Foothill yellow-legged frogs in the Sierra Nevada Region

- North Fork Feather River 2001-2007
- South Fork American River 2005 and 2007
- Others-Mokelumne, Stanislaus, Bear River, Consumnes, North and Middle Fork American...
Egg masses

- Timing of oviposition - onset and duration of breeding season
- FYLF breeding habitats at elevated flow levels
- Habitat characteristics of egg masses and breeding sites
  - detached egg masses
  - crayfish predation on egg masses
  - fungal egg masses
  - depth, distance to shore and velocity of egg masses locations
- scouring and stranding
- variation in annual counts
- breeding loci
- observed development rates - NFFR and SFAR, 2005 vs. 2007
Timing of oviposition - onset and duration of breeding season

• Across their range FYLF breeding from March to June

• On the NFFR, late April to mid June during 2002 to 2007

• Depends on water temperature (10 to 16°C) and flow levels (stable or declining)

• Dry, low water years are typically long seasons

• Wet, high water years are often short seasons
Breeding season 2004

[Graph showing water temperature, number of egg masses laid, and flow (CFS) over dates from April to July.]

- Poe data
- Cresta data
- Cresta hydrograph
- Poe hydrograph
# Breeding Season Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Poe</th>
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<th>Cresta</th>
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<tbody>
<tr>
<td><strong>First egg mass laid</strong></td>
<td><strong>Mean date</strong></td>
<td><strong>Duration (days)</strong></td>
<td><strong>First egg mass laid</strong></td>
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<tr>
<td>4/27/07</td>
<td>5/24</td>
<td>56</td>
<td>5/1/07</td>
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<td>5/29/06</td>
<td>6/7</td>
<td>20</td>
<td>6/7/06</td>
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<td>5/17</td>
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<td>4/18/04</td>
<td>5/7</td>
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<td>5/24/04</td>
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<tr>
<td>5/20/03</td>
<td>5/28</td>
<td>17</td>
<td>5/29/03</td>
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</table>
FYLF breeding habitat at elevated flow levels
Habitat characteristics of oviposition sites

- Attachment substrate = boulder
- Substrate at Egg Mass = cobble/boulder
- Orientation on Substrate = streamside
- Flow Orientation = no flow and along side
- Microhabitat = Edgewater
- Mainstream Habitat = run
Habitat characteristics of egg masses and breeding sites

- Depth
- Distance to shore
- Flow velocity
Depth of egg masses

![Graph showing the depth of egg masses versus water depth. The graph plots total egg masses against water depth in centimeters. The data points are represented by blue diamonds and pink squares, indicating different categories or conditions.]
Egg masses distance to shore
Water velocity at egg masses
Detached egg masses

• ~5% of egg masses found on the NFFR were detached when first observed
• Detached egg masses are very susceptible to scouring
• Crayfish, garter snakes, and fish may contribute to egg mass detachment
Fungal egg masses

• 26% of egg masses observed during 2002 to 2004 appeared to have been infected with a fungus.

• One tested positive for *Saprolegnia*
Scouring and Stranding
## Scouring and Stranding

<table>
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<th>Year</th>
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<td></td>
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<td>stranded</td>
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<tr>
<td>2007</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>average</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>8</td>
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</tbody>
</table>

**Project related**

**Natural events**
variation in annual counts

No of egg masses

2002 2003 2004 2005 2006 2007

Poe

Cresta

34 46 61 63 89 113

11 22 28 33 4 7
Breeding loci

• Egg masses are generally laid in the same areas each year i.e. at the same sites and the same general locations within each site.

• But, not always, e.g. 2003 eggs all at lower end vs. 2004-05 used top of site.
Tadpoles
Tadpole attrition

June 9, 2003

June 13, 2003
Tadpole attrition

Counts decreased 21 to 30 per day
Tadpoles found following search and rescue ramp down

Tadpole mortality at Subsite 1a found in shallow water the day following the search and rescue operation.

Injured FYLF tadpole found 26 July 2004 at Subsite 6b 48 hours post flow.
Predation

**Documented predators:**

- Sierra garter snake (23 small and 4 large tadpoles consumed by 5 snakes)
- Signal crayfish (video monitoring; tadpoles observed with tail injuries)

**Suspected predators:**

- Native cyprinids (one cyprinid attempted to consume recently-hatched tadpole)
- Smallmouth bass (common; Centrarchids known to consume ranid tadpoles)
Hannibal and cannibal
Juveniles
Fall count of juveniles

• Easiest life stage to survey for:
  – best access and survey conditions
  – most visible life stage
• Provides an index of recruitment
  – Alternative to egg mass counts alone
• Provides distributional information
  – Location of potential breeding sites
  – Location of different life stages
YOY vs. Juvenile vs. Subadult

YOY = young of the year <25mm SUL, 2007 cohort <6 months

Juvenile = 28 to 31 mm, 2006 cohort, 15 months

Subadult = 35 to 46 mm, 2005 cohort, 27 months

Adult male = 43 to 53 mm SUL (mean=48 mm), 3+ years
Adult female = 55 to 67mm SUL (mean=62.5mm), 3+ years
Distribution of juvenile and adult frogs
Adults
Adult frogs

- Movement patterns
- Surveys and catchability/detectability
- Location and activity
- Sex ratios
- Size frequency
- Growth curves
Adult movement patterns

Movement to River

River Breeding

Movement patterns

Amplexus

Oviposition

Tributary Refugia
Mean # Frogs Observed at Various Weather Conditions over 36 Survey Days Tributary 5 - 2005

\[ y = 0.175x + 7.215 \]
\[ R^2 = 0.068 \]
Number of Adult Frogs Observed Compared to Daily Accumulated Rainfall - Tributary 5a

![Graph showing the relationship between daily accumulated rainfall and the number of adult frogs observed. The graph includes a linear regression line with the equation $y = -0.019x + 0.827$ and an $R^2$ value of 0.023.](image)
Number of Adult Frogs Observed Compared to Daily Mean Air Temperature

- # of Frogs
- Daily Mean Air Temp

Linear (# of Frogs)

\[ y = 0.053x + 12.64 \]

\[ R^2 = 0.013 \]
Number of Adult Frogs Observed Compared to Daily Mean Tributary Temperature

$y = 0.020x + 11.66$

$R^2 = 0.010$
Adult frog location and activity

**Location**
- **Instream**: 53%
- **On the bank**: 38%
- **Underwater**: 9%
- **Off channel**: <1%

**Activity**
- **Basking**: 61%
- **Sitting in Shade**: 7%
- **Underwater**: 14%
- **Hiding**: 5%
- **Amplexus**: 1%
- **Swimming**: 6%
- **Floating**: 4%
- **Calling**: 2%
Location (N = 535) and activity (N = 485) categories for radio-tagged frogs observed during 2005

**Location**
- Instream: 56%
- On the bank: 40%
- Underwater: 4%
- Off channel: <1%

**Activity**
- Basking: 37%
- Sitting in Shade: 11%
- Hiding: 26%
- Underwater: 23%
- Floating: 2%
- Swiming: 0%
- Amplexus: 1%
Hiding in a crack
Sex ratios

Cresta Adult Frogs F:M = 1.38

Poe Adult Frogs F:M = 1.93
Adult Female Size Frequencies

Cresta Females

Poe Females

Lack of recruitment of adult frogs from eggs laid in 2002 and 2004
Size Frequencies By Sex

Females

Males
Size Frequencies By Sex and Size Class

SEX
- Females
- Males
- Unknown

Count

SUL

Adult Females
Young of the year
Juveniles
Adult Males
Unknown
Adult male size frequencies

Year: 2 3 4 5 6 7 8 9 10 11 12 or older?

Count

SUL

Proportion per Bar

1a-M1
5a-M11
5a-M40
5a-M5
9e-M3
FVC-M31
Adult Female Frog Size Frequencies

Year: 2 3 4 5 6 7 8 9 10 11 12 or older?
Female growth curves from VBGE

- Largest Female Found SUL=80.5 mm
- Oldest Female found was between ages 10 and 11 based on these models

*Oldest Female found was between ages 10 and 11 based on these models*
Female 6c-F7: Poe Reach female caught four years in a row

2004  Weight=24  SUL=60  4 years old

2005  Weight=36  SUL=62  5 years old

2006  Weight=49  SUL=64  6 years old

2007  Weight=38  SUL=67  7 years old
6c-F113:
Poe Reach female caught first as a subadult and later as an adult

2005
Age 2
8 grams
39 mm

2006
Age 3
31 grams
57 mm
6c-F196: Poe Reach female caught three years in a row

2005  Weight=18  SUL=52  ~3 or 4 years old?

2006  Weight=25  SUL=57

2007  Weight=41  SUL=62
Adult Female Frog Size Frequencies By Year and Reach

Cresta Females

YEAR
- 2004
- 2005
- 2006
- 2007

Poe Females

Count

SUL

25 45 65 85

20 40

0 10 20 30 40
Research Needs

• Continued adult longevity study
• Conduct juvenile study
  – Whereabouts in fall and winter
• Initiate baseline studies on unregulated reference reaches
  – Middle Fork Feather River
  – North Fork American River
  – Clavey R, Mill Ck, Deer Ck, Kanaka Ck, Spanish Ck, Otter Ck
Research Needs

• Life history strategies
  • Big river vs. small creek – diff risk factors
  • Prey resource and predator interaction
  • Breeding – annually? Age/size?

• Temperature effects – tad growth

• Mercury Accumulation

• GIS db of known data

• Climate change effects – change to ref reaches
Young-of-Year Demography Study

Multiple surveys in September and October along several breeding sites (with known egg mass #'s) and in adjacent tributaries to determine:

- Attrition at breeding sites.
- Emigration to tributary refugia.
- Diurnal fluctuations in numbers observed in relation to time of day and weather conditions.
- Site suitability (recruitment).
- Individuals identified by dorsal marking patterns/auxiliary marks.

Main objectives are to (1) define seasonal use of mainstem by YOY post-metamorphosis, and (2) determine optimal survey period and methods for protocol presence/absence surveys and recruitment assessments.