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Food Habits of the Spotted Frog (*Rana pretiosa*) from Managed Sites in Grant County, Oregon

Abstract

A great variety of insect food, including distasteful types, was eaten by the spotted frog (*Rana pretiosa*) in the Blue Mountains of Oregon, indicating that *pretiosa* is an opportunistic feeder. Frogs from four variously managed sites displayed different dietary habits, indicating that land management practices may have caused changes in the abundance or composition of local insect populations.

Introduction

The food habits of the spotted frog (*Rana pretiosa*) have been studied in various parts of its range (Moore and Strickland 1954, Turner 1959, Miller 1978). The present study was designed to contribute further regional information and to study possible differences in food habits among four different forest range management systems. Differences in food habits among sites reflect basic differences in availability of food that, in turn, may have been influenced by different management practices.

Study Areas

Frogs were collected at four sites in Grant County, Oregon, during July and August 1978. One pair of sites (Keeny-Clark and Flood) represented mountain-meadow habitats and the other pair (East Larch and West Larch) represented mixed conifer forest habitats. One site of each pair received intensive management, and the other was a

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control. The treated meadow habitat received numerous improvement practices, such as herbicide and fertilizer treatments, grass and legume seeding, and rodent control. The pine forest-range had overstory tree removal and timber thinning. The names, locations, and characteristics of the sites were:

Keeny-Clark

The study site is at the confluence of two meadows (Keeny and Clark) and tributaries to the south of Long Creek, 1652 m elevation. Most frogs were collected immediately south (upstream) of where USFS Rd. 1136 (T11S, R31E, S15) crosses Long Creek. The stream is somewhat intermittent, forming isolated pools in late summer. There is evidence of extensive bank erosion brought on by years of heavy cattle and sheep grazing. By late summer the pools take on a muddy and stagnant quality. The surrounding meadow is considered to be intensively managed, including reseeding and herbicide treatment. The grazing pattern is on a rotating schedule, which included no grazing in 1977 and late grazing, beginning 15 September 1978.

Flood

This study site is located just south (upstream) of USFS Rd. 1136 (T11S, R31E, S11) on a tributary of the middle fork of Long Creek, 1567 m elevation, as it emerges from a large meadow (Flood). The creek and surrounding meadow are relatively undisturbed. The clear water flows all summer long, and the banks are heavily vegetated. Management of the surrounding meadow is restricted to controlled livestock grazing. Grazing is on a rotating schedule, which included late grazing in 1977; no grazing in 1978; and early grazing starting 12 June 1979.

East Larch

This site was located southwest of Fox (T12S, R30E, S5) at 1463 m elevation. The collecting site consisted of a small pond, approximately 10 m in diameter, in a draw at the west end of a large meadow. The pond is surrounded on three sides by mixed conifer forest and is protected with shrub and tree vegetation. The forest to the north of the pond was thinned in 1977 on the eastern half and in 1978 on the western half. The slash was piled and burned in the winter of 1978-79. The entire area was grass seeded.

West Larch

This site is located (T11S, R29E, S35) 5.6 km west of the East Larch site, at 1402 m elevation. It consists of a 10 x 15 m artificial pond fed by a very small intermittent stream. A large meadow is situated to the east, and mixed coniferous forest borders the other three sites. There are large stumps in the forest indicating past logging, but there are several large *Pinus ponderosa* in the immediate vicinity of the pond. There is no active timber management or harvest in the surrounding area, which is currently used for cattle grazing. The pond is relatively open around the edges and has a thick blanket of algae that covers about 50 percent of the surface. This algal mat provides excellent cover and feeding sites for frogs.

Methods

Frogs were captured with hand-dip nets. To avoid sacrificing animals, a method similar to that used for fish (Meehan and Miller 1978), turtles (Legler 1977), and lizards and

amphibians (Legler and Sullivan 1979) was used to obtain dietary samples. A 5 mm diameter glass or rigid plastic tube, attached to a 50-cc syringe, was inserted through the mouth into the stomach of the frog and the contents simply flushed back out through the relatively short esophagus by forcing water into the stomach. The food fragments were separated from the flush water by straining through gauze, and its contents were placed in 10 percent formalin or 70 percent ethyl alcohol for preservation. The frogs were branded with hot chromel wire (Clark 1971) and returned to their habitat for continued diet sampling and capture-recapture population estimates.

Results and Discussion

A large variety of food was eaten by spotted frogs (Table 1). A total of 98 food categories was represented: 49 at Flood, 43 at Keeny-Clark, 51 at West Larch, and 51 at East Larch. The majority of the food was insect material, 73 categories representing 90.7 percent of the food by volume. Other invertebrates formed seven categories, and plant material formed three categories, representing 3.9 percent of the volume. Insignificant categories were bird feathers and shed frog skins. Most sampled items were terrestrial, but a few forms were aquatic, including mayfly naiads, larval trichopterans, tipulid larvae, clams, and *Daphnia*.

Major food categories (those comprising over 5 percent volume) are listed by order of decreasing volume for each of the four areas (Table 2). There was great variation. Only one item, adult moths (Lepidoptera) occurred as a major item in stomachs from all four sites (Table 2), ranging in volume from 6.1 (Flood) to 14.5 (East Larch). Two foods occurred in stomachs from two sites: ants (Formicidae) from Flood and East Larch, and grasshoppers (Acrididae) from Flood and Keeny-Clark. A total of 13 food categories appear in this table, but nine of them occurred at only one site as major foods: water striders (Gerridae), crane flies (Tipulidae), and soldier flies (Tachinidae) at Flood; hover flies (Syrphidae), spider (Araneae), and diving beetles (Dytiscidae) at Keeny-Clark; long-legged flies (Dolichopodidae) and wasps (Vespidae) at West Larch; and caddisflies (Trichoptera) and millipedes (Diplopoda) at East Larch. Also, the food in greatest volume differed (and was in a different order) in each case.

The great variety of food items consumed by *pretiosa* in Grant County is consistent with findings of Miller (1978), from western Montana, for the same species. Assuming that frog diet reflects abundance and diversity of available prey, as demonstrated by Whitaker (1961) and Turner (1960), the great differences among the four study sites is of special interest.

The study sites were initially selected because of differences in application of range and forest management practices. Keeny-Clark and Flood Meadows are relatively close together and similar in habitat characteristics (slope, exposure, elevation, proximity to forest), as are East and West Larch sites. The intensity and type of management is clearly different at each of the sites. However, owing to lack of replication and knowledge of insect habitat requirements, it is impossible to determine whether some of the differences are related to natural habitat differences or to land management activities. In a few cases—e.g., grasshoppers—the quantity of food items selected appears to indicate past management activities. Acrididae made the greatest contribution in the Keeny-Clark (20.5 percent) and Flood (8.8 percent) meadow sites and least contri-

TABLE 1. Food of spotted frogs, *Rana pretiosa*, from four localities in Grant County, Oregon.

	Flood			Meadow			Forest			Summarized Grant County data					
	n = 50			n = 50			n = 54			n = 52			n = 206		
	Volume	Percent	Frequency	Volume	Percent	Frequency	Volume	Percent	Frequency	Volume	Percent	Frequency	Volume	Percent	Frequency
Diptera															
Tipulidae—adult	7.2		28.0	0.7		2.0	3.2		9.3	2.4		11.5	3.4		12.6
Tachinidae	6.5		12.0										1.6		2.9
Dolichopodidae	4.6		14.0	0.7		10.0	10.9		51.9	1.0		9.6	4.4		21.8
Syrphidae	3.9		12.0	18.9		32.0	0.6		3.7				5.7		11.7
Acalypterata	0.9		8.0	0.2		4.0	0.7		7.4	3.6		13.5	1.4		8.3
Bombyliidae	0.6		4.0										0.15		1.0
Culicidae	0.4		4.0										0.2		1.5
Calliphoridae				1.3		8.0	0.7		1.9				0.5		2.4
Anthomyiidae				0.8		8.0	1.6		9.3	1.1		3.8	0.9		5.3
Tipulidae—larvae				0.7		6.0	0.3		1.9	4.6		15.4	1.4		5.8
Pipunculidae				0.2		2.0							0.05		0.5
Conopidae				0.1		2.0							0.02		0.5
Tabanidae (Chrysops)				0.1		2.0							0.02		0.5
Otitidae							1.2		7.4	0.1		1.9	0.3		2.4
Muscidae							0.8		1.9				0.2		0.5
Sarcophagidae							0.5		1.9				0.1		0.5
Simuliidae							0.1		1.9				0.02		0.5
Asilidae													0.02		0.5
Chironomidae										2.4		17.3	0.6		4.4
Stratiomyid larvae										1.0		5.8	1.0		1.5
Mycetophilidae										0.5		1.9	0.12		0.5
Dipterous larvae										0.4		1.9	0.09		0.5
Unidentified Diptera	2.9		10.0	1.1		10.0	0.6		3.7	2.5		13.5	0.17		1.0
Coleoptera							3.3		16.7				2.5		12.6
Staphylinidae	3.7		10	0.9		6	0.1		1.9				1.1		4.4
Carabidae	1.6		10	1.5		2	0.4		3.7	0.9		7.7	1.1		5.8
Cantharid larvae	2.1		10										0.5		2.4
Cerambycidae	1.2		2												
Tenebrionidae	1.0		6	1.0		2				1.9		1.9	0.8		1.0
Dytiscidae	0.8		2	5.9		16				4.3		11.5	1.6		4.9
Dytiscid larvae	0.2		2	0.3		2				2.5		11.5	2.3		7.3
Curculionidae	0.4		4	0.5		2				0.4		1.9	0.1		1.0
Chrysomelidae	0.3		4	0.4		2	0.3		1.9				0.4		2.4
Coccinellidae	0.3		2	0.6		4	0.4		1.9				0.6		1.5
Scarabaeidae	0.2		2										0.3		1.9
													0.50		0.5

TABLE 2. Major foods of spotted frogs at four localities (given in percent volume).

Flood	Keeny-Clark		West Larch		East Larch		
Gerridae	8.9	Acrididae	20.5	Vespidae	31.1	Lepidoptera	14.5
Acrididae	8.8	Syrphidae	18.9	Dolichopodidae	10.9	Formicidae	9.6
Tipulidae	7.2	Lepidoptera	10.0	Lepidoptera	9.1	Trichoptera	5.9
Tachinidae	6.5	Spiders	7.2			Diplopoda	5.8
Lepidoptera	6.1	Dytiscidae	5.9				
Formicidae	5.1						

bution in the East Larch (1.2 percent) and West Larch (0.6 percent) forest sites. Dempster (1963) reported that grasshoppers and certain other ovipositing Orthoptera require compacted soil for successful reproduction. Because of preferred livestock forage on meadows, soils there have been exposed to greater trampling compaction than soils in the forest sites, clay content notwithstanding. Similarly, the intensively managed sites of both meadow and forest habitats (Keeny-Clark and East Larch) had more grasshopper food items than their counterpart control sites (Flood and West Larch).

Assuming that management activities have an effect on diet available, some additional observations can be made. The diet of Keeny-Clark frogs contained a few food types, whereas that from Flood contained a greater variety in much smaller amounts. Also, the proportion of grasshoppers (Acrididae) and hover flies (Syrphidae) in the diet is much greater at the Keeny-Clark site. The intensive use and manipulation of Keeny-Clark may have led to a decrease in plant variability with corresponding increases in the proportion and number of a few insect species adapted for exploiting such conditions. The Flood site, with less past grazing use and current manipulation, has more luxuriant vegetation and a great variety of plants. Thus, stomach data indicate the resulting insect fauna is also varied, with no groups clearly dominating.

The differences in diets of frogs from the East and West Larch forest sites is more difficult to attribute, hypothetically, to specific management practices. In fact, differences in diet here may more clearly reflect natural site variability than differences caused by manipulation. West Larch, the control site, was an artificial pond fed by intermittent runoff in an otherwise dry, open savanna forest. Vegetation surrounding the pond was sparse. East Larch, on the other hand, was a natural pond along a mostly perennial watercourse. Surrounding vegetation was diverse and abundant. These site differences probably explain the greater variety and smaller amounts of invertebrate food items at East Larch than at West Larch.

The feeding habits described herein suggest that *pretiosa* is opportunistic in the taking of prey. That frogs consumed prey items usually shunned by insect predators when other items were available lends further support to this idea. Most noticeable among these prey were the water striders (Gerridae), taken at Flood; and the wasps, yellowjackets, and hornets (Vespidae), taken at West Larch. If the frogs are random samplers of the insects using a particular site, they can provide information on the changes in invertebrate, especially insect, populations brought about by man-made environmental changes.

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