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A THEORETICAL MODEL USEFUL IN ASSESMENT OF INVASION POTENTIAL OF THE SPECIES *PSEUDORASBORA PARVA* (TEMMINCK & SCHLEGEL, 1846) AS A CORRELATION OF THE CORPORAL CONDITION FACTORS AND THE VALUES OF PHYSICAL-CHEMICAL PARAMETERS OF WATER

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INTRODUCTION

Considering that the invasion of the species in Romania (as well as in a large part of Europe) begun with the establishment of a population of *Pseudorasbora parva* at the Nucet Fishery Research Station, we accepted this population as representative at least to Romania, due to the fact that only the individuals that were able to adapt to the physical – chemical conditions of water found at Nucet were able to produce descendants that would trigger the later invasion process. Thus, the water parameters at Nucet were considered as primordial parameters in the process of adaptation. The response to how fitted are these water parameters for the fishes' physiological demands resides in the effort invested by the organism to survive in the given conditions, appreciated here as the ratio between the observed mass of the fishes and the calculated mass for the respective given length. Nevertheless, the ratio itself is a result of how much do the mentioned parameters involve in the growth process of the fish, thus, it can be expressed as a function of each parameter; the function can be calculated as the formula of the trend line of the regression of M/M' (M=observed mass; M'= calculated mass as a function of length) and the values of each parameter; the reference points are represented by the value of the parameter that results the closest ratio value to 1, meaning that observed and calculated mass are around the same value, thus the growth process is well balanced. The further correlation of the involvement of each parameter in the final value of the M/M' ratio can be calculated as the product of all the involved/studied parameters raised to the power 1/n, where n represents the number of the parameters employed.

MATERIALS AND METHODS

A number of 296 individuals of *Pseudorasbora parva* were captured at the Nucet Fishery Research Station, between 2006 – 2008, in various periods of the year (March, April, May, June, July, September and December); further on, the fish were measured and weighed employing a TOPEX Vernier Dial Calliper (0-200mmX0,05) and a KERN TEE 150 – 1 digital scale (0 – 150 gX0,5).

The measurements interested total length, including the tail fork. The values obtained varied from 28 to 89,5mm, with a maximum frequency between 60 – 70 mm. Weights varied 0,2 – 11,1 g, with a maximum frequency between 4-7 g.

The M/M' ratios were arranged in an increasing order and correlated with the water parameters' values corresponding to the period when the respective individuals were caught, obtaining different water – parameters categories to which corresponded different values of M/M' ratios. The most frequent values were considered as representative for the given parameters.

The M/M' ratio was then calculated as a function of, respectively, pH, permanent water hardness, dissolved oxygen and temperature; since all functions expressed the same value (the M/M' ratio), the functions were regarded as different expressions of M/M', thus since M/M'*M/M'*M/M'*M/M' raised at the ¼ power equals M/M', then the product of all the functions raised to the ¼ power would give the same result, expressing the involvement of each water parameter in the growth process. Water samples were collected and noted (at least 5 determinations per month). Water analysis tests were conducted at the Nucet Fishery Research Station, and data was provided courtesy of Mrs. Cecilia Bucur, researcher within the Fishery Research Station, as daily temperature variations covering a period of 6 years (2002 – 2008) under the form of tables with noted values for each day and graphic interpretations of the variations; water chemistry tests were conducted weekly or more frequently, and were presented under the form of tables of values.

The employed statistical software was represented by Microsoft Office Excel 2003 and the XLSTAT PRO 7.5 add-on.

All correlations were tested for significance with Spearman's correlation coefficient test and prove values of significant association.

RESULTS AND DISCUSSIONS

Calculated weight has been appreciated by means of regression. The relation between total length and weight was described with a polynomial function. This kind of regression was preferred to linear regression due to the fact that the species has a differential growth, usually weighing around 0,5 g up to the length of 30 – 33 mm and then become much heavier (1,0g) after exceeding 38 mm in length.

The most relations between the M/M' ratio and different values of the water parameters were described by logarithmic functions; an exception was represented by pH, which described a quassi-gaussian curve. To ease the calculation process, we preferred to separate the pH values into two intervals of values, the first ranging from, 3 to 7,2 and the second from 7,2 to 14, which were described separately, by different functions. For pH greater than 7,2, we used a polynomial function, and for pH lower than 7,2 a logarithmic function was employed.

The results consisted in the following formulas:

M/M'= 0,3073 *Ln (dGH) + 0,5415; (term A);

M/M' = 0,2528 Ln (T^0C) + 0,429); (term B);

M/M' = 0,617 Ln (O_2) +0,1174; (term C);

M/M' = 1,3348 Ln (pH≤7,2) – 1,5019; (term D);

M/M'=0,012 $(pH>7,2)^2$+ 0,0827 (pH>7,2) + 1,2465; (term D');

The final formula writes:

M/M'=(termA*termB*termC*termD)^1/4, for pH values lesser than 7,2, or:

M/M'=(termA*termB*termC*termD')^1/4, for pH values greater than 7,2.

ABSTRACT

The authors propose a statistic-based model of regression associations of the ratio between observed mass of specimens and calculated mass, on one hand, and four major water parameters that influence growth. The results, expressed in trend line formulas, are correlated in the form of the product of the parameters raised to the 1/n power, where n represents the number of parameters for which regressions are estimated.

CONCLUSIONS

It is possible to appreciate in a calculable manner whether a species is advantaged or not by the parameters of the habitat it inhabits. Even if many species have a large array of tolerable values for each environment parameter involving in or conditioning their growth or survival, there is a certain, narrower interval of values for which the respective species has a good growth in terms of weight gain. A proper, adequate and efficient habitat would be represented by such a habitat where environment conditions do not involve energy consume higher than the energy provided by the respective habitat as food. Thus, calculating the involvement of the environment factors' complex in the growth of a certain population could provide useful data in analyzing whether a certain biotope would provide a satisfactory growth rate or not.

Possible applications of the proposed model could be:

- Calculating environmental optimal conditions for rare/endangered species, useful in habitat reconstruction, both for captive breeding in "best conditions" rather than "natural conditions" (not always the natural conditions where a species is found represent the best conditions for that species) and for natural habitat management, modeling it in a manner that would provide more advantages to the species;
- Estimating invasion potential by evaluating the values of the water parameters and choosing among those sites that provide "good" growth versus "insufficient" growth for a certain species; by monitoring the habitats adjacent to a certain area where an invasion took place, then by analyzing which of those habitats could provide successful growth, one could trace invasion routes which could be useful in watchdog actions and help in stopping/anticipating invasions; also, when introducing new species to aquaculture, such an assessment might prove useful in predicting whether an introduced species might trigger an invasion process in an area or not;
- Finding the "less energy demanding water formulas" to be utilized in fish farming;
- Back – calculating the values of one or more water parameters if a certain parameter is known and a certain M/M' ratio is desired – also useful in fish farming;
- Of course, more other water chemistry parameters can be still introduced into the formula, to provide a more accurate image of how a fish grows in certain environment conditions; nevertheless, further research is needed.

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