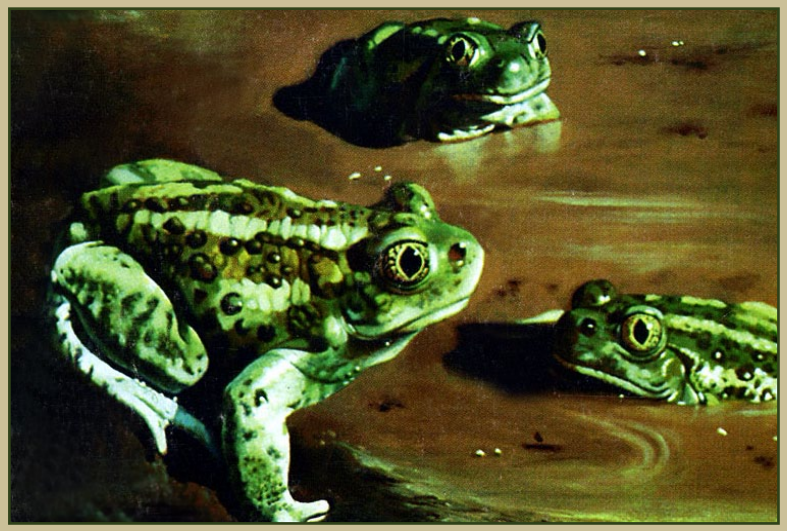
The Cornell Lab of Ornithology

Frog and Toad Calls of the Pacific Coast

Vanishing Voices

Carlos Davidson



USDA Forest Service
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This one hour audio field guide presents the voices of 29 species of frogs and toads that occur in the Pacific Coast states (Alaska, British Columbia, Washington, Oregon, California and North Baja California). Almost all of the species have a unique voice which can be used to identify them.

This booklet contains descriptions of calls, breeding season, and breeding habits for each species, as well as information on the different types of frog calls, on learning and identifying calls, and on the use of sound by biologists.

TRACK LISTING

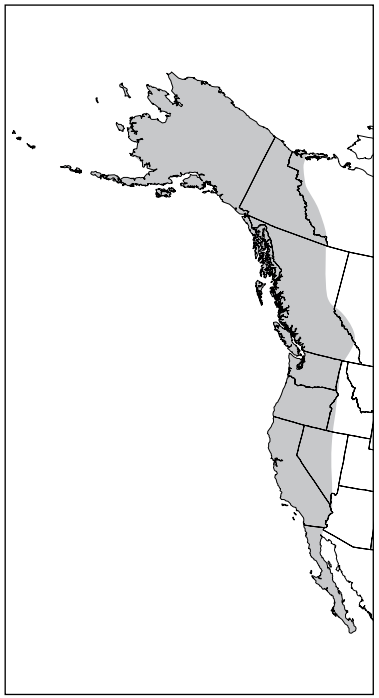
FROG AND TOAD CALLS OF THE PACIFIC COAST: Vanishing Voices

Carlos Davidson

1. Introduction

This guide is designed to help you learn to identify frog and toad calls of the Pacific Coast. There are 32 described species of frogs and toads in the Pacific Coast states and provinces (Alaska, British Columbia, Washington, Oregon, California, and North Baja California). This audio field guide presents the voices of 29 of these species, almost all of which have a unique voice that can be used to identify them. The only Pacific Coast species not included here are the Coastal and Rocky Mountain Tailed Frogs (*Ascaphus truei* and *Ascaphus montanus*), which are not known to have a voice, and the Boreal Chorus Frog (*Pseudacris maculata*), which occurs only in the far northeastern corner of British Columbia. Some California guides include the Arizona Toad (*Bufo microscaphus*), which may have occurred in the Colorado River on the California–Arizona border, but there are no historical records of the species occurring in California.

The voices of frogs and toads have filled the night for millions of years. This guide opens the door to a little known, and in some cases rapidly disappearing, world of natural sounds. For biologists, the guide can be a useful tool for survey, inventory, and monitoring.



Vanishing Voices

The populations of some species of frogs and toads on the Pacific Coast have sharply declined. For example, the California Red-legged Frog (*Rana draytonii*), the subject of Mark Twain's The Celebrated Jumping Frog of Calavaras County, was once abundant in the Sierra Nevada foothills. Today it is exceedingly rare there, although populations in the San Francisco Bay area are doing well. The Oregon Spotted Frog (*Rana pretiosa*) has largely vanished from western Washington and Oregon where it once occurred. Sierra Nevada populations of the two mountain yellow-legged frogs (*Rana muscosa* and *Rana sierrae*) have disappeared from over 90 percent of their historic sites. The Lowland Leopard Frog (*Rana yavapiensis*), which once occurred in southeast California, is now believed to be extirpated (locally extinct) in the state. At the same time, populations of a number of other species, such as the Pacific Chorus Frog (*Pseudacris regilla*) and the introduced Bullfrog (*Rana catesbeiana*), appear to be stable.

While habitat destruction and alteration are the most important causes of species loss in general, something different and still not completely understood is happening to amphibians. Around the globe, amphibian populations have crashed, in many cases in what appears to be pristine habitats. Disease caused by a pathogenic chytrid fungus is a leading cause of these population die-offs. It is still unclear if the chytrid fungus is a new disease attacking largely defenseless hosts, or if environmental changes such as climate change or contaminants have somehow facilitated disease epidemics.

Types of Calls

Frogs and toads make a variety of different calls. Calls can be classified based upon the function of the call. However, any classification system is a generalization; the specific function of each call varies by species, and not all species have a call of each type.

Advertisement call: These are the most commonly heard calls and are often produced by many individuals in a single location, creating a chorus. In Pacific Coast species, advertisement calls are given only by males and only by adults ready to breed. From a distance, advertisement calls serve to attract females and other males to breeding sites. At closer range, advertisement calls alert other males to the presence of a potential rival. Advertisement calls stimulate other males to respond with advertisement calls of their own, or with aggressive calls. In the past, only the mate-attraction aspect of advertisement calls was considered, and the calls were named "mating" or "breeding" calls.

Release call: Given by males and females to gain release when held by a male. Male frogs and toads are sometimes unable to distinguish suitable mates, and may attempt to mate with anything of about the appropriate size, shape, and feel. Males often clasp other males, mistakenly trying to mate with them. Upon giving a release call, the male is usually quickly released. Similarly, an unreceptive female will also give a release call when clasped by a male. Release calls are usually accompanied by body vibrations (release vibration), which may actually be more important in obtaining release than the call.

Encounter or aggressive call: Males give aggressive calls in close contact exchanges with other males. The calls are used to maintain territories, and may precede actual physical confrontation. Aggressive calls may also be used to disrupt the advertisement calls of nearby rival males.

Alarm and distress call: Alarm calls are given by an individual fleeing a potential predator. These are also known as "warning" calls; however, it is unclear whether the calls actually serve to warn other frogs. Distress calls are given by an individual when seized by a predator. Alarm and distress calls are given by males and females, and by both juveniles and adults.

Dry-land call: Given by males outside the breeding season and away from breeding sites. Also known as a "rain call," its function is unclear to scientists.

Classification by function is only one way to look at frog calls. Another approach is to examine the information contained in calls. Frog calls may contain information about the sender's sex, species identity, individual identity, size, physical condition, hormonal state, genetic quality, social status (such as call leader in a chorus, or holder of a territory), and location (distance or direction). The meaning of a call is separate from the information it contains, and depends upon who hears it. For example, the meaning of an advertisement call is different when heard by a receptive female, a rival male, or a predator looking for a meal.

Species Names

Names are constantly changing as new research supports the "splitting" of a species into two or more species, or determines that a species is more closely related to another than previously thought. For example, the California Red-legged Frog (*Rana draytonii*) and the Northern Red-legged Frog (*Rana aurora*) were previously treated as subspecies of a single red-legged frog species. Even bigger changes may be coming. It has been proposed that all of the toads in this guide currently in the genus *Bufo* be placed in a new genus *Anaxyrus*. For example, the scientific name of the Western Toad would be changed from *Bufo boreas* to *Anaxyrus boreas*. The only exception would be the Sonoran Desert Toad (currently *Bufo alvarius*), which would be given the scientific name *Ollotis alvarius*. Similarly the genus *Rana* would be split and seven of the species covered here (*Rana berlandieri, R. catesbeiana, R. clamitans, R. pipiens, R. sphenocephala, R. sylvatica*, and *R. yavapaiensis*) would be moved to the genus *Lithobates*.

With a few exceptions, the common and scientific names used in this guide match those in *A Field Guide to Western Reptiles and Amphibians (Third Edition, Peterson Field Guide Series)* by Robert C. Stebbins. This guide uses the names Pacific Chorus Frog (*Pseudacris regilla*) and California Chorus Frog (*Pseudacris cadaverina*), while the Stebbins guide uses the older names Pacific Treefrog (*Hyla regilla*) and California Treefrog (*Hyla cadaverina*). Here, both the red-legged frogs and the mountain yellow-legged frogs are split into two species each, while the Stebbins guide treats them as single species.

Choosing a correct pronunciation for scientific names is difficult. Herpetologists (scientists who study amphibians and reptiles) generally agree that classical Latin provides the "correct" pronunciation. However, in practice, Latin pronunciations are not always used. The pronunciations used here are based on consultation with western herpetologists, and are an attempt to reflect common usage.

Learning to Identify Calls

By using this guide, anyone can easily learn to identify frog and toad calls in the wild. The guide is arranged into three sections to help you learn the calls. To start, listen to the recordings of individual species calls in Part One and read the matching call descriptions in the reference section below. For help in learning to distinguish similar sounding species listen to Part Two. Once you have learned some of the calls, you can test your identification ability using the test sections in Part Three. When listening to the recordings, try to use a system with good quality bass. Many headphones and car stereo speakers poorly reproduce the low frequency calls of some frogs.

There are a number of tricks for learning calls. Try associating a call with a familiar sound, such as an infant's cry or a jackhammer. Or try phonetically writing out the sound of a call, such as *want-want-waaant-rowr* for the call of the California Red-legged Frog. The reference section below provides "sounds like ___" or phonetics for a number of calls, but making up your own can be even more effective. Computer-based training and quizzing can help biologists and others who need to accurately identify calls.

The recordings provide a good example of what each species sounds like. But in the field, the same species may sound different due to a number of factors:

Individual calls versus a chorus: The sound of a full chorus for some species is fairly different from the sound of a few calling individuals.

Individual differences in calls: Not all individuals sound identical, and the recordings are often of only a single individual.

Geographic differences: Populations of a single species in different locations may have slightly different calls. The recordings are usually only from a single location. It was not possible to obtain recordings from the Pacific Coast states for all species. Recordings for some species are from other western states, and for several species the only available recordings were from the East Coast. However, for the species in this guide, the known geographic differences in calls are sufficiently small that recordings from elsewhere are still representative of Pacific Coast populations.

Temperature: Call pitch, pulse rate (notes given per second), and sometimes other aspects of a call may be affected by temperature. Frogs and toads, which are cold-blooded, call in a lower pitch and a slower pulse rate in colder temperatures. The notes for most of the recordings indicate the temperature at the time the recording was made.

Distance: Some species sound different at close range than at a distance. For example, heard up close the Great Plains Toad (*Bufo cognatus*) sounds like a jackhammer, but at a long distance it sounds more like faint bells.

Volume: Recordings can be deceptive in that all sounds can seem equally loud (i.e., the sound of an ant's footsteps and a jet plane can be the same volume on a recording). See the last column in the breeding season chart and the call descriptions in the reference section for information on call volume.

Call type: Each species may make a variety of calls, and the audio guide does not include all call types for each species. The guide generally presents only the calls that are most often heard (usually advertisement calls). A full repertoire of calls is presented for only one species, the Pacific Chorus Frog (*Pseudacris regilla*).

Many Pacific Coast species can easily be identified by their call; others are more difficult. The following information can help you identify a call:

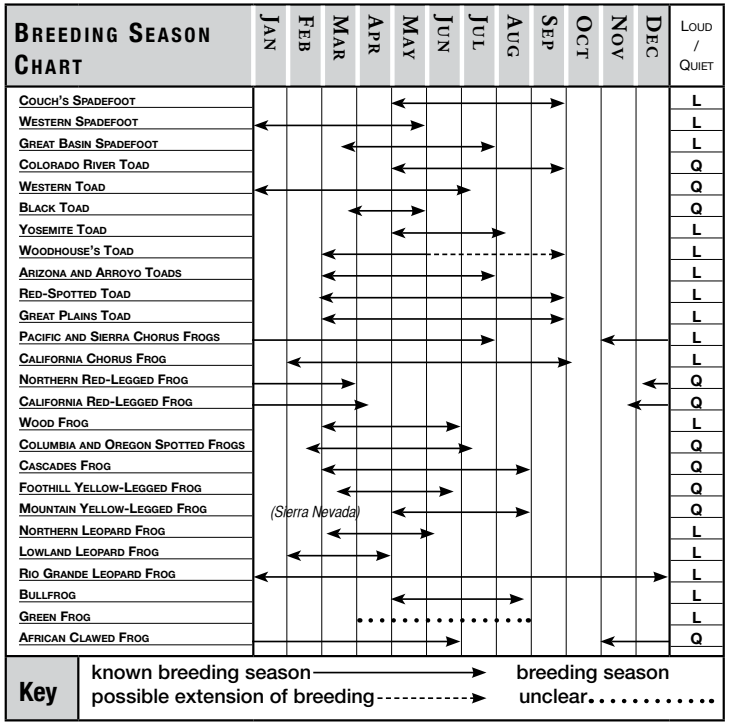
Species range: Knowing species' ranges in a given area will allow you to narrow the possibilities when trying to identify a call. For example, the calls of the Western and Great Basin Spadefoots (*Spea hammondii* and *Spea intermontana*) are extremely difficult to distinguish, but because their ranges do not overlap, range can be used to help decide which of the two you are hearing. Of the many species on the Pacific Coast, only a handful at most are likely to occur at any one location. To take advantage of range information, this guide should be used in conjunction with a standard field guide (see Bibliography). Keep in mind, however, that range information is not perfect, and therefore you can't always rule out a species because the field guide indicates it should not be in an area.

Time of year and breeding habitat: Once you have a tentative identification based on the sound of a call, check to see if the time of year and habitat matches the breeding season and breeding habitat in the booklet for that species. Time of year and breeding habitat are less definitive than range—a single individual may be calling out of season or in an unusual habitat.

Breeding Season Chart

The timing of breeding for many species varies with elevation and latitude. Generally, breeding begins first at lower elevations and may be delayed by many months at higher elevations. The breeding season includes the earliest and latest dates that the species breeds, but the breeding period in a single location is generally much shorter. For example, the breeding season for the California Red-legged Frog (*Rana draytonii*) is from late November to early April, but in a single location the breeding period is often only a few weeks within that time frame. Other species, such as the Pacific Chorus Frog (*Pseudacris regilla*), may call for many months.

The last column in the breeding season chart indicates whether a species' call is loud (can be heard from at least 40 yards) or quiet (not likely to be heard from 40 yards). Note that the 40-yard distance for the loud category is a minimum—the calls of many species, such as the spadefoots, can be heard from over 200 yards. The call descriptions in the reference section give additional information on the volume of calls. The breeding season chart does not include the Southern Leopard Frog, and the two mountain yellow-legged frog species and two spotted frog species are presented as single species. Breeding season details for these frogs are included in their individual species accounts.



The Use of Sound by Biologists

Biologists can use frog and toad calls to locate and identify breeding males. Thus, these sounds are useful for survey, inventory, and monitoring. Sound has a number of advantages over visual location and identification. For species with loud calls, a calling male can be detected from a long distance and in any direction. Often, calling individuals can be heard easily even when they are difficult or impossible to locate visually (e.g., animals hidden by vegetation in a marsh, or calling from a burrow). Some species are more easily identified by call than by sight. A major limitation of audio detection is that only calling males are detectable, and in the Pacific Coast states, many species call for only short periods (explosive breeders), and/or have very quiet calls, or call underwater.

Just as knowing what an eagle looks like increases the chance of a sighting, knowledge of frog calls increases the chances that a call will be noticed. In Wisconsin, Illinois, and Missouri, frog calls are being used in formal monitoring programs similar to the Breeding Bird Survey in that they use point counts and volunteer observers. The situation is different on the Pacific Coast because of the large number of explosive breeders and quiet callers, but the method is still applicable for some species and in some habitats. Automated recording equipment is now relatively inexpensive and can be used to monitor fixed points. The recording equipment can be automated to turn on and off at preset times and to take audio samples for short periods over any part of the day or night. The recording equipment can be coupled with a data logger to gather additional information on the conditions under which the animals call. For example, Amy Lind of the U.S. Forest Service has developed a setup with underwater microphones to study the impact of dams and altered stream flows on the breeding of the Foothill Yellow-legged Frog (*Rana boylii*).

2. Part One: Reference Section

The reference section contains individual recordings of 29 species of frogs and toads. Species are ordered by taxonomic families and closely match the order in *A Field Guide to Western Reptiles and Amphibians*. See the first page of this booklet for an index. For each species, the booklet gives the following information

Voice: A written description of the call or calls made by the species. If available, the time of day or night when the species primarily calls is indicated.

Breeding: The time of the breeding season and, if available, breeding habitats for the species.

Recording: A description of the recording or recordings for that species. All recordings are monaural unless specifically identified as stereo. A few recordings are two channel (but not true stereo), with the right channel recorded in air, and the left channel recorded underwater—use a balance control or separate volume controls to listen to either channel separately.

The call descriptions are based on a large collection of field recordings, but also draw heavily on the written descriptions in four field guides: *A Field Guide to Western Reptiles and Amphibians* (Peterson Guide Series), *Amphibians and Reptiles of the Pacific Northwest, Amphibians of Washington and Oregon*, and *The National Audubon Society Field Guide to Reptiles and Amphibians* (See the field guide section of the Bibliography for full citations). These same field guides are the main sources for the information on breeding activity. In the descriptions below, the phrase “in our area” refers to the Pacific Coast states and provinces covered by this guide: Alaska, British Columbia (except the far northeastern corner), Washington, Oregon, California, and North Baja California.

Spadefoot Toads
Family Scaphiopodidae

3. Couch's Spadefoot
Scaphiopus couchii

Voice: A plaintive, nasal call resembling the bleat of a lamb. Calls are short, lasting ½ to 1¼ seconds. A chorus can be heard from a long distance. Calls are given primarily at night.

Breeding: From May to September, in temporary pools during or right after heavy rains.

Recording: Two males giving advertisement calls. Background: probably crickets. Near Wickenburg, Maricopa Co., AZ. Approximately 79° F air. 7/13/91. Jim Rorabaugh.

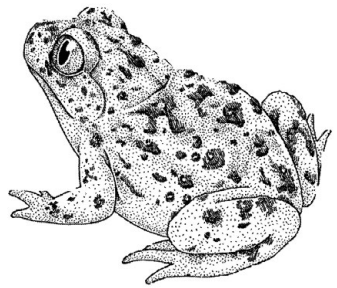
4. Western Spadefoot
Spea hammondii

Western Spadefoots have now largely disappeared in lowland southern California, although populations remain in other parts of the state.

Voice: A vibrating snore reminiscent of the purring of a cat, repeated over and over. Calls last ½ to 1½ seconds and can be heard from a long distance. The call is difficult to distinguish from that of the Great Basin Spadefoot *(Spea intermontana)*; however, the ranges of the two spadefoots do not overlap. Calls are given primarily at night.

Breeding: January to May, in quiet streams and temporary pools.

Recording: Individual advertisement calls with a chorus in the background. Near Palermo, Butte Co., CA. 4/8/78. Thomas L. Rogers with Marc P. Hayes and Howard Wulitzer.



Western Spadefoot
Spea hammondii

5. Great Basin Spadefoot
Spea intermontana

Voice: A short (⅕ to 1 second), low-pitched, hoarse snore *(kw-a-a-h, w-a-a-h* or *r-a-h)* that is repeated over and over. The calls can be heard from over 200 yards and are similar to those of the Western Spadefoot *(Spea hammondii)*. Calls are given at night.

Breeding: Sporadic breeders in rain puddles, small lakes, ponds, and irrigation ditches from April through July. Breeding may be stimulated by warm temperatures combined with rainfall or irrigation.

Recordings: a. Individual advertisement calls at the start of a chorus. Mono Lake, Mono Co., CA. 3/26/86. Bernard L. Krause, Ph.D.

b. Full chorus. Mono Lake, Mono Co., CA. 4/30/93. Bernard L. Krause, Ph.D.

True Toads
Family Bufonidae

6. Sonoran Desert Toad
Bufo alvarius

Also known as the Colorado River Toad.

Voice: A weak, rising cry, lasting about ½ to 1 second. At close range, the call somewhat resembles that of the Woodhouse's Toad *(Bufo woodhousii),* but is much shorter and quieter. Calls are given primarily at night.

Breeding: May to September, following summer rains.

Recordings: a. Individual advertisement calls. Background: Red-spotted Toads.

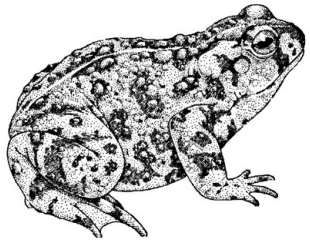
b. Release calls given by a handheld toad. Both recordings are from Skunk Creek, Maricopa Co., AZ. 79° F body. 8/24/92. Brian K. Sullivan.

7. Western Toad
Bufo boreas

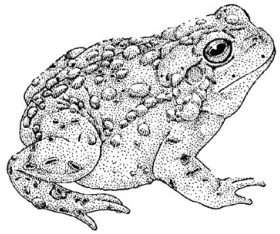
There are two subspecies of the Western toad: the California Toad *(Bufo boreas halophilus)* and the Boreal Toad *(Bufo boreas boreas)*. The voice and breeding descriptions below do not distinguish between subspecies; however, the audio guide includes recordings of both subspecies.

Voice: A very soft, high-pitched, plinking sound, like the peeping of a chick. The Western Toad's call was long thought to be solely a release call. However, a lone male Western Toad has been observed calling, indicating that the same call may serve other functions than just as a release call. Calls are given both at night and during the day.

Breeding: January to early July, in ponds, marshes, shallow lakes, streams, and river margins. Breeding only occurs during a few days or a week at any given site.



Western Toad
Bufo boreas



Yosemite Toad
Bufo canorus

Recordings: a. Lone male California Toad *(Bufo boreas halophilus).* Background: Pacific Chorus Frogs. Boulder Creek, near Descanso, Cleveland National Forest, San Diego Co., CA. 72° F water. 5/24/73. Frank T. Awbrey.

b. Boreal Toad *(Bufo boreas boreas)*. Small group calling while clasping females and fighting. Meta Lake, Mount St. Helens Volcanic National Monument, Skamania Co., WA. 4/25/92. Ann and Steve Dunsky.

8. Black Toad
Bufo exsul

Voice: Only a release call is known, a sharp squawk resembling geese heard from a distance. The call is very similar to that of the western toad *(Bufo boreas)*, but is higher pitched. As with the western toad, the release call may serve other functions. Black toads call during both day and night.

Breeding: Mainly from late March to May, although possibly into June.

Recording: Release calls made by males clasped by males, also by males that are clasping females that are in turn being harassed by single males. Corral Springs, Deep Springs Valley, Inyo Co., CA. 3/28/78. Cynthia Kagarise Sherman.

9. Yosemite Toad
Bufo canorus

The name *canorus* means "tuneful" in Latin.

Voice: A long musical trill of 10-20 or more notes, usually given at frequent intervals. Calls average about two and a half seconds in duration. Although the advertisement call is similar to several other toads, the Yosemite Toad is the only species with this type of advertisement call throughout its range in the Sierra Nevada. Yosemite Toads call primarily during the day, with calling peaking around midday.

Breeding: May through July and possibly into August, in shallow water.

Recording: Individual advertisement calls mixed with release calls. Tioga Pass Meadows, Inyo National Forest, Mono Co., CA. 70° F air. 6/3/77. Cynthia Kagarise Sherman.

10. Woodhouse's Toad
Bufo woodhousii

In the Pacific Coast states there is a single subspecies, the Woodhouse's Toad (*Bufo woodhousii woodhousii*).

Voice: Resembles an infant's cry or a scream in a horror movie. An explosive nasal *w-a-a-a-ah* lasting about 1 to 2½ seconds, often suddenly dropping in pitch at the end. Call is somewhat similar to that of the Sonoran Desert Toad *(Bufo alvarius*) heard at close range, but is much longer and louder. Woodhouse's Toads call primarily from dusk to dawn.

Breeding: March through June, although may extend as late as early September. Breeds in wetlands bordering still or slowly moving water.

Recording: Individual advertisement calls. Background: crickets and river. Harding Hole, Yampa River, Dinosaur National Monument, Moffat Co., CO. 6/20/89. Carlos Davidson with Anne Bradley.

11. Arroyo Toad
Bufo californicus

In the past this species was considered a subspecies of the Southwestern Toad (*Bufo microscaphus*).

Voice: A long, musical trill, usually lasting 6 to 10 seconds. Calls usually rise in pitch and pulse rate right at the start and end abruptly. Calls are given primarily at night.

Breeding: March to July, in shallow pools of slow moving streams in semi-arid regions. Breeding is not dependent on rainfall.

Recordings: a. Several male Arroyo Toads giving advertisement calls. Background: Great Horned Owl and crickets.

b. Release calls given by hand held Arroyo Toad. Both recordings from Mono Creek, Los Padres National Forest, Santa Barbara Co., CA. 56° F air, 66° F water. 5/20/94. Carlos Davidson with Damien Maloney. Stereo.

12. Red-spotted Toad
Bufo punctatus

Voice: A prolonged, high-pitched trill or scream, lasting from 6 to 10 seconds, occasionally dropping in pitch at the end. The call is similar to that of the Arroyo Toad (*Bufo californicus*), but is higher pitched. In pitch the call is similar to that of the Woodhouse's Toad (*Bufo woodhousii woodhousii*), but is much longer. Calls are given primarily at night.

Breeding: March to September, during or after rains. Breeds in springs, reservoirs, temporary pools, and intermittent streams.

Recording: Several individuals. Foreground: crickets. Cottonwood Springs, Joshua Tree National Monument, Riverside Co., CA. 80° F air. 5/22/83. Paul Matzner. California Library of Natural Sounds (A-260-2).

13. Great Plains Toad
Bufo cognatus

Voice: A harsh, high-pitched metallic trill or chatter resembling a jackhammer. Calls last from five to more than fifty seconds. At close range a large chorus can be deafening (one researcher reported three days of ringing ears after listening to a chorus of more than 200 toads). Calls are given primarily at night.

Breeding: March to September, usually during or after heavy rainfall.

Recording: Individual advertisement calls. Near Wilcox, Cochise Co., AZ. 70° F. 8/5/92. Brian K. Sullivan.

Treefrogs and Chorus Frogs
Family Hylidae

14. Pacific Chorus Frog
Pseudacris regilla

Formerly known as the Pacific Treefrog (*Hyla regilla*).

When Hollywood movie makers wanted frog calls to convey the feeling of night time outdoors, they recorded local Pacific Chorus Frogs. Consequently, the *ribbit-ribbit* calls of this species have become the stereotypical frog call, even in regions where they don't occur.

Voice: Advertisement call is a loud, two parted *kreck-ek*, or *ribbit*, often repeated many times. Advertisement calls resemble the California Chorus Frog's (*Pseudacris cadaverina*) but are generally two-parted and higher pitched. There is some geographic variation in calls, but all are easily recognizable as Pacific Chorus Frogs. In addition to advertisement calls, males have a one-parted (monophasic) call which is a "superstimulus" or enhanced mate attraction call given when they sense nearby vibration, potentially indicating a female is close. Males also give a slow trill encounter call in close interactions with other males. A dry land call made by males away from breeding ponds is a single note *Krr-r-r-ek*, and sounds very similar to the advertisement call of the California Chorus Frog (*Pseudacris cadaverina*). Pacific Chorus Frogs call mainly in the evening and at night, although they may call sporadically during the day at the height of the breeding season.

Breeding: November to July in still or slow-moving water.

Recordings: a. Advertisement calls, several individuals. Mt. Vision, Point Reyes National Seashore, Marin Co., CA. 4/9/88. Thomas G. Sander. Stereo. Macaulay Library (ML 111026).

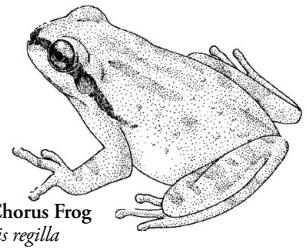
b. Full chorus. Limintour Ridge, Marin Co., CA. 2/28/88. Thomas G. Sander. Stereo. Macaulay Library (ML 110998).

c. Individual one parted (monophasic) calls. Cotati, Sonoma Co., CA. 66° F air. 4/12/91. Philip T. Northen.

d. Individual trilled encounter calls. Background: advertisement calls. Cotati, Sonoma Co., CA. 66° F air. 4/12/91. Philip T. Northen.

e. Release calls. Santa Rosa, Sonoma Co., CA. 2/86. Philip T. Northen.

f. Single male making dry land calls. Individual collected from Santa Cruz Island, Santa Barbara Co., CA. Recorded in the laboratory of H. Bradley Shaffer, University of California, Davis. Approximately 60° F air. 1/23/94. Carlos Davidson.



Pacific Chorus Frog
Pseudacris regilla

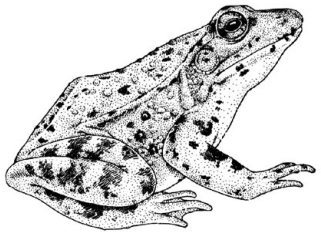
15. California Chorus Frog
Pseudacris cadaverina

Formerly known as the California Treefrog (*Hyla cadaverina*).

Voice: Advertisement call is an explosive, low-pitched, raspy quack. Calls are short (⅕ second), end abruptly, and are given repeatedly. The advertisement call is similar in tone to Pacific Chorus Frog (*Pseudacris regilla*) advertisement calls, and very similar to that species' dry land call. California Chorus Frogs also make a trilled encounter call like that of the Pacific Chorus Frog. California Chorus Frogs call night and day during the height of the breeding season.

Breeding: February to early October, in oases and rocky streams.

Recording: Individual advertisement calls. Indian Creek, Los Padres National Forest, Santa Barbara Co., CA. 39° F air, 68° F water. 5/20/94. Carlos Davidson with Damien Maloney. Stereo.



Northern Red-legged Frog
Rana aurora

True Frogs
Family Ranidae

16. Northern Red-legged Frog
Rana aurora

Voice: An accelerating series of 4 to 7 low-pitched notes. Call can be imitated by saying the word "want" repeatedly, stretching the "a"—*waant-waant-waant-waant* with more emphasis at the end. The call resembles the clucking of a chicken. Calls are given both underwater and in the air, and can only be heard from a short distance. The call of the Northern Red-legged Frog is very similar to that of the California Red-legged Frog (*Rana draytonii*) but the ending growl is rarely heard. Northern Red-legged Frogs call during both day and night.

Breeding: Mid-December through March. In a single location the breeding period is only a few weeks.

Recording: Individuals calling at the surface of the water. The right channel was recorded in the air, the left channel was recorded under water. Background: Pacific Chorus frogs. Fresh Water Lagoon, Del Norte Co., CA. Approximately 68° F air. 2/29/92. Alejandro Purgue.

17. California Red-legged Frog
Rana draytonii

Voice: A series of four to seven low notes often ending with a growl or groan—*want-want-want-waaant-rowr*. The California Red-legged Frog sounds very similar to the Northern Red-legged Frog, but often adds a growl or groan to the end of its call. The call is weak, although it can be heard under a full chorus of Pacific Chorus Frogs (*Pseudacris regilla*), with which the Red-legged Frog often shares breeding ponds. The California Red-legged Frog may call underwater, as does the Northern Red-legged Frog. Calls are given primarily at night, although they can occasionally be heard during the day.

Breeding: Late November to early April. At any single location breeding lasts only a few weeks.

Recording: Single male calling. Foreground: Pacific Chorus Frogs. Ponds near Bass Lake, Point Reyes National Seashore, Marin Co., CA. 2/18/89. Thomas G. Sander.

18. Wood Frog
Rana sylvatica

Voice: A series of strained, grating sounds resembling the quacking of a small duck or the sound made by rubbing an inflated balloon. Each note is short (about a second) and of medium volume. The calls are similar to some of the chuckling calls of the Northern Leopard Frog (*Rana pipiens*), but the Wood Frog does not have a "rattle" call like the Northern Leopard Frog. Calls are given both night and day.

Breeding: In our area breeds from April to June, for a 1 to 2 week period.

Recording: Small chorus. Tompkins Co., NY. 3/30/88. Lang Elliot.

19. Oregon Spotted Frog
Rana pretiosa

The frogs formerly called the "Spotted Frog" have been split into two species—the Oregon Spotted Frog and the Columbia Spotted Frog (*Rana luteiventris*). The Oregon Spotted Frog lives west of the Cascade Mountains and has disappeared from much of its former range.

Voice: A rapid series of 5 to 50 faint, low-pitched, hollow, notes. The call can be roughly imitated by knocking on wood with a fist, or clicking the tongue against the roof of the mouth. Spotted Frogs sometimes call underwater. The call is similar to that of the Northern Red-legged Frog (*Rana aurora*), but is generally longer and contains many more notes. Calls are primarily given during the day, while floating at the surface of the water.

Breeding: Late February in lowland sites to late June in montane sites, in large shallow wetlands.

Recordings: a. Several individuals calling. Foreground: Pacific Chorus Frogs. Trout Lake, Klickitat Co., WA. 60° F air, 55° F water. 3/16/95. Jonathan R. Storm. Macaulay Library (ML 120484).

b. Release calls of captive female. Collected at Trout Lake, Klickitat Co., WA. 3/16/95.

20. Columbia Spotted Frog
Rana luteiventris

Voice: A series of 5 to 50 faint, low-pitched, hollow notes very similar to that of the Oregon Spotted Frog.

Breeding: March to late June, in shallow bodies of water following winter thaw.

Recording: Single call sequence from east of the Cascade Mountains. Background: American Robin, Pacific Chorus Frogs, and Mallard. Virginian Ridge, Okanogan National Forest, near Winthrop, Okanogan Co., WA. 54° F air, 46° F water. 4/25/94. Jonathan Storm. Macaulay Library (ML 71693).

21. Cascades Frog
Rana cascadae

Voice: A rapid series of low-pitched single or double chuckles, with 4 to 6 notes per second. Sometimes there is a growl at the end of a series of calls. Cascades Frogs call both in the air and underwater and can only be heard a short distance. Calls are given during the day, although probably more often at night.

Breeding: March to mid-August, soon after snow and ice begin to melt.

Recording: Individual calls. Bear Creek, Jefferson Co., OR. 54° F water. 3/9/68. Jeffrey L. Briggs.

22. Foothill Yellow-legged Frog
Rana boylii

Voice: A short (½ sec.) rasping or grating sound like that made by rubbing an inflated balloon. Each call ends abruptly and may be made singly or in series. Foothill Yellow-legged Frogs make a variety of other calls, including a short "mew" call and a long "rattle" call. The call most likely to be heard in the field is a very quiet slow quack, usually given in pairs, with the time between calls lasting minutes (unfortunately, no recordings were available of this call). Males call in air and underwater, and can only be heard a short distance. Calling takes place both night and day.

Breeding: Mid-March to late June, in streams and rivers following high water from winter runoff.

Recordings: a. In air calls. Pepperwood Ranch, Sonoma Co., CA. 5/7/93. 59° F water. Tim C. Ziesmer.

b. Single male underwater calls. Pepperwood Ranch, Sonoma Co., CA. 56° F water. 4/23/92. Tim C. Ziesmer.

c. Underwater recording of single male making "mew" and "rattle" calls. Hurdygurdy Creek, Six Rivers National Forest, Del Norte Co., CA. 58° F water. 5/9/94. Amy J. Lind and Garth R. Hodgson.

23. Sierra Nevada Yellow-legged Frog
Rana sierrae

The former Mountain Yellow-legged Frog has been split into two species with separate ranges: the Sierra Nevada Yellow-legged Frog (*Rana sierrae*) in the Northern Sierra, and the Southern Mountain Yellow-legged Frog (*Rana muscosa*) in the southern Sierra Nevada and in southern California.

Voice: Short rasping call, often accelerating and rising in pitch at the end. The call is sometimes preceded by several calls without the rising end to form the phrase *uuun-uuun-unch*. Call is similar to that of the Foothill Yellow-legged Frog (*Rana boylii*), but is higher pitched and sounds strained as if the frog is struggling to make the call. Calling takes place during the day, and possibly also at night. Calls are given underwater and can only be faintly heard in air.

Breeding: May to July, in high elevation streams, wet meadows, or lakes as soon as the snow and ice melts. At lower elevations, breeding in streams follows high water runoff and starts as early as April.

Recording: Single male, underwater calls. Background: Pacific Chorus Frogs. Summit Meadow, Yosemite National Park, CA. 64.5° F water. 6/14/93. Tim C. Ziesmer.

24. Southern Mountain Yellow-legged Frog
Rana muscosa

This species occurs in the southern Sierra Nevada and in southern California. Mountain yellow-legged frogs in the northern Sierra are now considered a separate species: the Sierra Nevada Yellow-legged Frog (*Rana sierrae*). There are only a few small populations of Southern Mountain Yellow-legged Frogs remaining in southern California, and in the Sierra Nevada this species has disappeared from over 90 percent of its historic locations.

Voice: The call of the Southern Mountain Yellow-legged Frog sounds less strained than that of the Sierra Nevada Yellow-legged Frog (*Rana sierrae*). The call actually sounds closer to that of the Foothill Yellow-legged Frog *(Rana boylii)* than it does to the Sierra Nevada Yellow-legged Frog. Southern Mountain Yellow-legged Frogs call underwater during the day, and possibly at night.

Breeding: April to July, in high elevation lakes and meadows following ice-melt, and in lower elevation streams following high water runoff.

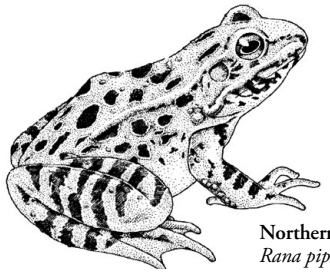
Recording: Individual calls. Hall Research Natural Area, San Bernardino National Forest, Riverside Co., CA. 64.5° F water. 5/24/94. Tim C. Ziesmer.

25. Northern Leopard Frog
Rana pipiens

Voice: Males make a variety of calls including a loud, long, accelerating rattle and low-pitched chuckling, grunting, and grating sounds similar to the sound made by rubbing an inflated balloon. Surprised individuals may give a squawk alarm call as they leap into the water, and when caught by a predator they may emit a scream. Calls are given night and day.

Breeding: Mid-March to early June, soon after ice and snow have melted. Generally breeds in still or slow moving water with aquatic vegetation such as cattails.

Recording: Individual advertisement calls followed by small chorus. Background: Western Chorus Frogs *(Pseudacris triseriata)*, which do not occur in our area. Walpole Island, Ontario, Canada. 4/8/69. William W. H. Gunn. Macaulay Library (ML 69299).



Northern Leopard Frog
Rana pipiens

26. Lowland Leopard Frog
Rana yavapaiensis

The Lowland Leopard Frog once occurred in the far southeastern corner of California, but it has now probably disappeared from the state.

Voice: Males make short, guttural, grunting calls and a series of higher pitched rattle or chuckling notes. The grunting calls resemble sounds made by rubbing an inflated balloon, and in this respect are similar to calls of the Northern Leopard Frog (*Rana pipiens*); however, the Lowland Leopard Frog's calls are higher pitched and shorter. Calls are given primarily at night, and sometimes during the day.

Breeding: February to April, although the species sometimes breeds in fall.

Recording: Several individuals. Background road noise. Hassayampa River, Hassayampa River Preserve, Maricopa Co., AZ. 64° F water. 4/24/94. Jim Rorabaugh.

27. Rio Grande Leopard Frog
Rana berlandieri

An introduced species along the Colorado River and in the Coachella Valley of southern California.

Voice: A loud, low-pitched rattle lasting about ½ to ⅔ of a second. Can be roughly imitated by fluttering the tongue against the roof of the mouth to produce a *p-r-r-r-r-r-r-t* sound. Rattle is given singly or in a series of 2 to 3 rattles. This species also gives a short rasping or squealing call repeated several times in a row. Calls are given at night.

Breeding: In our area breeds following rainfall, almost any time of year.

Recording: Individual calls. Background: An airplane. Near Yuma, Yuma Co., AZ. 59° F water. 10/29/84. Jim Rorabaugh.

28. Bullfrog
Rana catesbeiana

Native to the eastern United States and Canada, the Bullfrog has been introduced throughout the west. Bullfrogs are voracious predators and may have contributed to the decline of a number of native Pacific Coast amphibians.

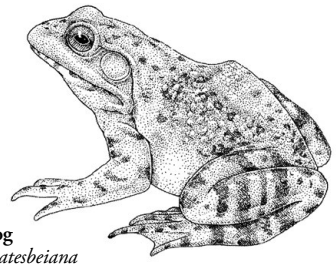
Voice: Advertisement call is a deep-pitched bellow or bray, variously described as *jug-o-rum* or *barroom*, that can be heard from a long distance. Calls are given both day and night. The Bullfrog's encounter call is a quick *phoot*. Frightened individuals, especially juveniles, may give a scream or squeak alarm call when they leap into the water. Bullfrogs, Green Frogs (*Rana clamitans*), and Northern Leopard Frogs (*Rana pipiens*) are the only species in our area known to have a squeak alarm call.

Breeding: In our area, from May to late August in slow moving or still water with aquatic vegetation.

Recordings: a. Individuals and large chorus. Background: occasional Green Frogs. Tompkins Co., NY. 6/7/89. Lang Elliot.

b. *Phoot* encounter calls. Background: Blanchard's Cricket Frogs (*Acris crepitans blanchardi*), which do not occur in our area. Bradley Co., Arkansas. 4/20/89. Lang Elliot.

c. Alarm calls and splashes as Bullfrogs leap into the water. Five Brooks Pond, Point Reyes National Seashore, Marin Co., CA. 75° F air. 9/2/94. Carlos Davidson and Cynthia Kaufman.



Bullfrog
Rana catesbeiana

29. Green Frog
Rana clamitans

An introduced species from the East Coast, now found in Washington and British Columbia.

Voice: An explosive *bung* or *c'tung*, resembling the plucking of a banjo bass string. Call usually given as a single note, but may be rapidly repeated several times. Calls are given both day and night. Surprised individuals give a high squeak while leaping into the water, very similar to the Bullfrog alarm call.

Breeding: In the West, breeding begins with warm temperatures in late spring or early summer.

Recordings: a. Advertisement calls. Connecticut Hill Wildlife Management Area, Tompkins Co., NY. 7/28/88. Greg Budney. Macaulay Library (ML 60445). Stereo.

b. Alarm calls. Background: crickets. Tompkins Co., NY. 9/15/91. Lang Elliot.

30. Southern Leopard Frog
Rana sphenocephala

Also known as the Florida Leopard Frog. Introduced from the eastern United States to the Santa Ana river basin of southern California.

Voice: This species makes a variety of rattling, chuckling, and grunting calls.

Breeding: Timing of breeding in California is unknown. In the southeastern United States the species may breed any time of the year, but breeding peaks in early fall and again in winter.

Recording: Nashville, Davidson Co., TN. 2/10/97. Robert English. Macaulay Library (ML 86846).

Tongueless Frogs
Family Pipidae

31. African Clawed Frog
Xenopus laevis

An introduced species in southern California.

Voice: A low-pitched, rising and falling, two-part trill. Each rise and fall lasts about ½ to ¾ second and may be repeated continuously for over a minute. Calls are given under water both night and day, and can only be heard faintly in the air.

Breeding: In southern California, breeds from November to June.

Recording: Single male calling under water. Laboratory of John Gerhart, University of California, Berkeley. 1/25/94. Carlos Davidson.

32. Part Two: Comparison of similar-sounding species

33. Five toad species: Sonoran Desert Toad (*Bufo alvarius*) Woodhouse's Toad (*Bufo woodhousii*), Red-spotted Toad (*Bufo punctatus*), Arroyo Toad (*Bufo californicus*) and Great Plains Toad (*Bufo cognatus*).

34. Pacific Chorus Frog *(Pseudacris regilla)* and **California Chorus Frog** (*Pseudacris cadaverina)*.

35. Foothill Yellow-legged Frog *(Rana boylii)* and **Sierra Nevada Yellow-legged Frog** (*Rana sierrae)* from the northern Sierra Nevada.

Note that the Sierra Nevada Yellow-legged Frog (R*ana sierrae*) and the Southern Yellow-legged Frog (*Rana muscosa*) sound very similar but their ranges do not overlap. The same is true for the Oregon and Columbia Spotted Frogs (*Rana pretiosa* and *Rana luteiventris*)

Recordings: All recordings used in this section are the same as those used for the species in the reference section (Part One), with two exceptions:

Woodhouse's Toad *(Bufo woodhousii)*. Near Westmoreland, Imperial Co., CA. 70° F body. 3/12/66. Frank T. Awbrey.

Pacific Chorus Frog (*Pseudacris regilla*) and California Chorus Frog (*Pseudacris cadaverina*) calling together. Mono Creek, Los Padres National Forest, Santa Barbara Co., CA. 56° F air, 66° F water. 5/20/94. Carlos Davidson with Damien Maloney. Stereo.

36. Part Three: Test section

This section of the audio guide can be used to test your ability to identify species calls. Each short recording is followed by an announcement of the species name(s). Listen carefully for species calling in the background.

The test recordings are divided into separate Northern and Southern sections. The Northern section contains all species that occur north of San Francisco, California, on the Coast, and north of the Sierra Nevada inland. The Southern section contains all species that occur south of San Francisco, or in the Sierra Nevada.

Recordings: Unless otherwise indicated, the recordings in this section are the same as those in the reference section (Part One). Information on a recording can be found by looking in the reference section under the name of the first species indicated in the narration for each of the test recordings. Recordings used in this section that are not included in the reference section are listed below. The letters or numbers before each recording description match the narration identifying the recording.

37. Northern Test Section

A. **Western Spadefoot Toad** *(Spea hammondii)* and **Pacific Chorus Frog** *(Pseudacris regilla)*

B. **Cascades Frog** *(Rana cascadae)*

C. **Columbia Spotted Frog** *(Rana luteiventris)*

D. **Pacific Chorus Frog** *(Pseudacris regilla)*

E. **Woodhouse's Toad** *(Bufo Woodhousii)*

F. **Great Basin Spadefoot Toad** *(Spea intermontana)*

G. **Pacific Chorus Frog** *(Pseudacris regilla)*

H. **Western Toad** *(Bufo boreas)*

I. **Bullfrog** *(Rana catesbeiana)*

J. **Pacific Chorus Frog** *(Pseudacris regilla)* and **Northern Red-legged Frog** *(Rana aurora aurora)*

K **Green Frog** *(Rana clamitans)*

L. **Great Plains Toad** *(Bufo cognatus)*

M. **Northern Leopard Frog** *(Rana pipiens)*

N. **Bullfrog** *(Rana catesbeiana)* **and Green Frog** *(Rana clamitans)*

O. **Wood Frog** *(Rana sylvatica)*

P. **Foothill Yellow-legged Frog** *(Rana boylii)*

Q. **Pacific Chorus Frog** *(Pseudacris regilla)* and **California Red-legged Frog** (*Rana aurora draytonii*)

R. **Oregon Spotted Frog** *(Rana pretiosa)* and **Pacific Chorus Frog** *(Pseudacris regilla)*

38. Southern Test Section

1. **Sonoran Desert Toad** *(Bufo alvarus)* and **Red-Spotted Toad** *(Bufo punctatus)*
2. **Couch's Spadefoot** *(Scaphiopus couchii)*
3. **Lowland Leopard Frog** *(Rana yavapaiensis)*
4. **Great Plains Toad** *(Bufo cognatus)*
5. **ArroyoToad** *(Bufo californicus)*, **Western Toad** *(Bufo boreas halophilus)*, and **Pacific Chorus Frog** *(Pseudacris regilla)*. The Arroyo and Western Toads are calling at the same time; the Pacific Chorus Frog can be heard only at the end. Pine Valley, Cleveland National Forest, San Diego Co., CA. 43° F air, 54° F water. 5/1/70. Frank T. Awbrey.
6. **California Chorus Frog** *(Pseudacris cadaverina)* and **Pacific Chorus Frog** *(Pseudacris regilla)*. Kitchen Creek, Cleveland National Forest, San Diego Co., CA. 5/4/73. Frank T. Awbrey.
7. **Western Spadefoot** *(Spea hammondii)* and **Pacific Chorus Frog** *(Pseudacris regilla)*. The trilled calls are Pacific Chorus Frog encounter calls. A few faint calls of the Western Toad *(Bufo boreas)* can be heard at the end. San Timoteo Canyon, Riverside Co. 3/18/94. Bruce Farnsworth.
8. **Northern Leopard Frog** *(Rana pipiens)*
9. **Western Toad** *(Bufo boreas)* and **Pacific Chorus Frog** *(Pseudacris regilla)*
10. **Bullfrog** *(Rana catesbeiana)* advertisement calls. Boulder Creek, near Descanso, Cleveland National Forest, San Diego Co., CA. 7/18/79. Frank T. Awbrey.
11. **Great Basin Spadefoot** *(Spea intermontana)*
12. **Pacific Chorus Frog** *(Pseudacris regilla)*
13. **African Clawed Frog** *(Xenopus laevis)*
14. **California Red-legged Frog** *(Rana draytonii)* and **Pacific Chorus Frog** *(Pseudacris regilla)*
15. **Arroyo Toad** *(Bufo californicus)*, **Pacific Chorus Frog** *(Pseudacris regilla)*, and **California Chorus Frog** *(Pseudacris cadaverina)*. Mono Creek, Los Padres National Forest, Santa Barbara Co., CA. 56° F air, 66° F water. 5/20/94. Carlos Davidson with Damien Maloney.
16. **Bullfrog** *(Rana catesbeiana)*
17. **Woodhouse's toad** *(Bufo woodhousii)* and **Rio Grande Leopard Frog** *(Rana berlandieri)*. Near Yuma, Yuma Co., AZ. 59° F water. 10/29/84. Jim Rorabaugh.
18. **Foothill Yellow-legged Frog** *(Rana boylii)*
19. **Pacific Chorus Frog** *(Pseudacris regilla)*
20. **Pacific Chorus Frogs** *(Pseudacris regilla)* are in the foreground. In the background is a single **California Red-legged Frog** *(Rana draytonii)*. Ludsen Marsh, Ana Dell State Park, Santa Rosa, Sonoma Co., CA. 3/25/92. Philip T. Northen.
21. **Red-spotted Toad** *(Bufo punctatus)*
22. **Yosemite Toad** *(Bufo canorus)*
23. **California Chorus Frog** *(Pseudacris cadaverina)*. Santa Ynez River, Los Padres National Forest, Santa Barbara Co., CA. 73° F air. 5/25/92. Jim Rorabaugh.
24. **Sierra Nevada Yellow-legged Frog** *(Rana sierrae)* and **Pacific Chorus Frog** *(Pseudacris regilla)*
25. **Black Toad** *(Bufo exsul)*
26. **Woodhouse's Toad** *(Bufo woodhousii woodhousii)*
27. **Southern Leopard Frog** *(Rana sphenocephala)*
28. **Southern Mountain Yellow-legged Frog** *(Rana muscosa)* and **Pacific Chorus Frog** *(Pseudacris regilla)*

39. Part Four: Longer recordings of selected choruses

The final section contains five recordings chosen for their beauty. Listen for how a bout of calling begins and builds, how it winds down, and the apparent rhythm of some choruses.

40. Northern Red-legged Frogs *(Rana aurora)* and **Pacific Chorus Frogs** *(Pseudacris regilla)*. The Northern Red-legged Frogs are calling at the surface of the water. The right channel was recorded in the air, the left channel was recorded underwater. Fresh Water Lagoon, Del Norte Co., CA. Approximately 68° F air. 2/29/92. Alejandro Purgue.

41. Woodhouse's Toad *(Bufo woodhousii)* and **Northern Leopard Frog** *(Rana pipiens)*. Near Saint George, Washington Co., UT. 4/6/66. Frank T. Awbrey.

42. Arroyo Toad *(Bufo californicus)*, **Pacific Chorus Frog** *(Pseudacris regilla)* and **California Chorus Frog** *(Pseudacris cadaverina)*. Mono Creek, Los Padres National Forest, Santa Barbara Co., CA. 55.5° F air, 66° F water. 5/20/94. Carlos Davidson with Damien Maloney. Stereo.

43. Great Basin Spadefoot *(Spea intermontana)* full chorus. Mono Lake, Mono Co., CA. 4/30/93. Bernard L. Krause. Stereo.

44. Great Basin Spadefoot *(Spea intermontana)* chorus winding down. Mono Lake, Mono Co., CA. 4/30/93. Bernard L. Krause. Stereo.

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Web Resources

Amphibiaweb:
www.amphibiaweb.org

Frogwatch USA:
www.nwf.org/frogwatchusa

Global Amphibian Assessment:
www.globalamphibians.org

Society for the Study of Amphibians and Reptiles:
www.ssarherps.org

The Center for North American Herpetology:
www.naherpetology.org

California Herps:
www.californiaherps.com

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The following two organizations are dedicated to recording and conserving natural sounds. They both hold field-recording workshops and put out newsletters with information on recording:

Macaulay Library
Cornell Lab of Ornithology
159 Sapsucker Woods Rd
Ithaca, NY 14850
(607) 254-2404
macaulaylibrary@cornell.edu
www.macaulaylibrary.org

The Nature Sounds Society
The Oakland Museum of California
1000 Oak Street
Oakland, CA 94607
(510) 238-7482
naturesounds@naturesounds.org
www.naturesounds.org

There are few recordings of most Pacific Coast species. If you make a new recording, consider donating a copy to a recognized sound archive.