

A FORMULA FOR DETERMINING THE TOTAL LENGTH OF THE LEOPARD FROG (*R. PIPIENS*) FOR A GIVEN BODY WEIGHT

SHINKISHI HATAI

The Wistar Institute of Anatomy

ONE FIGURE

In connection with a forthcoming paper on the seasonal variation in the weights of the central nervous system of the leopard frog (*R. pipiens*) Professor Donaldson asked me to fit the data on the total lengths for given body weights with a smooth continuous curve. The frogs used for this study were taken from the neighborhood of Chicago and from southern Minnesota. After several trials, the formula for such a curve was obtained and this has proved very satisfactory.

The formula is as follows:

$$y = 158 \log (x + 6.5) - 63$$

where y represents the total length in millimeters and x the body weight in grams.

The total length is the distance from the tip of the nose to the end of the longest toe, the frog being fully extended.

The body length is the distance from the tip of the nose to the tip of the urostyle and is 37.5 per cent of the total length. The body weight is given without ova in the case of the females and corrected for stomach contents when necessary.

If one wishes to compute the body weight for a given total length, this can be accomplished at once with the same formula by rearranging the variables. The expression then becomes as follows:

$$x = 10^{0.00633 (y + 63)} - 6.5$$

Although the formula is purely empirical, nevertheless it is useful for the exclusion of swollen or emaciated frogs from any series and also

for determining any variations in the weight-length relations in specimens from different stations or of different species.

The formula is based on specimens of *R. pipiens* from Chicago and southern Minnesota. It may be used for frogs weighing as little as 3.5 grams, and has been extended to those as heavy as 75 grams, though this is not necessarily the upper limit of its application.

This range of application in body weight is indicated as follows:

$$3.5 \leq x \leq 75 \text{ grams}$$

Calculations of the total length for body weights increasing by five gram increments are given below.

BODY WEIGHT	LENGTH CALCULATED	BODY WEIGHT	LENGTH CALCULATED	BODY WEIGHT	LENGTH CALCULATED
<i>gms.</i>	<i>mm.</i>	<i>gms.</i>	<i>mm.</i>	<i>gms.</i>	<i>mm.</i>
5	104.6	30	183.8	55	219.6
10	129.3	35	192.6	60	225.0
15	147.5	40	200.5	65	230.0
20	161.9	45	207.6	70	234.6
25	173.7	50	213.8	75	239.0

As an illustration of the use of this formula for determining variations according to the station, we find that the specimens of *R. pipiens* from the Brandywine Creek near Philadelphia are 4.4. per cent shorter than those from Chicago and southern Minnesota (Donaldson '11). Also on comparing the two European species (Donaldson '10) *R. esculenta* taken at Zurich, Switzerland and *R. temporaria* taken at Liverpool, England, with this standard for *R. pipiens*, it appears that *R. esculenta* is 5.1 per cent shorter and *R. temporaria* 3.5 per cent shorter. These species are in this character therefore more like the specimens of *R. pipiens* from the Brandywine Creek. In a case of this nature the choice of the material which is to be used for the standard formula is quite arbitrary. To indicate how the formula can be modified to suit other material let us assume that we desired to use the Brandywine frogs, which are 4.4. per cent shorter than the Chicago and Minnesota frogs, as the material for a standard formula.

The desired formula can be derived from the one given above in the following manner:

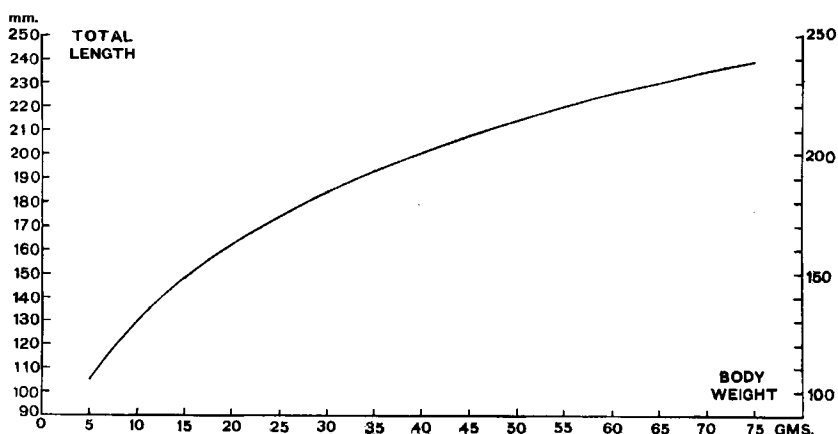
$$y = [158 \log (x + 6.5) - 63] - 0.044 [158 \log (x + 6.5) - 63]$$

that is, the new formula is obtained by reducing the two constants (158 and 63) by 4.4 per cent. It would then become:

$$y = 151.048 \log (x + 6.5) - 60.228$$

which represent the weight-length relations for the Brandywine frogs. By a similar process, corresponding formulas could be obtained for the two European species.

The graph of the formula for the total length at different values of the body weight is illustrated in the accompanying chart.



On the base line representing the body weight of the leopard frog (*R. pipiens*) given in grams, the ordinates show the total lengths in millimeters. The curve for these determinations of total lengths is given for frogs from 5 to 75 grams in weight.

LITERATURE CITED

- DONALDSON, H. H. 1910 Further observations on the nervous system of the American leopard frog (*Rana pipiens*) compared with that of the European frogs (*Rana esculenta* and *Rana temporaria*). Jour. Comp. Neur. Psych., vol. 20, no. 1, pp. 1-18.
- 1911 On the regular seasonal changes in the relative weight of the central nervous system of the leopard frog. Jour. Morph., vol. 22, no. 3.