

## ARTICLES

### SEASONAL ACTIVITY, REPRODUCTIVE CYCLES, AND GROWTH OF THE BRONZE FROG (*LITHOBATES CLAMITANS CLAMITANS*) IN NORTHERN LOUISIANA: THE LONG AND SHORT OF IT

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*Abstract:* We examined the seasonal activity, reproduction, and growth of the Bronze Frog (*Lithobates clamitans clamitans*) from northern Louisiana using 404 museum specimens, calling data, and mark-recapture data. We found longer activity and breeding seasons and earlier ages to sexual maturity than have been reported for northern populations of the Green Frog (*L. c. melanotus*). We also found smaller body sizes at larval transformation and among sexually mature individuals than northern populations, which corroborated earlier findings of this southern form. Our findings underscored the importance of region-specific life history data for species management and also identified biologically meaningful differences in this southern form of a geographically widespread polytypic species.

#### Introduction

The Bronze Frog, *Lithobates clamitans clamitans* (Latreille, 1801), is one of two recognized subspecies of the eastern North American Bronze Frog, *L. clamitans* (Latreille, 1801). Occurring in the Southeast, the Bronze Frog intergrades with the Green Frog, *L. c. melanotus* (Rafinesque, 1820) along the fall line in Georgia and Alabama. The Green Frog, in turn, replaces the Bronze Frog northward to southeastern Canada (Conant and Collins, 1998; Pauley and Lannoo, 2005). Less attention has been paid to the Bronze Frog in the literature than its nearest relative despite the ubiquity of this species in generally lentic aquatic systems in the South. We undertook this study to test earlier findings of small body size

of metamorphoslings (Wright and Wright, 1949) and adults (Wright and Wright, 1949; Mecham, 1954) of the Bronze Frog and to compare activity, reproduction, and growth of this form with northern populations of *L. c. melanotus*, whose seasonal activity is curtailed by the constraints of a north temperate climate.

#### Materials and Methods

Specimens (n = 404) of Bronze Frogs (*Lithobates clamitans clamitans*) collected during 1925-2001 from northern Louisiana (Figure 1) were examined from the holdings of the Carnegie Museum of Natural History, Illinois Natural History Survey, Louisiana State University, Northwestern State University, Tulane University, University of Colorado, Field Museum of Natural History,

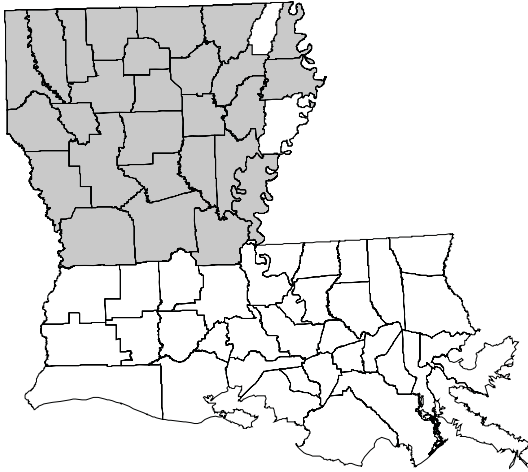


Figure 1. Louisiana parishes from which museum specimens of Bronze Frogs (*Lithobates c. clamitans*) were examined in this study.

ry, University of Kansas, and University of Oklahoma. Body lengths of all size-classes and of tadpoles were measured in mm snout-vent length (mm SVL).

Sexual maturity was determined in males using a slightly modified version of the technique by Martof (1956a), whereby the ratio of tympanum diameter: body size corresponded to enlarged testis, which signified sexual maturity. Martof (1956a) noted that the tympana generally were “nearly or quite round.” For most frogs, Martof (1956a) measured the antero-posterior diameter of the left tympanum. If irregular in shape, the right tympanum was measured. If both were misshapen, Martof (1956a) took the average of the antero-posterior and dorso-ventral measurements. Irregularly shaped tympana from our sample were greater in length than in height. For consistency, we measured the dorso-ventral diameter of the left tympanum and used the right tympanum only if the left one appeared to have been damaged in some way. As per Martof (1956a), sex index = body length/ tympanum diameter. The sex index was generally below 10 for sexually mature males (Martof, 1956a).

Another secondary sexual characteristic, enlarged thumbs, was not easily ascertained. The yellow throat of mature males, which easily fades to varying degrees in preservative, was not apparent. The length and width of the left testis as a percent of the body size was used to measure seasonal differences in testis dimensions.

Sexually mature females were associated with one of four ovarian stages. In the first ovarian stage oviducts were thin and just beginning to coil, and the ovaries are somewhat opaque. In the second ovarian stage, the oviducts were larger and more coiled, and the ovaries contained some pigmented oocytes. In

the third ovarian stage, oviducts were thick and heavily coiled, and the ovaries were in various stages of clutch development. In the fourth ovarian stage, oviducts were thick and heavily coiled, and the ovaries were full of polarized ova with few non-polarized ova, signifying a fully ripened clutch or gravid female (Meshaka, 2001). Fat body development was scored as absent, intermediate in volume in the body cavity, or extensive development that extended antero-posteriorly in the body cavity. The latter amount was used as an estimation of the monthly incidence of adult females containing extensive fat reserves. A subset of females was examined for clutch characteristics. Clutches were removed, patted on paper towel to remove excess moisture, a subset of ova was weighed on an electronic scale, and that mass was extrapolated to estimate clutch size. From each clutch, the diameters of 10 ova were measured using an ocular micrometer; the largest ovum was used in comparative relationships with clutch size and female body size.

Tadpoles were scored as per Gosner (1960). For practical purposes, tadpoles were in categories of having poorly developed hind legs (less than Gosner stage 37) or well-developed hind legs (Gosner stage of at least 37). Metamorphosing were distinguished from tadpoles by the presence of forelimbs (Gosner stage 42) and distinguished from juveniles by the presence of a tail. Means were followed by +2 standard deviations, and significance was recognized at  $P < 0.05$ .

Data from the Louisiana Amphibian Monitoring Program at Cotton Valley route, Webster Parish, during 1998–2008 and the Koran route, Bossier Parish, during 1998–2006 were used to determine calling season in the northwestern region of Louisiana. The NAAMP protocols dictate three runs per year during three sampling windows of six weeks each. The north Louisiana windows began on 27 January and ended 7 July. Unpublished data were collected on movements of Bronze Frogs to, from, and within a breeding pond at the Walter B. Jacobs Memorial Nature Park in Caddo Parish during November 1979–August 1984. Methodology, detailed by Raymond and Hardy (1990) in their demographic study of the Mole Salamander (*Ambystoma talpoideum*), made use of funnel traps along a drift fence that encircled the pond to capture incoming and outgoing frogs as well as movements within the pond using minnow traps located in the pond itself. We used those data to determine the extent of the egg-laying season.

## Results

Seasonal activity.— Bronze Frogs from northern Louisiana were collected in every month of the year

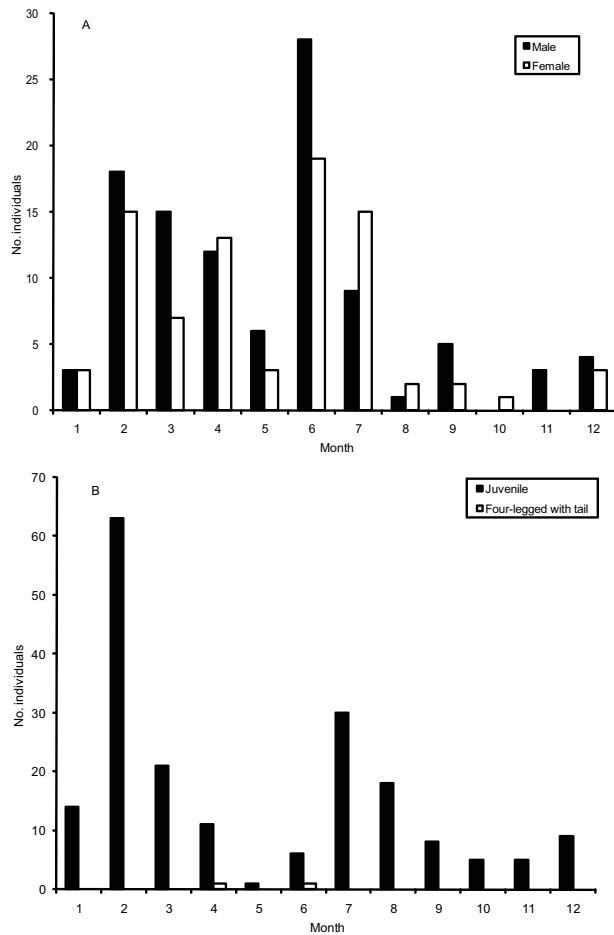


Figure 2. Seasonal incidence of captures of 380 Bronze Frogs (*Lithobates c. clamitans*) from northern Louisiana. A = adults, B = juveniles and metamorphoslings.

(Figure 2). The highest incidence of captures occurred during February–July and was followed by a rapid decline thereafter (Figure 2). However, within the February–July interval, a noticeable decrease occurred in captures of adults (Figure 2A). In the case of juveniles, February and July peaks in captures were followed by decreases thereafter (Figure 2B), perhaps relating to winter-spring emergence of overwintering tadpoles followed by summer-fall emergence of young produced from that same year’s clutches.

Movements of adult Bronze Frogs to and from a breeding pond were monitored for five years at the Walter B. Jacobs Memorial Nature Park in Caddo Parish of northwestern Louisiana. During this period, movements to the pond occurred during 12 April–3 September, with most movements during May–July. In turn, movements from the pond occurred during 3 May–18 September. Bronze Frogs were captured in minnow traps during 10 May–8 September.

Seasonal changes in testis size.— Measured as a percentage of male Bronze Frog body size, both

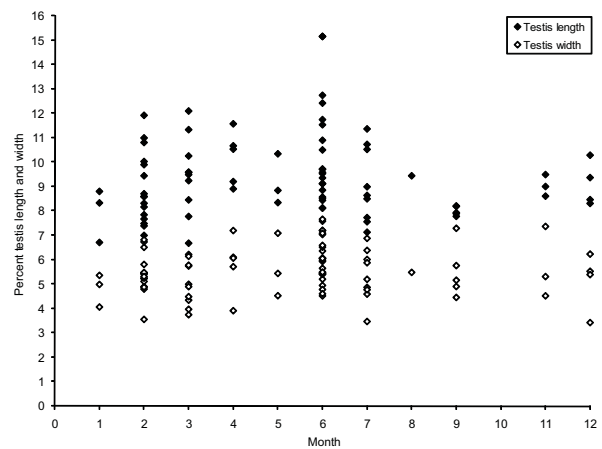


Figure 3. Monthly distribution of testis size of 82 Bronze Frogs (*Lithobates c. clamitans*) from northern Louisiana.

testis length and width were largest in June (Figure 3). More noticeable in the testis length, testis size decreased rapidly thereafter until fall at which time testis size began to increase once again into the following summer (Figure 3).

Calling.— Systematic calling surveys for Bronze Frogs were conducted from 27 January–7 July in Bossier Parish (1998–2006) and in the adjoining Webster Parish (1998–2008) in extreme northwestern Louisiana. At both sites, calling was heard during April–July (Figure 4). However, in Bossier Parish, three calling records were from March (Figure 4), the earliest of which was 2 March 2005.

Ovarian cycle.— Gravid (stage 4) or yolking-nearly gravid (stage 3) female Bronze Frogs were evident during February–September (Figure 5). During this period, the incidence of quiescent (stage 1) females decreased concomitant with an increase in the inci-

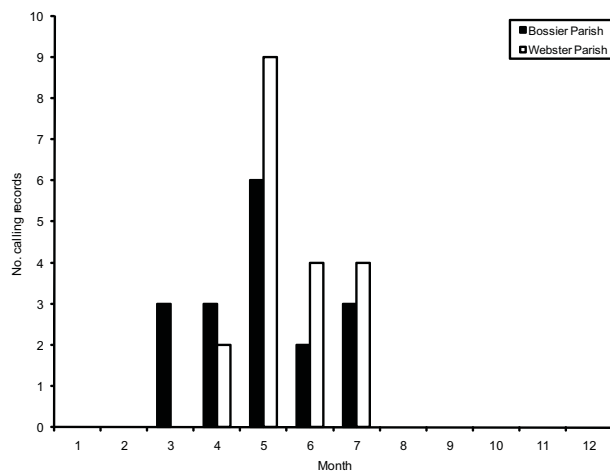


Figure 4. Monthly distribution of calls of male Bronze Frogs (*Lithobates c. clamitans*) from two sites in northwestern Louisiana.

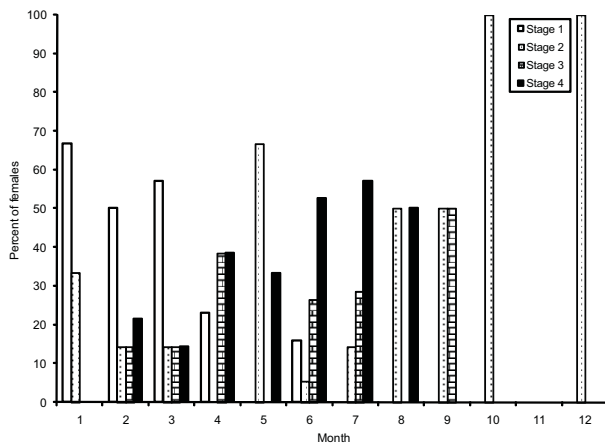


Figure 5. The annual ovarian cycle of 81 Bronze Frogs (*Lithobates c. clamitans*) from northern Louisiana.

dence of gravid females, with the highest incidence of gravid females having been found during June–August (Figure 5). Too few females were available in October ( $n = 1$ ), November ( $n = 0$ ), December ( $n = 3$ ), and January ( $n = 3$ ) to determine the full extent of the gravid season, although in light of the ovarian stages in September, it seemed likely that gravid females would have been present in September. Stage II females were present in each of the 11 months for which we had captures (Figure 5).

Female fat cycle and the presence of food.— The extent to which fat bodies were well-developed in female Bronze Frogs varied across the months, whereby winter stores of fat were gradually depleted in early summer (Figure 6). It was during this time that the highest numbers of gravid females began to appear (Figure 5). In turn, more gravid females were

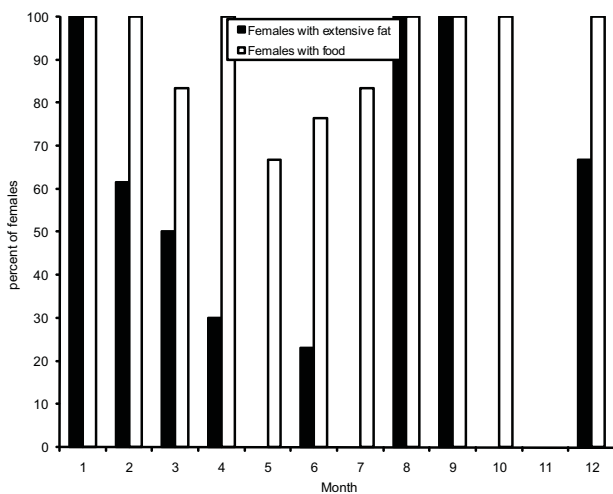


Figure 6. Monthly frequency of extensive fat ( $n = 65$ ) and the presence of food ( $n = 61$ ) in female Bronze Frogs (*Lithobates c. clamitans*) from northern Louisiana.

depleted of their fat compared to their non-gravid counterparts (Figure 7).

The incidence of Bronze Frog females containing food in their stomachs was relatively high through the year (Figure 6). May and June showed the lowest incidence of female stomachs containing food, perhaps having been a response to the enormity of body cavity space taken up by clutches. In that regard, the lowest incidence of stomachs containing food among females occurred in gravid individuals (Figure 7).

Clutch characteristics.— Mean clutch size of the Bronze Frog from northern Louisiana was estimated

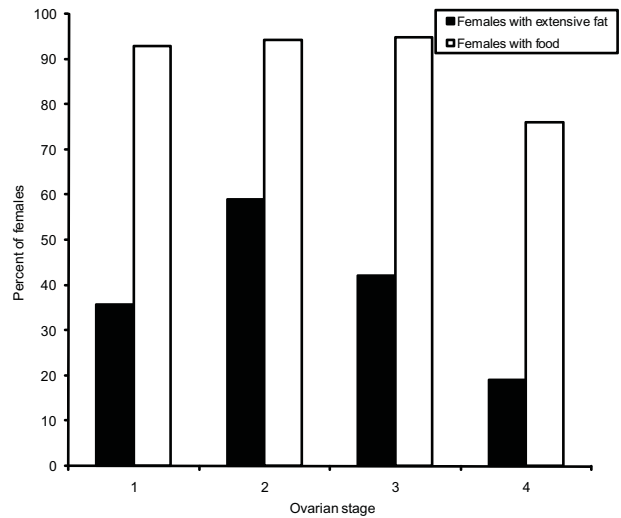


Figure 7. Frequency of extensive fat ( $n = 71$ ) and the presence of food ( $n = 75$ ) in each of the four ovarian stages of female Bronze Frogs (*Lithobates c. clamitans*) from northern Louisiana.

to be  $2550 \pm 873$  eggs (range = 1600–4200;  $n = 9$ ). Mean ovum diameter from these clutches measured  $1.68 \pm 0.15$ ; range = 1.3–2.0;  $n = 90$ ). In northern Louisiana, clutch size positively co-varied with female body size (mean =  $76.0 \pm 4.7$  mm SVL; range = 66.7–82.1;  $n = 9$ ; Figure 8); however, no significant association ( $P > 0.05$ ) was detected between ovum diameter and female body size or with clutch size.

Growth and sexual maturity.— The length of the larval period for Bronze Frogs in northern Louisiana could only be estimated for summer by examination of size class-distributions of the tadpoles in July and August (Figure 9). We assumed that the smallest individual (4 mm SVL) captured on 27 July had hatched that month. The four individuals captured on 4 August (8.9–14.2 mm SVL) were thought to represent the next month's growth. The largest tadpole of that month measured 21.4 mm SVL and had well-developed hind legs. It was also captured on 4 August and probably represented a separate size-class, such that

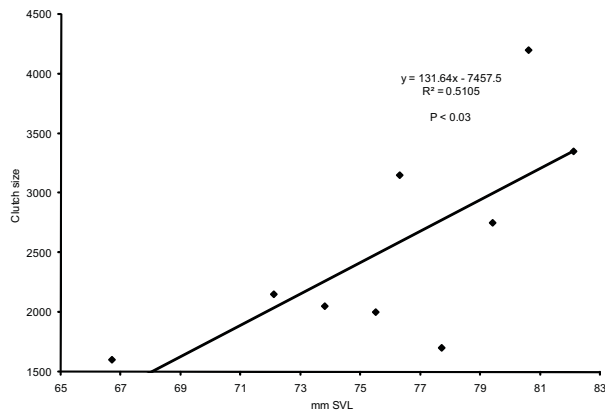


Figure 8. The relationship between clutch size and body size in mm SVL of nine female Bronze Frogs (*Lithobates c. clamitans*) from northern Louisiana.

a tadpole born in late July would have transformed sometime in September.

The monthly distribution of Bronze Frog body sizes from northern Louisiana was indicative of an extended, if not continuous, annual production of metamorphoslings (Figure 9). Captures of metamorphoslings from the pond at the Walter B. Jacobs Memorial Nature Park occurred during 23 May 1980–1 November 1981. A very small juvenile was also trapped on 20 November 1982.

Bronze Frog body size at transformation was small. Two metamorphoslings with tails measured 21.2 and 32.4 mm SVL, and the smallest juvenile measured 19.0 mm SVL (Figure 9). For 104 individuals with 19.0–32.4 mm SVL, mean body size was  $27.3 \pm 3.07$  mm SVL. From these data, growth trajectories from the monthly distribution of body size indicated that male Bronze Frogs reached sexual maturity in three months of post-metamorphic age at 40.7 mm SVL (Figure 9). Five months beyond reaching sexual maturity, males attained their mean body size of  $61.0 \pm 10.1$

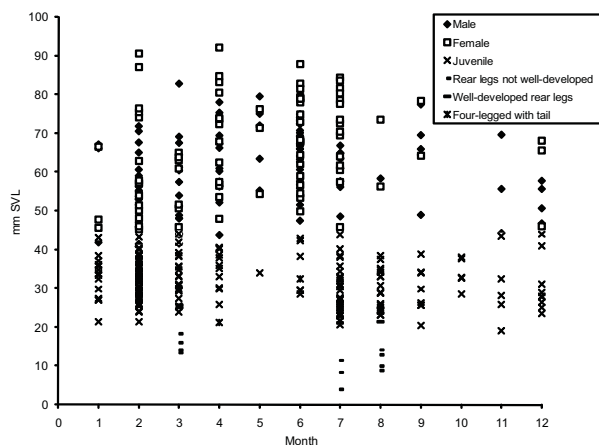


Figure 9. Monthly distribution of body sizes of 404 Bronze Frogs (*Lithobates c. clamitans*) from northern Louisiana.

mm SVL (range = 40.7–82.8;  $n = 106$ ).

Mean sex index (body length/tympanum) for 106 male Bronze Frogs was  $7.8 \pm 0.97$  mm (range = 6.1–10.4). Values exceeding 10 were found in two males: 47.0 mm SVL (10.4), 59 mm SVL (10.2). The sex index negatively co-varied with male body size (Figure 10) because tympanum diameter, which co-varied with the body size of adult males (Figure 11), was relatively larger in large males.

Female Bronze Frogs from northern Louisiana

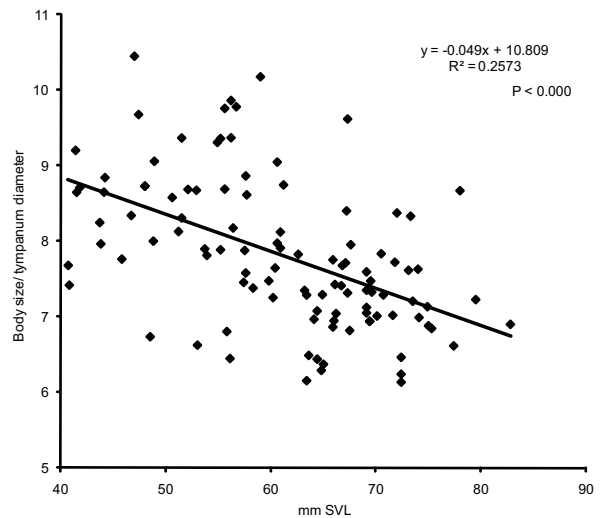


Figure 10. The relationship between sex index and body size of 106 male Bronze Frogs (*Lithobates c. clamitans*) from northern Louisiana.

reached sexual maturity in as few as four months after metamorphosis at 45.5 mm SVL ( $n = 21$ ; ovarian stage I) or 45.2 mm SVL ( $n = 17$ ; ovarian stage II; Figure 9). The smallest females bearing substantial clutch development (ovarian stage III) reached sexual maturity at seven months after metamorphosis at 56.7 mm SVL ( $n = 20$ ; Figure 9). The smallest gravid females (ovarian stage IV) reached sexual maturity at eight months after metamorphosis at 60.1 mm SVL ( $n = 20$ ; Figure 9). Mean body size for all sexually mature females was reached at approximately 10 months after metamorphosis at  $66.4 \pm 12.3$  mm SVL ( $n = 87$ ) and was significantly larger than that of males ( $F = 0.668$ ;  $P < 0.02$ ;  $T = -3.276$ ;  $df = 165$ ;  $P < 0.001$ ). Gravid females ( $77.4 \pm 7.3$  mm SVL; range = 60.6–87.9;  $n = 29$ ) were significantly larger ( $F = 0.325$ ;  $P < 0.001$ ;  $T = 4.825$ ;  $df = 83$ ;  $P < 0.000$ ) than all other females of a combined sample ( $62.9 \pm 12.9$  mm SVL; range = 45.2–92.2;  $n = 58$ ).

## Discussion

The Bronze Frog is a geographically variable species within which two subspecies are recognized; the

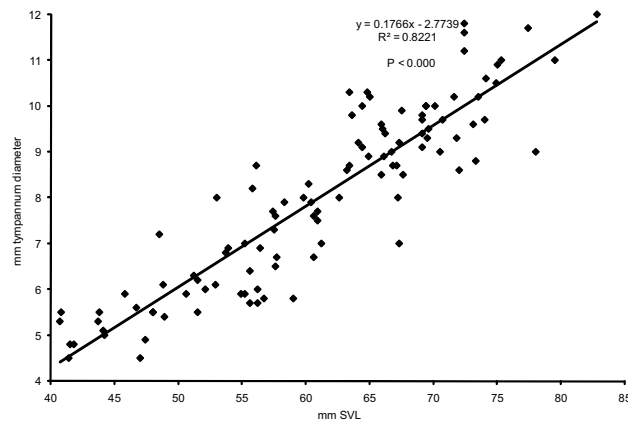


Figure 11. The relationship between tympanum diameter and body size of 106 male Bronze Frogs (*Lithobates c. clamitans*) from northern Louisiana.

Bronze Frog and the Green Frog (Conant and Collins, 1998). Besides differences in color pattern (Mecham, 1954), body size differences are apparent between the two forms with the southern nominate form being smaller in body size than its larger northern relative (Wright and Wright, 1949; Mecham, 1954). Body size at transformation was also shown to be smaller in southern populations (Wright and Wright, 1949).

Our study provided life history data on the lesser studied southern subspecies (*Lithobates clamitans clamitans*) in comparison to the northern race (*L. c. melanotus*). Compared to the northern race, the activity versus maturation and body sizes of our southern sample (from north Louisiana) provided the long and short of it, respectively (Table 1, 2). Continuous activity of the southern sample contrasted with shorter active seasons of the northern sample (Table 1). In the north, *L. c. melanotus* was reported to breed from the end of May to mid-August, whereas southern populations were described as late breeders (Wright and Wright, 1949). Pauley and Lannoo (2005) corroborated the presence of latitudinal differences in an otherwise extended breeding season in *L. c. melanotus*. To that end, breeding seasons were shorter in the north than in the south (Table 2). In Louisiana, calling was heard during mid-March–early September (Table 1; Dundee and Rossman, 1989), and eggs and/or tadpoles were to be expected throughout the year (Dundee and Rossman, 1989). Enlarged testes as early as February and the presence of gravid females for at least seven months, and probably eight months, having peaked during April–August, were both suggestive of a longer opportunity to reproduce than northern populations. In northwestern Louisiana, males were heard calling during March–July, and movements by adults to the Caddo Parish pond began in April and all subsequent movements ended in September. These two measures of reproductive

activity were indicative of a March–September breeding season, which was longer than those reported for northern populations (Table 2).

Data on clutch characteristics are rare for both the Bronze Frog and Green Frog. The mean and maximum values clutch size estimates from northern Louisiana were smaller than the 4924 eggs (73.8 mm SVL) and 5730 eggs (72.7 mm SVL) reported for this form from Arkansas (Trauth et al., 2004). Our conclusions are limited on this matter; however, the mean value of female body size from which we calculated clutch size was large, and females of similar body sizes than those measured by Trauth et al. (2004) contained much smaller clutches. In Michigan, Martof (1956b) estimated clutch size (3800, 4100, 4300 eggs) for three females of unreported body size. Thus, it remains unknown if per unit body size Bronze Frogs from northern Louisiana produced smaller clutches than northern populations of the Green Frog. However, the strong relationship between clutch size and female body size and overall smaller female body size of our sample are suggestive of clutch size reduction in the southern population. We also do not know if seasonal differences in clutch size were apparent in our sample, whose first clutches would have had the benefit of being produced in large part from fat reserve.

Table 2. Geographic variation in breeding seasons of the Bronze Frog (*Lithobates c. clamitans*) in the United States arranged from the south (top) to the north (bottom).

Location	Breeding Season
Florida (Carr, 1940) .....	April–August
Northern Louisiana (this study).....	March–September
Louisiana (Dundee and Rossman, 1989).....	March–September
Alabama (Mount, 1975).....	April–September
Georgia (Wright, 1931) .....	April–August (call)
Georgia (Wright, 1931) .....	June–August (eggs)
Kansas (Collins, 1993) .....	April–June
Missouri (Johnson, 1987) .....	April–August
Kentucky (Barbour, 1971).....	May–August
West Virginia, south (Pauley and Barron, 1995).....	April–July
West Virginia, north (Rogers, 1999) .....	June–August
Maryland (Lee, 1973) .....	May–July
Delaware (Lee, 1973).....	May–July
Illinois (Smith, 1961).....	May–September
Indiana (Minton, 2001).....	May–July
Ohio (Walker, 1946).....	May–July
Pennsylvania (Hulse et al., 2001).....	April–August
Michigan (Martof, 1956b).....	May–August
Minnesota (Breckenridge, 1944) .....	May–August
Southern New England (Klemens, 1993) .....	May–July
Maine (Hunter et al., 1992, 1999).....	May–August

Table 1. Geographic variation in life history traits of the Bronze Frog (*Lithobates c. clamitans*) in the United States.

Parameters	Northern La (this study)	Louisiana Dundee & Rossman 1989	Georgia Wright 1931	S. New England Klemens 1993	Indiana Minton 2001	Michigan Martof 1956a,b	Penn Hulse et al. 2001
Active season	Continuous		Apr (?) –Sept (?)	Mar–Nov	6 Mar –2 Dec	last wk Mar– first half Nov	Mar–Oct/ early Nov
Breeding season	Feb–Sep	mid-Mar –early Sep	Apr–Aug call 2 Jun–10 Aug eggs	May–Jul	mid-May –most of Jul	mid-May –mid-Jul	Apr–Aug
Male age at sexual maturity since metamorphosis	3 months	–	2 years	–	–	1 year	1 year
Female age at sexual maturity since metamorphosis	4 months	–	2 years	–	–	1 year	1 year
Meta-morphosing mean and range of body size in mm SVL	27.3 (19.0–32.4)	–	25 (20–23)	–	–	32.6 (28.4–36.3)	–
Male mean and range of adult body size in mm SVL	61.0 (40.7–82.8)	–	52–72	68.8 (52–84)	72 (60.0–84.5)	79.8 (60–103)	86.1 (60–95)
Female mean and range of adult body size in mm SVL	66.4 (45.4–92.2)	–	58–75	64.8 (52–94)	76.3 (64–88)	80.3 (65.7–105)	85.5 (70–94)

The length of the larval period of north Louisiana Bronze Frogs could only be roughly estimated from our data. The smallest size-class in July followed by two separate and larger size classes in August were suggestive of a summer larval period that barely extended beyond two months. This estimation is near the lower end of a 70–85 day larval period of tadpoles of early-breeding Green Frogs in a Michigan population (Martof, 1956a). Dundee and Rossman (1989) considered that range to be plausible in Louisiana and also thought that tadpoles might over-winter. We do not know if Bronze Frog tadpoles over-wintered in northern Louisiana. One explanation of the initial movements to the pond (12 April 1980) and the first metamorphosing juvenile captured at the pond (23 May 1980) is that larval periods could actually have been as short as 41 days. Alternatively, this metamor-

phosing juvenile could have been the product of the previous year's clutch at least as late as September, which would yield an eight month larval period, shorter than the 335–360 larval period experienced by tadpoles of late-breeding Green Frogs in Michigan (Martof, 1956a). The capture of a small individual with no tail on 20 November 1982 could have been produced from a September clutch or one earlier than that. Mark-recapture will be needed to discern if the ca. 21 mm SVL juveniles and metamorphoslings collected during winter-spring represented delayed emergence (over-wintering) or simply less growth after the larval period.

Regardless of whether or not Bronze Frogs in northern Louisiana over-winter as tadpoles, larval transformation of the Bronze Frog in this region occurred during more months of the year than in north-

ern populations of the Green Frog. For example, in northern Louisiana, metamorphosing juveniles were apparent throughout the year and captured during May–November, and in the Okefinokee Swamp of southeastern Georgia larval transformation occurred during April–September (Wright, 1931). In Michigan, early clutches produced metamorphosing juveniles during 3 August–28 September, whereas clutches laid after about 25 June–10 July did not transform until the following dates of 5 June–12 July (Martof, 1956a)

Body sizes of metamorphosing Bronze Frog juveniles, like those from southeastern Georgia, were smaller than those from Michigan (Table 1). Likewise, the post-metamorphic age at which northern Louisiana Bronze Frogs reached sexual maturity was shorter than northern populations (Table 1). Excluding winter, both sexes of Michigan Green Frogs required nearly nine growing months to reach sexual maturity as compared to the three (males) and four (females) months necessary for continuously active northern Louisiana Bronze Frogs. Recently-matured Bronze Frogs from northern Louisiana could have then begun breeding within the same season, whereas Green Frogs from Michigan generally became sexually active the following year (Martof, 1956a). In Ithaca, New York, Green Frogs that transformed by late June at ca. 31 mm SVL or larger were capable of breeding one year later, whereas those transforming after late June or at smaller body sizes were sexually mature one year later but had to wait until the season after that for an opportunity to reproduce (Ryan, 1953).

Interestingly, the time needed for the Bronze Frog to reach sexual maturity in southeastern Georgia was twice that of Michigan (Table 1). In light of the other similarities between Wright's (1931) finding and ours, we wonder if perhaps a larger sample from the Okefinokee would provide a sufficient test of what appears to be an unusually long delay to maturity.

For both sexes of the Bronze Frog in northern Louisiana, small metamorphosing juveniles quickly grew to reach sexual maturity at body sizes that were smaller than those of northern populations (Table 1). Among females, this finding held true even in comparing the smallest yolking female and gravid female from northern Louisiana to the smallest gravid female (65.7 mm SVL) in Michigan (Martof, 1956a). Martof (1956a) thought that females probably reached sexual maturity at sizes similar to males (58.6 mm SVL) but required more time for their gametes to ripen. Exceptionally, the smallest adult female examined by Wright (1931) was larger than that of a southern New England sample measured by Klemens (1993) (Table 1).

Subsequent growth of either sex of Bronze Frogs from northern Louisiana occurred quickly to mean

body sizes that were smaller than those of northern populations. In all but one case, the maximum body size attained in northern Louisiana was smaller than that reported in northern populations (Table 1). Maximum values reported for southeastern Georgia were smaller than for all other reported values (Table 1).

Between sexes of adults from northern Louisiana, male Bronze Frogs were smaller in minimum, maximum, and mean body size than females. Elsewhere, males were also sexually mature at smaller body sizes than females, but, with the exception of southern New England (Klemens, 1993), mean and adult body sizes were similar between the sexes (Table 1). Across sites, females tended to reach larger maximum body sizes than males (Table 1).

As in a Michigan population (Martof, 1956a), adult male Bronze Frogs from northern Louisiana could be identified by a sex index (male body size/male tympanum diameter) value that was generally below 10. In Michigan, the mean sex index was 8.3 (range = 6.7–10.2) for all males, and was 7.7 for males at breeding ponds (Martof, 1956a). The sex index from our sample closely approximated that of Martof's (1956a) value for breeding pond males. Also, like Martof (1956a), we found that although tympanum size increased with male body size, it did so at a rate that was disproportionate to the body size of the male. Consequently, the sex index was smallest among the largest males because the tympanum was relatively larger in large males than in small males.

The similarity of sex indices between our sample and that from Michigan (Martof, 1956a), was likely due either to a disproportional number of large males in our series or a significant difference in the y-intercepts of the tympanum diameter-body size relationship between northern Louisiana and Michigan.

Our results corroborated observed trends of a later (Wright and Wright, 1949) and longer (Dundee and Rossman, 1989) breeding season and in reduced body size of adults (Wright and Wright, 1949; Mecham, 1954) and metamorphosings (Wright and Wright, 1949) in the southern form. To these findings we add longer activity and larval transformation seasons, and shorter age to sexual maturity and first breeding. Such is the long and short of it. These biologically meaningful differences in life history traits are useful in species management plans with respect to productivity and are useful in evaluating the variation associated with geographically widespread species which, in this case, is a regionally distinct form with distinctive life history traits.

*Acknowledgments:* This study would not have been possible without the commitment of the aforementioned institutions to collect and preserve amphib-

ians, turtles, and reptiles or without the willingness and time taken by institutional staff to pack and ship these specimens for study. To that end, we wish to especially extend our gratitude to Harold A. Dundee for his single-handed efforts in packing and shipping an enormous lot of Bronze Frogs from the Tulane University collection.

In addition, on 8 July 2004 one of the authors (WEM) made the first email research request ever sent out by *The Center for North American Herpetology*. It asked for information on the life history traits of *Lithobates clamitans*. The response was overwhelming and because of the tremendous amount of data received through that CNAH request, this paper is the first of hopefully many that will address the biology of this fascinating frog.

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