陽明山國家公園向天池
真湖蚌蟲攝食構造發育研究

受委託者：國立台灣大學生態學與演化生物學研究所

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Abstract

Keywords: Branchiopoda; functional morphology, ontogeny, feeding

1. Introduction

Eulimnadia brauerianafrom Siangtian pond, Yangmingshan National Park had been demonstrated to change their phototaxis from positive to negative through ontogeny. From the changein phototaxis and range of activity, we hypothesized that the change in phototaxis might be related to changes in feeding habits. Since their morphology also changes greatly, and function is highly related to morphology, the aim of this study is to understand the feeding ability of E. brauerianathrough studying ontogenin morphology

2. Material and methods

Eulimnadiabrauerianawere sampled and sorted according to their developmental stage. The time needed to reach each stage was recorded and specimens were examined under stereomicroscope and scanning electron microscope.

3. Results and discussion

The most significant change from nauplius to juvenile stage should be the growth of carapace and thoracopods. In addition, the main feeding structures used at the nauplius stage (spines on the second antenna and mandible basis) reduced, and the feeding structures of juveniles were almost identical to those of mature individuals. Based on morphology, the nauplii should feed on planktonic particles, while juveniles and adults might feed by suspending benthic particles. The timing in morphological changes was identical to those in phototaxis, suggesting correlation

between morphology and phototactic behavior

4. Suggestions

The life of *E. brauerianai* is closely linked and strongly affected by the soil of Siangtian pond. But various religious groups visiting this side frequently include burning incents and other things in their ceremony. This behavior would disturb the dormant egg ban, change the content of superficial soil drastically, and is also very dangerous. More frequent patrolling is suggested, along with promoting the right concepts to visitors, in hope to decrease further damage.

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[2] Olesen, J. 2007. Monophyly and phylogeny of branchiopoda, with focus on morphology and homologies of branchiopod phyllopodous limbs. Journal of Crustacean Biology 27(2): 165-183

[3] Olesen, J. 2003. On the ontogeny of the Branchiopoda (Crustacea): contribution of development to phylogeny and classification. p 217-269. in: Scholtz G, editor. Crustacean issues 15, Evolutionary developmental biology of Crustacea. Lisse/Balkema. Tokyo.

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[4] Olesen, J. 2009. Phylogeny of branchiopoda (Crustacea): Character evolution and contribution of uniquely preserved fossils. Athropod Systematics and Phylogeny 67(1): 3-39.

[5] Plodsomboon, S., A. M. Maeda-Martínez. H. Obregón-Barboza, and L-O. Sanoamuang. 2012. Reproductive cycle and genitalia of the fairy shrimp Branchinella thailandensis (Branchiopoda: Anostraca). Journal of Crustacean Biology 32(5):711-716.

[6] Sanoamuang, L-O., G. Murugan, P. H. H. Weekers and H. J. Dumont. 2003. Streptocephalus sirindhornae, new species of freshwater fairy shrimp (Anostraca) from Thailand. Journal of Crustacean Biology 20(3):559-565.

[7] Rogers, C. D. 2009. Branchiopoda (Anostraca, Notostraca, Laevicaudata, Spinicaudata, Cyclestherida). Elsevier Inc. 2-42.

[8] Watling, L. and Thiel, M. 2013. Functional morphology and diversity. The Natural History of Crustacea, Volume 1. New York: Oxford University Press.

[9] ¬ * i ô ó € i ô & ê # ö 2008 ö Ú 4 ¾ o Î æ Û ú # — I * O , ‘ « “ ô 2 ö ã y ý < L ÿ Ú 4 ¾ o Î æ … [À ö

[10] Ferrari, F. D. and M. J. Grygier. 2012. Variability of trunk limbs along the anterior/posterior body axis of juvenile and adult Lynceus biformis (Ishikawa, 1895) (Branchiopoda, Laevicaudata, Lynceidae).

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Crustaceana 85 (3): 355-377.

[11] Fryer, G. 1983. Functional, Ontogenetic Changes in Branchinecta ferox (Milne-Edwards) (Crustacea: Anostraca). Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 303: 229-343.

[12] Møller, O. S., J. Olesen and J. T. Høeg. 2004. On the larval development of Eubranchipus grubii (Crustacea, Branchiopoda, Anostraca), with notes on the basal phylogeny of the Branchiopoda. Zoomorphology 123: 107-123.

[13] Ferrari, F. D. and M. J. Grygier. 2012. Variability of trunk limbs along the anterior/posterior body axis of juvenile and adult Lynceus biformis (Ishikawa, 1895) (Branchiopoda, Laevicaudata, Lynceidae). Crustaceana 85 (3): 355-377.

[14]

[15] Richter, S. 2004. A comparison of the mandibular gnathal edges in branchiopod crustaceans: implications for the phylogenetic position of the Laevicaudata. Zoomorphology 123: 213-231.

[16] Fryer, G. and G. Boxshall. 2009. The feeding mechanism of Lynceus (Crustacea: Branchiopoda: Laevicaudata), with special reference to L. simiaefacies Harding. Zoological Journal of the Linnean Society 155: 513-541.

[17] Møller, O. S., J. Olesen and J. T. Høeg. 2004. On the larval development of Eubranchipus grubii (Crustacea, Branchiopoda, Anostraca), with notes on the basal phylogeny of the Branchiopoda. Zoomorphology 123: 107-123.

[18] Rogers, D. C., D. L. Quinney, J. Weaver, J. Olesen. 2006. A new giant species of predatory fairy shrimp from Idaho, USA (Branchiopoda: Anostraca). Journal of Crustacean Biology 26(2): 1-6.

[19] Fryer, G. 1966. Branchinecta gigas Lynch, a non-filter-feeding raptatory anostracan, with notes on the feeding habits of certain other anostracans. Proceeding of the Linnean Society London 177(1): 19-35.

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[25] Huang, S. L., C. C. Wang, W. P. Huang and L. S. Chou. 2010. Indeterminate growth of the fairy shrimp, Branchinella (Branchinellites) kugenumaensis (Crustacea: Branchiopoda) in an unpredictable ephemeral pool. Journal of Crustacean Biology, 30: 366-372.

[26] Huang, S. L., C. C. Wang, W. P. Huang and L. S. Chou. 2011. Reproductive potential of the fairy shrimp, Branchinella (Branchinellites) kugenumaensis, in an unpredictable ephemeral pool. Journal of Crustacean Biology, 31: 254-259.

[27] Wang, C. C., S. L. Huang, W. P. Huang, L. S. Chou. 2012. Spatial Niche Differentiation of Sympatric Branchiopoda in a Highly Unpredictable Ephemeral Pond. Journal of Crustacean Biology, 32(1): 39-47.

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[29] Weeks, S. T., T. F. Sanderson, S. K. Reed, M. Zofkova, B. Knott, U. Balaraman, G. Pereira, D. M. Senyo, W. R. Hoeh. 2006. Ancient androdioecy in the freshwater crustacean Eulimnadia. Proceedings of the Royal Society B 273: 725-734

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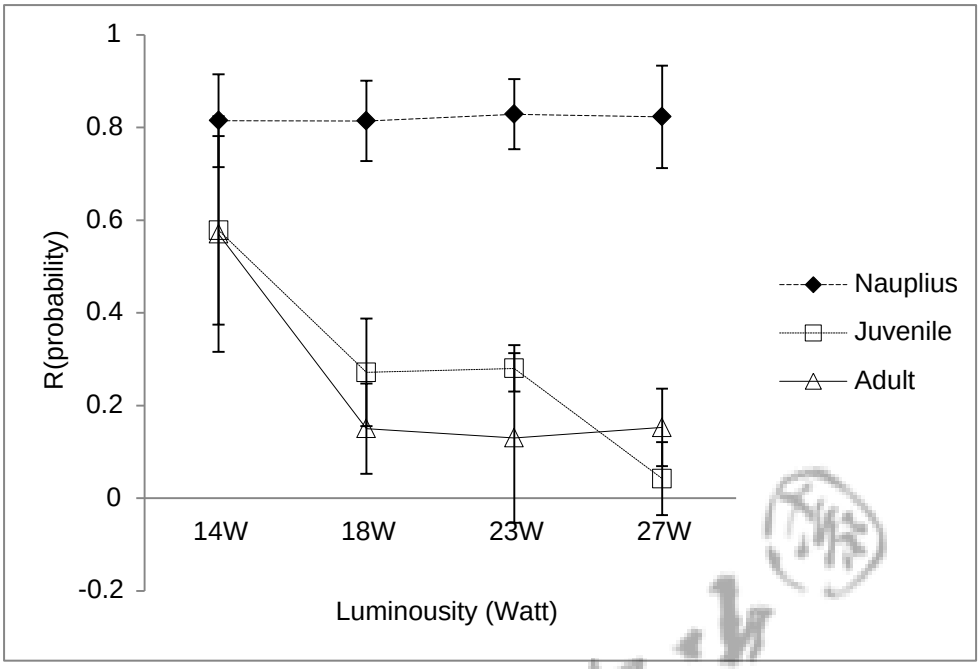

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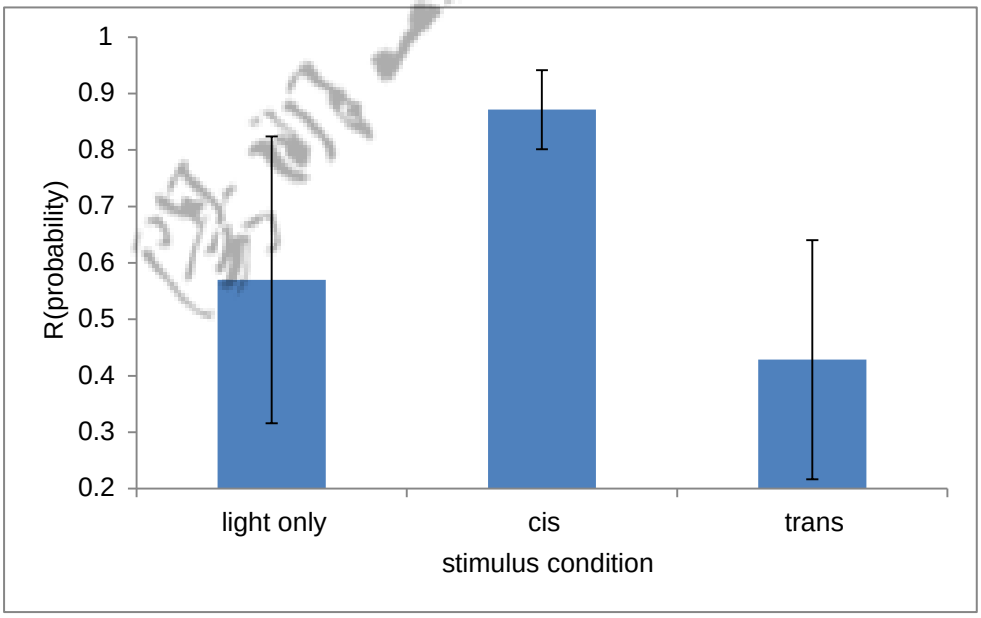

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[32] Brendonck, L. 1994. Molar Surface Morphology in Streptocephalus coomansi (Crustacea: Branchiopoda: Anostraca). Journal of Morphology 219: 163-173.

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• ë í] ' ; x 3 Q ‰ c é Á ï t O õ t O õ O Ÿ Ø ¤ (Ä 3-1) ö — ¶ € | ï ï U ô n ö Ì € ˜ ¶ Å I ‘ ï t O Ø ¤ ô Ø ¤ û ‘ Õ ¦ Á ƒ ’ ù { A ÷ µ “ ‘ ´ { # (palp) ´ ö t O Ø ¤ ¹ þ ˜ ô ` Ø , € " “ × È š ù O þ , € " ¹ þ ˜ * € “ × È š ‘ • O ô ç Î ¢ â ’ Î (sexual dimorphism)ö ï t O ‘ ' ; Ô µ Á ‹ ú ô t O þ Á d ‰ Ö ú ö

ï t O > ¶ € | ï ï U ‘ ƒ ‹ º Â € " Þ Z ” ‘ ƒ ’ ù { A ô ` n 8 Ø , é ï ô Å I ¨ , Ò È ' ; ô n 8 µ ‡ \ Î ( Ù 3-1A) ö µ ƒ ’ º Ò È n 8 L L ÏôO L µ ô ` ƒ ’ © ƒ Ÿ º Đ Ô (‘ O µ » Đ f ô Î ¢ 4 I B ï ö ƒ ’ º ï t O O Ï µ 200 m (Ù 3-1B õ 3-2A) ô ƒ Ÿ º þ µ Á 300 m (Ù 3-1C õ 3-2B) ô ç 24℃ ô ï ï U ‘ ƒ ‹ • » á Q ' ; ? Ø ¤ ö ƒ d º Õ ¬ (- ï ï U ƒ ‹ » @ \ ô Ø ¤ ¶ û • Ø ¤ ‘ T q ç - ƒ ’ ù { A ¢ ‘ naupliar processô ç ƒ „ n Î • é D (Ù 3-1D õ 3-2C) ö ƒ Ö º ‘ • O Ò È ' ; ˜ ¶ Å I ô ` ˜ Ý , _ Â º V ' ; Í ‘ Å I ( Ù 3-1E õ 3-2D) ô ( Ö - ï ï U ƒ Ÿ » @ \ ö ƒ ä º ˜ _ Â ? ƒ ‹ ù Å I À ( Ù 3-1F õ 3-2E) ô ƒ Ž º ˜ þ _ Â ? ƒ Ÿ ù ' ; Í ‘ Å I ô ¶ ƒ ä º ì - • A Â 1 > E _ ] O ô ` ` , ï \ ? _ ( Ù 3-1G ô Ù 3-2F) ö ƒ ä © ƒ Ž º è ˜ ô `] O Z . Ý ¶ û s º ï t O ì Õ ô n 8 ¨ Ë , Û _ Ò õ t O O ö > ï ï Ï ? ƒ Ž º (- û ! 12 » ô ` ¹ ƒ Ž º ‘ Ï (— ƒ Ž º Á t O) þ » ? ÿ – » (Ä 3-2) ö

½ • O € È ¹ Ä E _ à O ‘ ˜ Ò È á ‰ , t O ô ‘ • O Ž ù ² O È š ‘ Å I ö t O Ø ¤ ç ˜ õ ƒ ’ ù { A õ À ï B ï h Ì 4 I ô ¿ q ' ; ï B (I q ‘ , Å I § ž ö > Ž ù Å I Ò È ô • O ç Õ û ” À â > “ I > Q

0 î ‰ ‘ Å I œ‹ ù (Ù 3-1H õ l) ô — ß ” • · I > þ \ f Q î ‰ ‹ ‰ ’
ù ' ; Í ‘ Å I (Ù 3-3A) ô Ì € – (asetose limbs) â 0 ç ² O Í ¨ Q 0
£ á Á ± — ô t O Ø ¤) 0 Å I § ž : Ø ¤ T é ô t Å n Ö • Ø ¤ ö û • º µ
ÿ ! > 8 » ‘ ' ; Ô ô ` > • ù Å I ' ; ? @ \ ƒ œ ù þ µ ! > 28 »
ô µ œ ù Å I ' ; ? œ ‹ ù µ Á 20 » ô € " œ ‹ ù Å I ? Õ Ð Ô þ Ô
– 38 » ö • Ø ¤ ! > ‘ Ô Ì ‹ ô µ ¢ « × È Õ þ ' ; ! Ô «
Ï (Ä 3-2) ö

ƒ ’ ï ï t O ª g , ÷

• ë í] ï t O — _ € ô g p Ò ± Ï ¢ ¯ (labrum) • Â ô ƒ ’ ù { A
÷ µ “ í ï ¢ Ú \ Û ± ý ‘ ¿ (spine) ô 6 » “ (maxilla) ™ ƒ µ “ ô ` h µ “ ×
È À „ ô Å I þ Ø , ' ; Ý Ì € " ² O È š ö

ï t O Ø ¤ > ï ï U á € " O - Ð ý ‘ ƒ ’ ù { A ô ç • w ý Ÿ é Ð
‹ À ‘ ¿ Ï € Á naupliar process) (€ basal masticatory spine) ë) , ÷ ç ï t
O ƒ ‹ º è - » ô ` Â Q { ÷ ¢ ¯ ö ¿ q ' ; ô naupliar process) ƒ „ n - ï
t O ƒ d º b “ é D (bifid) ô é D ¢ ÿ € < (setae) ô Ù 3-4) ö

ï t O Ø ¤ ‘ µ “ Q é Á w ï (coxa) © — w ï f A ï \ ‘ ƒ ‹ ? ƒ Ÿ ï ô
• Í ƒ ‹ ï ž € í ï (basis) ö í ï ¢ • • \ Û ã A ‘ é D ô ƒ ‹ º á € " ‰ Î
(Ù 3-5A) ô ` - ƒ ’ º U ƒ „ É € < ƒ , ÷ (Ù 3-5B) ö w ï ç ï t O ƒ ‹
º Á µ 3 ƒ (Ù 3-6A) ô ¿ q ' ; ô L Û ã A ï \ ô ç ƒ ’ º Q - ã A p S
w ï × È À ‘ “ _ (molar surface) \ < ƒ © Á ƒ ô ` ” ‰ ƒ d º Á ô
ˆ “ _ Ý d Ø { ô * ƒ ’ ‰ ƒ Ö º “ _ Î ì _ (Ù 3-6) ö ƒ ‹ » “ þ û
ÿ Æ < (Ù 3-7) ô O - ƒ ‹ » “ © ƒ ‹ ù Å I Ð Ô ‘ ƒ ’ » “ þ , ç ƒ Ö º Ð
U É î ³ ‰ (Ù 3-7C) ô ‰ ƒ Ž º Á ÿ] , - » ‘ p ƒ (Ù 3-7D) ö

ƒ Ÿ ï tO ª g , ÷

tO ÷ O Ø ¤ € ¹ þ ˜ ô ƒ ’ ù { A - ² O n \ @ ˜ Ð f ô Å

I Â € ² O È š ô ¢ ¯ © ï t O ì Õ _ Â P µ õ » “ ô ` â Á ¹ þ ˜

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tO ÷ O ‘ ƒ ’ ù { A Q é Á • ï © ƒ „ ‘ ‹ ù é D ô naupliar process

ç Õ Ð û á n ¹ Ä ï (Ù 3-8A) ô ï t O º ø ç ‘ µ “ ƒ ‹ ‰ ƒ Ÿ ï Õ ¬

n ô L ï (Ù 3-8B) ö t O µ “ “ _ (molar surface) µ ‡ \ Î ô • ¢ ‘ <

ƒ © Á ƒ / K ¿ q Ï 6 Z C ô “ _ ¨ ô L Q î @ Ì Õ T q Î T é (Ù

3-9) ö ƒ ‹ » “ ¶ ï t O º ì N @ ó 4 ô ‘ Ž ² ô ç t O º á Â € "

Õ Î ô O - ã A è È • ã ‘ 3 ƒ – ç • O Õ û á Q { ÷ µ “ ô ç U „ A

\ ‹ Á ƒ (Ù 3-10) ö O - ƒ ‹ » “ ¶ ƒ ‹ ù Å I Ð Ô ‘ ƒ ’ » “ ô ç t O

U º Î Á - Ç ƒ ô h ƒ ‹ » “ » ô ƒ „ € < (Ù 3-10A) ö 6 t O Å I (

‘ ¢ ¦ (epipod) f ô • © ƒ é D ã € – ô O - O f A (lateral) ‘ – è

È g ž (Ù 3-11A) ô f ¦ (exopod) – w ý \ ‹ ¿ ƒ (Ù 3-11B) ö O - O ã

A ‘ Ö " ã (endite) ¢ ‘ – è È h ™ • * B ‹ ã • È – (Ù 3-11C) ô

(ž È p ‘ ƒ Ö ã • • í ƒ , ÷ ô • ã A \ ‹ È (Ù 3-11D) ö

ƒ d ï O ª g , ÷

O f ¶ t O ì _ ô] q , ç » “ ÷ I ¬ N ‘ – , ÷ ö O ƒ ’ ù

{ A é D Ð û ‘ é ï Ì 4 I (Q È é ï) ö ¶ t O ì ô ç • A ‘ – ¹

Ä ' ; ô Å – È ô é D U þ Q é Á – ï ô ï ã – © ñ Î è È ‘ ¿ ƒ

(Ù 3-12) ö O µ “ “ _ ‡ \ ] Î ô A f ‘ / K r ‰ 10 P (Ù 3-13) ö

“ _ , ÷ ` Ú] B ‹ Î ô 6 , Q . q T é T q á f ú “ _ f ç A ÷ A

Ì Õ Î ‘ ô “ _ Í g µ ý é _ H þ , € Ì Õ þ è È þ ° ‘ s _ (Ù

3-13B) ô O - A U „ ‘ Á ƒ / 30 m ö 6 ç O Í Å I Í ô â ƒ ‹ ©

f ’ ù ÷ *f* • ‰ *f* œ ‹ ù Å I n ö]ïö *f* • ‰ *f* œ ù ‘ f ¦ n Û

A ï \ (Ù 3-14) ô *f* œ ‹ ù - ã A w ý n ‹ Ì Õ þ ì *f* , ÷ (Ù 3-15) ô 6 â

n - *f* ‹ © *f* ’ ù ' Ö @ z • Ô (claspersô Ù 3-1L õ 3-16) ö

Ä 3-1 õ • ë í] Ú ' ; Ø ¤ Î á f

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ï t O	‰*		
t O	‰	‰	
O	‰	‰	‰

* û º Ì € " ô @ Ä 3-2 : ƒ Ö º ;

Ä 3-2 õ • ë í] ï t O Ÿ º T é ± — ÷ 24 W ‘ ' ; Ô

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	ƒ d º	Naupliar processƒ é Á ’ é D	ƒ 1 »
	ƒ Ö º	˜ Ò È ' ; ôç A µ “ U „ Î • + ƒ (Anlagenof carapaceë)Å I Ò È ' ; ö	ƒ 3 »
	ƒ ä º	˜ - A µ _ Â ? ƒ ‹ ù ' ; Í ‘ Å I	Q ô á
	ƒ Ž º	˜ - A _ Â ? ÿ û Ÿ ù ' ; Í ‘ Å I	ƒ 12 »
t O	ƒ ‹ º	Ž ù Å I	ƒ 20 »
	ƒ ’ º	– ù Å I	ƒ 28 »
	ƒ Ÿ º	• ù Å I	ƒ 36 »
	ƒ d º	œ ù Å I	ƒ 64 »
	ƒ Ö º	œ ‹ ù Å I	ƒ 84 »
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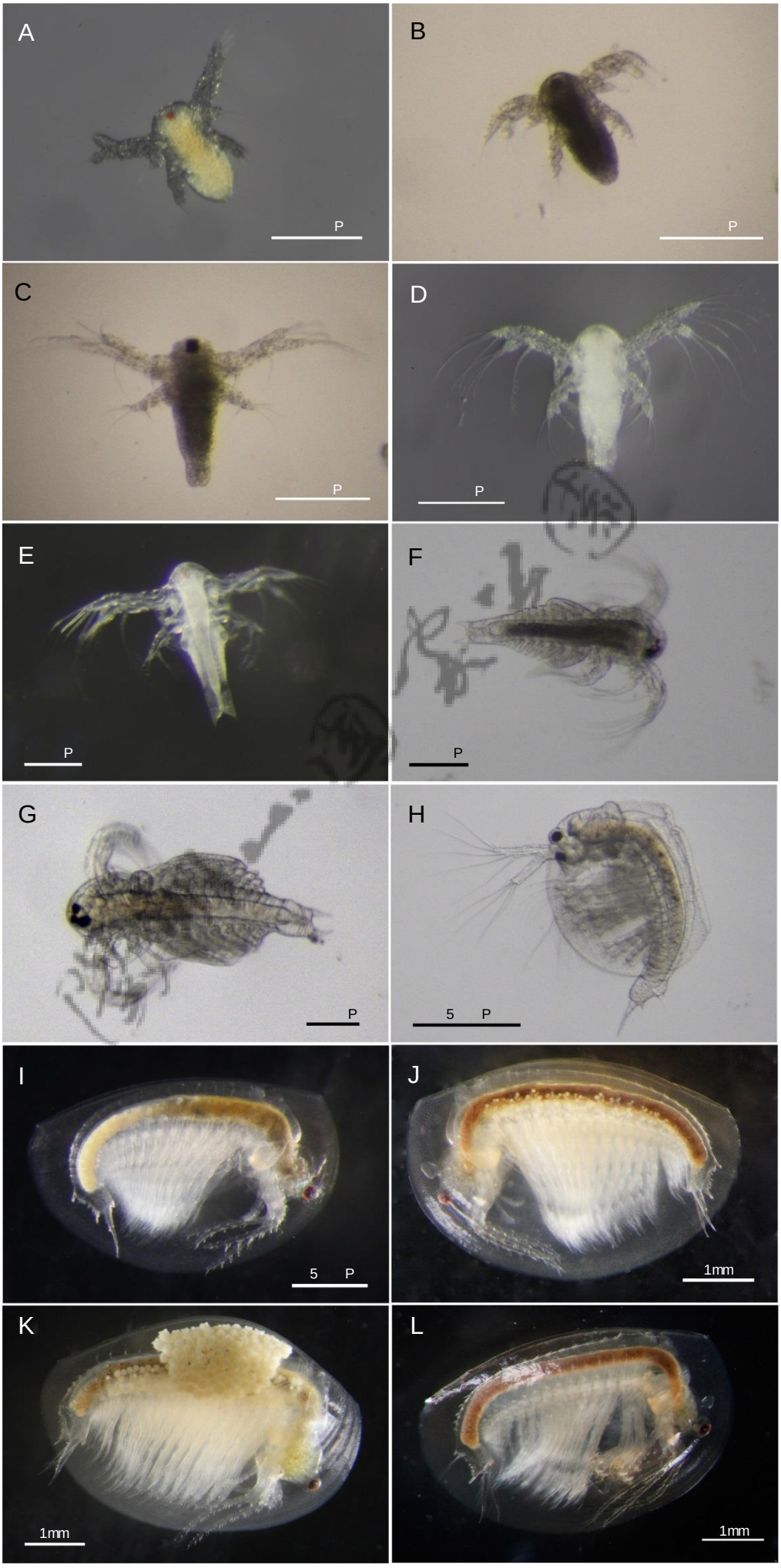
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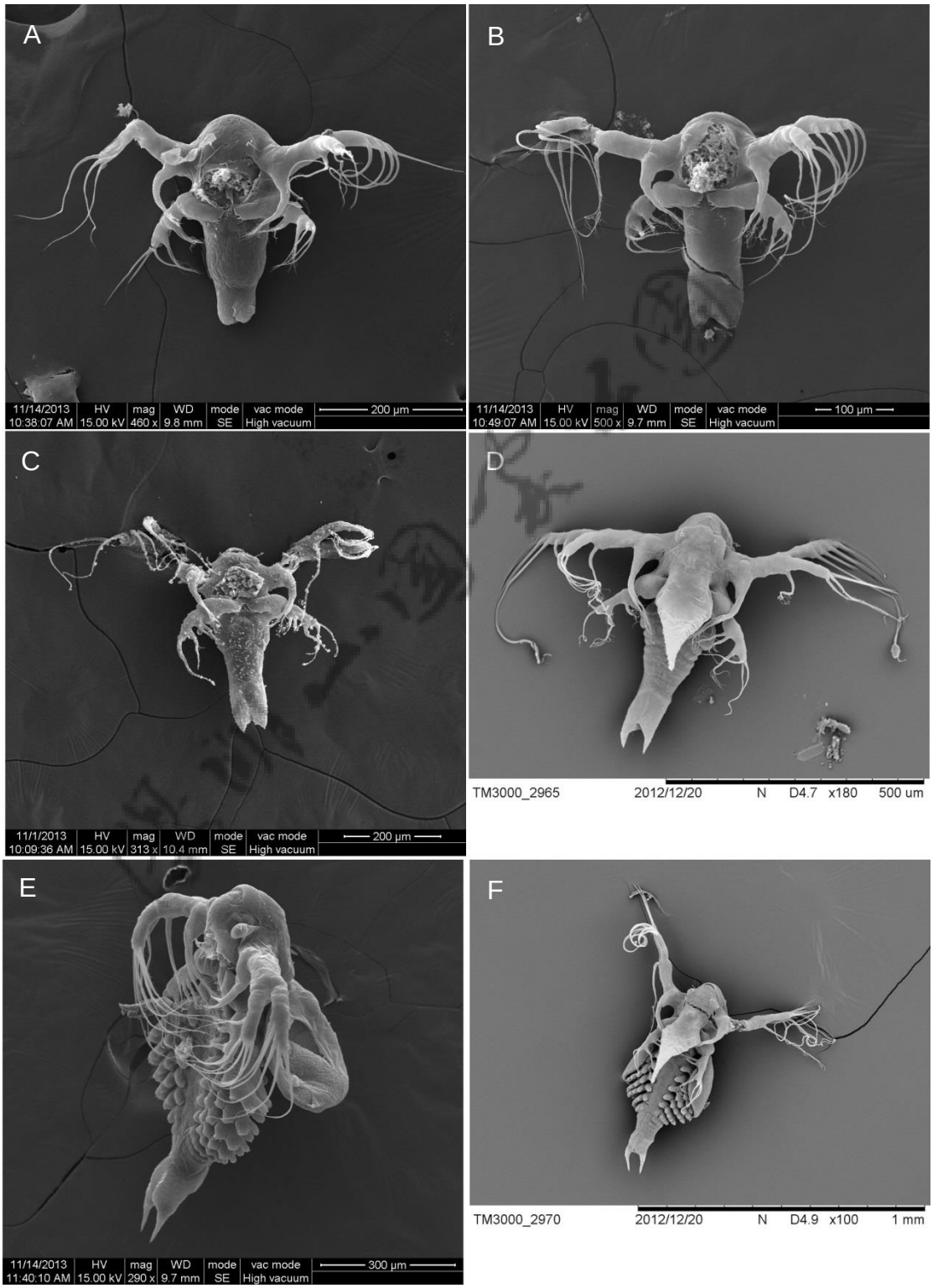
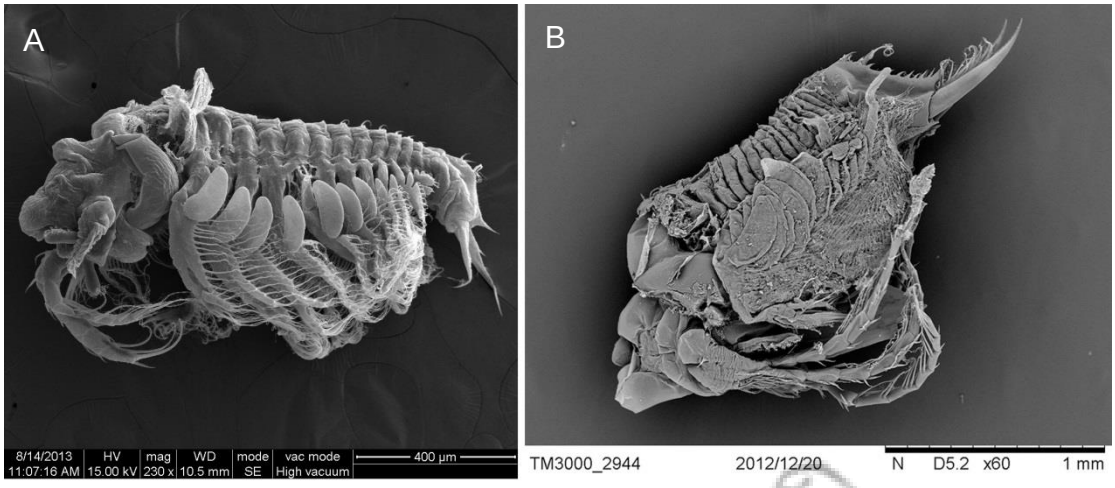
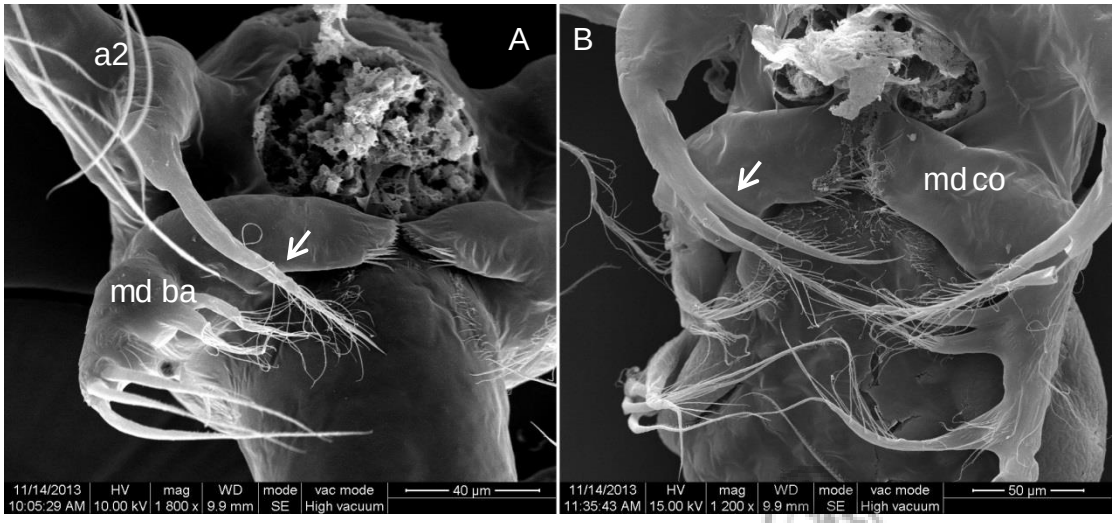
Ù3-1õ•ëí]';x3ö A) ïtO*f*‹ºô B) ïtO*f*'ºô C) ïtO*f*Ÿºô D) ïtO*f*dºô E) ïtO*f*Öºô F) ïtO*f*äºô G) ïtO*f*Žºô H) ºtOô I) ºtOô J) º Oô K) OôL) â Oö



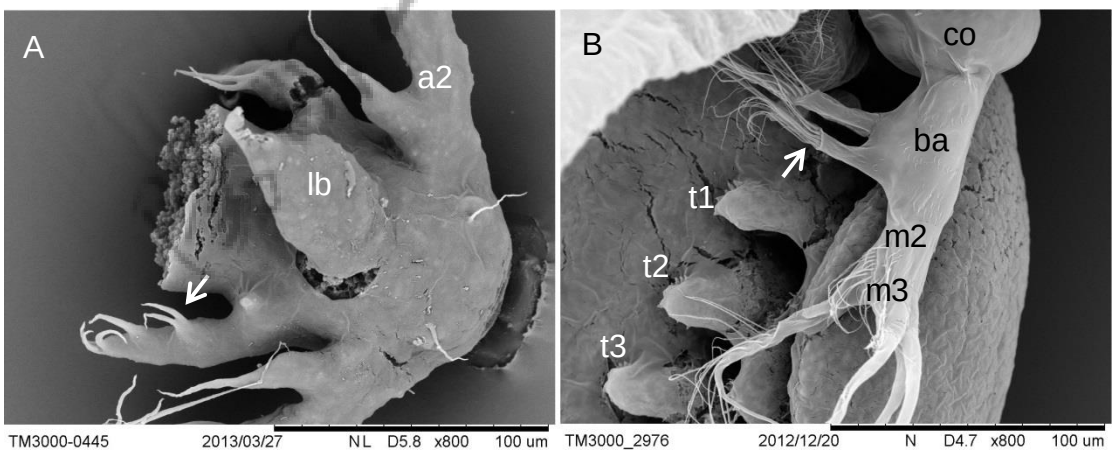
Ù3-2õ•ëíß"•·I>y½ö A) ïtO*f*'ºô B) ïtO*f*Ÿºô C) ïtO*f*dºô D) ïtO*f*Öºô E) ïtO*f*äºô F) ïtO*f*Žº ö



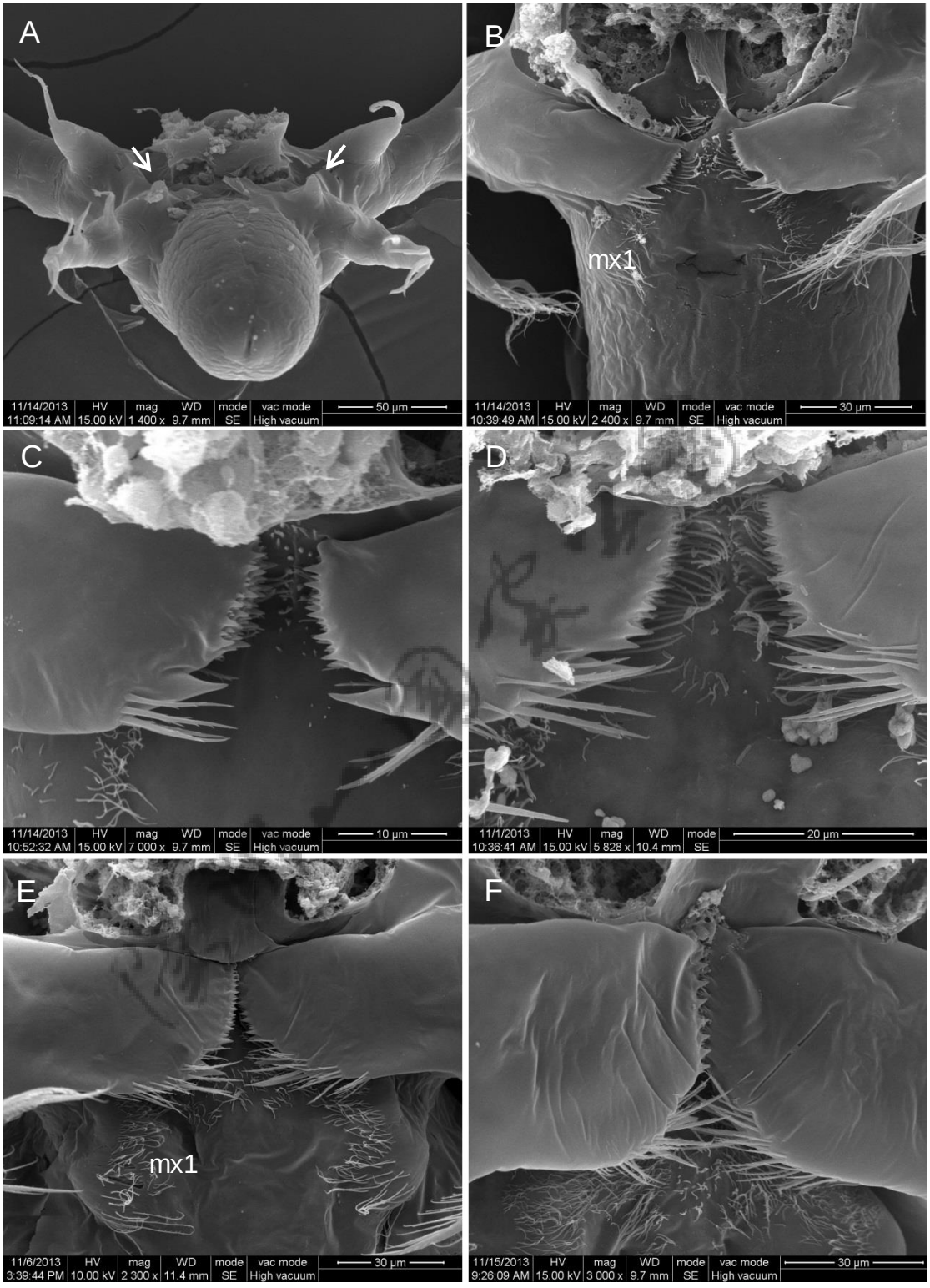
Ù3-3õ (P ˜Ð •ëí] Î ôA) tOô B) Oö



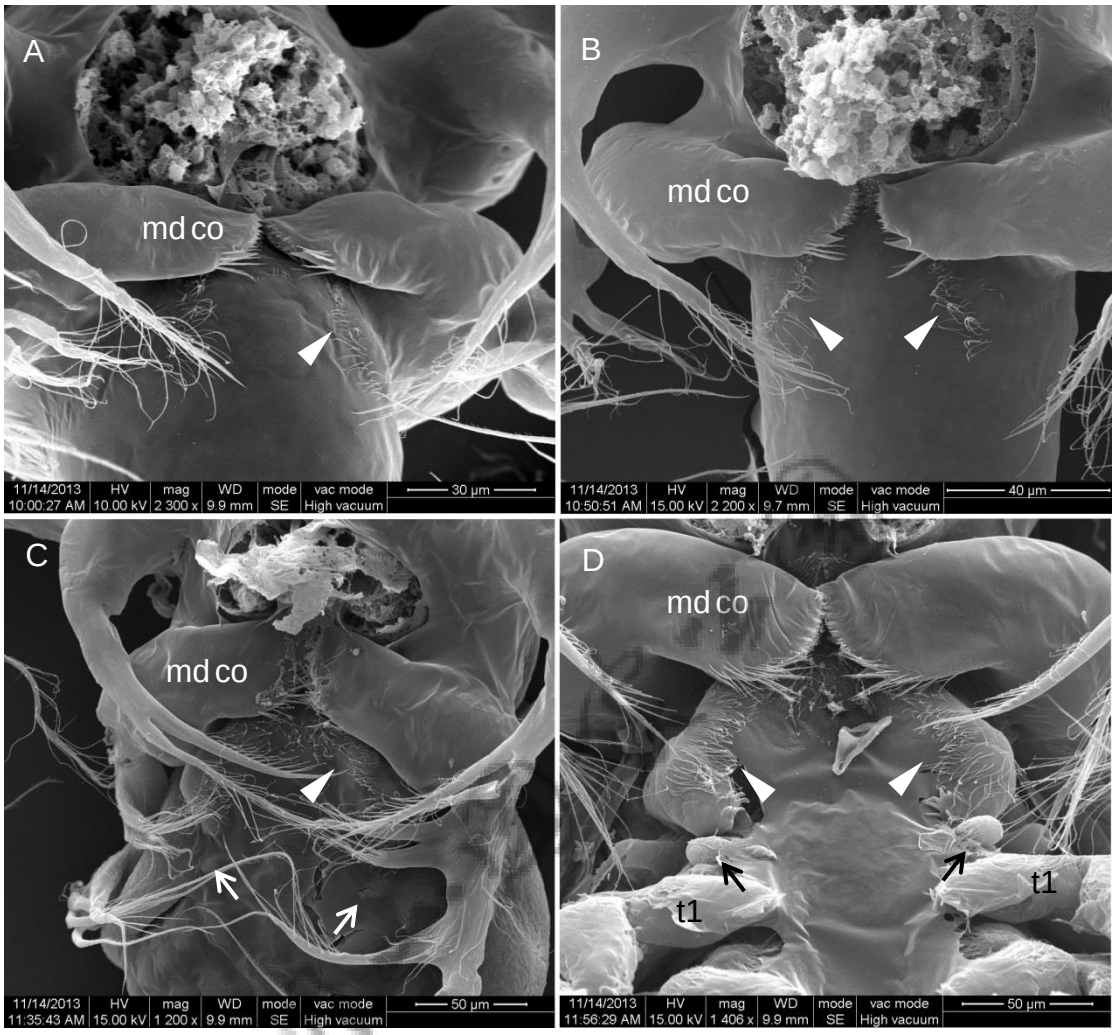
Ù 3-4 õ ï t O naupliar processî ôA) ƒ d º 0 û Ø ¸ é ô B) ƒ d º U ƒ „ Î • é ö m j ú md ô µ “ ö & ô naupliar processè a2 ô ƒ ’ ù { A ù md baô µ “ í ï ù md coô µ “ w ï ö



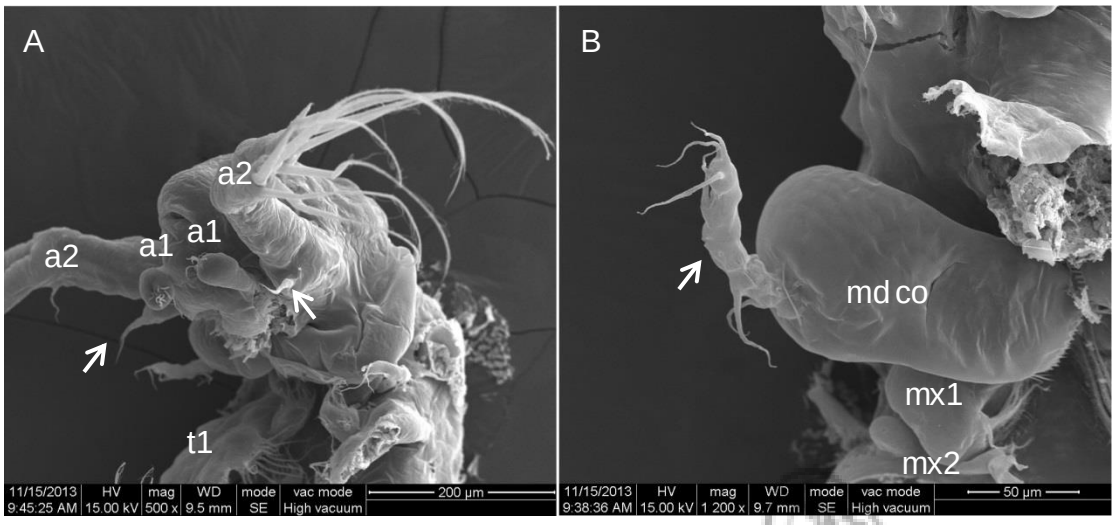
Ù 3-5 õ ï t O µ “ w ï ¿ ƒ Î ôA) ï t O ƒ ‹ º ‘ µ • ¸ ÷ ô B) ƒ ’ º U Ð Î ö & ô µ “ w ï ¿ ƒ ù a2 ô ƒ ’ ù { A ù baô µ “ í ï ù coô µ “ w ï ù lb ô ¢ ¯ ù m2 ô µ “ ƒ ’ ï ù m3 ô µ “ ƒ Ÿ ï ù t1-3 ô ƒ ‹ ‰ ƒ Ÿ ù Å l ö



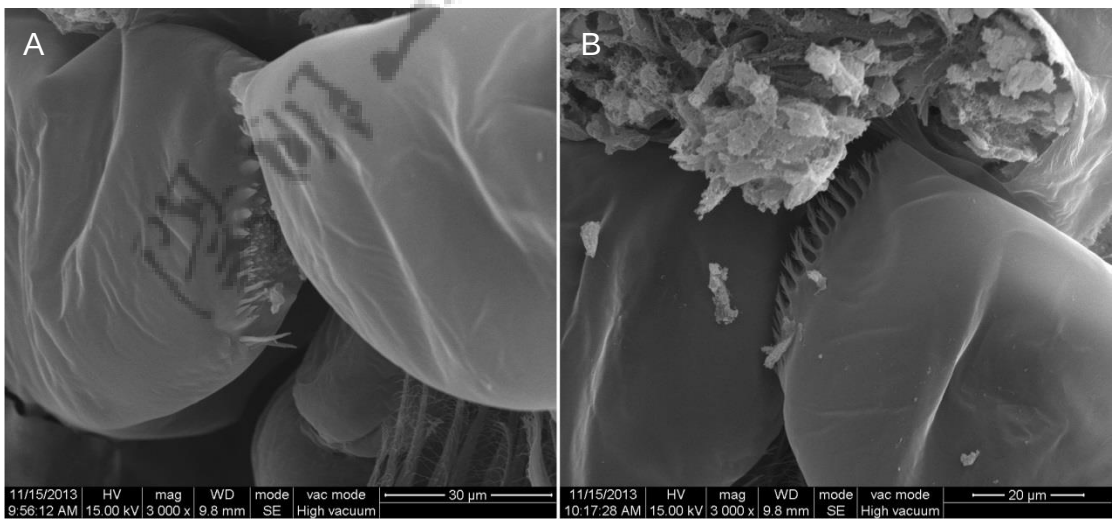
Ù3-6õ ïtOµ“ wï Î ôƒ’?ƒÖº Î ì_ô`•“_Ô1ôLm »ô A) ïtOƒ‹ºô B) ïtOƒ’ºô C) ïtOƒŸºô D) ïtOƒdºô E) ïtOƒÖºô F) ïtOƒŽºö & ôµ“íï ùmx1ôƒ‹»“ ö



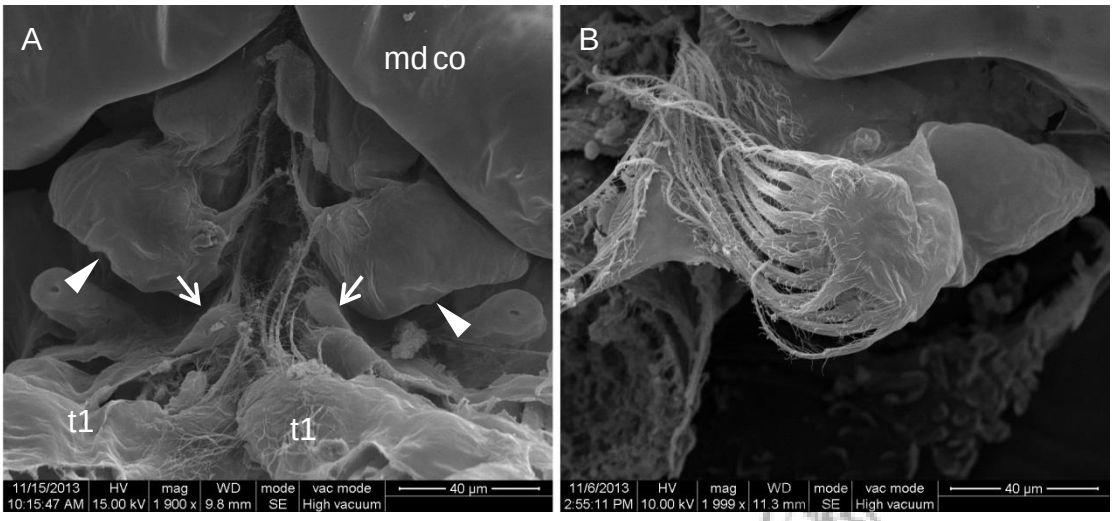
Ù3-7õ ïtO»“ Î ôƒ‹»“ôLÜ ôƒ’»“-ƒÖºUÉÒÈ'
;ô A) ïtOƒ’ºô B) ïtOƒŸºô C) ïtOƒÖºô D) ïtOƒŽºö Ð ôƒ‹»“ ù & ôƒ’»“ ùmd baôµ“íïù md coôµ“ wïù t1úƒ‹ùÅl ö



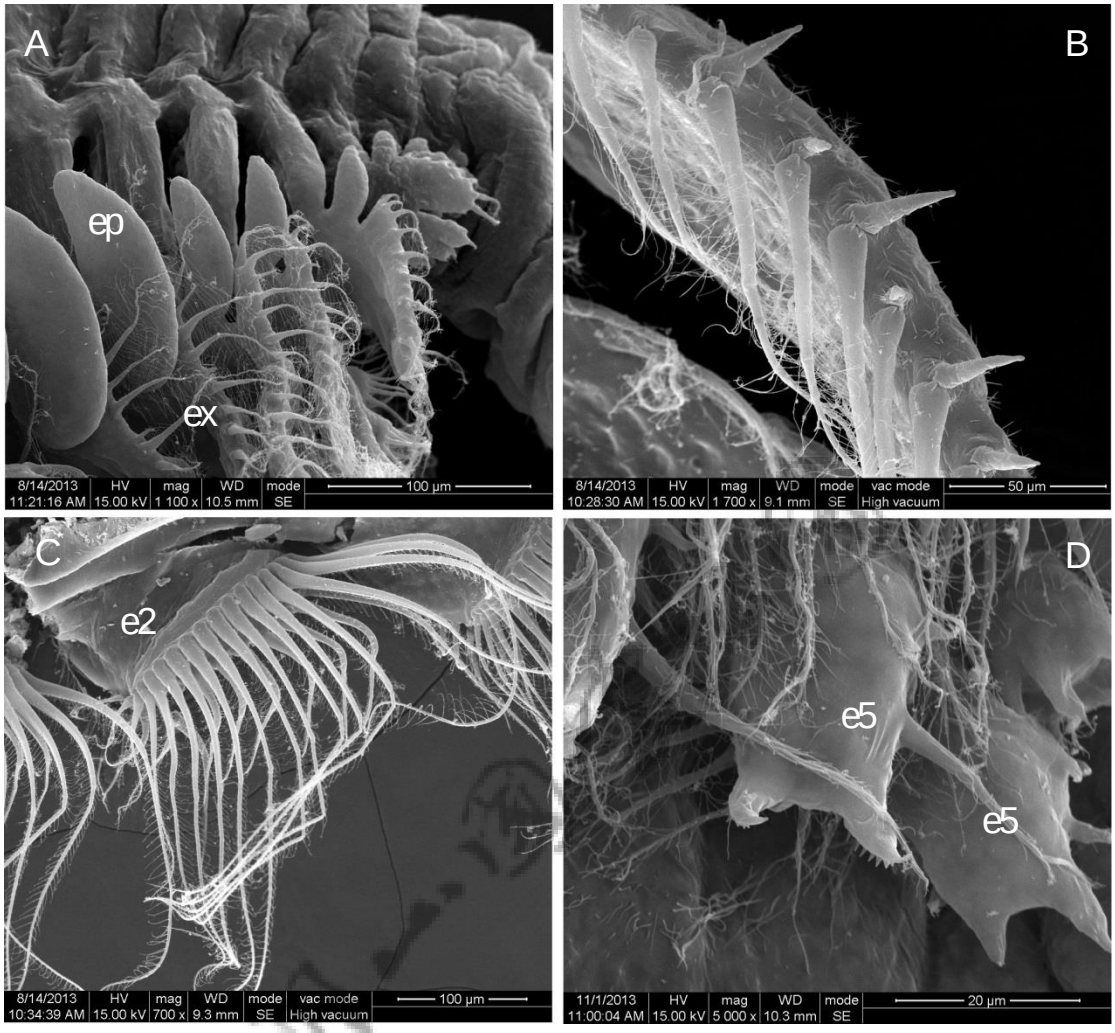
Ù 3-8 õ t O º ô L ï ‘ ï t O , ÷ ô A) naupliarprocess (&) ô B) µ “ *f* ‹ ? *f* Ÿ ï (&) ö a1 ú *f* ‹ ù { A ù a2 ô *f* ’ ù { A ù md co ô µ “ w ï ù mx1 ô *f* ‹ » “ ù mx2 ô *f* ’ » “ ù t1 ô *f* ‹ ù Å I ö



Ù 3-9 õ t O µ “ Î ô “ _ µ Á Î ô p õ t ˜ A Î Ì Õ ô A) S “ “ _ ô B) p “ _ A ö



Ù 3-10õ t O » “ Î ôA) ƒ ‹ © ƒ ’ » “ ì ù O ü ô B) ƒ ‹ » “ U „ Î ö Ð ô ƒ ‹ » “ ù & ô ƒ ’ » “ ù md coô µ “ w ï ù t1 ô ƒ ‹ ù Å l ö



Ù3-11õtO÷ OÅl Î ôA) ¢¦¶f¦ô B) f¦¢'¿ƒ ô C) ã» '^èœ ô D) ƒÖã»pãA'íƒ,÷ö epô¢¦ù exôf¦ô e2ôƒ'ã» ù e5ôƒÖã» ö

Ù3-12õ•ëí] O*ƒ*'ù{A Î ô ïtOªg,÷Â¹Ä ïô`'Ö
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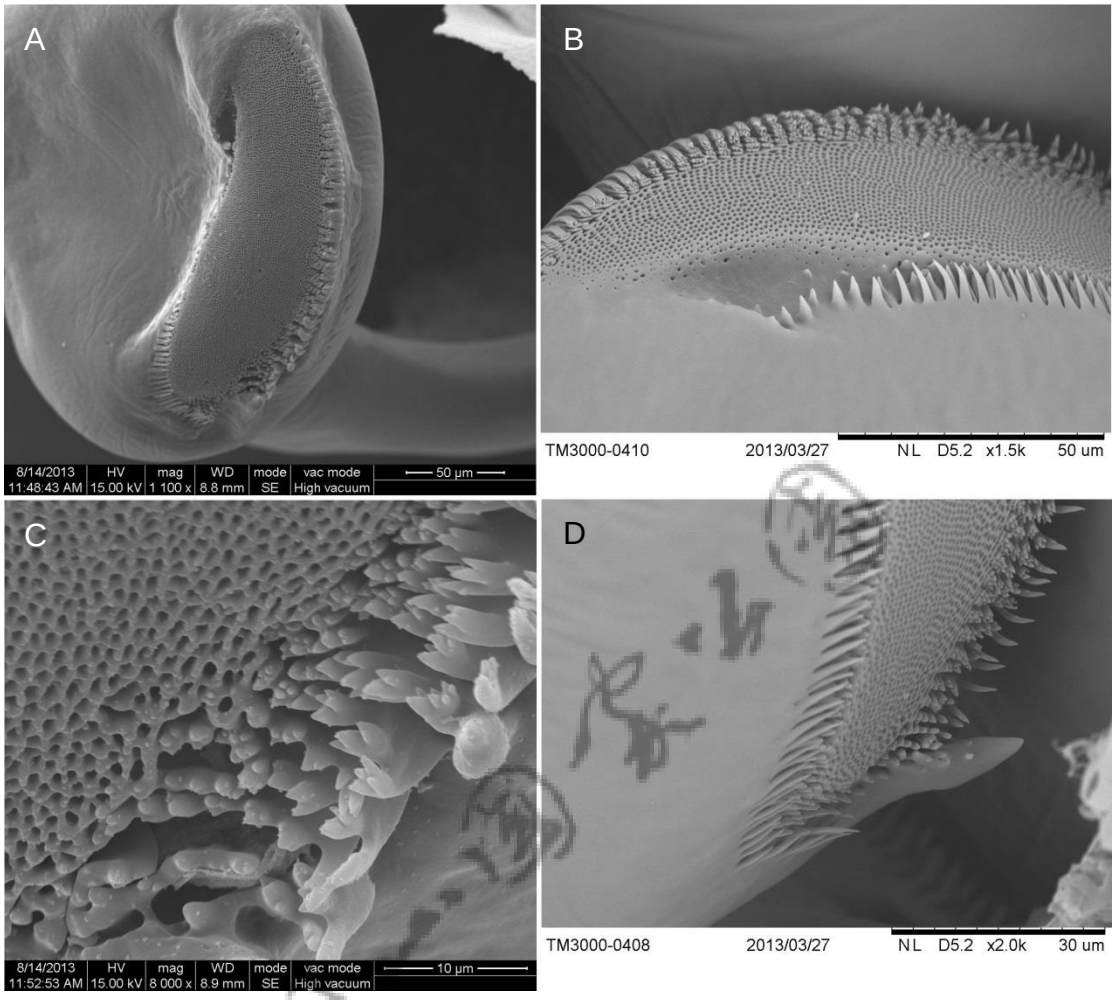
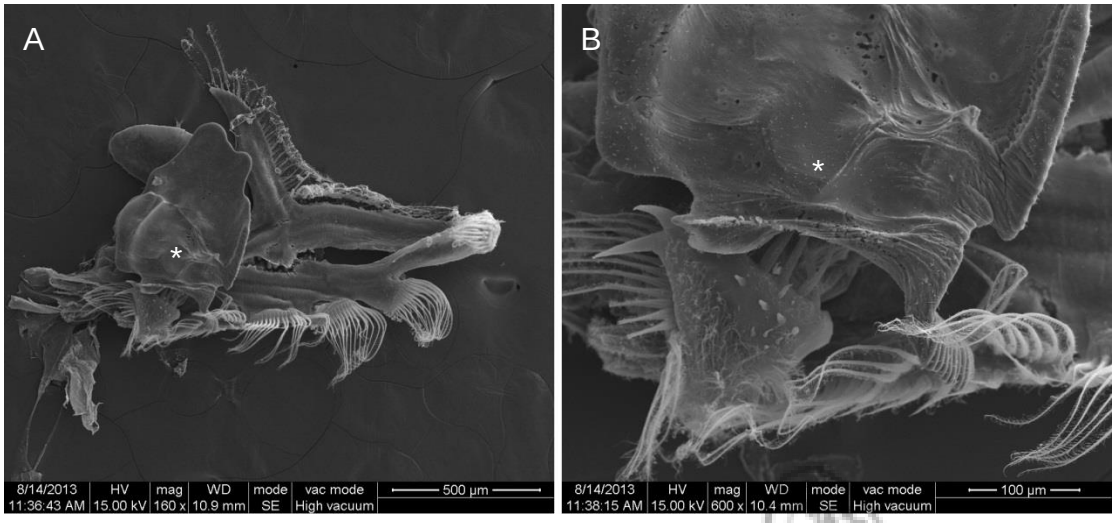


Ù3-13õ Oµ“ “_ Î ôA) S“ Î ôB) “_ûJ Î ôC) “_ A Î ôD) AU„ĐÁƒ

Ù 3-14 õ • ë í] O Å I Î öA-R é q 6 Ä *ƒ* ‹ ? *ƒ* œ – ù öI Ù f ¦ ï Ï ý é - À [x 3 Í ‹ ö



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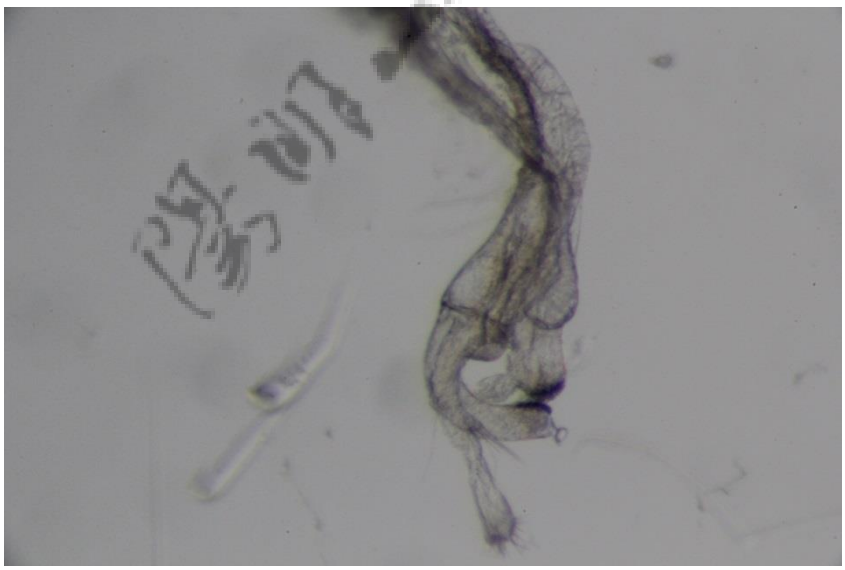

Ù 3-16 õ â z • Ô Î A _ € ô S A Á Ð „ _ ö

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xPù-Ú4¾oÎæ Ûú#Ÿ•Å qµ —I*‘ô2I¢ô T¾aD

•]çf ‘ Õ Ô Á–ú [33]ô—sí] ÁœÖú(,'Ä)ô6•ëí]

µ ÁŽúôô Õ ÔniIÜ•K6 áfö ÕUô—I*nb nø

-²FÍ‘¶€| ôç ‹ H Î ïïö¶ Õ Ôì ôÌÕ,•''

;òK¨n áq [34, 35]ô` xPÿ ô2 qÀ-ÚŸº''; Ôö•ô2Íù

-•ëí] Õû‘ÚŸº¾IA’öµô'\ •ëí]¹ ‹•Ÿº‘ Ôµ

¢¿q Ï6ZCö–ïï Qç‹•» ã¹ Ÿ•Ÿºô? ïtO‘(

U‹Ø¤þ!>–» ôþ•tOØ¤þ!>¬x 48» ôâç ïtOØ

¤hÖò¹ ';ö(ÐfôtOØ¤ÒÈ ˜ôù-‹d» Òg£ G

¥b”ôÖò¹ ˜‘ ïtOØ¤QÈQ0^eÏ g‘eÀö 6ç

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•ëí]¦¿ÀžôŸ *“,¯yÏáÁ ïtO ºÁ g ô O

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[33] ¬*iôó€iô&ê#ö 2008öÚ4¾oÎæ Ûú#—I*O,‘ «“ ô2öãyý <LÿÚ4¾oÎæ …[Àö

[34] Pereira, G. A., M. Gonzalez. 1994. Larval development and population biology of Dendrocephalus geayi Daday, 1908 (Anostraca) in temporary ponds from Venezuela. Crustaceana 66(2), Proceedings of the First European Crustacean Conference, 1992, p. 176-183

[35] Bernice, R. 1972. Hatching and postembryonic development of Streptocephalus dichotomus Baird (Crustacea: Anostraca). Hydrobiologia 40(2): 253-278.

þ i ž í k × Õ ° q o * ¢ “ [36]ö — I * ï t O ª g D È _ ô 2 , > Ö

ø ƒ ’ ù { A ¢ ‘ naupliar processõ µ “ w ï ‘ “ _ 0 ÷ µ “ í ï ‘ ¿ ƒ , ÷ ù

O ý é þ , Ö ø µ “ “ _ õ Å I ÷ ÿ Æ ‘ ˜ D È ô 2 ö • ë í] ‘ Î µ ï

ï Ï ? O ö Ú í B ï ô B i ª g ì " , ÷ 6 B ô • ë í] — ï t O o B

Á t O n ö Å I ' ; õ ˜ ' ; õ » “ ' ; õ ƒ ’ ù { A ‘ Î © D È o B õ

µ “ ‘] ï ; ô — â U Ì U , ç Z . ª g I Á ¢ ÿ n ö Ì Õ 3 K ‘ o B ö

ç ï t O ƒ ‹ º ô µ “ w ï Ë] , µ • ƒ ô » “ , Ò È ' ; ô naupliar

process] È ® Ø ‰ ¢ ¯ ô µ “ í ï ¢ ‘ é D ¨ Ë r ‰ Q { ÷ ± ý ‘ Ï K ô

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[37] Anderson, D. T. 1967. Larval development and segment formation in the branchipod crustaceans Limnadiastanleyana King (Conchostraca) and Artemia salina (L.) (Anostraca). Australian Journal of Zoology 15(1): 47-91

[38] Schrehardt, A. 1987. A scanning electron microscope study of the post-embryonic development of Artemia P. 5-32 in: Sorgeloos, P., Bengtson, D. E., Decleir, W., Jaspers, E. (eds.): Artemia Research and its Applications Vol. 1. Morphology, Genetics, Strain characterization, Toxicology. Proceedings of the Second International Symposium on the brine shrimp Artemia Universa Press. Wetteren, Belgium.

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[39] Fryer, G. 1983. Functional Ontogenetic Changes in Branchinecta ferox (Milne-Edwards) (Crustacea: Anostraca). Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 303: 229-343

[40] Fryer, G. 1983. Functional Ontogenetic Changes in Branchinecta ferox (Milne-Edwards) (Crustacea: Anostraca). Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 303: 229-343

[41] Fryer, G., Boxshall, G. 2009. The feeding mechanisms of Lynceus (Crustacea: Branchiopoda: Laevicaudata), with special reference to L. simiaefacies Harding. Zoological Journal of the Linnean Society. 155: 513-541

[42] Scourfield, D. J. 1926. On a new type of crustacean from the Old Red Sandstone (Rhynic Chert Bed, Aberdeenshire)—Lepidocaris rhyniensis, gen, et sp. nov. Philosophical Transactions of the Royal Society, Series B 214:155-187

[43] Fryer, G. 1985. Structure and habits of living branchiopod crustaceans and their bearing on the interpretation of fossil forms. Transaction of the Royal Society of Edinburgh 76:101-111

[44] Watling, L. and Thiel, M. 2013. Functional morphology and diversity. The Natural History of Crustacea, Volume 1. Oxford University Press, New York.

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[45] Anderson, D. T. 1967. Larval development and segment formation in the branchiopod crustaceans Limnadia stanleyana King (Conchostraca) and Artemia salina (L.) (Anostraca). Australian Journal of Zoology 15(1): 47–91

[46] Fryer, G. and Boxshall, G. 2009. The feeding mechanism of Lynceus (Crustacea: Branchiopoda: Laevicaudata), with special reference to L. simiaefacis Harding. Zoological Journal of the Linnean Society 155: 513–541

[47] Ferrari, F. D., Grygier, M. J. 2012. Variability of trunk limbs along the anterior/posterior body axis of juvenile and adult Lynceus biformis (Ishikawa, 1895) (Branchiopoda, Laevicaudata, Lynceidae). Crustaceana 85(3): 353–377

[48] Fryer, G. 1983. Functional Ontogenetic Changes in Branchinecta ferox (Milne-Edwards) (Crustacea: Anostraca). Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 303: 229–343

[49] Watling, L. and Thiel, M. 2013. Functional morphology and diversity. The Natural History of Crustacea, Volume 1. Oxford University Press, New York.

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[50] Brendonck, L. 1994. Molar Surface Morphology in *Streptocephalus coomansi* (Crustacea: Branchiopoda: Anostraca). Journal of Morphology 219: 171–185

[51] Mura, G. and del Caldo, L. 1992. A scanning electron microscopy study of the molar surface of the mandibles in *Branchinella spinosa* H. Milne Edwards (Branchiopoda) with some remarks on the taxonomical status of this character. Crustaceana 64(3): 333–336

[52] Fryer, G. and Boxshall, G. 2009. The feeding mechanism of *Lynceus* (Crustacea: Branchiopoda: Laevicaudata), with special reference to *L. simiaefacis* Harding. Zoological Journal of the Linnean Society 155: 513–541

[53] Richter, S. 2004. A comparison of the mandibular gnathal edges in branchiopod crustaceans: implications for the phylogenetic position of the Laevicaudata. Zoomorphology 123: 23–31

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Anderson, D. T. 1967. Larval development and segment formation in the branchipod crustaceans Limnadia stanleyana King (Conchostraca) and Artemia salina (L.) (Anostraca). Australian Journal of Zoology 15(1): 49-77.

Bernice, R. 1972. Hatching and postembryonic development of Streptocephalus dichotomus Baird (Crustacea: Anostraca). Hydrobiologia 40(2): 253-278.

Brendonck, L. 1994. Molar Surface Morphology of Streptocephalus coomani (Crustacea: Branchiopoda: Anostraca). Journal of Morphology 219: 157-162.

Ferrari, F. D. and M. J. Grygier. 2012. Variability of trunk limbs along the anterior/posterior body axis of juvenile and adult Lynceus biformis (Ishikawa, 1895) (Branchiopoda, Laevicaudata, Lynceidae). Crustaceana 85 (3): 337-359.

Fryer, G. and Boxshall, G. 2009. The feeding mechanisms of Lynceus (Crustacea: Branchiopoda: Laevicaudata), with special reference to L. similiaefacis Harding. Zoological Journal of the Linnean Society 155: 514-541.

Fryer, G. 1983. Functional Ontogenetic Changes in Branchinecta fera (Milne-Edwards) (Crustacea: Anostraca). Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 303: 229-293.

Fryer, G. 1985. Structure and habits of living branchiopod crustaceans and their bearing on

the interpretation of fossil forms. Transaction of the Royal Society of Edinburgh 76:103-111

Huang, S. L., C. C. Wang, W. P. Huang and L. S. Chou. 2010. Indeterminate growth of the fairy shrimp, Branchinella (Branchinellites) kugenumaensis (Crustacea: Branchiopoda) in an unpredictable ephemeral pool. Journal of Crustacean Biology 30: 323-326

Huang, S. L., C. C. Wang, W. P. Huang and L. S. Chou. 2011. Reproductive potential of the fairy shrimp, Branchinella (Branchinellites) kugenumaensis, in an unpredictable ephemeral pool. Journal of Crustacean Biology 31: 245-249.

Møller, O. S., J. Olesen and J. T. Høeg. 2004. On the larval development of Eubranchipus grubii (Crustacea, Branchiopoda, Anostraca), with notes on the basal phylogeny of the Branchiopoda. Zoomorphology 123: 107-123.

Mura, G. 1996. Pattern of mandibular morphology in Anostraca with some taxonomical remarks. Crustaceana 69(2): 125-154

Mura, G. and del Caldo, L. 1992, A scanning electron microscopy study of the molar surface of the mandibles in Branchinella spinosa H. Milne Edwards (Branchiopoda) with some remarks on the taxonomical status of this character. Crustaceana 64(3): 316-326

Olesen, J. 2007. Monophyly and phylogeny of branchiopoda, with focus on morphology and homologies of branchiopod phyllopodous limbs. Journal of Crustacean Biology 27(2): 165-183

Olesen, J. 2009. Phylogeny of branchiopoda (Crustacea): character evolution and contribution of uniquely preserved fossils. Athropod Systematics and Phylogeny 67(1): 3-39

Olesen, J. and Grygier, M. 2003. Larva GHYHORSPHQW RI -DSDQHVH µFRlarval development of Eulimnadia braueriana (Crustacea, Branchiopoda, Spinicaudata, Limnadiidae) compared to that of other limnadiids. Acta Zoologixa 84: 41-61

Olesen, J. 2003. On the ontogeny of the Branchiopoda (Crustacea): contribution of GHYHORSPHQW WR SKYORJHQ\. In: Scholtz, G. (ed.) ¿FDWLRQ S Crustacean issues 15, Evolutionary developmental biology of Crustacea. Lisse/Balkema. Tokyo.

Pereira, G. A., M. Gonzalez. 1994. Larval development and population biology of Dendrocephalus geayi Daday, 1908 (Anostraca) in temporary ponds from Venezuela. Crustaceana 66(2), Proceedings of the First European Crustacean Conference, 1992, p. 163-177.

Plodsomboon, S., A. M. Maeda-Martínez. H. Obregón-Barboza, and L. O. Sanoamuang.

2012. Reproductive cycle and genitalia of the fairy shrimp Branchinella thailandensis (Branchiopoda: Anostraca). Journal of Crustacean Biology 32(5): 726-741

Richter, S. 2004. A comparison of the mandibular gnathal edges in branchiopod crustaceans: implications for the phylogenetic position of the Laevicaudata. Zoomorphology 123: 31-44

Rogers, C. D. 2009. Branchiopoda (Anostraca, Notostraca, Laevicaudata, Spinicaudata, Cyclestherida). Elsevier Inc. 242-249

Richter, S. 2004. A comparison of the mandibular gnathal edges in branchiopod crustaceans: implications for the phylogenetic position of the Laevicaudata. Zoomorphology 123: 31-44.

Rogers, D. C., D. L. Quinney, J. Weaver and J. Olesen. 2006. A new giant species of predatory fairy shrimp from Idaho, USA (Branchiopoda: Anostraca). Journal of Crustacean Biology 26(1): 1-12.

Sanoamuang, L.-O., G. Murugan, P. H. H. Weekers and H. J. Dumont. 2000. Streptocephalus Sirindhornae, new species of freshwater fairy shrimp (Anostraca) from Thailand. Journal of Crustacean Biology 20(3): 560-565.

Schrehardt, A. 1987. A scanning electron microscope study of the post-embryonic development of Artemia. P. 532 in: Sorgeloos, P., Bengtson, D., Decleir, W., Jaspers, E. (eds.). Artemia Research and its Applications Vol. 1. Morphology, Genetics, Strain characterization, Toxicology. Proceedings of the Second International Symposium on the brine shrimp Artemia. Universa Press. Wetteren, Belgium.

Scourfield, D. J. 1926. On a new type of crustacean from the Old Red Sandstone (Rhynic Chert Bed, Aberdeenshire). Lepidocaris rhyniensis, gen. et sp. nov. Philosophical Transactions of the Royal Society, Series B 214: 153-187.

Watling, L. and Thiel, M. 2013. Functional morphology and diversity. The Natural History of Crustacea, Volume 1. Oxford University Press. New York.

Wang, C. C., S. L. Huang, W. P. Huang, L. S. Chou. 2012. Spatial Niche Differentiation of Sympatric Branchiopoda in a Highly Unpredictable Ephemeral Pond. Journal of Crustacean Biology, 32(1): 34-47.

Weeks, S. T., T. F. Sanderson, S. K. Reed, M. Zofkova, B. Knott, U. Balaraman, G. Pereira, D. M. Senyo, W. R. Hoeh. 2006. Ancient androdioecy in the freshwater crustacean Eulimnadia. Proceedings of the Royal Society B 273: 717-725