HYDRODYNAMIC PROPERTIES OF SOME PELAGIC CRUSTACEA FROM THE NORTH-EQUATORIAL GULFSTREAM

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I. SUMMARY

Measurements on underwater weight, weight in air and terminal sinking rate were collected using 8 different species of pelagic crustacea from the North-Equatorial Gulfstream. From these data (1) animal density, (2) shape constant, determining frictional resistance at terminal sinking velocity and (3) an estimate for the minimum power requirement for keeping depth were derived.

Densities varied between 1.036-1.1112 $g.ml^{-1}$; shape constants ranged between 465 and 1280; power demand (per gram) ranged between 4.5 and 24 µWatt/gram fresh weight.

In species found at different localities a clear intraspecific variation of density and shape constant is observed; by the contribution of the exoskeleton to the density of crustaceans, density and shape constant are positively related.

The relatively low densities correspond to the pelagic modes of life; the low shape constants, which do not contribute

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III. MATERIAL AND METHODS

The measurements were carried out using the following species: *Systellaspis debilis* (A. Milne Edwards), *Phyllosoma* larvae (Palinuiridae); *Glaucothoe* larvae (Paguridae), *Streetsia challengeri* (Stebbing), *Phrosima semilunata* Risso, *Parapronoe crustallum* Claus, *Phromina sedentaria* (Forskal) and *Sergestes henseni* Ortman.

The animals were collected during the "NECTAR" expedition in November 1978 with the vessel "H.M. Tydeman", using an Isaacs-Kidd mid-watertrawl, meshsize 5 mm, trawling time 1.3-2.5 hour at depths between 0-300 m. Positions were: $18^{o}13'$WL/ $23^{o}24'$NB (station 2); $23^{o}20'$WL/$19^{o}49'$NB (station2) and $27^{o}40'$WL /$19^{o}54'$NB (station 3). The animals obtained were fixated in 4% formaline/seawater; measurements of weight in air, underwater weight and sinking rate were carried out at the laboratory on Texel. Animal density was derived from the values for weight in air and underwater weight; as fixation in formaline might affect density (by watersubstraction and reactions of formaline with body proteins) the values should be considered with great care. Fixation in formaline is supposed to have no influence on body shape, determining the drag coefficient viz, the ratio of underwater weight and terminal sinking velocity.

Table I.

Density ($S_a^{20°}$), shape constant (c) and power requirement (P_i) for maintaining constant depth for various pelagic crustaceans from the North Equatorial Gulfstream (N, number of animals; σ, standard deviation).

Genus and species	Sta.	W_{min}-W_{max} (gram)	N	S_a^{20} ($g.ml^{-1}$)	σ	c	σ	$\bar{w}$ (gram)	P_i ($\mu Watt.g^{-1}$)
Decapoda									
Systellaspis debilis	2	0.19-2.34	20	1.066	0.009	72.4	121	0.17	10.8
	3	0.14-4.34	20	1.063	0.007	594	159	0.17	12.7
	4	0.09-2.94	20	1.045	0.007	501	101	0.17	4.5
	av.		60	1.058	0.012	607	157		
Phyllosoma larvae	2	0.04-0.36	15	1.050	0.014	1280	683	0.16	2.4
	3	0.03-0.22	15	1.041	0.010	1033	376	0.16	1.4
	4	0.04-0.26	3	1.033	0.009	628	106	0.16	0.7
	av.		33	1.044	0.013	1109	552		
Glaucothoe larvae	2	0.04-0.07	10	1.112	0.012	896	122	0.05	24.0
	3	0.04-0.07	15	1.084	0.008	740	135	0.05	15.5
	4	0.03-0.05	15	1.086	0.032	918	396	0.05	13.2
	av.		40	1.092	0.024	846	271		
Amphipoda									
Streetsia challengeri	2	0.01-0.15	15	1.084	0.021	811	230	0.08	16.2
Phrosima semilunata	2	0.09-0.52	10	1.055	0.009	505	101	0.31	6.7
	3	0.24-0.39	3	1.036	0.008	520	224	0.31	1.8
	av.		13	1.051	0.009	508	129		
Parapronoe crustullum	3	0.06-0.15	3	1.057	0.011	483	210	0.10	9.38
	4	0.04-0.14	8	1.054	0.011	465	149	0.10	8.0
	av.		11	1.055	0.010	470	157		
Phromina sedentaria	4	0.03-0.25	4	1.040	0.012	784	547	0.14	1.6
Euphausiacea									
Sergestes henseni	2	0.04-0.10	20	1.078	0.010	643	120	0.07	15.1
	3	0.03-0.13	20	1.060	0.007	521	84	0.07	9.4
	4	0.02-0.13	20	1.060	0.009	503	115	0.07	9.7
	av.		60	1.066	0.012	555	123		

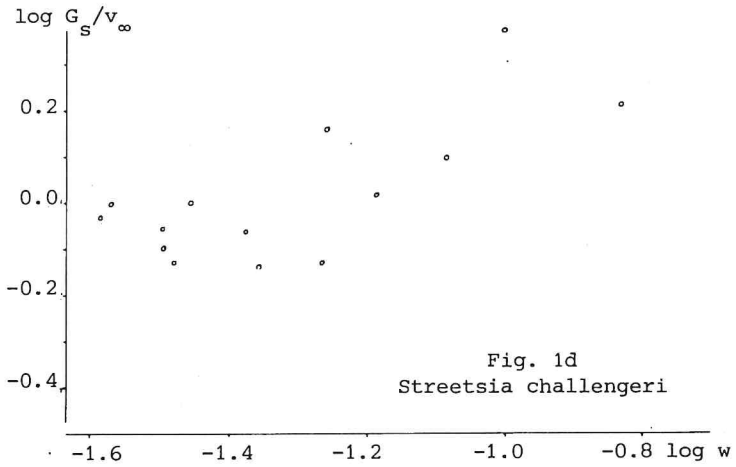

Fig. 1d
Streetsia challengeri

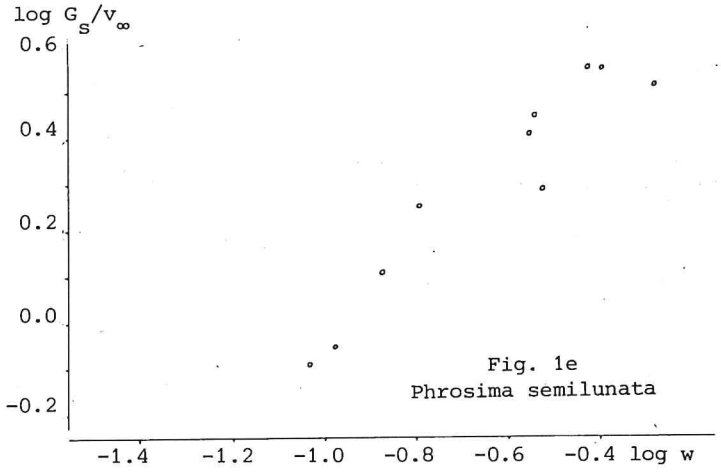

Fig. 1e
Phrosima semilunata

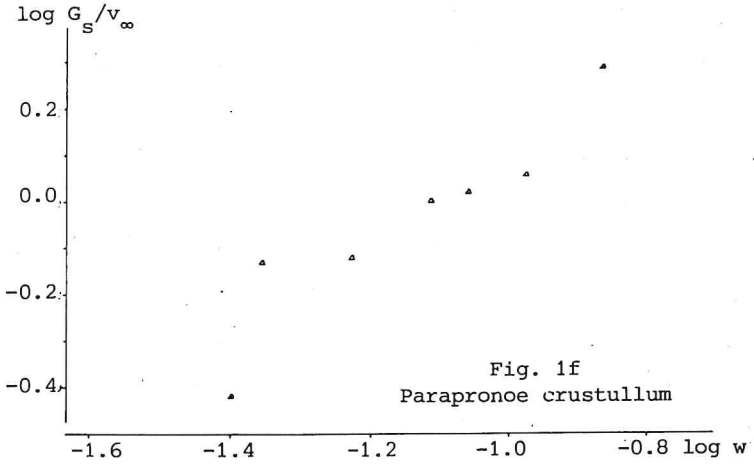

Fig. 1f
Parapronoe crustullum

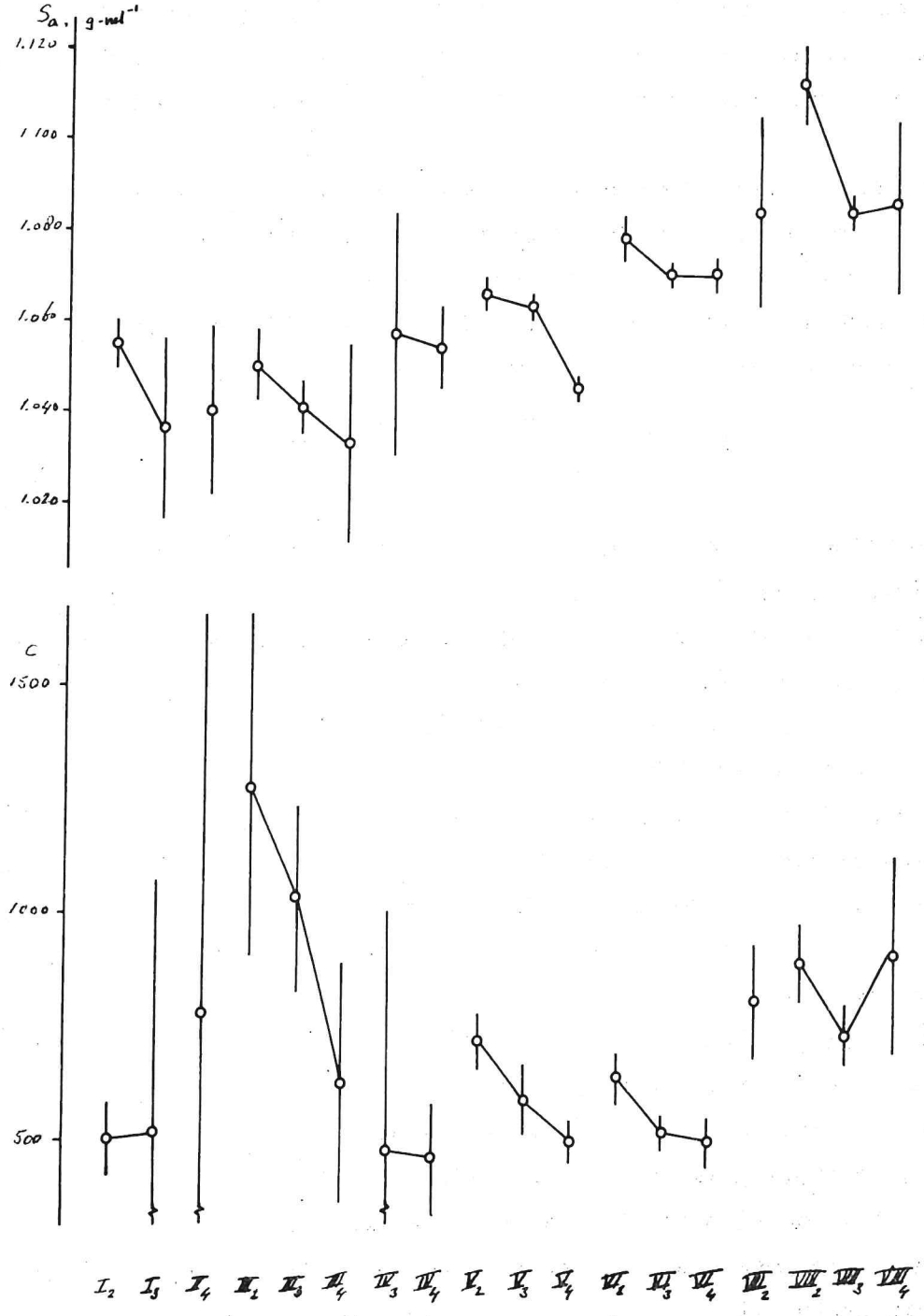

Fig. 2. Density (s_a) and shape constant (c) in various pelagic crustaceans: I. *Phrosima semilunata;* II. *Phromina sedentaria;* III. *Phyllosoma* larvae; IV. *Parapronoe crustullum;* V. *Systellaspis debilis;* VI. *Sergestes henseni;* VII. *Streetsia challengeri;* VIII. *Glaucothoe* larvae. The indices refer to the different stations of collection.

shape constant and (4) a high medium viscosity, which means a low water temperature. The data obtained suggest that all animals considered here are mainly adapted by applying the first two strategies.

V. REFERENCES

CHILDRESS, J.J. & M. NYGAARD, 1974. Chemical composition and buoyancy of midwater crustaceans as a function of depth of occurrence off South California.—Mar. Biol. 27: 225-238.

MORRIS, R.W., 1971. Comparison of the fat composition of oceanic copepods from different depth.—Comp. Biochem. Physiol. 40B: 275-281.

SPAARGAREN, D.H., 1979. Hydrodynamic properties of benthic marine Crustacea. I. Specific gravity and drag coefficients.—Mar. Ecol. Prog. Ser. 1(4): 351-359.

——, 1980. Hydrodynamic properties of benthic marine crustacea. II. Energy requirements for maintaining vertical position.—Mar. Ecol. Prog. Ser. 2(1): in press.