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Call Characteristics of Several Anuran Species from East Kalimantan[1)]

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Abstract

Call characteristics of *Ansonia leptopus*, *Rana cancrivora*, *R. nicobariensis*, *R. hosei* and *Polypedates macrotis*, recorded in East Kalimantan, were analyzed with a sound spectrograph. Calls of *R. cancrivora* could be differentiated in relation to its behaviour and were assigned to the advertisement calls reported for the other Ranid species. Calls of *R. nicobariensis* were compared with the published data of *R. erythraea* calls, and likewise, calls of *P. macrotis* were compared with those of *P. leucomystax*. The call characteristics were found to significantly differ between these closely allied species.

The amphibian fauna of the Borneo island has been intensively investigated by Inger (1956, 1964, 1966), and is better known compared with other parts of the Southeast Asia. The region hitherto surveyed, however, is generally limited to Sarawak and Sabah, and far wider area of Kalimantan region has been scarcely investigated. Further, the studies hitherto made are either taxonomical or ecological ones and ethological studies have rarely been conducted. Taxonomical works hitherto made were generally based on morphological ground and another useful taxonomic apprcach, i. e. the analyses of mating call characteristics, has only once tried (Matsui 1982).

In the present paper, I will report the call characteristics of five anuran species from East Kalimantan.

Materials and Methods

Recordings of anuran calls were made during the Biological survey of East Kalimantan undertaken by the Kyoto University Botanical Party headed by Prof. K. Iwatsuki. The survey was conducted from June to August, 1981 at Tarakan (3°20′ N, 117°35′ E, about sea-level altitude) and around Long Bawan (3°55′ N, 115°42′ E, alt. 975 m). The details for the study area will be reported in the future publications. Recordings were made by a cassette tape recorder (Sony M-102) with an external microphone (Sony ECM-150). The recorded calls were analyzed by a sound spectrograph (Kay 7029 A). In the following descriptions of the call characteristics,

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parameter means are expressed with one standard error.

Results and Discussion

Ansonia leptopus

Recordings were made in mid July at Muruk River, alt. 1200 m, 15 Km WNW of Long Bawan, air temperature 18.5 C. Four calls from two males were analyzed.

The mating calls are divided into two types. The short call consists of a single short note (duration = .01 seconds), which is emitted 2.2 times per second.

Harmonics are partial and not evident. Dominant frequency is 2900–3000 ($\bar{X}$=2974) hz, and a less intensive frequency band is sometimes traced at 1800–2000 hz.

The long call sometimes follows the short calls (Fig. 1). It lasts .72–.74 ($\bar{X}$= .73± .007) seconds and consists of six to eight ($\bar{X}$=7.3± .7) notes. The notes are irregularly emitted and variable in duration (.01– .06, $\bar{X}$= .039± .001 seconds). Each note includes one to four ($\bar{X}$=2.4±.2) pulses.

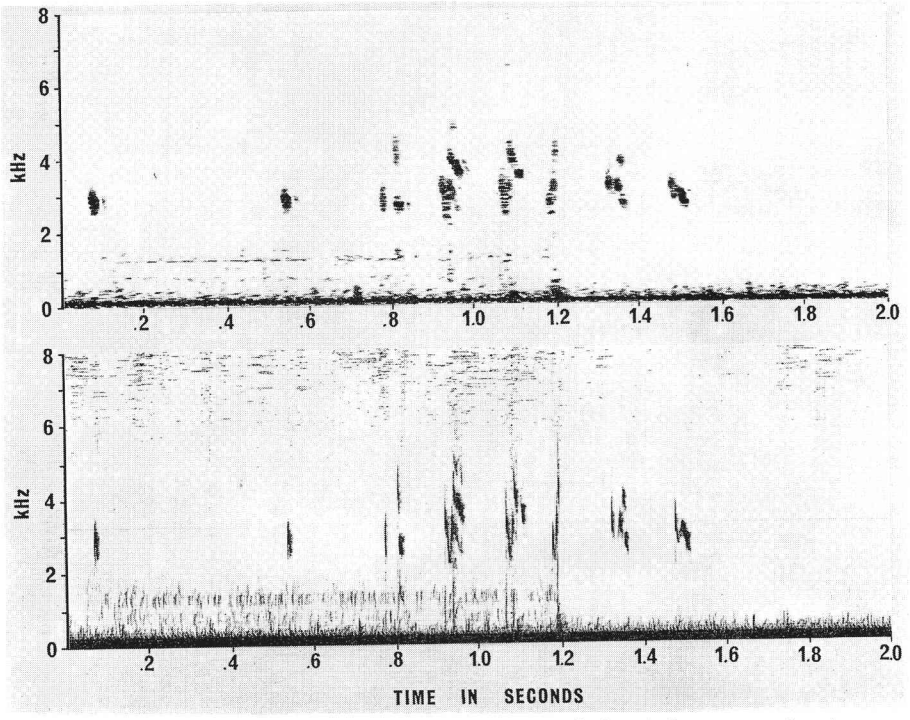

Fig. 1. Two successive short calls and a long call of *Ansonia leptopus*, analyzed with narrow (top) and wide (bottom) band filters.

The note basically has clear harmonics, and the fundamental frequency ranges about 1100 hz. Dominant frequency range varies within a call, and is lower in the notes at the beginning and at the end of the call; the average dominant frequency range is 2912 ± 12 hz, and is probably the third harmonic. In the notes of the middle portion of the call, the dominant frequency is 3933 ± 60 hz (probably the fourth harmonic), and evident frequency modulations are recognized within a note.

Rana cancrivora

Recordings were made in late June in the towns of Tarakan. The air temperature was 27 C. Ten calls from four males were analyzed.

The recorded calls included two different types. The short call (Fig. 2) lasts .19– .70 ($\bar{X} = .50 \pm .06$) seconds, and consists of regularly repeated three to 11 ($\bar{X} = 7.6 \pm .9$) notes. Each note lasts .03– .05 ($\bar{X} = .035 \pm .003$) seconds, and includes four to seven ($\bar{X} = 4.9 \pm .3$) pulses.

The dominant frequency ranges between 1900–2400 ($\bar{X} = 1993 \pm 63$) hz, and the second dominant frequency is found at 610–710 ($\bar{X} = 660 \pm 10$) hz.

The long calls (Fig. 3) are less frequently emitted than the short calls. It lasts 0.99–1.88 ($\bar{X} = 1.43$) seconds and includes three to six ($\bar{X} = 4.5$) notes. Each note lasts about .21 seconds. Sufficient analyses were impossible for determining the number of pulses included.

The dominant frequency is about 1775 hz, and the second dominant is about 579 hz. These frequency ranges are slightly lower than in the short call. The number of notes per second accounts for 3.1, and is far smaller than in the short call (15.3 per second).

Provisional observations on the breeding males of this species at Tarakan suggested the presence of territoriality. The short call mentioned above

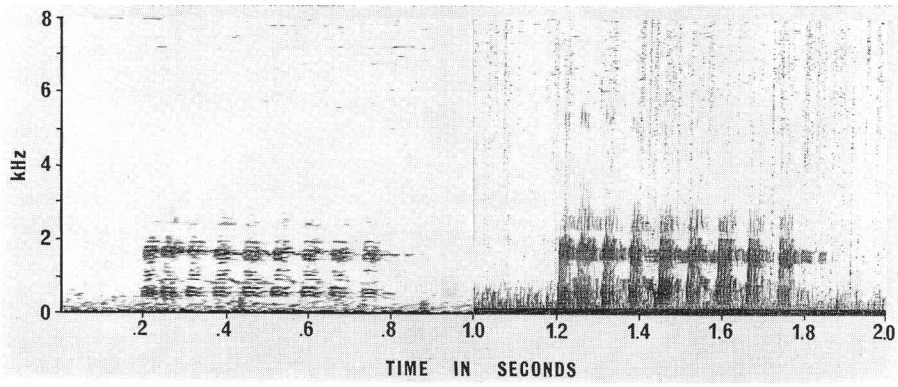

Fig. 2. A short call of *Rana cancrivora*, analyzed with narrow (left) and wide (right) band filters.

seems to correspond to the Type I advertisement call found in North American *Rana clamitans* (Wells 1978), and hence is regarded to be the so-called mating call. On the other hand, the long calls were found to be emitted when one male encountered another male, and are regarded to the Type II advertisement call of *Rana clamitans*.

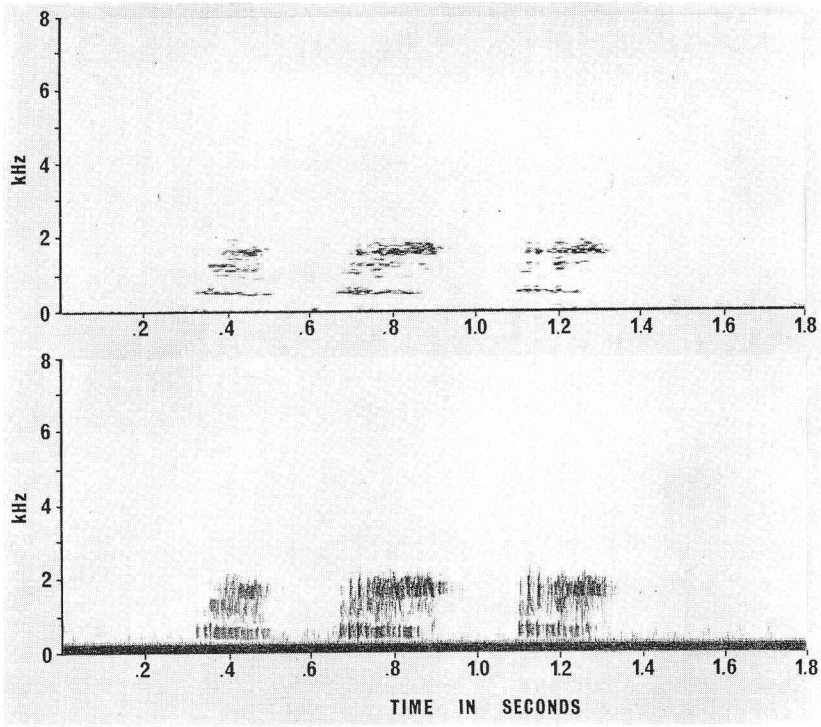

Fig. 3. A long call of *Rana cancrivora*, anlayzed with narrow (top) and wide (bottom) band filters.

Rana nicobariensis

Recordings were made in early July at Long Bawan and Long Api (a village about five km N of L. Bawan), air temperatures 22−23 C. Six calls from six males were analyzed.

The mating calls could be divided into two types (Fig. 4). The normal call lasts .60−1.02 ($\bar{X}$=.75± .07) seconds and consists of four to seven ($\bar{X}$ =5.2± .5) regular notes. Each note lasts .03− .05 ($\bar{X}$=.043± .006) seconds and consists of many fine pulses.

Harmonics are not clear, and the dominant frequency ranges between 2700− 3900 ($\bar{X}$=3210±29) hz. The second dominant frequency ranges between 650−1600 ($\bar{X}$=1240±53) hz.

The long call lasts about 1.6 seconds and consists of 13 notes. The

note duration (.028± .001 seconds) is shorter than in the normal call, whereas the dominant (2895± 29 hz) and the second dominant frequency (1037±9 hz) are lower than in the latter. Note repetition rate (8.0) tends to be larger than in the normal call (6.9± .1), but the sample number is inadequate for precise comparisons.

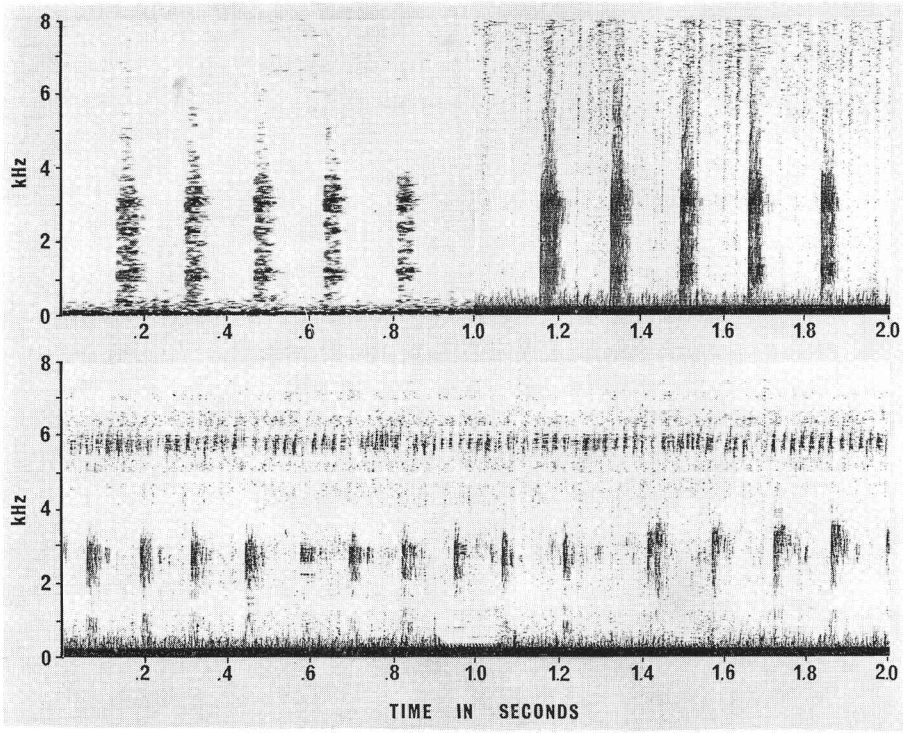

Fig. 4. Normal (top) and long (bottom) calls of *Rana nicobariensis*. The normal call was analyzed with narrow (left) and wide (right) band filters, while the long call was analyzed with a wide band filter. The background noise around 5700 hz in the bottom figure is the calls of grasshoppers.

The abovementioned call characteristics of *Rana nicobariensis* are generally similar to those obtained for morphologically related *R. erythraea* (Matsui 1982), but they differ in several temporal properties.

The comparable calls of *R. erythraea* were recorded at 26−27 C, and these values are 3−5 C higher than the air temperatures under which the calls of *R. nicobariensis* were recorded. Previous reports on the frogs and toads of other genera than *Rana* suggested that the increase in temperature results in the decrease in the dominant frequency range and call (or note) duration and increase in the note (or pulse) repetition rate (Blair 1958; Zweifel 1968; Schneider 1974; Kuramoto 1975; Nevo and Schneider 1976). Even if these assumptions were applied to the calls of *R. nicobariensis* and

R. erythraea, there still exist some differences between them.

The two species are almost similar in the properties in the frequency, but the call duration in the normal call of *nicobariensis* is shorter than the call of *erythraea*. The note length is longer and the number of notes per call is smaller in *nicobariensis*. Note repetition rate is also smaller in *nicobariensis*, but this tendency might be affected by the lower temperature conditions.

Around the village of Long Bawan, *R. nicobariensis* is the commonnest species, whereas *erythraea* is occasionally found. The clear differences in the call characteristics of these two species seem to be sufficient for preventing the possible interbreeding.

Rana hosei

Recordings were made in early July at Bawan River, near Long Api, at the air temperature of 22 C. Three calls from one male were analyzed, but the recorded tape included noises and sufficient analyses were unfortunately not possible. Some peculiarities of the calls of this species, however, were recognized.

The call consists of one or two notes. The call with one note lasts .07－.08 seconds, whereas when two notes are included, the second note immediately follows the first, and lasts .16－.17 seconds (Fig. 5). Thus, the call length, as a whole, lasts about .24 seconds.

The dominant frequency varies from one note to another, and is in the ranges between 3300－4500 hz. A sudden decrease in frequency sometimes occurs at the end of the note.

It is noteworthy that the calls of *R. hosei* from East Kalimantan fairly resemble those of *R. narina* from far distant Ryukyu Islands. The two species resemble with each other in the habitat and adult morphology, and might

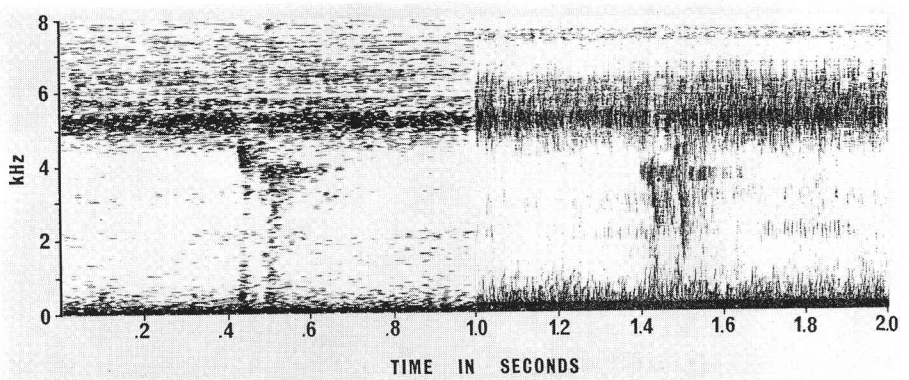

Fig. 5. Two mating calls of *Rana hosei*, analyzed with narrow (left) and wide (right) band filters. The background noises between 5000-7000 hz are the calls of crickets and grasshoppers.

have a close phylogenetic relationship.

Polypedates macrotis

Recordings were made in early July near the village of Long Api. The air temperature was 22 C. Three calls from two males were analyzed.

In contrast to Inger's (1966 : 319) saying, the calls of this species were weak and sometimes hardly distinguished among noisy calls of *Rana nicobariensis*. The mating calls are divided into main and short calls. The main call consists of one to three regular notes and lasts .10—.79 seconds. Each note lasts .09—.12 ($\bar{X}$ = .103± .004) seconds and consists of five to six ($\bar{X}$ =5.3± .2) clear pulses. The note repetition rate accounts for 2.9—3.1.

Clear harmonics are not recognized, and the emphasized frequency ranges between 400—1600 (Mid-point=1084±9) hz. Almost similarly intensive emphasized frequency ranges between 1500—2800 (Mid-point=2134± 13) hz.

The short calls are almost repeatedly emitted before and after main calls, and tend to form after calls (Fig. 6) as found in the related *P. leucomystax* from Sabah (Matsui 1982).

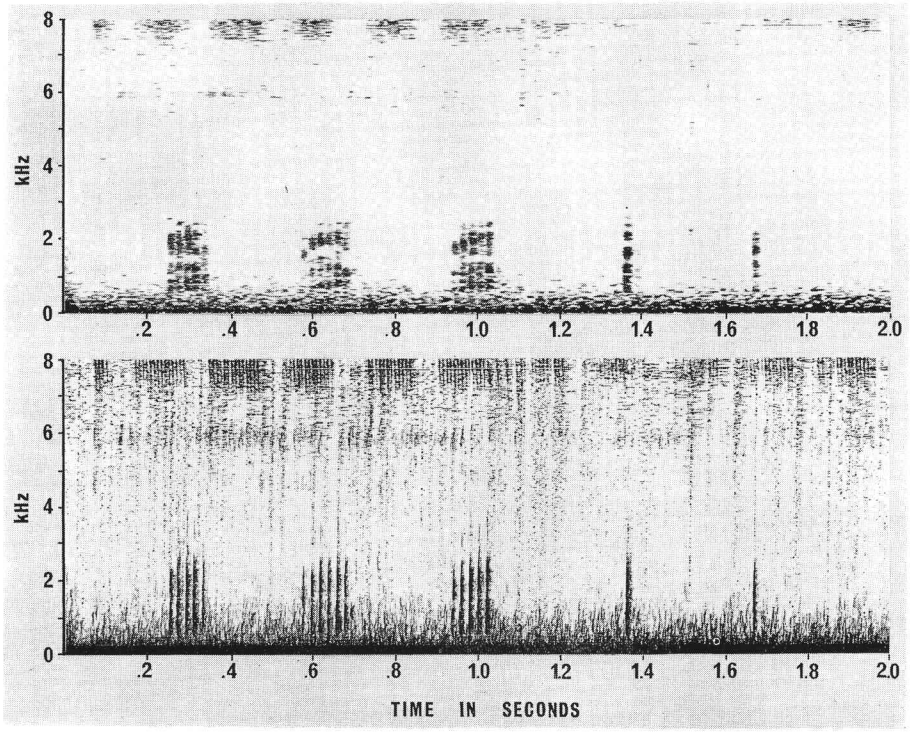

Fig. 6. A call group of *Polypedates macrotis*, analyzed with narrow (top) and wide (bottom) band filters. Three main notes and two short notes are shown.

Table 1. Comparison of characteristics of calls of five anuran species from East Kalimantan.

	N. of calls	Call Duration (sec)	Notes/call	Note Duration (sec)	Pulses/note	Dom. freq. (hz)	2nd dom. freq. (hz)
Ansonia leptopus							
mating call (short)	5	.01	1	.01	1	2974	1900
(long)	3	.73	7.3	.04	2.4	2912 or 3933	
Rana cancrivora							
mating call	15	.50	7.6	.04	4.9	1993	660
advertisement II	2	1.43	4.5	.21	?	1775	579
Rana nicobariensis							
mating call (normal)	6	.75	5.2	.04	?	3210	1240
(long)	1	1.60	13	.03	?	2895	1037
Rana hosei							
mating call	3	.08	1	.08	?	3300-4500	
		.24	2	.17			
Polypedates macrotis							
mating call (main)	3	.10-.79	1-3	.10	5.3	1084	2134
(short)	3	.005-.01	1	.005-.01	1	1200	1900

The short call consists of a single note with one pulse, and the duration is very short (.005—.01 seconds). The scund energy spreads over a wide frequency range from 400 to 2600 hz, and the emphasized frequencies are traced at about 1200 and 1900 hz.

Compared with the calls of the related *P. leucomystax* (Heyer 1971; Dubois 1976; Matsui 1982), the calls of this species most resemble the Thailand population of that species reported by Heyer (op. cit.). The number of pulses per note, however, is larger and the note duration is shorter than in the Thailand *leucomystax*. The presice comparisons are impossible since Heyer did not give temperature data, but from the general properties among parameters of anuran calls (Blair 1958; Zweifel 1968; Schneider 1974; Kuramoto 1975), relations between note duration and pulse per note mentioned above are regarded to actually differ between calls of *macrotis* from Kalimantan and those of *leucomystax* from Thailand.

From the calls of *leucomystax* from geographically adjacent Sabah (Matsui 1982), *macrotis* calls fairly differ in the number of pulses per note and dominant frequency of the main call, and in both the temporal and frequency properties of the after (short) calls. Thus, in spite of their close morphological and ecological similarities, the calls strongly suggest the two species being distinct at the specific rank as Inger (1966) proposed. The calls of *leucomystax* are suggested to differ geographically (Matsui 1982), and there is a possibility that the phenomenon of character displacement has taken place in the calls of Bornean *leucomystax* in relation to the calls of *macrotis*.

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Literature Cited

Blair, W. F. 1958. Mating call in the speciation of anuran amphibians, *Amer. Nat.* 92 : 27-51.

Dubois, A. 1976. Chants et écologie chez les amphibiens du Népal. *Colloq. Int. Centr. Nat. Rec. Sci.* 268 : 109-118.

Heyer, W. R. 1971. Mating calls of some frogs from Thailand. *Fieldiana : Zool.* 58 : 61-82.

Inger, R. F. 1956. Some amphibians from the lowlands of North Borneo. *Ibid.* 34 : 389-424.

———. 1964. Two new species of frogs from Borneo. *Ibid.* 44 : 151-159.

———. 1966. The systematics and zoogeography of the amphibia of Borneo. *Ibid.* 52 : 1-402.

Kuramoto, M. 1975. Mating calls of Japanese tree frogs (Rhacophoridae). *Bull. Fukuoka Univ. Educ.*, Pt. iii, 24 : 67-77.

Matsui, M. 1982. Amphibians from Sabah II. Acoustic characteristics of three common anuran species. *Contrib. Biol. Lab. Kyoto Univ.* 26 : 123-129.

Nevo, E. and H. Schneider. 1976. Mating call pattern of green toads in Israel and its ecological correlate. *J. Zool., Lond.* 178 : 133-145.

Schneider, H. 1974. Structure of the mating calls and relationships of the European tree frogs (Hylidae-Anura). *Oecologia* 14 : 99-110.

Wells, K. D. 1978. Territoriality in the green frog (*Rana clamitans*) : vocalizations and agonistic behaviour. *Anim. behav.* 26 : 1051-1063.

Zweifel, R. G. 1968. Effects of temperature, body size, and hybridization on mating calls of toads, *Bufo a. americanus* and *Bufo woodhousei fowleri*. *Copeia* 1968 : 269-285.

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