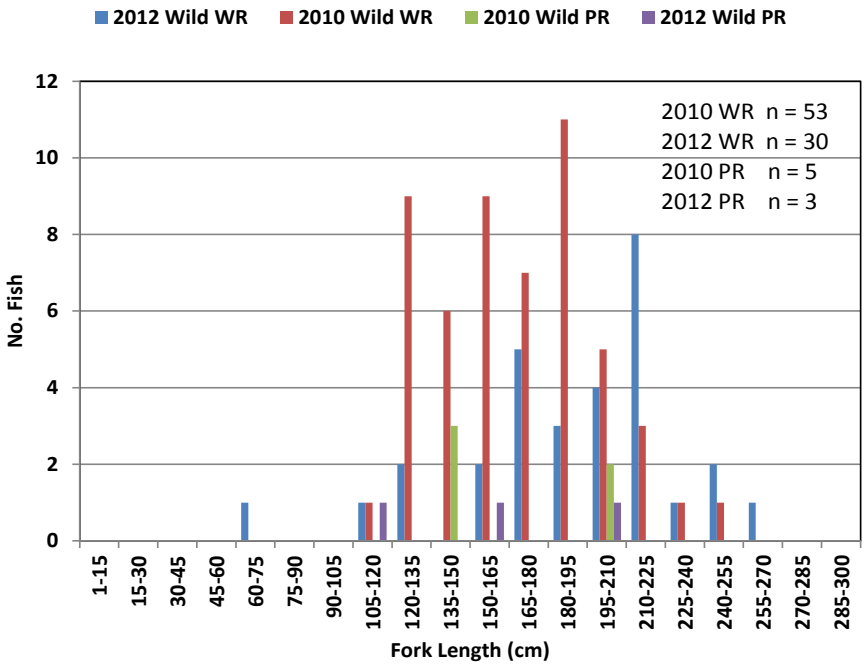
CRITFC White Sturgeon





- **Wanapum = 3,740 individuals (95% CI = 2,340 to 5,830)**
- **Priest Rapids = 1,729 individuals (95% CI = 889 and 3,181)**

Wild White Sturgeon



Wild White Sturgeon population = 505 fish (~13.5% of the hatchery population)

POPULATION MODELING

- **Population trajectories were modeled with a simple age-structure demographic model (Beamesderfer 2001) using:**
  - **Best available data on abundance, growth, maturation, and juvenile and adult survival**
  - **Hypothetical wild sturgeon recruitment rates**
  - **Generous adult population targets**

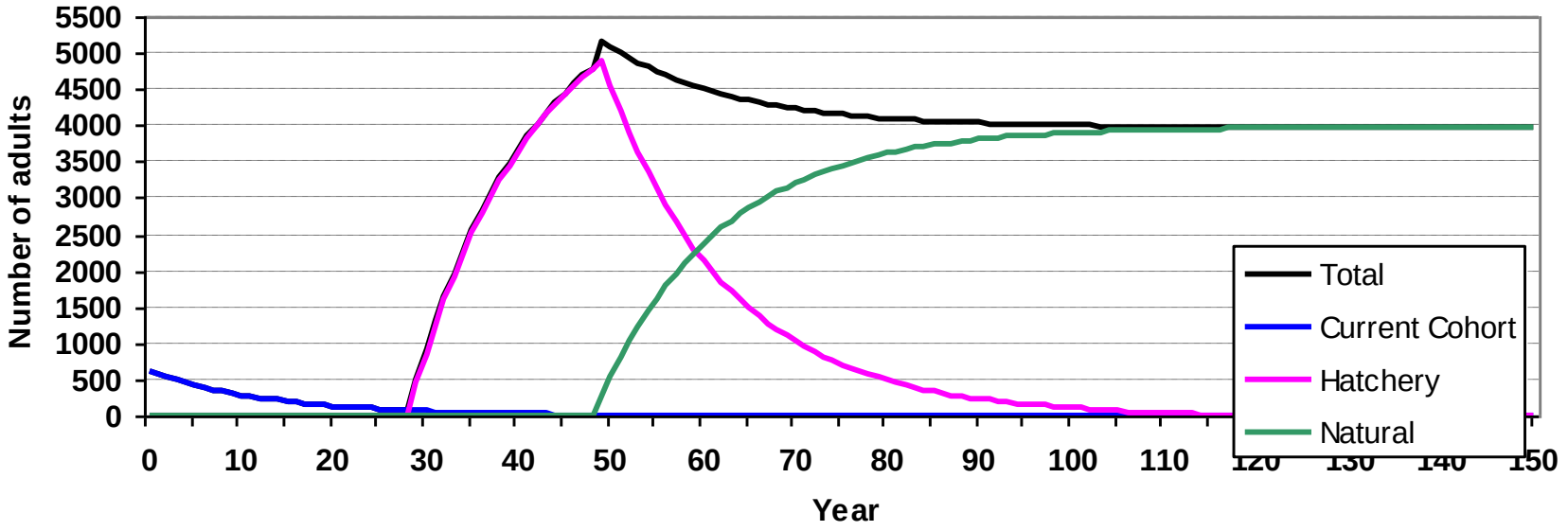
POPULATION MODEL ASSUMPTIONS

- **Data used as inputs to derive out-planting targets for each reservoir:**
  - **Growth data (PRPA)**
  - **25 years to female maturity (based on UCR data)**
  - **1:1 sex ratio**
  - **Female spawning interval of 5 years**
  - **60% survival in first year of release (based on KR data)**
  - **88% annual survival for age-1 to 10 (based on UCR data)**
  - **91% annual survival for >age-10 (based on UCR data)**
  - **Zero natural production for 25 years**

STOCKING RECOMMENDATIONS

Wanapum Reservoir

Stock 6,500 yearlings annually for 25 years
Natural recruitment of 3,250 yearlings/yr after 25 years
Peak of 5,000 adults in 50 years
Population stabilizing at 4,000 adults in 100 years.



STUDY PLAN REFINEMENTS

- **In 2008, GCPUD (with PRFF approval) commissioned Golder to update the initial WSMP with latest population data:**
  - **Update species life history data to incorporate new data on adult survival rates (from UCWSRI) and growth rates (from PRPA)**
  - **Re-run the population model using the updated data to assess validity of initial stocking targets**
  - **Review the breeding plan and revise based on new genetic data and sturgeon culture practices**
- **These changes indicated that based on the new survival values, stocking targets could be reduced while still achieving generous adult targets**

RATIONALE FOR ADULT TARGET REDUCTIONS

- **Target pop. of 4,000 adults in Wanapum (~58 km in length) = 68 adults/km**
  Target pop. of 2,000 adults in Priest (~29 km in length) = 69 adults/km

- **More reasonable adult targets for Wanapum and Priest Rapids reservoirs were considered to be in the neighborhood of 1,500 adults and 400 adults (~15/km), respectively**

- **These could be achieved with substantially lower juvenile stocking rates in the future**

- **Led to recommendation of an annual release of up to 6,500 yearlings into the PRPA for the next 5 years (maximums of 2,000/yr in PR and 4,500/yr in WR)**

STURGEON DENSITIES IN THE COLUMBIA RIVER

Estimates are relevant to the publication date and have not been standardized.

River System	Population Segment	Habitat Type [Length] [1]	Population Estimate (95% CI) [min FL]	Reference	No. Fish per RKM
Columbia (Lower)	Unimpounded	Riv (187 km) Est (48 km)	895,500 (678,000-1,058,300) [54 cm]	DeVore et al., 1995	3810
	Bonneville	Res (75 km)	128,548 (108,300-143,300) [54 cm]	Kern et al., 2001	1714
	The Dalles	Res (39 km)	59,800 (52,400-68,200) [70-166 cm]	Ward et al., 1999	1533
	John Day	Res (122 km)	29,831 (27,070-33,122) [54 cm]	Kern et al., 2002	562
Columbia (Mid)	Hanford Reach and McNary	Riv (89 km) Res (80 km)	5,200 (3,800-9,100)	Rien et al., 1997	31
	Priest Rapids	Res (53 km)	134 (48-2,680) [45 cm]	Golder 2004a	3
	Wanapum	Res (96 km)	551 (314-1,460) [45 cm]	Golder 2004a	6
	Rocky Reach	Res (69 km)	47 (23- 237) [60 cm]	Golder 2003a	<1
	Wells	Res (48 km)	31 (13-218) [65 cm]	Jerald 2007	<1
	Chief Joseph	Res (82 km)	-		
Columbia (Upper)	Roosevelt Reach	Res (214 km) Riv (26km)*	2,037 (1,093-3,223) [70 cm]	Howell and McLellan, 2007b	20
	Keenleyside Reach	Riv (56 km)	1,160 (415-1,900) [50 cm]	Irvine et al., 2007	21
Snake (Lower)	Ice Harbor	Res (51 km)	4,830 [54 cm]	Ward 1998	95
	Lower Monumental	Res (46 km)	4,262 [54 cm]	Ward 1999	92
	Little Goose	Res (60 km)	6,492 [54 cm]	Ward 1999	108
	Lower Granite	Res (63 km) Riv (162 km)	4,171 (3,584-5,082) [50 cm]	Everett et al., 2003	18
	Brownlee	Res (88 km) Riv (190 km)	155 (70-621) [60 cm]	Lepla et al., 2001	<1
	Swan Falls	Res (17) km Riv (40 km)	566 (330-1,995) [60 cm]	Lepla 2008b	10
	C.J. Strike	Res (38 km) Riv (68 km)	3,013 (1,956-4,762) [60 cm]	IPC 2005	28
	Bliss	Res (8 km) Riv (13 km)	83 (53 – 196) [60 cm]	Lepla et al., 2004	4
	Lower Salmon	Res (12 km)	21 (19 – 27) [60 cm]	Lepla et al., 2004	2
	Upper Salmon	Res (8 km) Riv (46 km)	777 (574-1,201) [~ 60 cm]	Lepla et al., 2002	14

[1] Riv = Riverine: Res = Reservoir: Est = Estuarine: Del = Delta

* Denotes sections with large storage reservoirs and variable river and reservoir lengths; values provided represent lengths of each habitat type at typical full reservoir level; sturgeon only occupy upper third of reservoir so total useable length set to 100 km

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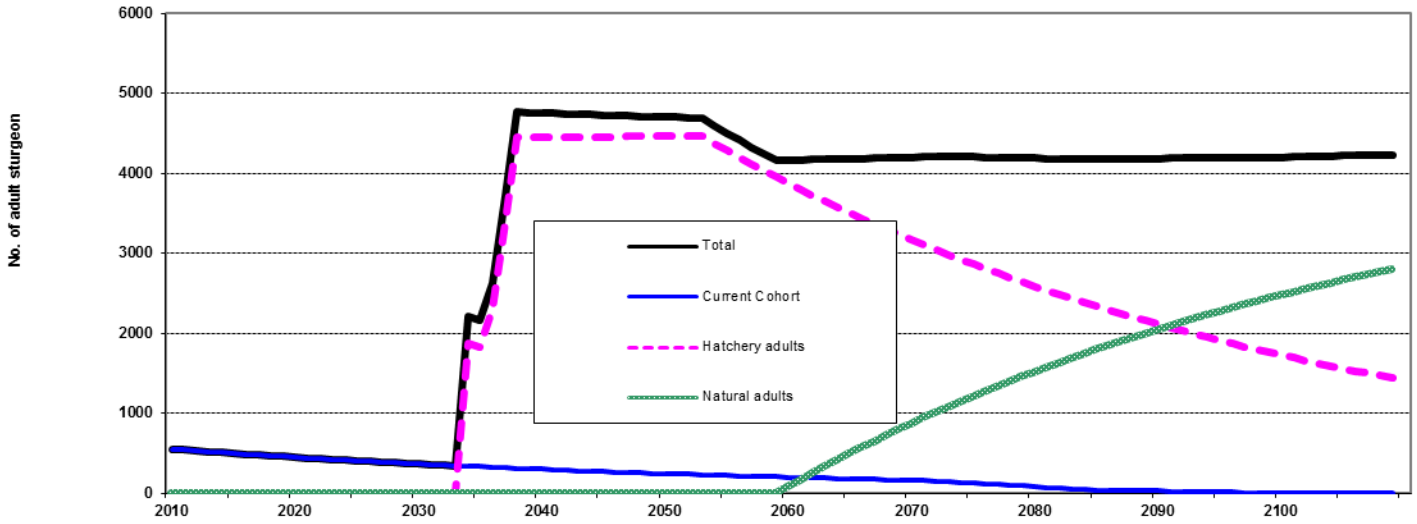
MODEL UPDATES - 2015

- **Most recent data used as inputs to the model:**
  - **86% (vs 30%) annual survival in first year (UCR data) for 200g juvenile**
  - **98% annual survival for >age-2 (UCR data)**
  - **Zero natural production for 25 years**
- **Revised model projections using these most recent survival values (shown on next two slides) indicate that substantially lower annual stocking rates would still produce adult numbers that are likely above the carrying capacity of the PRPA**
- **Population densities of this magnitude will likely have impacts on resident species**

PRPA POPULATION MODEL UPDATES - 2015

Wanapum Reservoir

Stocked 19,351 juveniles from 2011 to 2015
Stock 400 yearlings annually for next 20 years
Natural recruitment of 400 yearlings/yr after 25 years
Population stabilizing at ~4,000 adults in 50 years.



PRPA POPULATION MODEL UPDATES - 2015

- **Most recent data used as inputs to the model indicate:**
  - **Of the 19,351 juveniles stocked in Wanapum from 2011-2015, 9,662 (166 fish/RKM) would survive to 30 years (2041)**
  - **Of the 6,814 juveniles stocked in Priest Rapids from 2011-2015, 3,400 (117 fish/RKM) would survive to 30 years (2041)**
- **These fish would be adults in 30 years and at these population levels would exceed any known adult (or adult and juvenile combined) densities in the Middle or Upper Columbia River basin**
- **Population densities of this magnitude will likely have impacts on resident species**

Keys to Recovery

- **Main factors that affect the path to recovery of White Sturgeon:**

  - **Numbers and survival of hatchery juveniles stocked annually**
    - **Determines rate of recovery**

  - **Carrying capacity of the system**
    - **Determines the upper limit of recovery**

  - **Proportion of the available genetic diversity that has been captured by the breeding/release programs**
    - **Determines the reproductive and adaptive quality of the fish released**

Summary and Recommendations

- **Original stocking targets and adult targets for PRPA were too aggressive**
- **Available data from PRPA and other recovery programs support reducing stocking rates**
- **Continue to collect data from M&E programs to adaptively adjust future stocking rates**
- **Use wild caught eggs and larvae as a replacement for broodstock to enhance genetic diversity**

WSMP TASKS – WHERE ARE WE AT

- **Task 1: Determine effectiveness of the supplementation program**

  - **Appears very successful**
  - **Juvenile survival appears to be high based on abundance in catch and data from other populations**
  - **Growth and condition also high**
  - **Abundance and size of CRITFC fish also supports assumptions of suitable conditions for juvenile growth and survival in PRPA**

WSMP TASKS – WHERE ARE WE AT

- **Task 2: Determine the carrying capacity of each reservoir**
  - **Still undetermined**
  - **Ecopath modelling investigated**
  - **Available data from other reservoirs in Columbia system suggest existing adult population targets in PRPA may be too high**

WSMP TASKS – WHERE ARE WE AT

- **Task 3: Participate and cooperate in the development of regional White Sturgeon management efforts**
  - **Active and ongoing**

WSMP TASKS – WHERE ARE WE AT

- **Task 4: Determine juvenile downstream passage rate and survival.**
  - **Available data suggests downstream entrainment rates are low and not at a level that should require adjustment of stocking rates**