STOCKPOND MANAGEMENT FOR THE BENEFIT OF CALIFORNIA RED-LEGGED FROGS (*Rana draytonii*)

In many California red-legged frog populations, artificial ponds maintained for watering livestock provide habitats for all the life stages of the frogs. In some cases, these ponds are the principal sources of young frogs that annually repopulate the system. In dry areas, a pond can represent a long-lasting water source. At wetter sites, ponds are often the only quiet water sites for egg-laying and tadpole development outside of swiftly flowing streams. In both areas, ponds can give a stability and predictability that would not ordinarily be present.

However, in some special cases, ponds can be extremely detrimental to red-legged frogs. Perhaps the most common nuisance pond is one that attracts and provides habitat for exotic predators, including bullfrogs (*Lithobates catesbeianus*), crayfish (usually *Procambarus*), and predatory fish. In many instances, these predators can eliminate red-legged frogs or suppress the population so that the pond becomes a sink. Another type of detrimental pond is one that becomes an attractive nuisance by attracting breeding adults, but then it dries up before tadpoles can undergo metamorphosis. These types of ponds can eliminate the entire reproductive output of the frogs that breed in them, with possible serious consequences to a metapopulation of frogs over time.

California red-legged frogs have evolved in California's Mediterranean climate with wet winters and springs and long dry summers and falls, but most of their introduced predators have not. In most cases, pond management that mimics the natural water cycle will be most beneficial for red-legged frogs.

Red-Legged Frog Biology

Ponds that successfully enhance California red-legged frog populations must complement their biology. The frogs breed from December to April in ponds and streams. They seem to choose the sites that have the warmest water available, as long as it is at least 20 cm deep, and that will persist long enough for tadpole metamorphosis. Eggs hatch in a few days, depending on temperature, and the tadpoles develop through the spring. Usually, they start to transform into froglets in July, and by late August most have completed the process. Tadpoles usually do not overwinter, but it does occur.

Outside of the breeding season, adult frogs seek out deeper water (>1 m) to escape from predators. In some areas, late summer water can be very scarce, and in these circumstances frogs will travel up to several hundred meters to congregate in well boxes, deep water holes in drying streams, and around small springs and seeps where they can bury themselves in the sediment. They can also take refuge in damp leaf litter or duff for short periods of time. With the first soaking rains of fall, frogs tend to move away from their summer refuges. During a rainy winter, they may establish a temporary residence

quite a distance from any body of water. At this time they often gradually move towards the late winter breeding site.

Choosing a Site

Stock ponds can be useful for rehabilitation and enhancement of red-legged frog populations, but only if the frogs can get to them. The transport and re-establishment of red-legged frogs into areas where they do not now occur can do more harm than good, and thus is under tight regulation by the U.S. Fish and Wildlife Service. It is only considered after intensive studies of the site, with guarantees that the donor population will not be damaged. Given this, ponds for the benefit of red-legged frogs are limited to areas that already contain at least a remnant population. In such areas, if the ponds are suitable, the frogs will find them on their own; they do not need to be moved.

Ponds should be located as far as possible from predator source-areas. Bullfrogs from a pond with a large population will quickly invade a new pond up to a few hundred meters away, but it should take them longer to build up to damaging population levels if the ponds are separated by a kilometer or more. Raccoons (*Procyon lotor*) are a serious red-legged frog predator in many places, especially where they build up to many times the normal population density in urban areas and campgrounds with a plentiful supply of garbage and pet food.

Pond Design

Suggestions for pond design are based on observations of frogs in many habitats, but they have not been experimentally tested for efficacy. Further research will surely modify or eliminate some of these suggestions. The final design depends on a number of non-biological considerations such as the soil composition, the terrain, the use of the pond, and the adequacy and timing of the water supply. From a biological point of view, pond design is most tightly restricted when exotic predators are present in the area.

The ideal pond typically has two main components: A deep-water portion and a shallow tadpole- and juvenile-rearing section. The former should have holes that are deep enough (probably > 1.5 m) to discourage aquatic emergent plants, such as willows (*Salix*), cattails (*Typha*) and bulrushes (*Scirpus*), from growing and thus shading the entire pond. These deep portions also provide predator escape for adult frogs. Mats of floating and submerged aquatic vegetation in deep water seem to be ideal for adult frogs in the non-breeding season. Predators such as raccoons and herons (Ardeidae), and even large bullfrogs, probably find it difficult to reach red-legged frogs on floating mats.

The tadpole-rearing portion should be unshaded and shallow enough to warm quickly in the winter sun. Submerged aquatic vegetation seems to be tolerated, but a dense cover of emergents such as willows, cattails, or bulrushes with no direct sunlight seems to discourage breeding because the water tends to be much cooler. The pond must contain water for tadpole development during the entire rearing season (minimally February through August in most areas), but it can be allowed to dry at other times of the year.

An island, created in the middle of the deep water area, will provide refugia for adults and aquatic vegetation for metamorphs. The slopes should be steep enough so that emergent vegetation doesn't crowd out the island.

Shoreline refugia are important as well, and can be in the form of downed logs or rock piles. Individuals will use these escapes throughout the year. Rock piles at the bottom of the pond are also beneficial.

Some adult frogs regularly use a summer refuge that is different form the breeding pond. In places with a high water table, these can be well boxes if they have deep, perennial water and protecting vegetation. Small springs can also be modified with a collection box or small dam to serve as summer refuges.

Discouraging Predators

Perhaps the most important factor in discouraging aquatic vertebrate predators of red-legged frogs is to provide a way of drying perennial ponds with the installation of a drain. If the pond can be regularly and completely drained, even once every three or four years, bullfrog, crayfish, predaceous insect, and exotic fish populations will be greatly reduced or eliminated. Bullfrog eggs are laid in spring and early summer (April-July), and the majority of tadpoles do not transform until the following year. If the pond is completely drained in the fall, bullfrog (and fish) life cycles will be interrupted.

Bullfrog tadpoles and adults are often associated with deep water, and extensive shallow, marshy areas may favor red-legged frogs. Also, small isolated ponds a few meters across, such as excavated springheads, may harbor red-legged frogs, but may not be attractive to bullfrogs.

Chemical means of bullfrog tadpole and fish control are possible, but their use requires the permission of the California Department of Fish and Wildlife and the U.S. Fish and Wildlife Service to ensure that red-legged frogs and other native wildlife will not be harmed, and hand control is recommended.

The Role of Grazing

Pond management usually needs to be integrated with the local livestock grazing program. Grazing can be an important tool to help keep the shallower, tadpole-rearing portions of the pond free of emergent vegetation that shades the water. However, these shallows should not be churned into a mucky mire. This can be accomplished by varying the number of livestock using the site and by ensuring that the water is deep enough. Ponds with fluctuating levels where the shallow portions are flooded in the winter (breeding season), but dry each summer (after metamorphosis) appear to be ideal.

Many ponds used by cattle gradually become shallow mud holes, caused by cattle trampling the banks. To prevent this, portions of the pond should be fenced so that cattle cannot enter. This can be done in a manner such that the primary function of the pond to provide livestock water is not compromised, but some deep escape water and some shallow breeding habitat is protected for frogs. In fencing out cattle, consideration should also be given to protecting nearby densely vegetated terrestrial habitats that frogs may use as short term refuges when a pond dries.

The critical period for livestock water on many California ranges is late summer and early fall. Draining of ponds for bullfrog and fish control needs to accommodate livestock needs. For example, a temporary catch basin below the drained pond could provide livestock water. Water in the catch basin could be maintained until the main pond refills, then drained. A catch basin should also be used if there is danger of releasing unwanted predators into a downstream body of water.

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