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NOTE

Community structure and vertical distribution of cyclopoid and poecilostomatoid copepods in the Red Sea. III. Re-evaluation for separating a new species of *Oncaea*

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ABSTRACT: Fine mesh net samples from the upper mesopelagic zone (100 to 450 m) of the central and northern Red Sea during autumn and winter 1980-81 were re-examined to separate the abundance and vertical distribution of 2 very similar small *Oncaea* species, *O. tregoubovi* and *Oncaea* sp. K, which previously had been considered as a single species. *O. tregoubovi* is more abundant and lives at deeper layers than *Oncaea* sp. K. The new results alter the ranks of important cyclopoid and poecilostomatoid species in both subzones of the upper mesopelagic zone, although the dominance of *O. tregoubovi* in the lower part, at 250 to 450 m, still remains very high.

In a detailed study on the abundances and vertical distribution patterns of small pelagic cyclopoid and poecilostomatoid copepods from the central and northern Red Sea during autumn and winter 1980-81 (Böttger-Schnack 1988, 1990a, b), *Oncaea tregoubovi* Shmeleva was reported to be one of the most numerous species in the upper mesopelagic zone, dominating especially in the 250 to 450 m depth layer. In the course of a recent analysis of microcopepods sampled in the same area during summer 1987 (Böttger-Schnack unpubl.) it was noticed that the taxon previously identified as *O. tregoubovi* also included a very similar species, which is still unidentified and referred to as *Oncaea* sp. K hereafter (see Böttger-Schnack 1988).

Oncaea sp. K is similar to *O. ivlevi* Shmeleva in the shape of the caudal rami and genital segment, but lacks the conspicuous stout spine on the external posterior margin of caudal rami. It also resembles *O. prendeli* Shmeleva in certain characters, but differences in body proportions and the length ratio of the genital segment to the rest of the urosome segments separate the 2 species. The taxonomic description of these small *Oncaea* species is rather poor. *O. ivlevi* and *O. prendeli* were first described by Shmeleva (1966, 1969), *O. tregoubovi* was described by Shmeleva (1968, 1969). A redescription of both sexes of *O. ivlevi* and of female *O. tregoubovi* was given by Malt (1982). A more detailed description of this taxon from the Red Sea is needed.

The present study re-examines the autumn-winter plankton material obtained with a fine mesh net from the Red Sea to separate *Oncaea tregoubovi* and *Oncaea* sp. K quantitatively. The new data complement and revise the earlier results on community structure and vertical distribution of cyclopoid and poecilostomatoid copepods given by Böttger-Schnack (1988, 1990a, b).

Methods. The quantitative re-analysis of the 2 species was conducted on subsamples from 11 vertical profiles which had been taken with a 0.1 mm mesh multiple opening-closing net at 50 m intervals, between depths of 100 and 450 m. Samples from the epipelagic zone (0 to 100 m) were not re-evaluated quantitatively, as they were known to contain only very small numbers of the species (< 5 % of the total standing stock of both species combined). Three vertical daytime series were each analysed from the central Red Sea (above Atlantis II Deep) during autumn (October-November 1980) and winter (February 1981) and from the northern Red Sea (above Kebrit Deep)

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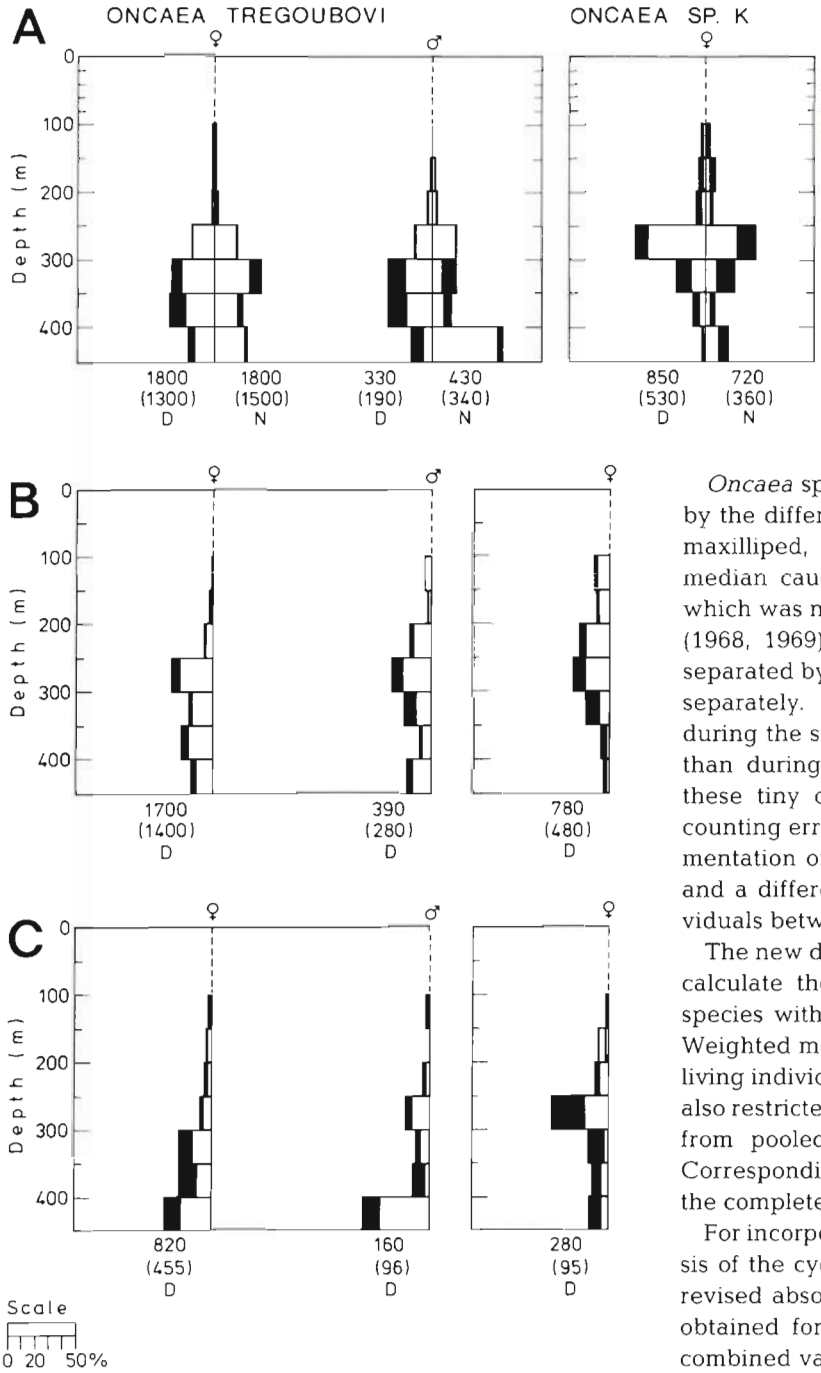

Fig. 1 *Oncaea tregoubovi* (left panels), *Oncaea* sp. K (right panels). Corrected vertical distributions during day (D) and night (N) in the central Red Sea during (A) autumn and (B) winter, and (C) in the northern Red Sea during autumn. Percentage values are given per 50 m depth interval. Mean total standing stocks of dead and living individuals beneath 0.25 m^2 in the 100 to 450 m layer given below each profile were calculated using new data from second analysis (see text); values in parentheses refer to the total number of living individuals. Unfilled bar: living ind.; solid bar: dead ind.

during autumn 1980. Two nighttime series from the central Red Sea during autumn were also re-evaluated in order to investigate possible diurnal vertical migration of the species. For details of the sampling methods, subsampling techniques, criteria for the determination of carcasses, and environmental data during the sampling period see Böttger-Schnack (1990a, b).

Oncaea sp. K was distinguished from *O. tregoubovi* by the different body forms, the ornamentation of the maxilliped, and the presence of a long 'saw-like' median caudal seta in both sexes of *O. tregoubovi*, which was not noticed in the descriptions of Shmeleva (1968, 1969) and Malt (1982). Adult copepods were separated by species and sex. Carcasses were counted separately. Total number of individuals observed during the second analysis was about 5 to 10 % lower than during the first analysis. Besides some loss of these tiny organisms during handling and/or some counting error, this may have been mainly due to fragmentation of fragile carcasses after the first counting and a different separation of 'dead' and 'living' individuals between the 2 studies.

The new data from this second analysis were used to calculate the percentage depth distribution of both species within the 100 to 450 m depth layer (Fig. 1). Weighted mean values for standing stock of dead and living individuals given below each profile in Fig. 1 are also restricted to this depth range. Values were derived from pooled day and night samples, respectively. Corresponding values from individual vertical series of the complete analysis differed by less than 5 %.

For incorporation into the preceding complete analysis of the cyclopoid and poecilostomatoid community, revised absolute and relative abundance values were obtained for both species by splitting the originally combined values (Böttger-Schnack 1988, Table 2, and 1990b, Tables 1, 4 & 5) according to the abundance ratios derived from the present analysis.

Results and discussion. Independent of seasonal and regional differences, the following generalizations can be made with regard to the population characteristics of the 2 species in the Red Sea. Compared to *Oncaea tregoubovi* the population of *Oncaea* sp. K lives at shallower depths (Fig. 1), occurs in lower total abundance (Table 1), includes a lower proportion of males (Table 2) and has a higher proportion of carcasses (Fig. 1).

Table 1. *Oncaea tregoubovi, Oncaea* sp. K. Corrected daytime standing stocks in the upper 450 m of the central and northern Red Sea during autumn and winter 1980-81. Abundance values were calculated by splitting the abundance data of the first analysis (Böttger-Schnack 1988, Table 2, and 1990b, Tables 1 & 5) according to the abundance ratio obtained during the re-examination (see text). $\bar{x}$: Mean abundance beneath 0.25 m^2; R: range; %: mean percentage of each species of total number. Sexes are (F) females, (M) males

Species	Sexes	$\bar{x}$	R	%
Central Red Sea (Atlantis II Deep)				
October-November 1980 (autumn)				
Oncaea tregoubovi	F M	1600	1000–2400	4.8
Oncaea sp. K	F M	570	370–840	1.6
Total cyclopoids and poecilostomatoids		34000	30000–39000	100
February 1981 (winter)				
Oncaea tregoubovi	F M	1900	1500–2500	4.4
Oncaea sp. K	F M	590	470–790	1.4
Total cyclopoids and poecilostomatoids		42000	32000–50000	100
Northern Red Sea (Kebrit Deep)				
October 1980 (autumn)				
Oncaea tregoubovi	F M	620	490–780	2.5
Oncaea sp. K	F M	110	86–140	0.4
Total cyclopoids and poecilostomatoids		25000	18000–31000	100

Table 2. *Oncaea tregoubovi, Oncaea* sp. K. Percentage of males in adult populations in the Red Sea. Arithmetic mean ($\bar{x}$) and range (R) were derived from the pooled data of 3 vertical series in the 100 to 450 m depth layer taken during daytime

Species	$\bar{x}$	R
Central Red Sea (Atlantis II Deep)		
October-November 1980 (autumn)		
Oncaea tregoubovi	12.5	12–14
Oncaea sp. K	2.4	0–4.8
Oncaea tregoubovi	17	12–20
Oncaea sp. K	3.9	1.6–5.7
Northern Red Sea (Kebrit Deep)		
October 1980		
Oncaea tregoubovi	17	11–25
Oncaea sp. K	2.8	0–5.0

In the central Red Sea during autumn, female *Oncaea tregoubovi* were more or less evenly distributed between 250 and 450 m, with no obvious diurnal vertical movement (Fig. 1A). Males had a similar depth distribution to females during the day but showed a conspicuous accumulation in the 400 to 450 m depth layer at night (Fig. 1A). Female *Oncaea* sp. K occurred mainly at 250 to 300 m with no diurnal variation (Fig. 1A). Male *Oncaea* sp. K were caught irregularly and mostly between 100 and 300 m, their numbers were too low to allow for a reliable calculation of their percentage depth distribution.

In a recent analysis of sampling series taken down to 1050 m during summer 1987, it was found that *Oncaea tregoubovi* occurred in high abundances also in the *lower* mesopelagic zone at 450 to 600 m (Böttger-Schnack unpubl.). Thus, the interpretation of the present data on vertical migration for this species has to be done with care, since only samples above this depth were considered.

Comparing the results from autumn and winter in the central Red Sea, differences in the abundance (Table 1), the sex ratio (Table 2) and vertical distribution (Fig. 1B) of both species were only minor.

Comparing the results from the central and northern Red Sea during autumn, more pronounced differences were found for the 2 species: the standing stocks of living individuals were lower (Table 1) and the percentages of carcasses were higher in the north (Fig. 1A, C). *Oncaea* sp. K seemed to find less favourable conditions in the northern area than *O. tregoubovi*, judged by the somewhat stronger decrease in number and the stronger increase in the proportion of carcasses. The vertical distribution of both sexes of *O. tregoubovi* showed a downward shift by about 50 to 100 m to the north (Fig. 1C). A similar observation had previously been made for several other oncaeid species (Böttger-Schnack 1990b). It corresponds with differences in the depth of the oxygen-minimum zone, which was situated ca 100 m deeper in the northern region than in the central part. For female *O. tregoubovi*, however, the regional change in vertical distribution had not been previously noted, due to the combination with female *Oncaea* sp. K.

Table 3 [from Table 4 of Böttger-Schnack (1990b)] summarizes the absolute and relative abundances of dominant cyclopoid and poecilostomatoid species, i.e. those contributing more than 1 % to the total number in a respective layer, for the 2 different vertical zones investigated in the present study. Due to the separation of *Oncaea* sp. K, previously combined with *O. tregoubovi*, there are some changes in ranking the species in both subzones of the upper mesopelagic zone. *O. tregoubovi*, however, still remains one of the most numerous species in the lower part of the upper mesopelagic zone, at 250 to 450 m (Table 3).

Table 3. Corrected daytime standing stock (n = no. ind. beneath 0.25 m^2) and percentages of total numbers in a layer (%) of dominant cyclopoid and poecilostomatoid species in the upper mesopelagic zone in the central (Atlantis II Deep) and northern (Kebrit Deep) Red Sea during winter and autumn 1980–81. Only species contributing more than 1 % to the total cyclopoids and poecilostomatoids in a given layer are considered. Species listed in order of decreasing n. Corrected values for *Oncaea tregoubovi* and *Oncaea* sp. K are given in **bold** (for calculation see 'Methods')

Central Red Sea, winter 1981			Central Red Sea, autumn 1980			Northern Red Sea, autumn 1980		
Species[a]	n	%	Species[b]	n	%	Species[c]	n	%
			Upper mesopelagic, O_2-gradient (100–250 m)					
Paroithona sp.	1800	20	*Paroithona* sp.	850	16	*Paroithona* sp.	920	22
Oncaea zernovi	1150	13	*Oncaea zernovi*	750	14	*Oncaea zernovi*	480	12
Oncaea dentipes	370	4.2	*Oncaea dentipes*	270	5.3	*Oncaea dentipes*	360	8.9
Oncaea ivlevi	280	3.2	*Oncaea ovalis*	250	4.9	*Oncaea ivlevi*	120	2.9
***Oncaea* sp. K**	**255**	**2.9**	*Oncaea ivlevi*	240	4.7	*Oncaea minuta*	100	2.5
Oncaea tregoubovi	**225**	**2.6**	*Oncaea media* f. *minor*	220	4.3	*Oncaea ovalis*	83	2.0
Oncaea minuta	175	2.0	*Oithona simplex*	155	3.0	*Oithona simplex*	81	2.0
Oncaea simplex	130	1.5	***Oncaea* sp. K**	**53**	**1.0**	*Oncaea media* f. *minor*	46	1.6
Oncaea media f. *minor*	120	1.4				***Oncaea tregoubovi***	**45**	**1.5**
Oncaea ovalis	120	1.3						
			Upper mesopelagic, O_2-minimum (250–450 m)					
Oncaea tregoubovi	**1600**	**29**	***Oncaea tregoubovi***	**1500**	**27**	*Oncaea ovalis*	910	30
Oncaea ovalis	1000	18	*Oncaea ovalis*	1100	19	***Oncaea tregoubovi***	**550**	**18**
Oncaea zernovi	680	13	***Oncaea* sp. K**	**500**	**9.1**	*Oncaea zernovi*	390	13
Oncaea media f. *minor*	410	7.6	*Oncaea zernovi*	320	5.6	*Oncaea media* f. *minor*	175	5.8
***Oncaea* sp. K**	**265**	**4.8**	*Oncaea media* f. *minor*	250	4.4	*Oncaea minuta*	120	4.1
Paroithona sp.	71	1.3	*Paroithona* sp.	160	2.8	***Oncaea* sp. K**	**85**	**2.8**
Oncaea ivlevi	56	1.0	*Oncaea ivlevi*	160	2.8	*Paroithona* sp.	73	2.4
			Oncaea hawii[d]	120	2.2	*Oncaea ivlevi*	54	1.8
			Lubbockia squillimana	82	1.4	*Lubbockia squillimana*	52	1.7
			Oncaea minuta	82	1.4	*Oncaea hawii K*[d]	37	1.2

[a] Sexes/stages given in Table 1 of Böttger-Schnack (1990b)
[b] Sexes/stages given in Table 1 of Böttger-Schnack (1990a)
[c] Sexes/stages given in Table 5 of Böttger-Schnack (1990b)
[d] *Oncaea* sp. E/F in Böttger-Schnack (1990a, b)

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