#5

Trinity River Restoration Program

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MEMORANDUM

TO: TRINITY ADAPTIVE MANAGEMENT WORKING GROUP (TAMWG)

FROM: ERNIE CLARKE, SCIENCE PROGRAM COORDINATOR, TRINITY RIVER RESTORATION PROGRAM (TRRP)

CC: JENNIFER FALER, INTERIM EXECUTIVE DIRECTOR, TRRP

SUBJECT: SCIENCE PROGRAM REPORT

DATE: SEPTEMBER 13, 2010

Background

The TAMWG requested the following in a June 15, 2010 letter, "Ask the science coordinator to provide a periodic Adaptive Management report that documents TRRP hypothesis testing, with results to date, revisions or additions made or under consideration for the hypotheses, etc.". A joint presentation at the September 2010 TAMG meeting constitutes the first such report.

Presentation Content / Participants

The joint presentation showcases fish, wildlife and physical hypotheses being evaluated in support of the TRRP. Each contributor was asked to present the following: 1) research question(s), 2) relevance to program, 3) findings to date, 4) management recommendations and 5) future products. Presenters are listed in bold and their slides are attached.

Adult salmonids

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Future Reports

Will be updated quarterly, strive to be comprehensive, and use the IAP as a framework.

TRRP ADULT SALMONID HYPOTHESIS

Rehabilitation actions implemented under the ROD will increase annual recruitment of naturally produced anadromous species to achieve both escapement goals and enhanced harvest opportunities for dependent tribal, sport and commercial fisheries.

TRRP SUB-HYPOTHESES

1. An increase in the amount and quality of juvenile rearing habitat will lead to increased survival and abundance of juvenile salmonids. (Increase carrying capacity)
2. Flow and gravel augmentation will improve/increase spawning habitat leading to increased spawner distribution and egg survival/fry emergence
3. Improved spring/summer temperature regimes will improve survival and health of out-migrating juvenile salmonids
4. Improved in-river juvenile salmonid habitat conditions will result in improved hatchery/wild fish ratios. (given constant hatchery production)

ALTERNATIVE HYPOTHESES

1. Recruitment of Trinity River anadromous fishes will not increase due to limitations in spawner escapement caused by excessive fishing mortality.
2. Recruitment of Trinity River anadromous fishes will not increase due to limitations imposed by lower Klamath River, Klamath estuarine and/or ocean conditions.
3. Recruitment of Trinity River anadromous fishes will not increase due to limitations imposed by density dependent habitat constraints.
4. Recruitment of Trinity River anadromous fishes will not increase due to limitations imposed by hatchery–natural interactions.

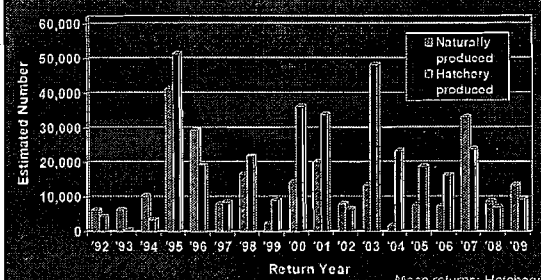
METRICS FOR HYPOTHESIS TESTING

1. ***Adult anadromous spawner escapement*** of adult anadromous fish, specifically:
   - *62,0000 naturally produced fall Chinook salmon;*
   - *6,000 naturally produced spring Chinook salmon;*
   - *40,000 naturally produced steelhead; and*
   - *1,400 naturally produced coho salmon.*
2. ***Contribution of Trinity River naturally produced anadromous fish*** to dependent, sport and commercial fisheries and recruitment
3. ***Hatchery to natural adult ratios***

IMPORTANT CROSS DISCIPLINE METRICS

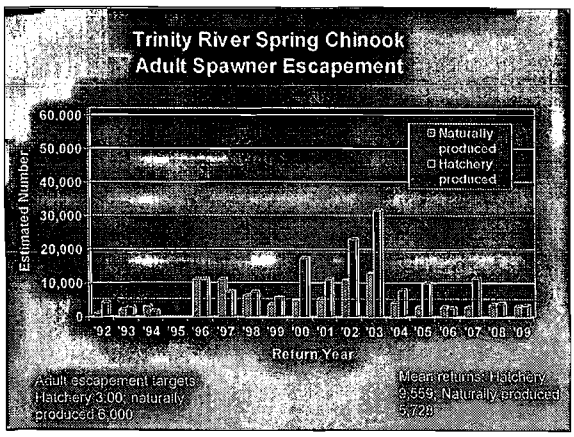
5. ***Smolts per spawner*** Natural area escapement estimates and RST juvenile emigration estimates.
6. ***Distribution of spawners***. Natural area escapement estimates and redd survey distribution mapping.
7. ***Prespawn mortality*** rates. Natural area escapement estimates and carcass survey mortality estimates.
8. ***Juvenile fish density*** (fish/habitat unit or area)

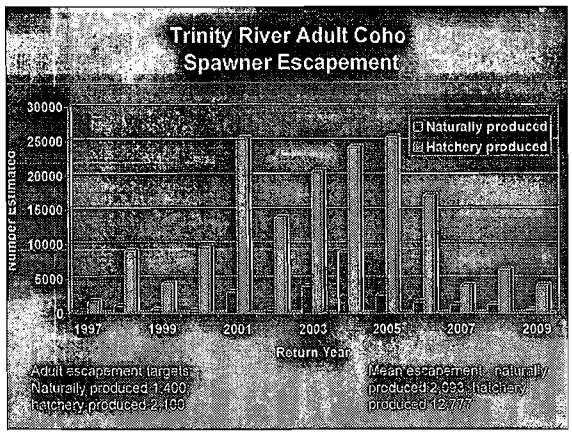
Trinity River Fall Chinook Adult Spawner Escapement

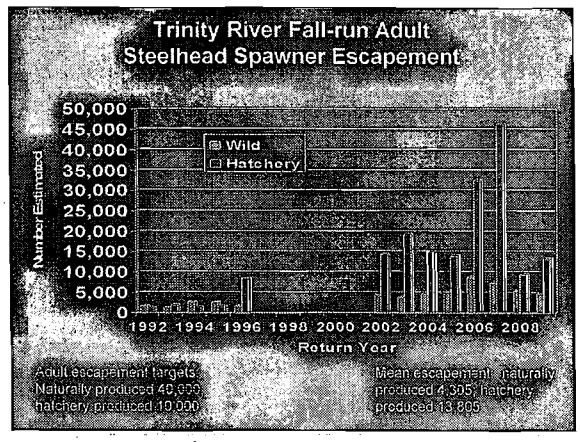


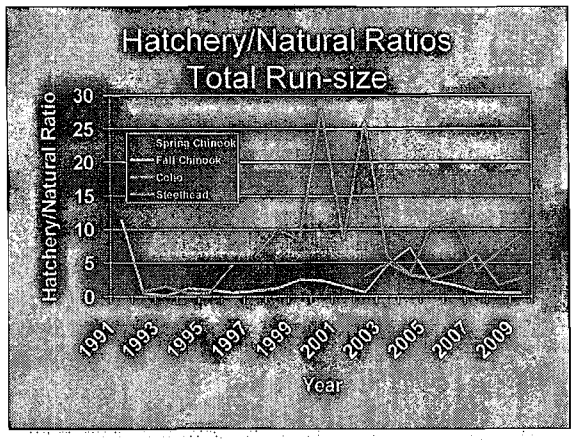
Adult escapement targets: Hatchery 9,000; naturally produced 62,000

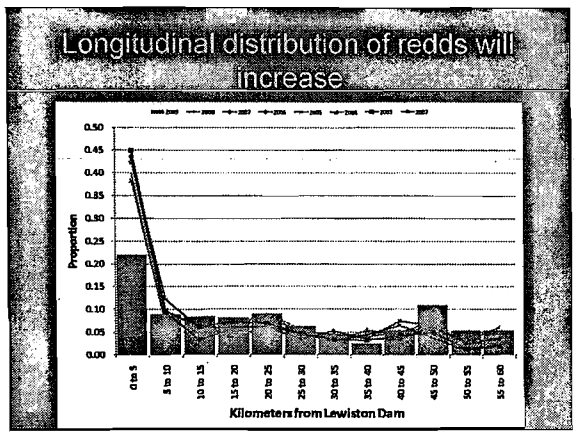
Mean returns: Hatchery 19,191; Naturally produced 14,099


Trinity River Spring Chinook
Adult Spawner Escapement
Estimated Number
60,000
50,000
40,000
30,000
20,000
10,000
0
'92 '93 '94 '95 '96 '97 '98 '99 '00 '01 '02 '03 '04 '05 '06 '07 '08 '09
Return Year
Naturally produced
Hatchery produced
Adult escapement targets: Hatchery 3,000; naturally produced 6,000
Mean returns: Hatchery 9,559; Naturally produced 5,728


Trinity River Adult Coho
Spawner Escapement
Number Estimated
30000
25000
20000
15000
10000
5000
0
1997
1999
2001
2003
2005
2007
2009
Return Year
Naturally produced
Hatchery produced
Adult escapement targets: Naturally produced 1,400; hatchery produced 2,100
Mean escapement: naturally produced 2,093; hatchery produced 12,777


Trinity River Fall-run Adult
Steelhead Spawner Escapement
Number Estimated
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1992 1994 1996 1998 2000 2002 2004 2006 2008
Return Year
Wild
Hatchery
Adult escapement targets: Naturally produced 40,000; hatchery produced 10,000
Mean escapement: naturally produced 4,305; hatchery produced 13,805


Hatchery/Natural Ratios
Total Run-size
Hatchery/Natural Ratio
30
25
20
15
10
5
0
Spring Chinook
Fall Chinook
Coho
Steelhead
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Year


Longitudinal distribution of redds will increase
Proportion
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Kilometers from Lewiston Dam

Adult spawner escapement of hatchery- and naturally-produced Trinity River salmonids[1]

	Naturally Produced Adult Spawner Escapement[2]								Trinity River Hatchery Produced– Adult Spawner Escapement[3]							
	Fall Chinook[4]		Spring Chinook[5]		Fall Steelhead[6]		Coho[7]		Fall Chinook[4]		Spring Chinook[5]		Steelhead[6]		Coho[7]	
Year	Actual	% of Target Goal	Actual	% of Target Goal	Actual	% of Target Goal	Actual	% of Target Goal	Actual	% of Target Goal	Actual	% of Target Goal	Actual	% of Target Goal	Actual	% of Target Goal
1992	6,507	10%	1,320	22%	1,565	4%	ND	ND	4,411	49%	1,119	37%	1,189	12%	ND	ND
1993	6,350	10%	2,127	35%	1,186	3%	ND	ND	363	4%	2,950	98%	1,676	17%	ND	ND
1994	10,508	17%	3,218	54%	2,418	6%	ND	ND	3,662	41%	1,877	63%	1,281	13%	ND	ND
1995	41,466	67%	ND	ND	2,548	6%	ND	ND	51,588	573%	ND	ND	1,448	14%	ND	ND
1996	29,629	48%	11,172	186%	1,751	4%	ND	ND	19,428	216%	11,412	380%	8,091	81%	ND	ND
1997	8,152	13%	11,204	187%	ND	ND	252	18%	8,742	97%	7,477	249%	ND	ND	1,732	82%
1998	16,742	27%	6,451	108%	ND	ND	1,001	72%	22,014	245%	7,490	250%	ND	ND	9,008	429%
1999	2,487	4%	3,806	63%	ND	ND	543	39%	9,303	103%	6,023	201%	ND	ND	4,271	203%
2000	14,533	23%	5,163	86%	ND	ND	342	24%	36,365	404%	17,550	585%	ND	ND	9,704	462%
2001	20,551	33%	5,603	93%	ND	ND	3,075	220%	34,247	381%	11,227	374%	ND	ND	25,395	1209%
2002	8,225	13%	11,142	186%	4,593	11%	458	33%	6,701	74%	23,336	778%	13,711	137%	13,849	659%
2003	13,501	22%	13,160	219%	3,879	10%	3,930	281%	48,530	539%	31,804	1060%	18,899	189%	20,721	987%
2004	1,842	3%	4,484	75%	4,769	12%	8,901	636%	23,677	263%	8,138	271%	14,625	146%	24,122	1149%
2005	7,832	13%	2,892	48%	5,343	13%	2,648	189%	19,045	212%	10,142	338%	13,862	139%	25,678	1223%
2006	7,494	12%	3,119	52%	8,698	22%	1,586	113%	16,323	181%	2,609	87%	31,781	318%	17,123	815%
2007	33,280	54%	2,999	50%	7,484	19%	1,157	83%	24,179	269%	11,568	386%	43,484	435%	4,048	193%
2008	9,047	15%	3,781	63%	5,439	14%	1,223	87%	7,309	81%	4,126	138%	9,152	92%	6,381	304%
2009	14,490	23%	3,280	55%	4,894	12%	520	37%	9,558	106%	3,648	122%	11,938	119%	4,067	194%
Means:	14,035	23%	5,584	93%	4,197	10%	1,972	141%	19,191	213%	9,559	319%	13,164	132%	12,777	608%

1. Data compiled by DFG.
2. Estimates of naturally-produced adult salmonid spawner escapement for combined natural and hatchery spawning areas.
3. Estimates of hatchery-produced adult salmonid spawner escapement for combined natural and hatchery spawning areas.
4. Fall Chinook estimates upstream of Wilow Creek weir 1992 - 2000. Trinity River Basin estimate for 2001 - 2009 (assumes no straying of hatchery produced spawner escapement downstream of Willow Creek weir).
5. Spring Chinook estimates upstream of Junction City weir combined with dive counts for the South Fork Trinity River and miscellaneous tributaries.
6. Fall-run steelhead estimates upstream of Willow Creek weir for all years shown. Does not include summer- or winter-run steelhead estimates.
7. Coho estimates upstream of Willow Creek weir for all years shown.

TRRP adult escapement goals

Species	Natural	Hatchery
Fall Chinook	62,000	9,000
Spring Chinook	6,000	3,000
Coho	1,400	2,100
Steelhead	40,000	10,000

Foothill Yellow-legged Frogs
TAMWG 13Sept10

Egg Masses on Hurty Gurty Creek, Del Norte County: 8May04

Foothill Yellow-legged Frogs

Sub-objective 6.4: Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs (FYLF)

6.4.1 Increase population size, survival, distribution, and recruitment success of Foothill Yellow-legged Frogs

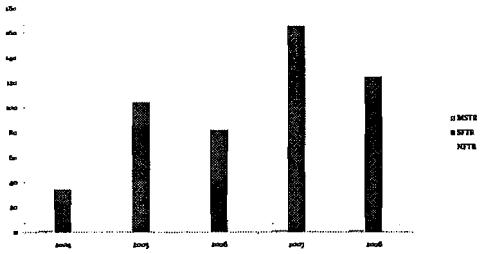
6.4.2 Increase quality and quantity of breeding and rearing habitat for Foothill Yellow-legged Frogs.

Egg Masses per Kilometer

	2004	2005	2006	2007	2008	2009
NFTR	58.5	44.7	45.7	NA	39.3	85.9
SFTR	34.3	101.9	81.7	165.6	124.6	74.8
MSTR	1.07	0.48	0.54	0.92	0.28	2.0

"Em/km" is a measure of reproductive effort, not reproductive success.

Graphical Representation

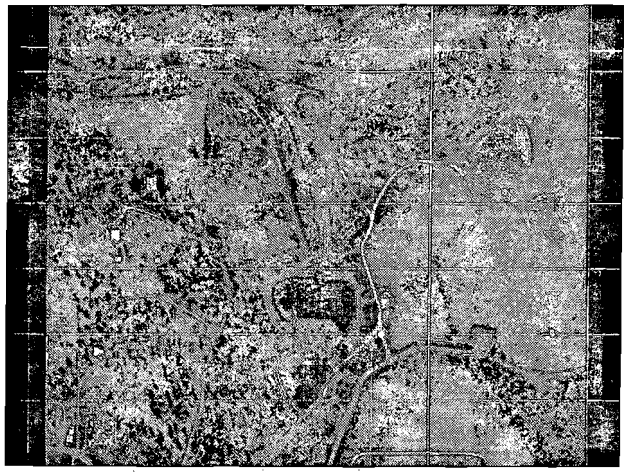


Float Surveys (2008)

River	Date	Egg Masses	Distance (Km)	Egg Masses per Kilometer
SFTR	22-May-08	810	6.5	124.61
MSTR	4-Jun-08	1	21.19	0.047
MSTR	18-Jun-08	9	21.19	0.4247
MSTR	2-Jul-08	19	21.19	0.8966
MSTR	17-Jul-08	6	21.19	0.2831"
NFTR	11-Jun-08	53	1.35	39.25925926
Weaver Ck	10-Jun-08	54	1.02	52.94117647
Mad	18-May-08	226	2.51	90.03984064

Float Surveys 2008 (Recruitment)

- Four repeated float surveys on MSTR
- Distribution of 8 Sites for 19 Egg Masses
- Post drop in flows from 2000 cfs to 700 cfs desiccates 13 of 19 Egg Masses (68%) and strands 6 of 8 Sites (75%)

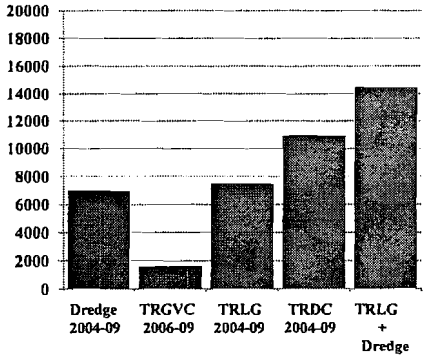


Wellock Pond was constructed in 1984 – it was re-excavated to some extent in 1986 and in 1995, but has otherwise not been regularly maintained. Wellock Pond was a long, narrow deepening of the GVC channel. It has partially filled. Upper and Lower Hamilton Ponds were excavated in 1988 and 1989, respectively. Diameters 200 to 300 feet.

Year	Dredge (yards)	Fill (yards)	Source	Notes
1984			DWR 1994	Wellock pools constructed
1985	0		Trso 2004 and DWR 1994	
1986	30000		Trso 2004 and DWR 1994	Wellock pond dredged
1987	0		Trso 2004 and DWR 1994	
1988	0		Trso 2004 and DWR 1994	Upper Hamilton constructed
1989	4300		Trso 2004 and DWR 1994	Lower Hamilton constructed
1990	0		Trso 2004 and DWR 1994	
1991	0		Trso 2004 and DWR 1994	
1992	6600		Trso 2004	Hamilton only, DWR 1994 reported 5000
1993	6048		Trso 2004	Hamilton only
1994	0		Trso 2004	
1995	53600		Trso 2004	48000 from Hamilton, 5600 from Wellock*
1996	0		Trso 2004	
1997	13000		Trso 2004	
1998	34700	14000	Trso 2004	Ponds full, 14000 tons spilled to river
1999	0		Trso 2004	
2000	No data	2930	GMA survey (fill)	
2001	No data	1140	GMA survey (fill)	
2002	6200	1120	RCD pers. com. (dredge) GMA survey (fill)	
2003	2900		RCD pers. com. (dredge) GMA survey (fill)	
2004	3700	7080	RCD pers. com. (dredge) GMA survey (fill WY2003-04)	
2005	3650	1500	RCD pers. com. (dredge) GMA survey (fill)	
2006	9200	4740	RCD pers. com. (dredge) GMA survey (fill)	
2007	11700		RCD Report	
2008	0		RCD Report	
2009	0		RCD Report.	

Dredge and fill records for Hamilton and Wellock Ponds. GMA refers to Graham Matthews and Associates; RCD refers to the Trinity County Resource Conservation District. *Wellock pond has not been dredged since 1995.

GVC delivery compared with mainstem transport



Hamilton Ponds Management Recommendation

Potential sediment deliveries from GVC are about 1/3 of sediment yields at the time the ponds were constructed.

Mainstem fine sediment loads upstream from Indian Creek would increase by factors between 2 to 5 if dredging were discontinued.

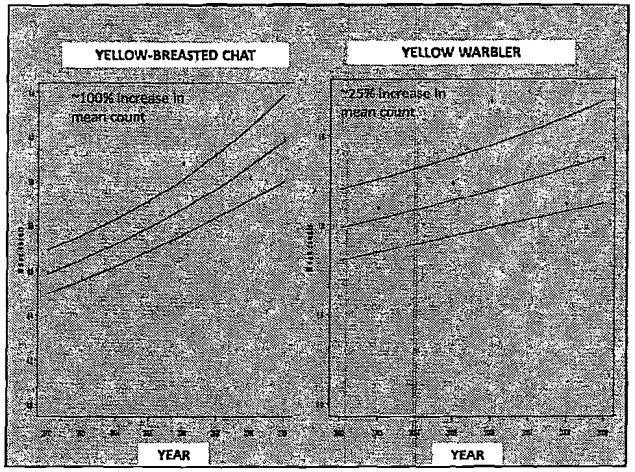
- Substrate conditions upstream from Indian Creek could resemble current conditions downstream from Douglas City;
- However, the additional fine sediment loading from GVC could be effectively managed with mainstem flow releases.

Dredging to maintain a storage capacity of 7,500 yards in one of the ponds for the next 3-5 years is recommended.

The need for continued dredging should be re-assessed after 3-5 years – accurate record keeping is key.

Future Needs

- Continued Monitoring of Riparian and Riverine Birds
- Continued Analyses to Identify Causes of Changes in Abundance
  - Updated riparian habitat maps
  - Continues monitoring of amount of aquatic habitats



Here the peak was in 2006 and 2007, and again a decline to a low in 2008.

It's too bad we couldn't follow up on this this year.

What Have We Learned?

- 4 of 5 Target Riparian Species Increased
- Abundance Varied by Species and Year
- Additional years of monitoring are needed to measure changes in bird populations

- Abundance has increased of 4 of the 5 target riparian species since 2002, before restoration efforts began
—— that's the good news!

- As especially indicated by Yellow Warblers, abundance varies by over time and monitoring should continue through the implementation phases of restoration to assure measurement across the possible ranges of variation

TREND ANALYSES FROM POINT COUNT SURVEYS

Generalized Linear Model with Mixed Effects

$$\log\lambda = a + b \times Year + \varepsilon_{Reach} + \varepsilon_{Year(Reach)}$$

With a Random Reach Component:

$$\varepsilon_{Year(Reach)} \sim N(0, \sigma^2)$$

And A Random Year within Reach Component:

$$Cov(\varepsilon_{Year_i(Reach)}, \varepsilon_{Year_j(Reach)}) = \sigma^2 \rho^{|Year_i - Year_j|}$$

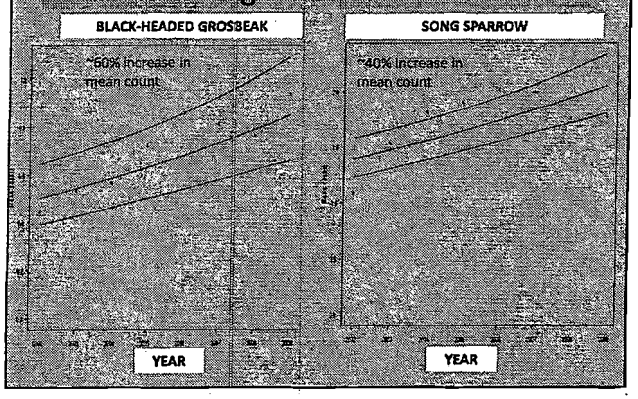
One way we are testing the example hypothesis is by looking at trends in bird abundance from point count surveys.

We used a Generalized Linear Model to look for trends in abundance ---

With the log of the mean counts per km as a linear function of the year -- plus some error terms

We included a random reach component and a random Year-within-reach component to account for differences by reach and year not associated with the trend.

TRENDS
40-Mile Program Area --2002-2009



Analysis has given us a measure of bird abundance on the Trinity across the entire 40 miles...

From 2002-2009 we found significant increases in 4 Target species of riparian birds.

Notice the year to year variation, with a peak in 2006 in both species, and a low in 2008

SURVEY METHODS

- Point Counts
- Area Search
- River Float Surveys
- Demographics
- Vegetation Plots
- Species Specific Surveys
- Pre-Construction Breeding Activity

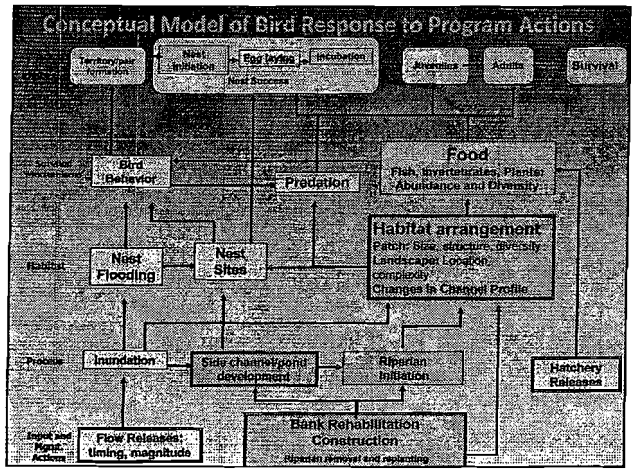
- Several types of surveys were used to address different hypotheses
- To measure abundance

- Point Counts -- Mainstem, Rehab, Tribs
- Area Search -- Mainstem, Rehab, Demog stations
- River Float Surveys – Aquatic Bird Abundance and Distribution
- Demographics – Age Ratios, Population Growth, Survival, Health
- Vegetation Plots Habitat Quality and Quantity, and Associations
- Species Specific Surveys – Presence, esp. for Compliance, i.e. WIFL surveys
- Pre-Construction Breeding Activity – Assessing risk of starting construction

Annual Bird Survey Summary 2002 to 2010

SURVEY TYPE	TOTAL STATION VISITS	2002	2003	2004	2005	2006	2007	2008	2009	2010
River Pt.Cnts	1720	292	292	75	416	136	95	245	141	0
Rehab Pt.Cnts	141		96	60	135	78	95	35	138	0
Trib. Pt.Cts	240			132	109					0
So. Fork Pt.Cts	944	706		238						0

- Data from various point count sampling designs were combined to measure response.



- We developed testable hypotheses from Conceptual models of bird response to changes in the river and riparian habitat
- Today we will focus on one of these hypothesis addressed by bird monitoring:

IN ORANGE:

- The quantity and quality of riparian habitat resulting from bank rehab sites and side channel construction will increase survival of target riparian bird species in the 40 miles of the Program area.
- Measures of habitat quality include habitat amount and arrangement, presence of cover from predation, and availability of food.
- Survival is measured by abundance at point count survey stations sampled across the Program

Why is Bird Monitoring Important for TRRP?

- Hypotheses Testing
  Example: Habitat changes following bank rehabilitation construction and riparian initiation will increase food resulting in increased total number of breeding adults and juveniles.
- Compliance Goals Met?

- Several metrics for testing hypotheses:
  - Population: Number of adults and number of breeding adults measures by point counts
  - Reproduction: Number of juveniles and ratio of juveniles to adults measured at demographic/banding stations.
  - Survival: Population Growth rates and survival rates measured at banding stations

- Is the required 1:1 riparian habitat replacement meeting the ROD needs to maintain or enhance wildlife populations?
  - Are the riparian patches resulting from different rehabilitation efforts all performing equally well for the birds?

Bird Monitoring: A Restoration Tool

Bird Response Hypothesis Testing

REDWOOD SCIENCES LABORATORY and
KLAMATH BIRD OBSERVATORY

BIRD MONITORING OBJECTIVES ADDRESS SCIENCE AND COMPLIANCE REQUIREMENTS

- Wildlife Objective as stated in the IAP is to: Rehabilitate and protect wildlife habitats and maintain or enhance wildlife populations following implementation
- Sub-Objectives for Birds:
  Maintain Trinity River populations and species diversity of birds that are using the riparian and riverine habitats in the Program Area