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# ANNUAL CYCLE IN LIVER WEIGHT OF MARSH FROG *RANA RIDIBUNDA* PALLAS, 1771

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## ABSTRACT

The dry weight of the liver of *Rana ridibunda* was expressed as percentage of the dry weight of the body. The female liver weight always exceeds that of the male, except in July and September. The difference between males and females for the whole year, regardless of months, was not significant. Livers of both sexes were relatively large prior to hibernation (December), decreased during hibernation (January and February) until a minimum weight in March (post-hibernation).

The increase of liver weight during December is apparently simply to meet the metabolic requirements for survival during hibernation. The percent reduction in liver weight during hibernation was 1.081% in males and 1.356% in females. The decrease in liver weight during the hibernation months may be attributed to the utilization of liver glycogen. The rise in mean weight from August to October indicates that marsh frogs, after spawning, were actively feeding.

## INTRODUCTION

The liver in amphibia represents an important organ, which stores depot substances. Many workers have noted seasonal changes which occur in the liver of the frog. According to Smith (1950), the first report on the occurrence of marked seasonal changes in glycogen contents of frogs was in 1899. The literature provides several works concerning the seasonal changes of liver weight (Maruyama, 1979; Morton, 1981), liver metabolism (Schlaghecke and Blum, 1978), lipid composition and protein content of the liver (Milone *et al*., 1978, 1983), and cyclic changes in liver glycogen (Byrne and White, 1975). Experiments mostly were carried out on the biochemistry and physiology of *R. ridibunda* (Conlon *et al*., 1993; Munoz *et al*., 1993; Vitanova *et al*., 1993).

The objective of the present study is to through a light on the quantitative descriptive of the annual cycle in liver weight of the marsh frog *R. ridibunda*, as it appears that this frog is one of the most successful anurans in Iraq.

## MATERIALS AND METHODS

Frogs were collected from superficial waters, brooks, ponds and other places where the water is nearly stagnant, found in various parts of Baghdad and its suburbs. A total of 167 specimens of *R. ridibunsa* (82 males and 85 females) were captured throughout the year 1994. No samples were collected in June. The collected frogs were transported to the laboratory for measurments and sex determination. Liver and stomach contents were removed. All specimens and livers were dried at 70 oC until no further loss of weight occurred, usually 24 hours. The weight of the liver has been deducted from the total body weight. The dry weight of the liver was expressed as percentage of the dry weight of the body. The differences in the

mean values were evaluated by the student t-test. The means are considered statistically significant at the 95% confidence level.

## RESULTS

Table (1) shows the mean percent liver weight of both males and females of marsh frog. The females' liver weight always exceeded that of the males, except in July and September. However, the difference between males and females for the whole year, regardless of months, was not significant (P>0.05). In females, all mean weights in January, April and December were significantly greater than in males (P<0.5). The marsh frog, in Baghdad 1994, entered hibernation during the last week of December and emerged during the first week of March. The mean temperature of January and February was 6.1 ± 7.2 ℃ and 8.6 ± 4.3 ℃, respectively. Livers of both sexes exhibited annual changes in relative weight. They were relatively larger prior to hibernation (December), 1.857% in males and 2.288% in females, decreased during hibernation (January and February) to reach a minimum weight in March (posthibernation), 0.786% in males and 0.932% in females. All mean weights of all individuals, regardless of sex, in December were significantly greater than those of March. The first obvious increase took place in April and May, decreased in July, than increased continuously until October. There was a significant change in liver weights between sexes in April but not in May.

Table (1): Percent liver weight (gm) of *R. ridibunda.*

| Month | Males | | | Females | | |
|---|---|---|---|---|---|---|
| | Mean | S. E. | No. | Mean | S. E. | No. |
| January 1994 | 1.492 | 0.322 | 7 | 2.019 | 0.467 | 6 |
| February | 0.950 | 0.227 | 5 | 1.168 | 0.236 | 5 |
| March | 0.786 | 0.183 | 8 | 0.932 | 0.145 | 10 |
| April | 1.222 | 0.338 | 9 | 1.843 | 0.503 | 8 |
| May | 2.038 | 0.480 | 11 | 2.337 | 0.407 | 12 |
| June | -- | -- | -- | -- | -- | -- |
| July | 1.985 | 0.745 | 7 | 1.438 | 0.415 | 8 |
| August | 1.927 | 0.329 | 9 | 2.200 | 0.257 | 11 |
| September | 2.372 | 0.431 | 8 | 2.268 | 0.347 | 7 |
| October | 2.741 | 0.231 | 6 | 2.896 | 0.107 | 6 |
| November | 1.573 | 0.337 | 8 | 1.755 | 0.308 | 7 |
| December | 1.867 | 0.199 | 4 | 2.288 | 0.296 | 5 |

$$\text{* Percent liver weight} = \frac{\text{Dry liver weight}}{\text{Dry body weight}} \times 100$$

The liver weight shows a remarkable rise in October with a maximum weight (2.741% in males and 2.896% in females), than decreased in November and again increased in December (Fig.1). In females, the mean weight in December was significantly greater than in males.

## DISCUSSION

The results show that livers in both sexes of *R. ridibunda* exhibited an increase in December (prehibernation). The increase of liver weight during this month is apparently simply to meet the metabolic requirements for survival during hibernation. It has been known from many years that fat and glycogen are accumulated in amphibians prior to hibernation (Smith, 1950). The decrease in liver weight during the hibernation months (57.90% of liver weight in males and 59.25% in females) may be attributed to the utilization of liver glycogen. Liver glycogen may be utilized to provide the energy needed for gametogenesis and for storage of food reserves in the ovary (Smith, 1950). Bush (1963) demonstrated that *R. pipiens* could metabolize, during hibernation, about 75% of liver carbohydrates before death. It is possible that the increase of liver weight during April and May (after reproduction) is the direct effect of food intake as most of the stomachs examined at this time were found to be full food materials. The rise in mean weight from August to October indicates that March frogs accumulate glycogen to serve them as energy supply for the next breeding season (Morton, 1981).

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# التغيرات السنوية لوزن كبد ضفدع المستنقعات *Rana ridibunda*

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## الخلاصة

استخرج الوزن الجاف لكبد ضفدع المستنقعات نسبة الى وزن الجسم الجاف. كان وزن كبد الأنثى دائماً يزيد على وزن كبد الذكر عدا أوزان كبود شهري آب و أيلول. وبغض النظر عن أوزان كبود الضفادع خلال كل شهر على حده لم تختلف أوزان كبود الذكور عن أوزان كبود الإناث خلال السنة اختلافا معنويا. كانت كبود الجنسين كبيرة نسبيا قبل سباتها في شهر كانون الأول وقد انخفضت أوزان الكبود أثناء السبات في شهري كانون الثاني وشباط حتى وصلت الى اقل وزن لها بعد السبات في شهر آذار. وتعزى الزيادة في وزن الكبد لشهر كانون الأول الى حاجة الحيوان لمتطلبات البقاء على قيد الحياة خلال فترة السبات. بلغت نسبة انخفاض وزن الكبد أثناء السبات ١،٠٨١% في الذكور و ١,٣٥٦% في الإناث، وقد تعزى نسبة انخفاض وزن الكبد أثناء اشهر السبات الى استهلاك الكلايكوجين الموجود في الكبد ويعود سبب ارتفاع معدل وزن الكبد من شهر آب الى تشرين الأول الى إن ضفدع المستنقعات كان يتغذى بنشاط بعد فترة التناسل.

A Liver weight of marsh frog

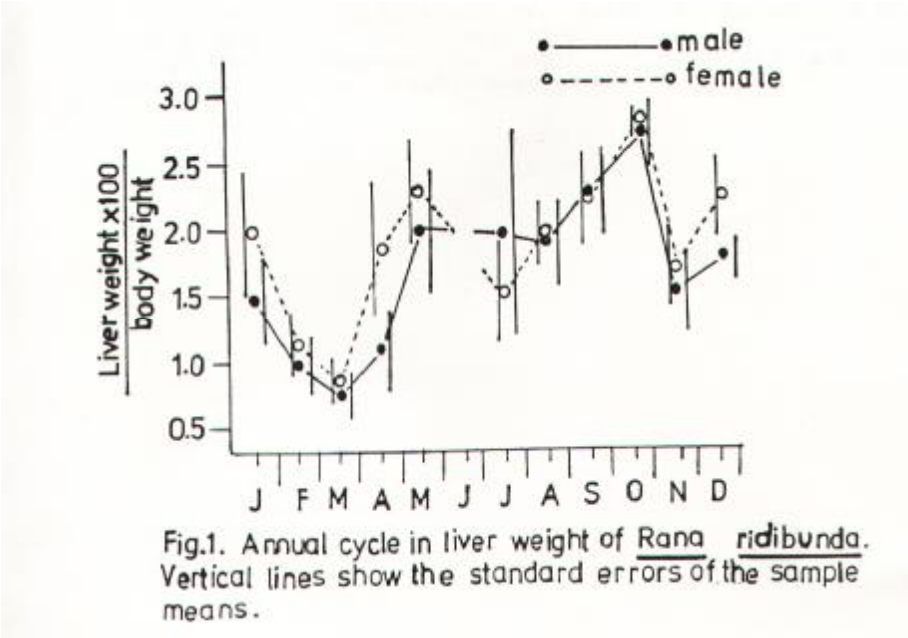


Fig.1. Annual cycle in liver weight of Rana ridibunda. Vertical lines show the standard errors of the sample means.