North coast region
project locations
Breeding Patterns and Mating Strategy of the Foothill Yellow-legged Frog at Hurdygurdy Creek

Clara A. Wheeler and Hartwell H. Welsh, Jr.
USDA Forest Service Redwood Sciences Laboratory
Objectives:

1) Characterize the temporal breeding pattern and examine how it relates to stream flow and date

2) Determine if adult males have site fidelity to small regions within the larger breeding area

3) Examine the spatial distribution of adult frogs relative to breeding sites

4) Examine operational sex ratios

5) Investigate possible mating patterns
Methods:

We monitored the onset and duration of breeding activity during 2002-2007 breeding seasons.

We used daily stream discharge data for Smith R. to relate breeding activity to stream flow.

A generalized additive model was used to examine the effects of stream flow, date, and year on breeding activity.

Spearman rank correlation analyses were used to examine associations between reproductive output, onset, duration, and stream flows for the six years.
Results and Conclusions:

<table>
<thead>
<tr>
<th>Year</th>
<th>Duration</th>
<th># New Egg Masses</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>50 days</td>
<td>10</td>
</tr>
<tr>
<td>2003</td>
<td>19 days</td>
<td>10</td>
</tr>
<tr>
<td>2004</td>
<td>52 days</td>
<td>10</td>
</tr>
<tr>
<td>2005</td>
<td>51 days</td>
<td>10</td>
</tr>
<tr>
<td>2006</td>
<td>42 days</td>
<td>10</td>
</tr>
<tr>
<td>2007</td>
<td>48 days</td>
<td>10</td>
</tr>
</tbody>
</table>

Stream flow (m/sec):

- 2002: Duration – 50 days
- 2003: Duration – 19 days
- 2004: Duration – 52 days
- 2005: Duration – 51 days
- 2006: Duration – 42 days
- 2007: Duration – 48 days
Stream flow and day within the breeding season influenced breeding activity. Year did not have a significant effect.

* P<0.0001
The first day of breeding activity was associated with mean annual stream flow ($R = 0.88, P = 0.02$).

The mean duration of breeding activity was associated with stream flow on the first day of breeding activity ($R = -0.83, P = 0.04$).

The total number of egg masses was associated with maximum annual stream flow ($R = -0.89, P = 0.02$).
Breeding Phenology of the Foothill Yellow-legged Frog in the Trinity River Drainage

Jamie B. Bettaso\textsuperscript{1}, Hartwell H. Welsh, Jr.\textsuperscript{2}, and Don T. Ashton\textsuperscript{2}

\textsuperscript{1}USDI Fish & Wildlife Service
\textsuperscript{2}USDA Forest Service Redwood Sciences Laboratory
Objectives:

1) Monitor the reproductive output along the Mainstem Trinity River, South Fork Trinity River and North Fork Trinity River

2) Assess the influence of stream flow and water temperature on the onset of breeding activity.

3) Examine differences in the breeding phenology, from oviposition through larval development, between the three rivers.
Methods:

Float surveys were used to locate egg masses.
### Results and Conclusions:

<table>
<thead>
<tr>
<th>Location</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NFTR</strong></td>
<td>26may</td>
<td>27jun</td>
<td>28jun</td>
<td>-</td>
</tr>
<tr>
<td>~ 1 mi.</td>
<td>69 EMs</td>
<td>72 EMs</td>
<td>55 EMs</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>13.3°C</td>
<td>14.5°C</td>
<td>15.9°C</td>
<td>-</td>
</tr>
<tr>
<td><strong>SFTR</strong></td>
<td>9jun</td>
<td>10jun</td>
<td>14jun</td>
<td>23may</td>
</tr>
<tr>
<td>~ 10 mi.</td>
<td>62 EMs</td>
<td>806 EMs</td>
<td>489 EMs</td>
<td>510 EMs</td>
</tr>
<tr>
<td></td>
<td>820 cfs</td>
<td>1170 cfs</td>
<td>900 cfs</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>15.8°C</td>
<td>18.0°C</td>
<td>-</td>
</tr>
<tr>
<td><strong>MSTR</strong></td>
<td>14jun</td>
<td>9jun</td>
<td>29jun</td>
<td>18jun</td>
</tr>
<tr>
<td>~ 20 mi.</td>
<td>26 EMs</td>
<td>12 EMs</td>
<td>7 EMs</td>
<td>7 EMs</td>
</tr>
<tr>
<td></td>
<td>2530 cfs</td>
<td>2440 cfs</td>
<td>2970 cfs</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>11.7°C</td>
<td>11.4°C</td>
<td>11.5°C</td>
<td>-</td>
</tr>
</tbody>
</table>
MSTR 2006
SFTR 2006

15MAY 1890 cfs
29JUN 2970 cfs
15 MAY  14.8°C
6 JUN  12.4°C
29 JUN  11.5°C
Foothill Yellow-legged Frog Response to Fisheries Restoration on the Trinity River: Hocker Flat Restoration Site

Don T. Ashton¹, Hartwell H. Welsh, Jr.¹, and Jamie B. Bettaso²
¹USDA Forest Service Redwood Sciences Laboratory
²USDI Fish & Wildlife Service
Objective:
Monitor the use of fisheries restoration sites for frog reproduction

Background:
Damming in the early 1960’s altered the flow regime, leading to a series of habitat changes. Recent efforts to recover salmonid fisheries involved mechanical removal of vegetated berms, regrading, and management of flows to maintain dynamic river bars.
Case Study – Hocker Flat Restoration Site:

Prior to restoration

Restoration (constructed September 2005)

Photos from TRRP website
Results and Conclusions:

1\textsuperscript{st} year after construction no breeding was documented at the site (2006).

Frogs did breed in the tributary confluence across the river from the restoration site; however, appropriate breeding habitat was inundated until mid-July on the Mainstem.
The following year (2007) was a dry water year and flows were reduced. Appropriate habitat was available during the breeding season and 7 egg masses were observed.

Proper habitat & timing of flows are required for successful reproduction.
Seasonal Movements of the Foothill Yellow-legged Frog in Tehama County, California

Ryan M. Bourque and Sharyn B. Marks
Humboldt State University
Department of Biological Sciences
Objectives:

1) Investigate differences in movement distances, rates and directionality by season and gender

2) Examine associations between movements and environmental variables

3) Describe habitat use
Methods:

Individuals were tracked using radiotelemetry during three seasons: spring 2004 (Apr-Jun), fall/winter 2004 (Oct-Jan) and fall/winter 2005 (Oct-Jan).

GPS locations and minimum distance to water were recorded.

Habitat variables collected included stream habitat type, width and depth, dominant substrates and vegetation.

Weather variables collected included air and water temperatures, relative humidity, and precipitation.
Results and Conclusions:

### Longitudinal distances

<table>
<thead>
<tr>
<th>Season</th>
<th>Sex</th>
<th>N</th>
<th>Mobile</th>
<th>Mobile %</th>
<th>Median</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>M</td>
<td>5</td>
<td>5</td>
<td>55.6</td>
<td>149</td>
<td>72</td>
<td>578</td>
</tr>
<tr>
<td>S1</td>
<td>F</td>
<td>23</td>
<td>16</td>
<td>80</td>
<td>525</td>
<td>130</td>
<td>7043</td>
</tr>
<tr>
<td>FW1 &amp; 2</td>
<td>F</td>
<td>44</td>
<td>24</td>
<td>60</td>
<td>333</td>
<td>60</td>
<td>3693</td>
</tr>
</tbody>
</table>

### Rates

<table>
<thead>
<tr>
<th>Season</th>
<th>Sex</th>
<th>N</th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>Abs Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>M</td>
<td>5</td>
<td>76.8</td>
<td>67.5</td>
<td>54.1</td>
<td>22</td>
<td>161.9</td>
<td>407</td>
</tr>
<tr>
<td>S1</td>
<td>F</td>
<td>16</td>
<td>85.3</td>
<td>70.5</td>
<td>43.9</td>
<td>21.4</td>
<td>159.4</td>
<td>355</td>
</tr>
<tr>
<td>FW1 &amp; 2</td>
<td>F</td>
<td>24</td>
<td>93.7</td>
<td>37.1</td>
<td>25.6</td>
<td>10.7</td>
<td>513.8</td>
<td>1386</td>
</tr>
</tbody>
</table>

### Directionality

<table>
<thead>
<tr>
<th>Season</th>
<th>Sex</th>
<th>N</th>
<th>D'Agostino Skewness test</th>
<th>Directionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>M</td>
<td>9</td>
<td>-1.77</td>
<td>no bias</td>
</tr>
<tr>
<td>S1</td>
<td>F</td>
<td>22</td>
<td>3.24</td>
<td>upstream</td>
</tr>
<tr>
<td>FW1 &amp; 2</td>
<td>F</td>
<td>44</td>
<td>-3.62</td>
<td>downstream</td>
</tr>
</tbody>
</table>
Longest female *R. boylii* movement path
(Spring 2004)
Distance to stream

<table>
<thead>
<tr>
<th>Season</th>
<th>Sex</th>
<th>N</th>
<th>Mean</th>
<th>SE</th>
<th>Range</th>
<th>Median</th>
<th>LCL</th>
<th>UCL</th>
<th>Maxa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>M</td>
<td>9</td>
<td>1</td>
<td>0.16</td>
<td>0.58-1.85</td>
<td>1.45</td>
<td>0.95</td>
<td>3</td>
<td>6.9</td>
</tr>
<tr>
<td>Spring</td>
<td>F</td>
<td>20</td>
<td>1.2</td>
<td>0.13</td>
<td>0.33-2.53</td>
<td>2.72</td>
<td>1.9</td>
<td>3.9</td>
<td>10.7</td>
</tr>
<tr>
<td>FW 1 &amp; 2</td>
<td>F</td>
<td>44</td>
<td>2.8</td>
<td>0.26</td>
<td>0.72-6.9</td>
<td>8.65</td>
<td>6.5</td>
<td>11.6</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>--</td>
<td>73</td>
<td>2.1</td>
<td>0.18</td>
<td>0.32-6.9</td>
<td>4.6</td>
<td>3.7</td>
<td>7.4</td>
<td>40</td>
</tr>
</tbody>
</table>

Weather associations

**Spring**: movement not associated with weather conditions.

**Fall/winter**: movement associated with cumulative seasonal rain, cumulative 3-day rain, and mean 5-day average humidity.
Movement histories for *R. boylii* tracked in fall/winter 2004, showing association with precipitation.
Habitat use

In the spring season, nine females (39%) were observed using tributaries following breeding activity.

In the fall/winter season, 16 females (36%) moved from the main channel to tributaries.
Habitat differentiation and resource use among different age classes of post-metamorphic *Rana boylii* on Red Bank Creek, Tehama County, California

Miranda Haggarty and Sharyn B. Marks
Humboldt State University
Department of Biological Sciences
Research Questions:

1) Do different age classes use different habitats and are there seasonal differences in habitat use?

2) How do environmental variables influence the probability of observing frogs?

3) Do different age classes consume different food resources?
Methods:

VES capture data were pooled by season, which was based on precipitation (two dry seasons and one wet season).

Kruskal-Wallace analysis was used to examine differences in habitat use between age classes within each season.

A generalized additive model was used to examine the effects of stream flow, water temperature, habitat and survey day on frog detections.
Results and Conclusions:

During the first dry season (2004), metamorphs were observed in runs significantly more than adults ($P=0.048$).

During the second dry season (2005), metamorphs were observed in glides and runs more than adults and subadults ($P=0.028$ and $P=0.008$, respectively).
Probability of observing frogs

logFlow vs. Julian Day

temp vs. Julian Day

habitat vs. Julian Day
Species Status in the North Coast Region:

The North Coast/Klamath Bioregion from Lind (2005) includes the area near the Coast mountain range from San Francisco north to central coastal Oregon.

There were 94 localities (65.7%) where frogs were present and 49 (34.3%) where frogs were absent (Lind 2005).
Potential Risk Factors in the North Coast Region:

Effects of flow regulation (e.g., effects of increasing base flows; effects of recreation regulated flows; and effects of hypolimnetic releases on habitat, availability of habitat, and direct impact on frogs and breeding activity)

Mercury contamination effects – *R. boylii* do bioaccumulate mercury in muscle tissue

Presence of Chytrid in a population

Predation/competition with bullfrogs and pike minnow

Timber harvesting effects on habitat or populations

Gravel and cobble harvesting
Risk Factor Research Needs in the North Coast Region:

Effects of industrial and mining contaminants (e.g., dioxins, mercury)

Effects of agricultural and forestry contaminants

Effects of parasites/disease (e.g., *Lernia* spp. in S.F. Eel River)

Presence of Chytrid

Predation/competition with bullfrogs, pike minnow, crayfish, brown trout

Timber harvesting effects on habitat and/or populations

Grazing effects on habitat (e.g., eutrophication and increased parasite threats)
Ecological Research Needs:

Annual movements and habitat use, metamorph dispersal

Longevity

Metapopulation dynamics, especially breeding and distribution on mainstems and tributaries

Climate change effects on hydrology and temperature

Behavior (e.g., overwintering, reproductive)