

**Light Sources and Binoculars
for Visual Encounter Surveys
of
Adult California Red-legged Frogs**

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Visual Encounter Surveys are used to conduct surveys by detecting eye shine from frogs. 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 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 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.

Visual Encounter Surveys are also a key component of the U.S. Fish and Wildlife Service (USFWS) protocol for conducting surveys of adult California red-legged frogs (*Rana draytonii*). No federal or state permit is required to conduct USFWS protocol-level nocturnal surveys for *R. draytonii*, because no capture, handling or contact of frogs, tadpoles, or larvae is permitted to occur. However, the protocol requires that Visual Encounter Surveys be conducted to determine presence or absence of individuals, using a light source and binoculars (USFWS 2005).

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 to the frog. 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. This is 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 (as well as suitable binoculars) becomes one of the most important aspects of successfully accomplishing an accurate 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 Field Survey Protocol (USFWS 2005) provides recommendations and sets limitations for lights:

4) A. “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 are too weak, and lights with 100,000 candle watt or greater are too bright and would not meet the Service 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. NJS notes that lights that are too bright can make it difficult for eye shine to stand out from reflected light from vegetation.

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 vary 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.

Selecting Lights for Visual Encounter Surveys:

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, C4 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 is not easy to handle with binoculars during visual encounter surveys for amphibians.

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 headlamps, 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 designed for helmets or modified ball caps, so some reconfiguring or adaptation is generally needed to use them in the most efficient way.

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.).

Expect to spend a minimum of \$40-\$60 at the lower end of the price range for high-output LED flashlights with non-rechargeable batteries and less efficient reflectors, but if you are serious about increasing survey efficiency and results, you will probably need to spend more. While it is possible to spend \$200 or more on other flashlights, high-quality C4 LED lights with excellent reflectors, rechargeable batteries, and chargers will run between \$70-\$150, online pricing.

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.

How to Use Lights with Binoculars During Visual Encounter Surveys:

Lights are used to reflect amphibian eye shine that is viewed through binoculars. Binoculars are 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 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 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 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.