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

Classroom, Demonstration and Field Topics

Classroom Topics

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Norm Scott
Trish Tatarian
2013

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*)

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Stockpond Management for the Benefit of California Red-Legged Frogs (*Rana draytonii*)

WORKSHOP POWERPOINT PRESENTATION

WORKSHOP BIBLIOGRAPHY

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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

Gosner Embyro/Tadpole Staging System

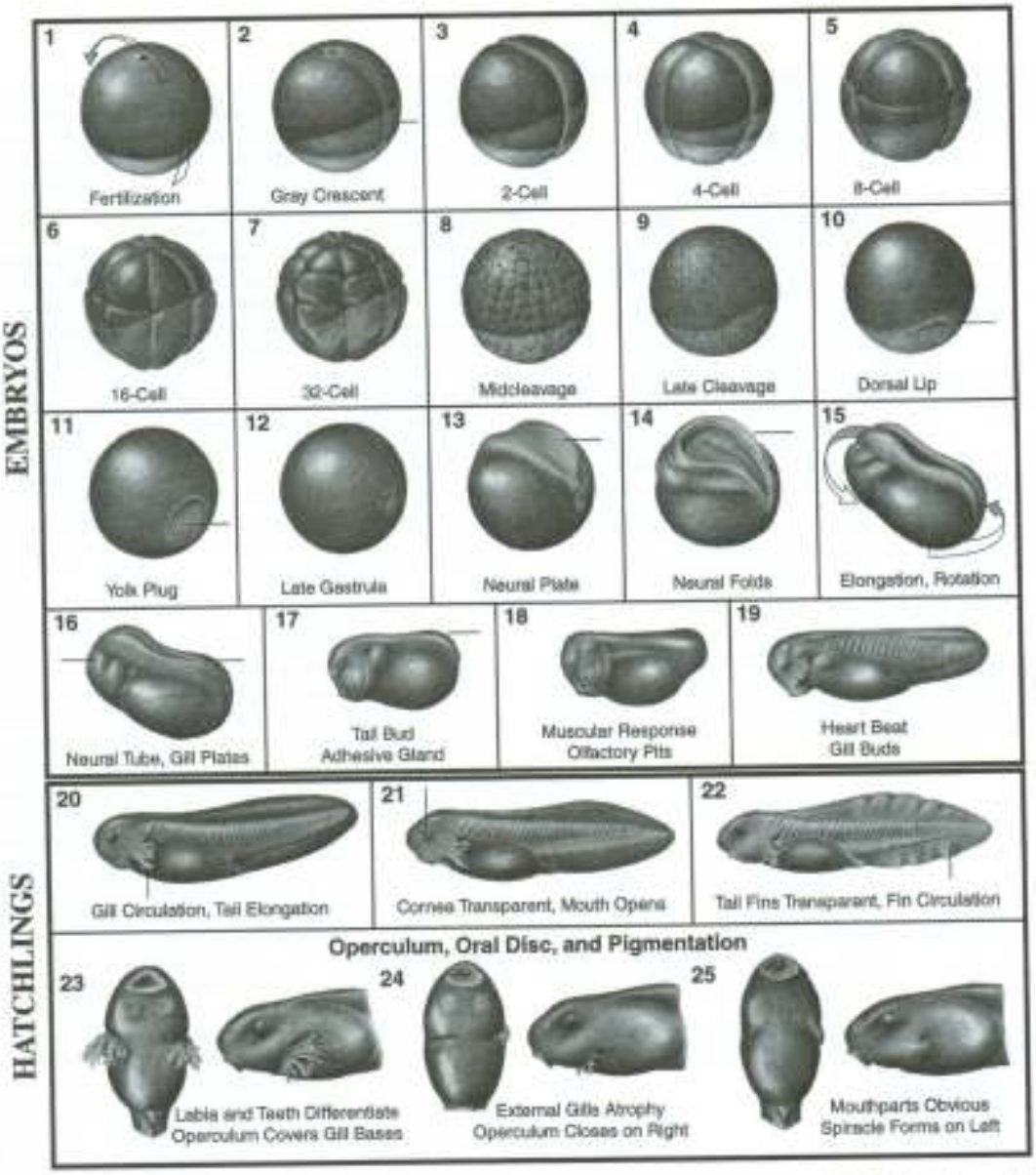
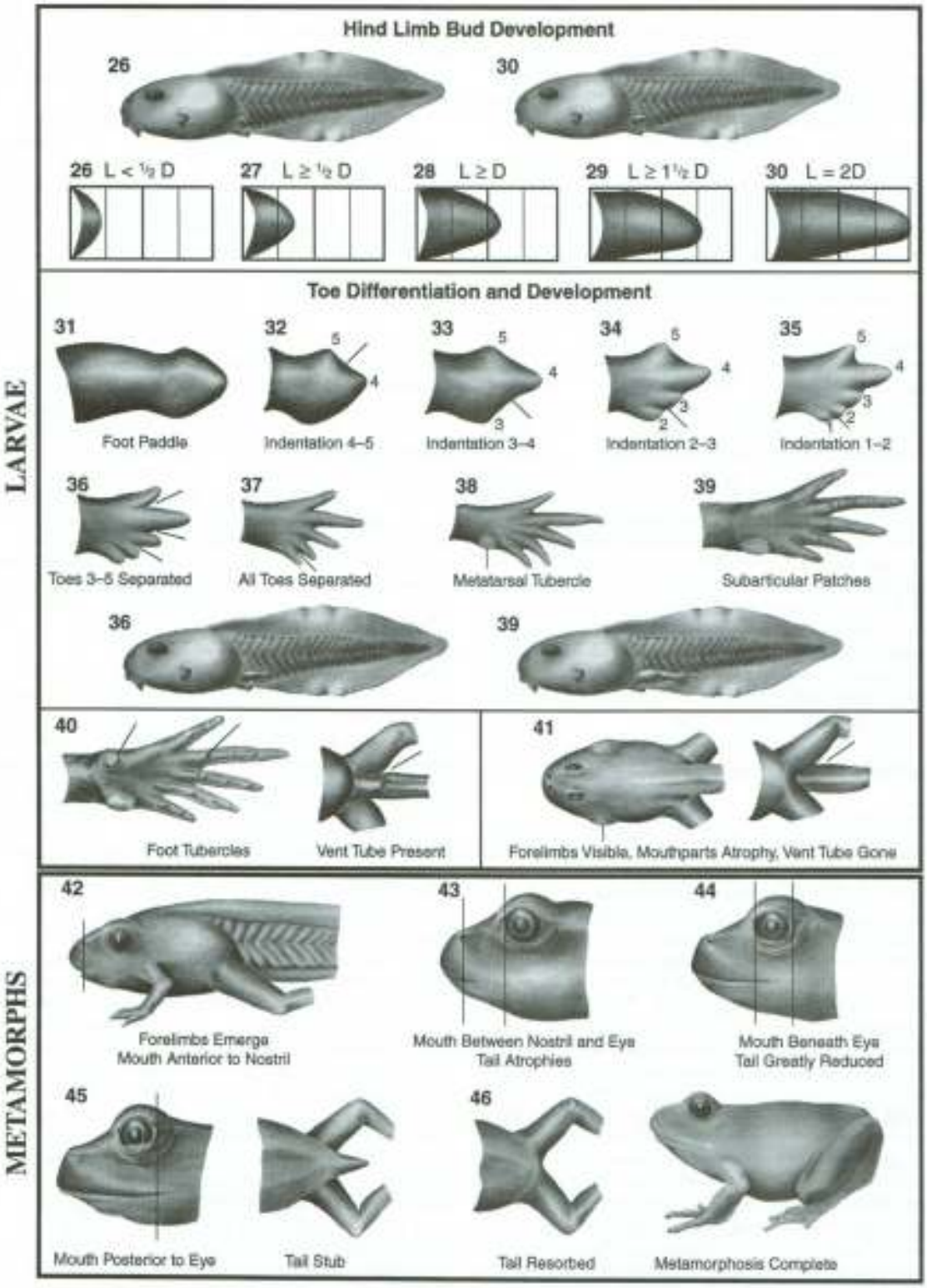


Fig. 2.1. The Gosner (1960) staging system recommended for use with exotrophic tadpoles; developmental stages are based on *Rana sphenocephala* raised at 25° C. Translations to other staging systems are shown in table 2.1. Embryos: stages 1–19, 41.5 h (6.2%) developmental time. After fertilization (stage 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.

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

Gosner Embyro/Tadpole Staging System



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.

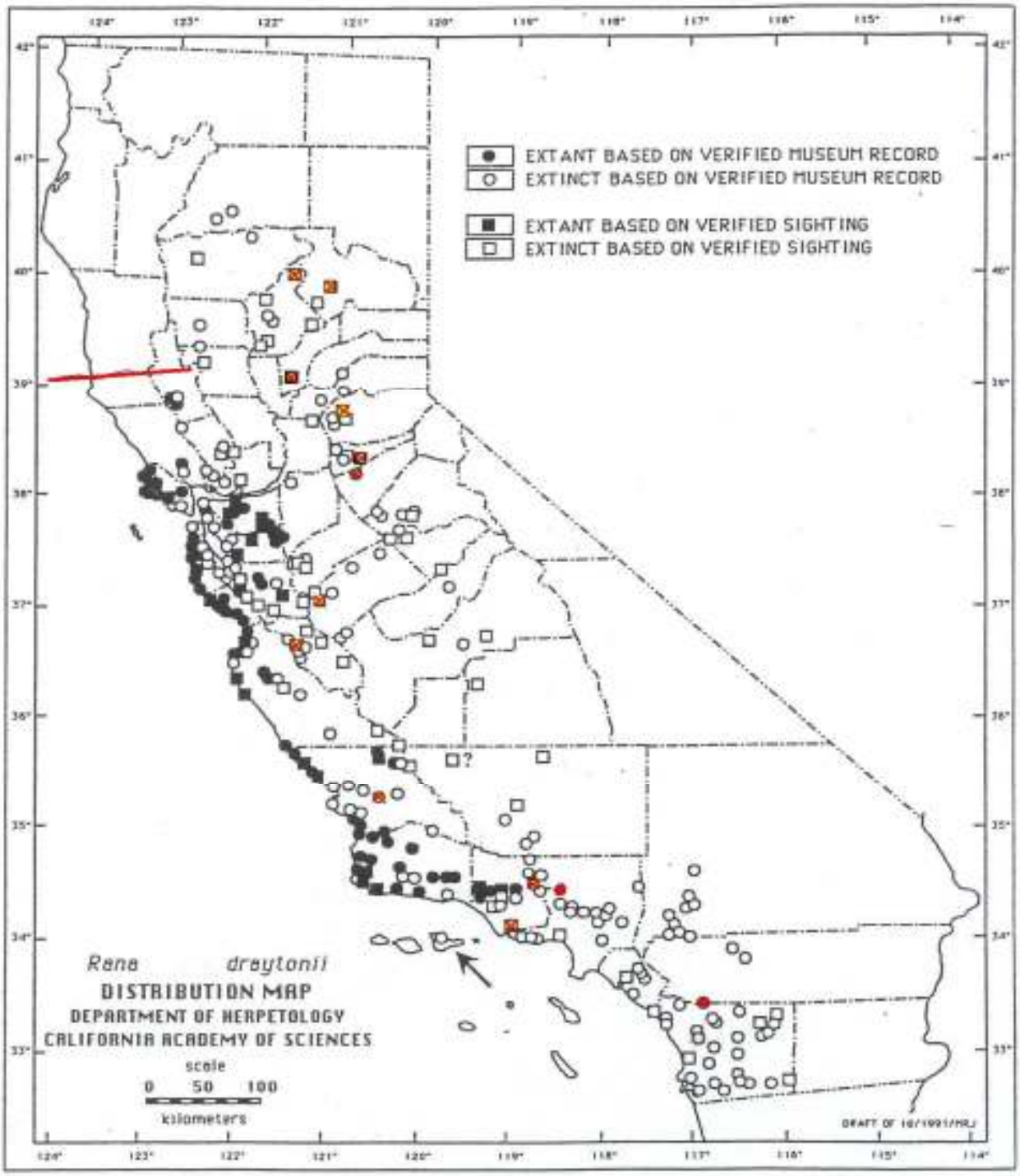
Metamorph - Normally for red-legged frogs, the period from the time it loses its tail at about 5 months of age until it is about 10 months old. In tadpoles with delayed development, metamorphosis may occur 12 or more months after egg laying.

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.

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



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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*)

San Simeon Area (1992-1999)

Age in Years	Sample Size	Survivorship Percent
0 (eggs)		2.0 *
0.5 (metamorphs)	81	9.9
1	8	
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**

N. Scott

G. Rathbun

May 2005

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 57. 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 0.25 acres (~100 yd on a side).....5 points
- Less than 0.25 acres (~10 yd on a side)..... .....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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8 October 2012

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

NON-PERMITTED SURVEYS

Lights/Headlamps

Binoculars

Waders

Float tubes

Data Recorder

Decontamination Equipment

PERMITTED SURVEYS

Dip Nets

Tadpole Traps

Light Sources and Binoculars for Visual Encounter Surveys of Adult California Red-legged Frog (*Rana draytonii*)

Visual Encounter Surveys (Crump and Scott 1994) are a key component of the U.S. Fish and Wildlife Service (USFWS) protocol for conducting surveys of adult California red-legged frogs (*Rana draytonii*) in order to determine their presence or absence by using a light source and binoculars if necessary (USFWS 2005). No federal or state permits are required to conduct USFWS protocol-level nocturnal surveys for *R. draytonii,* because there is no handling of frogs and tadpoles. The proper selection and use of lights and binoculars is outlined in the protocol. The selection of the correct light source (as well as suitable binoculars) becomes one of the most important aspects of successfully accomplishing an accurate survey. In order to properly view the morphological characteristics of the species for which you are conducting surveys, adequate illumination of the animal is a must.

Choosing a Light

Recent technological advances in portable light technology have provided herpetologists and other biologists that study nocturnal taxa with an ever-increasing selection of this critical tool. Coupled with a good set of binoculars, and with the proper training, these two tools are invaluable when conducting Visual Encounter Surveys. Insufficient light will likely result in false negative survey results, and lights that are too bright tend to drown out the frog's eye-shine. In order to detect frog eye-shine, the light must be held within a few inches of your eyes or binoculars.

The following excerpt from the Field Survey Protocol (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 watts. 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 watts or greater are too bright and also would not meet the Services requirements."

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 requirement of 100,000 "candle watt" (sic – should have been "candlepower") roughly translates to 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.

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 at the 100,000 candlepower limitation set by the 2005 protocol. They also consume less energy, so batteries last much longer during use, which is a significant advantage over incandescent bulb lights. Currently, S4 LED lights are about the brightest on the market, and are used in many flashlights and light conversion units.

To adequately detect eye shine in *R. draytonii*, we recommend a light rated between 160-230 lumens. This is roughly equivalent to between about 40,700 to 58,525 candlepower. Flashlights with these ratings are readily available from various manufacturers, and, though brighter units are available, these are generally in lantern-style, or very large diameter flashlights formats, which are not easy to handle with binoculars during visual encounter surveys.

Visual Encounter Surveys 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 typical for high-capacity, high-intensity incandescent lights with equivalent light intensity ratings. Even with this longer life, either multiple lights or extra, recharged batteries should be carried in the field for longer surveys.

Prior to the 2005 protocol, Wheat lamps and Nite Lites, high-capacity, 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 80,000 to 150,000 candlepower. Some of the newer Nite Lites are available in high intensity LED, which can make them useful for Visual Encounter Surveys, 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. Their advantage is that their larger batteries last more than the entire night.

Other types of headlamps commonly used for camping, hiking or other uses (i.e., Apex, Petzl, Black Diamond, Princeton Tec, etc.), at 45-130 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. These are useful for other uses when not conducting surveys, however, so selection of a high-quality LED headlamp for non-survey needs is advisable.

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 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 with 230-Lumen LED conversion units by TerraLUX, and Streamlight Strion HP LED flashlights, 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.

Choosing Binoculars

Lights are used to reflect amphibian eye shine that is can be viewed through binoculars. Surveys conducted without the use of binoculars will call into question the validity of negative surveys (USFWS 2005).

The selection of binoculars should be made with the same consideration for quality and effectiveness as your lights; we recommend roof-prism binoculars only, because they gather and transmit more light than porro-prism designs, and are more compact, making them easier to use while holding your light 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 when needed.

The most effective angle of the light is next to 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 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.

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January 2013