CALCULATION OF THE INTRINSIC RATE OF NATURAL INCREASE, \( r_m \), WITH RHABDITIS MARINA BASTIAN 1865 (NEMATODA)

BY

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The life-cycle of Rhabditis marina Bastian 1865 was studied at 25°C and 20‰ salinity. The following demographic parameters were computed from life-table data: the intrinsic rate of natural increase (\( r_m \)) = 0.914 day; net reproductivity (\( R_0 \)) = 400; minimum generation time (\( T_{min} \)) = 4.5 days; cohort generation time (\( T_c \)) = 7.2 days; mean generation time (\( T \)) = 6.6 days; and the age of an adult female when a median egg is deposited (\( T \)) = 6.1 days. Several approximate equations used to estimate \( r_m \) were compared with these life-table calculations. Some give erroneous estimations and should be used with extreme caution. For iteroparous organisms (including most free-living nematodes), \( T_{min} \) only gives an indication of the development time and is therefore unsuitable for describing ‘mean generation time’.

Key words: life-table, net reproductivity, development time, generation time, life cycles.

Rhabditis marina Bastian 1865 is a cosmopolitan species that is both euryhaline and eurythermal (Tietjen et al., 1970; Hopper et al., 1973). It has been collected in great numbers from seaweeds stranded between tides in the upper littoral zone (Inglis and Coles, 1961; Sudhaus, 1974) and from decaying mangrove leaves (Hopper et al., 1973). Sudhaus (1974) illustrates its distribution in Europe, differentiating northern and southern subspecies. Feeding of this species has been studied, both gnotobiotically (Tietjen et al., 1970; Tietjen and Lee, 1977a) and axenically (Tietjen and Lee, 1975). Although R. marina has been studied very intensively, no life table data are available.

This paper discusses the intrinsic rate of natural increase ‘\( r_m \)’ as originally defined by Lotka for a population with a stable age-distribution and growing in an unlimited environment. It is calculated from:

\[
\sum_{x=0}^{\text{max age}} e^{-r_m x} \cdot l_x \cdot m_x = 1
\]

requiring knowledge of age-specific survival (\( l_x \)) and age-specific fecundity (\( m_x \)). Traditionally these are summarized in life tables (see Mertz (1970) and Southwood (1978) for a lucid discussion of concepts). However, some confusion has arisen about \( r_m \) because many authors (Tietjen and Lee, 1977b; Alongi and Tietjen, 1980; Romeyn et al., 1983) use \( r_m \) as the actual rate of increase in any environment whether or not the population has a stable age distribution.
where \( t \) is time and \( N \) the number of individuals. In the following we shall use \( r_m \) as the increase defined by equation (1).

Several approximate methods for the calculation of \( r_m \) have been used:

a. The capacity of increase (Laughlin, 1965):

\[
 r_c = \frac{\ln R_0}{T_c}
\]

where \( R_0 \) is the net reproductivity,

\[
 R_0 = \sum_{x=0}^{\text{max age}} l_x m_x
\]

\[
 T_c = \frac{1}{R_0} \sum_{x=0}^{\text{max age}} x l_x m_x
\]

b. the formulae used by Heip et al. (1978) for the predatory nematode *Oncholaimus oxyurus*:

\[
 r_m = \frac{1}{T_{\text{min}}} \ln (p N_e)
\]

where \( T_{\text{min}} \) is the minimum generation time (= time between two identical stages of successive generations), \( p \) the proportion of females in the adult population and \( N_e \) the total number of eggs produced by an average female (fertility);

c. the estimations used by Grootaert (1976) for the saprophagous nematode *Mesodiplogaster lheritieri*, Grootaert and Jacques (1979) for the predatory nematode *Butlerius degrissei* and Grootaert and Small (1982) for the predatory nematode *Labronema vulvapapillatum*:

\[
 r_m = \frac{\ln (p N_e^*)}{T_{\text{min}}}
\]

where \( N_e^* \) is the daily egg-production.

**MATERIAL AND METHODS**

*Rhabditis marina* was obtained from the "Dievengat" a polyhaline brackish water pool, situated near the Nature Reserve "het Zwin" in north-western Belgium. Following the method described by Vranken et al. (1982), *R. marina* was cultivated in a 0.8% bacto-agar, made with water from the Dievengat (20/00 salinity) enriched with 1% Vlasblom-medium (Vranken et al., 1982) and 0.5-1.0% Na₂SiO₃·9H₂O (0.053 M stock solution). Unidentified bacteria, supplied in excess, served as food-supply. Salinity during the experiments was measured with a refractometer. The experiments were carried out in the dark with animals adapted to room temperature. The development of 47 eggs was followed at 25°C and 20/00 salinity.