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INVESTIGATIONS ON THE PRODUCTIVITY OF THE MACRODECOMPOSER ISOPOD, TRACHELIPUS NODULOSUS C. L. KOCH

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Abstract

The productivity parameters of macrodecomposer Arthropods were investigated on the laboratory populations of the Isopod Trachelipus nodulosus, mainly by laboratory methods. By the measurements the daily food consumption of the adult individuals (C) is 1,57% of their body weight, the daily growth of their biomass is 0,25%. The increase of biomass from components of the production gives a logistic curve as a function of age.

The calorific content of animal body, food and faeces was determined by a Phillipson microbomb calorimeter. The values agree with the data given in the literature for other species.

Introduction

The Isopods were investigated because of their role in decomposition in the earlier years, too (DUDICH et al., 1952; GERE, 1956a, 1956b, 1962; McBRAYER et al, 1971; PARIS et al., 1967; WHITE, 1968). The authors of publications written about the material and energy turnover of these populations made their studies in forests of different types (REICHLE, 1967; SAITO, 1965, 1969; STACHURSKY, 1972, 1974). Little is known about the Isopods' ecological position and role in grasslands (PARIS et al., 1962; PARIS et al., 1965; WIEGERT et al., 1967). No Hungarian investigation is known in this theme. The aim of this work is to examine the productivity of an Isopod species widely distributed in the grassland of the Hungarian Plain.

Materials and Methods

The animals used for measurements were originated from the "Emlékerdő" at Ásotthalom, in the neighbourhood of Szeged and from the area Bugacpuszta in the Kiskunság National Park (Hungary).

The investigated parameters:
- the total food intake (C),
- the production (P),
- the respiration,
- the rejecta (FU), that part of total food intake wich is not used for production and respiration.

The single parameters were named on the basis of the nomenclature of PETRUSEWICZ (1976a, 1976b), and PETRUSEWICZ and MACFADYEN (1970). The measurements concerning the respiration of the species are discussed in a separate paper, so they are not detailed now.

For determing the food consumption of juvenil and adult animals separate measurings were carried out. As the Isopods are very sensible for the humidity of their surroundings and the change of water content of their food respectively, assuring the suitable circumstances requires much care. For preventing the desiccation of the animals, the experimental populations were kept in glass dishes. On the bottom of the dishes filterpapers cut to size were placed, with their daily re-moistening I insured the required moisture degree of food and air. 100—100 juvenil animals were placed in the dishes in the parallel experiments, inmediately on the day after their hatching. (The individuals were hatched already in the laboratory by pregnant femails collected previously.)

Dead plant material (*Populus alba* leaf-litter) originated from the locality place of the animals was used as food. It was dried (60 °C, 2 days) and the dry weight of every portion given to the animals was weighted. The dry plant material was rehydrated one day long before using. Control measurements were made in every case when plant material—treated in the same way—was placed in dishes without animals, so it was possible to determine the oxidative weight-loss and to make corrections. As on the damp plants mold appears after about 5 days, it seems practical to exchange the plants for new ones. This is confirmed by WHITE's observations (1968). The change in the animals' number was recorded, their living weight was observed and the faeces was removed after every ten days. The remained plant material and feaces were weighted after drying (60 °C, 2 days). During the experiments the environmental temperature was 20 °C. There was no possibility to remove the dead individuals and the exuviae because they were aeten by the animals presumably for supplying their high Ca-demand. So called model-populations — consisting 5—5 individuals — were used for determining the food consumption of adult animals. It was carried out under the same circumstances as before. These measurements were continued 10—10 days, the total biomass, then it's dry weight, the food and food remains, the faeces were weighted — in dry weight — at the beginning and after finishing the experiments. The values measured in laboratory give only informatory data, the examined parameters are influenced by more factors, their volume changes under natural circumstances. The calory contents of animal body, food, faeces were determined by Phillipson microbomb oxygen calorimeter. Pills — with the weight of 4—30 mg — were made by pressing from the examined materials, after drying and pulverizing. The samples known in weight were burned in oxygen gas, at 30 atm pressure. After burning the animal body relatively large quantity of ash remained, owing to the high Ca-content, and the data were corrected with its weight. The heat amount resulted by the burning could be read off with intercession of a thermo element on a Honeywell potentiometer. The calibration of the calorimeter was made with benzoic acid.

Results and discussion

Food consumption: Figures 1. and 2. show the food consumption, the cumulative values of FU and A for juvenil laboratory populations in mg/mg animal per day. The initial time means the one day old individuals. Comparing the two figures it is evident that in the case of different initial individual number over and above the prominent irregular mortality, the amount of C, FU and A relating the same time period is also different. (In the same way fundamental differences are concerning the weight growth of the two populations being in dishes with the same surface and supplied with sufficient food.) It appears from the curves that the food consumption of a body weight unit is slowing down in time. That of juveniles is relative higher (Fig. 3). In the case of adult individuals the daily food consumption is 1,57 per cent, the daily growth of their biomass is 0,25 per cent of their body weight.

Assimilation efficiency: the relation of the assimilated material (A) to the food ingested is generally used for the characterisation of the amount of assimilated material. This assimilation efficiency (A/C) was examined in Isopods by different authors. The values given by them are very different, but it turns out unambigously that assimilation efficiency under laboratory circumstances is generally low, it's value remains between 6—53 per cent on the basis of the data detailed in Table 1. Under field circumstances these values are much higher, 53—75 per cent as it turns out from the

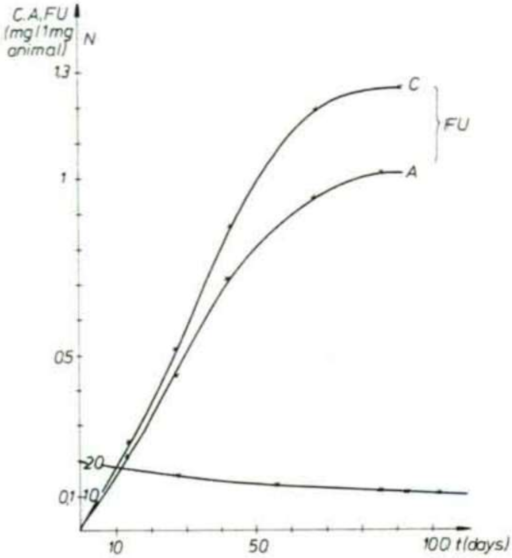

Fig. 1

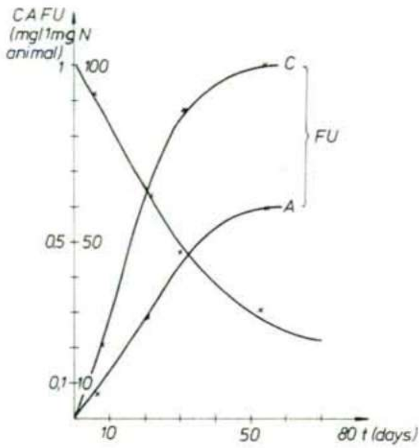

Fig. 2

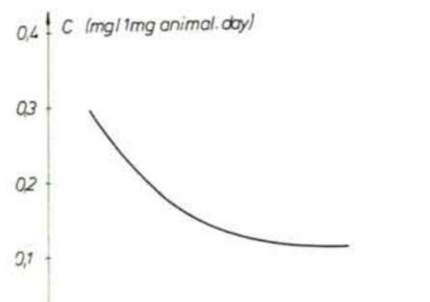

Fig. 3

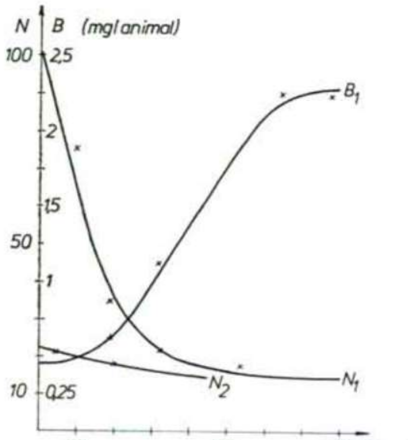

Fig. 4

Fig. 1—2. C, A and FU values of juvenil model populations (mg/lmg animal, 1 day), at different initial individual numbers.

Fig. 3. The food consumption per body weight unit decreases with the growth of body weight.

Change of indi vidual number of model populations in time (N_1) respectively the logistic curve ofbiomass (B_1) changes; mortality at low initial number of individuals (N_2).

measurements of HUBBEL et al. (1965) and REICHLE (1967) who made them with isotop technics. WHITE (1968) proved that the assimilation efficiency is decreasing when the food passes through the intestines rapidly. Under natural circumstances these animals look for sites with lower temperature, where their metabolism is slower and much more effective. The A/C rate depends on the body size of the animals and on the quality of food, too. Among others these can explain the very diverse results of the different authors. In my own investigations the assimilation efficiency of *Tr. nodulosus* was found to be 46,78 per cent. This shows a very good congruence with the ascertainment of SAITO and STACHURSKY who assumed the A/C rate to be 50 per cent.

Table 1	A/C rate (%)	°C	author
Glomeris sp.	10,9—22 23	—	BOCOCK, 1963
Armadillidium vulgare	29—53	20	SAITO, 1969
	64	20	REICHLE, 1967
A. vulgare in laboratory	6—13	23	HUBBEL et
outdoor	53—75	10	al 1965
Oniscus asellus	16.2	20	HARTENSTEIN, 1964
Protracheoniscus politus	16.7	20	GERE, 1956
Cylisticus convexus	60	20	REICHLE, 1967
Ligidium hypnorum	50	—	STACHURSKY, 1974

Faeces: As it turns out from the figures 1. and 2., the rate of faeces (FU) grows with the increase of food consumption (C). Expressed in the rate of consumption (FU/C):

Tr. nodulosus juv. 28—30. days 23—40 per cent
53—86. days 67—75 per cent
Tr. nodulosus adult . 46 per cent

P-ΔB relation: Of the two parameters the change of biomass (B) is measurable, the value of production may be calculated from that:

$$P = \Delta B + E.$$

E — elimination, that is the weight of perished individuals. E was immeasurable in my experiments as the exuviae casted and the dead animals were eaten by the examined Isopods. (SAITO (1970) experienced the same.) I observed also a certain degree of cannibalism at juvenil populations several times. Namely that the companions begin to champ the soft parts of injured respectively casting and therefore nearly helpless animals, and they eat the whole animal at last. Because of the elimination the number of individuals decreases strongly — expecially in the initial time period. This function is shown by N_1 curve of fig. 4., which corresponds to the third type of survival curves established by SLOBODKIN (1962). The tendency of elimination at different initial number is an interesting observation. At lower initial number of individuals (at the same surface) the mortality is considerably less, it shows the adequate part of the curve of higher initial number. This refers to the fact, that the change in individual number is influenced by density dependent factors.

The individual weight-growth was measurable among the outward forms of production in laboratory populations. At juvenils the next relation can be done for the growth of biomass:

$$y = \frac{K}{1 + e^{a+bx}}$$

The growth of biomass is logistic, which corresponds to the hypotetic model of PETRUSEWICZ and MACFADYEN (Fig. 4. B_1).

Energetics: The calorific values of *Tr. nodulosus:*

animal	:3,19 gcal/mg
ash free	:4,378 gcal/mg
faeces	:3,666 gcal/mg
food	:4,382 gcal/mg

During the drying needed for the calorimetry, knowing the living weight of animals, the average dry material — and ash-content can be given:

dry material content in p.c. of living weight	:30,01
ash content in p.c. of dry weight	:31,68

Data with similar type are published by GERE (1962), he gives the water content of the animals percental. The dry material content can easily be counted from this. The dry material content of different Iso- and Diplopods derive from his data are between 31,39—35,99 per cent.

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