BIOLOGY AND MANAGEMENT OF THE CALIFORNIA RED-LEGGED FROG (*Rana draytonii*)

Classroom, Demonstration and Field Topics

Classroom Topics

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Recent Taxonomic Changes
Identification –
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Biology
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Tadpole sampling and ID
Float tube navigation
Spotting and ID frogs
Capturing and handling frogs

Trish Tatarian
Greg Tatarian
(Norm Scott)
2015

BIOLOGY AND MANAGEMENT OF THE
CALIFORNIA RED-LEGGED FROG (*Rana draytonii*)

MANAGEMENT GUIDELINES

Selected and Annotated Bibliography of the Biology and Management of the California Red-Legged Frog (*Rana draytonii*) – on the website - http://www.elkhornsloughctp.org/reference/subissue_detail.php?SUBISSUE_ID=37

Scoring Ponds and Small Streams as Breeding Habitat for California Red-Legged Frogs (*Rana draytonii*) – included in your packet

Stockpond Management for the Benefit of California Red-Legged Frogs (*Rana draytonii*) – on the website - http://www.elkhornsloughctp.org/reference/subissue_detail.php?SUBISSUE_ID=37

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WEBSITE: www.californiaherps.com/
Lots of nice pictures of all frog stages and habitats, with pretty accurate text.

BIOLOGY AND MANAGEMENT OF THE

CALIFORNIA RED-LEGGED FROG (*Rana draytonii*)

IMPORTANT POINTS

- **Water regimes -- Mediterranean climate**
- **Population dynamics**
- **Agriculture--cattle and ponds**
- **Identify breeding sites**
- **Manage larval survival**
- **Manage populations, not individuals**
- **Start with clear management objectives**

RECENT TAXONOMIC CHANGES

SIERRAN CHORUS FROG (formerly PACIFIC TREE FROG)

Hyla regilla >> *Pseudacris sierra*

WESTERN TOAD

Bufo boreas >> *Anaxyrus boreas*

BULLFROG

Rana catesbeiana >> *Lithobates catesbeianus*

CALIFORNIA RED-LEGGED FROG

Rana aurora draytonii >> *Rana draytonii*

MOUNTAIN YELLOW-LEGGED FROG

Rana muscosa

SIERRA MADRE
YELLOW-LEGGED FROG

Rana muscosa

SIERRA NEVADA
YELLOW-LEGGED FROG

Rana sierrae

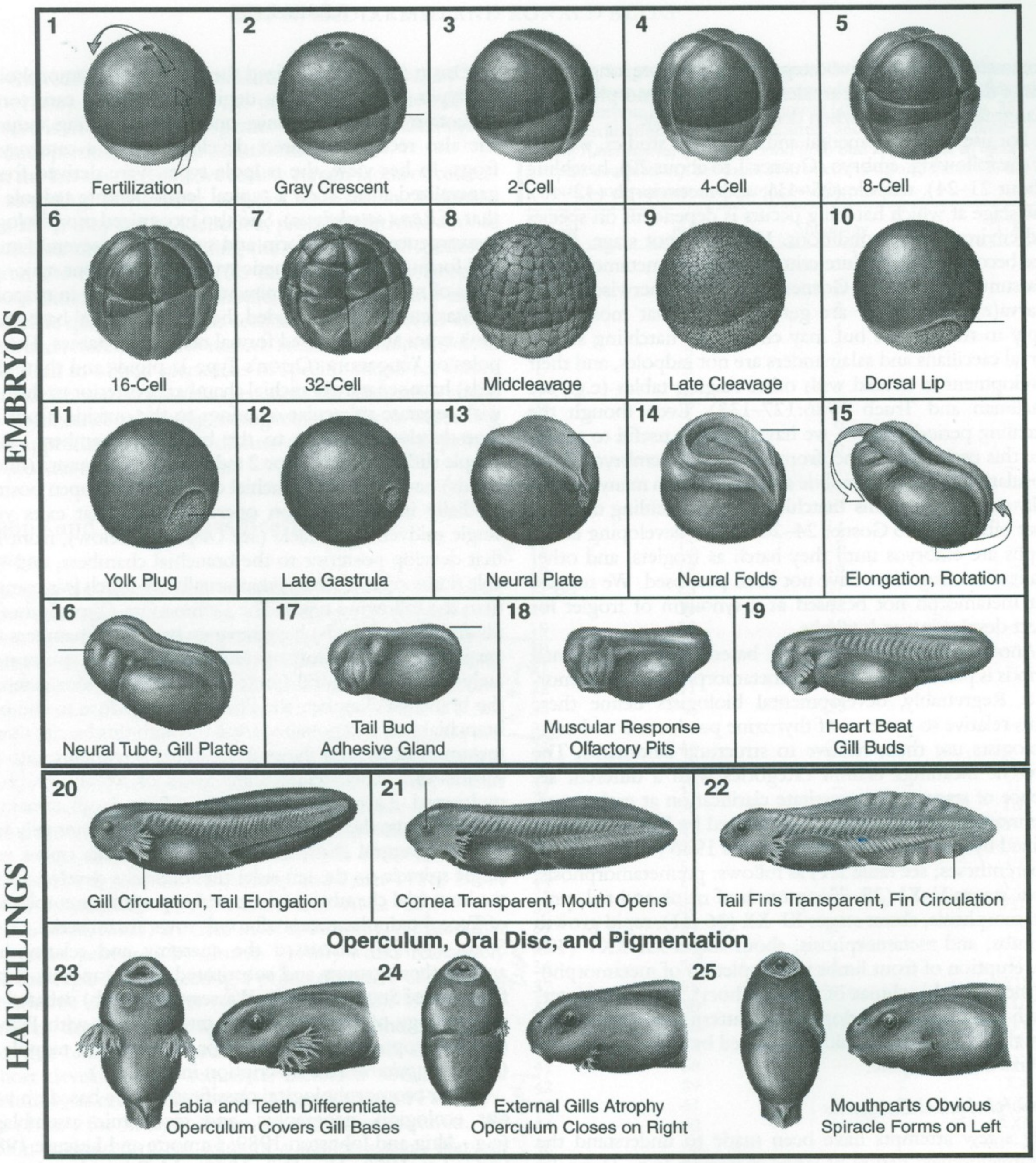
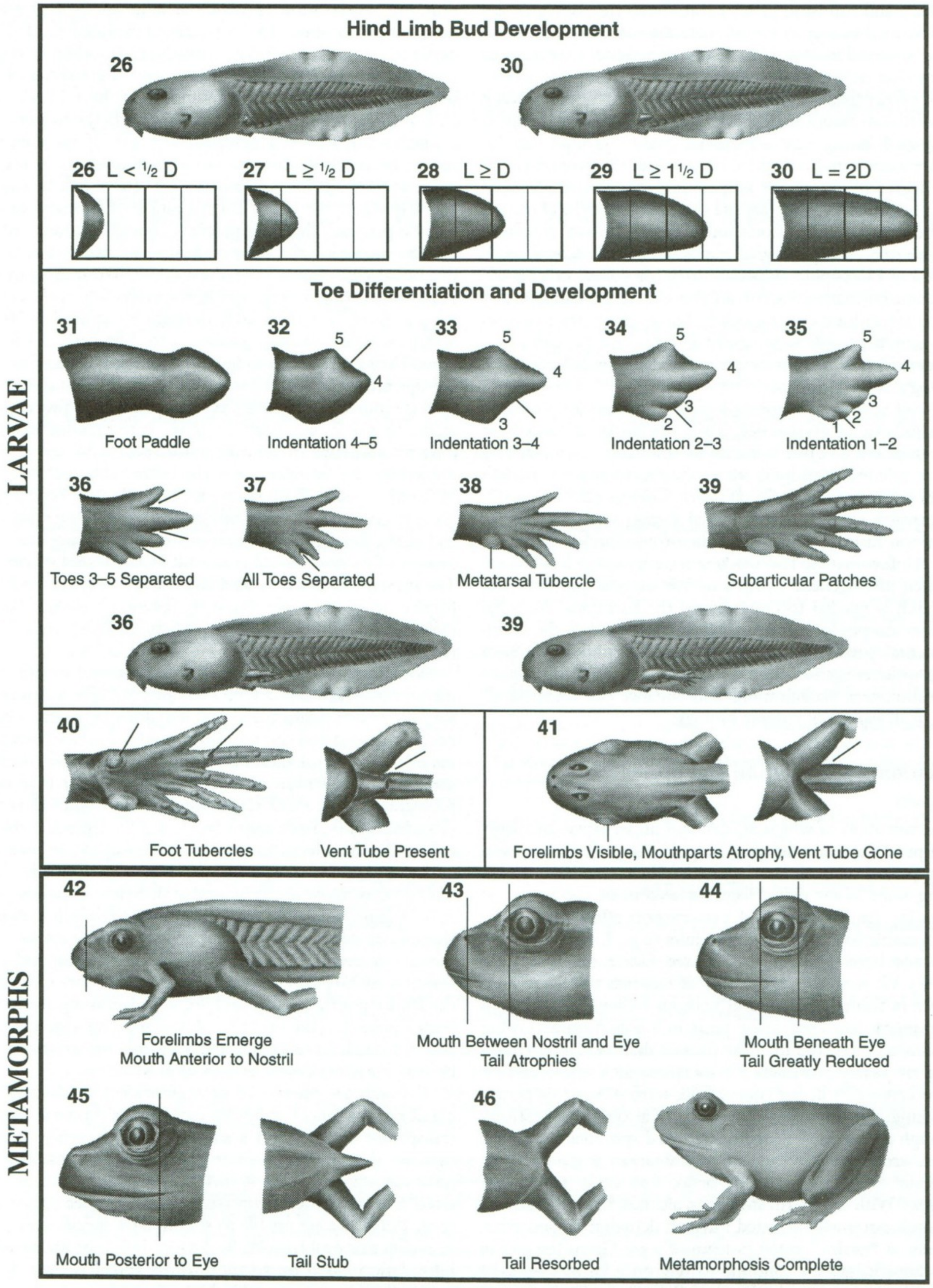


Fig. 2.1. The Gosner (1960) staging system recommended for use with exotrophic tadpoles; developmental stages are based on *Bufo valliceps* raised at 25° C. Translations to other staging systems are shown in table 2.1. Embryos: stages 1–19, 41.5 h (6.2%) developmental time. After fertilization (stage 1) and release of the second polar body (2), the zygote undergoes cleavage to stage 9 without an increase in size. Germ layers begin to form during gastrulation (10–12), which is followed by neural tube formation (13–15). Sensory structures appear during stages 16–19 and somitogenesis occurs in stages 18–19). Hatching may occur as early as stage 16. Hatchlings: stages 20–25, 73.5 h (11.0%) developmental time. This period represents the transition from a relatively immobile embryo to an active, feeding tadpole; external gills atrophy and the spiracle forms. Structures associated with feeding and swimming appear and pigments begin to form larval color patterns. Tadpoles: stages 26–41, 384 h (57.6%) developmental time. This is the longest part of the larval period and is marked by growth and limb development. Metamorphs: stages 41–46, 168 h (25.2%) developmental time. During this crucial period the tadpole loses its larval characteristics and takes on adult structures; the tail begins to atrophy (43), larval feeding structures are replaced by adult jaws and tongue (41–43), and forelimbs and hind limbs become functional. This period typically is marked by a passage from the aquatic to the terrestrial environment. Metamorphosis is complete (46) when the tadpole has become a froglet. Original drawings of stages 1–25 were provided by Linda Trueb (Duellman and Trueb 1986); depictions of stages 26–46 were redrawn by Kate Spencer; additional drawings were prepared by Ty Thierry.

Gosner Embyro/Tadpole Staging System



Scanned from McDiarmid, R. and R. Altig. 1999. Tadpoles: The Biology of Anuran Larvae.

TERMINOLOGY APPLIED TO CALIFORNIA RED-LEGGED FROG (*Rana draytonii*)

Age - Calculated from the time of egg fertilization. Assumed to be 1 April in our population models from San Simeon area.

Egg - Technically an unfertilized ovum, but in our common usage, it refers to an early embryo through gastrulation, before the embryo starts to noticeably elongate.

Embryo - Stages from egg fertilization until the frog breaks free of the jelly coat in the egg mass and becomes a free-swimming tadpole.

Tadpole - A larval frog, from hatching until it starts to lose its tail and becomes a metamorph.

Larva - Tadpole.

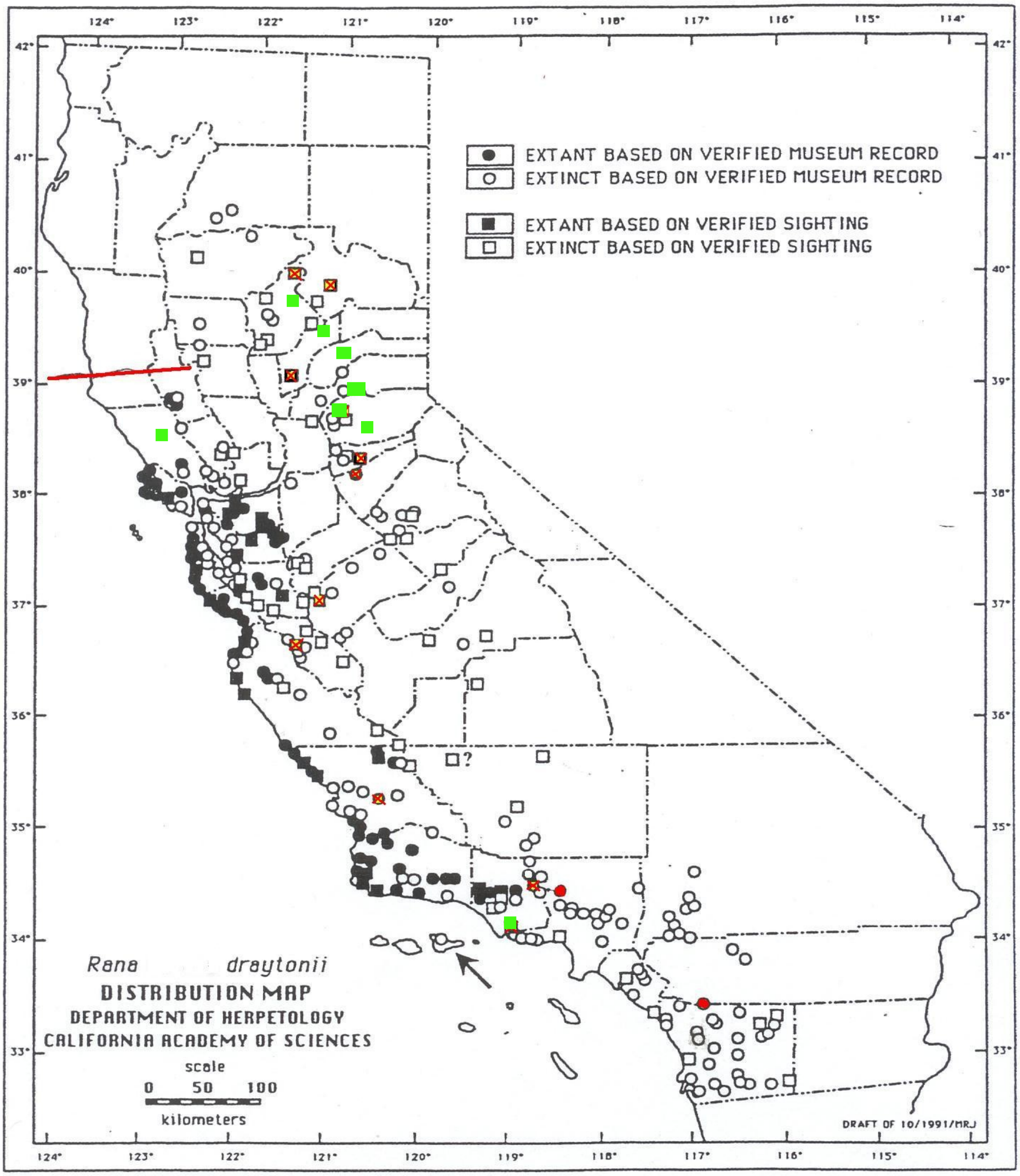
Metamorph - Normally for red-legged frogs, the period from the time it loses its tail at about 5 months of age until it is about 10 months old. In tadpoles with delayed development, metamorphosis may occur 12 or more months after egg laying.

Froglet - An informal term for a small, young frog.

Juvenile - A frog from the time it starts metamorphosis until it is able to breed. This term includes the metamorph stage. On average this is from about 5 months of age to 2years.

Adult - A frog that is capable of breeding. In the red-legged frogs that we studied, this was two years of age for most males and probably the same for some females.

N.J. Scott
G.B. Rathbun
April 2010



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ANNUAL CYCLE OF
CALIFORNIA RED-LEGGED FROG (*Rana draytonii*)

Calling and Egg-Laying - (November) December through April (June)

There is some indication that egg-laying is somewhat earlier in the northern part of the range (Bay Area, Santa Cruz County) than in the south, and that it is delayed in streams and rivers. In the creeks and sloughs near Cambria, the peak of egg-laying is in March.

An exceptionally early record for eggs in November was preceded by unusually heavy rainfall (Storer 1925), and eggs have been recorded in June near the Carmel River after heavy winter flows (Reis, pers. comm.).

Hatching and Tadpole Stage—mostly through September

Hatching takes 2-3 weeks, depending on water temperature. Metamorphs (except for overwintering tadpoles—see below) can be found as early as June, with a peak of metamorphosis in August at most sites.

In some scattered areas, tadpoles that overwinter are rarely or commonly found (Fellers, et al. 2001). These tadpoles usually transform the following spring. At Los Vaqueros, Contra Costa County 12% of the ponds were found to contain overwintering tadpoles (Alvarez, et al. 2004).

Metamorphs

Immediately after metamorphosis, froglets can be commonly found around the natal pond, but they soon disperse, often to shallow-water habitats with good cover. Here they are safe from adult frogs that might eat them.

Juveniles

Juvenile frogs are rarely found in ponds with adults. They disperse widely, and can often be found in small bodies of water 100s of meters from the natal pond. Observations support the idea that juvenile frogs are the principle source of propagules for isolated, previously uninhabited, ponds. Most males and a few females reproduce during the second spring following metamorphosis (2-yrs old), and all probably reproduce at the end of their 3rd year.

Adult Cycle

Adults, if they are not already at the breeding site, move to one during the winter, often starting with the first heavy rains (November-December; Bulger et al. 2003). They may take several months for the journey. Males tend to remain at the breeding site during the whole breeding season, but many females abandon the pond soon after egg-laying.

If the adult frog leaves the breeding site, it moves to a summer habitat and stays there over the dry season. All adults may wander widely during winter rains.

DURATION OF LIFE STAGES

Calling..1-2 months
Egg...2-3 weeks
Tadpole..............usually 4-6 months, some to 1 year
Juvenile...20-32 months

Adult..........................majority 1 year, maximum 7+ years

N. Scott

G. Rathbun

May 2005

POPULATION DATA FOR CALIFORNIA RED-LEGGED FROG (*Rana draytonii*)

Scott and Rathbun - San Simeon Area (1992-1999)

Age in Years	Sample Size	Survivorship Percent
0 (eggs)		2.0 *
0.5 (metamorphs)	81	9.9
1	8	
End of First Year		
1	536	25.4
2 (first breeding)	136	34.6
3	47	38.3
4	18	33.3
5	6	33.3
6	2	0
7	0 **	0

*** Literature data** **** Two older frogs were more than 7 years old**

SCORING PONDS AND SMALL STREAMS AS BREEDING HABITAT FOR CALIFORNIA RED-LEGGED FROGS (*Rana draytonii*)

This scoring system is based on our experience, the experience of others, and the literature. We have arranged the analysis from large scale (surrounding biotic factors) to small scale (the pond itself). It is highly subjective and the scores indicate which factors we believe to be most important to red-legged frog breeding and which factors seem to be less important.

The system is probably not suitable for large rivers and lakes, complex aquatic systems, or those influenced by sea water (e.g., Russian River, Pescadero Marsh, San Simeon Creek lagoon). Intermediate scores can be applied subjectively. Maximum score is 52. Most successful ponds that we have scored are in the low to mid 40s. Red-legged frogs probably will not consistently breed in habitats that score zero for one or more of the factors with an asterisk, or if the overall score is less than about 30.

Pond Physical Parameters

***Sufficient duration (through July or August)**

- Pools with tadpole habitat present through August.....................5 points
- Pools do not hold water through July in most years...................0 points

***Water flow**

- Low water flow (ponds or pools in creek)..................................5 points
- High water flows………………...0 points

***Pond Nutrients**

- High level of nutrient input (livestock, sewage, etc.)..................5 points
- Low level of nutrient input (deep well, spring water)...................1 point

Urban proximity

- Urban development further than 1 km.......................................2 points
- Urban development closer than 200 m......................................1 point

***Distance to other breeding areas**

- Two or more breeding sites within 500 m..................................5 points
- No other breeding sites within 2 km..0 points

Pond persistence

- Intermittent - Dries up in fall at least every 2-4 years.................2 points
- Perennial - Never dries up..1 point

Aquatic vegetation

- Mosaic of open and vegetated water..5 points
- Choked with vegetation...2 points
- No vegetation (a rocky cobble substrate can substitute for vegetation in a stream)..0 points

***Exotic fishes**

- No fish..5 points
- Mosquitofish or crayfish, or exotic predatory fish with some escape cover..3 points
- Exotic predatory fish (also possibly *Xenopus*) and little escape cover..…........................0 points

Refugia

- Vegetation/structure in pond.………..5 points
- No vegetation/structure..0 points

***Bullfrogs**

- No bullfrogs...3 points
- Bullfrogs abundant and reproducing..1 points

Frog Habitat Presence

Egg and tadpole rearing area

- Greater than 0.1 ha (0.25 acres)..5 points
- Less than 0.01 ha (0.25 acres)...2 points

Summer water temperature

- Above about 80^{0} F...5 points
- Below about 60^{0} F...0 points

***Metamorph habitat** (little is known about this variable)

- Shallow water micro-habitat with good emergent cover and few or no adult red-legged frogs or bullfrogs...3 points
- No cover and abundant adult frogs or other predators................0 points

Summer/juvenile refuges*

- Summer/juvenile refuges at site or within 200 m........................2 points
- Summer/juvenile refuges >2 km away.......................................0 points

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Greg Tatarian
(Norman J. Scott)
March 2015

SURVEY EQUIPMENT TO BE USED DURING SURVEYS FOR CALIFORNIA RED-LEGGED FROG (*Rana draytonii*)

NON-PERMITTED SURVEYS

Lights/Headlamps

Binoculars

Waders

Data Recorder

Decontamination Equipment

PERMITTED SURVEYS

Float tubes

Dip Nets

Tadpole Traps

Criteria for the Selection and Use of Light Sources and Binoculars for Visual Encounter Surveys of Adult and Sub-Adult California Red-legged Frogs (*Rana draytonii*)

Greg Tatarian, Wildlife Research Associates
Trish Tatarian, Wildlife Research Associates

Updated 2/10/2015

Visual Encounter Surveys (VES) are used to conduct surveys of adult and sub-adult frogs by detecting eye shine reflecting back to the observer. The use of the proper lights and binoculars increases detection rate, increases the detection distance from the observer to the frog, reduces the need to enter water bodies and associated vegetation, thereby reducing risk of trampling adults, larvae, or egg masses, and with experience, in many instances can provide the observer enough detail to determine species.

Recent technological advances in portable light technology have provided herpetologists and other biologists who study nocturnal taxa with an ever-increasing selection of this critical tool. Coupled with a good set of binoculars, and with the proper training and practice, these two tools are invaluable when conducting Visual Encounter Surveys.

Visual Encounter Surveys are a key component of the current U.S. Fish and Wildlife Service (USFWS) protocol for conducting surveys of the Federally-listed (Threatened) adult California red-legged frogs (*Rana draytonii*), as identified in the *Revised Guidance on Site Assessment and Field Surveys for the California Red-legged Frog* (USFWS 2005). This method is used to determine presence or absence of individuals, and must be conducted using a light source and binoculars (USFWS 2005). No capture, handling or contact of frogs, tadpoles, or larvae is legal to conduct without the appropriate permits; however, no permit is required to conduct USFWS protocol-level Visual Encounter Surveys for R. draytonii.

One significant advantage of properly-conducted VES, as stated earlier, is reducing or eliminating the risk of direct injury or mortality to various life stages of *R. draytonii* (or other vegetation and amphibian species present in the pond). It is not always possible to avoid entering water bodies to conduct surveys, whether because vegetation obscures or blocks the observer’s view of the survey area, or because the size of the water body demands it, however, the proper selection and use of lights and binoculars permits the biologist to work at greater distances from the pond’s interior or edge. This minimizes the potential for disturbance, harm, or mortality to frogs, tadpoles, larvae, and habitat that could occur when entering the pond or bank vegetation, and is precisely why it was written into the USFWS protocol for this listed species.

Because visual encounter surveys occur at a distance from the frogs, the selection of the correct light source and appropriate binoculars becomes one of the most important aspects of successfully accomplishing an accurate and complete survey. Adequate illumination of the animal is a must, in order to properly view the morphological characteristics of the amphibians for which you are conducting surveys.

The following excerpt from the *Revised Guidance* (USFWS 2005) provides recommendations and sets limitations for lights:

> "Nighttime surveys shall be conducted with a Service-approved light such as a Wheat Lamp, Nite Light (sic) or sealed beam light that produces less than 100,000 candle watt. Lights that the Service does not accept for surveys are lights that are either too dim or too bright. For example, Mag-Light-type lights and other types of flashlights that rely on 2 or 4 AA/AAA's, 2 C's or 2D batteries. Lights with 100,000 candle watt or greater are too bright and also would not meet the Services requirements."

The intention of these upper and lower limits of illumination is obvious; insufficient light will likely result in false negative survey results, while there is concern that excessively bright lights could harm the eyes of *R. draytonii* and other amphibians, although research on that effect is lacking.

Interpreting Brightness Ratings:

At the time the USFWS protocol was written in 2005, light manufacturers typically used candlepower as a brightness rating. However, it is widely understood today that candlepower ratings varies widely among manufacturers, and that a more uniform measure of the amount of light emitted by a source is represented as Lumens. Although there is no absolute correlation between candlepower and Lumens, the USFWS limitation of 100,000 "candle watt" (sic – should have been "candlepower") roughly translates to about 393 Lumens, based on equivalence of light output measurements provided by Streamlight, the manufacturer of one of the lights used in the formulation of the 2005 USFWS protocol. Lights should be selected which are below the approximate 393-Lumen upper limitation in the protocol.

Selecting Lights for Visual Encounter Surveys:

Two types of lights are recommended for conducting Visual Encounter Surveys for *R. draytonii* or other amphibian species; a flashlight for long and medium-range work in combination with binoculars, and a headlight for moving through the survey area and for close work.

Light and battery technology has advanced rapidly in the years since the 2005 protocol was written, and now extremely bright, white LED lamps with highly efficient reflectors or fresnels are commonly available. Incandescent lights are still available and are useful; however, the newest LED lights produce light in wavelengths that are more visible to the human eye, making it unnecessary to use lights near the 100,000 candlepower (395-Lumen) limitation set by the 2005 protocol. The new LED lights also consume less energy, so batteries last much longer during use, which is a significant advantage over incandescent bulb lights. In addition, LED lighting continues to decline in price, making these excellent field tools at an affordable cost.

When the first version of this document was written in 2013, Cree model C4 LED lights were about the brightest on the market, and are still used in many flashlights and light conversion units. One year later, there are much brighter individual bulbs, such as the Cree XM-LED, and lights with multiple bulbs which provide enormous amounts of illumination, but many of these are well above what is required for our purposes.

To adequately detect eye shine in *R. draytonii* when using binoculars, we recommend selecting a flashlight rated between 160-350 Lumens. This is roughly equivalent to between about 40,000 to 90,000 candlepower. Even better are lights with multiple settings, for added flexibility. Flashlights with these ratings are readily available from various manufacturers, many with two or more output settings for reduced light and increased battery life. If brighter flashlights are selected, *only* those with several output settings should be selected, to conform to the USFWS Protocol, and avoid harm to amphibians' eyes.

We strongly recommend rechargeable lights to reduce battery costs, because although LED technology provides increased use times, VES may last 4-6 hours each night in some instances. At a minimum, the battery in your light should last for 2-3 hours between recharging, which is significantly longer than the 40 minutes that is typical for high-capacity, high-intensity incandescent lights with equivalent light intensity ratings. Even with this longer life, it may be necessary to carry either multiple lights or extra, recharged batteries, when conducting longer surveys.

Headlamps commonly used for camping, hiking or other uses (i.e., Apex, Petzl, Black Diamond, Princeton Tec, etc.), at 50-100 Lumens, do not provide enough light intensity or focus to adequately detect amphibian eye shine at any practical distance, and would be less effective than the Mag-Light types or others described in the 2005 protocol as unacceptable. In 2015, there are LED headlamps with claimed ratings up to 700 Lumens; however, these are not best suited for conducting VES in combination with binoculars, due to parallax error and obscuring of the beam by hands or binoculars. Instead, headlamps are optimal for walking around the survey area, approaching the pond and/or amphibians, manipulating survey equipment, or other close-distance tasks. Incandescent headlamps have been largely replaced with bright LED versions, and there are new models and features flooding the market every day. Headlamps that feature brightness level controls are very useful, as are those with the ability to change the beam from wide-angle to spot.

Prior to the 2005 protocol, headband, hat or helmet-mounted Wheat lamps and Nite Lites - high- capacity, lower-wattage incandescent light systems commonly used for hunting, trapping and caving, were often used for wildlife and amphibian surveys, and these lights can now be obtained in brightness ratings from about 350-600 Lumens. Some of the newer Nite Lites are available in high intensity LED, which can make them useful for general herpetological surveys, bullfrog management, etc. when it is necessary to have both hands free. However, these lights are generally optimized for helmets or hats, so some reconfiguring or adaptation is generally needed to use them in the most efficient way. They are not optimal for conducting Visual Encounter Surveys because they are difficult to place in line with the viewing axis of your binoculars, due to their configuration, as with headband-mounted headlamps, as discussed above.

So, what should you choose? We recommend selecting the best quality, high-output LED flashlights you can afford, because they are generally well constructed, have well-designed reflectors and/or fresnels, and are rechargeable (some with Ni-MH or even Lithium-ion batteries). They are also compact, lightweight, sometimes waterproof or water-resistant, and can be slipped into a flashlight ring or holder when both hands are needed (e.g. walking through vegetation, deep water, handling nets or gigs, etc.). Currently, we are using Streamlight UltraStingers, which come equipped with xenon incandescent bulbs, however; we replace the standard Xenon bulbs with 230- Lumen LED conversion units by TerraLUX. We also use Streamlight Strion HP LED flashlights, which are light very light and compact, and feature three brightness levels along with rechargeable batteries with long life. This model has recently been updated, and is now called the Strion HPL; it provides three brightness levels – 615, 320, and 160 Lumens. However, there are many manufacturers and models available, with more coming onto the market every few months. We recommend you make your decision based on the recommended Lumens, flashlight format, and rechargeable features of the light that best suit your needs.

Selection and Use of Binoculars During Visual Encounter Surveys:

Lights are used to reflect amphibian eye shine that is viewed through binoculars. The use of binoculars is *required* under the 2005 survey protocol to adequately detect amphibian eye shine. *Surveys conducted without the use of binoculars will call into question the validity of the survey* (USFWS 2005).

The selection of binoculars should be made with the same consideration for quality and effectiveness as your lights. We recommend using roof-prism binoculars only, as opposed to porro- prism models. Roof-prism binoculars gather and transmit more light than porro-prism designs, and are more compact, making them easier to use while holding your flashlight against them. Use the highest-quality waterproof binoculars you can afford – you will notice the difference, compared to lower-quality units. For those times when you must force your way through vegetation, deep water, or will be leaning toward the water, the use of binocular harnesses can be helpful. We typically tuck our binoculars into our waders to keep them under control and out of the water.

The most effective angle of the light is in the same approximate plane as your binoculars, so that the greatest amount of light reflected off the amphibian's retina is visible through the binoculars. Depending on the size and format of your lights, you might hold your light immediately above, below, or adjacent to the binoculars. For an earlier discussion on this technique, see:

> *Corben, C. and G.M. Fellers. 2001. A technique for detecting eye shine of amphibians and reptiles. Herpetological Review 32(2): 89-91.*

The proper selection and use of lights and binoculars is critical to conducting effective, accurate amphibian surveys, because they permit visual observation of identifying characteristics at a safe distance. Following the guidance in this document will aid in the selection of the best equipment for conducting amphibian visual encounter surveys.