Ann. Fac. Sci. Saigon, 1967, 93-102

The taxonomic problem of EUCALANUS ELONGATUS dana *

by

BUI - THI - LANG

Abstract. — In extension of Dr. M.W. Johnson's previous study of four forms of **Eucalanus elongatus** Dana in the N.E. Pacific, an examination of this copepod throughout the Pacific shows a fifth form close to **E. enermis,** restricted to the Indonesian-Philippines oceanic waters. This provides an other examples of diversity in the populations of a planktonic species on the two sides of the tropical Pacific Ocean.

TOÁT YẾU. Tiếp theo cuộc nghiên-cứu của M.W. Johnson về bốn kiểu hình thái của loại Copepoda *Eucalanus elongatus* Dana ở vùng Đông-Bắc Thái Bình Dương, một cuộc khảo-sát phiêu-sinh trên khắp Thái Bình Dương tìm ra thêm một kiểu thứ 5, chỉ sống ở ngoài khơi vùng Nam-Dương — Philuật-Tân. Sự-kiện này biện-chứng thêm sự khác biệt của hai chủng-tộc cùng sống vùng nhiệt-đới nhưng ở riêng phía bờ Đông và Tây Thái Bình Dương.

The copepod species identified in the past as **Eucalanus elongatus** is distinguished from other species of the genus by a four-segmented urosome of the female, with two free segments between genital and anal segments. Although described as a single species by Dana (1849), Giesbrecht (1892) considered it as consisting of 3 varieties :

1 — **hyalinus** having pointed lateral processes on the last thoracic segment,

2 — **inermis** lacking these lateral processes,

3 — **bungii,** like **inermis** but the head is more elongated and the first legs have 2 outer spines on the terminal segment of the exopod in contrast to a single spine in the other varieties (Figure 1).

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* This paper was presented at the XVI International Congress or Zoology, Washington, D.C., August 20-27, 1963.

Equatorial Region, **E. e. hyalinus** in the Biantitropical zones, **E. b. californicus** in the North Transition zone, and **E. b. bungii** in the Subarctic sector of the Pacific.

The presence of five closely related forms in the Pacific Ocean, and only a single form, **E. e hyalinus,** in the Atlantic Ocean poses an interesting question of population isolation and speciation. The homogeneity of morphologic characters of the **E. e. hyalinus** population in the Atlantic, from 66° North through the Gulf of Guinea to 54° South, seems to preclude the possibility that in the Pacific, the observed morphological variations reflect the effects of different environmental conditions on the phenotypic development of one species.

The biantitropical subspecies **E. e. hyalinus,** which is mostly oceanic but come inshore near the Equator along the continents, overlaps with **E. e. elongatus** in the west, and with **E. inermis** in the east. Morphologically **E. e. hyalinus** differs from the two other forms by having pointed posterior processes on the last thoracic segment. It also differs from **E. inermis** by having, like **E. e. elongatus,** a seta on the second basis of the first legs. **E. e. elongatus** is thus, apparently morphologically intermediate between **E. e. hyalinus** and **E. inermis.** This raises questions about its taxonomic position and the degree of affinity among the three forms.

Because **E. e. elongatus** is located within the Indo-West Pacific region where the annual Monsoon reversal causes a to-and-fro flow, its populations should not be genetically isolated from the populations of **E. e. hyalinus** of the North and South Transition Regions. These circumstances might be expected to inhibit the differentiation of the two forms. There may, however, be little net displacement of the Indo-Pacific populations from the environmental regions to which they are adapted. In fact, Wickstead (1961) and our data from the Naga Expedition show only a small seasonal extension of **E. e. elongatus** toward the north. As **E. inermis** and **E. e. elongatus** are neretic species, presumably none or few individuals could survive the long journey, either westward in the Equatorial Current or eastward in the Counter-Current that would bring them together. Thus **E. e. elongatus** and **E. inermis** populations are isolated and could have acquired partial (subspecies status) or complete (species status) genetical isolation. The California Current from the north and the Peru Current from the south converge toward the East Equatorial Pacific, and thus may prevent **E. inermis** populations from spreading to higher latitude but bring **E. e. hyalinus** toward them. The morphological differences between **E. e. hyalinus** and **E. inermis** suggest that the belong to distinct, competing species in a sympatric environment. Alternatively they can both be considered as subspecies derived from a predecessor like **E. e. elongatus** and not two distinct species. The absence of **E. e. elongatus** and **E. inermis** in the Atlantic Ocean can be explained by the absence of distinct equatorial water masses in this ocean (**E. e. hyalinus** was reported abundant in the Gulf of Guinea by Vervoort, 1936).

E. b. californicus and **E. e. hyalinus** populations overlap the southern range of **E. b. bungii** in the area south of the Subarctic Boundary (Uda, 1963). However, the center of abundance and apparently the spawning grounds of **E. b. bungii** and **E. b. californicus** are separated : off the Kurile Islands and in the Bering Sea for **E. b. bungii,** off the California coast for **E. b. californicus** (Johnson, 1937, 1938 ; Bogorov and Vinogradov 1955, 1960).

In general, subarctic species are endemic to the ocean in which they occur (Brinton, 1962), while species that inhabit the Transition Zones between Subarctic or Subantarctic and Central Water masses are biantitropical and panoceanic as expected, the subarctic subspecies, E. b. bungii, is endemic to the region but **E. b. californicus,** although a Transition-water form, is also endemic. This contrasts with the Transition-water subspecies **E. e. hyalinus,** which is biantitropical. Since some specimens of **E. b. californicus** have been found farther south on the east side of the Pacific Ocean, there is the possibility of a future tropical trangression that would in the long run render this northern form biantitropical in distribution. With the present lack of Knowledge of their geographical origins, environmental adaptations, etc., it is convenient to regard **E. e. bungii** and **E. b. californicus** as subspecies to indicate the difference between the two forms as related to geographical distribution, while as the same time indicating their close relation.

ACKNOWLEDGEMENTS

I wish to express my gratitude to Drs. M. W. Johnson and A. Fleminger for their direction of my studies of the problem, the Scripps Institution of Oceanography for permitting me to use its plankton collections, and the United States Agency for International Development for its grants.

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Fig. 1 : Distinctive characters of species belonging to the **«Eucalanus elongatus»** group.

E. e. hyalinus : 1 : female dorsal view, **2 :** mandible, **3 :** 1st leg ; **E. e. elongatus : 4 :** female dorsal view, **5 :** 2nd mandibular basis, **6 :** 1st leg ; **E. inermis : 7 :** female dorsal view, **8 :** 2nd mandibular basis, **9 :** 1st leg ; **E. bungii californicus : 10 :** female dorsal view, **11 :** 2nd mandibular basis, **12 :** 1st leg ; **E. b. bungii : 13 :** female dorsal view, **14 :** 2nd mandibular basis, **15 :** 1st leg.

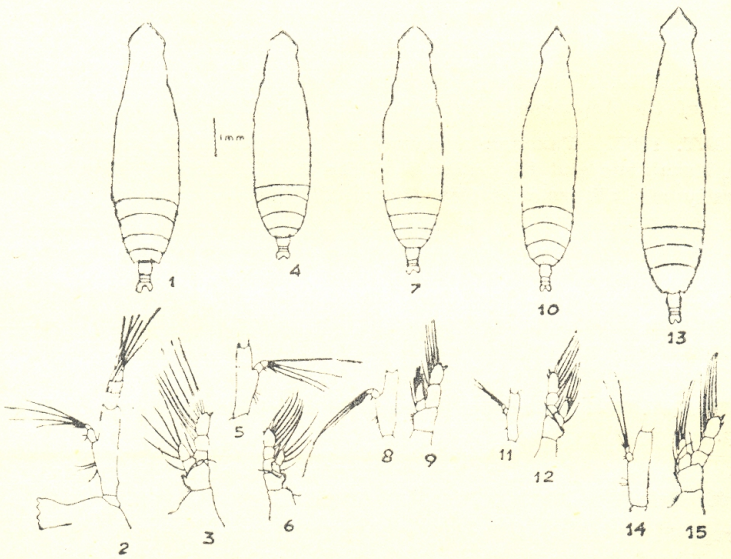

Fig. 2 : Geographical Distribution of **Eucalanus bungii bungii.**

1-4 : records from Johnson, 1938 ; **5-6 :** Johnson, 1956 ; **7 :** Johnson, 1938 ; Brodsky, 1954 ; Vinogradov, 1956 ; Minoda, 1958 ; Zenkevitch, 1963 ; **8 :** Lubny-Gerzick, 1959 (northern limit in Okhotsk Sea) ; **9 :** Aikawa, 1933 ; Anraku, 1954 ; **10 :** Brodsky, 1948 ; Kokubo, 1950 ; Furuhashi, 1953 ; Yamazi, 1953 ; Zenkevitch, 1963.

Dotted lines, from north to south : Subarctic Boundary, North Tropical Convergence.

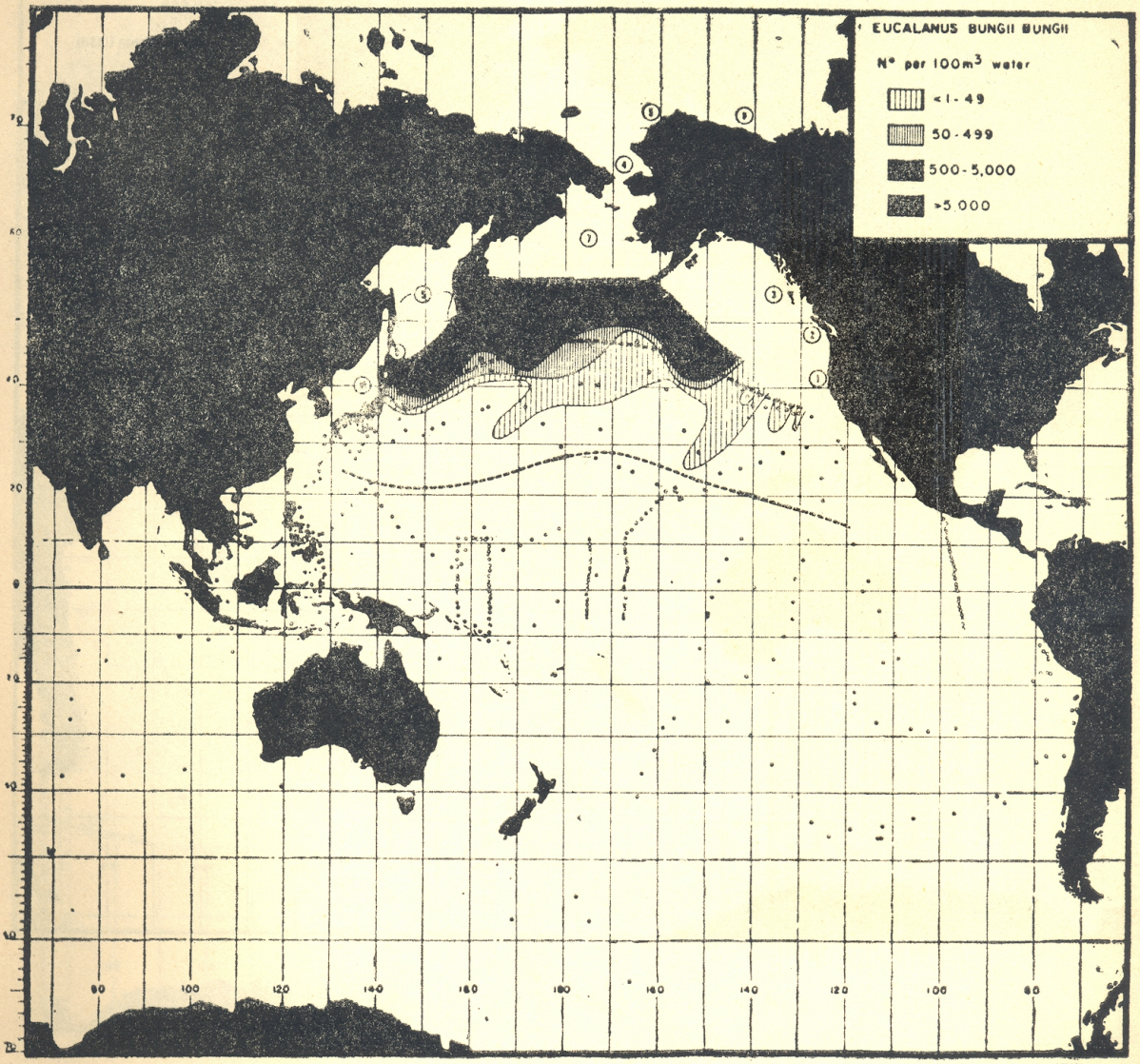

Fig. 3 : Geographical Distribution of **Eucalanus bungii californicus.**

Dotted line, from north to south : Subarctic Boundary, North Tropical Convergence.

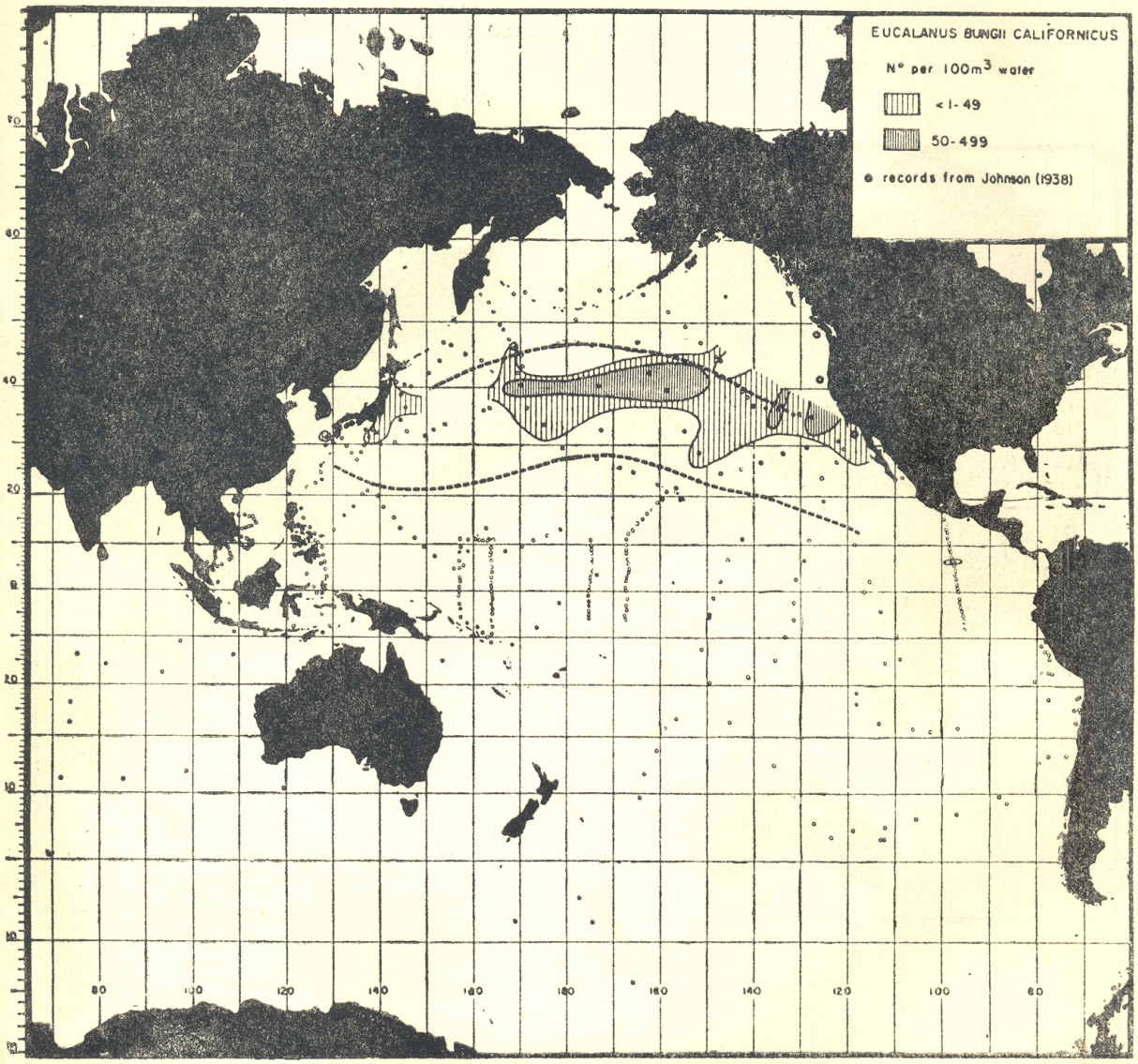

Fig. 4 : Geographical distribution of **Eucalanus elongatus hyalinus.**

1 : Mori, 1937 ; **2 :** Brodsky, 1955 ; **3-4 :** Johnson, 1938 ; **5-7 :** Wilson, 1950 ; **8-12 :** Giesbrecht, 1888 ; **13-19 :** Farran, 1929 ; **20 :** Farran, 1936 ; **21 :** Dakin and Colefax, 1933, 1940 ; **22-25 :** Vervoort, 1957 ; **26 :** Tsuruta **et al.**, 1957 ; **F :** Fleminger's data.

Dotted lines, from north to south : Subarctic Boundary, North Tropical Convergence, South Tropical Convergence, Antarctic Convergence.

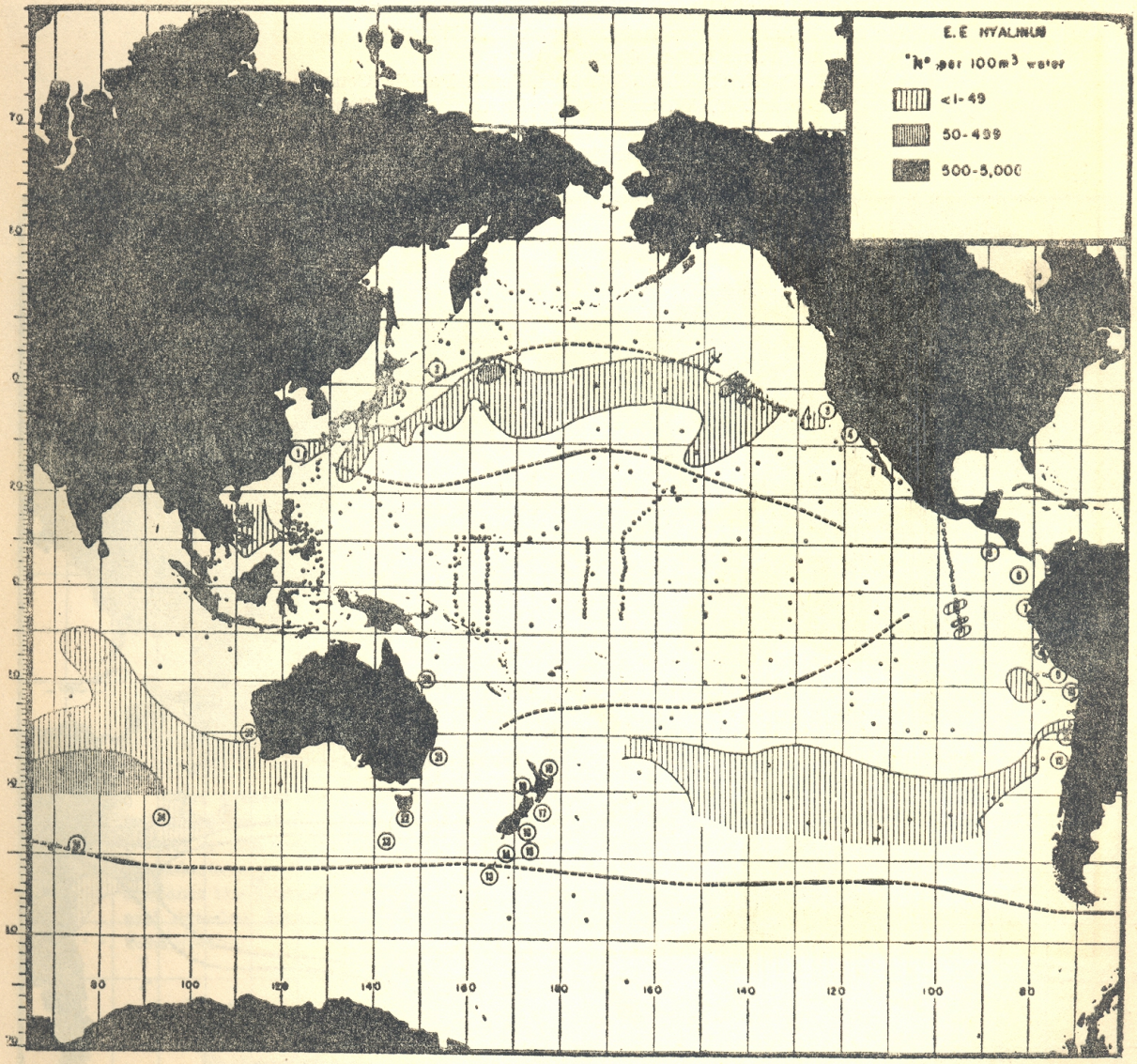

Fig. 5 : Geographical Distribution of **Eucalanus elongatus elongatus** and **E. inermis.**

Records of **E. inermis : 1-13 :** Wilson, 1950 ; **4, 8 :** also Johnson, 1938.
Records of **E. e. elongatus : 14 :** Wickstead, 1961 ; **15-16 :** Sewell, 1947.
Water masses (Sverdrup **et al.,** 1942) :

I. W. = intermediate water.
Sub-Arct. P. W. = Subarctic Pacific Water.
T. R. = Transition Region.
W. N. Pacif. C. W. = Western North Pacific Central Water.
E. N. Pacif. C. W. = Eastern North Pacific Central Water.
Pacif. Equat. W. = Pacific Equatorial Water.
Ind. Equat. W. = Indian Equatorial Water.
Ind. C. W. = Indian Central Water.
W. S. Pacif. C. W. = Western South Pacific Central Water.
E. S. Pacif. C. W. = Eastern South Pacific Central Water.
Sub-Ant. W. = Subantarctic Water.
Circ. W. = Circumpolar Water.