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**FOOD HABITS OF THE RIVER TROUT (*SALMO TRUTTA MACROSTIGMA*,
DUMERIL 1858) IN A RIVER OF SEBOU HYDRAULIC BASIN (Morocco): SIDI
RACHID RIVER**

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ABSTRACT

The study aims at determining the diet of brown trout species (*Salmo trutta macrostigma*, Dumeril, 1858), species endemic to Morocco, in a small stream of the Middle Atlas in Morocco: Sidi Rachid River. The determination of the diet was studied among 348 fish collected by electro fishing (May 2007 and April 2010). The total length of fish is between 6.3 cm and 37.5 cm. During the study period, the diet spectrum varies according to seasons. The main food source consists of gammaridaes (Amphipoda 45%) and insect larvae mainly Ephemeroptera, Diptera, Plecoptera and Tricoptera; larvae living in great abundance in the stream. The seasonal food rhythm is influenced by its own reproduction and ecological conditions of the environment. For composite indexes, the amphipods (Amphipoda) are the preferred prey.

**Keywords: Common Trout, Diet, Food Spectrum, Diet Index, Sidi Rachid River Middle
Atlas, Morocco**

INTRODUCTION

The brown trout (*Salmo trutta macrostigma*, Dumeril, 1858) is a species which colonizes the rivers of high mountains. In Morocco, the common trout is generally widespread in the upstream water parts of the rivers of the Middle Atlas like Sidi Rachid River [1, 2]. This species is found in fresh water whose temperature does not generally exceed 22°C and a rate of dissolved oxygen which exceeds 80% [3, 4]. In Morocco, the common trout is affected by the degradation of its habitat and by the periods of drought which Morocco has faced [4, 5]. To solve the problem and to support the numbers the trout population, the National Centre of Hydrobiology and fish farming has resorts particularly to the artificial reproduction at the station of salmon breeding of Ras ALMA (Azrou/Ifrane) [6, 5].

The management of the fishing resources requires good knowledge of the ecological and biological bases of the fish species in the aquatic environment [7].

The diet of a species constitutes one of the first steps in their ecology [8, 9, 10] since it makes it possible to explain the variations of growth, certain physiological aspects like reproduction [11], as well as the relations predatory-preys within the study [12] and the phenomena of inter and intra specific competitions [13]. The diet varies with environmental factors such as the effect of

season, environment and prey availability as well as biological factors such as reproduction, sex and size of fish [14, 5].

MATERIALS AND METHODS

Physical Environment

The geographical coordinates of Sidi Rachid River are 5°9' N and 33°28' W and the river is located at an altitude of 1620m in the North-West of the town of Azrou (Figure 1). It belongs to the 1,500 km of water classified first class of Morocco [15]. The width of the river does not exceed 10m and its depth ranges between 20cm and 1.20 m at most. The river is one of the rare streams which are permanent in the Province of Ifrane, an area that is located at the Middle Central Atlas [5]. It is permanently supplied by Sidi Rachid springs (sources) in addition to the melting of the snow of the surrounding areas. The Middle Atlas is characterized by carbonated geological formations Liasic [16].

Biological Material

After the catching by electric fishing season, the trouts are dissected, the stomachic contents of each fish is put individually in a bottle containing formal at 5% to ensure better conservation of the stomachic contents [17]. Then, the stomachic contents of each trout are examined under a binocular of Olympus type [18, 19, 20].

Descriptive Indices of the Stomachic Contents

The methods used in the analysis of the stomachic contents are used by several authors such as [21, 22, 23, 24, 18, 25, 26, 20, 27]. It is the determination of the following diet indices:

Vacuity Index (CV %)

The ratio is expressed as a percentage between the number of empty stomachs (EV) and the total number of examined stomachs (EE). $CV (\%) = EV/EE * 100$

The Diet Index of Hureau

The determination of the food index (IA) of Lauzane [28] is based on the combination of the volumetric index (IV) and the frequency of existence of a prey (CO) according to the following formula $IA = IV * CO / 100$

The Diet Index Geistdoerfer

Besides the index of frequency of a prey determined by: $F = \text{Number of stomach containing item } i \times 100 / \text{Total number of the full stomachs}$, Geistdoerfer [39] proposes the following subdivisions:

Q > 100 and F > 30%: the preys are said principal preferential; **Q > 100 and F < 30%**: the preys are said principal occasional (=casual); **10 < Q < 100 and F > 10%**: the preys are said secondary frequent; **10 < Q < 100 and F < 10%**: the preys are secondary and incidental; **Q < 10 and F > 10%**: the preys are complementary at first order; **Q < 10 and F < 10%**: the preys are complementary at second-order.

RESULTS AND DISCUSSION

The analysis of the digestive contents has made it possible to determine 2873 preys. The relative abundance of the preys shows the order of Amphipoda with 45.97%, Ephemeroptera (25.85 %), and the third order is formed by Diptera (12.68%). The other orders (Trichoptera, Plecoptera) have a relative abundance that is lower than 10% (**Figure 2**). Regarding classes, the insects constitute more than 50 % of the stomachic contents, the shellfish constitute more than 45 %, and the other preys constitute less than 4 % of the total of the ingested preys.

The study of the variations of the food spectrum of this salmonide according to the seasons shows that the nature and the importance of the number of ingested preys vary according to the seasons (**Figures 2, 3, 4, 5 and 6**), with a relative important predominance of Amphipoda during all seasons except for the winter when Ephemeroptera are well represented. These results can be explained by the fact that the common trout tends to select the most abundant preys and the potentially more vulnerable taxons of the medium [30]. Moreover, these preys as well as others constitute to the trout fario the much sought-after taxons because they have a certain number of characteristics like the exposure on the substrate and or in the water column[31], their great mobility [32],

mottled [33], without morphological defenses [34, 35], or chemical ones [36], and of intermediate size ranging between 5 and 20mm [37].

The rate of vacuity is of 6,38%. The mature specimens constitute the majority of fish presenting an empty stomach (66.66%) vs. 33.33% for the immature ones. The season when the fish present an empty stomach is the winter, a season which coincides with the period of reproduction of common trout when the gonads occupy a very important volume of the abdominal cavity, and thus the gonads can compress the digestive tract and reduce the alimentary canal [19, 20, 18, 7, 4].

For the food index Q of Hureau. Amphipods (Amphipoda) constitute the preferential

preys since the Q index is higher than 200, for the ephemeroptera and Diptera of which the diet index $20 < Q < 200$, the preys are said secondary, for the rest of the preys of which $Q < 20$, they are said incidental.

For GEISTDOERFER [30], who also takes account of the index of $F\%$ frequency $F\%$ ($F = \text{Number of stomachs containing a prey } p\% / \text{Number of examined full stomachs}$), the gammaridae (Amphipoda), the dipterous ones (Diptera) and the éphéméroptères (Ephemeroptera) constitute the preferential principal preys since $Q > 100$ and $F > 30\%$. The trichoptera, constitute the secondary frequent preys ($10 < Q < 100$ and $F > 10\%$); whereas, the other preys are said second-order complementary preys ($Q < 10$ and $F < 10\%$).

Table 1: Physicochemical Parameters of River Water

Parametres	Val. Max	Val. Moy	Val. Min
Temperature (°C)	15,7	13,79	11,8
Dissolved oxygen (mg/L)	13,32	10,04	7,38
Potential Hydrogen (pH)	8,06	7,38	7,11
Orthophosphates(mg/L)	3,16	0,62	0,08
Nitrites(mg/L)	0,014	0,011	0,009
Total HardnessTH (mg/L)	104	72,75	48
TAC(mg/L)	35,39	25,04	18,92

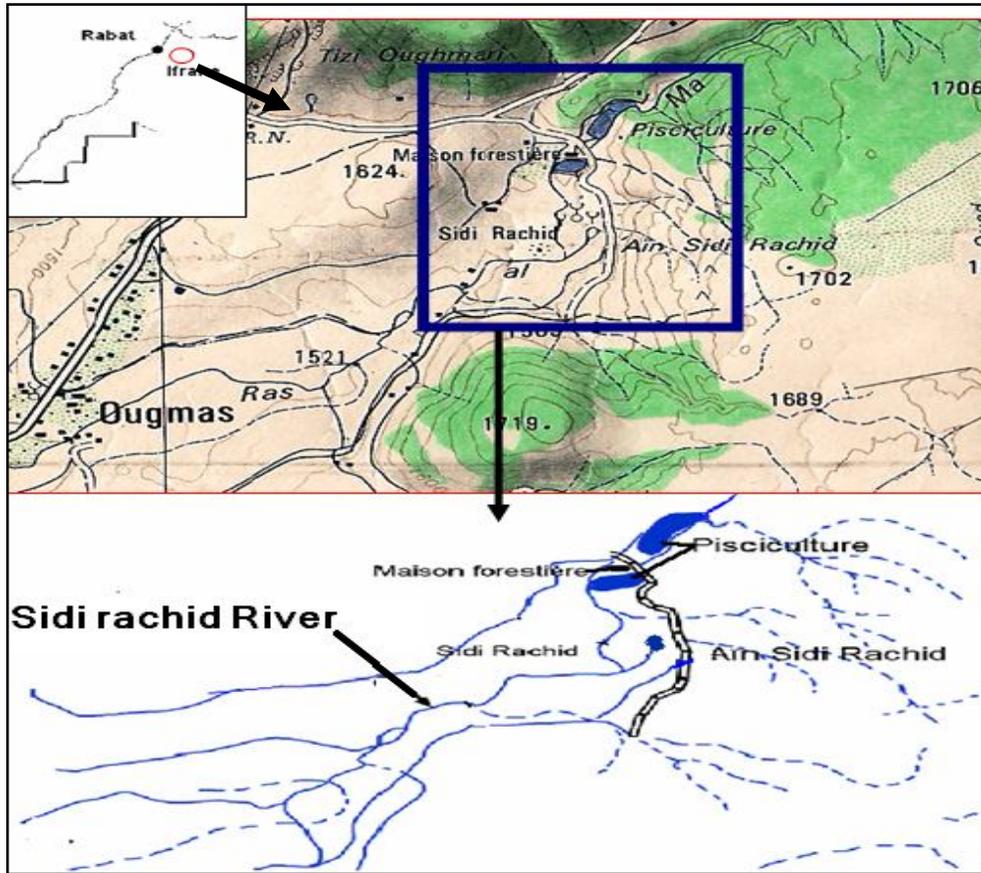


Figure 1: Location of Study Site

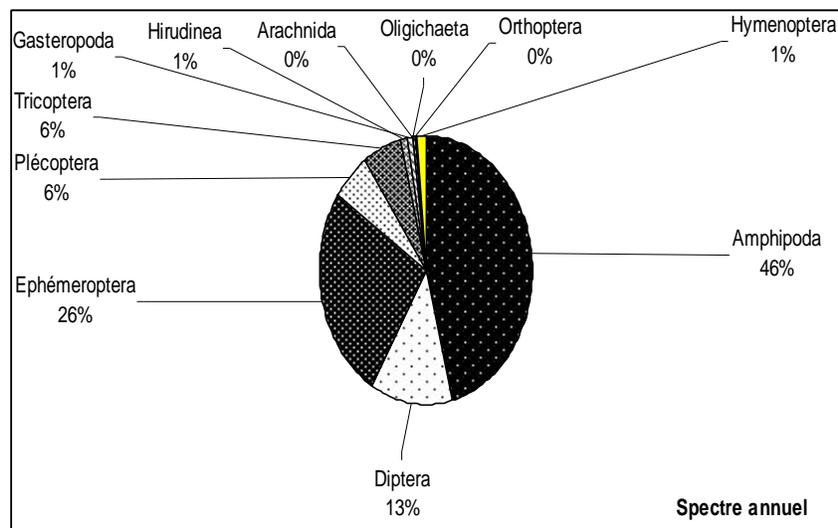


Figure 2: Annual Food Spectrum of the Brown Trout

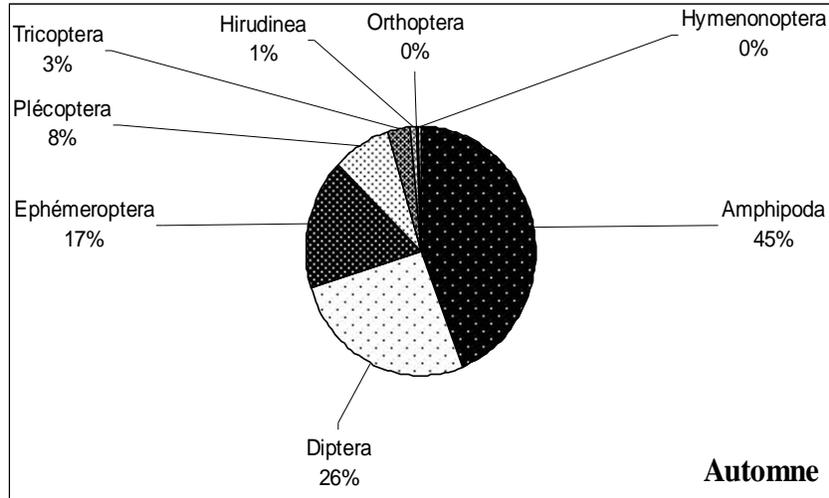


Figure 3: Food Spectrum of the Brown Trout (Autumn)

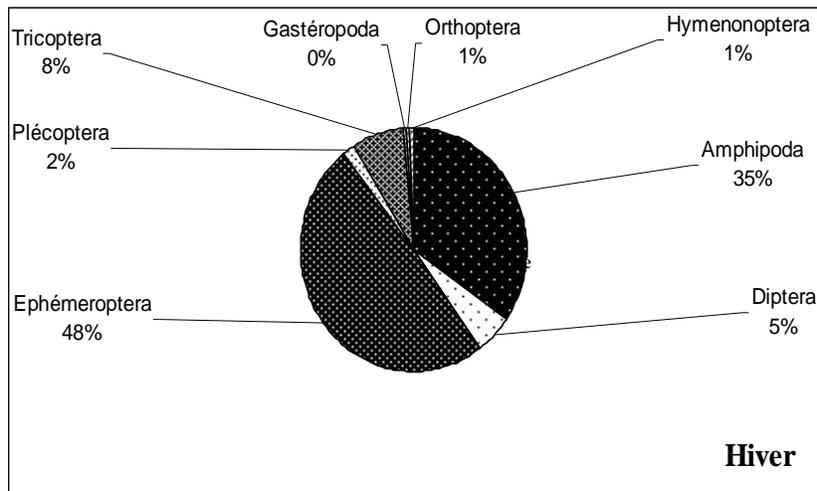


Figure 4: Food Spectrum of the Brown Trout (Winter)

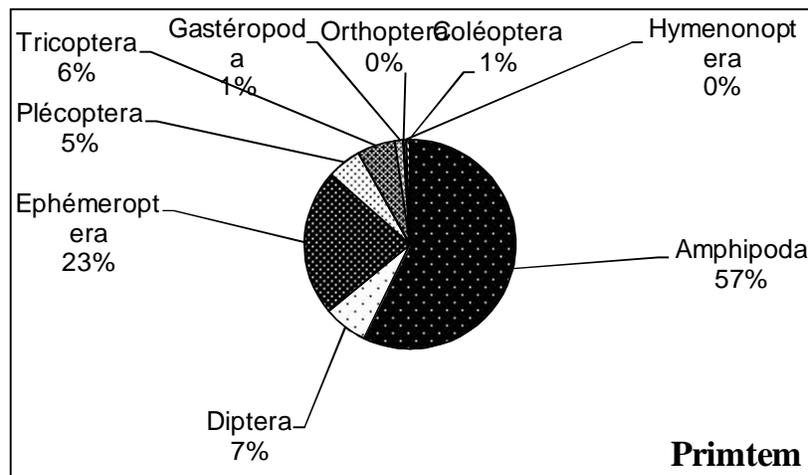


Figure 5: Food Spectrum of the Brown Trout (Spring)

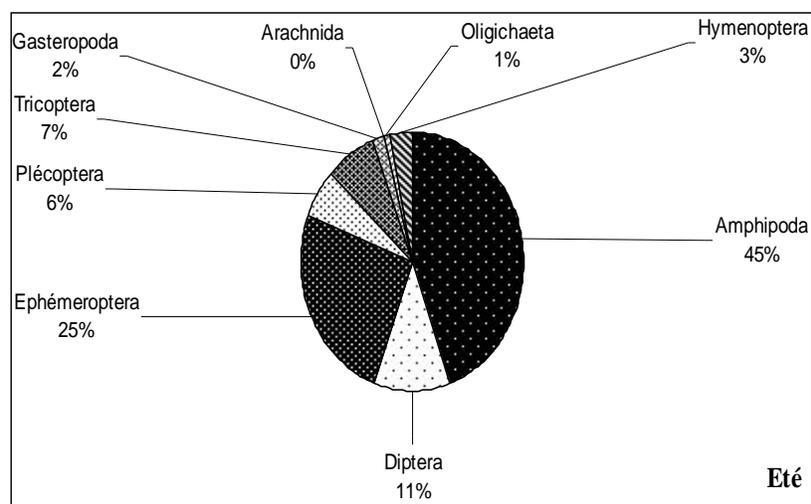


Figure 6: Food Spectrum of the Brown Trout (Summer)

CONCLUSION

The diet of brown trout of the River Sidi Rachid is varied and generally comprises three trophic compartments such as the drift of surface, the drift of the water column as well as the benthos generally well represented during the study period. The amphipods and the larvae of the insects constitute the most abundant taxons in the stomachic contents. This study of the diet also shows that the trout fario has a seasonal diet affected by the physiological state of the fish like the reproduction which greatly influences the rate of vacuity during the winter.

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