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Determination of age and growth by scale of a population of common trout (*Salmo trutta macrostigma*, Dumeril, 1858) at the level of Sidi Rachid River (Ifrane. Morocco)

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ABSTRACT:

The determination of age and growth from the scales of trout river (*Salmo trutta macrostigma*, Dumeril, 1858) at Sidi Rachid River; was employed out of 438 specimens used the size varies between 6.3 cm and 37.5 cm, the relation linking the growth in length of the fish and the growth of the scale. Varied according to the equation Log Lt = 0.8674 ×Log Rt + 0.5349, with a coefficient of correlation(r) = 0.86592138. The period of the end of growth to this population of trout is between December and January, this period is characterized in the middle of the atlas by important reductions in temperature on one hand, the decrease of the network trophique on the other hand which gets coincided with the period of reproduction of the trout. The resumption of the growth is made in a important way from March. The age of the trout's determined by scales varies between 0 + to 5 +. The retro measures are lower than those observed and the equation of theoretical growth of Van Bertalanffy is of the following type: Lt = 34, 96 (1-exp-0,309 (t-0, 27)).

Keywords:
River trout, age, growth, scales, Sidi Rachid River. Morocco

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INTRODUCTION

The fishing of salmonids constitutes one of the main concerns of the members of fishing associations in the nation. Both the common trout (*Salmo trutta macrostigma*, Dumeril, 1858) and the rainbow trout (*Oncorhynchus mykiss*) are appreciated in the fishing sport. This activity plays an important role in the socioeconomic development of the region. To alleviate the disappearance of the endemic common trout, the administrators in Morocco resort to the repopulation of rivers with vesicle alevins stemming from artificial reproduction which is carried out at the salmon farming station of Ras El Ma.

For a long time, numerous studies were conducted in the determination and knowledge of the lines of fish the populations of in various aquatic circles. Besides the parameters size and mass, we also quote the age of the fish. These various biological lines once determined, can be exploited in the perspectives of management of the various types of peaches professionally. The estimation of the age of a fish is of a big importance to understand the dynamics of a population. This determination of the age can be made either in a direct way, or in an indirect way. In this study, we limited ourselves to one of the direct methods by means of the osseous structures (Spillmann, 1961; Bagliniere et Maisse, 1990). Although the use of scales for certain species are questioned (Pikitch et Demory, 1988), the scales are used for a majority of families with species dulçaquicoles and amphihalines temperate or cold regions to be known, almonds, cyprinids and precedes (Bagliniere et Lelouarn, 1987; Meunier, 1987; Bouhbouh, 2002). During this study, method used for the determination of age and growth of brown trout (*Salmo trutta macrostigma*, Duerile 1858) is by the number, size and pattern of scales. Indeed, the growth of the structures mineralized as the scales is proportional to the length of the fish (Lea, 1910; Hattour *et al*., 2005). In temperate zones, the growth of the fish presents a seasonal rhythm with fast growth at the spring and summer and a stops its growth during winter period. This annual growth rate is marked on the various osseous structures among which scales are present. The study of these osseous structures will allow determining the period of the stop of growth and consequently the age and its relation with the size of the specimens of the population of trout in the Sidi Rachid River.

MATERIALS AND METHODS

Presentation of the environment of study

The environment of study (Figure-1) is Sidi Rachid River, present in the geographical coordinates of 5°9'N N and 33°28'W W. It is at a height of 1620m and belongs to the rural district of Ait Ali Ouikoub (province of Ifrane). The brook is fed by the sources of Sidi Rachid of which it takes its name with a maximum debit of 172 L/S (Abba, 2011) for a main source as well as the waters from the station of salmon farming of Ras El Ma (Abba *et al*., 2011). From the morphométric point view, the River presents a low width which can vary from 2m to 6 m, and a depth which does not exceed 1m generally.

Biological material

Sampling of fishes

The method used in our case is the electric fishing realized by technicians' team of the National Center of Hydrobiology and Fish farming of Azrou. The number of fish every month varies between 30 and 50 specimens. For every sinned fish, we have proceed to the measure of its total length (Lt (cm)) with an ichtyometer, and before putting it back in the housing environment, scales in number from 6 to 20 were removed in the zone recommended for salmonids according to Ombredane and Richard(1990). Scales are then tidied up in envelopes and numbered for further study in the laboratory with a microfiche (×40).

Determination of the structure of the population

The determination of the number of classes of size of the population of trout at the level of the Sidi

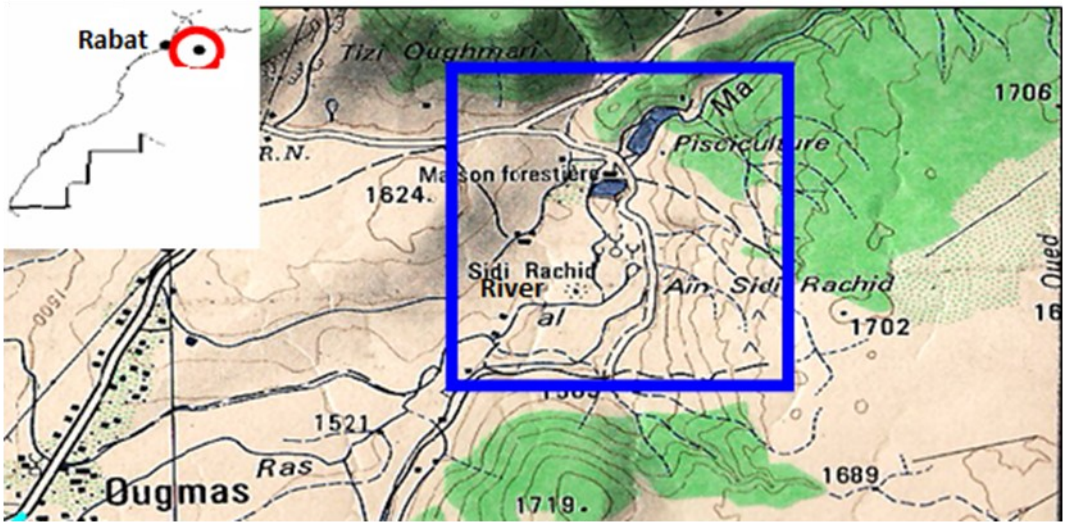

Figure 1: Situation of area of study (Extracted from the map of Azrou. E: 1/50. OOO; division of the map, 1974)

Rachid River during the period of study was made by applying the ruler of Sturge. Number of class = 1 + (3, 3 log N), were N is the sample Size.

Preparation and reading of scales

The preserved scales dried on the referenced envelopes were taken and rubbed between fingers and cleaned by the water to eliminate any sorts of residues (Jearld, 1983). The examination of scales can be made by several ways. The reading chosen in this work as the determination of the age of the fish was made by a reader of microfiche. The criteria used for the determination of rings for the stop of growth vary according to the species. For the salmon kind, the criteria are generally as follows:

- Contraction of several circuli in the form of a concentric band making the tour (ballot) of the scale (Bagliniere and Lelouarn , 1987);
- Discontinuity of circuli or absence of discontinuity of the circuli in which the thickness decreases;
- Stepping of the circuli of the annulus on those previously trained in the side fields either

Measures made on scales

The rings of ruling of growth allow making measurements on the scale to calculate the marginal extension (AM). The latter is used to determining of the period of stop of growth. The front of the scale generally held to salmonids (Bagliniere *et al.,* 1991) is used for the determination of the total shelf R and other shelves r corresponding to the various annuli, r_1, r_2, r_3 to r_n. The measure was made by means of a graduated ruler on a device microfiche for the same swelling (×42). To work always in the same condition, the measure of the beam was made on the main line, which corresponds to the previous field of the scale. The Extension Margin (EM) was calculated according to, Benabid (1990).

Determination of the retro calculation on growth

The relation binding the size of the fish and the shelf of its scale is linear and is determined by the following formula (Bryuzgin, 1970): L = b Ra (or Log L = a Log R + Log b), with, , 'L':: length of the fish (cm) in the capture, 'R': the previous shelf of the scale of the fish (cm) ie., distance between the center of the scale and its outside edge according to a direction strictly constant, 'a': and , 'b': are constants.

The formula of Le Cren (1947) and Philippart, (1975) allows then the retro calculation of the size of the fish every age. Log Ln = Log L + a (Log Rn - Log R). With, 'Ln' length calculated at the time of the training of the nème ring of the stop of growth in mm; 'L': length

observed by some fish in mm; , 'R':: length observed by the previous beam of the scale in mm; , 'Rn': length of the previous beam of the scale up to the nème ring in mm; and , 'a': constant. The theoretical model of growth used is the one of Von Bertalanffy (1938): (Lt = L∞ [1-exp (-K (t-t0))]). (Benabid, 1990; Bouhbouh, 2002). With K (years- 1): growth rate; L∞ (cm): cut that the fish in time infinite should have; t0 (years): the age in the worthless length.

RESULTS AND DISCUSSION

The histogram of the structure of population of the trout (Figure-2) shows a good representation of the individuals and the size of which is between 14 (the Middle = 13.8) and 17 cm (the Middle of 16.8).This type of structure is a characteristic of young populations. This structure is explained by the fact that the adults are generally fished by farmers in the station of fish farming as a source of gametes during the period of artificial reproduction which comes true in the station of Ras El Ma.

Among 438 individuals sampled during the period of study, the number of river trout presenting scales of regeneration is 50 specimens, this constitutes a number raised with regard the size of the sample; it is 11, 44 % (Ombredane and Richard, 1990).

The determination of the period of appearance of the rings to the stop of growth was made by monthly analysis of the variations of average Marginal Extension (AM) on 387 trout's which presents normal scales. During this study, some scales do not present rings on the stop of growth; it is about scales of truitelles stemming from on-the-spot cross-posted or born alevins from March, 2007. The (figure-3) shows the results obtained for all the scales of fishes representing stops of growths.

The analysis of variations of the results showed that Marginal Extension presents the minimum only one marked well for December and January. This minimum translates not only shows the ring of wintry stop of growth but also it corresponds to the period of heavyweight at the river trout. Indeed this stop of growth is not only due to the period of reproduction which slows down the growth of the fish but also on the severe conditions which exist during this period of year as the important decrease of temperature and trophiques resources (Pourriot and Meybeck, 1995) which are generally due to the snow coverage which knows in this region. The resumption of the growth begins gradually from February and reaches its maximum during August.

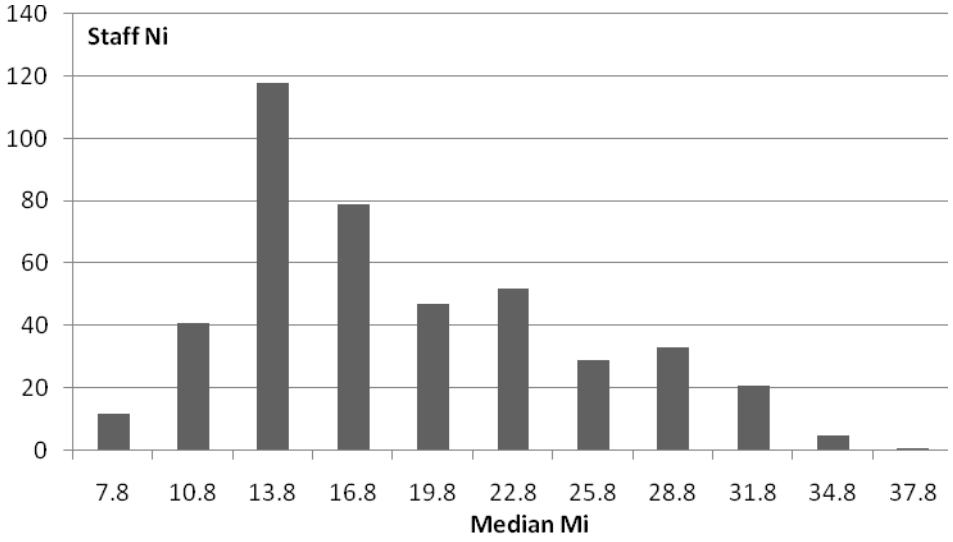

Figure 2: Representation schedules of various classes of common trout and their staff at the level of the Sidi Rachid River during the period of study

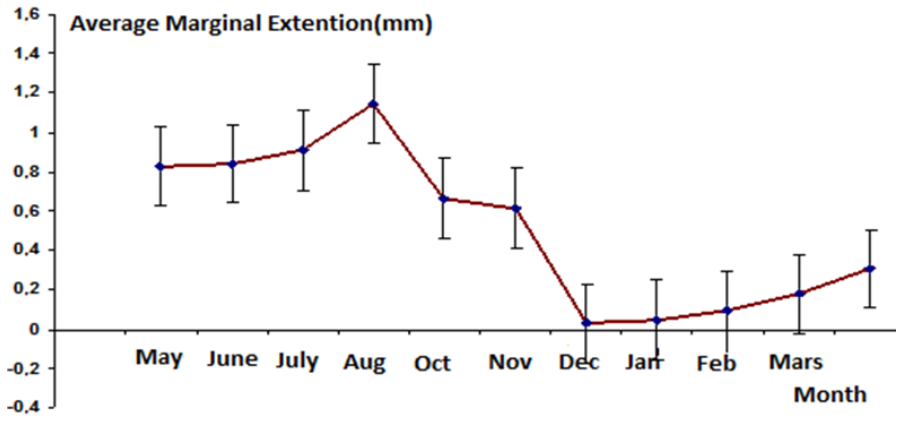

Figure 3: Monthly evolution of Average Marginal Extension (AME) of the river trout

This important growth is due to the favorable conditions of the housing environment as the temperature and the abundance of the food reserves, on 438 scales examined (51, scales of regeneration), the age is between 0 + and 4+ for sizes going from 6.3 cm to 37.5 cm. The determination of the size of the trout's at the various moments of their life is based on the principle of proportionality of the growth of the scale with that of its body. For this end, the equation connecting the previous beam R of the scale and the total length (Lt) used in this study was determined as continuation. Log Lt = 0, 8674 ×Log Rt + 0, 5349. The relation between the total length of the body of the trout (Lt) and the length of the previous shelf of its scale (R) (Figure-4) can be allometrique (Giles and Giguere, 1992).

The introduction of the coefficient of regression of the relation length (Lt) and length (R) of the scale gives the following equation: Log Ln = Log L + 0.8674 × (Log Rn - Log R) (Le Cren, 1947; Benabid, 1990; Bouhbouh, 2002). The total retro measure lengths from the equation above are listed in the table -1.

The results obtained for the total retromeasures lengthes are used for the determination of the annual average linear increase (C) as well as the specific speed of growth noted VSC established by Ricker (1958): C = Ln-Ln-1. (Ln and Ln-1: annual lengthes retro measures in time n and n-1 expressed in years. VCS = Ln -Ln-1 × 100/Ln-1. The obtained results showed that, the calculated total retro measures lengths are quite lower than the observed annual average lengths. This

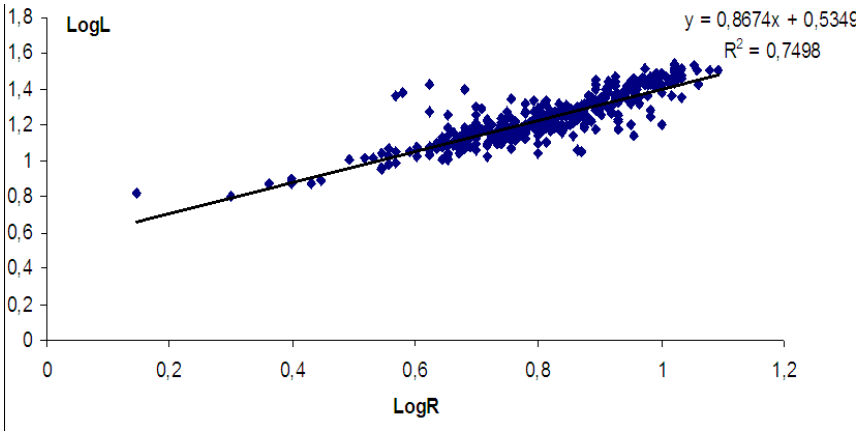

Figure 4: Relation between the length of the fish and the previous shelf of its scale at the common trout of the Sidi Rachid River.

Table 1: Linear retro measures at the Growth of common trout (combined Sexes)

Age group	Age group	Observed average length (mm)	Length averages retro measures (mm)				
			I	II	III	IV	V
2008	I	134.60	91.20				
2007	II	152.40	103.27	141.25			
2006	III	190.09	104.71	147.90	177.07	-	-
2005	IV	263.35	112.20	165.95	213.79	245.47	-
2004	V	318.11	128.82	190.54	234.42	275.42	309.02
Number of fish retro measures			358.00	285.00	194.00	83.00	9.00
Annual average length retro measures			108.63	161.41	208.42	260.44	309.03
Standard deviation			13.84	20.04	29.04	21.17	-
Increase in annual average length (mm)			91.20	37.98	29.17	31.68	33.61
Specific speed of growth				44.39	28.33	14.85	12.20

difference of length can give some explanation by the fact that the observed average lengths correspond to the lengths of fish at various moments of the year or the growth is made. On the other hand the total retro measures lengths correspond to the lengths of fish at the time of the training of annuli stag of stop of growth during December generally. The average lengths observed to both sexes and individuals of the indefinite sex do not present notable difference for age groups I (1 +) and II (2 +). Beyond this age, we notice a variation in favour of females (age groups III (3 +) and IV (4 +)), to become slightly raised to the males of age group V (5 +). These variations can be due to the sexual maturity which influences the growth and which is premature in a general way at males. Also, the retro measure averages are slightly superior at the females than at the males of the same age group. As for the specific speed of the growth, it is very important for the class II (2 +) and it exceeded 40 % (combined sexes and various sexes). The decrease is in a very remarkable way as the age of the fish increases and achieves approximately 10 % for fishes of age group V (5 +). For the theoretical model of the growth of Von Bertalaffy (the obtained results watch that the theoretical maximal size of the fish is of L8 = 34.96cm. The theoretical equation becomes then for the population of trout of the Sidi Rachid River is Lt = 34.96 (1-exp-0.309 (t-0.27)). The theoretical length (34.96cm) is lower than the maximal length of the biggest trout (37.5cm) scales of which are used for the determination of the age. The use of reliable software can give even more reliable results for this equation because the sizes sinned in other circles sometimes exceed 40cm.

CONCLUSION

The use of scales and other osseous structures allow determining particularly the aspects of age and the analysis of dynamics of a fish population growth. With salmonids, the most recommended method is the scale, despite some disadvantages such as the difficulty of scales reading or the high number of scales of regeneration that we obtain. Similarly, the use of another method can be very beneficial and will allow having more information.

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REFERENCES

Abba H. 2011. Etude écologique et biologique de la truite commune (*Salmo trutta macrostigma*, Dumeril 1858) dans une rivière de Moyen Atlas (Oued Sidi Rachid) Maroc. Thèse de Doctorat Es Science. Univ. Ibn Tofail. Fac .Sc. Kenitra. Maroc. pp.194.

Abba H, Belgghyti D Benabid M, ELIbaoui H, Fadli M and Eby Ould Mohamadou A. 2011. Physicochemical Typology of water of a Middle Atlas River (Morocco) where the common trout *(Salmo trutta macrstigma, Duméril, 1858) live:* Oued Sidi Rachid.

African Journal of Environmental Science and Technology. 5(5): 348-354.

Bagliniere JL and Lelouarn H. 1987. Caractéristiques scalimétriques des principales espèces de poissons d'eau douce de France. Bull. Fr. Pêche Piscic. 306 : 1-39.

Bagliniere JL and Maisse G. 1990. La croissance de la truite commune (Salmo trutta L.) sur le bassin de Scorff. Bull. Fr. Pêche Piscic. 318 : 89-101.

Bagliniere JL, Castanet J, Conaud F et Meunier FJ. 1991. Tissus durs et âge individuel des invertébrés. Colloque national Bondy, France 4 - 6 mars.

Benabid M. 1990. Bioécologie de deux espèces du Barbeau (Barbus Barbus callensis(Gthr) Barbus Labeobarbus frifschii (Val.)) d'un cours d'eau du haut-Atlas du Maroc. Thèse du 3ème cycle Fac. Sci. Marrakech. Maroc.

Bouhbouh S. 2002. Biologie - Ecologie de *Barbus Callensis(Valencienne,1842)* et *Barbus Frishi Fritschi (Gunther,1874).*au niveau du reservoir Allal El Fassi.Maroc Thèse de Doctorat Nat Uni.Sidi Mohamed Ben Abdellah.fac.Sci.Dhar.ElMehraz. Fes.Maroc.

Bryuzgin V.L. 1970. Use of empirical to study the growth of fishes. Hydrobiol. J. 6 : 85-94.

Giles T et Giguere LA. 1992. Relation longueur/écaille allométrique chez le saumon atlantique (Salmo salar) durant la phase marine. Can. J. Fish.Aquat. Sci. 49 (1) : 46-51.

Hattour A, Gaamoura A et Ben Smida MA. 2005. Etude preliminaire de l'âge et de la Croissance de l'éspadon (<Xiphias gladius>) des eaux Tunisiennes, Bull. Inst. Natn. Scien. Tech. Mer de Salammbô. 32.1-6.

Jearld A. 1983. Age determination In: Fisheries Techniques Nielsen LA and Johnson DL, Eds., American Fisheries society, Bethesda, MD. Blacksburg . 301-324.

Lea E. 1910 .On the methods used in the herring investigations. Publ. Circons. Cons. Perm. Int. Explor. Mer. 53 : 175 p.

LE Cren ED. 1947. The determination of the age and growth of the perch (Perca fluviatilis) from the opercular bone. J. Anim. Ecol. 16 (2): 188-204

Meunier FJ. 1987. Structure et minéralisation des écailles de quelques Osteoglossidae (Ostéichtyens,téléostéens). Am. Sci. Nat. Zool., 13e série. 6 : 11-24.

Ombredane D and Richard A. 1990. Détermination de la zone optimale de prélèvement d'écailles chez les juvéniles smolt de truites de mer (Salmo trutta L.). Bull. Fr. Pêche Piscic. 319 :224-238. Sous presse.

Philippart JC. 1975. Dynamique des populations de poissons d'eau douce non exploitées. In Problèmes d'Ecologie : La démographie des populations de vertébrés. Lamotte M. et Bourlière F.Masson et Cie, Editeurs, Paris

Pourriot R and Meybeck M. 1995. Limnologie générale. Paris: Masson. 956 pages.

Pikitch EK and Demory RL. 1988. Assessment of scales as a means of aging dover sole. Tram. Amer. Fish. Soc. 117(4): 345-349.

Von Bertalanffy L. 1938. A Quantitative theory of organic growth. (Inquires on growth laws). Hum. Biol. 10(2): 181-213.

Ricker WE. 1958. Hand book of computations for biological statisties of fish populations. Fish. Res. Board Can. Bull.No 119. 300 p.

Spillmann J. 1961. Faune de France : 65 poissons d'eau douce. Féd. Fr. Soc. Sci. Nat. Off. Cent. Faunis., Paul Lechevalier,, Paris. 301 p.