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Additional Records of *Tetrabalanus polygenus* Cornwall, 1941 (Cirripedia, Thoracica)

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ABSTRACT: The four-plated balanid barnacle *Tetrabalanus polygenus* Cornwall, 1941, unreported since its original description from Puna Island, Gulf of Guayaquil, Ecuador, is recorded from the Guayas River estuary at Guayaquil, Ecuador, Santa Elena Bay, Ecuador, and Puntarenas, Costa Rica. The latter occurrence increases the known range of this monotypic genus over 12.5° of latitude to the north, and suggests a wide distribution for the species in the Panamic Province. Although capable of living in waters of normal marine salinities, *Tetrabalanus polygenus* appears to prefer estuarine conditions commonly associated with typical mangrove facies.

INTRODUCTION

The unusual porose-walled, four-plated balanid *Tetrabalanus polygenus* Cornwall, 1941 has not been reported since its original description from shore localities on Puna Island in the Gulf of Guayaquil, Ecuador. Four additional lots have now been uncovered that provide supplementary data on morphology, geographic distribution, and ecology of this species.

The first lot to come to my attention was obtained by Mr. Robert Schuster, University of California at Davis, on 5 March 1964 during the 1964 Galápagos International Scientific Project. Six large individuals were taken from a moderately dense population at mid-tide on dock pilings at Porto Nuevo, Guayaquil in the Guayas River estuary (California Academy of Sciences (CAS) locality 40748). Two additional lots were uncovered in the following year at the Academy of Natural Sciences of Philadelphia (ANSP). One, consisting of four specimens from Santa Elena Bay, Ecuador, had been donated by Herbert N. Lowe in 1933 (ANSP cat. no. 2602). The second, of six individuals, was taken on the oyster *Ostrea* (*Crassostrea*) *columbiensis* Hanley, 1846, attached to mangroves on the mud flats along the Estero at Puntarenas, Costa Rica, by George

and Mary Kline in January, 1966 (ANSP catalog number 7302). A fourth lot of over 50 specimens was found on two shells of *Ostrea columbiensis* in the collection of the California Academy of Sciences (CAS locality 28027). The oysters, from mangrove roots in Santa Elena Bay, Ecuador, were donated by Herbert Lowe in 1934, and probably represent the same collection as that of ANSP catalog number 2602.

Morphology

Shell (figs. 5–6, 11–12). Many of the specimens on hand are larger than those of the type lot. The largest, from the dock at Guayaquil, is 24 millimeters in carinorostral diameter, and most of the others from that locality are 20 millimeters in diameter, or at least twice the diameter of the largest type lot individual. A conspicuous yellow to dirty-brown epidermis covers at least the lower half of the shell in most specimens. The radii vary somewhat in width, but always have steeply oblique summits and thick sutural edges whose septa are denticulate on their lower sides. The alae are short with gently sloping summits that project above the radii. The sheath is short, but usually hangs free, leaving a space under its lower edge. The numerous parietal tubes are square to rectangular in outline when viewed basally, tend to be filled in their upper parts, and are crossed by transverse septa for most of their remaining length. The basal edge of the outer lamella of the shell wall bears minute, regularly spaced denticulae and, usually, one to three large secondary septa that project into the parietal tubes, but do not reach the inner lamella. These secondary septa are denticulate basally and form part of the articulation between shell wall and basis.

Scuta (figs. 1, 3, 8, 9). The exterior of the scutum is concave between basal margin and apex, and is covered with a thick, yellow-brown epidermis. Underneath, the scutum is tricolored, with a broad central band of purple-pink flanked by narrow white stripes on the occludent and tergal margins. The growth lines are irregular, but not prominent and are crossed by faint radial striations. The articular ridge is short, being roughly half the length of the valve, but quite prominent and reflexed over the deep articular furrow. The prominent adductor ridge is short, centrally located on the valve, and parallel to the occludent margin. It overhangs a large, deep, triangular pit that extends

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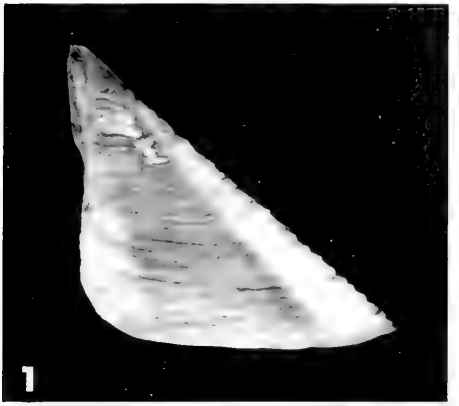
Figures 1–4. Opercular valves of *Tetrabalanus polygenus* Cornwall, hypotype CAS 13148, CAS locality 40824, Ecuador. Figure 1, exterior of scutum showing color pattern, height 6 mm.; figure 2, exterior of tergum, height 5.6 mm.; figure 3, interior of scutum, height 6 mm.; figure 4, interior of tergum, height 5.6 mm.

Figures 5, 6. Shells of *Tetrabalanus polygenus* Cornwall, CAS locality 40824, Ecuador. Figure 5, basal view showing details of septation, hypotype CAS 13152, greatest diameter of base 21 mm.; figure 6, rostrum with outer lamella removed to show transverse septa of parietal tubes, hypotype CAS 13151, greatest width of plate 15 mm.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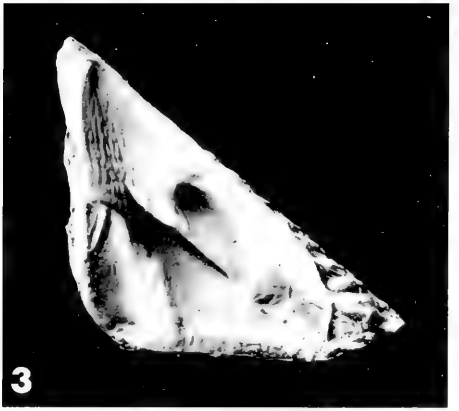
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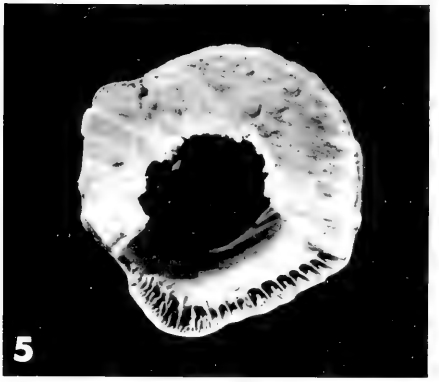
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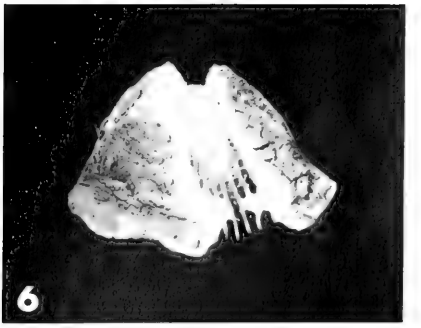
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upward beneath the arch formed by the confluence of the upper end of the adductor and the lower end of the articular ridges. The adductor pit is large and deep. In young specimens there is little or no indication of a lateral depressor muscle pit, but in larger ones a small shallow pit is found at the basiscutal angle. In all specimens examined, a low ridge extends from the base of the articular ridge along the occludent border of the lateral depressor muscle pit area to the basal margin, forming an elongate triangular hollow between it and the reflexed tergal margin of the valve. The apical part of the interior of the scutum is conspicuously roughened and ridged.

Terga (figs. 2, 4, 7, 10). The exterior of the tergum also has a thick epidermal covering. The cleaned valve is white with a suffusion of pink on the carinal half. The spur furrow is open throughout its length, but well marked by grooves on either side. The tergal spur is about one-fifth the height of the valve and occupies one-fourth to a little less than one-third the basal margin. It is rounded basally and placed close to the basiscutal angle. The articular ridge is low and erect and does not curve basally towards the scutal margin. The articular furrow is correspondingly shallow and broad. Lateral depressor muscle crests are numerous and prominent and project below the basal margin of the valve. The carinal side of the interior of the tergum is roughened and ridged.

Mouthparts (figs. 13–18). Two individuals, one from Guayaquil (CAS locality 40748) and the other from Puntarenas (ANSP cat. no. 7302) were dissected for comparison with the type description. The labra are deeply notched and the number of teeth on the crest is variable. The Puntarenas specimen has three on either side, whereas that from Guayaquil has two on the right and none on the left. The mandibles have three large upper teeth, the second being bifid, and two smaller molariform teeth below. The superior and inferior margins are setose. The first maxillae have straight margins except for the lower third which is slightly protrudent. There is no notch below the two large upper spines. The central third bears seven or eight slender spines, followed on the protrudent third by two large spines and several short spinules at the inferior angle. The superior and inferior margins are setose. The second maxillae are ovate, bilobed, and densely setose.

Cirri (figs. 19–23). The outer (anterior) ramus of cirrus I is antenniform and at least half again as long as the inner ramus. The lower articles of the

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Figures 7–10. Opercular valves of *Tetrabalanus polygenus* Cornwall, ANSP cat. no. 7302, Costa Rica. Figure 7, interior of tergum, height 5.5 mm.; figure 8, interior of scutum, height 6 mm.; figure 9, exterior of scutum, height 6 mm.; figure 10, exterior of tergum, height 5.5 mm.

Figures 11, 12. Shells of *Tetrabalanus polygenus* Cornwall. Figure 11, group of shells on *Ostrea columbiensis* Hanley showing epidermis, hypotype Lot CAS 13149, CAS locality 28027, Ecuador, length of oyster 56 mm.; figure 12, dorsal view of largest shell, hypotype CAS 13150, CAS locality 40824, Ecuador, carinorostral diameter 24 mm.


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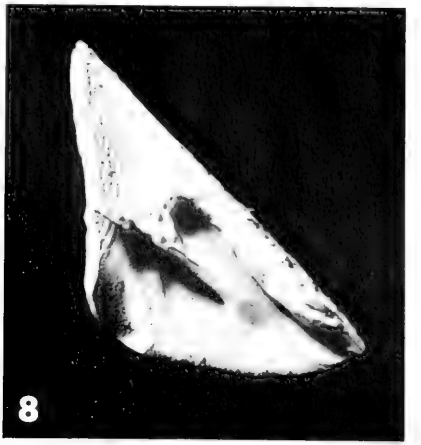
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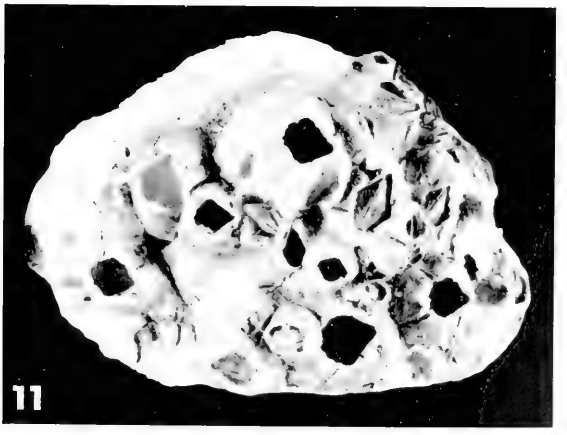
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inner ramus are protuberant and densely setose, whereas the distal articles are sparsely setose and attenuate. The rami of cirrus II are short, broad, of nearly equal length, and have densely setose, protuberant articles. The nearly equal rami of cirrus III are short, but longer and more slender than those of cirrus II, and without protuberant articles. The articles of the lower half of each ramus bear numerous small teeth scattered over their anterior faces, and one to four upwardly recurved teeth near the distal posterior edge. Cirri IV–VI are slender and elongate, and the articles of the lower half of each ramus bear a single upwardly recurved tooth at the distal posterior edge. The median articles of cirrus VI have up to seven pairs of spines.

Ecology and Distribution

Although salinity data for the localities described herein were not available to me, the records suggest that *T. polygenus* is a euryhaline species that may prefer brackish environments. With the exception of the type lot from shore rocks in apparently marine waters, all localities indicate lowered salinity conditions for at least part of the year. The Guayas River locality is 48 kilometers from the sea, and the Santa Elena and Puntarenas specimens appear to be associated with typical brackish mangrove facies.

The presumed brackish water representatives of this species differ from the type lot in their larger average size and in their possession of an epidermal covering. Parallel situations can be found in other euryhaline species such as *Balanus eburneus* Gould, 1841, and *B. improvisus* Darwin, 1854, on the East Coast of North America. Individuals living in estuaries (15–20‰) attain greater average size and possess a more conspicuous epidermis than do those in normal marine environments (30–34‰). This greater development of epidermis may be a response to the effects of lowered pH in brackish water on shell dissolution.

The occurrence of *Tetrabalanus polygenus* at Puntarenas, Costa Rica, increases the known range of this species over 12.5° of latitude to the north, and suggests that it is widely distributed in the Panamic Province. Although the barnacles of this province are poorly known, it is unusual that more specimens of *T. polygenus* have not been encountered in museum collections. If, however, this species is usually associated with brackish mangrove facies, its absence in collections is more easily understood, as most marine invertebrate collecting in the Panamic Province has been directed at the normal marine environment.

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Figures 13–19. Mouth parts and Cirrus II of *Tetrabalanus polygenus* Cornwall. Figure 13, mandible; figure 17, labrum; figure 19, Cirrus II, hypotype CAS 13148, CAS locality 40824, Ecuador, × 30. Figure 14, mandible, × 30; figures 15, 16, maxilla I, × 45; figure 18, labrum, × 30, ANSP cat. no. 7302, Costa Rica.
(Prints by G Dallas Hanna)

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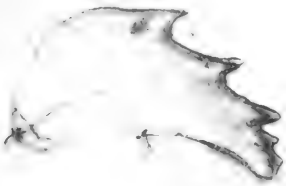

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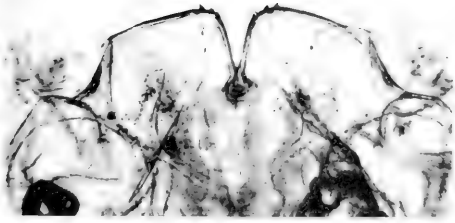

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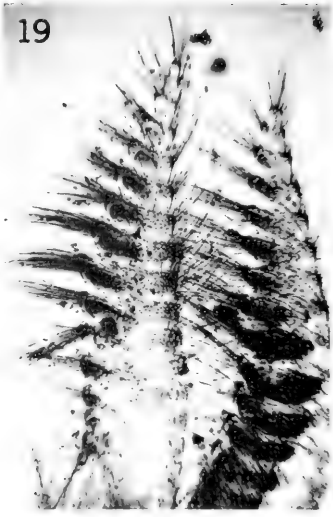

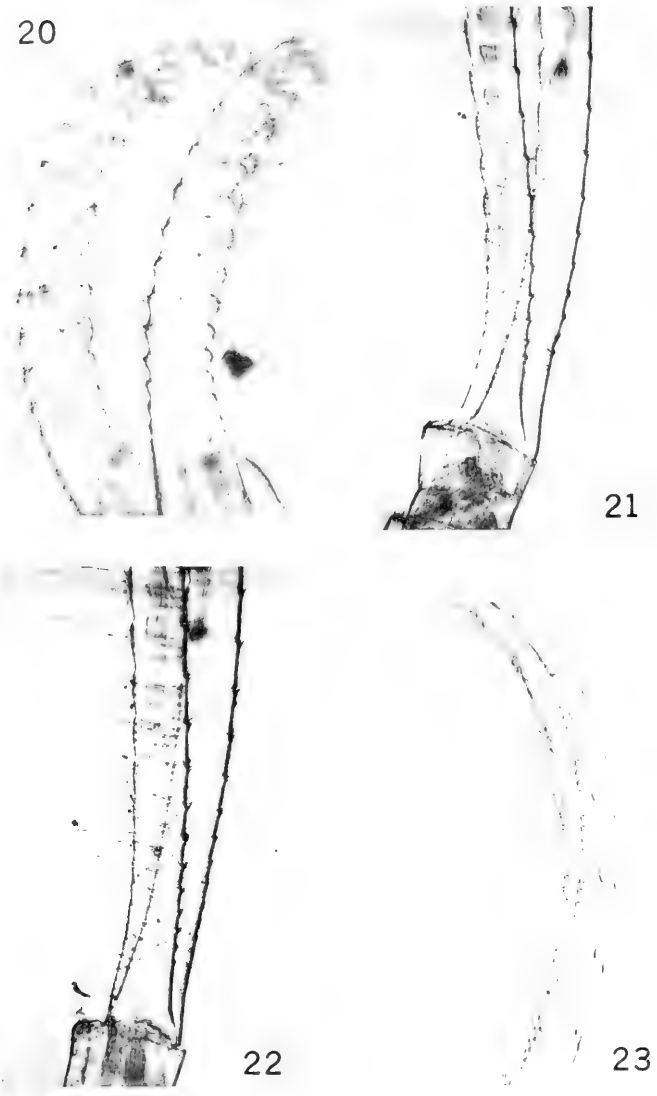

Figures 20–23. Details of cirri of *Tetrabalanus polygenus* Cornwall, × 30. Figure 20, Cirrus III; figure 21, Cirrus IV; figure 22, Cirrus V, hypotype CAS 13148, CAS locality 40824, Ecuador. Figure 23, Cirrus VI, ANSP cat. no. 7302, Costa Rica.
(Prints by G Dallas Hanna)

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