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Critical Literature Review of the Evidence for Unpalatability of Amphibian Eggs and Larvae

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ABSTRACT.—**We examined 142 papers, which contained 603 separate predator-prey trials, to investigate whether unpalatability is an important defense against predation for amphibian eggs and larvae. Although unpalatability is often cited as an antipredator defense, it was rarely demonstrated that 89% of the trials that we reviewed found prey to be palatable. The most extensively studied taxa, the genera *Bufo* and *Rana*, were diagnosed unpalatable at rates comparable to all other taxa. Diagnoses of unpalatability were not always consistent for a prey species across different predators and were influenced by experimental method. Despite these limitations and our conservative definition of unpalatability, several patterns emerged. First, across all taxonomic groups, eggs and hatchlings were unpalatable more often than mobile larval stages. Second, species that breed in temporary ponds were more likely to be palatable to fish predators than those that breed in permanent habitats. Third, fish and caudates were more likely to find amphibian prey unpalatable than insect predators. We conclude that unpalatability is rare, but when it occurs, it is a property of an ensemble (predator, prey, and alternative prey) and a life-history stage in a particular circumstance but is not a species-specific attribute. We suggest methods of experimentation that could strengthen future research on the palatability of amphibian eggs and larvae.**

Unpalatability of eggs and larvae of amphibians has often been suggested as a mechanism for protection from predation (Licht, 1969; Brodie et al., 1978; Kats et al., 1988; Henrickson, 1990; Peterson and Blaustein, 1991; Stebbins and Cohen, 1995) and is listed as a primary defense mechanism in several general amphibian texts (Duellman and Trueb, 1994; McDiarmid and Altig, 1999; Zug et al., 2001). The implicit meaning of unpalatability in this context is an antipredator defense consisting of an unpleasant taste that can be learned by a predator and that causes the predator to avoid the prey in the future. Some species are protected by absolute unpalatability: they are never eaten or are eaten only once and not thereafter, such as adult dendrobatid frogs (Myers and Daly, 1983). Many more species are considered relatively unpalatable: Predation rates on these species are low, even when they appear readily available, and the low rates are thought to reflect a preference of predators for other prey.

The unpalatability of amphibian eggs and larvae to fish predators was, at one time, arguably the primary mechanism invoked for the coexistence of fish and amphibians (Woodward 1983; Kats et al., 1988; Wellborn et al., 1996). In particular, fish predators are believed to avoid species such as *Bufo* spp. and *Rana catesbeiana* because they are unpalatable (Licht, 1968; Kruse and Francis, 1977; Werner and McPeek, 1994). Other attributes besides palatability have been discovered to play prominent roles in structuring amphibian communities across predation gradients (Morin, 1983a; 1983b; 1985; Brodie and Formanowicz, 1987; Kats et al., 1988; Wellborn et al., 1996). Eggs are immobile and are protected from predation by a protective jellycoat or being hidden from predators (Werschkul and Christensen, 1977; Miaud, 1993). Amphibian larvae have antipredator behaviors and activity patterns that allow them to reduce their encounter rates with predators (Kats et al., 1988; Lawler, 1989; Richardson, 2001a). Many growth patterns and morphological features are phenotypically plastic in response to perceived predation risk; this plasticity reduces cumulative losses to particular predator species (Van Buskirk and McCollum, 1999; Van Buskirk and Schmidt, 2000; Relyea, 2001). In light of these antipredator adaptations, it is unclear how important a role is played by palatability, either absolute or relative to other prey species, in determining larval habitat use and survivorship.

Inspired by this question, we undertook to reexamine the topic of larval amphibian palatability. We present a literature review that demonstrates that relatively few papers have shown amphibian eggs and larvae to be absolutely unpalatable to predators. In addition, the design of many experiments precludes any conclusions about the palatability of the prey

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species that were studied. However, we claim that, despite these limitations, there are patterns in apparent palatability that can help to explain features of larval amphibian life history and habitat use. We suggest new directions for research to refine our understanding of unpalatability and its causes.

Materials and Methods

We performed a literature review by systematically searching herpetology journals (*Journal of Herpetology, Herpetologica, Copeia, Herpetological Review*, and others) and ecology journals (*Ecology, Oecologia, Oikos, Animal Behaviour*, and others) for references that provided information concerning palatability of amphibian eggs and larvae. We limited our review to papers published prior to the year 2000, and the majority of papers focused on North American amphibians. This review sampled the methods used to test palatability and the results purported to demonstrate unpalatability. We focused our review on studies of eggs and larvae but not adult amphibians because of morphological differences between larval and adult amphibians; the granular glands responsible for the unpalatability of adult amphibians are usually not present in the larval stage or develop at the end of the larval period just prior to metamorphosis (Formanowicz and Brodie, 1982; Zug et al., 2001).

This literature search produced 142 papers, including some studies dealing strictly with palatability but also studies with other objectives that provide information about palatability. Published records of feeding observations of predators, diet records that include amphibian eggs and larvae, experiments with objectives other than determining palatability that used an amphibian species as prey, and any other paper that documented an amphibian egg or larvae being consumed by a predator were included. Papers that did not directly show that a predator consumed a prey species were excluded (e.g., if a predator decreased the survival of a group of prey but was not documented to actually feed on the prey in the paper; Morin, 1983b). Many papers contained more than one experiment or experimental treatment on more than one prey species. These experiments will be called trials in this paper. It is important to note that trial does not mean replicate; most trials consisted of several replicates. We recorded six variables for each trial from each paper in the review: (1) species of prey; (2) stage of prey (egg, hatchling, larvae [caudate], or tadpole [anura]; (3) predator species; (4) predator type (sunfish, odonate naiad, coleopteran larvae, etc.); (5) palatability of prey (palatable or unpalatable); and (6) method of study (feeding trial, choice, field observation, diet specimen, see below for details).

We considered a species used in each trial to be palatable if a predator consumed it during a study. Species in trials that were always rejected or eaten once and rejected were classified as unpalatable. We chose this classification because it was the most objective and simple way to classify the results of many different experiments and observations in a consistent and repeatable fashion. Our interpretation of results may differ from that of some authors in our review because we considered prey that were eaten rarely as palatable, whereas some authors may have denoted these prey as unpalatable. In addition, this conservative definition of unpalatability increases our confidence that any patterns that emerge from the analysis are likely biologically significant.

We recognized four general methods to determine whether predators would consume prey: feeding trial, choice, field observation, and diet specimen. In a feeding trial, a predator ate a prey during the course of an experiment. Our feeding trial classification embraces experiments designed to see whether a predator would consume a prey and experiments designed for broader purposes. The data from such a study usually consisted of the number of prey a predator consumes over a defined time interval. Observations of predators consuming prey in the laboratory, but not during a specific experiment, were placed in the feeding trial category because they took place in the lab and not in nature. In choice trials, a predator was offered more than one prey species of amphibian at a time, and survival of the two species is compared. For our review, any species consumed was considered palatable even if the other species in the choice trial was consumed at a higher rate. Field observations documented a predator consuming a prey in nature. Diet specimens indicated that an amphibian egg or larvae was found in the gut of a predator. These last two methods cannot demonstrate unpalatability by definition because they are evidence of ingestion by a predator. However, we chose to include these papers in our review because they provided important information about predation on amphibians in nature.

In addition to the six variables listed above that we recorded for all papers, we also recorded as much other information from each paper as possible to evaluate the influence of experimental design on diagnosis of palatability. For feeding trial and choice experiments, we recorded whether the predator was starved prior to the experiment, whether refuges were provided for prey, and whether alternate prey were provided for predators. For papers considering egg predation, we recorded whether the authors considered the jellycoat of eggs to serve as a defense from predation. In addition, we classified some of the prey species used in experiments into two groups: species that usually breed in temporary, fishless ponds and those that often breed in permanent water with predatory fish. This habitat classification was based on published species accounts (e.g., Mount, 1975), information in papers used for the review, and our personal observations. Species that are capable of breeding in habitats with fish but are also found in habitats without fish, such as *Notophthalmus viridescens* and *Bufo americanus*, were considered permanent pond breeders for this analysis.

We used Pearson χ^2-contingency analyses to determine whether observed counts of palatable and unpalatable results differed from random with respect to specific categories of observations. Counts of palatable and unpalatable results were compared for the following categories: trials using egg, hatchling, and larvae/tadpoles; trials with and without alternate prey; trials where predators were and were not starved; trials by method (feeding trial vs. choice); trials with vertebrate (fish and caudate) and insect (odonate, coleopteran, and hemipteran) predators; and trials using fish predators with prey species usually found in habitats with and without fish.

The majority of our conclusions were drawn from the sample of 142 papers. However, we also critically evaluated the design and analysis of each study and, in a complementary assessment, compared our conclusions to those we would draw only from those studies with the most rigorous designs. Papers were eliminated from this group if they were observational or nonexperimental, lacked adequate experimental replication (at least three replicates), if the description of methods was too vague to determine what the methods were, or if the design of the experiments had weaknesses that precluded drawing robust conclusions. These restrictions left 37 papers whose conclusions we deemed robust. We based the majority of our analysis on the whole literature sample, however, because this provides the most information about how unpalatability is evaluated for amphibian eggs and larvae.

Results

Attributes of Prey and Predator.—From the 142 papers reviewed, a total of 603 different observations or experiments were recorded on 112 different prey species (88 species of anurans and 24 species of caudates, summary of literature review listed in Appendix 1). Only 11% of trials showed prey to be unpalatable. Nine genera of amphibians were found to be unpalatable in at least one trial: five of 26 anuran and four of 14 caudate genera. No species proved unpalatable in all trials in which it was tested. In fact, for nearly every taxon that was diagnosed unpalatable in any trial, unpalatability was diagnosed in less than 25% of the trials in which it was studied. This list included the anurans *Hyla boans* (1 trial showing unpalatability:10 trials showing palatability), *Hyla geographica* (3:14), *Hyla regilla* (1:15), *Osteocephalus buckeyi* (1:4), *Spea multiplicata* (1:5), and two groups widely considered to be unpalatable, the genera *Bufo* (18:78) and *Rana* (24:160). This list also included the caudates *Ambystoma maculatum* (3:26), *Ambystoma texanum* (2:12), *Ambystoma tigrinum* (1:12), *Taricha torosa* (1:8) and *Notophthalmus viridescens* (1:6). Unpalatability was diagnosed at a higher rate in only three taxa: the anuran *Osteocephalus taurinus* (4:8) and the salamandrid caudates *Triturus alpestris* (7:4) and *Taricha granulosa* (1:1). Interestingly, the taxa most commonly considered to have unpalatable larvae and that have been studied most often, the genera *Bufo* and *Rana*, were diagnosed as unpalatable at a similar frequency (in 15% of all trials in which they were used as prey) to that of all other taxa found to be unpalatable in any trial (18% of all trials).

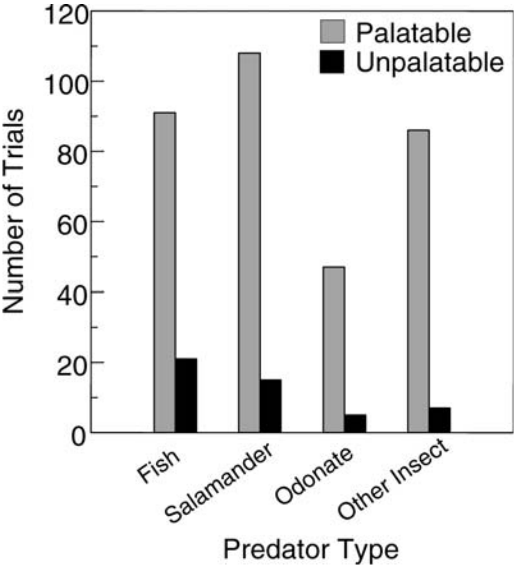

FIG. 1. Number of trials from a literature review demonstrating amphibian eggs and larvae to be palatable or unpalatable for four predator types. Salamander includes larval and adult caudates, and Other Insect consists mostly of trials with Coeleopteran and Hemipteran predators.

Many types of predators found amphibian eggs and larvae to be unpalatable (Fig. 1). Fish, including sunfish (Centrarchidae), catfish (Ictaluridae), shiners (Cyprinidae), and mosquitofish (Poeciliidae), found amphibian prey unpalatable more often than any other predator: in 21 of 112 trials in which they were used as predators. The

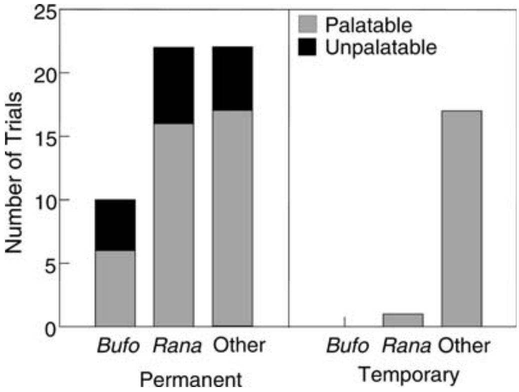

FIG. 2. Number of trials demonstrating palatability or unpalatability to fish predators of amphibian eggs and larvae that typically occur in temporary, fishless habitats or permanent habitats with fish. No *Bufo* were classified as exclusively breeding in temporary ponds.

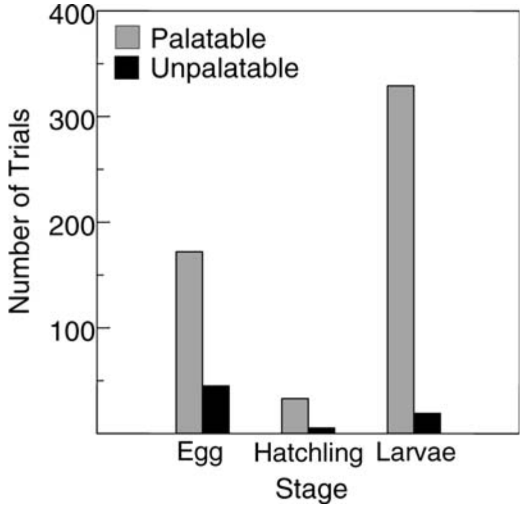

FIG. 3. Number of trials from a literature review finding eggs, hatchlings, and larvae/tadpoles of amphibians to be palatable or unpalatable to predators.

most common predators used in trials were salamander adults and larvae, which found prey unpalatable in 15 of 123 trials (Fig. 1). Other predators finding prey unpalatable in some trials were aquatic insects (odonate naiads, coleopterans, heteropterans, and others), snakes (*Thamnophis* spp.), tadpoles, snails, mammals, and turtles. Vertebrate predators (fish and salamander adults and larvae) were twice as likely to find prey unpalatable than insect predators (Odonata, Hemiptera, and Coeloptera; $\chi^2 = 5.16$, $P = 0.023$).

The degree of palatability of some prey species varied with the predator species in the study. Several trials conducted with the same prey but different predator types showed some predators may find a species palatable, whereas others find it unpalatable. *Ambystoma texanum* larvae and *B. americanus* tadpoles were unpalatable to some fish but palatable to others (Petranka, 1983; Kats et al., 1988). *Rana catesbeiana* was unpalatable to some sunfish (*Lepomis* spp.; Kats et al., 1988) but palatable to odonate naiads (Werner and McPeek, 1994) and newts (Walters, 1975). Several often-cited papers used predators that are not a part of any natural aquatic community and are probably irrelevant to our understanding of palatability (e.g., laboratory mice on toad eggs, Licht, 1968; humans on tadpoles, Wassersug, 1971).

We found conflicting evidence for unpalatability in some combinations of predator and prey. For example, toad (*Bufo*) eggs, hatchlings, and tadpoles were the subject of 99 trials, in only 18 of which the toad rejected as a prey item (Henrickson, 1990; Denton and Beebee, 1991). In those 18 trials, toads were rejected by fish, leeches, odonate naiads, adult newts, and mammals. However, in the remaining 81 trials, other investigators found toads palatable to all of these predators except newts and mammals. Ranid frog eggs and tadpoles were unpalatable in only 24 of 184 trials performed. Most trials finding unpalatability included three species: *Rana arvalis* (six trials), *R. catesbeiana* (five trials), and *Rana clamitans* (five trials). Predators that rejected Ranid eggs and tadpoles included fish, odonate naiads and other aquatic insects, adult newts, snakes, larval salamanders, and turtles. As with the toad experiments, other investigators also found Ranids to be palatable to all of these predator types.

Species that commonly breed with fish were more likely to be found unpalatable by fish predators (Fig. 2). Of species that commonly breed with fish in permanent water, 15 of 54 trials (28%) with fish predators indicated the prey was unpalatable. Species that usually breed in temporary ponds were palatable to fish in all 18 trials. These differences in frequency were significant ($\chi^2 = 6.32$, $P = 0.012$). This difference holds if the genera *Rana* and *Bufo* are removed and all remaining species are analyzed ($\chi^2 = 4.43$, $P = 0.035$); however, no *Bufo* and few *Rana* species were classified as temporary pond breeders.

Palatability was found to differ by stage used in experiments (Fig. 3). Tadpoles were the most common stage studied in this literature review and were the subject of 49% of the trials followed by egg (36%), salamander larvae (9%), and hatchling (6%). Eggs and hatchlings were not significantly different in palatability, but eggs were unpalatable significantly more often than larval stages (salamander larvae and tadpoles,

$\chi^2 = 31.1$, $P < 0.001$). Although hatchlings were found to be unpalatable more often than larval stages, this difference was only marginally significant ($\chi^2 = 3.48$, $P = 0.06$). Eggs were found to be unpalatable in 45 of 217 trials in which they were used, and the jellycoat was suggested as the source of unpalatability (prevention of ingestion) in 11 of these trials.

Attributes of Experimental Design.—Feeding trial was the most common method used in the literature, accounting for 70% of the trials in this review. Although feeding trials were twice as likely as choice trials to diagnose unpalatability (Fig. 4), this difference was not significant. The level of predator satiation at the start of the experiment (predators starved in advance or not) did not affect a diagnosis of unpalatability. Predators were starved before 155 trials; in 135 of these, the prey was palatable, whereas in 20 the prey was unpalatable; this distribution was not significantly different than random.

The addition of alternate prey to experimental trials was rare, and the few authors who provided alternate prey did not assess the palatability of their focal species relative to the alternate prey. Alternate prey, besides other amphibian species in choice trials, was provided in only 21 trials, seven of which showed the focal species to be unpalatable. Alternate prey usually consisted of small invertebrates such as zooplankton (Semlitsch, 1993) and chironomid larvae (Miaud, 1993). Trials using alternate prey would be expected to be more likely to demonstrate unpalatability for species that are protected by unpalatability than other methods because the predator does not have to choose between fasting and eating the unpalatable prey. In our review, trials with alternate prey were significantly more likely to find the focal prey unpalatable than trials that did not provide alternate prey ($\chi^2 = 10.29$, $P = 0.001$).

Many trials provided refuges as a means for diagnosing antipredator behavior. Refuges for prey were provided in 68 trials, all of which found the prey to be palatable. Refuges consisted of vegetation (Werner and McPeek, 1994) and physical structures such as a plate on the bottom of the enclosure (Gamradt and Kats, 1996). In some experiments the presence of a refuge increased survival (Babbitt and Tanner, 1997).

Review of Subset of Papers.—Our evaluation of a subset of papers consisted of 37 of the original 142 papers. Most papers that were eliminated were not replicated sufficiently, or the experimental method was inadequate or not clearly explained. An alarming number of papers gave no indication of the number of replicates performed or information on the reuse of predators and prey individuals in multiple trials. These 37 papers contained 216 separate trials on 16 genera of which only 10 trials (5%) demonstrated unpalatability. The species found to be unpalatable in the limited sample were *Bufo bufo*, *Rana arvalis*, *Rana catesbeiana*, and *Taricha torosa*.

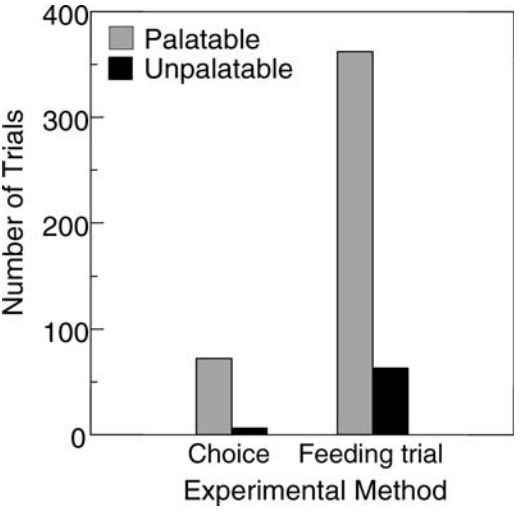

FIG. 4. Influence of experimental method on determining palatability of amphibian eggs and larvae from a literature review.

DISCUSSION

Evidence for Unpalatability.—Our literature review indicates that evidence for unpalatability as an antipredator defense in amphibian eggs and larvae is scarce. An overwhelming number of studies indicate that amphibian eggs and larvae are subject to predation by many predator types. However, despite the prevalence of studies finding amphibian eggs and larvae to be palatable, several important patterns emerge from our literature review. First, we found evidence that species of amphibians that usually occur as eggs and larvae in permanent habitats with fish tend to have higher survival rates with fish predators than those amphibian species that rarely breed with fish. Although we found no evidence that *Bufo* and *Rana* were found unpalatable at a higher rate than other taxa, the perception that *Bufo* and *Rana* are more often unpalatable may arise because they are typically found in permanent pond habitats (Richardson, 2001b). Second, our analysis suggests a widespread ontogenetic change in palatability from egg through larval stages. This change was studied specifically by Brodie and Formanowicz (1987) for *B. americanus* and is supported for other taxa by this literature review. Third, fish and salamanders appear more likely to find amphibian prey unpalatable than aquatic insect predators (Kats et al., 1988). This could be caused by the different feeding methods of these predator types: vertebrates tend to consume whole prey items, including skin, whereas many aquatic insects do not consume the skin of prey items but use piercing mouthparts to feed on prey (Brodie et al., 1978; Wilbur, 1997).

There is no evidence that any species is absolutely unpalatable to all predators it might encounter or even all predators of a particular type such as fish or insects. In this light, unpalatability does not appear likely to be a major defense mechanism for larval amphibians. Palatability, whether absolute or relative, appears best understood as a property of the ensemble of predator, prey, and alternative prey. But the evidence does suggest that unpalatability is an important defense mechanism for eggs and hatchlings in permanent waters. In this light, further work on understanding unpalatability and its effectiveness in these stages is worthwhile.

Importance of Experimental Design.—Finding patterns of unpalatability in amphibian eggs and larvae is complicated by the fact that many different experimental designs have been used in its study and different experimental methods can lead to different conclusions. Trials performed with the same method using the same predator and prey always found similar results. However, for trials performed using the same predator and prey but different methods, results were sometimes conflicting. For example, leeches were used as a predator of *Ambystoma maculatum* eggs in two trials; Cory and Manion (1953) showed leeches found the eggs unpalatable, yet Cargo (1960) observed a leech feeding on eggs in nature. This indicates that experimental manipulations may not always accurately demonstrate what transpires in nature. In addition, trials using different species of similar predators on the same prey sometimes produced conflicting results. For example, eggs of *A. maculatum* were used in experiments with several species of caddisfly larvae; eggs were unpalatable in some feeding trials (Stout et al., 1992) but palatable in other feeding trials and observations (Stout et al., 1992; Rowe et al., 1994).

The majority of papers in our literature review were not designed specifically to test palatability of amphibian eggs and larvae because we searched for any papers that contained information about predators of amphibian eggs and larvae. Of our 142 papers, only 16 indicate in the title that the paper attempts to evaluate the palatability of amphibian eggs or larvae. However, these papers generally cite their results in terms of number of prey eaten, which is affected by a number of factors other than palatability of prey. Our analysis revealed that addition of alternate prey to experiments significantly increased the likelihood of finding the focal prey unpalatable. However, predator preference for a certain prey item does not necessarily mean that the prey is more palatable than other species.

The methods currently in use for testing unpalatability of amphibian eggs and larvae usually do not actually provide information about the palatability of the species but instead offer information about predation rates. In most studies, a count of prey eaten is used as a measure of unpalatability: species that a predator eats less of are assumed to be less palatable. However, there are many reasons that a predator may choose to consume a prey item, and isolating the existence and effectiveness of unpalatability requires more than a simple feeding trial.

To adequately test the hypothesis that unpalatability functions as an antipredator adaptation in amphibian eggs and larvae, experiments designed specifically to evaluate palatability should be undertaken. First, the influence of palatability must be isolated from other characteristics of prey and predators that may influence predation rate, including prey behavior, appearance, and caloric content and predator hunger level and foraging effectiveness. The chemicals that cause unpalatability are probably found in the skin of amphibian larvae (Brodie et al., 1978). An experiment to demonstrate that it is the taste of amphibian larvae that results in reduced predation rates ought to begin by training the predator to consume a prepared food ration with a standardized caloric content. Then, the feeding rate of a predator could be quantified on a control food ration and a food ration treated with the skin of the amphibian larvae of interest.

Once it has been established that a prey species is unpalatable to a predator, an experiment should evaluate whether predators are capable of distinguishing palatable from unpalatable prey and of learning to avoid unpalatable prey once they have encountered it. For unpalatability to function as an antipredator defense, the predator must be capable of distinguishing between palatable and unpalatable prey by a nonlethal method, such as vision or chemoreception. Consumption of unpalatable prey may result in negative postingestive effects on predators as a result of the chemicals that cause unpalatability. Thus, predators can learn to associate the negative postingestive effect with the taste or appearance of a prey and can avoid this prey in the future without consuming it. For example, Brodie and Formanowicz (1981) demonstrated that Dytiscid beetle larvae were capable of learning to avoid attacking newts and preferred tadpole prey. A second experiment demonstrated that it is a chemical cue from the skin of the newts responsible for this avoidance behavior: Beetle larvae attacked cotton swabs treated with tadpole extract more often than swabs treated with newt extract (Brodie and Formanowicz, 1981).

Second, the influence of predator motivation on predation rate must also be evaluated. Both predator hunger level and choice of alternative food are likely to influence whether a predator consumes a particular prey item unless it is absolutely unpalatable. However, it seems likely that even a very unpalatable prey item may be consumed by a predator if the predator is sufficiently hungry and there is no alternative prey to consume. Experiments evaluating these characteristics of prey and predator will add to our understanding of the importance of unpalatability relative to other antipredator adaptations of amphibian eggs and larvae.

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APPENDIX 1. Information from a literature review of papers providing information about the palatability of amphibian eggs and larvae. Trials are organized by prey species, then stage, then predator species. Abbreviations are as follows: E = egg, H = hatchling, T = tadpole, L = larvae, Pal = palatability, P = palatable, U = unpalatable; Meth = method, FT = feeding trial, C = choice, OBS = observation, D = diet specimen, F = breeds with fish, NF = does not breed with fish, PS = predator starved, JC = jellycoat cited as defense of egg, AF = alternate food available, R = refuge available, * = included in subset review, NA = no information available, paed = paedomorphic, sal = salamander. Source indicates the paper from which the information was taken. For predator type, all odonates listed are naiads or nymphs, all other insects are adults unless noted as larvae.

Prey	Stage	Predator	Predator type	Pal	Meth	Notes	Source
Acris crepitans	E	*Gambusia affinis*	mosquitofish	P	FT	F/*	Grubb, 1972
Acris gryllus	T	*Lepomis* sp.	sunfish	P	FT	F	Kats et al., 1988
Agalychnis annae	E	*Megaselia scalaris*	phorid larvae	P	FT		Villa and Townsend, 1983
Agalychnis callidryas	T	*Homo sapiens*	human	P	FT		Wassersug, 1971
Agalychnis callidryas	T	*Orthemis ferruginea*	odonate	P	FT	PS	Heyer and Muedeking, 1976
Ambystoma annulatum	L	*Ambystoma annulatum*	sal larvae	P	D	NF	Nyman et al., 1993
Ambystoma gracile	H	*Ambystoma gracile*	sal larvae	P	FT		Hoffman and Larson, 1999
Ambystoma gracile	L	*Dicamptodon ensatus*	sal larvae	P	D		Johnson and Schreck, 1969
Ambystoma gracile	L	*Dicamptodon ensatus*	sal larvae	P	FT		Johnson and Schreck, 1969
Ambystoma gracile	L	*Thamnophis sirtalis*	garter snake	P	OBS		Lefcort et al., 1991
Ambystoma jeffersonianum	E	*Ambystoma maculatum*	sal larvae	P	FT	NF	Walters, 1975
Ambystoma jeffersonianum	E	*Notophthalmus viridescens*	adult newt	P	FT	NF	Walters, 1975
Ambystoma jeffersonianum	E	*Ptilostomis postica*	trichopteran larvae	P	OBS	NF	Rowe et al., 1994
Ambystoma jeffersonianum	H	*Notophthalmus viridescens*	adult newt	P	FT	NF	Walters, 1975
Ambystoma jeffersonianum	L	*Ambystoma jeffersonainum*	sal larvae	P	FT	NF	Rowe et al., 1994
Ambystoma jeffersonianum	L	*Notophthalmus viridescens*	adult newt	P	FT	NF	Walters, 1975
Ambystoma jeffersonianum	L	*Ptilostomis postica*	trichopteran larvae	P	FT	R	Rowe et al., 1994
Ambystoma macrodactylum	H	*Ambystoma gracile*	sal larvae	P	FT		Hoffman and Larson, 1999
Ambystoma macrodactylum	L	*Ambystoma macrodactylum*	sal larvae	P	FT	*	Wildy et al., 1998
Ambystoma maculatum	E	*Ambystoma* sp.	sal larvae	P	FT	JC/NF	Ward and Sexton, 1981
Ambystoma maculatum	E	*Anax junius*	odonate	P	FT	NF	Ward and Sexton, 1981
Ambystoma maculatum	E	*Banksiola dossuaria*	trichopteran larvae	P	FT	NF	Stout et al., 1992
Ambystoma maculatum	E	*Banksiola dossuaria*	trichopteran larvae	P	OBS	NF	Stout et al., 1992
Ambystoma maculatum	E	NA	chironomid larvae	P	FT	JC/NF	Ward and Sexton, 1981
Ambystoma maculatum	E	*Dineutus* sp.	coleopteran	U	FT	JC/NF	Ward and Sexton, 1981
Ambystoma maculatum	E	*Lepomis macrochirus*	bluegill sunfish	P	FT	JC/NF	Semlitsch, 1988
Ambystoma maculatum	E	*Macrobdella decora*	leech	P	OBS	NF	Cargo, 1960
Ambystoma maculatum	E	*Macrobdella decora*	leech	U	FT	JC/NF	Cory and Manion, 1953
Ambystoma maculatum	E	*Notophthalmus viridescens*	adult newt	P	OBS	NF	Hamilton, 1932
Ambystoma maculatum	E	*Oronectes virilis*	crawfish	P	FT	JC/NF	Ward and Sexton, 1981
Ambystoma maculatum	E	*Parachironomous forceps*	chironomid larvae	P	OBS	NF	Leclaire and Bourassa, 1981
Ambystoma maculatum	E	*Physa gyrina*	snail	P	FT	JC/NF	Ward and Sexton, 1981
Ambystoma maculatum	E	*Pimephales notatus*	minnow	P	FT	JC/NF	Ward and Sexton, 1981
Ambystoma maculatum	E	*Platycentropus radiatus*	trichopteran larvae	U	FT	NF	Stout et al., 1992
Ambystoma maculatum	E	*Ptilostomis postica*	trichopteran larvae	P	FT	NF	Rowe et al., 1994
Ambystoma maculatum	E	*Ptilostomis postica*	trichopteran larvae	P	OBS	NF	Rowe et al., 1994

APPENDIX 1. Continued.

Prey	Stage	Predator	Predator type	Pal	Meth	Notes	Source
Ambystoma maculatum	E	*Ptilostomis* sp.	trichopteran larvae	P	OBS	NF	Murphy, 1961
Ambystoma maculatum	E	*Rana sphenocephala*	tadpole	P	FT	JC/NF	Ward and Sexton, 1981
Ambystoma maculatum	E	*Rana sylvatica*	tadpole	P	FT	AF/NF	Petranka et al., 1998
Ambystoma maculatum	H	*Ambystoma jeffersonianum*	sal larvae	P	FT	NF	Rowe et al., 1994
Ambystoma maculatum	H	*Notophthalmus viridescens*	adult newt	P	FT	NF	Walters, 1975
Ambystoma maculatum	L	*Dytiscus verticalis*	coleopteran larvae	P	FT	NF/*	Formanowicz and Brodie, 1982
Ambystoma maculatum	L	*Lepomis macrochirus*	bluegill sunfish	P	FT	R/NF/*	Semlitsch, 1988
Ambystoma maculatum	L	*Lepomis macrochirus*	bluegill sunfish	P	C	R/NF/*	Semlitsch, 1988
Ambystoma maculatum	L	*Lepomis* sp.	sunfish	P	FT	NF	Kats et al., 1988
Ambystoma talpoideum	E	*Lepomis macrochirus*	bluegill sunfish	P	FT	NF/*	Semlitsch, 1988
Ambystoma talpoideum	L	*Lepomis macrochirus*	bluegill sunfish	P	FT	R/NF/*	Semlitsch, 1988
Ambystoma talpoideum	L	*Lepomis macrochirus*	bluegill sunfish	P	C	R/NF/*	Semlitsch, 1988
Ambystoma texanum	E	*Ambystoma maculatum*	sal larvae	P	FT	F	Walters, 1975
Ambystoma texanum	L	*Ambystoma maculatum*	sal larvae	P	FT	F	Walters, 1975
Ambystoma texanum	L	*Etheostoma caeruleum*	darter	P	FT	R/F	Petranka, 1983
Ambystoma texanum	L	*Etheostoma spectabile*	darter	P	FT	R/F	Petranka, 1983
Ambystoma texanum	L	*Lepomis cyanellus*	green sunfish	P	FT	R/F	Petranka, 1983
Ambystoma texanum	L	*Lepomis cyanellus*	green sunfish	P	FT	R/F/*	Sih et al., 1988
Ambystoma texanum	L	*Lepomis macrochirus*	bluegill sunfish	P	FT	R/F/*	Sih et al., 1988
Ambystoma texanum	L	*Lepomis megalotis*	longear sunfish	P	FT	R/F	Petranka, 1983
Ambystoma texanum	L	*Lepomis* sp.	sunfish	P	FT	F	Kats et al., 1988
Ambystoma texanum	L	*Nerodia sipedon*	water snake	P	D	F	Kats, 1986
Ambystoma texanum	L	*Nerodia sipedon*	water snake	P	OBS	F	McCallum, 1995
Ambystoma texanum	L	*Notropis ardens*	shiner	U	FT	R/F	Petranka, 1983
Ambystoma texanum	L	*Notropis cornutus*	shiner	P	FT	R/F	Petranka, 1983
Ambystoma texanum	L	*Pimphales promelas*	minnow	U	FT	R/F	Petranka, 1983
Ambystoma texanum	L	*Semotilus atromaculatus*	chub	P	FT	R/F	Petranka, 1983
Ambystoma tigrinum	E	*Ambystoma tigrinum*	adult sal	P	FT	NF	Hamilton, 1948
Ambystoma tigrinum	E	*Ambystoma tigrinum*	sal larvae	P	OBS	NF	Holomuzki, 1986a
Ambystoma tigrinum	E	*Ambystoma tigrinum*	sal larvae	P	FT	NF	Holomuzki, 1986a
Ambystoma tigrinum	E	*Macrobdella decora*	leech	U	FT	NF	Cory and Manion, 1953
Ambystoma tigrinum	E	*Notophthalmus viridescens*	adult newt	P	FT	NF/*	Morin, 1983a
Ambystoma tigrinum	E	*Notophthalmus viridescens*	adult newt	P	OBS	NF/*	Morin, 1983a
Ambystoma tigrinum	L	*Ambystoma tigrinum*	paed sal	P	D	NF	Norris, 1989
Ambystoma tigrinum	L	*Ambystoma tigrinum*	sal larvae	P	FT	NF/*	Collins and Cheek, 1983
Ambystoma tigrinum	L	*Cathartes aura*	turkey vulture	P	OBS	NF	Duncan, 1999
Ambystoma tigrinum	L	*Dytiscus auricus*	coleopteran	P	FT	NF	Holomuzki, 1986b
Ambystoma tigrinum	L	*Rana aurora*	frog	P	OBS	NF	Baldwin and Stanford, 1987
Ambystoma tigrinum	L	*Thamnophis eques*	garter snake	P	D	NF	Garcia and Drummond, 1988
Ambystoma sp.	L	*Ambystoma tigrinum*	sal larvae	P	FT	*	Wilbur, 1972
Bombina variegata	E	*Rana temporaria*	tadpole	P	FT		Heusser, 1970

APPENDIX 1. Continued.

Prey	Stage	Predator	Predator type	Pal	Meth	Notes	Source
Bufo americanus	E	*Ambystoma maculatum*	sal larvae	P	FT	F	Walters, 1975
Bufo americanus	E	*Notophthalmus viridescens*	adult newt	P	FT	F	Walters, 1975
Bufo americanus	E	*Rana sylvatica*	tadpole	P	FT	F	Petranka et al., 1994
Bufo americanus	H	*Ambystoma maculatum*	sal larvae	P	FT	F	Walters, 1975
Bufo americanus	H	*Rana sylvatica*	tadpole	P	FT	F/*	Petranka et al., 1994
Bufo americanus	T	*Anax junius*	odonate	P	FT	F	Anholt et al., 1996
Bufo americanus	T	*Anax junius*	odonate	P	C	F/*	Brodie and Formanowicz, 1987
Bufo americanus	T	*Batrachobdella picta*	leech	P	FT	F	Brockleman, 1969
Bufo americanus	T	*Belostoma* sp.	heteropteran	P	C	F/*	Brodie and Formanowicz, 1987
Bufo americanus	T	*Chrysemys picta*	painted turtle	P	FT	F	Walters, 1975
Bufo americanus	T	*Dytiscus marginalis*	coleopteran larvae	P	FT	R/PS/F	Young, 1967
Bufo americanus	T	*Dytiscus verticalis*	coleopteran larvae	P	FT	F	Brodie et al., 1978
Bufo americanus	T	*Dytiscus verticalis*	coleopteran larvae	P	FT	F/*	Formanowicz and Brodie, 1982
Bufo americanus	T	*Lepomis gibbosus*	sunfish	P	FT	F	Walters, 1975
Bufo americanus	T	*Lepomis macrochirus*	bluegill sunfish	P	FT	PS/F	Voris and Bacon, 1966
Bufo americanus	T	*Lepomis* sp.	sunfish	U	FT	F	Kats et al., 1988
Bufo americanus	T	*Lethocerus americanus*	heteropteran larvae	P	FT	F	Brodie et al., 1978
Bufo americanus	T	*Leucorrhina* sp.	odonate	P	FT	F	Brockleman, 1969
Bufo americanus	T	*Notophthalmus viridescens*	adult newt	P	C	F/*	Brodie and Formanowicz, 1987
Bufo americanus	T	*Notophthalmus viridescens*	adult newt	P	FT	F	Walters, 1975
Bufo americanus	T	*Sternotherus odoratus*	musk turtle	P	FT	F	Walters, 1975
Bufo boreas	E	*Ambystoma gracile*	sal larvae	P	FT	F	Licht, 1969
Bufo boreas	E	*Gasterosteus aculeatus*	stickleback fish	P	FT	F	Licht, 1969
Bufo boreas	E	*Haemopsis* sp.	leech	U	FT	F	Licht, 1969
Bufo boreas	E	*Salmo clarkii*	trout	P	FT	F	Licht, 1969
Bufo boreas	H	*Dytiscus* sp.	coleopteran larvae	P	C	F/*	Peterson and Blaustein, 1992
Bufo boreas	H	*Lethocerus americanus*	heteropteran larvae	P	C	PS/F/*	Peterson and Blaustein, 1992
Bufo boreas	T	*Aeshna umbrosa*	odonate	P	FT	PS/F	Hews, 1988
Bufo boreas	T	*Ambystoma gracile*	sal larvae	P	C	PS/F/*	Peterson and Blaustein, 1991
Bufo boreas	T	*Anas platyrhinos*	mallard duck	P	FT	F	Jones et al., 1999
Bufo boreas	T	*Dytiscus* sp.	coleopteran larvae	P	C	PS/F/*	Peterson and Blaustein, 1992
Bufo boreas	T	*Lethocerus americanus*	heteropteran adult	P	FT	PS/F	Hews, 1988
Bufo boreas	T	*Lethocerus americanus*	heteropteran larvae	P	C	PS/F/*	Peterson and Blaustein, 1992
Bufo boreas	T	*Lethocerus americanus*	heteropteran larvae	P	C	PS/F/*	Peterson and Blaustein, 1992
Bufo boreas	T	*Perisoreus canadensis*	bird	P	OBS	F	Beiswenger, 1981
Bufo boreas	T	*Taricha granulosa*	adult newt	P	C	PS/F/*	Peterson and Blaustein, 1991
Bufo boreas	T	*Thamnophis elegans*	garter snake	P	D	F	Arnold and Wassersug, 1978
Bufo boreas	T	*Thamnophis sirtalis*	garter snake	P	D	F	Arnold and Wassersug, 1978
Bufo bufo	E	*Aeshna* sp.	odonate	U	FT	PS/F/*	Henrickson, 1990
Bufo bufo	E	*Corixa dentipes*	heteropteran	P	FT	PS/F/*	Henrickson, 1990
Bufo bufo	E	*Cymatia bonsdorffi*	heteropteran	P	FT	PS/F/*	Henrickson, 1990

APPENDIX 1. Continued.

Prey	Stage	Predator	Predator type	Pal	Meth	Notes	Source
Bufo bufo	E	*Dytiscus lapponicus*	coleopteran	P	FT	PS/F/*	Henrickson, 1990
Bufo bufo	E	*Glaenocorista propinqua*	heteropteran	P	FT	PS/F/*	Henrickson, 1990
Bufo bufo	E	*Leucorrhinia dubia*	odonate	U	FT	PS/F/*	Henrickson, 1990
Bufo bufo	E	*Notonecta glauca*	heteropteran	P	FT	PS/F/*	Henrickson, 1990
Bufo bufo	E	*Rana temporaria*	tadpole	P	FT	F	Heusser, 1970
Bufo bufo	E	*Rhantus exoletus*	coleopteran	P	FT	PS/F/*	Henrickson, 1990
Bufo bufo	E	*Triturus helveticus*	adult newt	U	FT	F	Denton and Beebee, 1991
Bufo bufo	E	*Triturus vulgaris*	adult newt	U	FT	F	Denton and Beebee, 1991
Bufo bufo	E	*Triturus vulgaris*	adult newt	U	FT	PS/F/*	Henrickson, 1990
Bufo bufo	H	*Triturus helveticus*	adult newt	U	FT	F	Denton and Beebee, 1991
Bufo bufo	H	*Triturus vulgaris*	adult newt	U	FT	F/*	Henrickson, 1990
Bufo bufo	T	*Aeshna* sp.	odonate	P	FT	PS/F/*	Henrickson, 1990
Bufo bufo	T	*Corixa dentipes*	heteropteran	P	FT	PS/F/*	Henrickson, 1990
Bufo bufo	T	*Cymatia bonsdorffi*	heteropteran	P	FT	PS/F/*	Henrickson, 1990
Bufo bufo	T	*Dolomedes triton*	fishing spider	P	FT	F	Bleckman and Lotz, 1987
Bufo bufo	T	*Dytiscus lapponicus*	coleopteran	P	FT	PS/F/*	Henrickson, 1990
Bufo bufo	T	*Glaenocorista propinqua*	heteropteran	P	FT	PS/F/*	Henrickson, 1990
Bufo bufo	T	*Leucorrhinia dubia*	odonate	P	FT	PS/F/*	Henrickson, 1990
Bufo bufo	T	*Notonecta glauca*	heteropteran	P	FT	PS/F/*	Henrickson, 1990
Bufo bufo	T	*Rhantus exoletus*	coleopteran	P	FT	PS/F/*	Henrickson, 1990
Bufo bufo	T	*Triturus cristatus*	adult newt	P	FT	R/F/*	Cooke, 1974
Bufo bufo	T	*Triturus vulgaris*	adult newt	P	FT	R/F/*	Cooke, 1974
Bufo bufo	T	*Triturus vulgaris*	adult newt	P	FT	PS/F/*	Henrickson, 1990
Bufo calamita	E	*Bufo bufo*	tadpole	P	OBS	F	Banks and Beebee, 1987
Bufo calamita	E	*Bufo calamita*	tadpole	P	OBS	F	Banks and Beebee, 1987
Bufo calamita	E	*Pelobates cultripes*	tadpole	P	FT	PS/F/*	Tejedo, 1991
Bufo calamita	E	*Pelobates cultripes*	tadpole	P	OBS	F/*	Tejedo, 1991
Bufo calamita	E	*Pelodytes punctatus*	tadpole	P	FT	PS/F/*	Tejedo, 1991
Bufo calamita	E	*Pelodytes punctatus*	tadpole	P	OBS	F/*	Tejedo, 1991
Bufo calamita	E	*Rana temporaria*	tadpole	P	FT	F	Heusser, 1970
Bufo calamita	E	*Rana temporaria*	tadpole	P	OBS	F	Banks and Beebee, 1987
Bufo calamita	E	*Triturus helveticus*	adult newt	U	FT	F	Denton and Beebee, 1991
Bufo calamita	E	*Triturus vulgaris*	adult newt	U	FT	F	Denton and Beebee, 1991
Bufo calamita	H	*Triturus helveticus*	adult newt	U	FT	F	Denton and Beebee, 1991
Bufo calamita	H	*Triturus vulgaris*	adult newt	U	FT	F	Denton and Beebee, 1991
Bufo calamita	T	*Dytiscus pisanus*	coleopteran larvae	P	FT	PS/F/*	Tejedo, 1993
Bufo cognatus	T	*Hydrophilus triangularis*	coleopteran larvae	P	OBS	F	Bragg, 1940
Bufo cognatus	T	*Schaphiopus hammondi*	tadpole	P	OBS	F	Bragg, 1940
Bufo compactilis	T	*Schaphiopus bombifrons*	tadpole	P	FT	F	Bragg and Nelson, 1966
Bufo marinus	E	*Limnodynastes ornatus*	tadpole	P	FT	F	Crossland, 1998
Bufo marinus	E	*Litoria alboguttata*	tadpole	P	FT	F	Crossland, 1998

APPENDIX 1. Continued.

Prey	Stage	Predator	Predator type	Pal	Meth	Notes	Source
Bufo marinus	T	*Homo sapiens*	human	U	FT	F	Wassersug, 1971
Bufo marinus	T	*Leptodactylus pentadactylus*	tadpole	P	FT	R/F/*	Heyer et al., 1975
Bufo marinus	T	*Leptodactylus pentadactylus*	tadpole	P	C	F/*	Heyer et al., 1975
Bufo marinus	T	*Pantala flavescens*	odonate	P	FT	F/*	Heyer et al., 1975
Bufo terrestris	E	*Bufo terrestris*	tadpole	P	OBS	F	Babbitt, 1995
Bufo terrestris	T	*Macrobdella decora*	leech	P	FT	F/*	Travis and Trexler, 1986
Bufo valliceps	E	*Gambusia affinis*	mosquitofish	P	FT	F/*	Grubb, 1972
Bufo valliceps	E	*Ictaluras melas*	catfish	U	FT	F	Licht, 1968
Bufo valliceps	E	*Lepomis cyanellus*	green sunfish	U	FT	F	Licht, 1968
Bufo valliceps	E	*Lepomis megalotis*	sunfish	U	FT	F	Licht 1968
Bufo valliceps	E	NA	laboratory mouse	U	FT	F	Licht 1968
Bufo woodhousei	T	*Micropterus salmoides*	largemouth bass	P	C	PS/F/*	Kruse and Stone, 1984
Bufo sp.	T	*Nerodia sipedon*	water snake	P	OBS	F	Arnold and Wassersug, 1978
Bufo sp.	T	*Thamnophis elegans*	garter snake	P	OBS	F	Arnold and Wassersug, 1978
Colostethus nubicola	T	*Homo sapiens*	human	P	FT		Wassersug, 1971
Cryptobranchus alleganiensis	E	*Cryptobranchus alleganiensis*	adult sal	P	D		Smith, 1907
Cryptobranchus alleganiensis	L	*Cryptobranchus alleganiensis*	adult sal	P	D		Smith, 1907
Desmognathus ocoee	E	*Pterostichius* sp.	coleopteran	P	FT	PS	Hess and Harris, 2000
Dicamptodon ensatus	L	*Dicamptodon ensatus*	sal larvae	P	FT	F	Johnson and Schreck, 1969
Dicamptodon ensatus	L	*Thamnophis couchii*	garter snake	P	OBS	F	Lind and Welsh, 1990
Dicamptodon ensatus	L	*Thamnophis ordinoides*	garter snake	P	D	F	Fitch, 1936
Eleutherodactylus coqui	E	*Megaselia scalaris*	phorid larvae	P	OBS		Villa and Townsend, 1983
Engystomops pustulosus	T	*Homo sapiens*	human	P	FT		Wassersug, 1971
Eurycea bislineata	L	*Lepomis* sp.	sunfish	P	FT		Kats et al., 1988
Eurycea lucifuga	L	*Lepomis* sp.	sunfish	P	FT		Kats et al., 1988
Gastrophryne olivacea	E	*Gambusia affinis*	mosquitofish	P	FT	*	Grubb, 1972
Hemidactylium scutatum	E	*Pterostichius* sp.	coleopteran	P	FT	PS	Hess and Harris, 2000
Hemidactylium scutatum	E	*Pterostichius* sp.	coleopteran	P	FT	PS/AF	Hess and Harris, 2000
Hemidactylium scutatum	L	*Lepomis* sp.	sunfish	P	FT		Kats et al., 1988
Hyla arborea	E	*Rana temporaria*	tadpole	P	FT		Heusser, 1970
Hyla boans	E	*Aequidens tetramerus*	fish	P	FT	PS	Magnusson and Hero, 1991
Hyla boans	E	*Colostethus marchesianus*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Hyla boans	E	NA	coleopteran (dytiscid)	P	FT	PS	Magnusson and Hero, 1991
Hyla boans	E	*Gynacanther* sp.	odonate	P	FT	PS	Magnusson and Hero, 1991
Hyla boans	E	*Hyla boans*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Hyla boans	E	*Hyla geographica*	tadpole	U	FT	PS	Magnusson and Hero, 1991
Hyla boans	E	*Leptodactylus knudseni*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Hyla boans	E	*Leptodactylus pentadactylus*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Hyla boans	E	*Osteocephalus taurinus*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Hyla boans	E	*Phyllomedusa vaillanti*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Hyla boans	E	*Pyrrhulina* sp.	fish	P	FT	PS	Magnusson and Hero, 1991

APPENDIX 1. Continued.

Prey	Stage	Predator	Predator type	Pal	Meth	Notes	Source
Hyla chrysoscelis	E	*Gambusia affinis*	mosquitofish	P	FT	F/*	Grubb, 1972
Hyla chrysoscelis	E	*Ilybius* sp.	coleopteran larvae	P	FT	F/*	Resetarits, 1998
Hyla chrysoscelis	E	*Pachidiplax longipinnis*	odonate	P	FT	F/*	Resetarits, 1998
Hyla chrysoscelis	H	*Ilybius* sp.	coleopteran larvae	P	FT	F/*	Resetarits, 1998
Hyla chrysoscelis	H	*Pachidiplax longipinnis*	odonate	P	FT	F/*	Resetarits, 1998
Hyla chrysoscelis	T	*Lepomis* sp.	sunfish	P	FT	F	Kats et al., 1988
Hyla cinerea	T	*Lepomis macrochirus*	bluegill sunfish	P	FT	F/*	Blouin, 1990
Hyla cinerea	T	*Lepomis macrochirus*	bluegill sunfish	P	C	*	Blouin, 1990
Hyla faber	T	*Hyla faber*	tadpole	P	OBS		Bernarde and Machado, 1999
Hyla femoralis	T	*Dolomedes* sp.	fishing spider	P	OBS	NF	Johnson, 1996
Hyla geographica	E	*Aequidens tetramerus*	fish	P	FT	PS	Magnusson and Hero, 1991
Hyla geographica	E	*Colostethus marchesianus*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Hyla geographica	E	NA	coleopteran (dytiscid)	P	FT	PS	Magnusson and Hero, 1991
Hyla geographica	E	*Epipedobates femoralis*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Hyla geographica	E	*Gynocanther* sp.	odonate	P	FT	PS	Magnusson and Hero, 1991
Hyla geographica	E	NA	coleopteran (hydrophilid)	P	FT	PS	Magnusson and Hero, 1991
Hyla geographica	E	*Hyla boans*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Hyla geographica	E	*Hyla geographica*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Hyla geographica	E	*Hyla granulosa*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Hyla geographica	E	*Leptodactylus knudseni*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Hyla geographica	E	*Leptodactylus pentadactylus*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Hyla geographica	E	*Leptodactylus rhodomystax*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Hyla geographica	E	*Osteocephalus tarinus*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Hyla geographica	E	*Phyllomedusa bicolor*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Hyla geographica	E	*Phyllomedusa tarsius*	tadpole	U	FT	PS	Magnusson and Hero, 1991
Hyla geographica	E	*Phyllomedusa tomopterna*	tadpole	U	FT	PS	Magnusson and Hero, 1991
Hyla geographica	E	*Pyrrhulina* sp.	fish	U	FT	PS	Magnusson and Hero, 1991
Hyla gratiosa	T	*Ambystoma talpoideum*	sal larvae	P	FT	PS/R/NF	Caldwell et al., 1980
Hyla gratiosa	T	*Anax junius*	odonate	P	FT	PS/R/NF	Caldwell et al., 1980
Hyla gratiosa	T	*Lepomis machrochirus*	bluegill sunfish	P	FT	NF/*	Blouin, 1990
Hyla gratiosa	T	*Lepomis machrochirus*	bluegill sunfish	P	C	NF/*	Blouin, 1990
Hyla minuta	T	*Hyla minuta*	tadpole	P	OBS		Peixoto and Gomes, 1997
Hyla pseudopuma	E	*Hyla pseudopuma*	tadpole	P	FT	*	Crump, 1983
Hyla pseudopuma	E	*Hyla pseudopuma*	tadpole	P	OBS	*	Crump, 1983
Hyla pseudopuma	H	*Hyla pseudopuma*	tadpole	P	FT	*	Crump, 1983
Hyla pseudopuma	T	*Aeshna* sp.	odonate	P	FT	*	Crump, 1984
Hyla pseudopuma	T	*Rhantus guticollis*	coleopteran	P	FT	*	Crump, 1984
Hyla pseudopuma	T	*Rhantus guticollis*	coleopteran	P	OBS	*	Crump, 1984
Hyla pseudopuma	T	*Sympetrum nigrocreatum*	odonate	P	FT	*	Crump, 1984
Hyla rosenbergi	E	*Belostoma porteri*	heteropteran	P	OBS		Kluge, 1981
Hyla rosenbergi	E	*Hyla rosenbergi*	tadpole	P	OBS		Kluge, 1981

APPENDIX 1. Continued.

Prey	Stage	Predator	Predator type	Pal	Meth	Notes	Source
Hyla rosenbergi	E	*Leptodactylus pentadactylus*	tadpole	P	FT	PS	Kluge, 1981
Hyla rosenbergi	E	*Leptodactylus pentadactylus*	tadpole	P	OBS		Kluge, 1981
Hyla rosenbergi	E	*Physalaemus pustulosus*	tadpole	P	OBS		Kluge, 1981
Hyla rosenbergi	E	NA	planarian	P	OBS		Kluge, 1981
Hyla rosenbergi	H	*Hyla rosenbergi*	tadpole	P	OBS		Kluge, 1981
Hyla rosenbergi	H	*Leptodactylus pentadactylus*	tadpole	P	FT	PS	Kluge, 1981
Hyla rosenbergi	H	*Leptodactylus pentadactylus*	tadpole	P	OBS		Kluge, 1981
Hyla rosenbergi	H	*Physalaemus pustulosus*	tadpole	P	OBS		Kluge, 1981
Hyla rosenbergi	H	*Synobranchus marmoratus*	swamp eel	P	OBS		Kluge, 1981
Hyla rosenbergi	T	*Ancylometes valentine*	fishing spider	P	OBS		Kluge, 1981
Hyla rosenbergi	T	*Belostoma porteri*	heteropteran	P	FT		Kluge, 1981
Hyla rosenbergi	T	*Belostoma porteri*	heteropteran	P	OBS		Kluge, 1981
Hyla rosenbergi	T	*Homo sapiens*	human	P	FT		Wassersug, 1971
Hyla rosenbergi	T	*Hyla rosenbergi*	tadpole	P	OBS		Kluge, 1981
Hyla rosenbergi	T	*Leptodactylus pentadactylus*	tadpole	P	FT	R	Heyer et al., 1975
Hyla rosenbergi	T	*Leptodactylus pentadactylus*	tadpole	P	OBS		Kluge, 1981
Hyla rosenbergi	T	*Physalaemus pustulosus*	tadpole	P	OBS		Kluge, 1981
Hyla rosenbergi	T	NA	libellulid odonate	P	OBS		Kluge, 1981
Hyla rutifela	T	*Homo sapiens*	human	P	FT		Wassersug, 1971
Hyla squirella	T	*Anax junius*	odonate	P	FT	R/F	Babbitt and Tanner, 1997
Hyla squirella	T	*Lethocerus americanus*	heteropteran	P	FT	R/F	Babbitt and Tanner, 1997
Hyla versicolor	E	*Notophthalmus viridescens*	adult newt	P	FT		Walters, 1975
Hyla versicolor	H	*Ambystoma maculatum*	sal larvae	P	FT		Walters, 1975
Hyla versicolor	T	*Ambystoma maculatum*	sal larvae	P	FT		Walters, 1975
Hyla zeteki	E	*Hyla zeteki*	tadpole	P	D		Dunn, 1937
Hylarana albolabris	T	*Thalassius spinosus*	fishing spider	P	OBS		McIntyre, 1999
Hymenochirus boettgeri	T	*Hymenochirus boettgeri*	tadpole	P	FT		Sokol, 1962
Hynobius nebulosus	L	*Hynobius nebulosus*	sal larvae	P	FT		Kusano et al. 1985
Lechriodus fletcheri	T	*Lechriododus fletcheri*	tadpole	P	FT		Martin, 1967
Leptodactylus knudseni	E	*Leptodactylus rhodomystax*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Limnodynastes tasmaniensis	T	*Hemicordulia tau*	odonate	P	FT		Richards and Bull, 1990
Mixophytes fasciatus	T	*Alcedo azurea*	kingfisher bird	P	OBS		Bolitho and Retallick, 1996
Necturus maculosus	E	*Necturus maculosus*	adult sal	P	D		Eycleshymer, 1906
Notophthalmus viridescens	E	*Ambystoma maculatum*	sal larvae	P	FT	F	Walters, 1975
Notophthalmus viridescens	E	*Ambystoma tigrinum*	sal larvae	P	OBS	F/*	Morin, 1983a
Notophthalmus viridescens	E	*Notophthalmus viridescens*	adult newt	P	OBS	F/*	Morin, 1983a
Notophthalmus viridescens	H	*Ambystoma maculatum*	sal larvae	P	FT	F	Walters, 1975
Notophthalmus viridescens	L	*Dytiscus verticalis*	coleopteran larvae	P	FT	F/*	Formanowicz and Brodie, 1982
Notophthalmus viridescens	L	*Lepomis* sp.	sunfish	U	FT	F	Kats et al., 1988
Notophthalmus viridescens	L	*Notophthalmus viridescens*	adult newt	P	FT	F	Walters, 1975

APPENDIX 1. Continued.

Prey	Stage	Predator	Predator type	Pal	Meth	Notes	Source
Osteocephalus buckeyi	E	*Hyla boans*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Osteocephalus buckeyi	E	*Hyla geographica*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Osteocephalus buckeyi	E	*Leptodactylus knudseni*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Osteocephalus buckeyi	E	*Osteocephalus taurinus*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Osteocephalus buckeyi	E	*Pyrrhulina* sp.	fish	U	FT	PS	Magnusson and Hero, 1991
Osteocepahlus taurinus	E	*Aequidens tetramerus*	fish	U	FT	PS	Magnusson and Hero, 1991
Osteocepahlus taurinus	E	*Dendrophyniscus minutus*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Osteocepahlus taurinus	E	NA	coleopteran (dytiscid)	P	FT	PS	Magnusson and Hero, 1991
Osteocepahlus taurinus	E	*Hyla geographica*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Osteocepahlus taurinus	E	*Leptodactylus knudseni*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Osteocepahlus taurinus	E	*Leptodactylus pentadactylus*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Osteocepahlus taurinus	E	*Osteocepahlus taurinus*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Osteocepahlus taurinus	E	*Phyllomedusa bicolor*	tadpole	U	FT	PS	Magnusson and Hero, 1991
Osteocepahlus taurinus	E	*Phyllomedusa tarsius*	tadpole	U	FT	PS	Magnusson and Hero, 1991
Osteocepahlus taurinus	E	*Phyllomedusa tomopterna*	tadpole	U	FT	PS	Magnusson and Hero, 1991
Osteocepahlus taurinus	E	*Phyllomedusa vaillanti*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Osteocepahlus taurinus	E	*Pyrrhulina* sp.	fish	P	FT	PS	Magnusson and Hero, 1991
Osteopilus septontrionalis	T	*Osteopilus septontrionalis*	tadpole	P	FT		Crump, 1986
Pelobates cultripes	T	*Dytiscus pisanus*	coleopteran larvae	P	FT	PS/*	Tejedo, 1993
Phyllomedusa distincta	E	*Liophis miliaris*	water snake	P	OBS		Castanho, 1996
Phyllomedusa trinitatis	T	*Pantala flavescens*	odonate	P	C	*	Sherratt and Harvey, 1989
Phyllomedusa vaillanti	E	*Hyla geographica*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Phyllomedusa vaillanti	E	*Leptodactylus knudseni*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Phyllomedusa vaillanti	E	*Osteocephalus taurinus*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Phyllomedusa vaillanti	E	*Phyllomedusa vaillanti*	tadpole	P	FT	PS	Magnusson and Hero, 1991
Phyllomedusa vaillanti	E	*Pyrrhulina* sp.	fish	P	FT	PS	Magnusson and Hero, 1991
Physalaemus pustulosus	T	*Chrysemys picta*	turtle	P	FT	PS	Heyer and Muedeking, 1976
Physalaemus pustulosus	T	*Leptodactylus pentadactylus*	tadpole	P	FT	R/*	Heyer et al, 1975
Physalaemus pustulosus	T	*Leptodactylus pentadactylus*	tadpole	P	C	*	Heyer et al., 1975
Physalaemus pustulosus	T	*Orthemis* sp.	odonate	P	FT	PS	Heyer and Meudeking, 1976
Physalaemus pustulosus	T	*Pantala flavescens*	odonate	P	FT	*	Heyer et al., 1975
Physalaemus pustulosus	T	*Pantala flavescens*	odonate	P	C	*	Sherratt and Harvey, 1989
Physalaemus sp.	T	*Hyla minuta*	tadpole	P	FT		Peixoto and Reis, 1997
Plethodon cinereus	E	*Plethodon cinereus*	adult sal	P	FT		Highton and Savage, 1961
Pleurodema borelli	T	*Pitangus sulphuratus*	bird	P	FT	*	Crump and Vaira, 1991
Pleurodema borelli	T	*Pitangus sulphuratus*	bird	P	OBS	*	Crump and Vaira, 1991
Pseudacris clarkii	E	*Gambusia affinis*	mosquitofish	P	FT	*	Grubb, 1972
Pseudacris clarkii	E	*Notropis lutrensis*	fish	P	FT	*	Grubb, 1972
Pseudacris clarkii	H	*Notropis lutrensis*	fish	P	FT	*	Grubb, 1972
Pseudacris crucifer	E	*Notophthalmus perstriatus*	adult newt	P	D	F	Christman, 1973
Pseudacris crucifer	T	*Ambystoma jeffersonianum*	sal larvae	P	FT	R/F/*	Brodie and Formanowicz, 1983

APPENDIX 1. Continued.

Prey	Stage	Predator	Predator type	Pal	Meth	Notes	Source
Pseudacris crucifer	T	*Anax junius*	odonate	P	C	F/*	Brodie and Formanowicz, 1987
Pseudacris crucifer	T	*Anax junius*	odonate	P	FT	R/F/*	Brodie and Formanowicz, 1983
Pseudacris crucifer	T	*Belostoma* sp.	heteropteran	P	C	F/*	Brodie and Formanowicz, 1987
Pseudacris crucifer	T	*Belostoma* sp.	heteropteran	P	FT	R/F/*	Brodie and Formanowicz, 1983
Pseudacris crucifer	T	*Dytiscus verticalis*	coleopteran larvae	P	FT	R/F/*	Brodie and Formanowicz, 1983
Pseudacris crucifer	T	*Dytiscus verticalis*	coleopteran larvae	P	FT	F	Brodie et al., 1978
Pseudacris crucifer	T	*Dytiscus verticalis*	coleopteran larvae	P	FT	F	Formanowicz and Brodie, 1982
Pseudacris crucifer	T	*Lepomis* sp.	sunfish	P	FT	F	Kats et al., 1988
Pseudacris crucifer	T	*Lethocerus americanus*	heteropteran larvae	P	FT	F	Brodie et al., 1978
Pseudacris crucifer	T	*Lethocerus americanus*	heteropteran adult	P	FT	R/F/*	Brodie and Formanowicz, 1983
Pseudacris crucifer	T	*Micropterus salmoides*	largemouth bass	P	C	PS/F/*	Kruse and Stone, 1984
Pseudacris crucifer	T	*Notophthalmus viridescens*	adult newt	P	C	F/*	Brodie and Formanowicz, 1987
Pseudacris crucifer	T	*Notophthalmus viridescens*	adult newt	P	FT	R/F/*	Brodie and Formanowicz, 1983
Pseudacris nigrita	E	*Ambystoma maculatum*	sal larvae	P	FT	NF	Walters, 1975
Pseudacris nigrita	T	*Ambystoma maculatum*	sal larvae	P	FT	NF	Walters, 1975
Pseudacris nigrita	T	*Dytiscus marginalis*	coleopteran larvae	P	FT	R/PS/NF	Young, 1967
Pseudacris nigrita	T	*Notophthalmus viridescens*	adult newt	P	FT	NF	Walters, 1975
Pseudacris regilla	E	*Salmo clarkii*	trout	U	FT	F	Licht, 1969
Pseudacris regilla	H	*Dytiscus* sp.	coleopteran larvae	P	C	F/*	Peterson and Blaustein, 1992
Pseudacris regilla	H	*Lethocerus americanus*	heteropteran larvae	P	C	PS/F/*	Peterson and Blaustein, 1992
Pseudacris regilla	T	*Ambystoma gracile*	sal larvae	P	C	PS/F/*	Peterson and Blaustei, 1991
Pseudacris regilla	T	*Ambystoma macrodactylum*	sal larvae	P	OBS	F	Fitch, 1936
Pseudacris regilla	T	*Ambystom macrodactylum*	sal larvae	P	FT	F	Wildy et al., 1998
Pseudacris regilla	T	*Dytiscus* sp.	coleopteran larvae	P	C	PS/F/*	Peterson and Blaustein, 1992
Pseudacris regilla	T	*Lethocerus americanus*	heteropteran	P	C	PS/F/*	Peterson and Blaustein, 1992
Pseudacris regilla	T	*Lethocerus americanus*	heteropteran	P	FT	PS/F	Hews, 1988
Pseudacris regilla	T	*Lethocerus americanus*	heteropteran larvae	P	C	PS/F/*	Peterson and Blaustein, 1992
Pseudacris regilla	T	*Taricha granulosa*	adult newt	P	C	PS/F/*	Peterson and Blaustein, 1992
Pseudacris regilla	T	*Thamnophis elegans*	garter snake	P	D	F	Arnold and Wassersug, 1978
Pseudacris regilla	T	*Thamnophis hydrophilus*	garter snake	P	FT	R/F	Kupferberg, 1998
Pseudacris regilla	T	*Thamnophis sirtalis*	garter snake	P	D	F	Arnold and Wassersug, 1978
Pseudacris regilla	T	*Thamnophis sirtalis*	garter snake	P	FT	F	De Vito et al., 1998
Pseudacris regilla	T	*Rana muscosa*	frog	P	OBS	F	Pope, 1999
Pseudacris triseriata	T	*Ambystoma laterale*	sal larvae	P	FT	NF	Smith, 1983
Pseudacris triseriata	T	*Ambystoma tigrinum*	sal larvae	P	FT	NF	Kiesecker, 1996
Pseudacris triseriata	T	*Anax junius*	odonate	P	FT	NF	Smith, 1983
Pseudacris triseriata	T	*Ictalurus melas*	catfish	P	C	NF/PS	Kruse and Francis, 1977
Pseudacris triseriata	T	*Lepomis macrochirus*	bluegill sunfish	P	FT	NF/PS	Voris and Bacon, 1966
Pseudacris triseriata	T	*Lepomis* sp.	sunfish	P	FT	NF	Kats et al., 1988
Pseudacris triseriata	T	*Micropterus salmoides*	bass	P	C	NF/PS	Kruse and Francis, 1977
Pseudacris triseriata	T	*Rhantus binotatus*	adult coleopteran	P	FT	NF	Smith, 1983

APPENDIX 1. Continued.

Prey	Stage	Predator	Predator type	Pal	Meth	Notes	Source
Pseudacris triseriata	T	*Thamnophis sirtalis*	garter snake	P	FT	NF	Wassersug and Sperry, 1977
Pseudoeurycea sp.	E	*Rhadinaea* sp.	snake	P	D		Myers, 1974
Pseudotriton montanus	L	*Nerodia sipedon*	water snake	P	D		Kats, 1986
Rana areolata	E	*Lepomis macrochirus*	bluegill sunfish	U	FT	JC	Werschkul and Christensen, 1977
Rana areolata	T	*Lepomis macrochirus*	bluegill sunfish	P	FT		Werschkul and Christensen, 1977
Rana areolata	T	*Notonecta indica*	heteropteran	P	FT	PS	Cronin and Travis, 1986
Rana areolata	T	*Notonecta undulata*	heteropteran	P	FT	PS	Cronin and Travis, 1986
Rana areolata	T	*Tramea lacerta*	odonate	P	FT	PS/*	Travis et al., 1985
Rana arvalis	E	*Aeshna* sp.	odonate	U	FT	PS/*	Henrickson, 1990
Rana arvalis	E	*Corixa dentipes*	heteropteran	P	FT	PS/*	Henrickson, 1990
Rana arvalis	E	*Cymatia bonsdorffi*	heteropteran	P	FT	PS/JC/*	Henrickson, 1990
Rana arvalis	E	*Dytiscus lapponicus*	adult coleopteran	P	FT	PS/*	Henrickson, 1990
Rana arvalis	E	*Glaenocorista propinqua*	heteropteran	P	FT	PS/JC/*	Henrickson, 1990
Rana arvalis	E	*Leucorrhinia dubia*	odonate	U	FT	PS/*	Henrickson, 1990
Rana arvalis	E	*Notonecta glauca*	heteropteran	U	FT	PS/*	Henrickson, 1990
Rana arvalis	E	*Rhantus exoletus*	coleopteran	U	FT	PS/*	Henrickson, 1990
Rana arvalis	E	*Triturus vulgaris*	adult newt	U	FT	PS/*	Henrickson, 1990
Rana arvalis	T	*Aeshna* sp.	odonate	P	FT	PS/*	Henrickson, 1990
Rana arvalis	T	*Corixa dentipes*	heteropteran	P	FT	PS/*	Henrickson, 1990
Rana arvalis	T	*Cymatia bonsdorffi*	heteropteran	P	FT	PS/*	Henrickson, 1990
Rana arvalis	T	*Dytiscus lapponicus*	coleopteran	P	FT	PS/*	Henrickson, 1990
Rana arvalis	T	*Glaenocorista propinqua*	heteropteran	P	FT	PS/*	Henrickson, 1990
Rana arvalis	T	*Leucorrhinia dubia*	odonate	P	FT	PS/*	Henrickson, 1990
Rana arvalis	T	*Notonecta glauca*	heteropteran	P	FT	PS/*	Henrickson, 1990
Rana arvalis	T	*Rhantus exoletus*	coleopteran	P	FT	PS/*	Henrickson, 1990
Rana arvalis	T	*Triturus vulgaris*	adult newt	P	FT	PS/*	Henrickson, 1990
Rana aurora	E	*Ambystoma gracile*	sal larvae	P	FT		Licht, 1969
Rana aurora	E	*Gasterosteus aculeatus*	fish	P	FT		Licht, 1969
Rana aurora	E	*Salmo clarkii*	trout	P	FT		Licht, 1969
Rana aurora	E	*Taricha torosa*	adult newt	P	OBS		Rathbun, 1998
Rana aurora	T	*Rana catesbeiana*	frog	P	FT		Kiesecker and Blaustein, 1997
Rana aurora	T	*Rana catesbeiana*	tadpole	P	FT		Kiesecker and Blaustein, 1997
Rana aurora	T	*Taricha granulosa*	adult newt	P	FT		Calef, 1973
Rana blairi	T	*Ictalurus melas*	catfish	P	C	PS	Kruse and Francis, 1977
Rana blairi	T	*Lepomis cyanellus*	sunfish	P	C	PS	Kruse and Francis, 1977
Rana blairi	T	*Micropterus salmoides*	bass	P	C	PS	Kruse and Francis, 1977
Rana blairi	T	*Nerodia harteri*	water snake	P	FT		Rose, 1989
Rana boylii	T	*Thamnophis ordinoides*	garter snake	P	D		Fitch, 1936
Rana cancrivora	T	*Fluta alba*	fish	P	FT	PS	Liem, 1961
Rana cancrivora	T	*Tilapia mossambica*	fish	P	FT	PS	Liem, 1961
Rana capito	T	*Nerodia fasciata*	water snake	P	D	NF	Aresco and Reed, 1998

APPENDIX 1. Continued.

Prey	Stage	Predator	Predator type	Pal	Meth	Notes	Source
Rana cascadae	H	*Dytiscus* sp.	coleopteran larvae	P	C	*	Peterson and Blaustein, 1992
Rana cascadae	H	*Lethocerus americanus*	heteropteran larvae	P	C	PS/*	Peterson and Blaustein, 1992
Rana cascadae	T	*Ambystoma gracile*	sal larvae	P	C	PS/*	Peterson and Blaustein, 1991
Rana cascadae	T	*Dytiscus* sp.	coleopteran	P	C	PS/*	Peterson and Blaustein, 1992
Rana cascadae	T	*Lethocerus americanus*	heteropteran larvae	P	C	PS/*	Peterson and Blaustein, 1992
Rana cascadae	T	*Lethocerus americanus*	heteropteran larvae	P	C	PS/*	Peterson and Blaustein, 1992
Rana cascadae	T	*Taricha granulosa*	adult newt	P	C	PS/*	Peterson and Blaustein, 1991
Rana catesbeiana	E	*Ambystoma gracile*	sal larvae	P	FT	F	Licht, 1969
Rana catesbeiana	E	*Gasterosteus aculeatus*	fish	P	FT	F	Licht, 1969
Rana catesbeiana	E	*Macrobdella decora*	leech	P	OBS	F	Howard, 1978
Rana catesbeiana	E	*Notophthalmus viridescens*	adult newt	P	FT	F	Walters, 1975
Rana catesbeiana	T	NA	odonate (aeshnid)	P	C	F	Woodward, 1983
Rana catesbeiana	T	*Ambystoma tigrinum*	adult sal	P	C	R/PS/F/*	Werner and McPeek, 1994
Rana catesbeiana	T	*Ambystoma tigrinum*	sal larvae	P	C	F	Woodward, 1983
Rana catesbeiana	T	*Anax junius*	odonate	P	C	R/PS/F/*	Werner and McPeek, 1994
Rana catesbeiana	T	*Anax* sp.	odonate	P	FT	F/*	Peacor and Werner, 1997
Rana catesbeiana	T	NA	heteropteran	P	C	F	Woodward, 1983
Rana catesbeiana	T	*Dolomedes triton*	fishing spider	P	OBS	F	Rogers, 1996
Rana catesbeiana	T	*Gambusia affinis*	mosquitofish	U	C	F	Woodward, 1983
Rana catesbeiana	T	*Ictalurus melas*	catfish	U	C	PS/F/*	Kruse and Francis, 1977
Rana catesbeiana	T	*Lepomis* sp.	sunfish	U	FT	F	Kats et al., 1988
Rana catesbeiana	T	*Lepomis cyanellus*	sunfish	P	C	PS/F/*	Kruse and Francis, 1977
Rana catesbeiana	T	*Lepomis macrochirus*	sunfish	P	C	F	Werner and McPeek, 1994
Rana catesbeiana	T	*Micropterus dolomieu*	bass	P	OBS	F	Saumure, 1993
Rana catesbeiana	T	*Micropterus salmoides*	bass	P	C	PS/F/*	Kruse and Francis, 1977
Rana catesbeiana	T	NA	heteropteran	U	C	F	Woodward, 1983
Rana catesbeiana	T	*Rana catesbeiana*	adult frog	P	FT	F	Beard and Baillie, 1998
Rana catesbeiana	T	*Rana catesbeiana*	adult frog	P	D	F	Stuart and Painter, 1993
Rana catesbeiana	T	*Thamnophis elegans*	garter snake	P	FT	F	Fox, 1952
Rana catesbeiana	T	*Thamnophis marcianus*	garter snake	U	C	F	Woodward, 1983
Rana chalconota	T	*Fluta alba*	fish	U	FT	PS	Liem, 1961
Rana chalconota	T	*Tilapia mossambica*	fish	U	FT	PS	Liem, 1961
Rana clamitans	E	*Ambystoma maculatum*	sal larvae	U	FT	F	Walters, 1975
Rana clamitans	E	*Ambystoma gracile*	sal larvae	P	FT	F	Licht, 1969
Rana clamitans	E	*Gasterosteus aculeatus*	fish	P	FT	F	Licht, 1969
Rana clamitans	E	*Notophthalmus viridescens*	adult newt	U	FT	F	Walters, 1975
Rana clamitans	E	*Salmo clarkii*	trout	P	FT	F	Licht, 1969
Rana clamitans	T	*Ambystoma maculatum*	sal larvae	U	FT	F	Walter, 1975
Rana clamitans	T	*Ambystoma jeffersonianum*	sal larvae	P	FT	R/F/*	Brodie and Formanowicz, 1983
Rana clamitans	T	*Ambystoma tigrinum*	adult sal	P	C	R/PS/F/*	Werner and McPeek, 1994

APPENDIX 1. Continued.

Prey	Stage	Predator	Predator type	Pal	Meth	Notes	Source
Rana clamitans	T	*Anax junius*	odonate	P	FT	R/F/*	Brodie and Formanowic, 1983
Rana clamitans	T	*Anax junius*	odonate	P	C	R/PS/F/*	Werner and McPeek, 1994
Rana clamitans	T	*Anax* sp.	odonate	P	FT	FT/F/*	Peacor and Werner, 1997
Rana clamitaus	T	*Belostoma* sp.	heteropteran	P	FT	R/F/*	Brodie and Formanowicz, 1983
Rana clamitans	T	*Cambarus diogenes*	crawfish	P	FT	F/*	Formanowicz and Brodie, 1982
Rana clamitans	T	*Chrysemys picta*	turtle	U	FT	F	Walters, 1975
Rana clamitans	T	*Dytiscus verticalis*	coleopteran larvae	P	FT	R/F/*	Brodie and Formanowicz, 1983
Rana clamitans	T	*Dytiscus verticalis*	coleopteran larvae	P	FT	F/*	Formanowicz, 1986
Rana clamitans	T	*Dytiscus verticalis*	coleopteran larvae	P	FT	F/*	Formanowicz and Brodie, 1982
Rana clamitans	T	*Lepomis macrochirus*	sunfish	P	C	F/*	Werner and McPeek, 1994
Rana clamitans	T	*Lepomis* sp.	sunfish	U	FT	F	Kats et al., 1988
Rana clamitans	T	*Lethocerus americanus*	heteropteran larvae	P	FT	R/F/*	Brodie and Formanowicz, 1983
Rana clamitans	T	*Notophthalmus viridescens*	adult newt	P	FT	R/F/*	Brodie and Formanowicz, 1983
Rana clamitans	T	*Oronectes propinquus*	crawfish	P	FT	F/*	Formanowicz and Brodie, 1982
Rana clamitans	T	*Rana catesbeiana*	adult frog	P	FT	F	Beard and Baillie, 1989
Rana clamitans	T	*Sternotherus odoratus*	musk turtle	U	FT	F	Walters, 1975
Rana cyanophilictis	T	*Rana cyanophilictis*	tadpole	P	FT		McCann, 1932
Rana erythraea	T	*Fluta alba*	fish	P	FT	PS	Liem, 1961
Rana erythraea	T	*Tilapia mossambica*	fish	P	FT	PS	Liem, 1961
Rana esculenta	E	*Rana temporaria*	tadpole	P	FT		Heusser, 1970
Rana esculenta	T	*Anax imperator*	odonate	P	FT	R/AF/*	Semlitsch, 1993
Rana esculenta	T	*Cordulia aenea*	odonate	P	FT	R/AF/*	Semlitsch, 1993
Rana esculenta	T	*Esox lucius*	pike fish	P	FT	R/AF/*	Semlitsch, 1993
Rana esculenta	T	*Triturus alpestris*	adult newt	P	FT	R/AF/*	Semlitsch, 1993
Rana lessonae	T	*Anax imperator*	odonate	P	FT	R/AF/*	Semlitsch, 1993
Rana lessonae	T	*Cordulia aenea*	odonate	P	FT	R/AF/*	Semlitsch, 1993
Rana lessonae	T	*Esox lucius*	pike fish	P	FT	R/AF/*	Semlitsch, 1993
Rana lessonae	T	*Triturus alpestris*	adult newt	P	FT	R/AF/*	Semlitsch, 1993
Rana limnocharis	T	*Fluta alba*	fish	P	FT	PS	Liem, 1961
Rana limnocharis	T	*Tilapia mossambica*	fish	P	FT	PS	Liem, 1961
Rana muscosa	T	*Euphagus cynocephalus*	blackbird	P	OBS		Bradford, 1991
Rana palustris	T	*Ambystoma jeffersonianum*	sal larvae	P	FT	R/F/*	Brodie and Formanowicz, 1983
Rana palustris	T	*Anax junius*	odonate	P	FT	R/F/*	Brodie and Formanowicz, 1983
Rana palustris	T	*Belostoma* sp.	heteropteran	P	FT	R/F/*	Brodie and Formanowicz, 1983
Rana palustris	T	*Cambarus diogenes*	crawfish	P	FT	*	Formanowicz and Brodie, 1982
Rana palustris	T	*Dystcus verticalis*	coleopteran larvae	P	FT	R/F/*	Brodie and Formanowicz, 1983
Rana palustris	T	*Dysticus verticalis*	coleopteran larvae	P	FT	*	Formanowicz and Brodie, 1982
Rana palustris	T	*Lethocerus americanus*	heteropteran larvae	P	FT	R/F/*	Brodie and Formanowicz, 1983
Rana palustris	T	*Notophthalmus viridescens*	adult newt	P	FT	R/F*	Brodie and Formanowicz, 1983
Rana palustris	T	*Oronectes propinqus*	crawfish	P	FT	*	Formanowicz and Brodie, 1982
Rana pipiens	E	*Ambystoma maculatum*	sal larvae	P	FT	F	Walters, 1975

APPENDIX 1. Continued.

Prey	Stage	Predator	Predator type	Pal	Meth	Notes	Source
Rana pipiens	E	*Ambystoma gracile*	sal larvae	P	FT	F	Licht, 1969
Rana pipiens	E	*Gambusia affinis*	mosquitofish	P	FT	F/*	Grubb, 1972
Rana pipiens	E	*Gambusia affinis*	mosquitofish	P	FT	F/*	Grubb, 1972
Rana pipiens	E	*Gasteroceus aculeatus*	fish	P	FT	F	Licht, 1969
Rana pipiens	E	*Lepomis macrochirus*	sunfish	U	FT	JC/F	Jennings and Schaefer, 1978
Rana pipiens	E	*Notropis lutrensis*	fish	P	FT	F/*	Grubb, 1972
Rana pipiens	E	*Salmo clarkii*	trout	P	FT	F	Licht, 1969
Rana pipiens	H	*Ambystoma maculatum*	sal larvae	P	FT	F	Walters, 1975
Rana pipiens	H	*Gambusia affinis*	mosquitofish	P	FT	F/*	Grubb, 1972
Rana pipiens	H	*Notropis lutrensis*	fish	P	FT	F/*	Grubb, 1972
Rana pipiens	T	NA	odonate (aeshnid)	P	C	F	Woodward, 1983
Rana pipiens	T	*Ambystoma tigrinum*	sal larvae	P	C	F	Woodward, 1983
Rana pipiens	T	NA	heteropteran	P	C	F	Woodward, 1983
Rana pipiens	T	NA	megalopteran larvae	P	C	F	Woodward, 1983
Rana pipiens	T	*Micropterus salmoides*	largemouth bass	P	C	PS/F	Kruse and Francis, 1977
Rana pipiens	T	NA	heteropteran	P	C	F	Woodward, 1983
Rana pipiens	T	*Thamnophis marcianus*	garter snake	U	C	F	Woodward, 1983
Rana ridibunda	E	*Rana temporaria*	tadpole	P	FT		Heusser, 1970
Rana sphenocephala	E	*Lepomis macrochirus*	bluegill sunfish	U	FT	JC/F	Werschkul and Christensen, 1977
Rana sphenocephala	T	*Lepomis macrochirus*	bluegill sunfish	P	FT	F	Werschkul and Christensen, 1977
Rana sylvatica	E	*Ambystoma maculatum*	sal larvae	P	FT	NF	Walters, 1975
Rana sylvatica	E	*Limnephilus* sp.	trichopteran larvae	P	FT	NF	Stein, 1985
Rana sylvatica	E	*Macrobdella decora*	leech	P	FT	NF	Cory and Manion, 1953
Rana sylvatica	E	*Macrobdella decora*	leech	P	OBS	NF	Cory and Manion, 1953
Rana sylvatica	E	*Notophthalmus viridescens*	adult newt	P	OBS	NF	Rowe et al., 1994
Rana sylvatica	E	*Ptilostomis postica*	trichopteran larvae	P	OBS	NF	Rowe et al., 1994
Rana sylvatica	H	*Ambystoma maculatum*	sal larvae	P	FT	NF	Walters, 1975
Rana sylvatica	H	*Notophthalmus viridescens*	adult newt	P	FT	NF	Walters, 1975
Rana sylvatica	T	*Ambystoma jeffersonianum*	sal larvae	P	FT	R/NF/*	Brodie and Formanowicz, 1983
Rana sylvatica	T	*Ambystoma tigrinum*	sal larvae	P	FT	NF/*	Wilbur, 1972
Rana sylvatica	T	*Ambystoma tigrinum*	sal larvae	P	D	NF/*	Wilbur, 1972
Rana sylvatica	T	*Anax junius*	odonate	P	C	NF/*	Brodie and Formanowicz, 1987
Rana sylvatica	T	*Anax junius*	odonate	P	FT	R/NF/*	Brodie and Formanowicz, 1983
Rana sylvatica	T	*Belostoma* sp.	heteropteran	P	C	NF/*	Brodie and Formanowicz, 1987
Rana sylvatica	T	*Belostoma* sp.	heteropteran	P	C	R/NF/*	Brodie and Formanowicz, 1983
Rana sylvatica	T	*Chrysemys picta*	turtle	P	FT	NF	Walters, 1975
Rana sylvatica	T	*Dolomedes triton*	fishing spider	P	OBS	NF	Zimmerman and Spence, 1989
Rana sylvatica	T	*Dysticus verticalis*	coleopteran larvae	P	FT	R/NF/*	Brodie and Formanowicz, 1983
Rana sylvatica	T	*Dysticus verticalis*	coleopteran larvae	P	FT	NF/*	Formanowicz and Brodie, 1982
Rana sylvatica	T	*Lepomis* sp.	sunfish	P	FT	NF	Kats et al., 1988
Rana sylvatica	T	*Lethocerus americanus*	heteropteran larvae	P	FT	R/NF/*	Brodie and Formanowicz, 1983
Rana sylvatica	T	*Notophthalmus viridescens*	adult newt	P	C	NF/*	Brodie and Formanowicz, 1987

APPENDIX 1. Continued.

Prey	Stage	Predator	Predator type	Pal	Meth	Notes	Source
Rana sylvatica	T	*Notophthalmus viridescens*	adult newt	P	FT	R/NF/*	Brodie and Formanowicz, 1983
Rana sylvatica	T	*Notophthalmus viridescens*	adult newt	P	FT	NF	Walters, 1975
Rana sylvatica	T	*Ptilostomis postica*	trichopteran larvae	P	FT	R/NF	Rowe et al., 1994
Rana sylvatica	T	*Rana sylvatica*	tadpole	P	OBS	NF	Bleakney, 1958
Rana sylvatica	T	*Sternotherus odoratus*	musk turtle	P	FT	NF	Walters, 1975
Rana sylvatica	T	*Gerris* sp.	waterstrider	P	OBS	NF	Eaton and Paszkowski, 1999
Rana temporaria	E	*Rana temporaria*	tadpole	P	FT		Heusser, 1970
Rana temporaria	E	*Triturus helveticus*	adult newt	P	FT		Denton and Beebee, 1991
Rana temporaria	E	*Triturus vulgaris*	adult newt	U	FT		Denton and Beebee, 1991
Rana temporaria	H	*Triturus helveticus*	adult newt	P	FT		Denton and Beebee, 1991
Rana temporaria	H	*Triturus vulgaris*	adult newt	U	FT		Denton and Beebee, 1991
Rana temporaria	T	*Perca fluviatilus*	fish	P	FT		Manteifel, 1995
Rana temporaria	T	*Percottus glehni*	fish	P	FT		Manteifel, 1995
Rana temporaria	T	*Rutilus rutilus*	fish	P	FT		Manteifel, 1995
Rana temporaria	T	*Triturus cristatus*	adult newt	P	FT	R/*	Cooke, 1974
Rana temporaria	T	*Triturus vulgaris*	adult newt	P	FT	R/*	Cooke, 1974
Rana tigrina	E	*Hiruda birmanica*	leech	P	OBS		McCann, 1932
Rana tigrina	T	*Belostoma indica*	heteropteran larvae	P	OBS		McCann, 1932
Rana tigrina	T	*Hiruda birmanica*	leech	P	OBS		McCann, 1932
Rana tigrina	T	*Rana cyanophlictis*	tadpole	P	OBS		McCann, 1932
Rana tigrina	T	*Rana tigrina*	tadpole	P	OBS		McCann, 1932
Rana tigrina	T	*Tropidonotus piscator*	snake	P	OBS		McCann, 1932
Rana sp.	E	*Haemopsis* sp.	leech	P	FT		Licht, 1969
Rhacoporus leucomystax	T	*Fluta alba*	fish	P	FT	PS	Liem, 1961
Rhacoporus leucomystax	T	*Tilapia mossambica*	fish	P	FT	PS	Liem, 1961
Rhinophrynus dorsalis	T	*Rhinophrynus dorsalis*	tadpole	P	D		Starrett, 1960
Scaphiopus couchi	E	*Gambusia affinis*	mosquitofish	P	FT	NF/*	Grubb, 1972
Scaphiopus couchi	T	NA	odonate (aeshnid)	P	C	NF	Woodward, 1983
Scaphiopus couchi	T	*Ambystoma tigrinum*	sal larvae	P	C	NF	Woodward, 1983
Scaphiopus couchi	T	NA	heteropteran	P	C	NF	Woodward, 1983
Scaphiopus couchi	T	NA	megalopteran larvae	P	C	NF	Woodward, 1983
Scaphiopus couchi	T	*Gambusia affinis*	mosquitofish	P	C	NF	Woodward, 1983
Scaphiopus couchi	T	NA	heteropteran	P	C	NF	Woodward, 1983
Scaphiopus couchi	T	*Thamnophis marcianus*	garter snake	P	C	NF	Woodward, 1983
Scaphiopus holbrooki	T	*Notophthalmus viridescens*	adult newt	P	FT	R/NF/*	Mori, 1983b
Smilisca phaeota	T	*Homo sapiens*	human	P	FT		Wassersug, 1971
Smilisca phaeota	T	*Leptodactylus pentadactylus*	tadpole	P	FT	R/*	Heyer et al., 1975
Smilisca phaeota	T	*Pantala flavescens*	odonate	P	FT	*	Heyer et al., 1975
Spea bombifrons	T	*Micropterus salmoides*	bass	P	C	PS/NF	Kruse and Francis, 1977
Spea bombifrons	T	*Spea bombifrons*	tadpole	P	FT	NF	Bragg and Nelson, 1966

APPENDIX 1. Continued.

Prey	Stage	Predator	Predator type	Pal	Meth	Notes	Source
Spea bombifrons	T	*Spea bombifrons*	tadpole	P	FT	AF/NF/*	Pfennig and Frankino, 1997
Spea intermontanus	T	*Corvus brachyrhynchos*	crow	P	OBS	NF	Harestad, 1985
Spea multiplicata	T	NA	odonate (aeshnid)	P	C	NF	Woodward, 1983
Spea multiplicata	T	*Ambystoma tigrinum*	sal larvae	P	FT	NF	Woodward, 1983
Spea multiplicata	T	NA	heteropteran	P	C	NF	Woodward, 1983
Spea multiplicata	T	NA	megalopteran larvae	U	C	NF	Woodward, 1983
Spea multiplicata	T	NA	heteropteran	P	C	NF	Woodward, 1983
Spea multiplicata	T	*Spea multiplicata*	tadpole	P	FT	NF/*	Pfennig and Frankino, 1997
Taricha granulosa	L	*Dicamptodon ensatus*	larval sal	U	FT	F	Johnson and Schreck, 1969
Taricha granulosa	L	*Thamnophis* sp.	garter snake	P	OBS	F	Fitch, 1936
Taricha torosa	E	*Gambusia affinis*	mosquitofish	U	FT	F/*	Gamradt and Kats, 1996
Taricha torosa	E	*Procambarus clarkii*	crawfish	P	FT	F/*	Gamradt and Kats, 1996
Taricha torosa	E	*Taricha torosa*	adult newt	P	OBS	F	Kaplan and Sherman, 1980
Taricha torosa	H	*Gambusia affinis*	mosquitofish	P	FT	R/F/*	Gamradt and Kats, 1996
Taricha torosa	H	*Procambarus clarkii*	crawfish	P	FT	R/F/*	Gamradt and Kats, 1996
Taricha torosa	L	*Rana catesbeiana*	frog	P	D	F	Jennings and Cook, 1998
Taricha torosa	L	*Taricha torosa*	adult newt	P	D	F	Hanson et al., 1994
Taricha torosa	L	*Thamnophis elegans*	garter snake	P	FT	F	Fox, 1952
Taricha sp.	L	*Thamnophis ordinoides*	garter snake	P	D	F	Fitch, 1936
Triturus alpestris	E	*Acilius sulcatus*	coleopteran	P	FT	AF/F	Miaud, 1993
Triturus alpestris	E	*Dysticus marginalis*	coleopteran	P	FT	AF/F	Miaud, 1993
Triturus alpestris	E	*Hygrobia hermanni*	coleopteran	U	FT	AF/F	Miaud, 1993
Triturus alpestris	E	*Ilyocoris cimicoides*	heteropteran	U	FT	AF/F	Miaud, 1993
Triturus alpestris	E	*Libellula depressa*	odonate	U	FT	AF/F	Miaud, 1993
Triturus alpestris	E	*Limnaea stagnalis*	snail	U	FT	AF/F	Miaud, 1993
Triturus alpestris	E	*Notonecta glauca*	heteropteran	U	FT	AF/F	Miaud, 1993
Triturus alpestris	E	*Rana temporaria*	tadpole	U	FT	AF/F	Miaud, 1993
Triturus alpestris	E	*Ranatra linearis*	heteropteran	U	FT	AF/F	Miaud, 1993
Triturus alpestris	E	*Triturus alpestris*	adult newt	P	FT	AF/F	Miaud, 1993
Triturus alpestris	E	*Triturus helveticus*	adult newt	P	FT	AF/F	Miaud, 1993
Triturus vulgaris	E	*Limnophilus vittatus*	trichopteran larvae	P	OBS	F	Bell and Lawton, 1975
Triturus vulgaris	E	*Planorbis corneus*	snail	P	FT	F	Bell and Lawton, 1975
Triturus vulgaris	E	*Triturus vulgaris*	adult newt	P	FT	F	Bell and Lawton, 1975
Xenopus laevis	T	*Hemicordulia tau*	odonate	P	FT		Richards and Bull, 1990