Assessment of storage lipid accumulation patterns in eucalanoid copepods from the eastern tropical Paci c Ocean

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a r t i c l e i n f o

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Accepted 1 les of particulate matter were generated to help
gies of these species and on differential accumulation of
x ester and triacylglycerol storage lipid components of these
ions around the oxygen minimum zone. Additional data on
ol fractions were also generated to obtain a comprehensive
s spp. accumulated relatively large amounts of storage lipids
.4(xplaining)-275.3(wh)29.2(y)-249.4(a)-272.8(give)15.8(n)-277.6(species)-275.5(accumulates)-273.1(primarily)-261.7(triacylgly)33.7(cerols)-264.7(or)-278.4(w)25.6(a)0(x)-252.8(esters,)-271.3(and)-268.9
water.t

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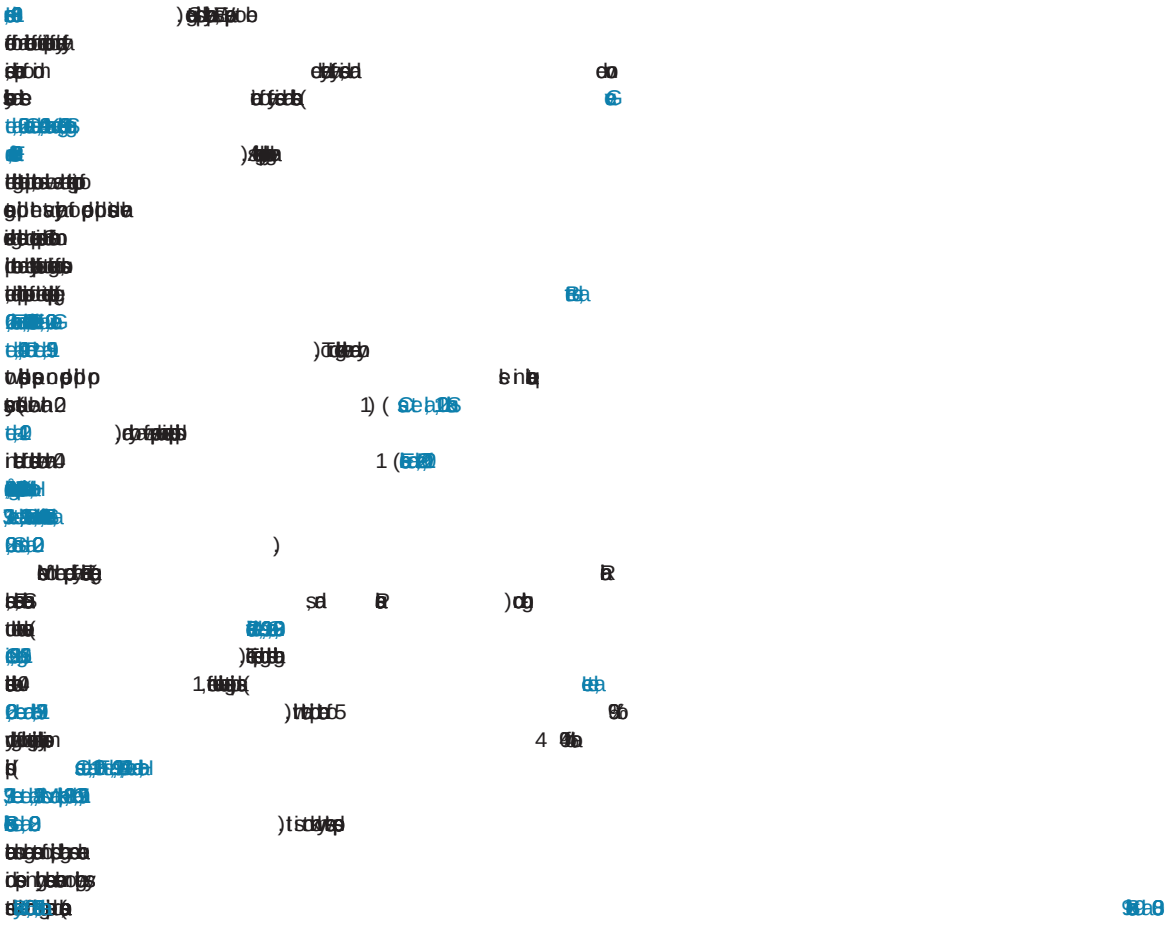


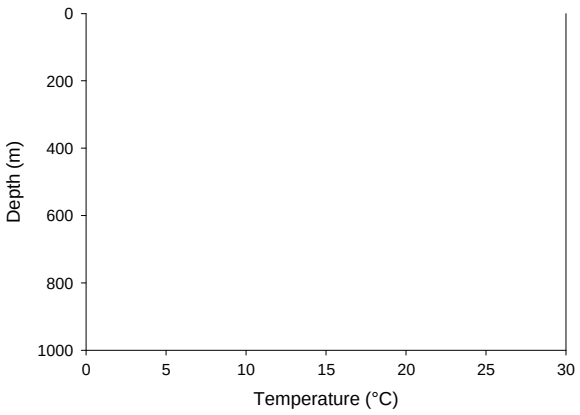
and height (h) dimensions were also recorded for visible lipid sacs and the volume of each lipid sac was estimated using the equation for an ellipsoid (V¼(4/3) n n(h/2) n(w/2) n(l

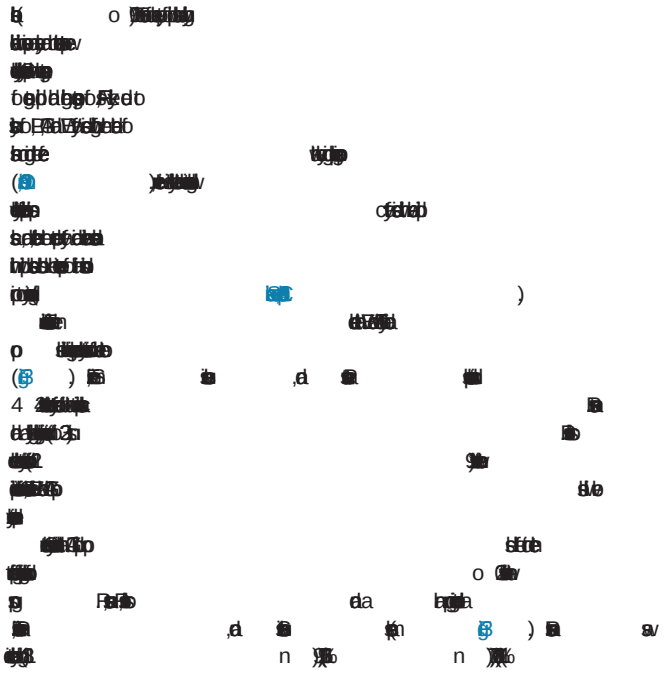
2.2. Copepod collection and measurement

Copepods included in lipid samples were collected at both the Tehuantepec Bowl and Costa Rica Dome using bongo tows, Tucker trawls, and MOCNESS (Multiple Opening/Closing Net and Environmental Sampling System) (Wiebe et al., 1976) tows in the upper 300 m of the water column. Copepods were collected from their respective depths of maximum abundance as determined by the MOCNESS (data courtesy of K. Wishner). Adult female Subeucalanus subtenuis and Pareucalanus attenuatus were targeted in the upper 50 m, while Rhincalanus rostrifrons and R. nasustus were primarily collected in the 200 –300 m range (for further information on Rhincalanus spp. collection, please see Cass et al. (2011)). Eucalanus inermis adult males were collected from the upper 50 m and adult females were collected from both the upper 50 m and 200–300 m depths (designated as shallow and deep individuals, respectively). Due to variations in abundance and spatial distribution between years, adult female R. nasutus were only collected in 2007 and adult female P. attenuatus were only collected in 2008. During both years, the Costa Rica Dome tows contained a wider diversity of the target species. Therefore, copepods used for these analyses were primarily collected at the Costa Rica Dome station. Exceptions to this include the S. subtenuis sample from 2007 and the E. inermis male, P. attenuatus, and S. subtenuis samples from 2008, where copepods collected at both stations were pooled to obtain the number of individuals needed for the lipid sample. E. inermis females from the upper 50 m in 2007 were all collected at the Tehuantepec Bowl.

Immediately after capture, copepods were sorted and individuals of each species were separated into small vessels containing 0.2 m ltered seawater at in situ temperature and held for approximately 3–12 h to allow them to empty their guts. All individuals were frozen in cryovials at 80 1C on board the ship and in land-based laboratory facilities. After both cruises, samples were shipped in dry ice between the port and the University of South Florida to ensure appropriately low storage temperatures were maintained.

Prior to lipid extraction, individuals were thawed and quickly measured for total and prosome length (in mm). Length (l), width (w)


0
200
400
600
800
1000
Depth (m)
0
5
10
15
20
25
30
Temperature (°C)



pro les: the two chlorophyll maxima samples (38 and 28 m in 2007 and 2008, respectively), the two deepest samples in 2007 (260 and 325 m) and the two deepest samples in 2008 (264 and 540 m) (Fig. 3). Major fatty acids for the chlorophyll maxima group included 16:0 (23 –30%), 14:0 (13%), 16:1(n 7) (9–11%), 22:6(n 3) (7–13%), 18:0 (4–8%), 18:1(n 9) (4–5%) and 20:5(n 3) (4%) (Table 4). Deep samples from 2007 had primarily 18:0 (42 –53%) and 16:0 (27 –33%) fatty acids with smaller amounts of 18:1(n 9) (5–7%), 16:1(

low overall alcohol content and erratic accumulation patterns. Within the Pareucalanus and Rhincalanus genera, each species showed very different fatty alcohol accumulation patterns, with distances of 4 55 units between species (Table 6). R. rostrifrons accumulated primarily 18:1 (71%), 16:1 (24 –25%) and 16:0 (4 5%) fatty alcohols. R. nasutus pro les only contained 16:0 (60%), 14:0 (31%) and 18:0 (8%) alcohols, while P. attenuatus had a more general accumulation pattern, with 18:0 (29%), 18:1 (27%), 14:0 (18%), 16:1 (15%) and 16:0 (11%) being almost equally abundant.

Sterol pro les among the copepods were highly similar, with cholest-5-en-3 -ol (75 –96%) and cholesta-5,22E-dien-3 -ol (3–25%) as the only sterols regularly observed at 4 1% of total sterols (Table 7). Cluster analyses indicated that although sterols in all copepods were generally similar (distances of o 30 units between all samples), three different groups of copepod samples emerged with distances of o 10 units within groups. One group was comprised of R. rostrifrons (cholest-5-en-3

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providing further support for a common food source for individuals found at all depths. Overall, this suggests feeding near the

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